ICT FOR GENERAL EDUCATION

Senior 6

STUDENT BOOK

Experimental version

FOREWORD

Dear Student

Rwanda Basic Education Board is honored to present Senior Six ICT Student book for General Education combinations excluding MCE and MPC. This book serves as a guide to competence-based teaching and learning to ensure consistency and coherence in the learning of the ICT subject. The Rwandan educational philosophy is to ensure that learners achieve full potential at every level of education which will prepare them to be well integrated in society and exploit employment opportunities.

In line with efforts to improve the quality of education, the government of Rwanda emphasizes the importance of aligning teaching and learning materials with the syllabus to facilitate your learning process. Many factors influence what you learn, how well you learn and the competences acquired. Those factors include the relevance of the specific content, the quality of the teacher's pedagogical approaches, the assessment strategies and the instructional materials available. We paid special attention to the activities that facilitate the learning process in which learners can develop ideas and make new discoveries during concrete activities carried out individually or with peers. With the help of the teacher, you will gain appropriate skills and be able to apply what you have learnt in real life situations. Hence, you will be able to develop certain values and attitudes allowing you to make a difference not only to your own life but also to the nation.

This is in contrast to traditional learning theories which view learning mainly as a process of acquiring knowledge from the more knowledgeable who is mostly the teacher. In competence-based curriculum, learning is considered as a process of active building and developing of knowledge and understanding, skills and values and attitude by the learner where concepts are mainly introduced by an activity, situation or scenario that helps the learner to construct knowledge, develop skills and acquire positive attitudes and values.

In addition, such active learning engages you in doing and thinking about what you are doing and you are encouraged to bring your own real experiences and knowledge into the learning processes. In this view, your role is to:

• Develop knowledge and skills by working on given activities which lead to the content;

• Communicate and share relevant information with other learners through presentation, discussion, group work and other active learning techniques such as role play, case studies, investigation and research in the library on internet or outside;

• Participate to and take responsibility for your own learning;

• Carry out research/investigation by consulting printed/online documents and resourceful people, and present your findings;

• Ensure the effective contribution of each group member in assigned tasks through clear explanations and arguments, critical thinking, responsibility and confidence in public speaking;

• Draw conclusions based on the findings from the learning activities.

I wish to sincerely extend my appreciation to the people who contributed towards the development of this book, particularly REB staff who organized the whole process from its inception. Special appreciation goes to the teachers who supported the exercise. Any comment or contribution would be welcome to the improvement of this textbook for the next versions.

Dr. MBARUSHIMANA Nelson

Director General of REB

ACKNOWLEDGEMENT

I wish to express my appreciation to all the people who played a major role in the development of this ICT student book for General Education combinations (excluding MCE and MPC). It would not have been successful without active participation of different education stakeholders.

I owe gratitude to different universities and schools in Rwanda that allowed their staff to work with REB in the production of this textbook. I wish to extend my sincere gratitude to lecturers from the University of Rwanda, teachers and all other individuals whose efforts in one way or another contributed to the success of writing of this textbook.

Finally, my word of gratitude goes to the Rwanda Basic Education Board staff particularly those from the Curriculum, Teaching and Learning Resources Department (CTLR) who were involved in the whole process of writing the adapted textbooks.

Joan MURUNGI,

Head of CTLR Department

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UNIT 1. DATABASE DESIGN

Introductory Activity:

One university in Rwanda has a paper based database and wants to have a computerized database to keep all its data. The different activities carried out in this university are among others teaching, researches and technology transfer. For teaching this university employs different lecturers who are hired after passing a recruitment exam. Students in this university are enrolled basing on their secondary performance. Every day students attend different lectures in different rooms depending on the established timetable. As years pass, students are promoted from one level to another till they are awarded their certificates.

1) By analysing this scenario answer the following questions:
   a) Differentiate a paper-based database from a computerized database
   b) What are the possible problems faced by the university administration by using the paper-based database
   c) What are benefits that this university will have once the computerized database is created?
2) Give examples of computerized databases in an institution near you

1.1. Database models

Activity 1.1.

1) A bank in Kigali stores its information in a database containing many tables. Which kind of database model is this?

2) Explain the database model provided in 1)

3) By doing a research identify the other types of database models?

A data model shows the logical structure of a database including the relationships and constraints that determine how data can be accessed and stored. When choosing the data model to use this will take into account the strength of a particular model such as speed, usability, etc

1.1.1. Relational model

The most common model, the relational model sorts data into tables known as relations. A relation (table) consists of columns (attribute). All attributes in a table are called **Domain**. One attribute or a group of attribute are chosen to be a primary key or a foreign key referring to the other tables.

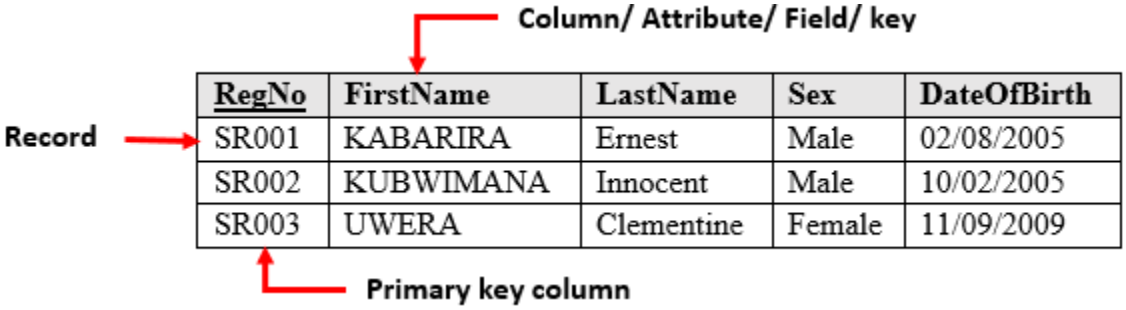


Figure 1. 1. A Relation (table) in a relational database

1.1.2. Hierarchical model

The hierarchical model organizes its data using a tree structure. The root of the tree is the parent followed by child nodes. A child node cannot have more than one parent, though a parent can have many child nodes.

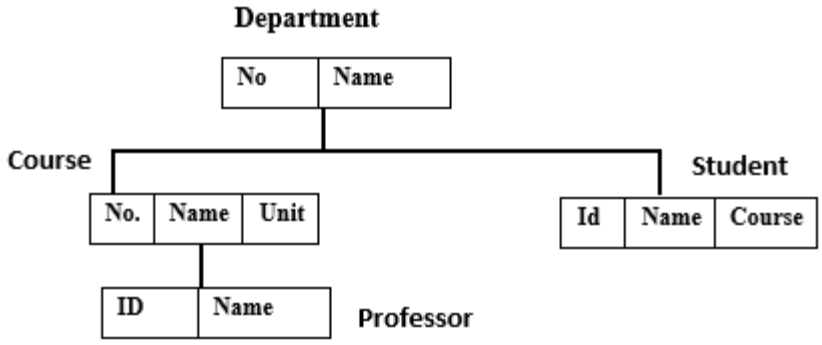


Figure 1. 2. An example of a Hierarchical model

1.1.3. Network model

The network model builds on the hierarchical model by allowing many-to-many relationships between linked records, implying multiple parent records. Based on mathematical set theory, the model is constructed with sets of related records. Each set consists of one owner or parent record and one or more member or child records. A record can be a member or child in multiple sets, allowing this model to convey complex relationships.

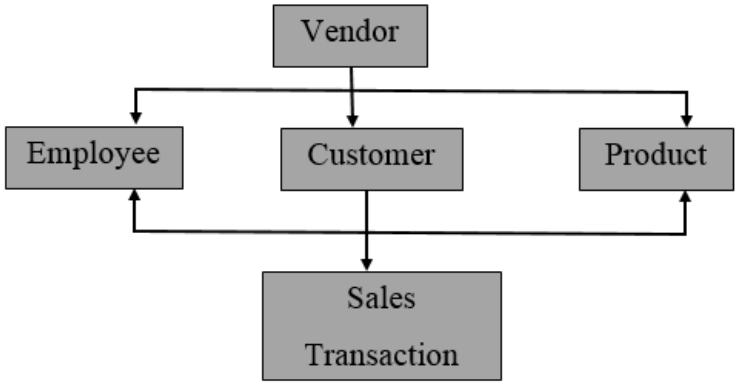


Figure 1. 3. Network model

1.1.4. Object-oriented database model

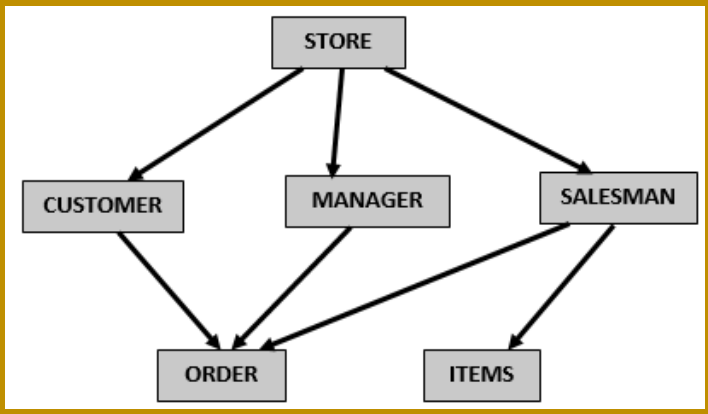
An object oriented database is a database management system in which information is represented in the form of real life objects as used in object-oriented programming. In this kind of model there are a collection of objects, or reusable software elements, with associated features and methods.

A. NoSQL database models

NoSQL databases also known as “not only SQL" are non-tabular databases and store data in a different way compared to relational tables. There are different types of NoSQL databases basing on their data model namely document, key-value, wide-column, and graph.

Application activity 1.1.

1) What is a database model?
2) Explain two database model of your choice
3) Observe the diagram below:



a) Which database model does it represent
b) Explain that kind of database model given in answer a)?

1.2. Database relational model

Activity 1.2.

1) By doing a research explain the following terms as used in relational database

a) Relation schema

b) Cardinality

c) Degree

A **Relational Model** represents the database as a collection of relations (tables). Each relation consists of a collection of rows and columns filled with data. The table name and column names are helpful to interpret the meaning of values in each row. In a relational model, data are stored as tables but the physical storage of the data is independent of the way the data are logically organized. To implement a relational database model there are different Relational Database Management Systems such as Oracle, DB2, SQL Server, MySQL, Access.

There are different concepts which are specific of the relational model as explained below:

- **Attribute:** Each column in a table is referred to as Attribute.
- **Tables**: This is where data are stored in a format having rows and columns. Rows represent records and columns represent attributes.
- **Tuple**: It is a single row of a table, which contains a single record.
- **Relation Schema:** A relation schema represents the name of the relation with its attributes.
- **Degree:** This is the total number of attributes which is also known as the degree of the relation.
- **Cardinality:** This is the total number of rows present in a table.
- **Column:** The column represents the set of values for a specific attribute.
- **Relation instance**: Relation instance is a finite set of tuples in the relational Database Management System.
- **Attribute domain**: This is the predefined value and scope that an attribute can take

1.2.1. Relational Integrity Constraints

For a table (relation) to be valid, there must be conditions that must be met. These Relational constraints in the database are derived from the real world which the table represents. In a Relational database management system, constraints can be divided into three main categories namely the Domain Constraints, Key Constraints and Referential Integrity Constraints.

A. Domain Constraints

Domain constraints means that a certain table accepts only allowed set of values. If the data that the database user is attempting to enter in the database are not included in those allowed the data being entered is rejected. Domain constraints specify that within each tuple, and the value of each attribute must be unique. This is specified as data types which include standard data types integers, real numbers, characters, Booleans, etc.

B. Key Constraints

An attribute that can uniquely identify a tuple in a relation is called the key of the table. The value of the attribute for different tuples in the relation has to be unique. For example, in a given table if the columns CustomerID is a key attribute of the Customer Table this column will always have unique values in such a way that no value will resemble another.

C. Referential integrity constraints

This constraint is based on the Foreign Key concept. A foreign key is an important attribute of a relation (table) which should be referred to in other relation (table). The referential integrity constraint is triggered when one attempts to enter data in a column with a referential integrity constraint.

Example:

Consider the two tables below CUSTOMER and SALES

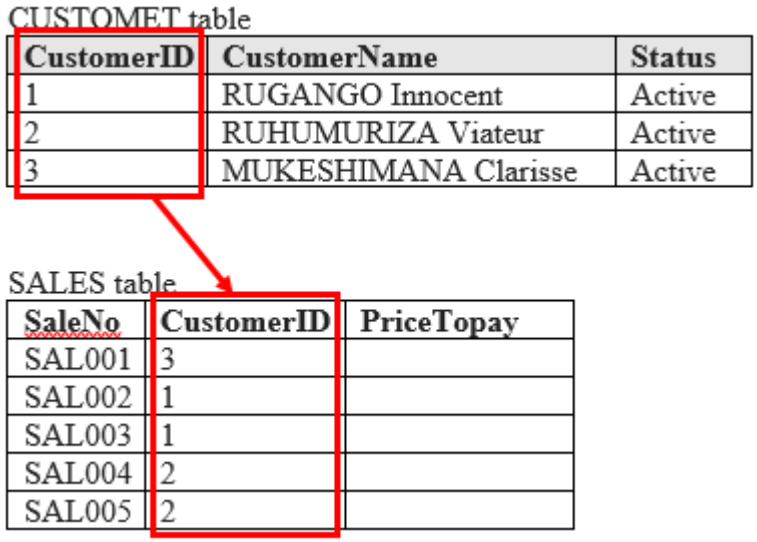


Figure 1. 4. Illustration of the Referential Integrity constraint

With the example on the two tables above, the only values that can be accepted in the CustomerID column are only those present in the CustomerID column of the CUSTOMER table. Any other value apart from those allowed will not be accepted.

D. Operations in relational database

When a relational database has been created, the database administrator and other users will need to use it. There are different basic operations that a database user may perform namely Insert, update, delete and select. Those operations are used respectively to insert data into the relation, to delete tuples from the table to change the values of some attributes in existing tuples and to choose a specific range of data.

1.2.2. Relational model with ERD

For a better understanding of a relational database a specific diagram known as Entity Relationship Diagram is used. An ERD is a graphical representation that depicts relationships among people, objects, places, concepts or events within an information technology system. They are commonly used in conjunction with a data flow diagram to display the contents of a data store. They help to visualize how data is connected in a general way, and are particularly useful for constructing a relational database.

An ERD is constructed using different symbols like in the example below about the relationship between the CUSTOMERS entity and the SALES entity using the Chen notation

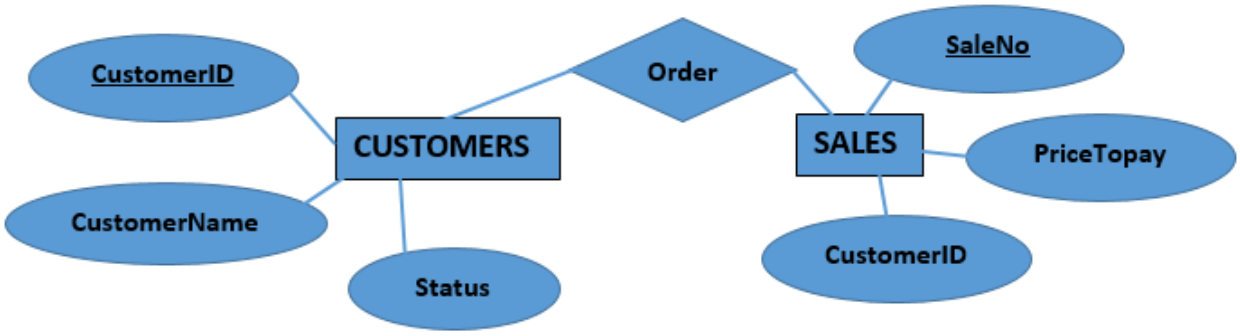
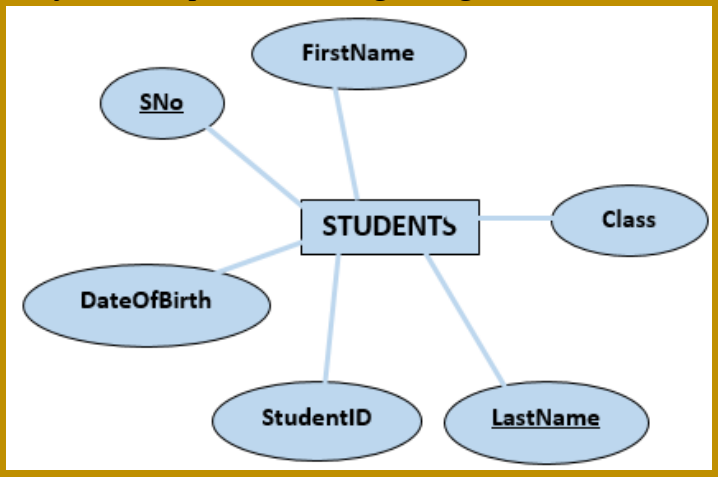


Figure 1. 5. Relationship between the CUSTOMERS and SALES table

Details on how ER diagrams are build will be elaborated in subsequent activities.

Application activity 1.2.

1) You are given an entity below represented using a diagram:



a) What is the name of the table

b) What are the table columns

c) Define a Primary key column and identify it in this entity

d) Will the column FirstName store numbers data? If not explain.

1.3. Database design steps: Investigation and identification of entities

Activity 1.3.

1. You are a student in Senior 6 and your school need to have a computerized database. By doing an investigation to the school administration give answers to the following:

a) What is the current database system at your school? Is it paper-based or computerized?

b) What are the identified weak points for that system?

c) What are the purpose of an investigation as a step in database creation?

All institutions having data need to have a mechanism by which they manage them. Institutions may have a paper-based database or a computerized database. A paper-based database is a group of meaningful data kept and managed using papers while a computerized database contains well organized electronic files kept in a location in a computer designed to allow easy storage and retrieval by a user.

The creation of a new database has to follow a number of steps so as to arrive at an appropriate database. Like an engineer planning to build a house, the most important thing to do to start designing a database is to think ahead. This implies that before using a computer and start creating a database first think about the type of information to work with and the types of questions that the database should answer, what information needs to be stored and what specifically are the links between them.

A well-designed database performs well and adapts to future needs by giving users access to essential information. Poor planning often results in a database that fails to meet overlooked needs. In planning the database, regardless of its size and complexity the following basic steps must be followed for a relational database:

1. Investigation
2. Identification of entities
3. Identification of relationships between entities
4. Database creation
5. Data entry

The 5 steps shown above will be developed throughout the unit. However their order may change.

1.3.1. Investigation

This is the very first step in database creation involving collecting information leading to the creation of the new database. Before creating a database, there is a need of good understanding of the problem that the database is expected to solve.

During investing information, there is a need to work with everyone involved in the existing system to see what is needed from the new database. Gathering techniques include collect copies of customer information, management reports, and any other documents that are part of the existing system, because these will be useful in designing the database and the interfaces.

At the time of investigation, the existing database may be a traditional database in a big register in which information is entered by using a pen or files written in a computer using Microsoft Word with no easy methods for retrieval of information. It can also be a computerized database with different defects which need to be fixed or needing to have new functionalities added. In all these cases the existing system will give most of the information needed in building the future database.

An example of the results of an investigation done in an hospital GIRUBUZIMA can be the following if this hospital wants to have a new database system:

In the GIRUBUZIMA Hospital patients are treated by Doctors who diagnose them. After being diagnosed patients' samples are taken and tested in the laboratory for different microbes which cause diseases. After the laboratory test, results are sent to the doctor who decides if the patient will stay in the hospital room or will take medicines from home. A staying patient is assigned a nurse who will be looking after him/her. After the lab test the doctor prescribes the medicines to be taken. When a patients is healed, he/she pays the bill for the medicines and the room and is then discharged.

1.3.2. Identification of entities

Entities or tables are derived from the information gathered. After the investigation, the key entities (tables) that will be in the database must be identified. The object can be a tangible thing, such as a person (for example student, employee, and patient) or a product, or it can be a more intangible item, such as a department in an institution, a Combination in a school. Each distinct item in the database should have a corresponding table for which column titles are attributes of the entity.

The information to be put in one entity must be important such that when lost the whole process may lose its meaning. In the case of the hospital investigation the final entities can be Patients, Doctors, Tests, Rooms, Nurses, Services.

A table must have different attributes which are used to keep all the information that were filled in different forms and registers when a paper based database approach was being used. In the table below there are different attributes that can be found in each entity:

Table name	Patients,	Doctors,	Tests,	Rooms,	PatientServices
Column names	PatientID, IDNumber, Names, Sex, DateOfBirth, Phone, Address, InsuranceNumber	DoctorID, Names, Position, Phone	TestNumber, TestName, Description, Price	RoomNo, Service, Status	PatientID, ServiceID Status (Paid/No)

Application activity 1.3.

1) You are now familiar of how investigation is done before building a database, identify an institution in your community and do an investigation for that institution and identify the tables that its database would have.

2) What are the consequences that someone may face if she/he does not do investigation well?

1.4. Identification of relationships between entities

Activity 1.4.

Students in Senior 5 Computer Science want to build a database system for their school. After doing the preliminary investigation and analysing the information got from it, they came up with the following tables in which all the data for that school will be kept:

Student, Teacher, Mark, Parent, Subject, Class

1) What are the tables among the 6 that are more likely to have relationships between one another

2) What are the possible columns for each of those tables?

3) Apart from those 6 tables, what are other tables that may be included in a school database?

One of the strengths of a relational database is the ability to relate or associate information about various items in the database. Isolated types of information can be stored separately, but the database can combine data when it is required. Identifying the relationship between entities in the design process requires looking at the entities, determining how they are logically related, and adding relational columns that establish a link from one table to another. Two tables are related when data in one column of one table have a relation with data in another column of the second table. For example, in a school database a teacher is related to the student as the teacher teaches a student.

1.4.1. Types of relationships between tables

There are different types of relationships that can be found between tables namely: One to One, One to Many, Many to One and Many to Many.

A. One-to one (1:1)

A single instance of an entity can relate to only one instance of the other entity. It is the relationship of one entity to only one other entity, and vice versa. It should be rare in any relational database design because it indicates that two entities actually belong in the same table. An example in a Company database with Employees tables and Spouse table one employee is associated with one spouse, and one spouse is associated with one employee.

Other Examples:

- A person can have only one passport.
- The relationship between the President and the country is an example of one-to-one relationship. For a particular country at a given time, there will be only one President.
- A House and a Location is a One to One relationship as a house is obviously in only one location.

B. One-to-many (1: M)

In a One to many relationship an instance of one entity can relate to multiple instance of another entity.

The relationship that associates one record of entity A to more than one record of entity B is called one-to-many relationship.

Example of one-to-many relationships

- A country may have many states and this makes this kind of relationship a one-to-many relationship.
- A parent-child relationship: In this relationship one parent can be for more than one child.
- A class has many students.

C. Many-to-One (M: 1)

In this relationship, many instances of one entity are related to one instance of another entity. The relationship between EMPLOYEE and DEPARTMENT is an example of many-to-one relationship because there may be many EMPLOYEES working in one DEPARTMENT.

D. Many-to-many (M: M)

In this relationship multiple instances of an entity can relate to multiple instances of another entity. For our company database.

Examples of this type of relationship are:

- A customers can purchase more than one book.
- The relationship between TEACHER entity and STUDENT entity is an example of many-to-many relationship. Many teachers teach many students.
- Employee and project, many employees can work on many projects

1.4.2. Representation of relationships with ERD

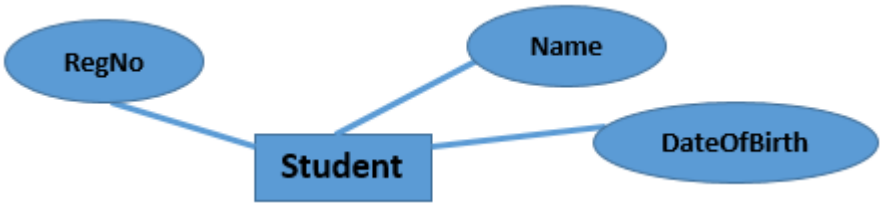
An entity relationship diagram, also known as an entity relationship model, is a graphical representation that shows the relationships between entities (tables) in a relational database. An Entity Relationship Diagram uses data modeling techniques that can help in understanding the business process of an institution.

A. Symbols in an Entity Relationship Diagram (ERD)

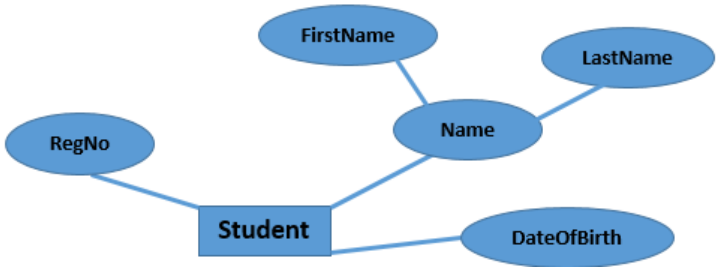
In an ER diagram attributes and relationships form the components of ER Diagram and there are defined symbols and shapes to represent each one of them.

- **Entity:** Entities are represented by means of rectangles. Rectangles are named with the entity set they represent.

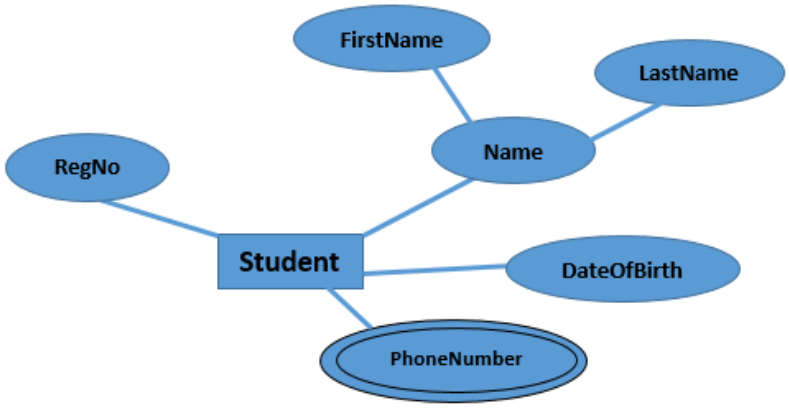
- **Attributes:** Attributes are the properties of entities. Attributes are represented by means of ellipses. Every ellipse represents one attribute and is directly connected to its entity (rectangle).



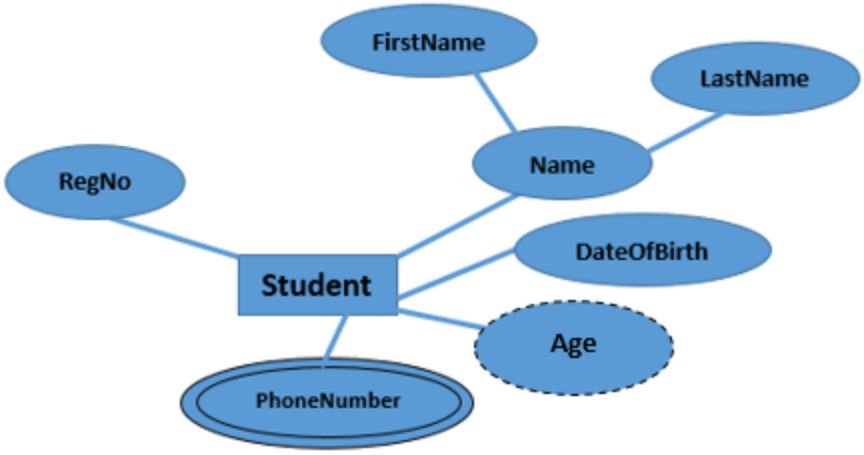
If the attributes are **composite**, they are further divided in a tree like structure. Every node is then connected to its attribute. That is, composite attributes are represented by ellipses that are connected with an ellipse.



Multivalued attributes are depicted by double ellipse. These are attributes which can have more than one value. For example, a person can have more than one phone number.



Derived attributes are shown by using dashed ellipses. In the ERD below, age is derived from the date of birth.

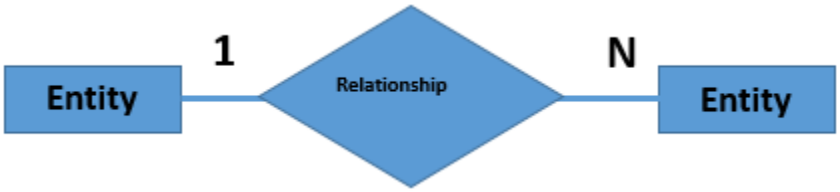


- **Relationship:** Relationships are represented by diamond-shaped box. Name of the relationship is written inside the diamond box. All the entities (rectangles) participating in a relationship, are connected to it by a line.

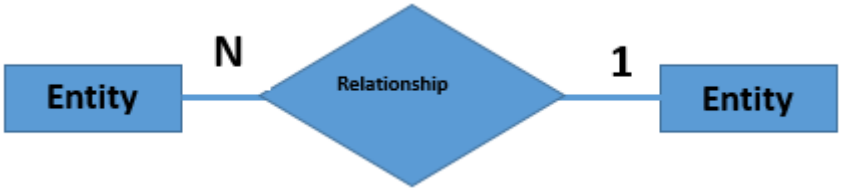
- **Binary Relationship and Cardinality:** A relationship where two entities are participating is called a **binary relationship**. Cardinality is the number of instance of an entity from a relation that can be associated with the relation.

One to One relationship: This relationship is marked as '1:1'. The following image represents such a relationship. It shows that only one instance of each entity should be associated with the relationship.

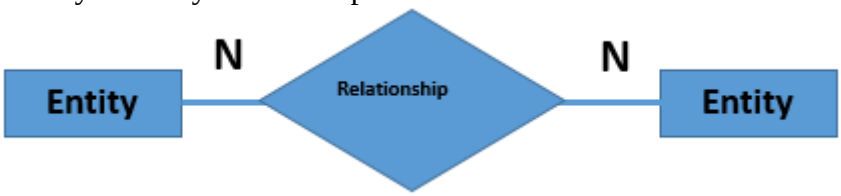
One to Many relationship: This relationship is is marked as '1:N' and is represented by two entities linked by a diamond where on the left side of the link there is a number 1 and on the right there is a letter N.



Many to One relationship: This relationship is shown using two entities linked by a relationship in the shape of a diamond. On the left side of that link there is a letter N while on the right there is a number 1.

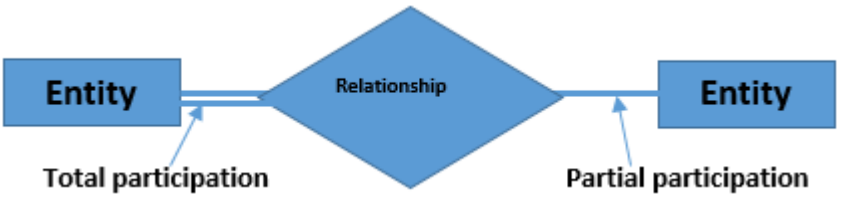


Many-to-many − The following image reflects that more than one instance of an entity on the left and more than one instance of an entity on the right can be associated with the relationship. It shows a many-to-many relationship.



Participation Constraints

- **Total Participation**: Each entity is involved in the relationship. Total participation is represented by double lines.
- **Partial participation**: Not all entities are involved in the relationship. Partial participation is represented by single lines.



An example of an Entity Relationship diagram for

Application activity 1.4.

1) Create a database for the following institutions and make an entity relationship diagram for each of them.

a) School library

b) Car rental company

c) A shopping mall (Supermarket)
2) What is the importance of a ERD for database?

1.5. Database Optimization through Normalization

Activity 1.5.

1) The table below contains information about doctors, patients and appointments. Observe it and answer the related questions:

StaffNo	DoctorName	patientNo	patientName	appointment	surgeryNo
RS001	KABAYIZA Emmanuel	P100	RUKUNDO Clement	12/09/2022	S10
RS001	KABAYIZA Emmanuel	P105	KAMANZI Adolph	13/09/2022	S15
RS002	IRIBAGIZA Alliane	P108	ILIZA Christine	12/09/2022	S10
RS002	IRIBAGIZA Alliane	P108	ILIZA Christine	14/09/2022	S10
RS003	KEZA Kelly	P105	KAMANZI Adolph	14/09/2022	S15
RS003	KEZA Kelly	P110	HABINSHUTI Aaron	15/09/2022	S13

a) Which columns contain information respectively for doctors, patients and appointments?

b) The hospital owning that database hires a new doctor whose name is RWIBASIRA Felecian with a staff number RS004. What are your observations?

c) This hospital admits a patient with these details: P111, UWIMANA Laurent, 17/09/2022, S16

d)Suppose one doctor named IRIBAGIZA Alliane quits this hospital and has to be deleted from the database. What will happen?

e) After doing the operations as stated in questions b), c) and d) what are your observations about the new resulting table?

f) How can you solve the problems stated in answer e)

One of the most important step to consider when designing a database is database definition. If tables are not set up properly, it can cause problems at the time of retrieving and entering data or when any other required operation is done. Understanding the rules of normalization enforces redundancy elimination and inconsistent dependency in database designs. **Normalization** is a database design technique that reduces data redundancy and eliminates undesirable characteristics like Insertion, Update and Deletion Anomalies. The Normalization process divides larger tables

into smaller tables and links them using relationships. The purpose of Normalisation in SQL is to eliminate redundant data and ensure data is stored logically.

1.5.1. Database anomalies

When database is not normalized, it presents anomalies namely insert anomaly, delete anomaly and update anomaly.

A. Insert anomaly

A database which is not normalized cause problems when it comes to inserting new records this is due to the fact that all the information for each record can not be found. Consider a table found in an hospital database with the following columns: *PatientID, FirstName, LastName, DateOfBirth, TestName, TestResults, MedicineName, DoctorName, RoomNo, RoomStatus.*

This table can keep information about a patient, laboratory tests done for that patient, the doctor who diagnosed him/her and the room where the patient will stay while in the hospital. If a room is created and no patient has stayed in it so far, only two columns *RoomNo* and *RoomStatus* will have information to be filled in them while the other columns will be empty. If in this table there are columns that do not allow null values, it will not be possible to enter data for only the two columns. To avoid this anomaly, the database must be normalized.

B. Delete anomaly

A delete anomaly is when deleting one unneeded data requires to delete other data that was not intended for deletion. Taking the same example as above, when there is a room which is no longer used and needs to be removed the removal of those details will require removing all the data in other columns because there is no query which can remove only a part of a record.

C. Update anomaly

An update anomaly is a data inconsistency that results from data redundancy and a partial update where only a few records among those meeting the criteria are updated. Consider the table below:

Employee_ID	Name	Department	Student_Group
123	Uwera	Accounting	Beta Alpha Psi
234	Uwimana	Marketing	Marketing Club
234	Uwimana	Marketing	Management Club
456	Munyurangabo	CIS	Technology Org.
456	Munyurangabo	CIS	Beta Alpha Psi

In the table above, each employee in a company has a department associated with them as well as the student group they participate in. If the database manager wants to update details for Munyurangabo he/she will have to update for all the two records. If the database manager who is updating the database does not realize that the data is redundant the update will not be done properly as only one record will be updated.

On the other hand, if data items are scattered in different tables and are not linked to each other properly, then it could lead to strange situations where when one data item having its copies scattered over several places is updated, a few instances get updated properly while a few others are left with old values and this makes the database be in an inconsistent state.

1.5.2. Types of Normal Forms

Normalization is a method to remove all the anomalies of a database which is not normalized so as to bring the database to a consistent state. Normalization involves different Normal Forms the most common being the First Normal Form, Second Normal Form and Third Normal Form.

A. First Normal Form

A relation (table) that contains a repeating groups of data or multiple entries for a single record is called unnormalised relation. Removing repeating groups is the starting point in the process to create tables that will not cause problems when the database starts being used.

The conversion to first normal form (lNF) requires splitting the data that was in one non atomic cells and put it in more than one record. Tables without repeating group are said to 1NF.

A relation is in first normal form if and only if the domain of each attribute contains only atomic (indivisible) values, and the value of each attribute contains only a single value from that domain

Example: A database has been designed to store data about sellers and the products they have sold. The following facts help to define the structure of the database:

- Each seller works in a particular shop
- Each seller has a unique Surname
- Each shop has one or more sellers
- Each product which is sold is manufactured by one company only
- Each seller can sell any of the products
- The number of products that each seller has sold is recorded

SurName	ShopName	ProductName	NumberofProducts	Manufacturer
KAGABO	CompuTech Ltd	Digital Camera Printer Laptop	3 2 6	Nikon Canon HP
KALISA	DigiTech	Hair dryer Electric shaver	1 8	Panasonic Phillips

KAMALI	CompuTech Ltd	Digital Camera	2	Nikon
		Printer	8	Canon
		Modem	4	Huawei
		Mobile Phone	3	Samsung

Table 1. 1. SHOPSALES table

The table above is not in the First Normal Form (1NF) because of the following reasons:

1. SHOPSALES table has repeated group of attributes

   (ProductName, Manufacturer)
   (ProductName, NumberofProducts),
   (NumberofProducts, Manufacturer)

2. Each seller (SurName) has a number of products

3. SurName and ShopName would need to be repeated for each record

In summary the table above has non-atomic cells where some cells contain more than one data like in the second record where in the "Manufacturer" column there is the content "Panasonic" and "Phillips". This table is converted to the First Normal Form by splitting non-atomic cells and becomes the table below:

SurName	ShopName	ProductName	NumberofProducts	Manufacturer
KAGABO	CompuTech Ltd	Digital Camera	3	Nikon
KAGABO	CompuTech Ltd	Printer	2	Canon
KAGABO	CompuTech Ltd	Laptop	6	HP
KALISA	DigiTech	Hair dryer	1	Panasonic
KALISA	DigiTech	Electric shaver	8	Phillips
KAMALI	CompuTech Ltd	Digital Camera	2	Nikon
KAMALI	CompuTech Ltd	Printer	8	Canon
KAMALI	CompuTech Ltd	Modem	4	Huawei
KAMALI	CompuTech Ltd	Mobile Phone	3	Samsung

Table 1. 2. SHOPSALES in 1NF

B. Second Normal Form

A table in Second Normal Form must first be in the First Normal Form. The relation is automatically in 2NF if, and only if, the Primary Key comprises a single attribute. On the other hand if a table has a composite primary key no attribute should depend on part of the primary key. If one attribute is dependent on part of the primary key this is referred to as **Partial Dependency.**

Examples of partial dependency and conversion to Second Normal Form

Example 1:

Consider the table below with a composite primary key with the primary key columns (Student_ID, ProjectID and other columns StudentName and ProjectName.

StudentID,	ProjectID	StudentName	ProjectName
S001	PRO01	MUGABO	School database
S004	PRO02	ISIMBI	School website
S003	PRO02	RUGAMBA	School website
S002	PRO01	KEZA	School database

By analysing the table above, it is clear that there is partial dependency whereby wherever there is the same StudentID, there is also the same StudentName and wherever there is the same ProjectID there is also the same ProjectName. This table is in the First Normal Form but not in the Second Normal Form. To convert it in the Second Normal Form, this partial dependency must be removed by splitting the table in such a way that columns which depend to one another make one table. Thus the columns StudentID and ProjectID make one column while the columns StudentName and ProjectName make another table. The new tables get new names respectively STUDENT and PROJECT with the structure below:

STUDENT (StudentID, StudentName) here the StudentID column becomes the primary key

PROJECT (ProjectID, ProjectName) here the ProjectID becomes the primary key

The original table becomes:

Student table:

StudentID,	StudentName
S001	MUGABO
S004	ISIMBI
S003	RUGAMBA
S002	KEZA

Project table:

ProjectID	ProjectName
PRO01	School database
PRO02	School website

Note: Because the primary key column does not allow duplicate values, those duplicated values have been removed.

C. Third Normal Form

To be in third normal form, the relation must be in second normal form. Also all transitive dependencies must be removed; a non-key attribute may not be functionally dependent on another non-key attribute.

In our case on table **PRODUCTSSOLD**, Manufacturer attribute is dependent on ProductName, which is not the primary key of the **PRODUCTSSOLD** table therefore there is no key dependency.

Consider the SHOPSALES table with the columns SurName, ShopName, ProductName, Numberof Products and Manufacturer. This table was split in two in order to make it be in the Second Normal Form and the resulting tables are SELLER (SurName, ShopName) and PRODUCTSSOLD (SurName, ProductName, NumberofProducts, Manufacturer). The table PRODUCTSSOLD is not in 3NF as there is transitive dependency between ProductName and manufacturer.

Process to convert to the 3NF:

1. Eliminate all dependent attributes in transitive relationship(s) from each of the tables that have transitive relationship.
2. Create new table(s) with removed dependency.
3. Check new table(s) and modified table(s) to make sure that each table does not contain inappropriate dependencies.

The new generated tables are:

SELLERS (SurName, Shop)

PRODUCTSSOLD (SurName, ProductName, NumberofProducts)

PRODUCTS (ProductName, Manufacturer)

SurName	**ShopName**
KAGABO	CompuTech Ltd
KALISA	DigiTech
KAMALI	CompuTech Ltd

Table 1. 3. SELLERS table

Table: PRODUCTSSOLDM1

SurName	ProductName	Manufacturer
KAGABO	Digital Camera	Nikon
KAGABO	Printer	Canon
KAGABO	Laptop	HP
KALISA	Hair dryer	Panasonic
KALISA	Electric shaver	Phillips
KAMALI	Digital Camera	Nikon
KAMALI	Printer	Canon
KAMALI	Modem	Huawei
KAMALI	Mobile Phone	Samsung

Table 1. 4.PRODUCTSSOLD table

Table: **PRODUCTS**	
ProductName	**Manufacturer**
Digital Camera	Nikon
Printer	Canon
Laptop	HP
Hair dryer	Panasonic
Electric shaver	Phillips
Modem	Huawei
Mobile Phone	Samsung

Table 1. 5. PRODUCTS table

Application activity 1.5.

1) Convert the following table to the first normal form:

FirstName	LastName	Course
Louis	KARASIRA	Chemistry, Biology, Geography
Leon	NTAGANDA	Entrepreneurship, Physics
Helen	KALIZA	History

2) Observe the table below and convert it to the third normal form

IDSt	LastName	IDProf	Prof	Grade

1	CYUBAHIRO	3	KARENZI	5
2	MANZI	1	INGABIRE	4
2	MANZI	3	KARENZI	5
3	KALISA	1	INGABIRE	4
1	CYUBAHIRO	2	MUNYEMANA	6
3	KALISA	3	KARENZI	5

1.6. Data types in Access

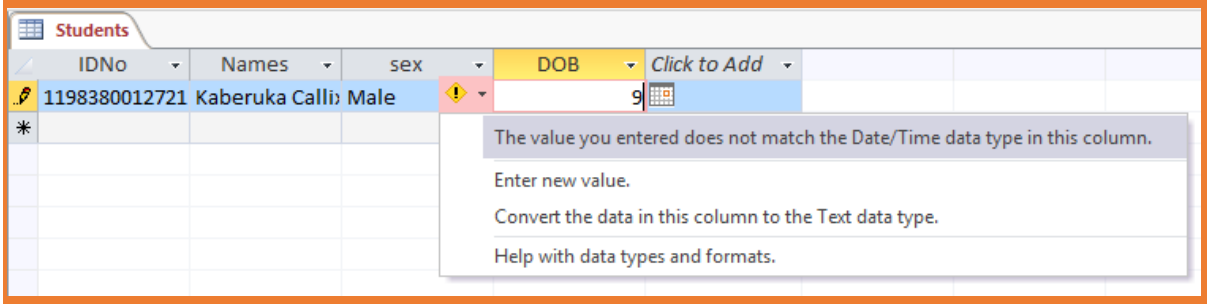
Activity 1.6.

1) Look at the following information written in a Word document:

a) Rwanda is a beautiful country
b) 01/01/2023
c) 2005
d) $500

What are the kinds of data represented in a), b), c) and d)?

2) The window below is an Access interface in which a student is attempting to enter his/her details. However, the student gets an error message as shown in the screenshot.



a) What may be the problem causing the displaying of the error message

b) How can that error message problem be solved?

c) Why aren't other columns displaying the same error message?

According to Wikipedia, in the field of computer science and computer programming, a data type is a set of possible values and a set of allowed operations on it. A data type tells the compiler or interpreter how the programmer intends to use the data. Most programming languages support basic data types of integer numbers, floating point numbers, characters and

Booleans. A data type constrains the possible values that an expression, such as a variable or a function, might take.

In Access, when creating tables, the data type for each column of data must be specified and chosen depending on the kind and range of data to be kept in it. The Short Text data type is a popular choice since it lets you enter almost any character (letter, symbol, or number). However, careful selection of data types can help take advantage of more Access features such as data validation and improves the accuracy of the information to be stored.

The data types in Access are: Short text, long text, number, date/time, currency, autonumber, Yes/No, OLE Object, Hyperlink, Attachment, Calculated, and Lookup Wizard as shown in the window below:

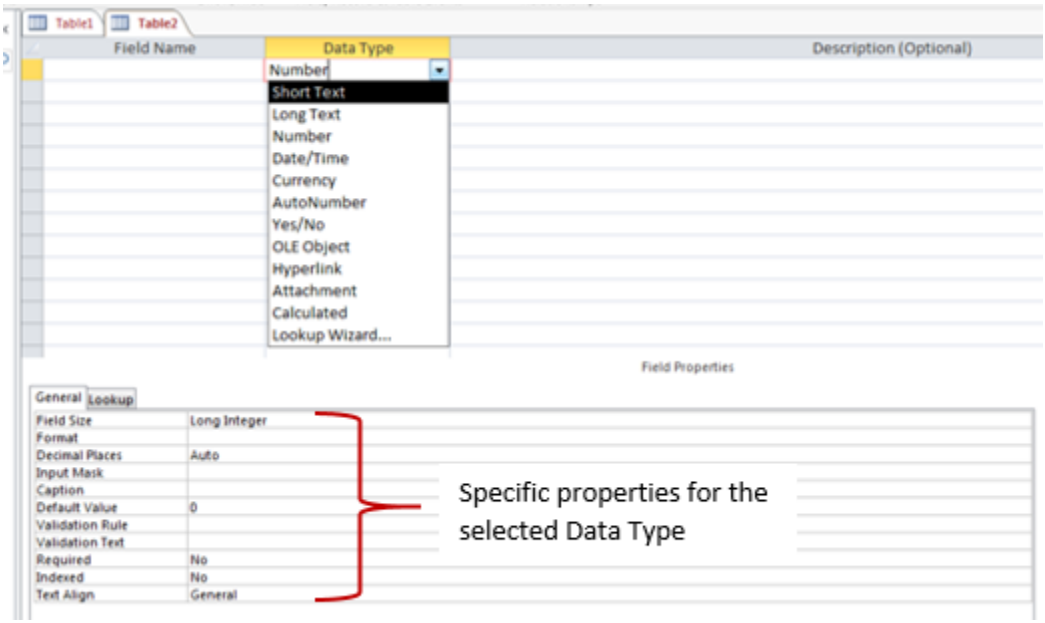


Figure 1. 6. Access data types as shown in an Access window

- **Short Text:** This data type is used for text whose length cannot exceed 255 characters. Any character beyond the 255 will not be accepted in the table.
- **Long text:** This data type can store up to 65,536 characters if the data is entered into Access directly meaning that if one page in Word can store 6000 characters this data type can store at least 10 pages of this same size. Using this data type when one wants to store names would be a waste of computer memory.
- **Number:** This data type can store any number depending on the specific type chosen in the **Field Properties** area. In this area the specific types are: long integer, Byte, Integer, Single, Double, ReplicationID and Decimal.
- **Date/Time:** The date/time data type displays the year, month and day of an event. This data type has different formats depending on the field properties one has chosen.

- **Currency:** This is a data type which is accurate for storing financial values that need precision but don't exceed four decimal places. The biggest number for Currency is 922 trillion.
- **AutoNumber:**
- **Yes/No:** A Yes/No field can only contain one of the two values: Yes or No, True or False, On or Off. It can never be null.
- **OLE Object:** This data type allows to embed files created by other applications like in Ms Word or Ms Excel.
- **Hyperlink:** This is a kind of special text that will act as a link to open a file when that text is clicked.
- **Attachment:** This data type is used for attaching different files like images and any other file type in your database like it is done when files are attached using emails.
- **Calculated:** This data type calculates values from an equation.
- **Lookup Wizard:** This kind of data type is used to establish a relationship between tables. It creates a foreign key that refers back to the primary key of another table.

Application activity 1.6.

1) You are tasked to create a database for a car garage with the table names below. For each table suggest the column names and the data types you will choose while creating these tables.

a) CARENTRY

b) CARSERVICES

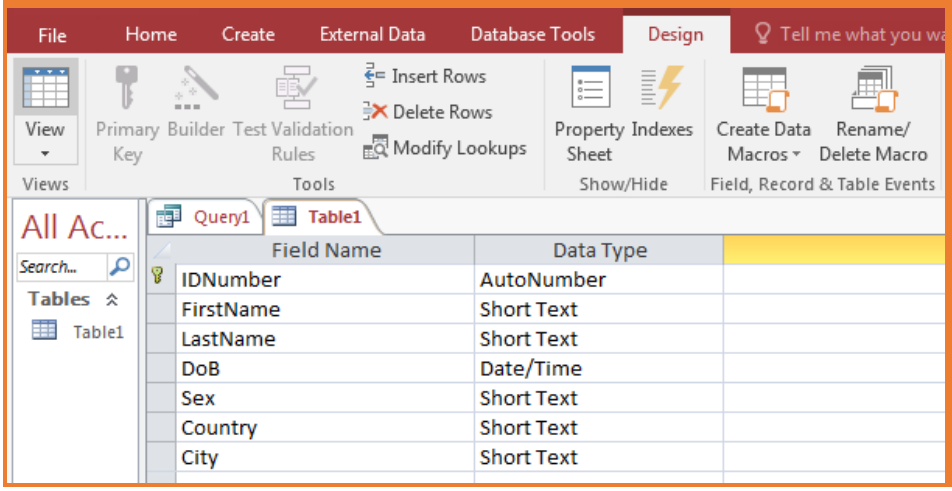
c) PAYMENTS

d) CAREXIT

1.7. Database creation

Activity 1.7.

1) Observe the table below of a screenshot of Access:



a) What are the columns of the table in this table?

b) What is the primary key column of the table in the screenshot above?

c) What is the data type for the DoB column

2) Open Access and create the table shown in the screenshot above.

The step of database creation is reached when all the previous steps have been gone through, all the tables have been identified and the relationship among them already established. In this step the database designer uses his/her computer to build the database using a Database Management System.

A. Choosing the database name

A database name should be shosen in such a way that it is easy to understand and is not too long. In Access a database is created by first opening Access then writing the database name in the **File Name** box and click on **Create**.

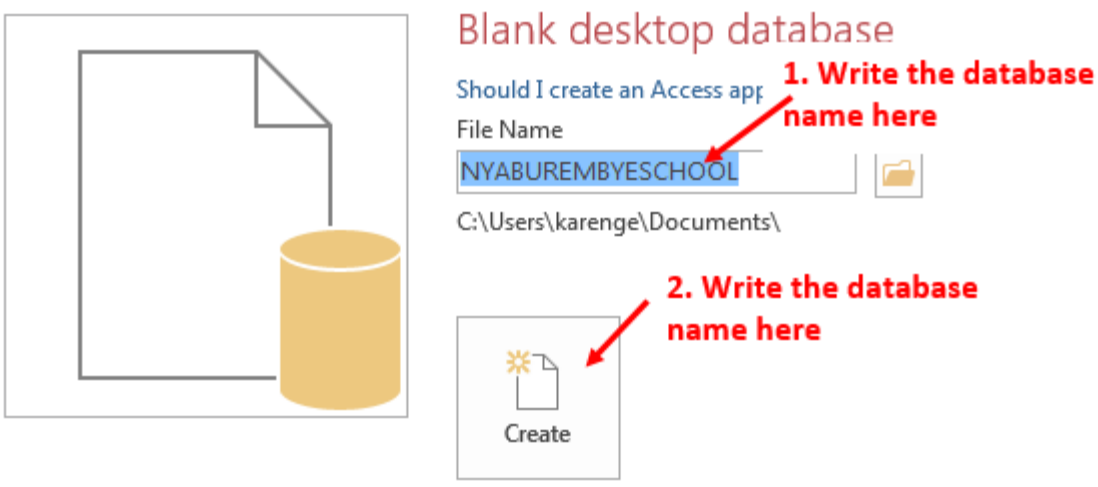


Figure 1. 7. Steps to create a database in Access

B. Creating tables inside the database using in Design View

Data in a Microsoft Access database is stored in various interlinked tables. A database also has forms for data entry though you can enter data directly in tables or use insert queries

The steps for creating a database in Microsoft Access Design view are:

Step 1: In the database already created, click on **Create**

Step 2: In the tools that appears click on the **Table** icon

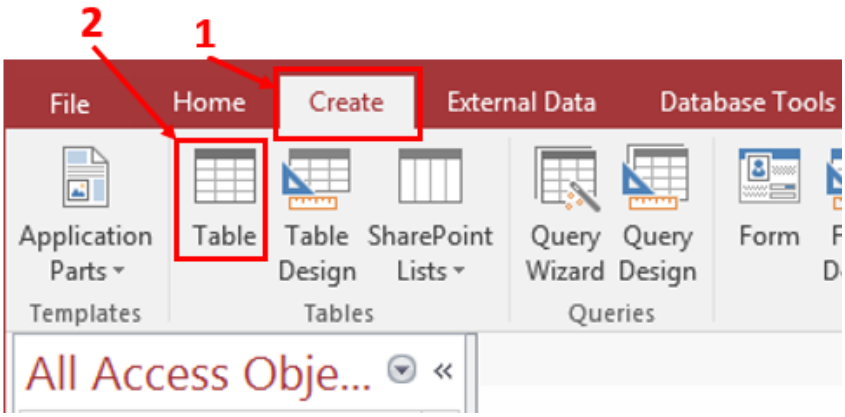


Figure 1. 8. Using Create menu and Table tool in creating a table

Step 3: Under the **File** menu click on the **View** arrow

Step 4: Click on **Design View** tool and save the new table as prompted to do so

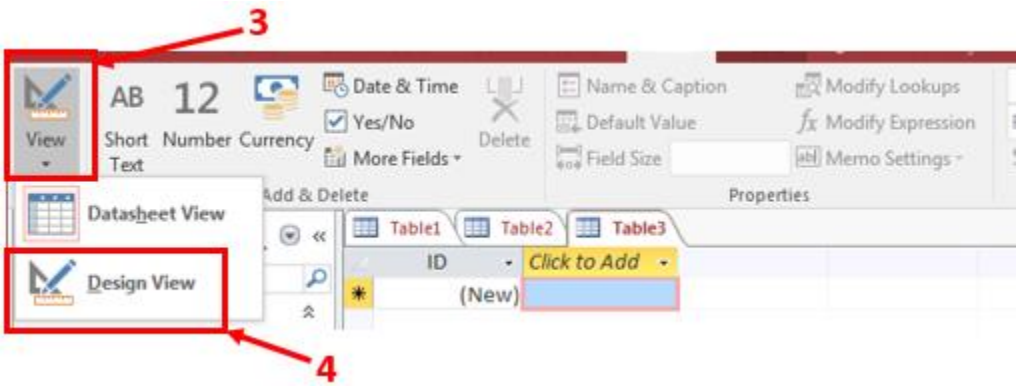


Figure 1. 9. Using the View and Design View tools in creating tables

Step 5: In the new window that appears write the field names and set the data types for those fields

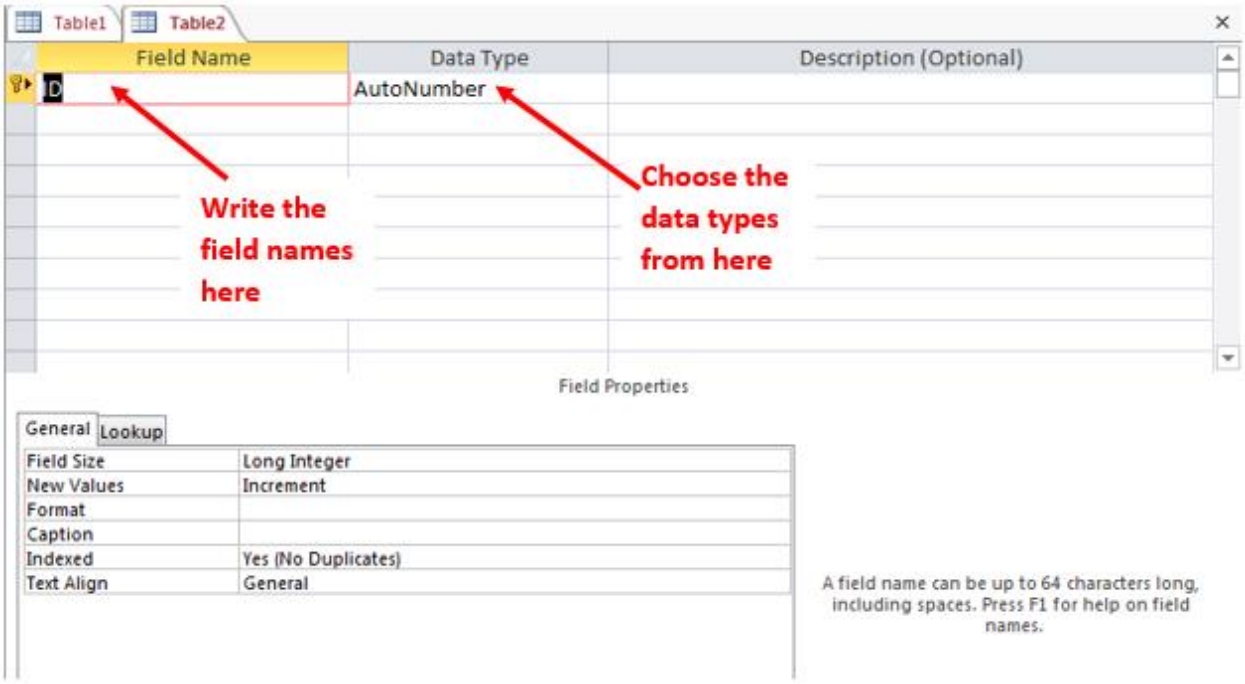


Figure 1. 10. The step to create fields and choose data types in creating tables

After creating a table, enter the data. Note that there are various methods to create tables in Access, such as by using Table Wizard, Datasheet View or by importing tables but the method demonstrated is using Design view.

The Design View of the table below shows the names of its different fields and their data types and the text it contains after doing data entry. The key icon on the **EmpId** field shows that it is a primary key column. The primary key column mush be chosen in such a way that it will never allow duplicate values and it is set by doing a **Right click** then clicking on **Primary Key** option.

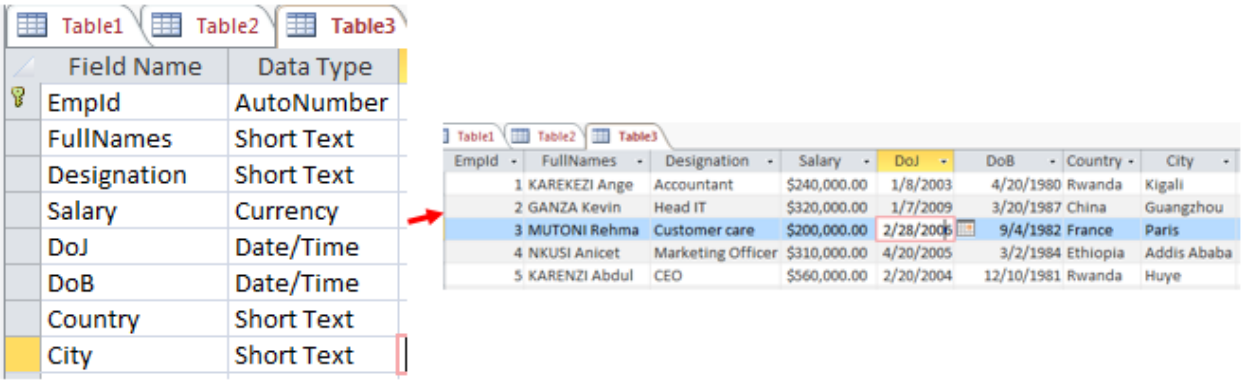


Figure 1. 11. Left: table's structure (field names and data types), Right: resulting table after data entry

C. Creating tables inside the database using in SQL View

SQL stands for Structured Query Language, which is a computer language for storing, manipulating and retrieving data stored in a relational database. It allows users to access data in a relational database management systems and perform other operations on data using an English like language.

To create a table using SQL in Access follow these steps:

Step 1: Click on **Create** menu
Step 2: Click on **Query Design** tool and close the Show table window that pops up
Step 3: Click on **SQL view** tool. Immediately the area where the SQL query is to be written appears

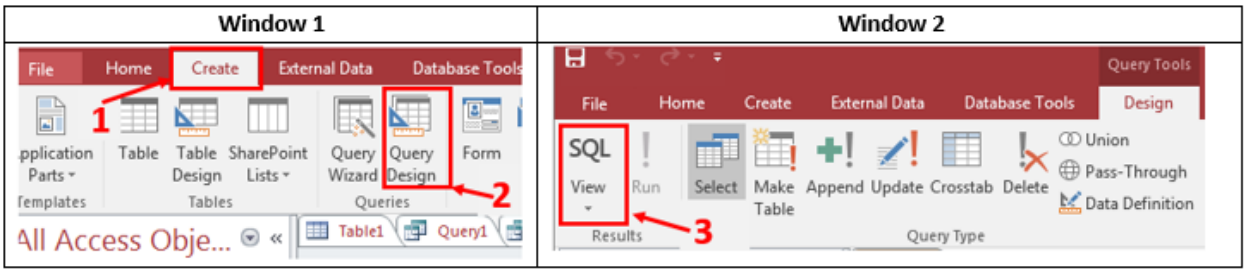


Figure 1. 12. Steps for getting an interface to write an SQL query

Step 4: Write the query and run it to get results. Click on **SQL view** tool. Immediately the area where the SQL query is to be written appears. A query to create the table that was created in Design view looks like this:

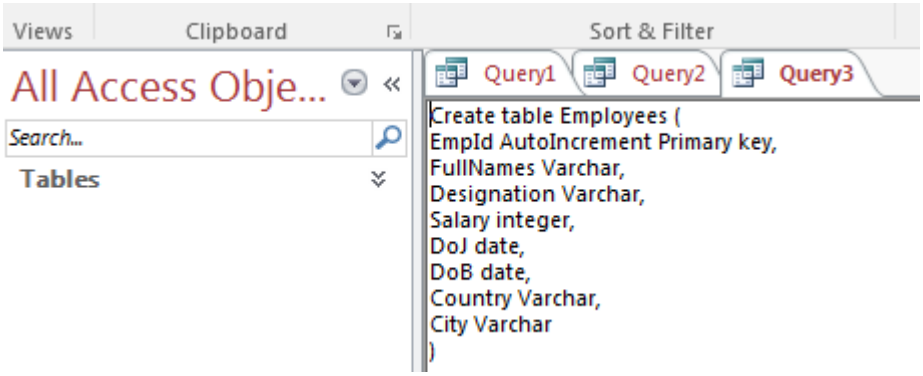


Figure 1. 13. A query for creating Employees table

Application activity 1.7.
1) Using both Design View and SQL View create the following tables:
a) PERSONALDETAILS (IDNumber, Names, Sex, DateOfBirth, QUALIFICATION)
b) PRODUCTS (ID, ProductID, DateCreated, DateSend)
c) CONTACTS (No, FirstName, LastName, Position, Email, PhoneNumber)
d) BOOKS (BookNo, BookName, Author, BookSummary)

1.8. Manipulation of data in an Access table

Activity 1.8

The school accountant wants to know which students have not paid for school fees for the last 6 years. This is done in order to avoid that no student leaves with a debt owed to the school. The school database has among others the following tables: STUDENTS, PROMOTIONS, SCHOOLFEES. Each table has the following columns: STUDENTS: StuID, FirstName, LastName, DateOfBirth; PROMOTIONS: (PromoID, Level, Combination, Year, StuID); SCHOOLFEES: PayNumber, TermName, StuID, Comments

1) Which tables will be used to know if a given student paid all the due school fees up to S6

2) What do you think will be stored in the columns TermName

3) There are more than one table with the column StuID.

a) What are those tables?

b) Why do they have the same column name?

4) The secretary wants to display names and dates of birth of students who study in S5. Which tables will be used in querying the database?

Data manipulation is the process of adjusting data to make it organised and easier to read. Manipulation of data in Access can be done in Design view which then allows the entering of new data, modification of existing data and viewing of data in a more organized way. As Access is a Database Management System, the data entered must be validated meaning that a column designed to accept text must not accept numbers. Therefore while entering data this must be taken into consideration.

1.8.1. Entering data in datasheet view

The entering of data in an Access table will depend on the type of data to enter. When it is text data entry will be done by just placing the cursor in the cell and writing the text. Thus the new record added will go at the bottom of the table.

Navigation among the cells is done by using the keyboard Arrow keys or the Tabs key. In the Access interface, navigation is done using the tools found at the bottom of the table which are First record, Previous record, Next record, Last record. On this tool there is also a Search box to be used to get a specific record.

Figure 1. 14. Access tools for navigating among the cells

1.8.2. Sorting and filtering data

A. Sorting

Sorting is a feature present in most if not all Office programs. This feature is used to order content either by ascending or descending order. To sort data in Access follow these steps:

Step 1: Select the column on which sorting is to be applied. Sorting in Access is done by placing the cursor at the top of the column

Step 2: On the **Home tab** click on **Ascending** or **Descending** depending on the type of sort to be applied. Immediately the data gets sorted by the column that was selected

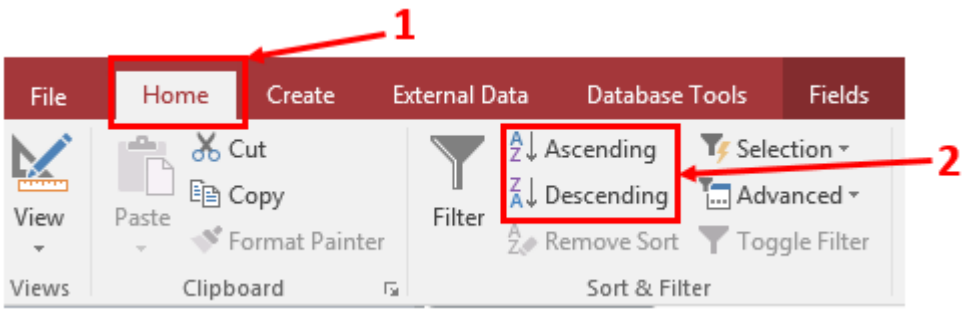


Figure 1. 15. Steps to sort data in Access

B. Filtering

Filtering is a way of displaying only needed data. For big tables, it is not easy to view data if the table has thousands of rows. For this reason, the **Filter** option is used to narrow down the records to be viewed. In Access it is possible to display specific records in a form, report, query, or datasheet. To filter data in Access, follow these steps:

Step 1: Select the column containing the data to be filtered

Step 2: On the **Home tab** click on the Filter icon

Step 3: In the new dialog box select the column on which the filter is to be applied

Step 4: Click on **OK**

Or: Select the column to be filtered and click on the down arrow then select the column for which the filter is to be applied.

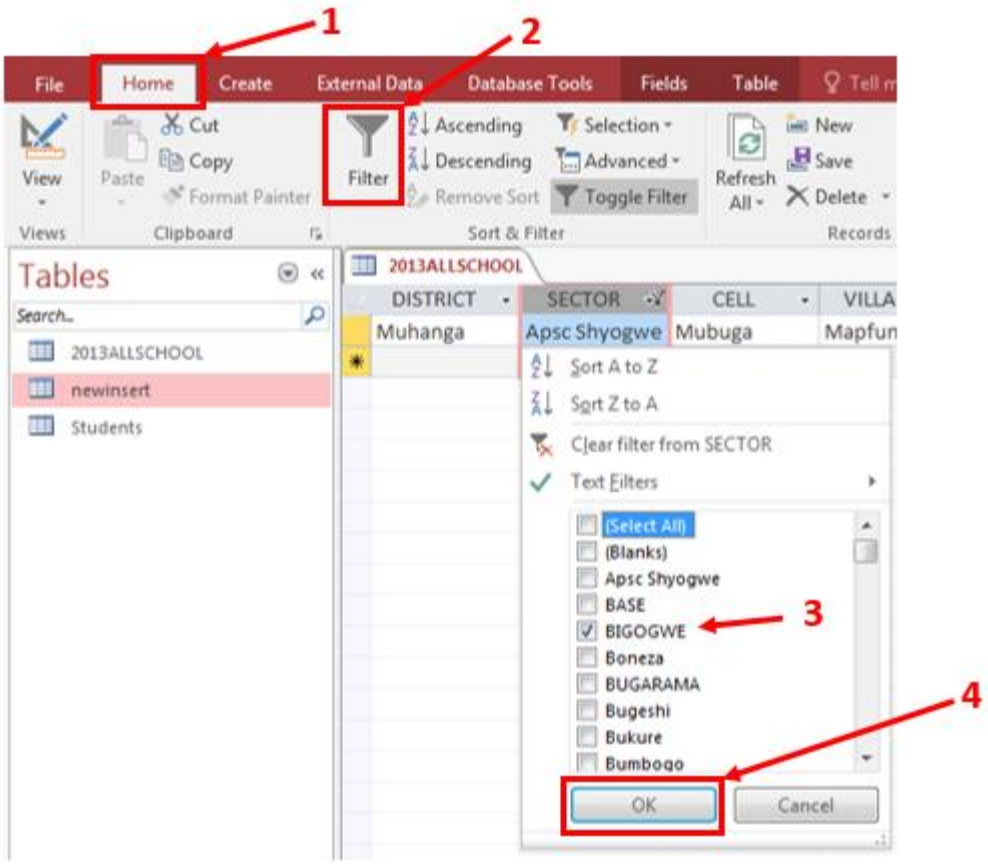


Figure 1. 16. Steps to filter data in an Access table

The result of the filter is a row which fulfil the conditions set in the filter (The condition is Sector Bigogwe). It is possible to filter by many columns if more precision is needed. For example in the screenshot above it was possible to filter by District, Sector and Cell.

1.8.3. Importing and Exporting

Being a database management system, Access is better at managing data compared to other Office programs. Therefore, when one can import or export Access data to Excel or import frm Excel to Access.

Importing and Exporting data in Access is done by using the tools available on the Access task bar under the **External Data** menu. Import data from other files follow these steps:

Step 1: Under the **External Data** menu in the Import & Link group click on any application from where the data is to be imported from. In this case the Excel tool was clicked.

Step 2: In the new dialog box select the source and destination of the data by first browsing the files on your computer and then specifying how and where to store the data in the current database

Step 3: Click OK to approve the options chosen

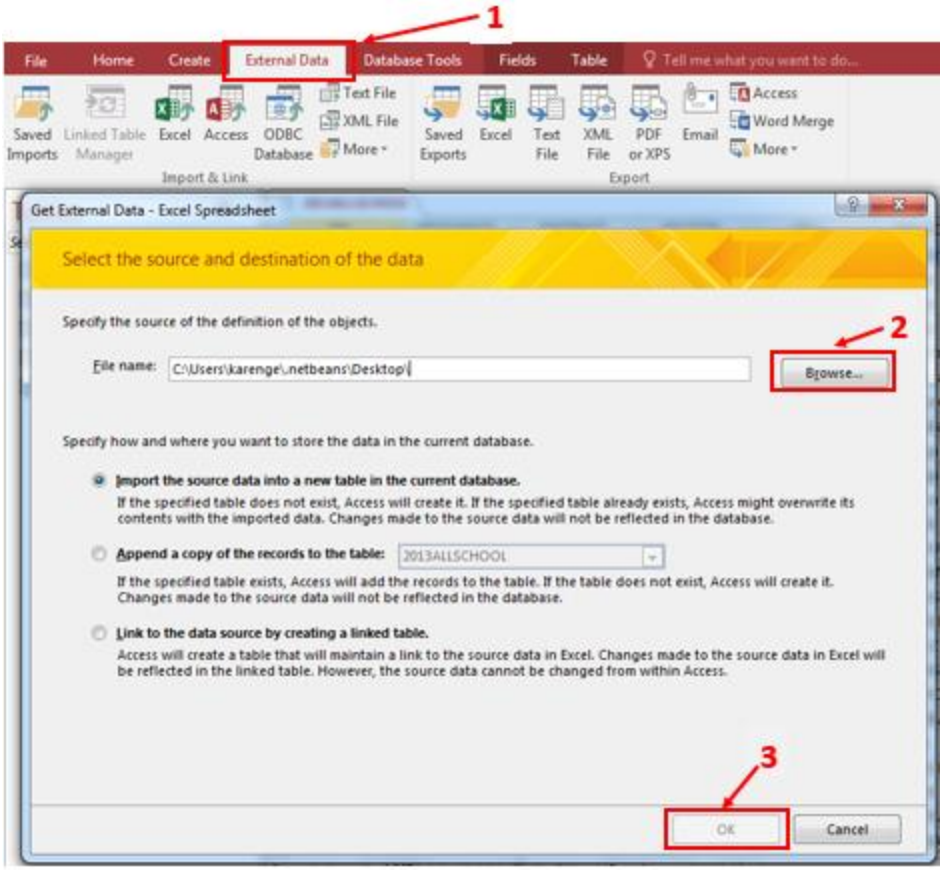


Figure 1. 17. Process for importing data from other applications to Access

Step 4: In the next dialog boxes that appear choose different options by using the different dialog boxes provided. Among the options to choose is making the first row contain column headings, choosing the primary key, etc. In all these options the dialog boxes will guide the process.

Exporting data from Access to other applications is done also by using the External Data menu. The detailed steps are shown below:

Step 1: Under the **External Data** menu in the **Export group** click on one of the application icons. In this case the icon for Excel was clicked.

Step 2: Browse the folders on the computer so as to choose where the new exported file will be stored and its format. Here also specify different options like "Export data with formatting and layout"

Step 3: Click Ok. Immediately the new file will be stored to the location specified.

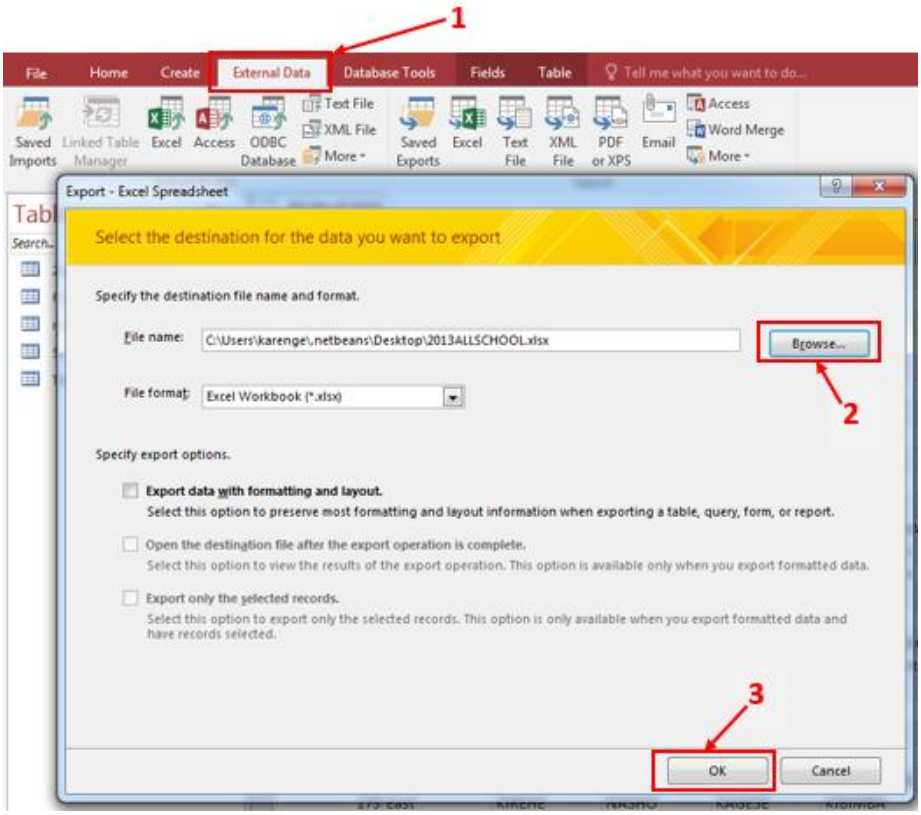


Figure 1. 18. Process for exporting Access data to other applications

1.8.4. Creating a query in design view

The Design view is one of the modes of visualizing Access tables in by which instead of seeing data in a table, the field names, the data types and different constraints on the table are displayed. For a table, the Design view mode can be used to specify column names and their data types and set different constraints line primary key, validation rule, etc.

Follow the following steps to create a query in Design view in Access:

A. First method:

Step 1: Under the **Create** menu in the **Queries** group click on **Query Design**

Step 2: In the dialog box that pops up choose the tables on which the query will be run

Step 3: Click Add to make those tables be part of the query

Step 4: Click **Add**

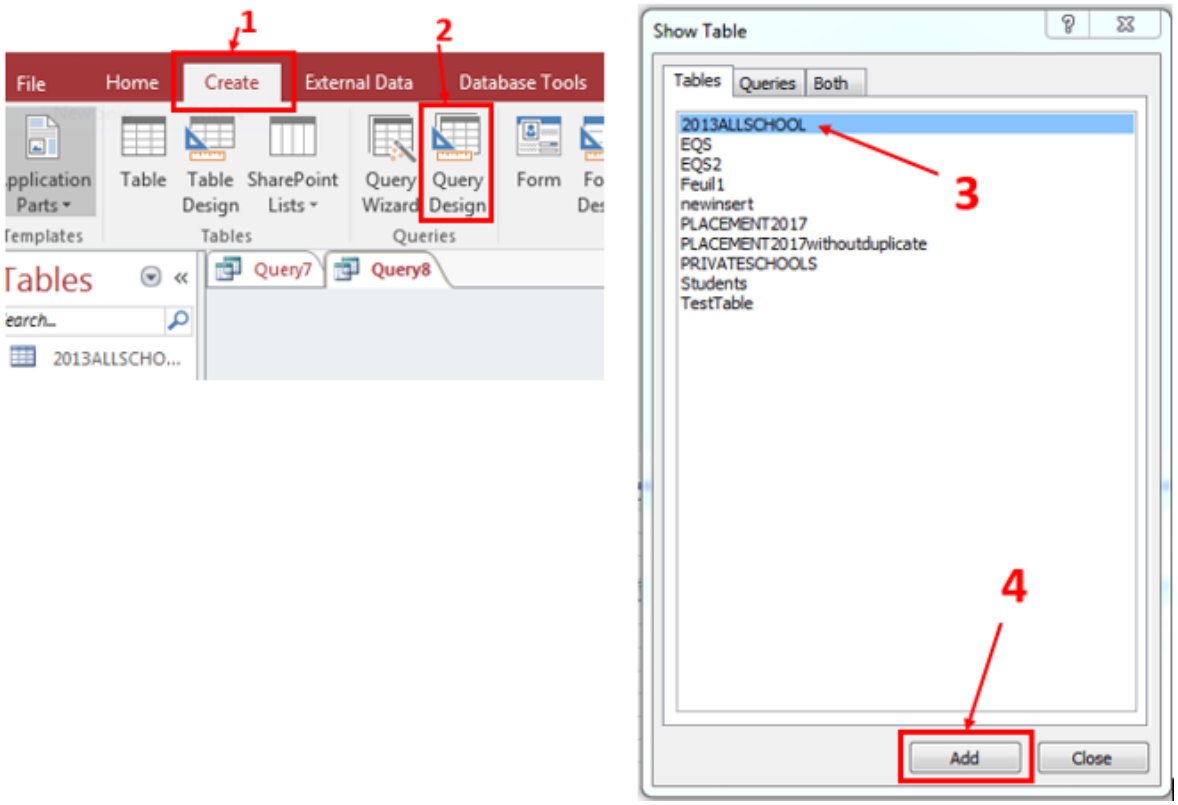


Figure 1. 19.Process to select tables for a query

Step 5: Select the columns to appear in the query results by double clicking them. As columns are selected they become coloured in pink and when they are double clicked they appear in the list of columns whose content will be displayed.

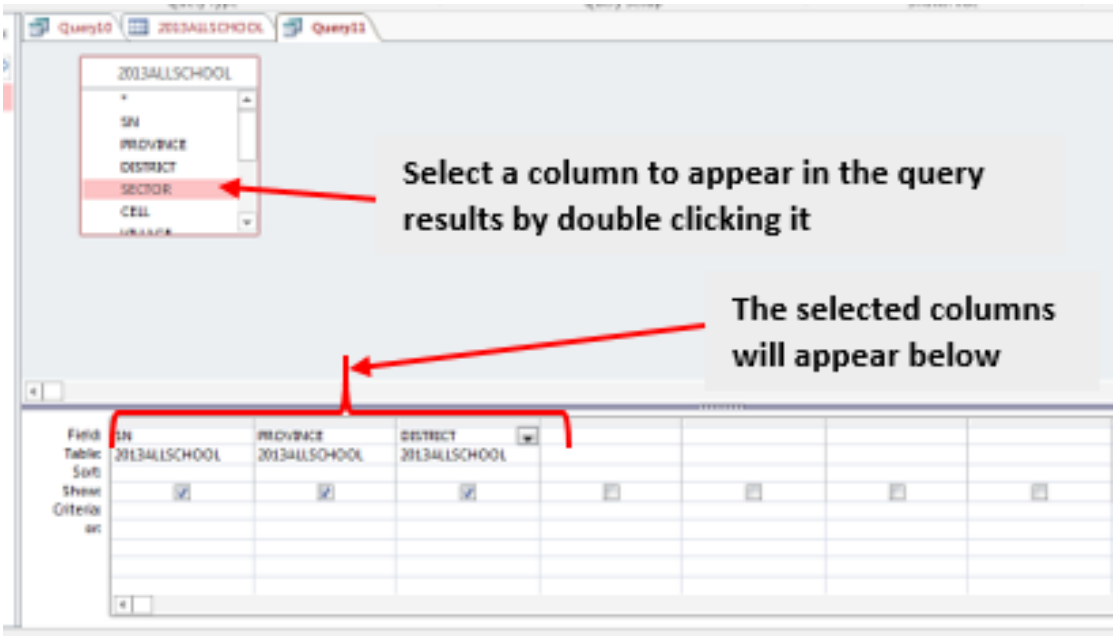


Figure 1. 20. Process to select columns that will appear in the query results

Step 6 (Optional): If the query is based on more than one table, link the related columns by dragging the column name from one table to the column to the other table. Immediately a line between the two columns is established. This means that the tables on which the query is based will be selected then added by clicking on Add button (Step 4)

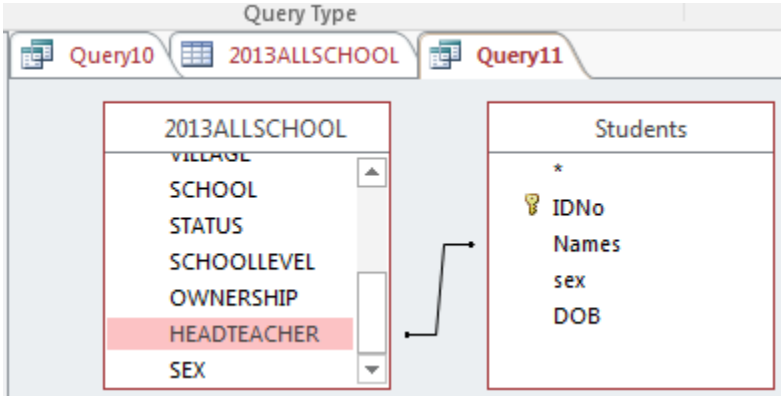


Figure 1. 21. Two tables on which the query will be based where two columns (HeadTeacher and Names) have been linked

Step 7: Run the query by clicking on **Run icon** (Exclamation mark)

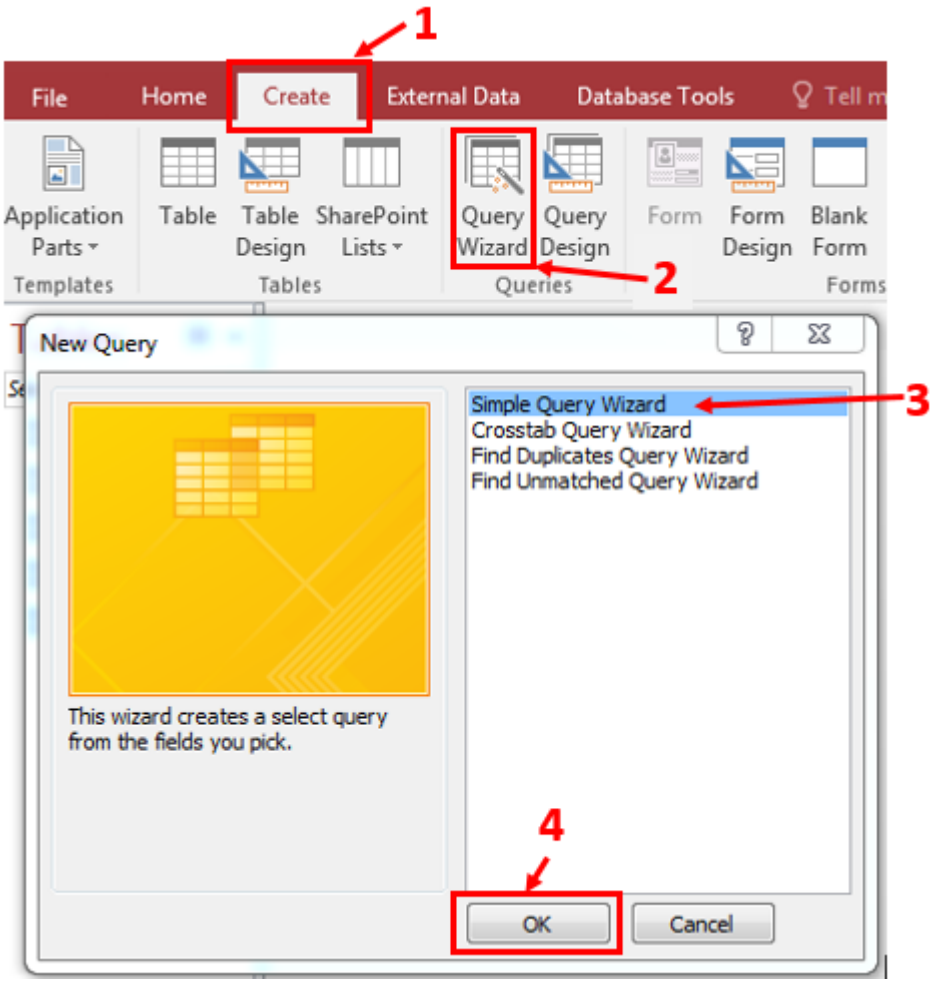
B. Second method: Creating a query by using the query wizard

Step 1: Click on **Create** menu,

Step 2: In the queries group click on **Query Wizard**

Step 3: Select (Click) one query type that is going to be used. The query types can be Simple Query Wizard, Crosstab Query Wizard, Find Duplicate Query Wizard, Find Unmatched Query Wizard. In this example the Simple Query Wizard was selected.

Step 4: Click **OK**



Step 5: In the new dialog box select the columns which will appear in the results of the query. The selected fields will move to the right in the area under "Selected fields"

Step 6: Click **Next** and follow the prompts. When the **Next** button is no longer active click on **Finish**.

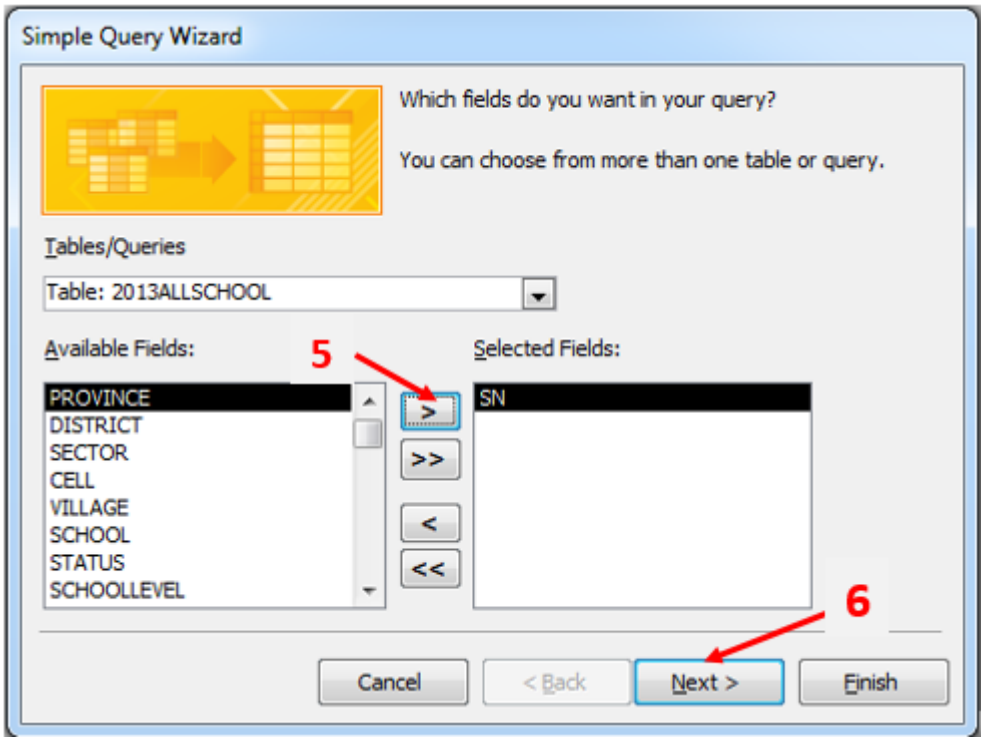


Figure 1. 22. Dialog box for selecting which columns to appear in the query results

Application activity 1.8.

1) Create a database and inside it creates the following tables (columns names are in parenthesis): STUDENTS (StuID, FirstName, LastName, DateOfBirth, District), PROMOTIONS (PromoID, Level, Combination, Year, StuID), SCHOOLFEES (PayNumber, TermName, Amount, StuID, Comments). Make sure foreign key columns are created.

2) In the database you have created, enter a list of your classmates in the STUDENTS table. Enter data in the other tables.

3) Run the following queries (in Design view) on the tables you have created:

a) Display students' names, level and combination of students in Senior Five

b) Display Students' names, TermName and Amount for all students in the school

4) Using filter option, show students from Burera District

END UNIT ASSESSMENT

Question 1.

The database below is composed of two tables. Use it to answer asked questions

BORROWERS

BorrowerId	BorrowerName	DOB
112018	KAYIRANGA	11/12/1987
122018	KAMANA	12/12/1989
132018	KAMIHANDA	12/01/1996

BOOKS

BookId	BookTitle	BorrowerId
10	Computer Science for Rwandan Schools Senior 4	112018
12	Data communications and Networking	112018
13	Fundamentals of Mathematics	122018
14	Production Economics: The Basic Theory of Production Optimization	132018
15	Encyclopedia of Mathematics	122018

i. What is the primary key for each table and give reasons.
ii. Identify the foreign key in the BOOKS table.
iii. Identify the relationship between BORROWERS and BOOKS tables and draw the Entity Relationship Diagram.

Question 2.

Write an ER Diagram for a Banking System. Assume your own entities (minimum 5), attributes and relation.

Question 3.

A picture gallery owner has decided to set up a database to keep information about the pictures he has for sale. The database table, **PICTURE**, will contain the following fields:

PicNo, PictureTitle, PictureArtist, PicDescription, PictSize, PicPrice, ArrivedDate (date picture arrived at gallery), Status(whether picture is already sold)

PicNo	PictureTitle	PictureArtist	PicDescription	PicSize	PicPrice	ArrivedDate	Status
P1000	Volcanoes In Rwanda	GATOTO	This pictures shows all volcanoes existed in Rwanda	10MB	150,000	21/12/2016	Unsold
P1001	Women and guitar	KAGABO	This pictures shows how women can also play guitar	20MB	200,000	01/06/2017	Sold
P1010	Flag Rwanda	GATOTO	Rwanda national flag	5MB	80,000	13/01/2016	Sold

(i) State what data type you would choose for each field.

(ii) State which field you would choose for the primary key.

(iii) Complete the query-by-example grid below to select and show the CatNo, PicTitle and PicPrice of all unsold pictures by the artist 'GATOTO'.

Field:					
Table:					
Sort:					
Show:					
Criteria:					
or:					

UNIT 2: SQL AND DATABASE PROJECT

Introductory Activity

The Farmer Ltd corporate wants to create a database. The database will manage its customers and employees. The proposed entity is Customer. Consider the following relational schema of the Farmer Ltd database;

Customer :(Cust_id (integer), Fname (text), Lname(text), city (text), Item_ID(Integer), Description (text), Quantity (number), Total (number))

Do the following:

1. Choose the primary key for Customer table
2. Using SQL statement
    i. Using SQL statement create the above relation (table)
    ii. Add the below records into customer table

Customer table

Cust_id	Fname	Lname	City	Item_ID	Description	Quantity	Total
01	FABRICE	Neza	Muhanga	100101	IKIVUGUTO	1000	50.000
02	KWIZERA	David	Ruhango	100102	INSHYUSHYU	20000	100,000
03	NSHUTI	Alice	Save	100103	YOGURT	10,000	150,000
04	UWINEZA	Josiane	Nyanza	100101	IKIVUGUTO	2000	100,000
02	KOBWA	Diane	Nyanza	100106	BUTTER	100	2500

2.1. Introduction to Structured Query Language

Activity 2.1

1. Discuss reasons why MS Access is considered as a RDBMS software

Structured Query Language (SQL) is a computer language that is used to request data from a database, to add, update, to remove data within a database and to manipulate the metadata of the database.

Commonly used statements are grouped into the following categories:

- Data Manipulation Language (DML)refers to a data manipulation language which is a computer programming language used for adding, deleting, and modifying data in a database. The SQL commands that deals with the manipulation of data present in the database belong to DML and this includes most of the SQL statements. It is the component of the SQL statement that controls access to data and to the database
- Data Definition Language(DDL): refers to the set of SQL statements that can create and manipulate the structures of a database. Data Definition Language actually consists of the SQL commands that can be used to define the database schema. It simply deals with descriptions of the database schema and is used to create and modify the structure of database objects in the database. DDL is a set of SQL commands used to create, modify, and delete database structures but not data
- Data Control Language(DCL) includes commands such as GRANT and REVOKE which mainly deal with the rights, permissions, and other controls of the database system

Application Activity 2.1

1. Discuss the role played by SQL language into Database management.
2. Differentiate with clear examples, the difference between DDL command and DML command

2.2. Data Definition Language (DDL)

Activity 2.2:

1. After the creation of the database in the MS access, what steps should follow?
2. List the SQL statements that fall in the category of data definition language?

Data definition language (DDL) refers to the set of SQL statement that can create and manipulate the structures of a database. DDL statements are used to create, change, and remove objects including indexes, triggers, tables, and views. Common DDL statements include:

- CREATE (generates a new table)
- ALTER (alters table)
- DROP (removes a table from the database

2.2.1 Creating and saving a database

A database is a collection of information. In Access, every database is stored in a single file and has to have a name and different objects. Different objects in an Access database are tables, queries, forms, reports, macros, and modules.

- **Tables:** They store information. A database can have as many tables as are needed.
- **Queries:** They let database users perform actions on tables which can be data definition queries or data manipulation queries.
- **Forms:** Those are attractive windows created by the database user and provide a way to view or change information in a table
- **Reports:** They are summary of the information contained in different tables which have a common characteristic.
- **Macros**: They are mini-programs that automate custom tasks.
- **Modules**: They are files that contain Visual Basic code that can be used to perform different tasks like updating 10,000 records or sending an email.

To create an Access database first start Microsoft Office Access by clicking on the start button then on MS Access.

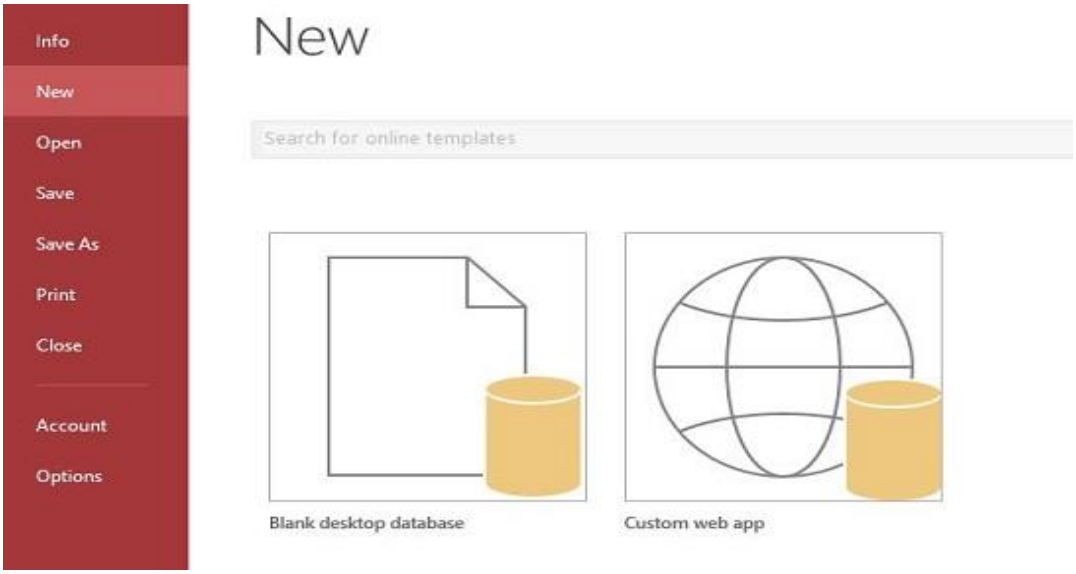


Figure 2.1:Step One in the database creation

In the window that will appear write the database name and click on **Create**

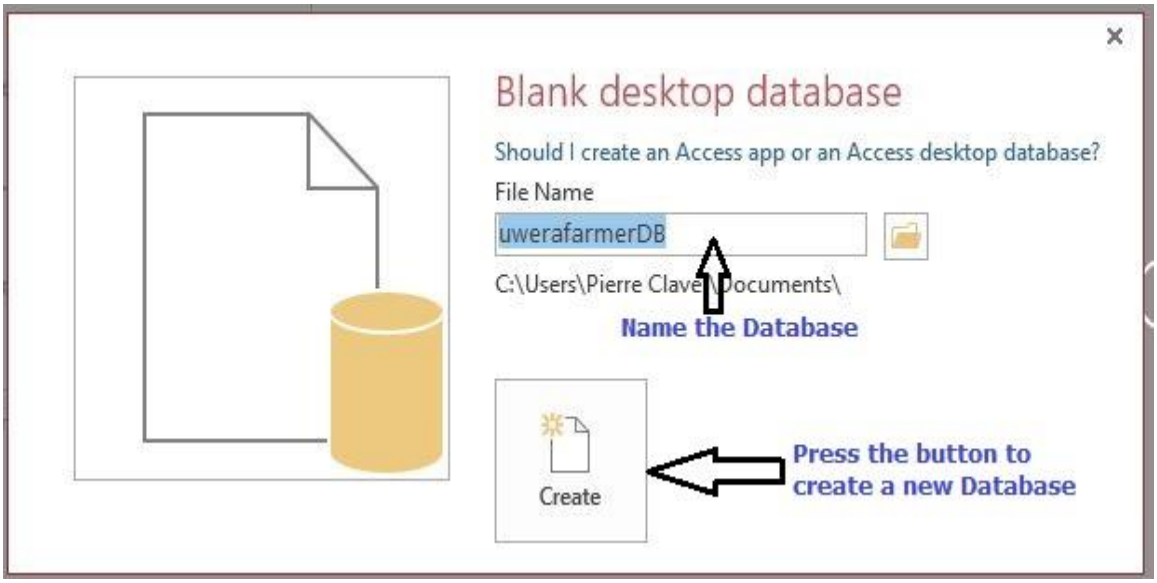


Figure 2.2:Access window for naming and creating a database

The new database **uwerafarmerDB** is now created but has no table. The next step is to create tables using SQL Statement. For most RDBMS software, the SQL query used is **"CREATE DATABASE "**in order to create a new database,

Here is the SQL Syntax to create a new database into RDBMS:

```
CREATE DATABASE databasename;
```

Note that MS Access does allow a user to create a database using the SQL statement CREATE DATABASE; it is because of that CREATE DATABASE is reserved into MS Access. In other RDBMS software this SQL statement can be executed by the user.

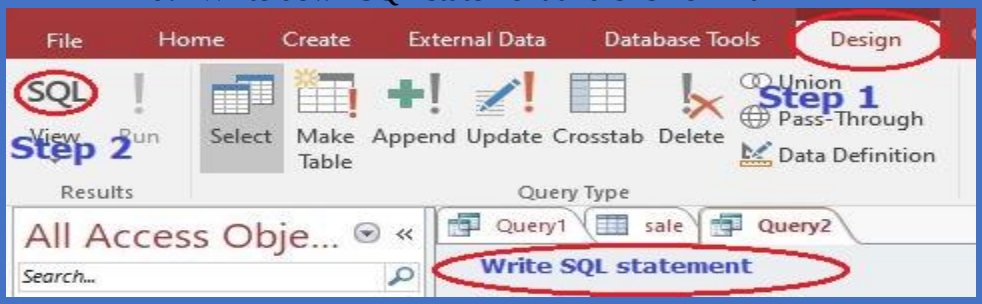
2.2.2 CREATE TABLE STATEMENT

CREATE TABLE is the keyword telling the database system what you want to do. In this case, you want to create a new table. The unique name or identifier for the table follows the CREATE TABLE statement.

Then in brackets comes the list defining each column in the table and what sort of data type it is. The syntax becomes clearer with an example below in the application activity

Exercise 2.1
Using the instructions below:

1. Create sale table using given SQL command.
2. Steps to use:
    a. Open the MS Access,
    b. Then choose Design TAB,
    c. fter click on SQL
    d. Write down SQL statement and **click on Run**




```
CREATE TABLE  sale (sale_id integer,Fname varchar (15),Lname varchar (15), Sale_Age  int
,District  varchar(15)    not  null,  Province  varchar(10),  PruductName  varchar(20),
```

Creating a basic table involves naming the table and defining its columns and each column's data type. The SQL **CREATE TABLE** statement is used to create a new table.
The syntax for creating a new table is this:

CREATE TABLE table name (column1 datatype, column2 datatype, column3 datatype, ...columnn datatype, primary key (one or more columns));

Note:

- In RDMBS, each table must have a **Primary Key**
- When creating a table, the data types most often used include: Strings (**VARCHAR** or **CHAR**); Numbers (**NUMBER** or **INTEGER**); and Dates (**DATE**).
- Semi-colon is required at the end of every SQL statement. It tells the system to process everything before it. If you leave it out, you may have strange results, or even receive errors.
- All the SQL queries are **case insensitive**, so it does not make any difference if you write SALARY or salary in WHERE condition.

2.2.3 DROP TABLE STATEMENT

The DROP TABLE statement allows a table to be removed from a MySQL database. This statement deletes the entire structure as well as the content of the table.

The syntax of drop table statement is as follows:

```
DROP TABLE table_name;
```

Exercise 2.2:

The SQL statement below creates Customer table in the uwerafarmerDB created above and answer the question:

Create table customer (customer_id integer, full_name(varchar), address(varchar));

If you have successfully created the customer table; Execute the SQL command below and react on the result.

Drop table customer;

1. Using your own words, discuss what happened to the customer table ?

The SQL DROP TABLE statement is used to remove a table definition and all its data.

Note that the user has to be careful while using this command because once a table is deleted then all the information available in the table would also be lost forever.

2.2.4 ALTER TABLE statement

The ALTER TABLE statement is used to add, delete or modify columns in an existing table, use the SQL Command ALTER TABLE followed by either **ADD** or **DROP** or **MODIFY**. ALTER TABLE command can also be used to add and drop various constraints on an existing table.

i. The basic syntax of **ALTER TABLE** to add a new column in an existing table is as follows:

```
ALTER TABLE table_name ADD column_name datatype;
```

ii. The basic syntax of ALTER TABLE to **DROP COLUMN** in an existing table is as follows:

```
ALTER TABLE table_name DROP column column_name;
```

ALTER TABLE table_name ADD constraint myprimarykey primary key (column1, column2...);

Application Activity 2.2:
The SQL statement below creates Customer table in the uwerafarmerDB created above and answer the question:

1. Create table customer (customer_id integer, full_name varchar (20), address(varchar), age integer, umudugu (text));
2. Add new column to the customer table (ProductName varchar (15))
3. Delete column address from the customer table

2.3 SQL CONSTRAINTS APPLICATION TO MS ACCESS TABLE

Activity 2.3
Using, the following SQL creates a new table called "Employee" and adds five columns, three of which, ID and NAME and AGE, specify not to accept NULLs:

Below is the SQL statement to create Employee:

create table Employee (id integer not null, name varchar (20) not null, age integer not null, address varchar (25) , salary number, primary key (id));

Constraints enable you to further control how data is entered into a table and are used to restrict values that can be inserted into a field and to establish referential integrity. Recall that referential integrity is a system of rules used to ensure that relationships between records in related tables are valid.

The following are commonly used constraints available in SQL. These constraints have already been discussed in the previous content.

- **Not null constraint:** ensures that a column cannot have null value.
- **Unique constraint:** ensures that all values in a column are different.
- **Primary key:** uniquely identified each rows/records in a database table.
- **Foreign key:** uniquely identified a row/record in any other database table.

2.3.1 NOT NULL Constraint

By default, a column can hold NULL values. If the user does not want a column to have a NULL value, then he/she needs to define such constraint on this column specifying that NULL is not allowed for that column. NULL is not the same as no data, rather, it represents unknown data.

2.3.2. UNIQUE Constraint

The UNIQUE Constraint prevents two records from having identical values in a particular column. In the "Customers" table, for example, you might want to prevent two or more people from having identical age.

Exercise 3.1:
Using, the following SQL creates a new table called "CasualWorker" and adds five columns, three of which, ID and NAME and AGE, specify not to accept NULLs and Age column is set to UNIQUE.

CREATE TABLE CasualWorker (id integer not null, name varchar (20) not null, age integer not null unique, address varchar (25) , salary number;

2.3.3 Drop a UNIQUE Constraint

Sometime you need to delete a constrain give to a column, in order to drop a UNIQUE constraint, use the following SQL:

```
ALTER TABLE "CasualWorker" DROP constraint myuniqueconstraint;
```

2.3.4 PRIMARY Key constraint

A primary key is a field in a table which uniquely identifies each row/record in a database table.

- Primary key column must contain unique values.
- Primary key column cannot have NULL values.

A table can have only one primary key, which may consist of single or multiple fields. When multiple fields are used as a primary key, they are called a **composite key**.

To create a PRIMARY KEY constraint on the "ID" column when "Employee" table already exists, use the following SQL syntax:

```
ALTER TABLE CasualWorker ADD primary key (ID);
```

Notice that to use the ALTER TABLE statement to add a primary key, the primary key column(s) must already have been declared to not contain NULL values (when the table was first created).

Application Activity 2.3
Using the following SQL command, add Unique constraint age and salary columns

1. ALTER TABLE "CasualWorker" MODIFY age integer not null unique;
2. ALTER TABLE "CasualWorker" MODIFY salary number not null unique;

The user can also use the following syntax, which supports naming the constraint in multiple columns as well:

3. ALTER TABLE "CasualWorker" ADD constraint myuniqueconstraint unique(age, salary);

2.4 DATA MANIPULATION LANGUAGE

Activity 2.4
Create saleperson table using the below SQL command:

CREATE TABLE saleperson (sale_id integer,Fname varchar (15),Lname varchar (15), Sale_Age int ,District varchar(15) not null, Province varchar(10), PruductName varchar(20), Quantity_Sold number not null ,Store_Location varchar (10),primary key (sale_id));

SALEPERSON TABLE

sale_ id	Fname	Lname	Sale_ Age	District	Province	Product Name	Quantity Sold	Store Location
1	Kabera	Divine	22	Kirehe	Eastern	Tomato	100	Gatore
2	Rurangayire	Ariane	25	Kamonyi	Western	Milk	40	Kamonyi
3	Butera	Scott	24	Gastibo	Western	Beans	234	Kiziguro
4	Gahizi	Allan	28	Karongi	Western	Potatoes	390	Gitesi
5	Kamali	Grace	27	Musanze	Northern	Coffee	90	Kimonyi
6	Ineza	Ornella	25	Nyamagabe	Western	Tea	123	Kitabi

After the creation of the saleperson ,Instert the above value into the saleperson table using the learnt method of inserting data into the table.

The SQL data manipulation language (DML) is used to query and modify database data. we are going to discuss how to use the INSERT, SELECT, UPDATE, and DELETE SQL statements.

Below are the main DML statements:

- INSERT: to insert data into a table
- SELECT: to query data in the database
- UPDATE: to update data in a table
- DELETE: to delete data from a table

In each Data Manipulation Language statement:

- Each clause in a statement should begin on a new line.
- The beginning of each clause should line up with the beginning of other clauses.
- If a clause has several parts, they should appear on separate lines and be indented under the start of the clause to show the relationship.
- Upper case letters are used to represent reserved words.
- Lower case letters are used to represent user-defined words.

2.4.1 INSERT INTO STATEMENT

The SQL **INSERT INTO** Statement is used to add new rows of data into a table in the database.

- INSERT specifies the table or view that data will be inserted into.
- Column_list lists columns that will be affected by the INSERT.
- If a column is omitted, each value must be provided.
- If you are including columns, they can be listed in any order.
- VALUES specifies the data that you want to insert into the table VALUES is required.

There are two basic syntaxes of INSERT INTO statement as follows:

Method 1:

The SQL INSERT INTO syntax would be as follows:

INSERT INTO table_name (column1, column2, column3,...columnn)] VALUES (value1, value2, value3,...valuen);

Here, column1, column2,...columnN are the names of the columns in the table into which you want to insert data.

Method 2:

You may not need to specify the column(s) name in the SQL query if you are adding values for all the columns of the table. But make sure the order of the values is in the same order as the columns in the table.

The SQL INSERT INTO syntax would be as follows:

INSERT INTO table_name VALUES (value1,value2,value3,...valuen);

When inserting rows with the INSERT statement, these rules apply:

- Inserting an empty string (‘ ‘) into a varchar or text column inserts a single space.
- All char columns are right-padded to the defined length.
- All trailing spaces are removed from data inserted into varchar columns, except in strings that contain only spaces. These strings are truncated to a single space.
- If an INSERT statement violates a constraint, default or rule, or if it is the wrong data type, the statement fails and MS Access displays an error message.

When you specify values for only some of the columns in the column_list, one of three things can happen to the columns that have no values:

1. A default value is entered if the column has a DEFAULT constraint, if a default is bound to the column, or if a default is bound to the underlying user-defined data type.
2. NULL is entered if the column allows NULLs and no default value exists for the column.
3. An error message is displayed and the row is rejected if the column is defined as NOT NULL and no default exists.

2.4.2 SELECT STATEMENT

The SELECT statement, or command, allows the user to extract data from tables, based on specific criteria.

Exercise 4.1 :

1. Create myschool database using MS access.
2. Consider the following student Table in myschool Database

RegNo	Fname	Lname	Sex	Age	Combination	Class	District
3003/16	Uwimana	Alphonsine	F	17	MCB	S5	Ngororero

The SELECT statement is used to select data from a database. The data returned is stored in a result table, called the result-set.

SELECT Syntax:

SELECT column1, column2, ...FROM table_name;

Here, column1, column2, ... are the field names of the table you want to select data from**. If you want to select all the fields available in the table, use the following syntax:**

*SELECT * FROM table_name;*

SELECT * (Select all)

Exercise 4.2 :

The following SQL statement selects all the columns from the "Student" table:

SELECT * FROM Student;

Result:

RegNo	Fname	Lname	sex	age	combinatior	class	district
2310/17	Nzabandora	James	M	20	PCB	S6	Rubavu
2789/16	Mutoni	Gloria	F	20	MCB	S6	Nyarugenge
3003/16	Uwimana	Alphonsine	F	17	MCB	S5	Ngororero
3140/16	Rusibiza	Louise	F	20	MPG	S6	Musanze
3452/18	Uwera	Sylvie	F	19	PCB	S5	Gasabo
3782/16	Muhirwa	Christian	M	18	PCB	S6	Gasabo
4532/15	Muhire	Andrew	M	18	MCB	S4	Gakenke
4627/15	Ntwali	Honore	M	17	MPG	S5	Musanze

2.4.3 The SQL SELECT DISTINCT Statement

The SELECT DISTINCT statement is used to return only distinct (different) values. Inside a table, a column often contains many duplicate values; and sometimes you only want to list the different (distinct) values. The SELECT DISTINCT statement is used to return only distinct (different) values.

SELECT DISTINCT Syntax

SELECT DISTINCT column1, column2 ...FROM table_name

Exercise 4.3

The following SQL statement selects all (and duplicate) values from the "Combination, Class, District" columns in the "Student" table:

SELECT DISTINCT combination, class , district FROM student;

combinatior	class	district
MCB	S4	Gakenke
MCB	S5	Ngororero
MCB	S6	Nyarugenge
MPG	S5	Musanze
MPG	S6	Musanze
PCB	S5	Gasabo
PCB	S6	Gasabo
PCB	S6	Rubavu

2.4.4 The WHERE Clause

The WHERE clause is used to extract only those records that fulfill a specified criterion.

The syntax is as follows:

SELECT column1, column2 ...FROM table_name WHERE <operator value>

Application Activity 2.4

WHERE CLAUSE Example

The following SQL statement selects all fields from "student”" where sex is "F"

Example

SELECT * FROM student WHERE sex='F’;

RegNo	Fname	Lname	sex	age	combinatior	class	district
3003/16	Uwimana	Alphonsine	F	17	MCB	S5	Ngororero
3140/16	Rusibiza	Louise	F	20	MPG	S6	Musanze
3452/18	Uwera	Sylvie	F	19	PCB	S5	Gasabo
2789/16	Mutoni	Gloria	F	20	MCB	S6	Nyarugenge

2.5 OPERATORS IN THE WHERE CLAUSE

Activity 5.1

Select all students in the student table whose age is above or equal to 18.

SELECT * FROM student WHERE age>=18;

RegNo	Fname	Lname	sex	age	combinatior	class	district
2310/17	Nzabandora	James	M	20	PCB	S6	Rubavu
3140/16	Rusibiza	Louise	F	20	MPG	S6	Musanze
4532/15	Muhire	Andrew	M	18	MCB	S4	Gakenke
3452/18	Uwera	Sylvie	F	19	PCB	S5	Gasabo
2789/16	Mutoni	Gloria	F	20	MCB	S6	Nyarugenge

The following operators can be used in the WHERE clause:

Operator	Description
=	Equal
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
<>	Not equal. Note: In some versions of SQL this operator may be written as !=

Table 2. 1: Operators

2.5.1 SQL UPDATE Statement

The UPDATE statement changes data in existing rows either by adding new data or modifying existing data.

UPDATE Syntax

UPDATE table_name SET column1 = value1, column2 = value2, ...WHERE condition;

Exercise 5.1:

Write an SQL query to change the record of Fname From Hirwa to Ntwali.

UPDATE Student SET Fname = "Ntwali" WHERE RegNo= 4627/15;

Result

RegNo	Fname	Lname	sex	age	combinatior	class	district
2310/17	Nzabandora	James	M	20	PCB	S6	Rubavu
2789/16	Mutoni	Gloria	F	20	MCB	S6	Nyarugenge
3003/16	Uwimana	Alphonsine	F	17	MCB	S5	Ngororero
3140/16	Rusibiza	Louise	F	20	MPG	S6	Musanze
3452/18	Uwera	Sylvie	F	19	PCB	S5	Gasabo

2.5.2 SQL DELETE Statement

The DELETE statement removes rows from a record set. DELETE names the table or view that holds the rows that will be deleted and only one table or row may be listed at a time. WHERE clause that limits the deletion to select records.

DELETE Syntax:

DELETE FROM table_name WHERE condition;

The rules for the DELETE statement are:

- If you omit a WHERE clause, all rows in the table are removed (except for indexes, the table, constraints).
- DELETE cannot be used with a view that has a FROM clause naming more than one table. (Delete can affect only one base table at a time.)

Note: Be careful when deleting records in a table! Notice the WHERE clause in the DELETE statement. The WHERE clause specifies which record(s) should be deleted. If you omit the WHERE clause, all records in the table will be deleted!

2.5.3 SQL ORDER BY Keyword

The ORDER BY keyword is used to sort the result-set in ascending or descending order. The ORDER BY keyword sorts the records in ascending order by default. To sort the records in descending order, use the DESC keyword.

ORDER BY Syntax:

SELECT column1, column2, ...FROM table_name ORDER BY column1, column2, ... ASC|DESC;

Exercise 5.2

Write an SQL query to display Fname, Lname, Age, Combination and District arranged by age in ascending order.

Result

Fname	Lname	age	combinatior	district
Ntwali	Honore	17	MPC	Musanze
Uwimana	Alphonsine	17	BCM	Ngororero
Muhirwa	Christian	18	PCB	Gasabo
Muhire	Andrew	18	BCM	Gakenke
Uwera	Sylvie	19	PCB	Gasabo
Mutoni	Gloria	20	BCM	Nyarugenge
Rusibiza	Louise	20	MPC	Musanze
Nzabandora	James	20	PCB	Rubavu
*				

2.5.4 The SQL AND, OR and NOT Operators

The AND, OR operators are used to filter records based on more than one condition

- The AND operator displays a record if all the conditions separated by AND are TRUE.
- The OR operator displays a record if any of the conditions separated by OR is TRUE.
- The NOT operator displays a record if the condition(s) is NOT TRUE.

Note: WHERE clause can be combined with AND, OR, and NOT operators.

AND Syntax:

SELECT column1, column2, ...FROM table_name WHERE condition1 AND condition2 AND condition3 ...;

OR Syntax:

SELECT column1, column2, ...FROM table_name WHERE condition1 OR condition2 OR condition3 ...;

NOT Syntax:

SELECT column1, column2, ...FROM table_name WHERE NOT condition;

Exercise 5.3

AND Example:

The following SQL statement selects all fields from "student’" where sex is "F" AND class is "S5":

Example

SELECT * FROM student WHERE sex='F' AND Class='S5';

RegNo	Fname	Lname	sex	age	combinatior	class	district
3003/16	Uwimana	Alphonsine	F	17	MCB	S5	Ngororero
3452/18	Uwera	Sylvie	F	19	PCB	S5	Gasabo

Exercise 5.4

OR Example:

The following SQL statement selects all fields from "student" where sex is "F" **OR** class is "S5":

Example:

SELECT * FROM student WHERE sex='F' **OR** Class='S5';

RegNo	Fname	Lname	sex	age	combinatior	class	district
3003/16	Uwimana	Alphonsine	F	17	MCB	S5	Ngororero
3140/16	Rusibiza	Louise	F	20	MPG	S6	Musanze
3452/18	Uwera	Sylvie	F	19	PCB	S5	Gasabo
2789/16	Mutoni	Gloria	F	20	MCB	S6	Nyarugenge

Exercise 5.5

NOT operator Example: The following SQL statement selects all fields from "student" where sex is NOT "F"

SELECT * FROM student WHERE NOT sex='F';

RegNo	Fname	Lname	sex	age	combinatior	class	district
2310/17	Nzabandora	James	M	20	PCB	S6	Rubavu
4532/15	Muhire	Andrew	M	18	MCB	S4	Gakenke
4627/15	Ntwali	Honore	M	17	MPG	S5	Musanze
3782/16	Muhirwa	Christian	M	18	PCB	S6	Gasabo

2.5.5. Combining AND, OR and NOT with the SELECT Statement

You can also combine the AND, OR and NOT operators. The SQL AND condition and OR condition can be combined to test for multiple conditions in a SELECT statement.

The Syntax of using AND and OR operator

*SELECT * FROM table_name WHERE condition1AND condition2*
OR condition_n;

Exercise 5.6

The following SQL statement selects all fields from "student" where district is "Musanze" AND age must be "18" OR class "S5" (use parenthesis to form complex expressions):

*SELECT * FROM student WHERE District ='Musanze' AND (age =17 OR class='S5');*

The following SQL statement selects all fields from “Customers” where address is NOT "Nyamagabe" and NOT "GASABO":

Application Activity 5.1
The following SQL statement selects all fields from "student" where combination is NOT "MPC" AND class not “S5”

SELECT * FROM student WHERE NOT Combination='MPC' AND NOT class='S5';

RegNo	Fname	Lname	sex	age	combinatior	class	district
2310/17	Nzabandora	James	M	20	PCB	S6	Rubavu
3140/16	Rusibiza	Louise	F	20	MPG	S6	Musanze
4532/15	Muhire	Andrew	M	18	MCB	S4	Gakenke
2789/16	Mutoni	Gloria	F	20	MCB	S6	Nyarugenge
3782/16	Muhirwa	Christian	M	18	PCB	S6	Gasabo

2.6 SQL AGGREGATE FUNCTIONS

Activity 6.1:
Discuss and list aggregate function in SQL?

Aggregate functions perform a calculation on a column of data and return a single value. Access provides a variety of aggregate functions, including: **SUM, COUNT, AVG** (for computing averages), **Min and Max**.

i. **SQL COUNT Function** - The SQL COUNT aggregate function is used to count the number of rows in a database table.

ii. **SQL MAX Function** - The SQL MAX aggregate function allows us to select the highest (maximum) value for a certain column.

iii. **SQL MIN Function** - The SQL MIN aggregate function allows us to select the lowest (minimum) value for a certain column.

iv. **SQL AVG Function** - The SQL AVG aggregate function selects the average value for certain table column.

v. **SQL SUM Function** - The SQL SUM aggregate function allows selecting the total for a numeric column.

2.6.1 SQL COUNT Function

SQL COUNT Function is the simplest function and very useful in counting the number of records, which are expected to be returned by a SELECT statement. In other word, the SQL COUNT function is an aggregate function rows returned by a query.

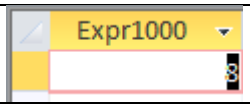
Example	Result
SELECT COUNT (age) from student;	

Table 2.2 : Example of Count Function

2.6.2. SQL MAX Function

SQL **MAX** function is used to find out the record with maximum value among a record set.

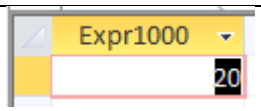
Example	Result
SELECT MAX (age) from student;	

Table 2.3: example of Max function

2.6.3 SQL MIN Function

SQL MIN function is used to find out the record with minimum value among a record set.

Example	Result

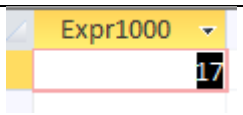
SELECT MIN (age) from student;	

Table 2. 4: Example of M in function

2.6.4 SQL AVG Function

SQL **AVG** function is used to find out the average of a field in various records.

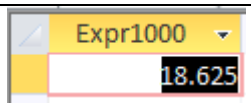
Example	Result
SELECT AVG (age) from student;	

Table 2. 5: Example of AVG Function

2.6.5 SQL SUM Function

SQL **SUM** function is used to find out the sum of a field in various records.

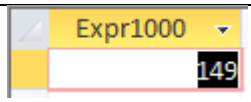
Example	Result
SELECT SUM (age) from student;	

Table2. 6: Example of Sum Function

Application Activity 6.1
Using the below table; Do the following using SQL statement:

1. Calculate the total quantity sold
2. Maximum Revenue
3. Minimum the minimum quantity sold

Cust_id	Fname	Lname	Item_ID	Description	Quantity_sold	Total_Revenue
01	FABRICE	Neza	100101	IKIVUGUTO	1000	50.000
02	KWIZERA	David	100102	INSHYUSHYU	20000	100,000
03	NSHUTI	Alice	100103	YOGURT	10,000	150,000
04	UWINEZA	Josiane	100101	IKIVUGUTO	2000	100,000
05	KOBWA	Diane	100106	BUTTER	100	250,000

2.7 STRING EXPRESSIONS in SQL

Activity 2.7
Discuss and list string expression in SQL that are compatible with MS Access?

SQL string functions are used primarily for string manipulation. The following table details the important string functions:

2.7.1 LEFT FUNCTION

The Microsoft Access Left function extracts a substring from a string, starting from the left-most character.

The syntax for the Left function in MS Access is:

LEFT (text, number_of_characters)

Parameters or Arguments for the Left function:

- **Text:** The string that you wish to extract from.
- **number_of_characters:** Indicates the number of characters that you wish to extract starting from the left-most character.

Note: If number_of_characters exceeds the number of characters in text, the Left function will return text.

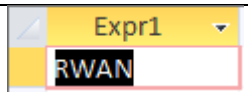
Example	Result
SELECT LEFT("RWANDANZIZA",4);	

Table 2. 7: Example of Left Function

2.7.2 LEN FUNCTION

The Microsoft Access Len function returns the length of the specified string.

The syntax for the Len function in MS Access is:

LEN (text)

The parameters or arguments is **Text** which is the string to return the length for.

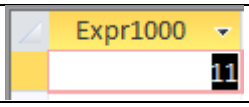
Example	Result
SELECT Len("RWANDANZIZA");	

Table 2.8: Example of Len Function

2.7.3 UCase function

The Microsoft Access UCase function converts a string to all upper-case.

The syntax for the UCase function in MS Access is:

UCase (text)

The parameter or argument for the Ucase function is Text which is the string to be converted in upper-case.

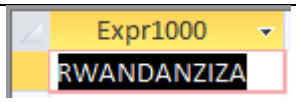
Example	Result
SELECT UCase("rwandanziza");	

Table 2. 9: Example of Ucase Function

2.7.4 LCase function

The Microsoft Access LCase function converts a string to all upper-case.

The syntax for the LCase function in MS Access is:

LCase (text)

The argument for this function is Text which is the string to be converted to upper-case.

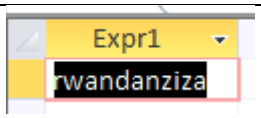
Example	Result
SELECT Lcase("RWANDANZIZA");	

Table 2. 10: Example of Lcase Function

2.7.5 StrReverse function

The Microsoft Access StrReverse function returns a string whose characters are in reverse order.

The syntax for the StrReverse function in MS Access is:

StrReverse (text)

The argument for this Text is the string whose characters are to be reversed.

Example	Result

SELECT StrReverse("RWANDANZIZA");	

Table 2. 11: Example of StrReverse Function

2.7.6 The StrComp() function

The StrComp() function compares two strings. The result is returned as an integer based on the comparison:

- If string1 = string2, this function returns 0
- If string1 < string2, this function returns -1
- If string1 > string2, this function returns 1
- If string1 or string2 is null, this function returns null

Syntax for StrComp ():
*StrComp(*string1, string2, compare*)*
Parameter Values

- *String1 and String2*, Required. The two strings to compare
- *Compare*, Optional. The type of comparison to perform.

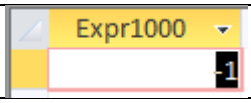
Example	Result
SELECT StrComp("gasabo", "Nyarugenge");	

Table 12: Example of strComp Function

Application Activity 2.7:

1. Find the length of the title of the song called" Imenagitero"
2. Reverse the name of the book "Imigenzo n'imiziririzo ya Kinyarwanda".
3. Compare the names "Nyamasheke" and "Nyagatare".
4. Change "Ndi umunyarwanda" in upper case.
5. Change "RWANDA GIHUGU CYANJYE" in lower case

2.8 Data Control Language (DCL)

Activity 8.1:
What do you understand by Data control language used in Database?

DCL commands are used to enforce database security in a multiple user database environment. Two types of DCL commands are GRANT and REVOKE commands. Only Database Administrator's or owners of the database object can provide/remove privileges on a database object.

2.8.1 SQL GRANT Command

SQL GRANT is a command used to provide access or privileges on the database objects to the users.

The Syntax for the GRANT command is:

GRANT privilege_name
ON object_name
TO {user_name |PUBLIC |role_name}
[WITH GRANT OPTION];

- **privilege_name** is the access right or privilege granted to the user. Some of the access rights are ALL, EXECUTE, and SELECT.
- **object_name** is the name of a database object like TABLE, VIEW, STORED PROC and SEQUENCE.
- **user_name** is the name of the user to whom an access right is being granted.
- **Public** is used to grant access rights to all users.
- **Roles** are a set of privileges grouped together.
- **With grant option** allows a user to grant access rights to other users.

2.8. 2 SQL REVOKE Command

The REVOKE command removes user access rights or privileges to the database objects.

Syntax for the REVOKE command is:

REVOKE privilege_name
ON object_name
FROM {user_name |PUBLIC |role_name}

Privileges and Roles

Privileges defines the access rights provided to a user on a database object. There are two types of privileges.

- **System privileges**: This allows the user to CREATE, ALTER, or DROP database objects.
- **Object privileges:** This allows the user to EXECUTE, SELECT, INSERT, UPDATE, or DELETE data from database objects to which the privileges apply.

Application Activity 2.8:

1. Discuss the role of Grant command in the management of a database
2. Discuss the role of Revoke command in the management of a database

End unit assessment:

1. Using MS access, Create a database and name it "teacherDB"
   a. In the teacherDB, Using SQL command, creation teacher table having below characteristics:

Teacher:(teacher_id (integer), Fname (text), Lname (text),DateofBirth(Date), salary number ,gender (text), JoinYear(number),subject varchar (10) , Department varchar (15));

   b. Using appropriate SQL statement, insert below records into the table.

Teacher_Id	Fname	Lname	Salary	Dateofbirth	Gender	Join Year	Subject	Department
1	Kabera	John	130,000	02/10/1986	M	2015	Mathematic	Science
2	Umwari	Amanda	150,000	13/07/1994	F	2018	Economics	Arts
3	Hogoza	Bella	120,000	14/04/1988	F	2018	Geography	Arts
4	Ntwari	John	115,000	12/11/1996	M	2017	Computer Science	Science
5	Umutoni	Sarah	150,000	09/02/1995	F	2017	Mathematic	Science
6	Kamanzi	David	130,000	22/10/1998	M	2015	Economics	Arts
7	Mucyo	Joel	125,000	10/09/1992	M	2017	Computer Science	Science
8	Isimbi	Ashley	160,000	26/03/1990	F	2016	Mathematic	Science
9	Gashagaza	Joelle	145,000	30/01/1991	F	2017	Geography	Arts
10	Kabandana	Fred	165,000	05/06/1990	M	2015	Mathematic	Science

   c. Retrieve FirstName, LastName, Salary, Join Year and subject for teachers who join before 2018.
   d. Retrieve using sql command all teachers whom salary is above or equal to 125,000
   e. Show the least salary among teachers.
   f. Show the total number of teacher in the teacherDB.
   g. Find the average price of teacher

UNIT 3 INTRODUCTION TO VISUAL BASIC

Introductory activity

Holly City Technology Ltd is a company which has a big number of clients but has the problem of managing their clients, Managing Director needs to computerize customer data.

a. Which software needed for solving the issue of clients' information system
b. On your draft paper show all the customer information
c. Using Visual Basic, design a front-end interface for Holly City technology client information system registration
d. Using MS Access, create the database for Holly city technology client information system registration
e. Using ActiveX Data Object (ADO), link the front and back end interfaces for Holly City technology client information system registration
f. Discus about the role of Visual Basic in database

In programming, the above scenario requires specific programming language that enables us to enter data using forms and save the data in database to receive them when it is needed. This unit will enable to build a simple desktop application for a real-life situation.

3.1. Event Oriented Programming using Visual Basic

Activity 3.1

1. Irasubiza is a student of S6 in one of General Education and they have been given a task of computerizing their traditional system of managing Library and they found out that in their computers there is only operating system, Microsoft office package and Antivirus installed in their computer.
   a. Which software will be needed to be connected to Microsoft access in order to accomplish his task?
   b. Discuss on how user can interact with electronic devices

3.1.1. General introduction

a. Visual Basic (VB) is an event-driven programming language and environment from Microsoft provides a Graphical User Interface (GUI) which allows programmers to modify code by simply dragging and dropping object and defining their behavior and

appearance. VB is derived from the BASIC programming language and is considered to be event driven and Object oriented.

b. **BASIC:** means Beginners' All-purpose Symbolic Instruction Code
c. **Object-oriented programming** (OOP), objects are the things you think about first in designing a program and they are also the units of code that are eventually derived from the process.
d. **Graphical User Interface.** A graphical user interface (GUI) is an interface through which a user interacts with electronic devices such as computers and smartphones.

A GUI uses a combination of technologies and devices to provide a platform that user can interact with, for the tasks of gathering and producing information.

Graphical user interface (GUI) is different from Command Line Interface (CLI) or Command Language Interpreter as Command Line Interface (CLI) enables users to type commands in a terminal or console window to interact with an operating system. Users respond to a visual prompt by typing a command on a specified line, and receive a response back from the system. Users type a command or series of commands for each task they want to perform.

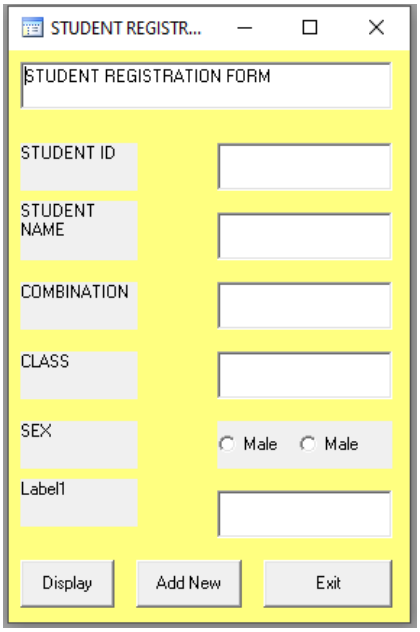


Figure 3.1 Graphical User Interface (GUI) Created using VB

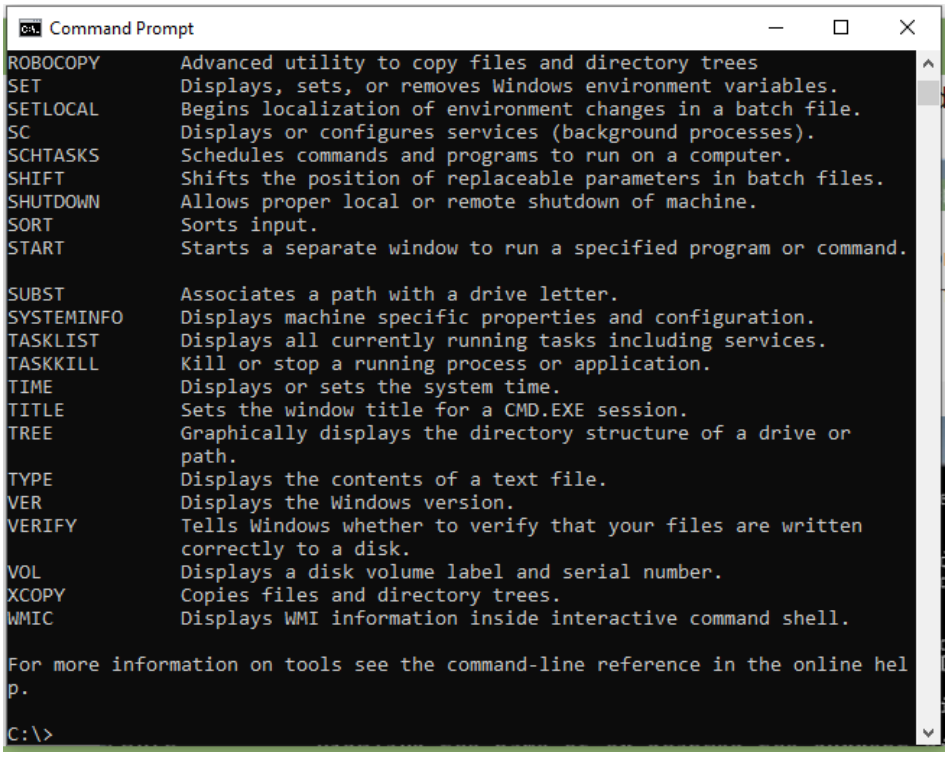


Figure 3.2 Command Line Interface (CLI)

3.1.2 Desktop application

A desktop application is a computer program that runs locally on a computer device, such as desktop or laptop computer, in contrast to a web application, which is delivered to a local device over the internet through browser from a remote server. Different user environments can impact whether a desktop or a web application is the best solution for your needs.

3.1.3 Difference between desktop and web applications

a. Desktop applications

- They must be developed for and installed on a particular operating system.
- Have strict hardware requirements that must be met to ensure that they function correctly.
- Updates to the applications must be applied by the user directly to their installation, and may require hardware upgrades or other changes in order to work.

b. Web applications

- A web application is any computer program that performs a specific function by using a web browser.
- The user accesses the application using the web browser and works with resources available over the internet, including storage and CPU processing power.
- This approach allows for “thin clients” (machines with limited hardware capabilities) to provide access to complex applications delivered from a centralized infrastructure.

c. Event oriented programming.

Event oriented programming is a paradigm in which the flow of program is determined by events, such as user actions (mouse clicks, key presses), sensor outputs or messages from other programs is commonly used in graphical user interfaces and other applications like Web applications, JavaScript, C#.

Visual Basic is Event oriented programming because of the following reasons:

- The programmer needs to write code that performs some tasks in response to certain events.
- Has events that occur by mouse clicking and moving or keyboard stokes (Some of the events are load, click, double click, drag and drop, pressing the keys and more.)
- Focus on the use of Graphical User Interface.
- The events usually comply but not limited to the user's inputs.

The most important events for the form are described in the following table.

Event	**Action taken when**
Click	Single click on object
Dbclick	Double click on object
Load	Loading the object

Visual Basic 6.0 has the following advantages:

- It is easier for the user to minimize code writing.
- The user will become more familiar with visual approach for other visual languages.
- It provides Input box and Output box as interactive windows with user.
- It is very easy program language compare with other.

Application Activities 3.1

1. When the following command used?
   a. SHUTDOWN
   b. VOL
   c. VER
   d. TASKLIST
2. Give the difference between Web Application and Desktop Application
3. Give at least two examples of event used in visual basic
4. Discuss and list at least 5 roles of GUI

3.2. The Features of Visual Basic

Activity 3.2

1. ICT Teacher Uwimbabazi bought a laptop which has only operating systems and has been given Setup of Visual basic
   Demonstrate and outline the procedure will be used by Uwimbabazi for having Visual basic in the computer
2. By using internet or library from your school discuss three command used in New Project window from Visual Basic program

3.2.1. Installation of Visual Basic

To install Visual Basic 6.0, you can first check if it is compatible with windows installed in the computer. If you opt for installation Visual Basic 6.0 , you have to save it on the storage memory like Flash disk, CD, DVD. The installation procedure starts as follows:

1. Connect a storage device to the computer and open it
2. Right click Visual Basic setup
3. Click on setup

Step 1: This is the first screen to see while installing Visual basic USB flash drive or DVD. choose Next to continue

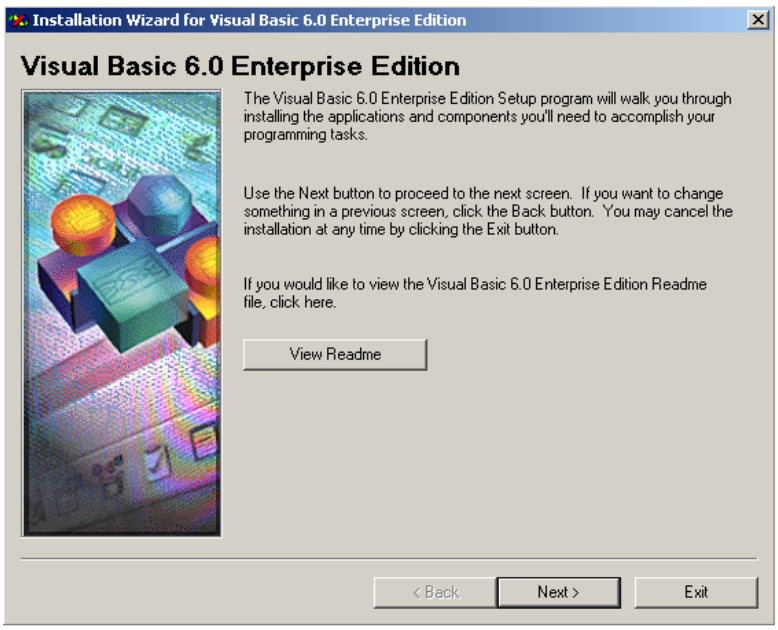


Figure 3.3 Visual Basic 6.0 Installation wizard

Click** Next **to start the installation process.

Step 2: In the next screen, select "*I accept the agreement*" for the end-user license agreement, people never read the license, but you should read it quickly as it contains some information about the usage of this software product

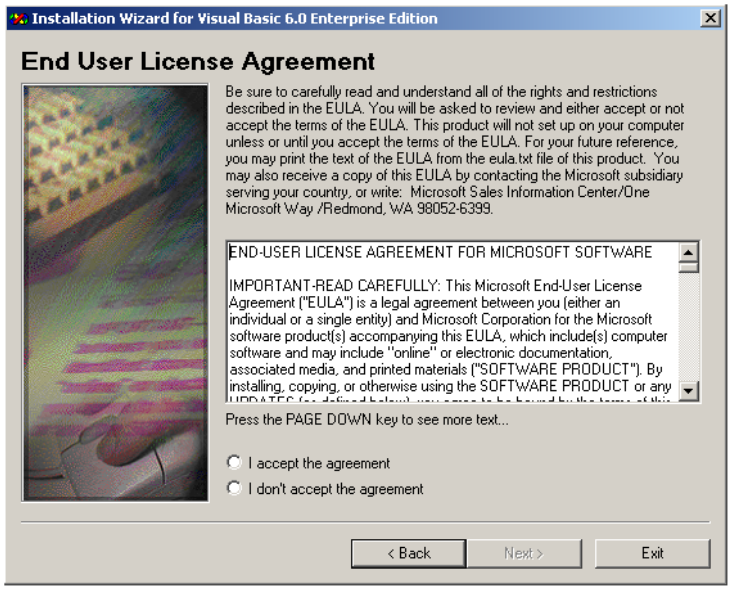


Figure 3.4 End user agreement

Step 3: In above provided screen enter the product number and a user id on the screen. The product number is supplied with the installation disk or written on the disk or (111-1111) as default. The username can be a personal name or an institution name if you are from an institution that has provided you with the software.

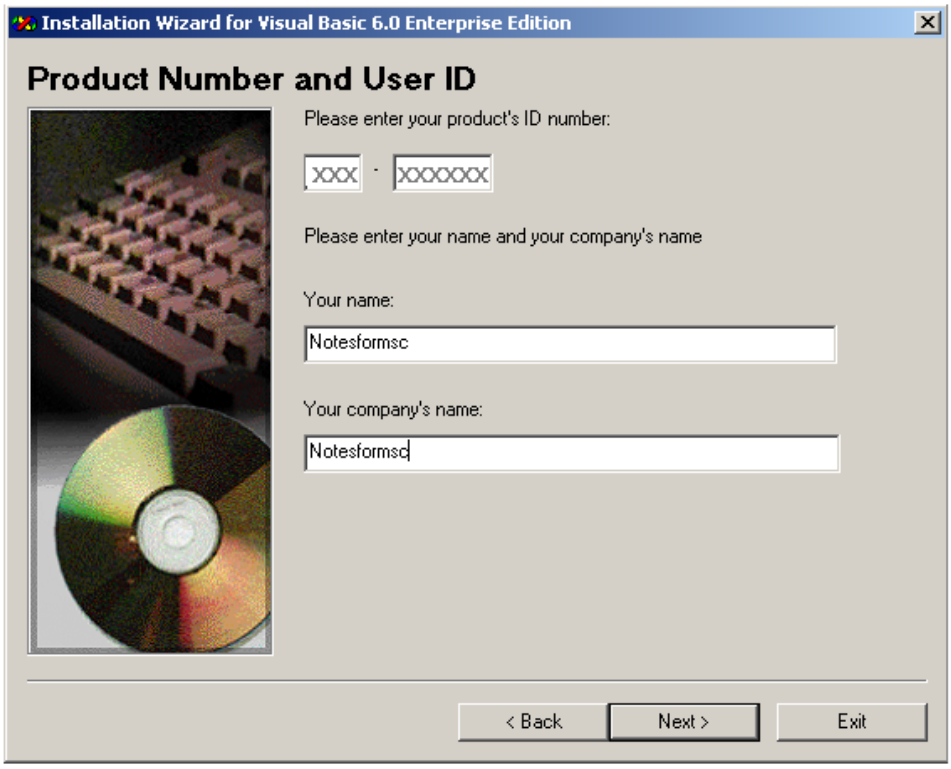


Figure 3.5 Enter Product number and user ID

Click Next to continue to the next screen.

Step 4: Now you are provided an interface with two options.

1. Install Visual Basic 6.0 Enterprise Edition
2. Server Applications

Notice: The first option installs everything and do not leave an option to choose what you want to install. Whereas, the second option gives you individual application or tools you can choose to install.

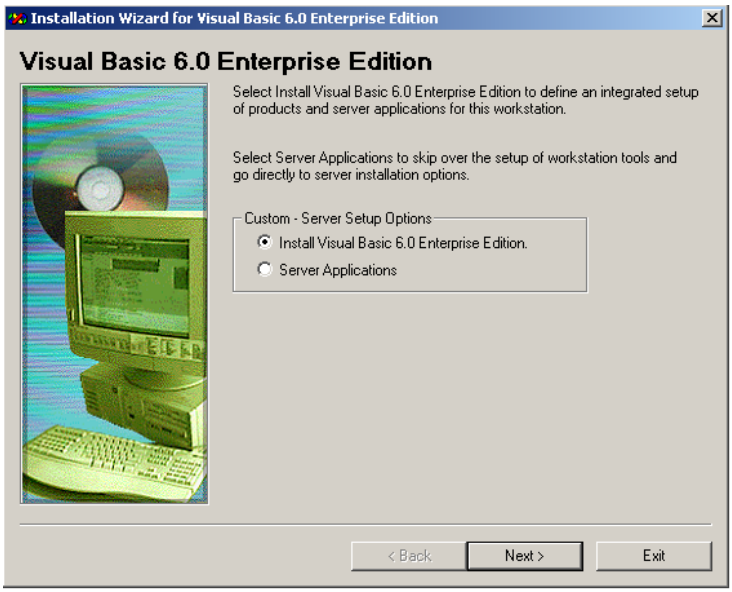


Figure 3.6 Visual Basic 6.0 Enterprise Edition

Step 5: Select "**Install Visual Basic 6.0 Enterprise Edition**" and click **Next** to continue.

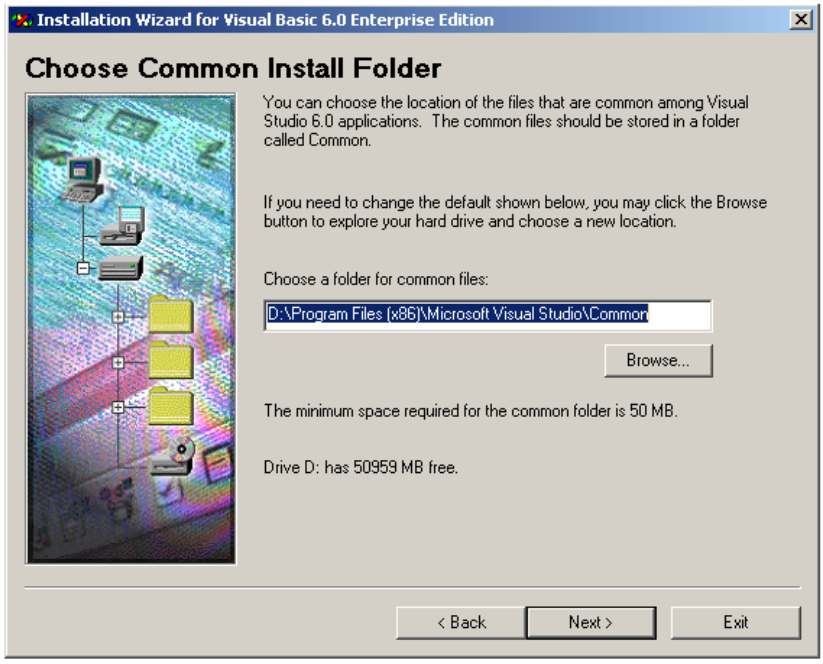


Figure 3.7 Choose an install folder

Choose an Install folder
Then click **Next** to continue click on **Ok**

Step 6: In the next interface you get the Visual Basic 6.0 Enterprise Setup screen, this is the setup which will install VB 6 on your computer

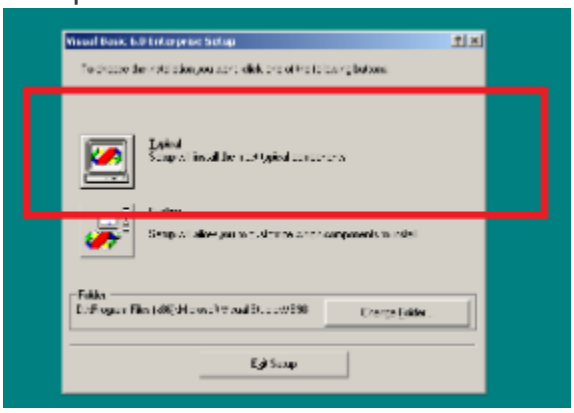


Figure 3.8 Visual basic 6.0 Enterprise setup

In the above screen, the actual VB 6 installation begins. Here setup gives you two choices.

1. Typical Installation
2. Custom

The typical components are the essential components of Visual Basic 6 software. It does not contain features that extends the functionality of Visual Basic 6 software.

The custom option gives you a chance to select exactly what you want. But you must be an advanced VB programmer to be able to do that.

Click on **Typical**

Click on **YES** and click on **Restart**

Launching Microsoft Visual Basic 6.0

To run this program on user computer: Start> Microsoft Visual Studio 6.0>standard EXE

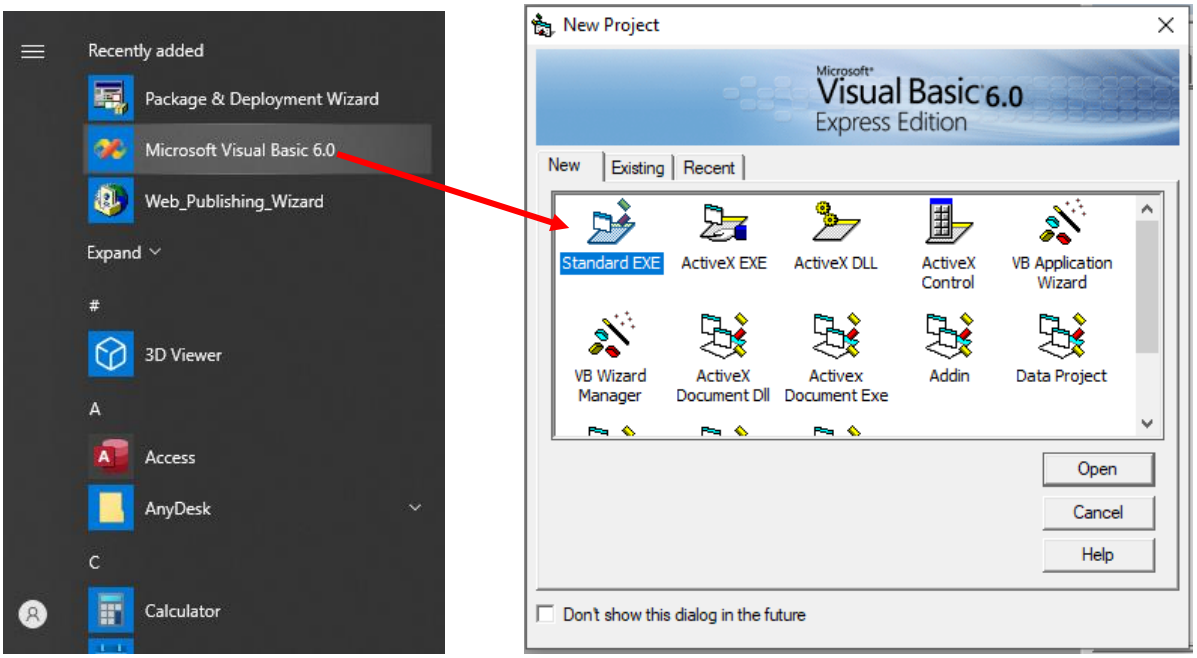


Figure 3.9 Visual basic start up

3.2.2. Visual Basic features:

1. **Data Access Features**: This allows programmers to develop database front end applications and server-side components for most popular database formats including MS SQL and other Databases.
2. **Active X Technologies:** That allows programmers to use the functionality provided by other applications, such as MS Office and other windows applications.
3. **Internet capabilities** make it easy to provide access to documents and applications across internet server applications.
4. **Your finished application is a true executable** (.exe) file that uses a Visual Basic Virtual Machine that you can freely distribute.

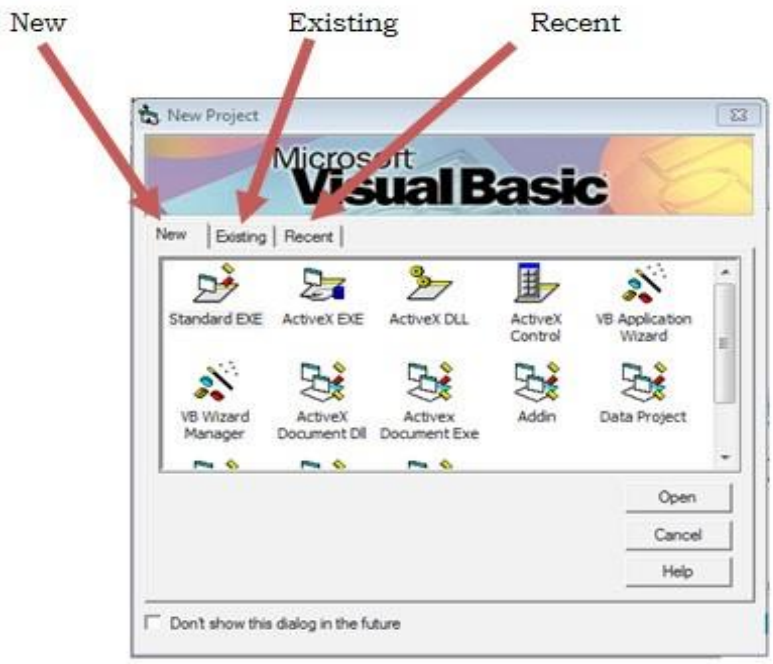


Figure 3.10 Dialog Box of VB 6.0 from project creation

3.2.3. Standard EXE Visual Basic Application

Using Visual Basic one can develop one of these main projects as indicated in the screen below:

Figure 3.11 The Highlighted is standard EXE

1. **Standard Exe project** is a typical application in which can use the database manipulation.

A standard exe application is one that is created using Standard EXE project. It is the most widely used Project type using VB6. Standard EXE application is normally the most widely used among the available Project types in Visual Basic. Stand-alone programs have an .EXE file extension. A standard EXE application is normally used when you want to develop a stand-alone application. Examples include calculators, text editors, and other similar applications.

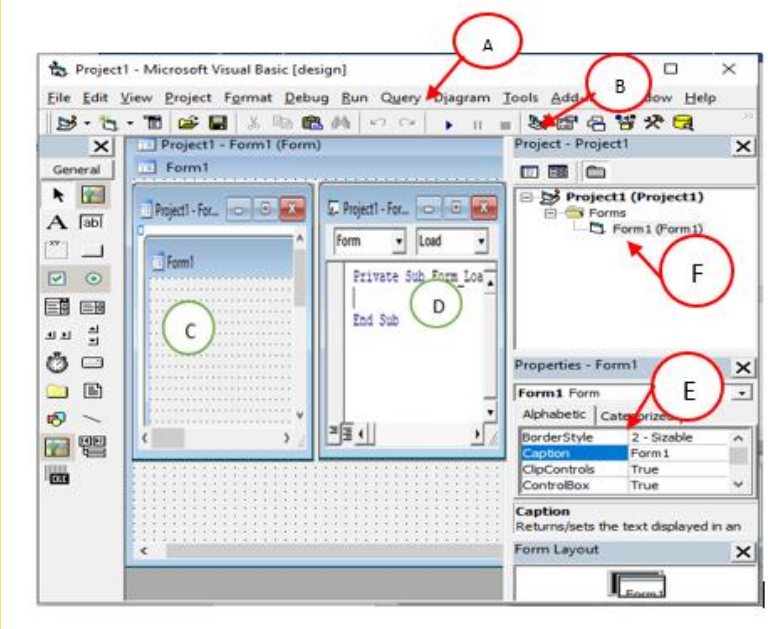
Application activity 3.2

1. Discuss about new project interface
2. Which Visual Basic Features used for developing database front end applications?
3. Discuss about what Active X Technologies is.
4. What happen when Recent command from new Project window is clicked?

3.3. Visual Basic Standard EXE Integrated Development Environment (VB-IDE)

Activity 3.3

1. Observe the figure below and name the objects labeled A, B, C, D,E and F



2. Identify the role of C and D shown in above figure

3.3.1. Visual Basic Integrated Development Environment

It is called integrated because we can access virtually all of the development tools that we need from one screen called interface. The IDE is also commonly referred to as the design environment, or the program.

3.3.2. Menu Bar

Menu Bar is where you can select actions to perform on all your project files and to access help. When a project is open extra menus of project, build and data, are shown in addition to the default menu selection of File, edit, View, Debug, tools, window and Help.

Figure 3.12 Menu Bar

3.3.3. Toolbar

The Toolbar has the most commonly used commands (button), if clicked an action represented by that button is carried out.

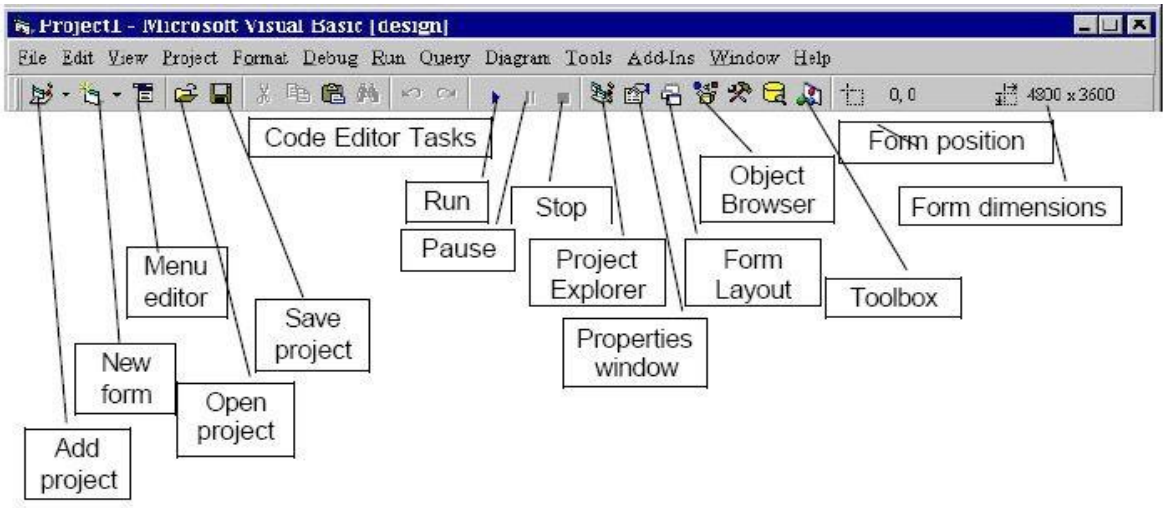


Figure 3.13 Toolbar

3.3.4. Form window

The form window is the window or background, where the user can design his form using various controls from the toolbox

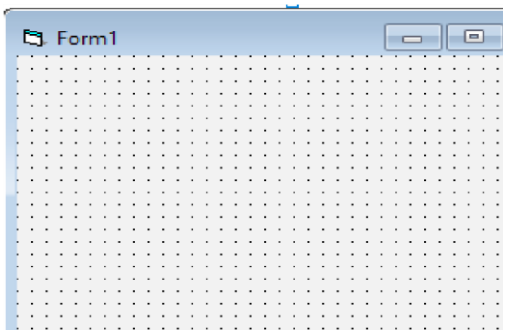


Figure 3.14 Form window

3.3.5. Properties Window

Properties Window is used to change the state of each control using particular properties associated with each control.

How to use Properties Window?

Before writing an event procedure for the control to response to a user's input, you have to set certain properties for the control to determine its appearance and how it will work with the event procedure. You can set the properties of the controls in the properties window or at runtime.

Consider the following picture

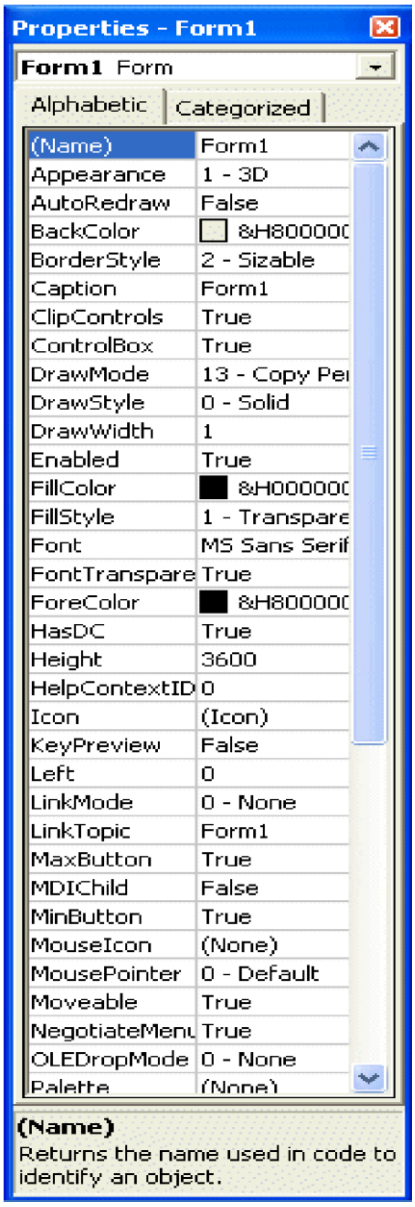


Figure 3.15 Properties Window

A property is **a value or characteristic held by a Visual Basic object**, such as Caption or Fore Color. Properties can be set at design time by using the Properties window or at run time by using statements in the program code

3.3.6 Project explorer

This is a list of forms and modules for the current projects. It is a hierarchical tree- branch structure, where the project at the top of the tree and other parts like forms, modules descend from this tree.

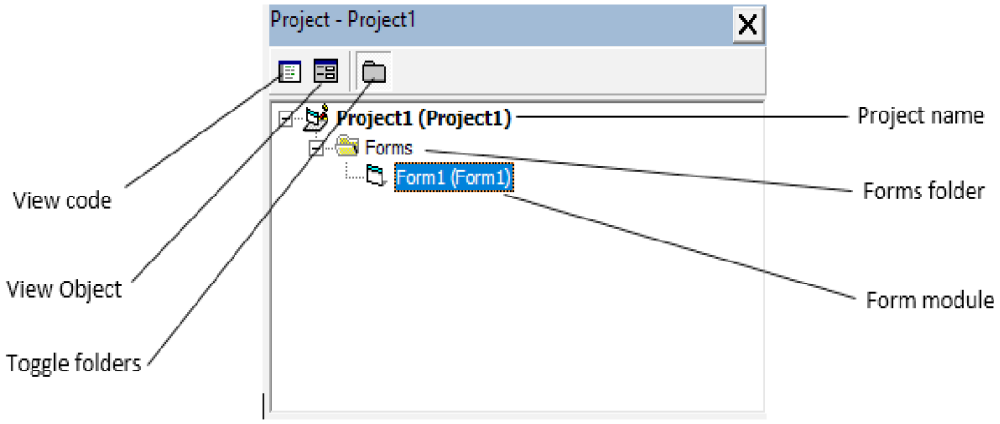


Figure 3.16 Project explorer window

3.3.7 Form Layout Window

The Form Layout window is a visual design tool which is used to control the placement of the forms in the windows environment when they are executed especially when you have more than one form in your program,

To position a form in the Form Layout window, simply drag the miniature form to the desired location in the window.

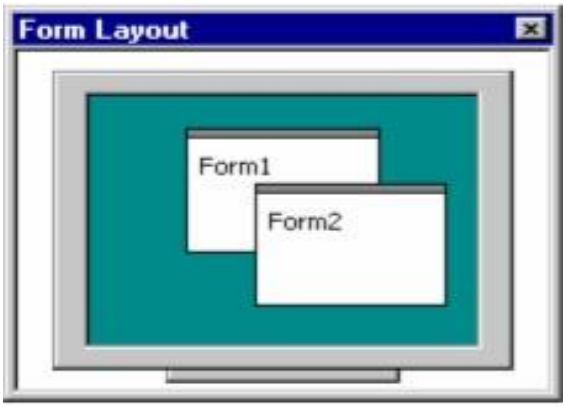


Figure 3.17 Form Layout Window

3.3.8 Code window or VB Editor

Each standard form has a code window in which the user can write to direct the behavior of a control. You open the code window by double clicking on a form or a control. If you double click a form, you will be taken to a procedure for the form, but once the code window is open, you can go to any procedure for any object on the selected form.

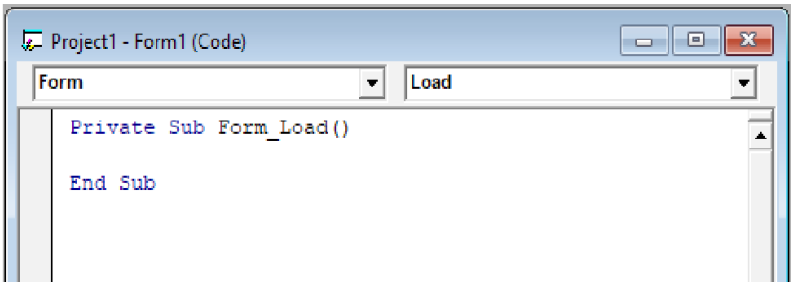


Figure 3.18 Code window or VB Editor

The codes are of two Categories:

Declaration is written before any procedure in the code window.
Statements. The user selects the required event then code statements are written inside these event procedures.

3.3.9. Tool Box

Items of tool box are used to design the application interface. These items are called **Controls** and are shown in the image below.

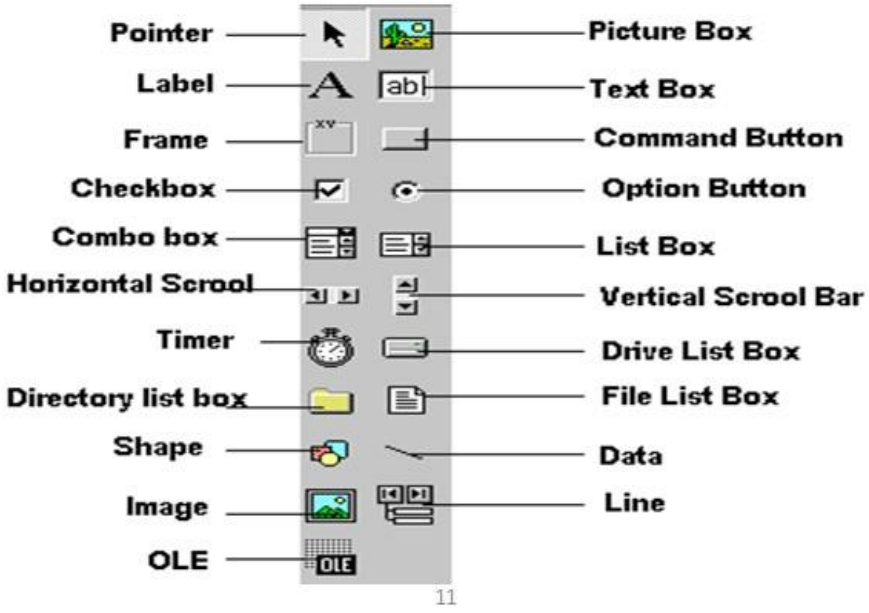


Figure 3.19 VB 6.0 Toolbox

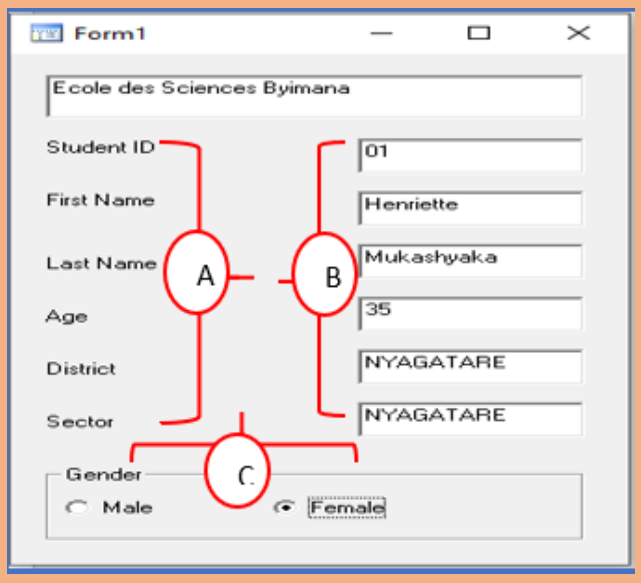
Application activity 3.3

1. Define the following parameters:
   a. Toolbar.
   b. ToolBox.
   c. Form designer
   d. Form layout.
   e. Project window,
   f. Properties window.
   g. Code editor window.
2. Discuss the difference between
   a. Checkbox and Option Button
   b. Horizontal Scroll and vertical scroll Bar
3. Discuss about properties usage

3.4. Controls in Visual Basic: Form, Label, Textbox and Radio Button

Activity 3.4

Observe the figure below and answer the questions.



1. Discuss about the tools use for designing A, B and C
2. Identify the procedures used for changing the color of District and Sector
3. Create a standard project with one form the name of the project "market seals" and the name of the form "stock markets" and save project on desktop with name marketing .exe
4. Design a standard project with four forms when running project all forms appear on screen

To design a form in Visual Basic, use the controls which are available in the Tool Box in the left side of the project window.

Use the following steps for each control that you want to add on the form:
Step 1: In the Tool Box, choose a control that you want and Click on it.
Step 2: Drag and draw a control in the form using mouse.
Step 3: Change state for Specific control like size etc.

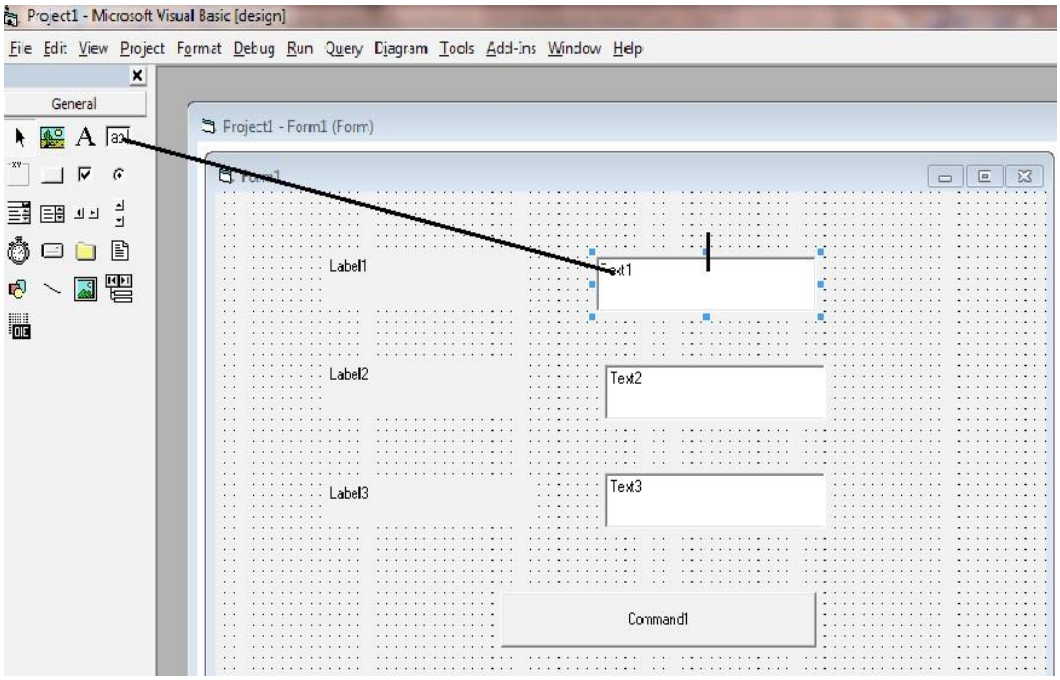


Figure 3.20 Adding a Text Box to a form

a. Form

Form is used when you start Visual Basic, a default form (Form1) with a standard grid (a window consisting of regularly spaced dots) appears in a pane called the Form window. You can use the Form window grid to **create the user interface** and to line up interface elements.

Steps to create a Form:

Step 1: Click Project on menu and choose **Add form** from the list of options

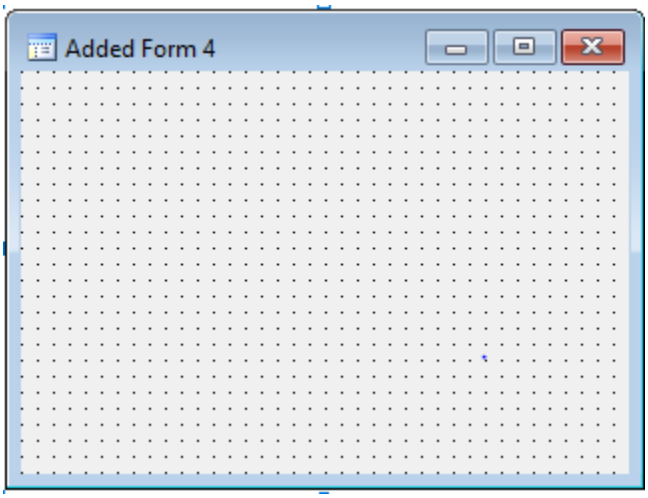


Figure 3.21 Create a form in project

Step 2: Click Form and click Open

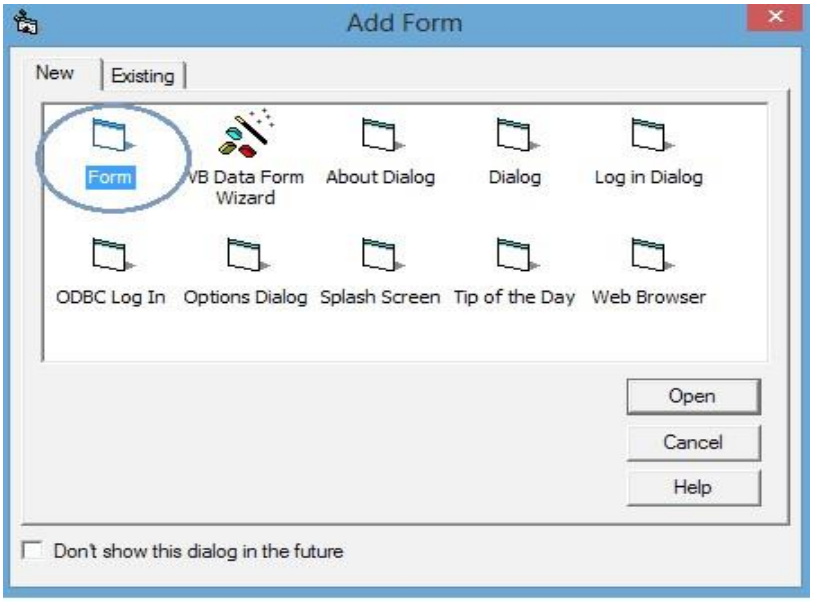


Figure 3.22 Dialog box to create a form

Step 3: Set the Properties for a Form

- **Name:** Enter the name of the Form. It returns the name used to identify the form.
- **Enabled:** Form controls can be enabled or disabled on initial execution with the enabled property.
- **Appearance:** It sets whether or not object is painted at run time with 3D effects.
- **Caption:** Enter the caption associated with the form. It sets the text displayed as the title of the form.

- **Backcolor:** Choose background color of textbox. It sets the background color used to display textbox.
- **Borderstyle:** Choose border style of the form
- **Fillcolor:** It sets the colour used to fill in shapes, circles and boxes.
- **Fillstyle:** It returns the fill style of a shape
- **Backstyle:** Choose background style; Opaque or transparent
- **Font:** It returns the font of a form.
- **Scaleheight:** It sets the number of units for the vertical measurement of form.
- **Scaleleft:** It returns the horizontal coordinates for the left edge of form.
- **Visible** shows or hide a control on a form. It sets value that determines whether an object is visible or hidden

b. Label

Label 

The label is a very useful control for Visual Basic, as it is not only used to provide instructions and guides to the users, it can also be used to display outputs. One of its most important properties is **Caption**. Using the syntax **label.Caption**, it can display text and numeric data. You can change its caption in the properties window and also at runtime.

The following are the steps to add a label on the form.

Step 1: Click on the label icon  on the toolbox

Step 2: Drag and drop a label control in the form **Step 3:** Set

Properties for label

- **Name:** Enter the name of the label control. It returns the name used to identify object.
- **Alignment**: It returns/sets the alignment of a label
- **Appearance:** It sets whether or not object is painted at run time with 3D effects.
- **Caption:** Enter the caption associated with the label. It sets the text displayed on the form.
- **Font:** It returns the font of object (font face, font style, size and effects)
- **Forecolor:** It returns foreground color of a label
- **Height**: Enter the height of the label.
- **Backcolor:** Choose background color. It sets the background color used to display label.
- **Borderstyle:** Choose border style of the label (None-no border or Fixed SingleWith border)
- **Backstyle:** Choose background style; Opaque or transparent

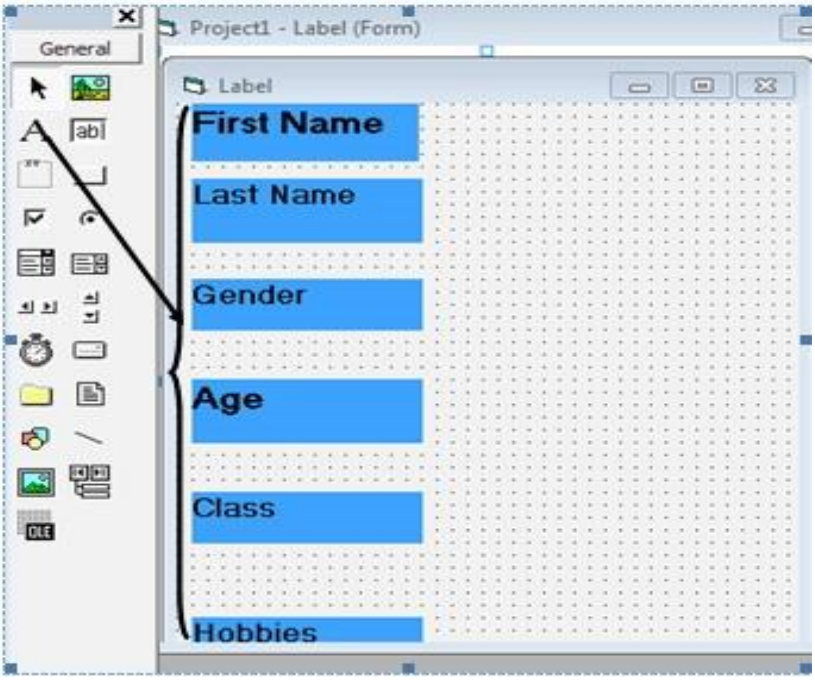


Figure 3.23 Labels drawn on form

c. Text Box

The text box is the standard control that is used to receive input from the user as well as to display the output. It can handle string (text) and numeric data but not images or pictures. String in a text box can be converted to a numeric data by using the function Val(text).

Steps to add Textbox

Step 1: Click on the Textbox icon  on the toolbox

Step 2: Drag and drop a Textbox control in the form

Step 3: Set Properties for Textbox such as Name, alignment, appearance, Backcolor etc.

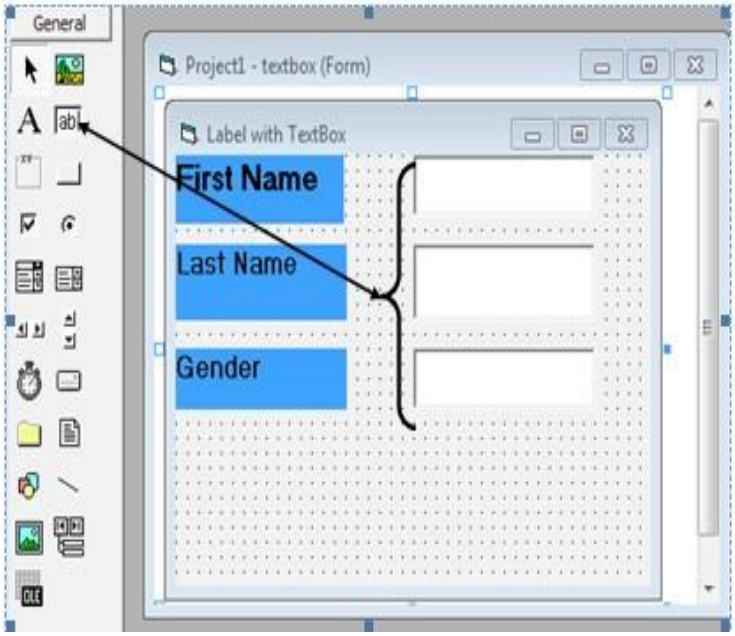


Figure 3.24 Textboxes drawn on form

a. Radio Buttons/ Option Buttons

The Option Box control lets the user selects one of the choices. However, two or more Option Boxes must work together because as one of the Option Boxes is selected, the other Option Boxes will be unselected. In fact, only one Option Box can be selected at one time. In computer terminology we call this 'mutual exclusion'. Therefore, two option box controls are said to be mutually exclusive of each other. When an option box is selected, its value is set to "True" and when it is unselected; its value is set to "False".

Steps to add Option Button manually

Step 1: Click on the OptionButton icon on the toolbox

Step 2: Drag and drop an OptionButton control in the form

Step 3: Set Properties for Option Button

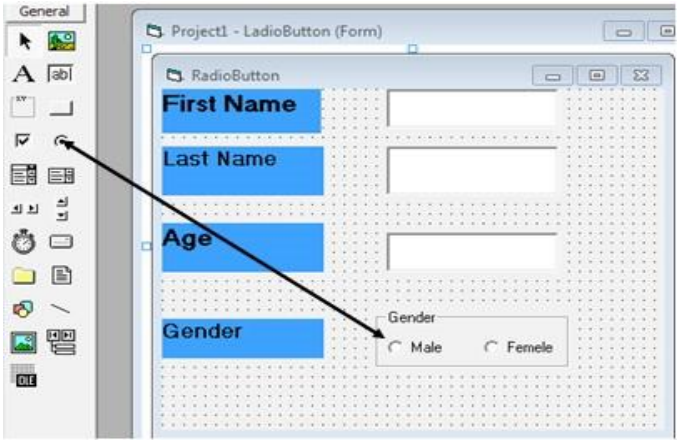


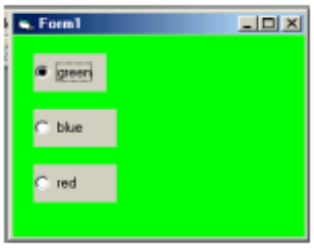
Figure 3.25 Radio Button

Steps to add Option Button manually Design a form with three option buttons " red ", " green " and " blue " such that when we click on options the color of the form colored by red, green and blue respectively.

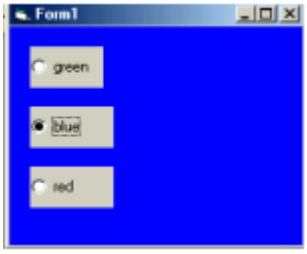
Source code

```
Private Sub Option1_Click()
Form1.BackColor = vbGreen
End Sub
```

Sample window




```
Private Sub Option2_Click()
Form1.BackColor = vbBlue
End Sub
```




```
Private Sub Option3_Click()
Form1.BackColor = vbRed
End Sub
```

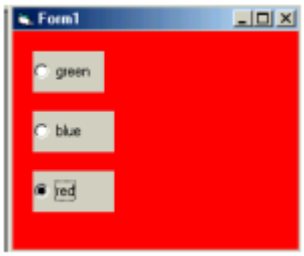
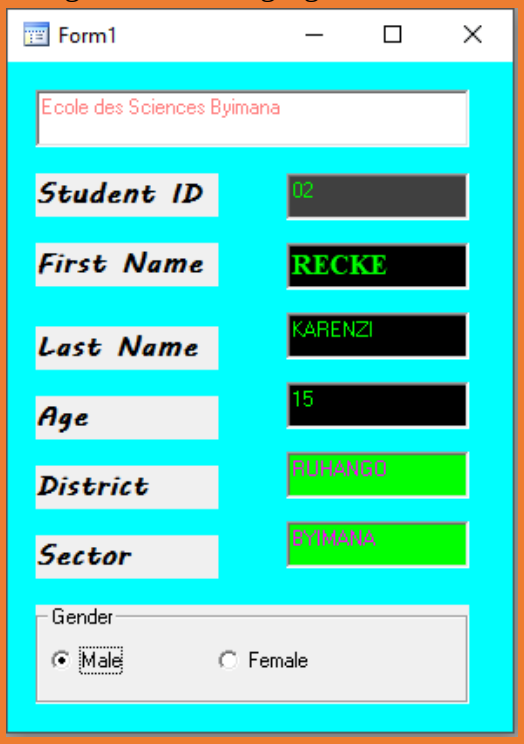


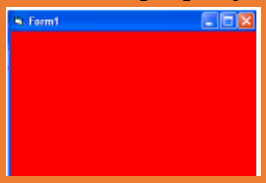
Figure 3.26. Option buttons grouped in a frame

Application activity 3.4

1. What is the role of option button?
2. Design the following figure as it is.



3. Design a form such that: In event load, when project runs, the form backcolor property changed (chose any color).



3.5. Controls in Visual Basic: Check box, Command button, image, timer calendar

Activity 3.5

John needs to develop a platform will help him to record student's information, which button will facilitate him to do the following task

a. Saving, Updating information in his platform
b. Selecting different option in in the same time
c. Uploading image

3.5.1 Check box control

The Check Box control  lets the user to select or unselect an option. When the Check Box is checked, its value is set to 1 and when it is unchecked, the value is set to 0. You can include the statements Check1.Value=1 to mark the Check Box and Check1. Value=0 unmark the Check Box, and use them to initiate certain actions. For example, the program will change the background color of the form to red when the check box is unchecked and it will change to blue when the check box is checked.

Steps to add CheckBox manually

Step 1: Click on the CheckBox  icon on the toolbox

Step 2: Drag and drop a CheckBox control in the form

Step 3: Set Properties for CheckBox

Steps to add CheckBox with code Design a form with one text box and three check boxes such that when click on boxes the following is done: change typing to bold, italic, underline.

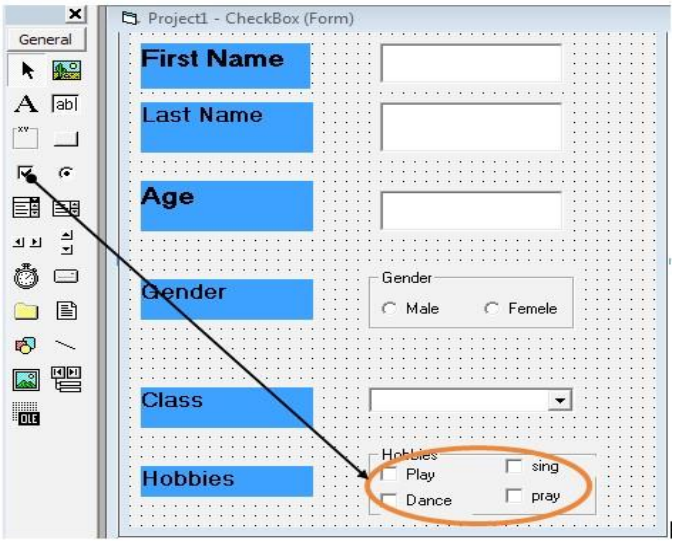


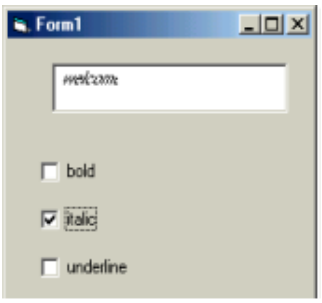
Figure 3. 27 Check box 1

Source code

```
Private Sub Check1_Click ()
Text1.FontBold = Check1.Value
End Sub
```

Window


```
Private Sub Check2_Click ()
Text1.FontItalic = Check2.Value
End Sub
```




```
Private Sub Check3_Click ()
Text1.FontUnderline = Check3.Value
End Sub
```

3.5.2 Command button

Command button acts as a switch.
To deal with tool property click on **command button**> property window appear> change setting of any desired property. Usually change set its caption property to a suitable string. To make the button functional, the user should add some code. To do this: click on command tool> code form appears with click event procedure. Write code in this event or other events like press key event.

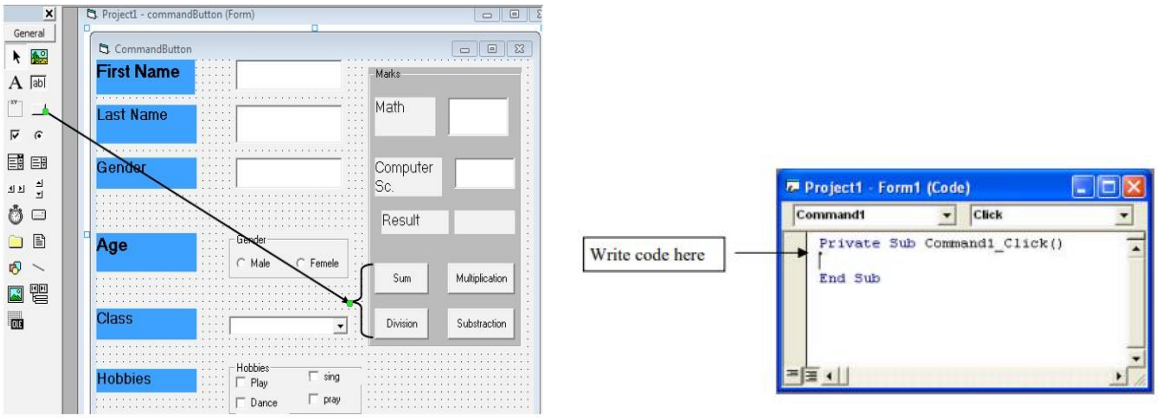


Figure 3.28 Command button

3.5.3. Image box

The Image Box is another control that handles images and pictures. It functions almost identically to the picture box. However, there is one major difference, the image in an Image Box is stretchable, which means it can be resized. This feature is not available in the Picture Box.

The syntax is as follows: Picture1.Picture = LoadPicture("C:\test.bmp")

3.5.4 Timer

When we need to perform tasks at regular interval we can use Timer  **.** Open a new project and place a timer object on your form. Then locate a label at the center of the form and adjust the size as shown in the figure below. For such a program a better look will be established by sizing your form as a pop up window.

Timer syntax: Label1.Caption = Time

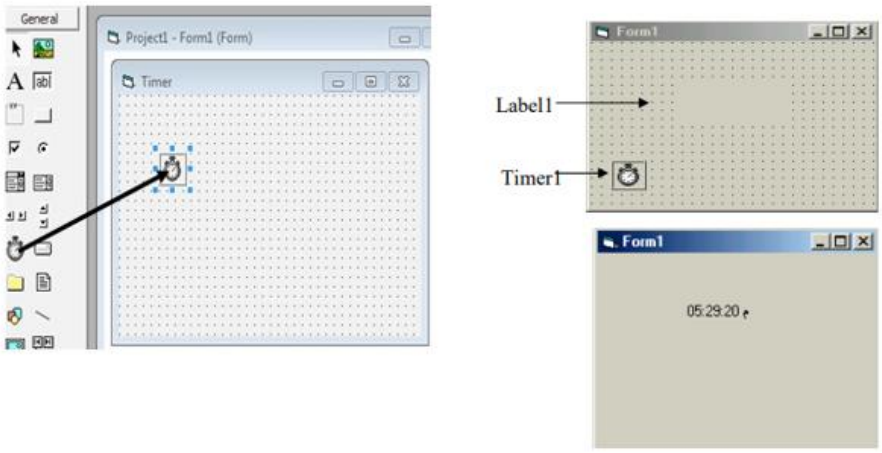


Figure 3.29 Timer button

Application Activity 3.5

1. Design a form containing specific title such that when we click on command1 the color of the font will change and we click on command2 the size of the font will be changed
2. A timer control is instantiated using _____
   a) Timer tool b) Control tool c) Stopwatch tool d) Timer Control Tool
3. The purpose of _____ is to process code at one or more regular intervals.
   a) Timer control b) Process control c) Code editor d) Interval control
4. You use the _____ tool to add a radio button to a form.
   a) Button b) Radio c) Option d) Radio Button
5. You use the _____ tool to add a checkbox to a form.
   a) Button b) Radio c) Option d) Checkbox

3.6. Controls in Visual Basic: ComboBox, ListBox and Drive

Activity 3.6

Identify graphical control elements that allows the user to choose one value from a list

3.6.1. Combo Box

The function of the Combo Box is also to present a list of items where the user can click and select the items from the list. However, the user needs to click on the small arrowhead on the right of the combo box to see the items which are presented in a drop-down list. In order to add items to the list, you can also use the **AddItem** method.

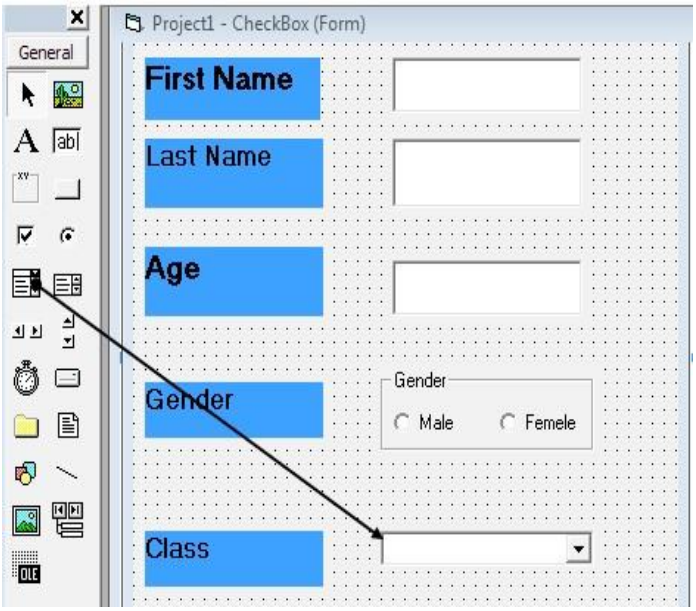


Figure 3.30 Combo box

3.6.2. List Box

The function of the List Box  is to present a list of items where the user can click and select the items from the list. In order to add items to the list, we can use the **AddItem** method.

ListBox.Item.Add("Text")

ListBox1.Items. Remove("text")

It is illustrated in the following example:

```
Private Sub Form1_Load (sender As Object, e As EventArgs) Handles MyBase.Load
ListBox1.Items. Remove ("Visual Basic 6")
End Sub
```

List Box contains a list of options from which user can choose. In windows the **Font List box** is an example of the use of a list box. The Selected item in a ListBox is given by the *Text**property.*** The ***sorted*** property determines whether the items in the list box will be sorted or not.

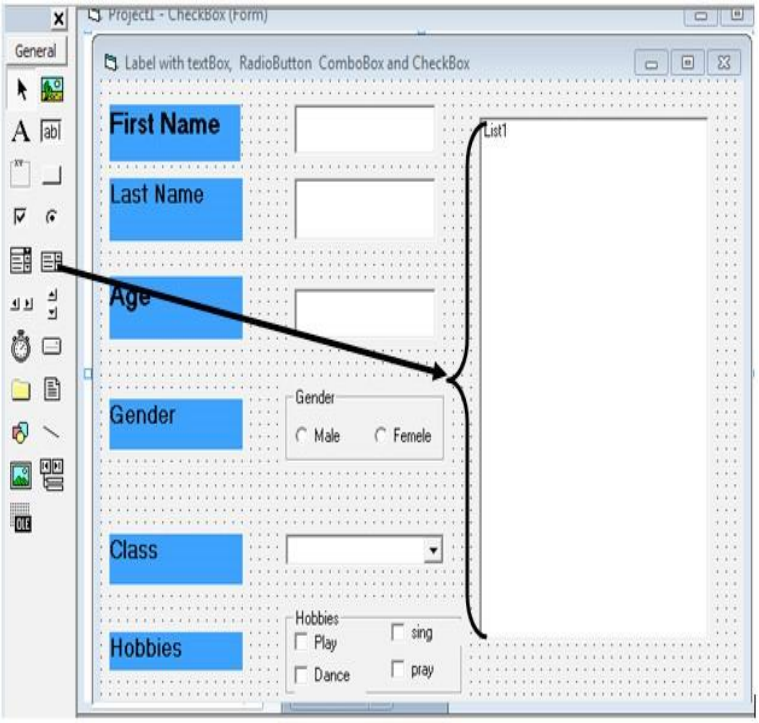


Figure 3.31 listbox button

Adding items to the list

a) Change property list from properties window: Open the list properties window and choose list property. Write a list of items to appear in the list box

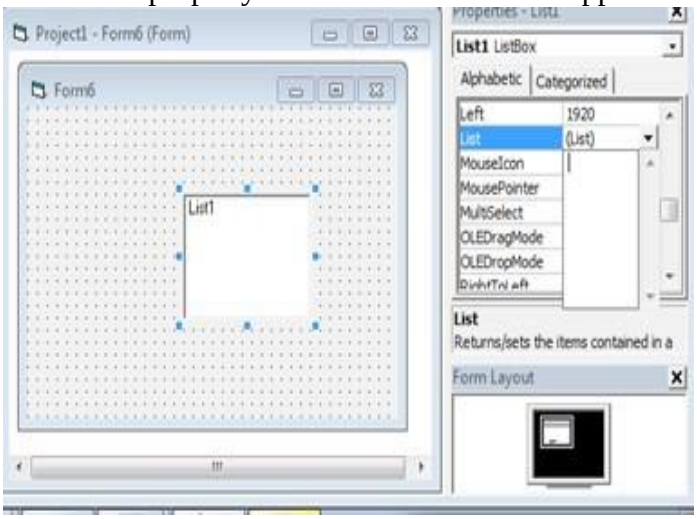


Figure 3.32 Adding items to the list

3.6.3 Drive List Box:

The Drive ListBox is for displaying a list of drives available in your computer. When you place this control on the form and run the program, you will be able to select different drives from your computer.

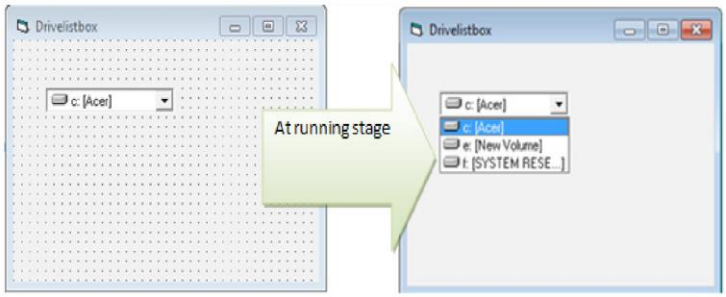


Figure 3.33 Use of driveList control

Application Activity 3.6

1. answer the following questions

a. How do I add an item to a ListBox?
b. How do I remove an item to a ListBox?
c. How do I remove all items in a ListBox?
d. Discuss about Drive List Box and list Box

3.7. Controls in Visual Basic: Frame, Picture Box, File system and director list box

Activity 3.7

1. Discuss about file list and directory list
2. How can you add a picture?
   a. In your application program
   b. Visual Basic program

3.7.1. Frame

If you want to create a group of controls that work together, you must first create a frame for the controls. (To do this, use Frame, a Visual Basic toolbox control.) Next, place your controls

inside the frame so that they can be processed as a group in your program code and moved as a group along with the frame

Steps to add Frame:

Step 1: Click on the Frame icon  on the toolbox

Step 2: Drag and drop a Frame control in the form

Step 3: Set Properties for Frame: on this step, you set preferred properties

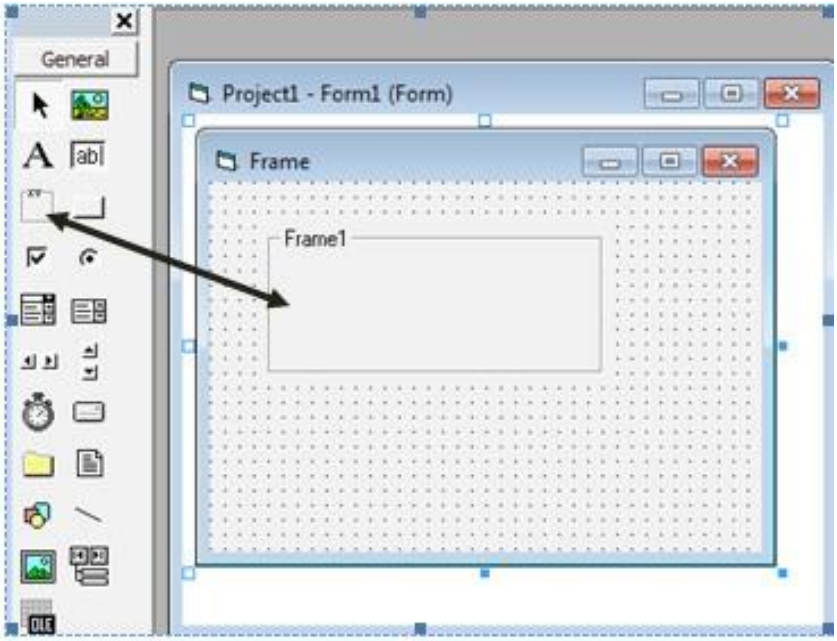


Figure 3.34 Frame on Form

3.7.2 Picture Box

 The Picture Box is one of the controls that used to handle graphics. You can load a picture at design phase by clicking on the picture item in the properties window and select the picture from the selected folder. You can also load the picture at runtime using the **LoadPicture** method. For example, the statement will load the picture grape.gif into the picture box.

```
Picture1.Picture=LoadPicture("C:\Images\grape.gif")
```

3.7.3. File System Controls

File System Controls are set of controls which help us to add file handling capabilities to our program. They are used together to provide an interface for accessing and exploring drives, folders and files. File system controls can be drive list box, directory list box and file list box.

3.7.4. Directory List Box:

Directory List Box is for displaying the list of directories or folders in a selected drive. When you place this control into the form and run the program, you will be able to select different directories from a selected drive in your computer.

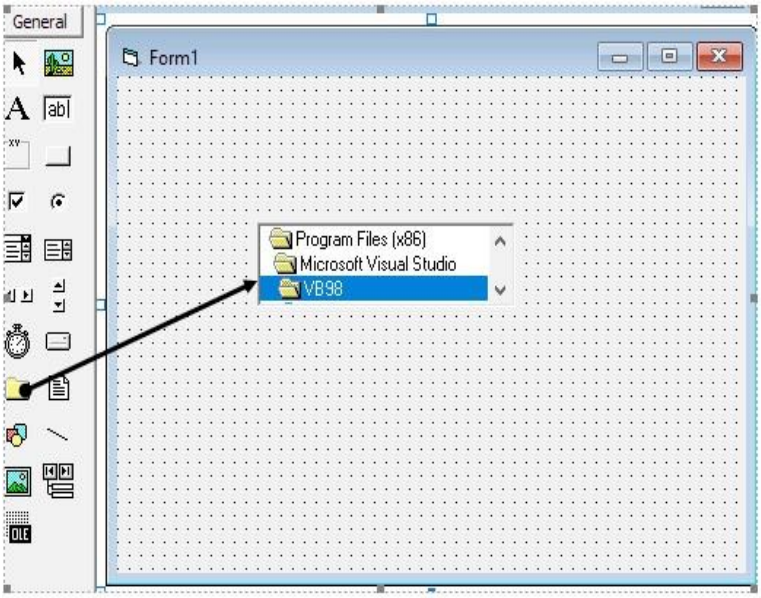


Figure 3.35 Directory List Box

3.7.5. File List Box:

This control displays a list of files in the current folder.
These are important controls even though there are plenty of controls used in VB.

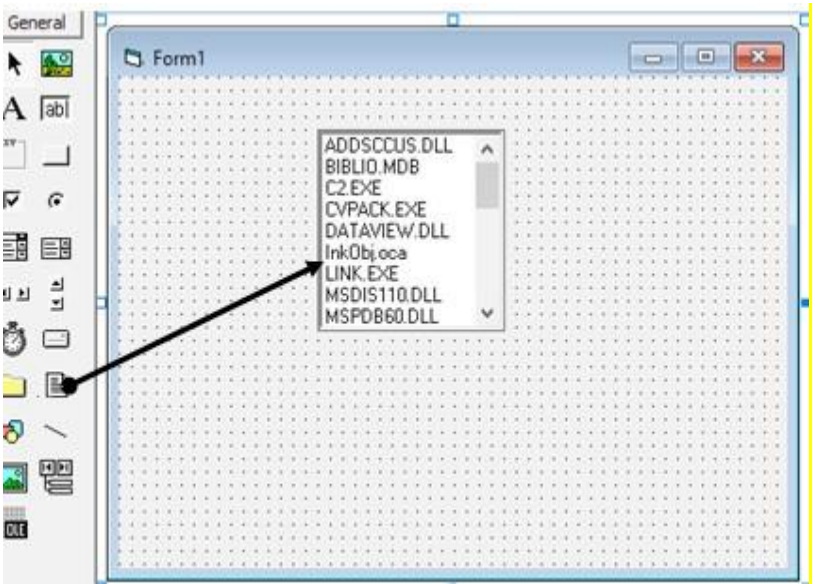


Figure 3.36 File Listbox

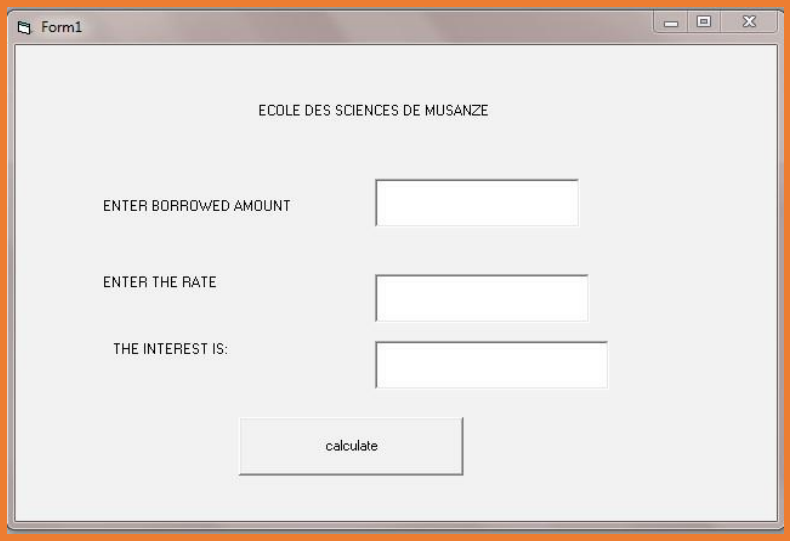
Application Activity 3.7

1. Define the following terms
a. Frame
b. LoadPicture
   Design
2. Design the following screenshot

3.8. Planning and Developing a Visual Basic program.

Activity 3.8

Consider and observe the following form that contains different controls help a school to calculate the monthly interest according to the borrowed money per month.



1. What is the role of each control on the form?
2. Which cause the command button named calculate to find and display the interest?
3. What happen if you do not find the simple interest?
4. What can you do if run a program and you are informed that the program contains errors?

3.8.1. The process of Planning and Developing a Visual Basic program

Developing a VB program is mainly done in three steps namely setting up user interface, defining the properties, and creating code.

a. Draw the interface

At this step, you will be using the object to design the interface of your application; the controls will be taken from the tool box by dragging it from there to the form designer.

b. Set properties

At this stage, you will be setting up properties for your form and controls. Those properties are set from the properties window.

c. Write the event code

Coding is to be done in the code window and you get there by double clicking the object you want to code. Now we double click on the form1, the source code Window for the form1 appears:

Private Sub Form_Load()
End Sub
You just have to write your code between two statements. In order to display the output, you have to add Form1.show

VB application to display the message: "**welcome to the world of programming:"**

Private sub Form_load()
Form1.show
Print"welcome to the world of programming" End sub.

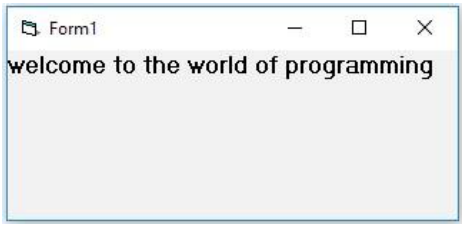
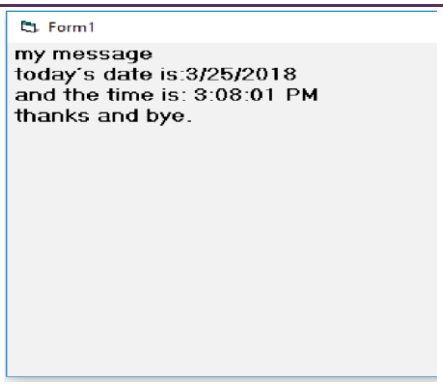


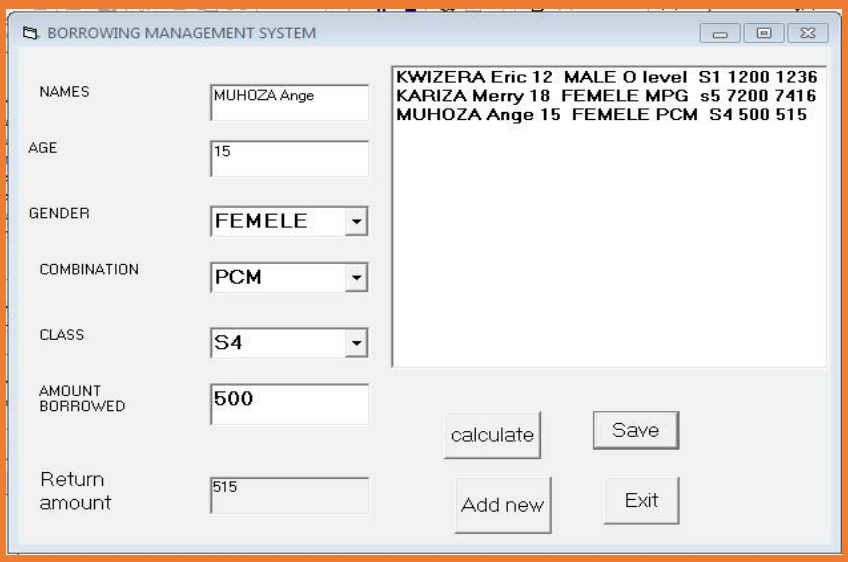
figure 3.37 Running form

application to display date, time and message

Codes: **Output:**

Private Sub Form_Load() *Form1.Show* *Print " my message"* *Print " today's date is:" & Date* *Print " and the time is: " & Time* *Print " thanks and bye."* *End Sub*	

Application Activity 3.8

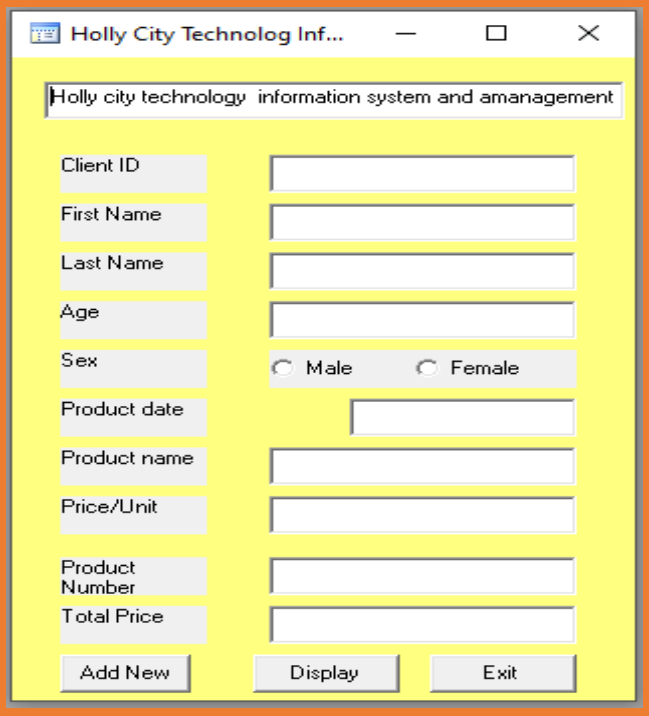


1. Design a form like above using all possible control and its proportional properties
2. Coding program

3.9. VB Project Planning

Activity 3.9

Director manager of Holly city technology Ltd needs to design a form which will help him to register and print the invoice of his clients



Observe the above figure and answers the following questions

1. Why Director Manager needs the above figure
2. What is the role of the following terms: Add new, Display, Exit

The project planning is an important phase of a software development. It works on the breakdown of activities, the scheduling, the human force distribution, its recruitment and capacity development.

3.9.1. Software requirement analysis

The software requirement or specification requirement phase allows both the developers and their clients to have a common understanding of the project and avoids mistakes that should cause failures.

1. **External Interface Requirements**

a. **User Interfaces**

Describe the logical characteristics of each interface between the software product and the users.

b. **Hardware Interfaces**

Describe the logical and physical characteristics of each interface between the software product and the hardware components of the system.

c. **Software Interfaces**

Describe the connections between this product and other specific software components (name and version), including databases, operating systems, tools, libraries, and integrated commercial components.

d. **Communications Interfaces**

Describe the requirements associated with any communications functions required by this product, including e-mail, web browser, network server communications protocols, electronic forms, and so on.

3.9.2. Project 2: Front end user interface in Visual Basic

In Visual Basic, the term Front End refers to the user interface, where the user interacts with the program through the use of the screen forms and reports.

Front-end interface for students' registration layout.

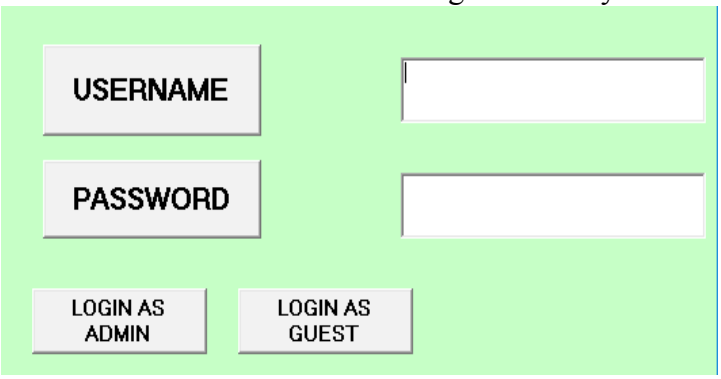


Figure 3.38 Front End

3.9.3 Back end database

(In Ms-Access, MySQL or any suitable RDBMS)

Database systems are comprised of a Front End and Back End. The Back End has the tables that store data, including the relationships between the tables, data queries and other behind the scenes technology that accepts information from and displays information to the user via the Front End.

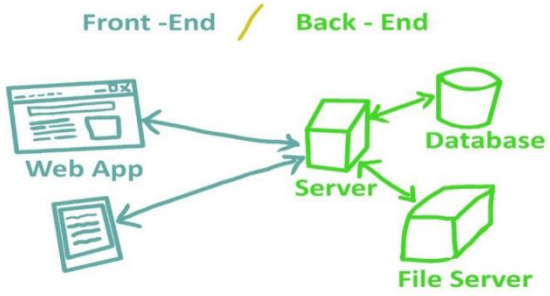
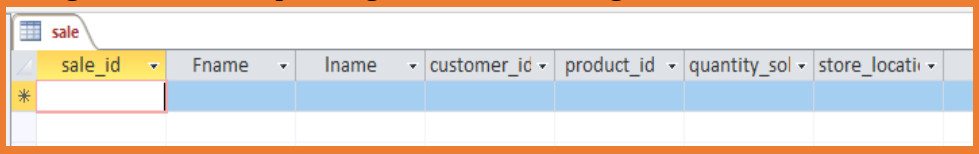


Figure 3.39 Back End

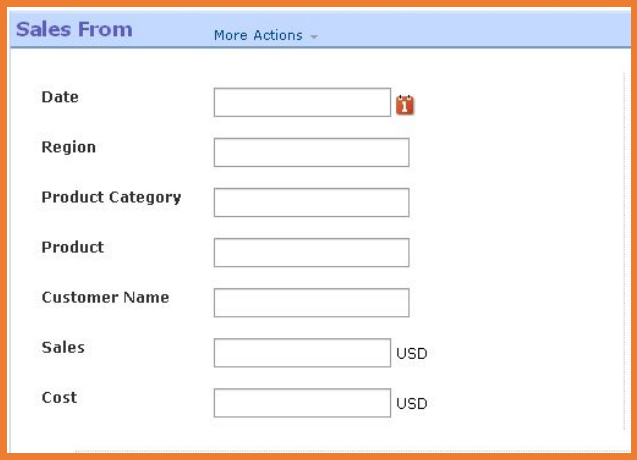
Application Activity 3.9

1. Define the following terms
   a. User interface
   b. Software interface
   c. Web browser
2. Differentiate Front End and Back End
3. Design a form corresponding with the following back end table



3.10. Connecting a Visual Basic 6.0 project to a database by using ADO

Activity 3.10



Observe the figure above and answer the questions

1. Is this form front end or back end
2. Discuss about the methods should be used for linking front End to Back End

ADO stands for ActiveX Data Object. It is a Microsoft Active-X component that is automatically installed with Microsoft IIS (Internet Information Services). The ADO is a programming interface that is used to access data in a database.

The ADO (ActiveX Data Object) data control is the primary interface between a Visual Basic application and a database. It can be used without writing any code or it can be a central part of a complex database management system. This icon may not appear in your Visual Basic toolbox. If it doesn't, select Project from the main menu, then click Components. The Components window will appear. Select Microsoft ADO Data Control, then click OK. The control will be added to your toolbox.

3.10.1. ActiveX data Object (ADO)

This control helps us to access a database data offering the possibility of working on different data sources such as text files, relational database etc.

i. Add ADO control

ADO controls contain multitudes of objects having properties, methods and events.

Access-connection: It allows your program to access a data source using a connection.

Its environment deals with transferring data.

ii. Record set:

This property work with the records which can be accessed by an ADO control.

- **Field:** Corresponds to the fields of a database which are connected to the program.
- **Error:** Errors may occur when a program fails to connect, execute a command or perform a given operation.
- **Event:** ADO uses the concept of events as other VB interfaces do, you can use also event procedures.
- **Record source**: Record source property specifies the source of the records accessible through bound controls on your form.
- **Data source:** The data source property specifies an object containing data to be represented as a record set object.

Command	**Sample**	**Usage**
Add	**Adodc1.RecordSet.AddNew**	**To add a record into a database**
Delete	**Adodc1.RecordSet.Delete**	**To delete a record into a database**
Refresh	Adodc1.Refresh	to refresh database data
Update	Adodc1.UpDateRecord or Adodc1.Update	To modifying a database fields
MoveNext	Adodc1.Recordset.MoveNext	Put the record pointer to the next record
MovePrevious	Adodc1.Recordset.MovePrevious	Put the pointer on the previous method
MoveFirst	Adodc1.Recordset.MoveFirst	Put the pointer on the first record of the database
MoveLast	Adodc1.Recordset.MoveLast	Put the pointer on the last record
Count	MsgBox adodc1.Recordset.RecordCount	Counting the records number

Exit	Unload me or End	End the interface

iii. Required for connecting Visual Basic to database

Connecting and communication applications with a database is a necessary part of any type of application. We may even say an application that does not communicate with the database is useless. Applications communicate with a database to retrieve data to the application or to insert, update or delete data after following the following steps:

Step 1. Create database tables in Microsoft access
Step 2. Design a Visual Basic Interface
Step 3. Data Control and Datagrid

3.10.2 Designing ADO Data Control 6.0 and DataGrid control 6.0

a. Right click under Tools Box Button
b. Click on Components
c. Activate microsoft ADO Data Control 6.0 (OLEDB) and microsoft DataGrid control 6.0(OLEDB)

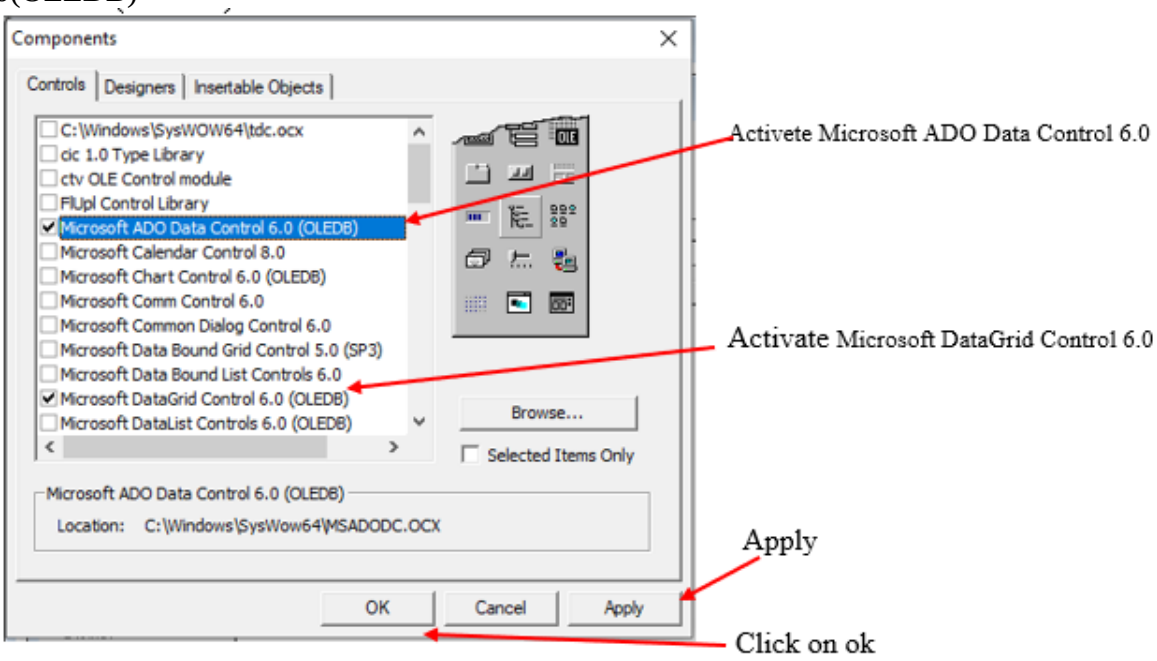


Figure 3.40 Ado data control and DataGrid control

From tools Box design ADO Data Control 6.0 (OLEDB) and DataGrid control 6.0 (OLEDB) drown by using their tools

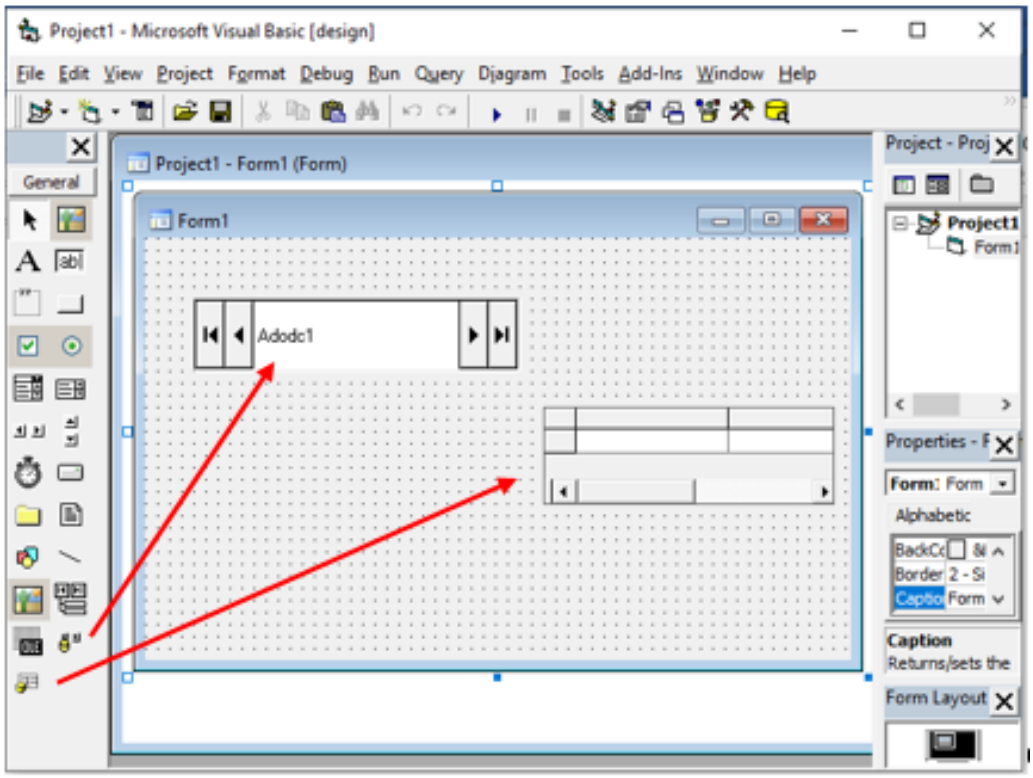


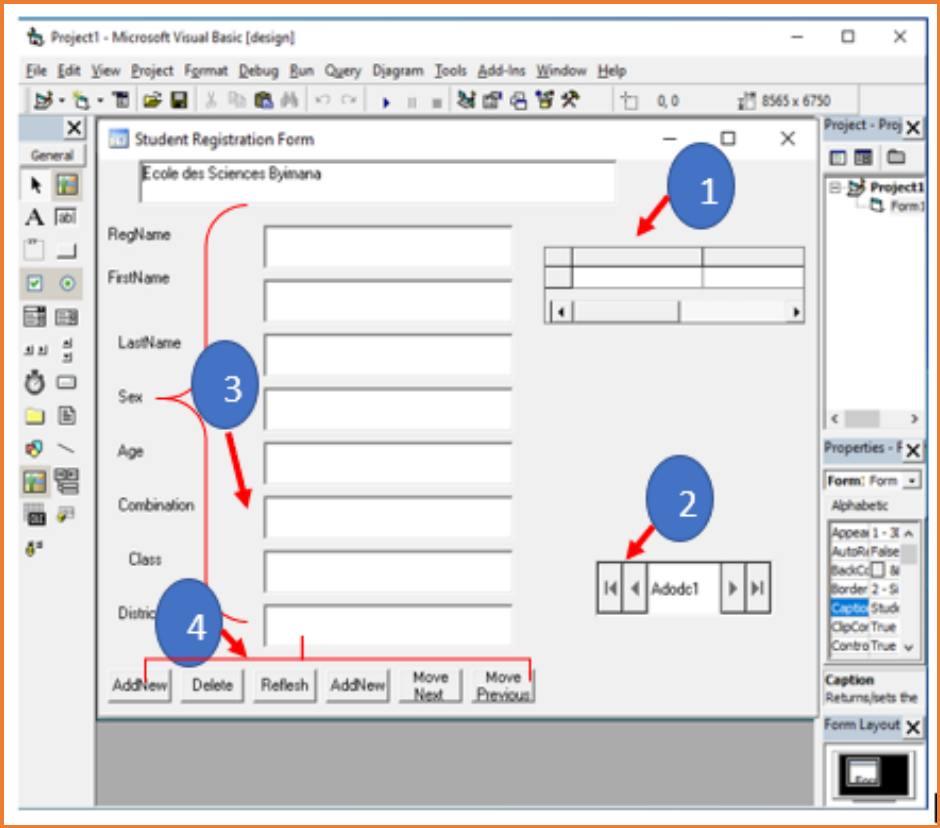
Figure 3.41 Adodc and DataGrid on the form

Application activity 3.10

1. Analyze and explain how MOVENEXT and MOVEPREVIOUS is used on data saved in database
2. Differentiate Record source and data source
3. When command UPDATE used in database

3.11. Connecting ADODC control to the tables within Access database

Activity 3.11



Analyze the above figure and identify how every part will be connected to the database

A visual basic database application has three main parts: user interface, the database engine and the data storage.

• The user interface: Is the Media through which the user interacts with the application.

• The database engine: Connects the application program with the physical database files. This gives you modularity and independence from the particular database you are accessing.

• The data storage: Is the source of the data. It may be a database or a text file. Database processing has become an integral part of all types of complex applications. A database is a system that contains different objects, which can be used together to store data. Using visual basic, you can create applications easily and make them have efficient access to data

3.11.1. ADODC to database

The ADODC or Active Data Objects Data Control is a method added in Visual Basic 6.0. It allows a programmer to put controls, such as labels, text boxes, list boxes and other display controls, on a form and connect them to the Data Control, which then connects to a database. This provides considerably more power to the developer in creating and maintaining databases

Follow the steps below to connect the database:

a. Right click **Ododc1** control
b. Left click on Adodc1 properties
c. On use Connecting String click on **Build**

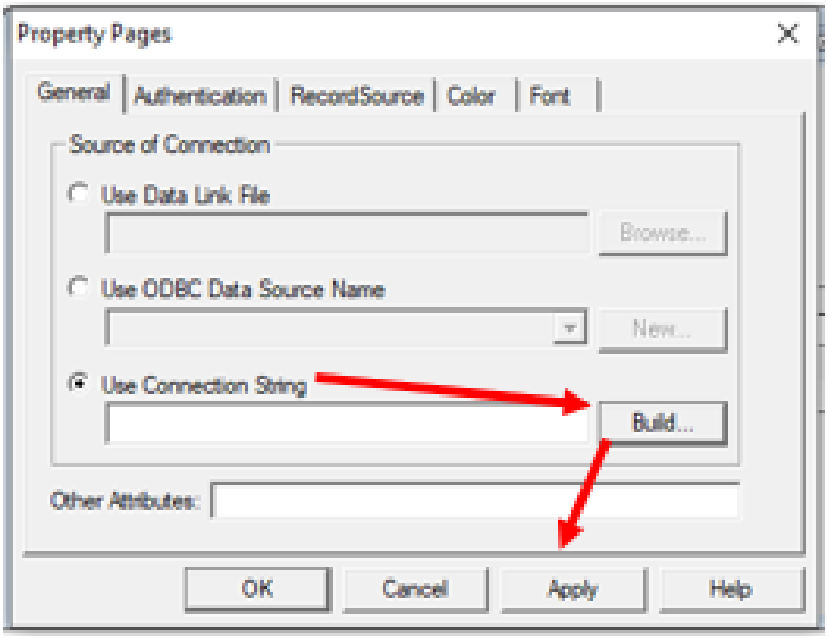


Figure 3.42 property page

d. Click on Apply
e. Select Microsoft Jet 4.0 OLEDB Provider

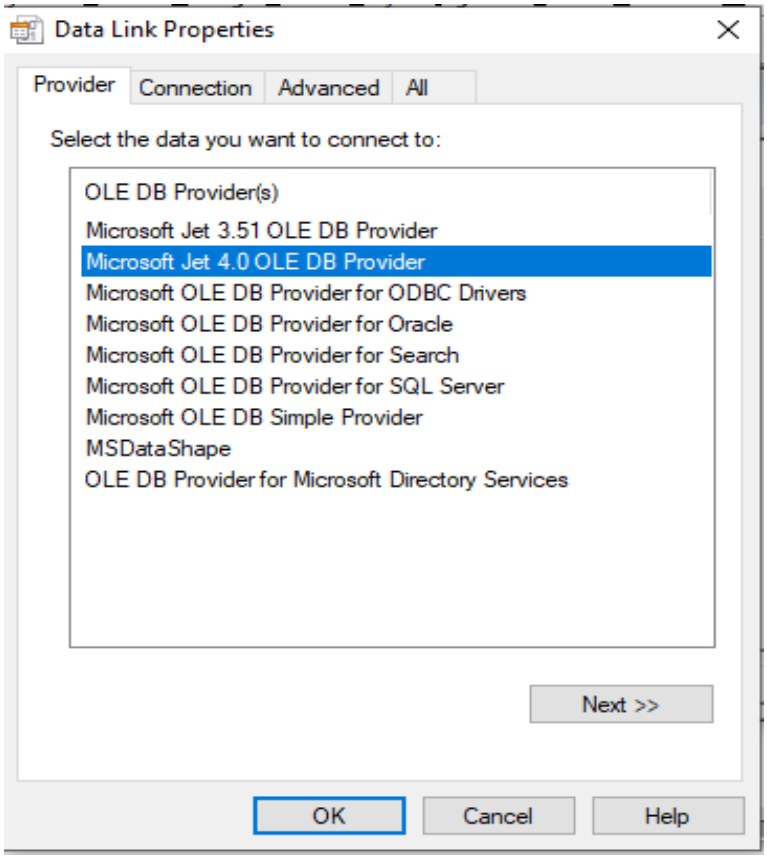


Figure 3.43 OLE DB Provider

f. Click on next
g. On Select or enter a database name Click on **three dots** (reflesh)

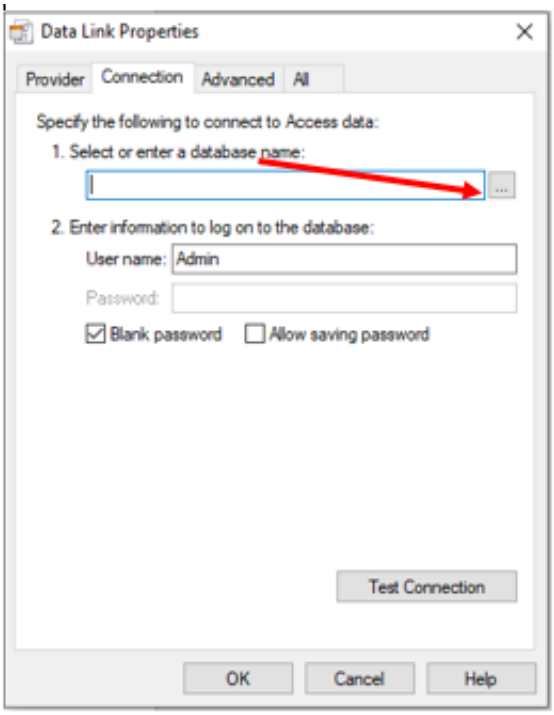


Figure 3.44 Database connection

h. Select the name of database save in 2000 Format
i. Click on **OPEN**

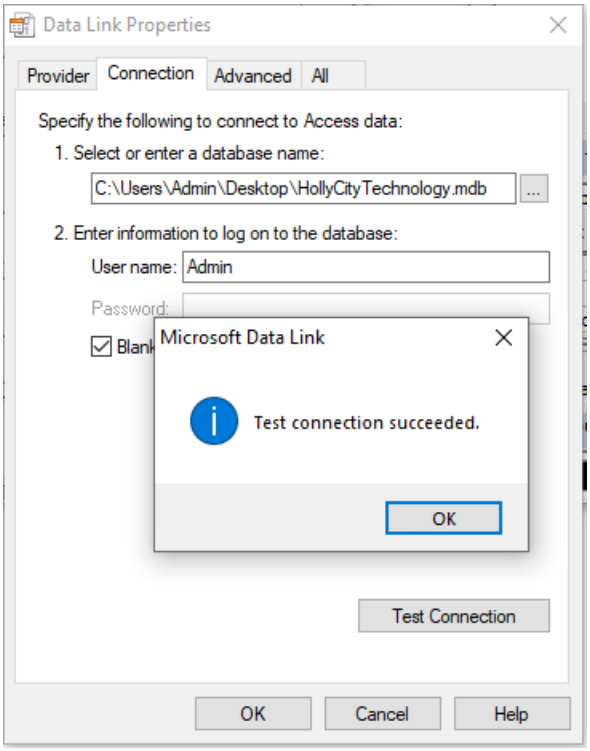


Figure 3.45 Database test connection

j. Click on Test
k. Click on OK and Then OK

3.11.2. To connect Adodc to the tables in database

When ADODC is connected to the database the next step is to connect to ADODC to the table created in database

a. Right click on Adodc1
b. Click on Adodc Properties
c. Click on RecordSource

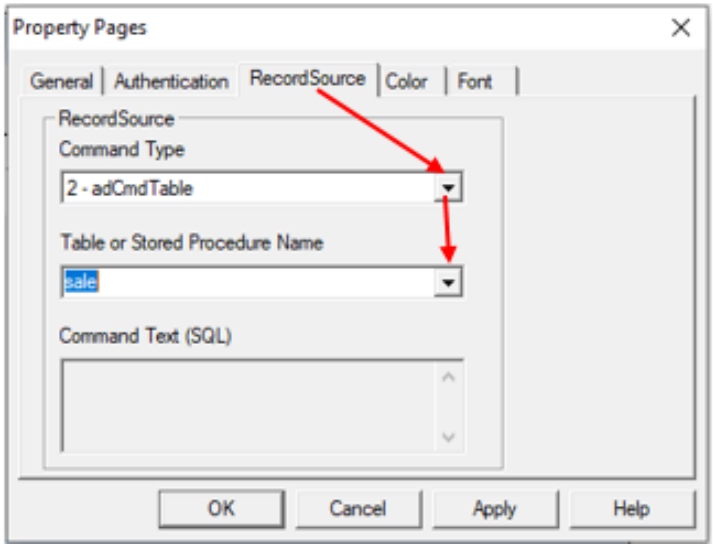


Figure 3.46 table connection

d. In Command Type, Select adCmdTable
e. In Table or Stored Procedure Name, select Table Name
f. Click on Apply and Then Click on Ok

3.11.2 Connect DataGrid control to the tables within Access database

a. Click on DataGrid control designed in in Visual Basic interface
b. In properties click on DataSource

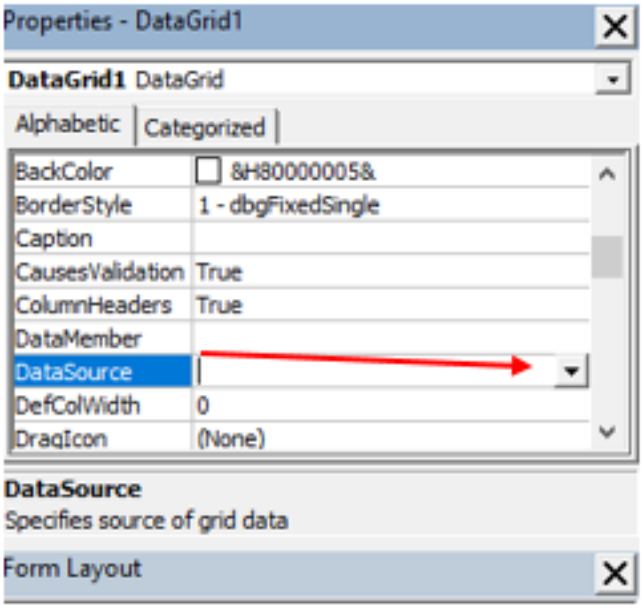


Figure 3.47 Data Source connection

c. Select Adodc1

3.11.3. Connect Text box controls to the tables Columns within Access database

1. Click on Text box of Client ID
2. In **Properties interface** click on **DataSource** and select **Adodc1**

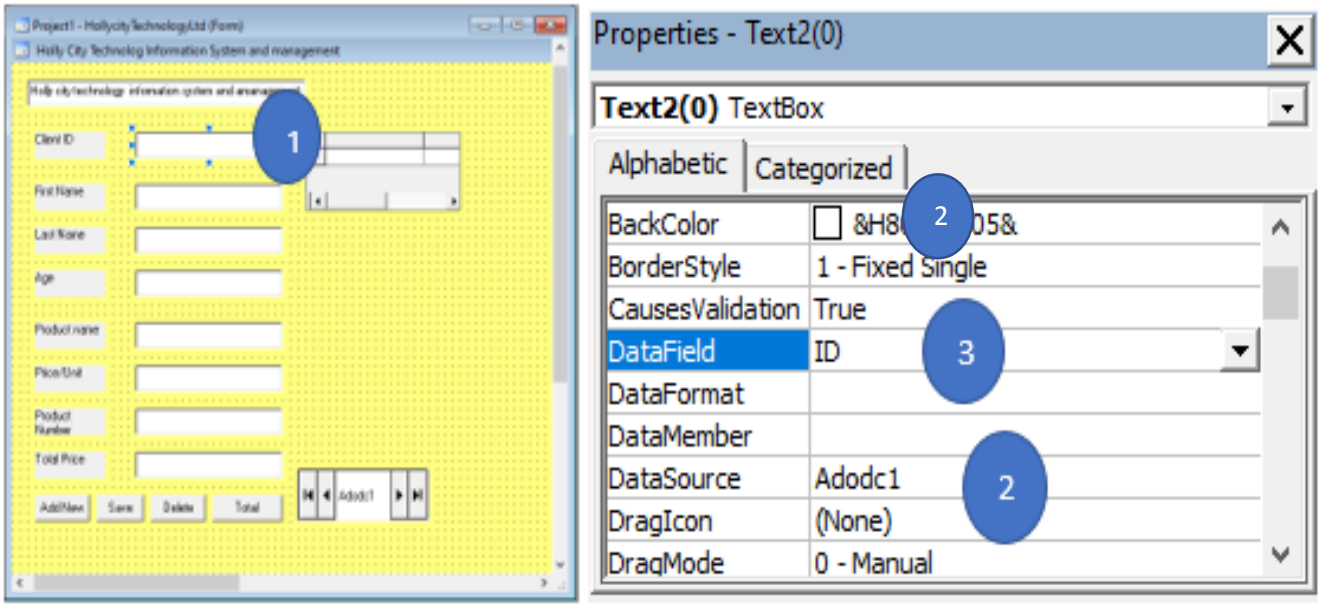


Figure 3.48 DataField

3. In DataFiel , select ID
   NB: Apply the above steps to all Text box designed into Visual Basic interface

3.11.4. Program Coding in command buttons

programming or writing program code is the means used to cause something to happen when an event, such as a button click occurs.

a. Adding new records

Use the **AddNew** method to create and add a new record in the **Recordset** object named by recordset. This method sets the fields to default values, and if no default values are specified, it sets the fields to Null (the default values specified for a table-type **Recordset**).

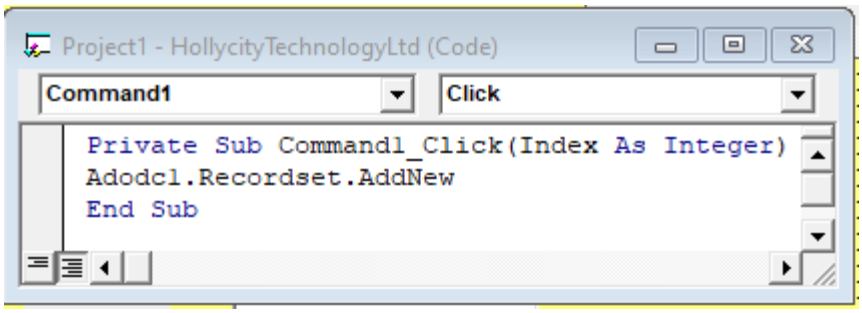


Figure 3.49 AddNew command used for adding new record

b. Saving records

Save method is used to save data in database; it allows to save the data according to the new values of the fields of a table

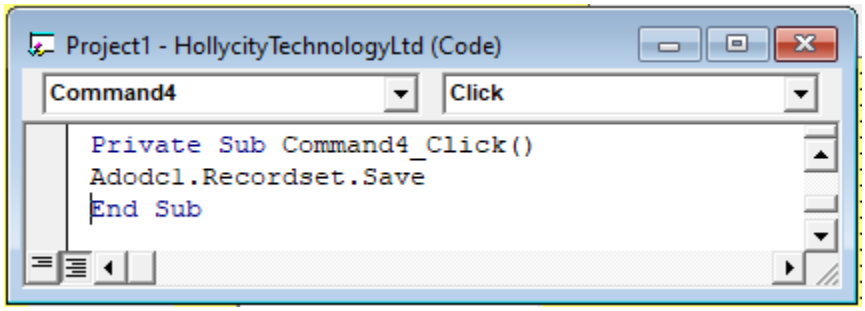


Figure 3.50 save used for saving data in database

c. Delete records

The Delete method is used to delete the current record or a group of records. After deleting a record, the deleted record remains current until you move to a different record.

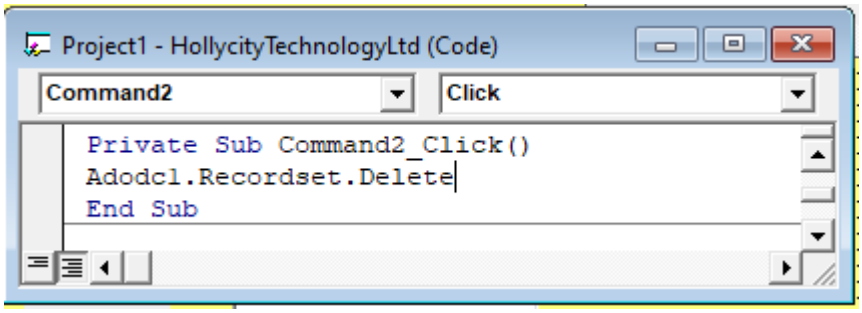
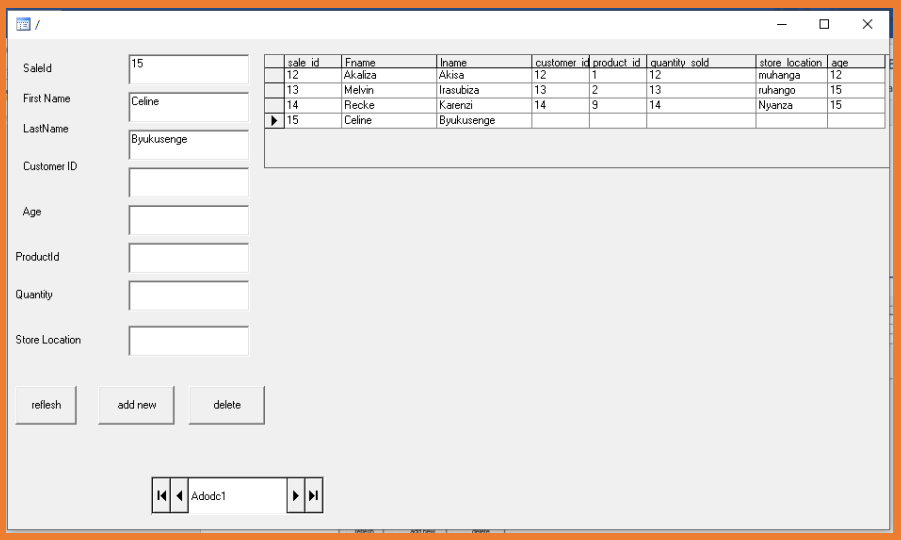


Figure 3.51 Delete used for Deleting data in database

Application activity 3.11

1. Write the procedures used for connecting Adodc to database
2. Explain what is data field
3. Design the following form and RUN Refresh, add new and Delete Button.



3.12 Building the interface and accessing the database

Activity 3.12

1. Identify the characteristics of good interface
2. What does friendly user interface mean?

3.12.1. Interface and accessing the database

- Interface is required to access a related database in order a user can add, modify, retrieve data and so many other interactions.

- Drawing the interface, you have to set properties and then coding
- You have to add the data control to connect your database.

3.12.2. Principles for designing a friendly and ergonomic user interface

Building the interface and accessing the database

- Interface is required to access a related database in order a user can add, modify, retrieve data and so many other interactions.
- Drawing the interface, you have to set properties and then coding
- You have to add the data control to connect your database.
- Add data control to be used to connect database

3.12.3. Ergonomic user interface

Designing a good user interface is an iterative process. There are appropriate techniques to use during the designing and implementation of a user interface.

a. **Principles of a friendly user interface:** The main principles of a friendly user interface.
b. **Principles for an ergonomic user interface**

Ergonomics derives from two Greek words: ergon, meaning work, and nomoi, meaning natural laws, to create a word that means the science of work and a person's relationship to that work. Ergonomics is a field of study that attempts to reduce strain, fatigue, and injuries by improving product design and workspace arrangement.

There are five aspects of ergonomics: safety, comfort, ease of use, productivity/performance, and aesthetics.

- **Safety:** This has to do with the ability to use a device or work with a device without short- or long-term damage to parts of the body.
- **Comfort:** Comfort in the human-machine interface is usually noticed first.
- **Ease of use:** This has to do with the ability to use a device with no stress
- **Productivity/performance:** Ergonomics addresses the performance of user interface by providing more options to the users, enabling them to easily and quickly skip some instructions as users' choice.
- **Aesthetics:** Signs in the workplace should be made consistent throughout the workplace to not only be aesthetically pleasing, but also so that information is easily accessible.

Application activity 3.12

1. What is the following terms stand for
   a. Ergon
   b. Nomoi
2. In your word discuss about any three aspect of ergonomics
3. Create a database in Microsoft access and an interface in Visual Basic6.0 then try to access it from VB form interface.
4. A. Name your database
   a. created in Microsoft access for example name it "school"
   b. Create three tables named for example Table1, Table2 and Table3. Fill your database in Table1 with the fields: RegNo, First name, Last name, Gender, Mother's name, Father's name, ID/Passport, Province, District, Sector, Option and class respectively.
   c. Using Visual Basic 6.0, draw the interface for your tables with the following controls:
      12 labels (RegNo, First name, Last name, Gender, Mother's name, Father's name, ID/Passport, Province, District, Sector, Option and class)
   d. 12text boxes RegNo, First name, Last name, Gender, Mother's name, Father's name, ID/Passport, Province, District, Sector, Option and class)
   e. Eight command buttons for Add, Delete, Next, Previous, Top, Bottom, Update, and Exit.

END UNIT ASSESSMENT

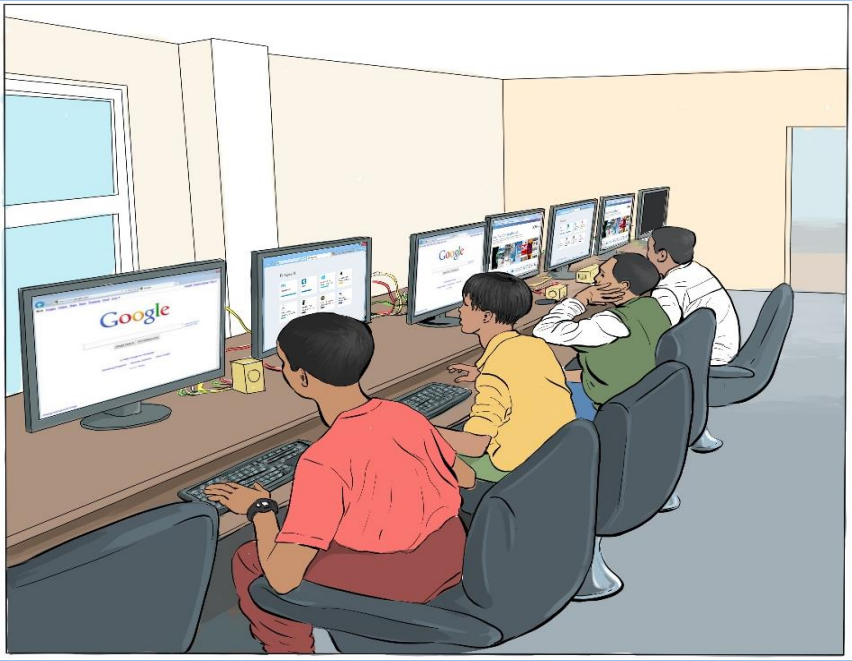
1. Differentiate Back end and Front end
2. Design a Library Management System will be used in your school

UNIT 4: INTRODUCTION TO WEB DESIGNING

INTRODUCTORY ACTIVITY

Read the following scenario and answer the related questions.

At UMURAVA secondary school, the parents' committee advised the school administration to have a school website on the Internet so that school information and social protection can be accessed via Internet browsers.



1. Observe the picture above and give the reasons why those people are so concentrated
2. Suppose you have the option to choose the name of the Umurava high school website. What is the specific name, you would give to the website?
3. Can you change or delete an information from a website? Explain your answer.
4. Discuss the 3 advantages and disadvantages of a website
5. Visit ***"www.igihe.com"*** website and identify at least five elements to web

4.1. Introduction to web designing

Today, large corporations, medium-sized, small -scale business organizations and individual are using websites to communicate company information and manage their projects. People are now reconnecting with their friends and family members on social media such as Facebook, Twitter, Instagram, YouTube etc. In this unit, we discuss basic concepts relating to web designing such as website, web page, web application, static web page and dynamic web page. The step by step process of developing a website is also discussed here.

4.1.1. Understanding of basic concepts

Activity 4.1

With a research using the internet, answer the following questions:

1. What do you understand by the terms below?

- Website
- Web page
- Web application

2. Discuss the difference between Static web page and Dynamic web page
3. Discuss the advantages of a static web page and dynamic web page

4.1.1.1. Key terms

i. Website

A **website** is a collection of several web pages with information on a subject that are connected together. Websites Can be easily searched using search engines like Google.
The World Wide Web is made of many websites and each is made of many webpages.

Advantages of a website

Websites present the following advantages:

- It is an effective method to showcase products and services
- Developing a site helps in creating a social proof of existence
- Helps in branding a business and achieving business goals
- Allows to reach out to customers for support

Disadvantages of a website

- A website may crash and when this happen people who were accustomed to reaching an organization through its website seem to have lost contact with it
- Contact form published on a website may invite lots of unwanted spam e-mails.

- The information on any website might be unreliable if it is not updated regularly.

ii. Web page

Each single resource on the web is called a **web page**. A web page is a document commonly written in HTML (Hypertext Markup Language) containing more specific information that is accessible through the internet or other networks using an internet browser. A web page is hypertext document that incorporates content such as text, images, sound, video and so on.

iii. Web application

A **Web application** (**Web app**) is an application program that is stored on a remote server and delivered over the internet through a browser interface. A web application is a software or program which is accessible using any **web** browser.

Advantages of web Applications

Web applications are more popular because of the following reasons:

- Compared to desktop applications, web applications are easier to maintain as they use the same code in the entire applications.
- Web applications can be used on any platform: Windows, Linux, Mac as they all support modern browsers
- Released any time and in any form. No need to remind users to update their applications.
- They can be accessed 24 hours of the day and 365 days the year from any computer.
- A computer or a mobile device can be used to access the required data.

Disadvantages of web Applications

- Security is not guaranteed, so it is vulnerable for unauthorized access
- The web app may not support multiple browsers with equal precedence
- The web application is built explicitly for a certain operating system, so it is difficult to discover from the app store.
- Limited scope to access the device's features.

Below are the prime difference between web application and website:

Parameter	**Web Application**	**Website**
Created for	A web application is designed for interaction with the end user.	A website mostly consists of static content. It is publicly accessible to all the visitors.
User interaction	In a web application, the user not only read the page content but also manipulate data.	A website provides visual & text content which user can view and read, but not affect it's functioning.
Authentication	Web applications need authentication, as they offer a much broader scope of options than websites.	Authentication is not obligatory for informational websites. The user may ask to register to get a regular update or to access additional options. This features not available for the unregistered website visitors.

Task and complexity	Web application functions are quite higher and complex compared to a website.	The website displays the collected data and information on specific page.
Type of software	The web application development is part of the website.IT is itself not complete website.	The website is a complete product, which you access with the help of your browser.
Compilation	The site must be compiled before deployment	The site doesn't need to be pre-compiled.
deployment	All changes require the entire project to be re-compiled and deployed	Small changes never require a full re-compilation and deployment, you just need to update the HTML code.

Table 4.1: Web Application and Website comparison

iv. Static web page

A static webpage is one whose contents do not change, or at least do not change quickly. A static page is one that is usually written in plain HTML and what is in the code of the page is what is displayed to the user. These are webpages that contain information that does not need to be updated. They are always the same unless the content is changed physically on the server's hard disk. That is the reason these web pages are known as static web pages.

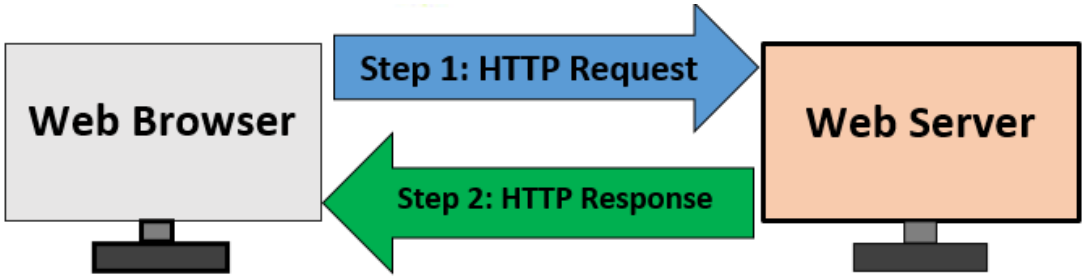


Figure 4.1: Web Browser Web Server interaction for Static Web Page

The particular thing in a static web page is that the content in these types of the web page does not change depending on the request.

v. A dynamic webpage

A dynamic webpage is one whose contents do change, and generally change very quickly.

For example: The website for a newspaper changes constantly because the news changes constantly.

If the information were never updated, users would stop visiting the sites. Therefore, dynamic web pages provide a solution for the static web pages. The dynamic web page content can vary depending on the number of parameters.

As it is discussed above that dissimilar to static web age, it not just simply sends HTML page in response. The web server calls a program located on the hard disk which can access a database,

perform transaction procedure. If the application program produces HTML output, which is used to construct an HTTP response by the web server. The web server sends the HTTP response thus created, back to the web browser.

The dynamic web pages are employed where the information changes very often such as stock prices, weather information, news and sports updates. Let's assume a person has to physically change the Web page every 10 seconds to show the latest update of the stock prices which is impractical to physically alter the HTML pages very often, so in this case, a dynamic web page can be used.

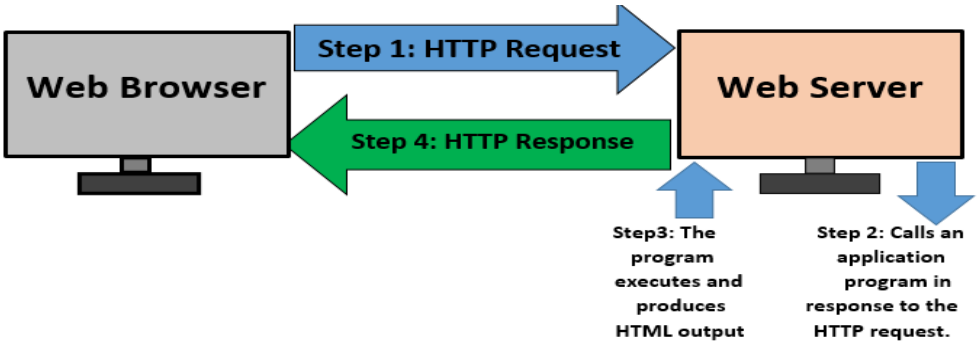


Figure 4.2. Web Browser Web Server interaction for Dynamic Web Page

There are several tools used for the creation of dynamic web pages. For example, **PHP** (Personal Home Page), CGI (Common Gateway Interface), **ASP** (Active Server Pages), **JSP** (Java Server Pages), **AJAX** (Asynchronous JavaScript and XML), etc.

Key differences between Statistic and Dynamic Web Pages

Parameter	**Static web pages**	**Dynamic web pages**
Technology languages used to create	HTML, JavaScript, CSS	CGI, AJAX, ASP, PERL, PHP, etc.
Task and complexity	Simple to construct	Complex to construct and design
Content to display	Display the same content each time when someone visits it.	Contents changes according to the user.
Loading speed	Loading quickly by consuming less time	Take more time while loading.
Updating content	Difficult to alter because it requires the change to be implemented at each point manually.	The contents can be changed regularly as the server generates unique content each time the page is loading with the same source code.
Database	No database is used	A database is used.

Table 4.2: Static web pages and Dynamic web pages comparison

Conclusion

There is no involvement of application program in the static web page whereas dynamic web page involves an application program which can perform the various operations. Although, static and dynamic web pages have to return HTML contents to the web browser with the use of HTTP protocol, in order to interpret and display them on the browser.

4.1.1.2. Importance of using both static and dynamic web pages

A. Advantages of static websites

- **Faster speed:** Being a static file when a user visits a page, all the web server has to do is return a file. No server-side code is executed. Differently with dynamic websites there is extra processing time required to deliver HTML pages.
- **More secure:** Since there is no back-end server-side processing, there is less surface area for attacks and there is no database available to be compromised.
- **Lower cost:** As they don't have a database, static websites require less maintenance and are cheap to host.
- **Easier to scale:** When a website is hosted on the Cloud it is ready to be scaled at any time. Although similar techniques can be applied with dynamic websites, it will be more complex as database scaling might be required.
- **Backups/Full editorial history:** It is possible to see who changed which content and when if version control tools such as GIT are used.

B. Advantages of dynamic websites

- **Easier to update content:** Using a CMS (Content Management System) web interface for managing content will allow to make changes easily.
- **More flexible:** When creating a dynamic website, the programmer has full control of the wheel to create whatever interactive feature needed.

APPLICATION ACTIVITY 4.1

1. Discuss different characteristics of a website and web application?
2. Define a web application and give two examples of web application?
3. Among web application and web site, what is the advantageous? Explain your answer.
4. With comparison table, differentiate static web page to dynamic web page
5. Discuss reason why it is easier to update dynamic web site compared to static website.
6. Is it very cheap to host static website in comparison with dynamic website? Explain.

4.2 Introduction and evolution of HTML

ACTIVITY 4.2

Using internet, find the answers to the following questions:

1) Write in full the abbreviated terms bellows:
   a) WWW
   b) HTML
2) Explain what is www
3) Discuss the importance of HTML
4) Discuss and write an essay on how Hypertext Markup Language (HTML) had evolved from 1991 to the current trends seen today.

4.2.1 Introduction to HTML

The World Wide Web is an Internet-based system or platform that allows hypertext documents to be interconnected by hyperlinks. A hyperlink is a word or phrase a user can click to move from one website or webpage to another.

Hypertext enables you to read and navigate text and visual information in a nonlinear way based on what you want to read next. The idea behind hypertext is that instead of reading text in a linear structure like in a book, you can easily jump from one point to another based on interests.

Hypertext Markup Language (HTML) refers to a language used to structure hypertext (web) documents for presentation on the World Wide Web. HTML is not a programming language but can be thought of as a presentation language used to instruct the browser on how to present text and multimedia content on the Web.

HTML is the standard markup language for creating Web pages.

4.2.2 Evolution of HTML

The HTML was invented by Tim-Berners Lee, the founder of World Wide Web. Lee's original HTML version was based on a more complicated document processing language known as Standard Generalized Markup Language (SGML). Soon, Lee released different versions of HTML causing incompatibilities between different developers using different versions. For this reason the following was done:

- A consortium known as World Wide Web Consortium (**W3C**) was established to standardize HTML.
- The first standard version of HTML that was developed and maintained by W3C was **HTML 2.0** released in 1995. It specifies a set of tags that must be supported by all browsers.
- In 1996, release of **HTML 3.2** standard then later **HTML 4.0** in 1997.
- Most web browsers today support variation of HTML known as *Extensible Hypertext Markup Language* (**XHTML**) that support mobile web application too. Today, there is **HTML5** which many browsers and developers are using to develop web applications.

APPLICATION ACTIVITY 4.2

1) HTML is not a programming language but can be thought of as a presentation language. Explain.
2) What is the difference between Hypertext and Hyperlink?
3) What are the particularities of XHTML over HTML 4.01?
4) Discuss the advantages of HTML 5 comparing to the previous versions.

4.3. HTML tags and syntax

ACTIVITY 4.3

1. What is a HTML tag?
2. Give the syntax of HTML tag
3. What is the role of an attribute of a HTML tag?

HTML tags are element names surrounded by **angle brackets** or **Less Than and Greater Than** symbols **(< >)**.

Syntax: *<tag_name>content goes here...</tag_name>*

Example: *<title> login page<title>*

- HTML tags normally come in pairs like and
- The first tag in a pair is the start tag, the second tag is the end tag
- The end tag is written like the start tag, but with a forward slash inserted before the tag name.

Note: The start tag is also called the opening tag, and the end tag the closing tag.

For example, to instruct a browser to present text as a paragraph, use the opening and closing tags as follows:

 This is a new paragraph separated from others by a blank line

An attribute is used to define the property or characteristics of an element inside the element's opening tag. All attributes are made up of two parts: name and value. For example, a paragraph may be right aligned using align attribute as follows:

<p align=**"** left **"**This is left aligned

APPLICATION ACTIVITY 4.3

1. Discuss the syntax of an HTML tag
2. Define an attribute
3. You are given the HTML statement below:
    Hello Rwanda

   What is the function of

   a) Color
   b) Green

4.3.1 HTML Syntax and HTML Page Structure

ACTIVITY 4.4

Open Notepad on your computer and type the below code.

```
<! DOCTYPE html>
<html>
<head>
<Title>My First Page</title>
</head>
<body>
<h1> This is my first web page </h1>
</body>
</html>
```

1. Save the above program as “myfirstpage.html”
2. Open the myfirstpage.html using any browser.

HTML tags are used to define a set of common web page features such as titles, paragraphs, and lists, tables, forms, images and multimedia.

Below is a visualization of an HTML page structure:

<html>
<head>
Document header related tags
</head>
<body>
Document body related tags
</body>

</Html>

Example: the following sample HTML code creates a web page that displays

"VISIT RWANDA Web Page":

<! DOCTYPE html>

<html>

<head>

<title>Page Title</title>

</head>

<body>

<h1>VISIT RWANDA Web Page</h1>

</body>

</html>

Explanation of above sample HTML code:

- The <DOCTYPE html> declaration defines the document type to be HTML5; there are many other declaration types which can be used in HTML document depending on which versions of HTML that are being used.
- The <html> element is the root element of a HTML page
- The <head> element contains meta information about the document
- The <title> element specifies a title for the document
- The <body> element contains the visible page content
- The <h1> element defines a large heading
- The <p> element defines a paragraph

APPLICATION ACTIVITY 4.4

1. Why does <DOCTYPE html> start every web page in HTML?
2. Give HTML tags found between <head>……</head> tags
3. Create a web page that displays the name of your school

4.4 Design a static web page using html tags and hyperlinks

ACTIVITY 4.5

Using Notepad, Type the below html code and execute them.

```
<html>
<head>
<title>Republic of Rwanda </title>
</head>
<body>
Visit the official Website of the Republic of Rwanda using the link below <br>
<a href="http://www.gov.rw/home/"> The official Website of the Republic of Rwanda </a>
</body>
</html>
```

Do the followings:

1. Save the program as "linkage.html"
2. Check if there is a linkage between your Webpage and the official website of the Republic of RWANDA.

The editor that is going to be used for designing web pages is Notepad. This editor is preferred in that it requires writing from scratch every html code and does not provide suggestions, error correction, etc and this is good for a learner as it ensures mastery of all the used codes.

Step 1: To open Notepad in Windows 10

Click on the **Start** and type Notepad in the start search box

Step 2: Write HTML into Notepad. The text below is to create a HTML page

```
<! DOCTYPE html>
<html>
<head>
<title>First page</title>
</head>
<body>
<h1>VISIT RWANDA Web Page</h1>
```

</body>
</html>

Step 3: Save the HTML Page

Select **File** tab then **Save or Save as** in the Notepad menu.

Name the file "index.htm" or any other name ending with htm.

You can use either .htm or .html as file extension as these two extensions are the same.

Step 4: View HTML Page in a web browser **(Mozilla Firefox, internet explorer, Google chrome.)**

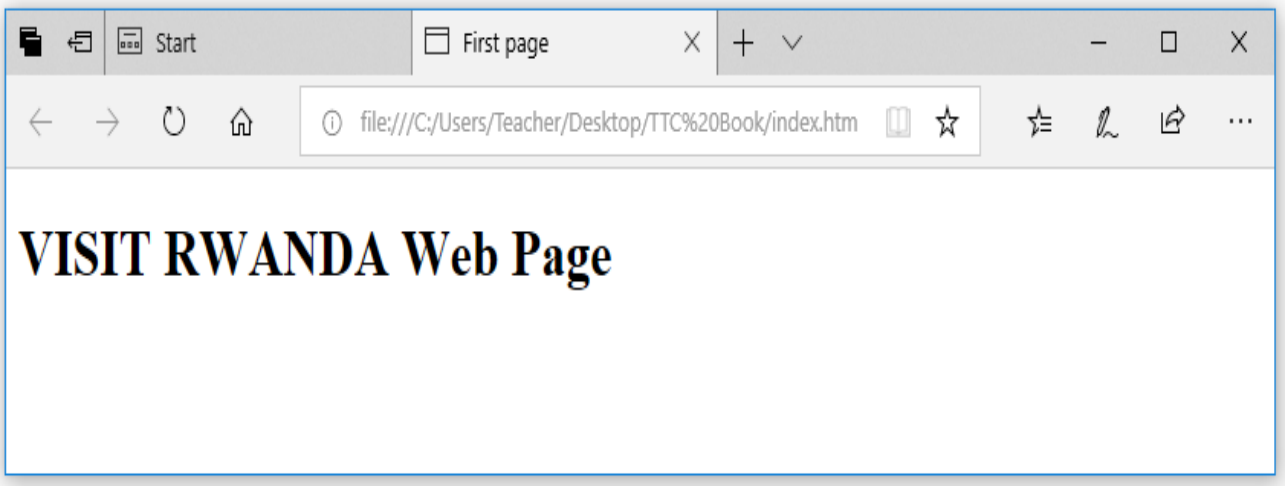


Figure 4.3: Sample web page

HTML Links - Hyperlinks

HTML links are hyperlinks. You can click on a link and jump to another document.

When you move the mouse over a link, the mouse arrow will turn into a little hand.

Note: A link does not have to be text. It can be an image or any other HTML element.

HTML Links - Syntax

Hyperlinks are defined with the HTML <a> tag:

link text

Example:

Visit Official Rwanda Revenue website

APPLICATION ACTIVITY 4.5

Open the Notepad software, Write an HTML page that displays your name and save it as "exercise.html" on desktop of your computer and then run the file using any browser you want.

4.4.1. Tags that identify and name documents

ACTIVITY 4.6

Using Notepad text editor, write the following HTML code and save the file as mypage.html, then run file in a browser you want

```
<! DOCTYPE html>
<html>
<head>
<title>Identifying elements</title>
</head>
<body>
<strong>Rwanda is known as a country of thousand hills! </strong> <br>
<mark>The development of Rwanda is based on its people</mark><br>
<del>strong and mark are HTML tags that organize web page
contents</del><br>
</body>
</html>
```

Study carefully the output of above HTML code and then answer the following questions:

1. What is the function of:
   - tag?
   - <mark> tag?
   - <del>tag?
2. Give any other 4 HTML tags that identify and name a document.

HTML language specification defines the markup that can be used to create a webpage, the **webpage author** decides which elements they will use to markup content.

For example:

a) **The appearance (formatting) tags**

A document heading may be created by making text larger, bold and with a different color. Presentational markup for such a heading may look like this:

```
<p>
< font size="36" color="red" > <b>ICT is a key of development </b>
```

* </p>*

Formatting elements were designed to display special **types of text**:
The table below shows html text formatting elements:

HTM Tag	**Description**
<b>	Defines bold text
	Defines emphasized text
<i>	Defines italic text
<small>	Defines smaller text
	Defines important text
<sub>	Defines subscripted text
<sup>	Defines superscripted text
<mark>	Defines marked/highlighted text
<ins>	Defines inserted text
<del>	Defines deleted text

Table 4.3: HTML text formatting elements

Example: The HTML document below shows how to use formatting HTML elements

```
<!DOCTYPE html>
<html>
<head>
<title>Formatting elements</title>
</head>
<body>
<mark><b>Rwanda has 4 provinces and Kigali City</b></mark> <br>
<strong>Kigali City has 3 districts</strong><sup> which ones?</sup><br>
<del>Kigali Convention Center is in Nyarugenge district</del><br>
<ins>Thank you! </ins>
</body>
</html>
```

The web page below is displayed by the above HTML document:

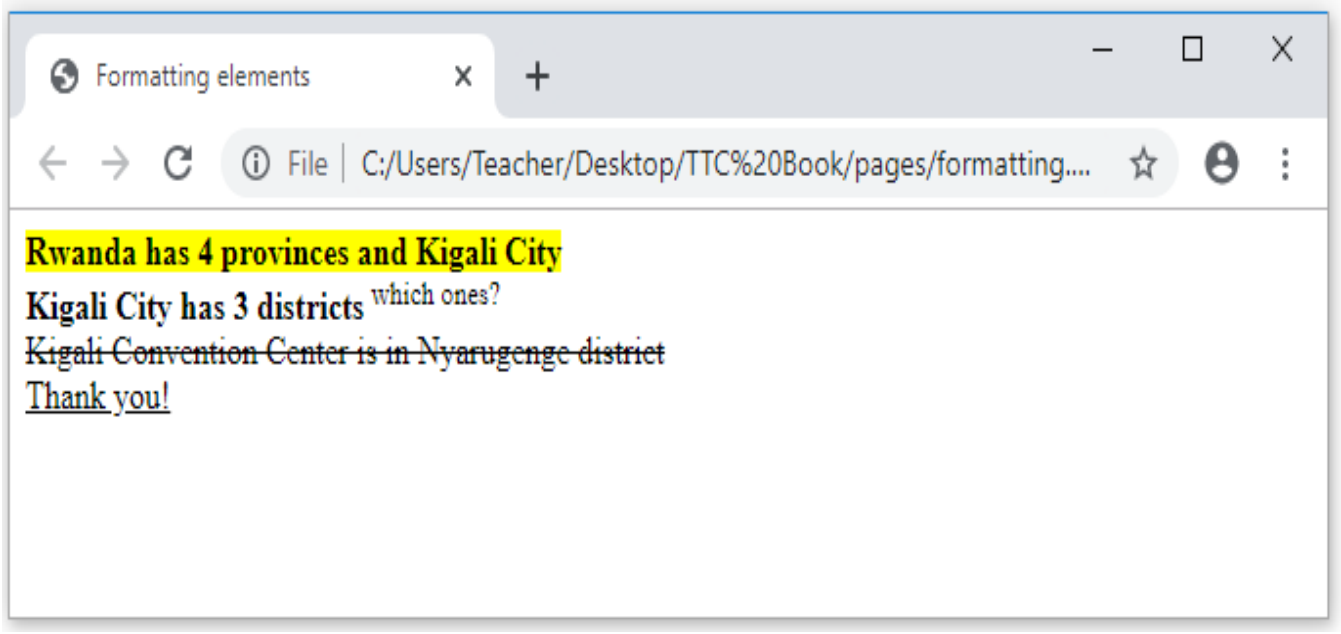


Figure 4.4: Formatting HTML elements

b) **Heading tags**

Heading tags are used in the body section to define section headings that stand out from the rest of the text. HTML provided six levels of section headings: <h1>, <h2>, <h3>, <h4>, <h5>, and <h6>.

Note that the size of the heading reduces progressively with h1 being the largest while h6 is the smallest.

The general syntax of heading element is:

<headlevel> text</heading level>

Example:

The following HTML document displays the six heading levels (h1 to h6)

```
<!DOCTYPE html>
<html>
 <head>
<title>Heading Example</title>
</head>
<body>
 <h1>This is heading 1</h1>
<h2>This is heading 2</h2>
 <h3>This is heading 3</h3>
```

<h4>This is heading 4</h4>

<h5>This is heading 5</h5>

<h6>This is heading 6</h6>

</body>

</html>

The figure below shows how the headings appear when displayed on a browser such as chrome or Mozilla Firefox.

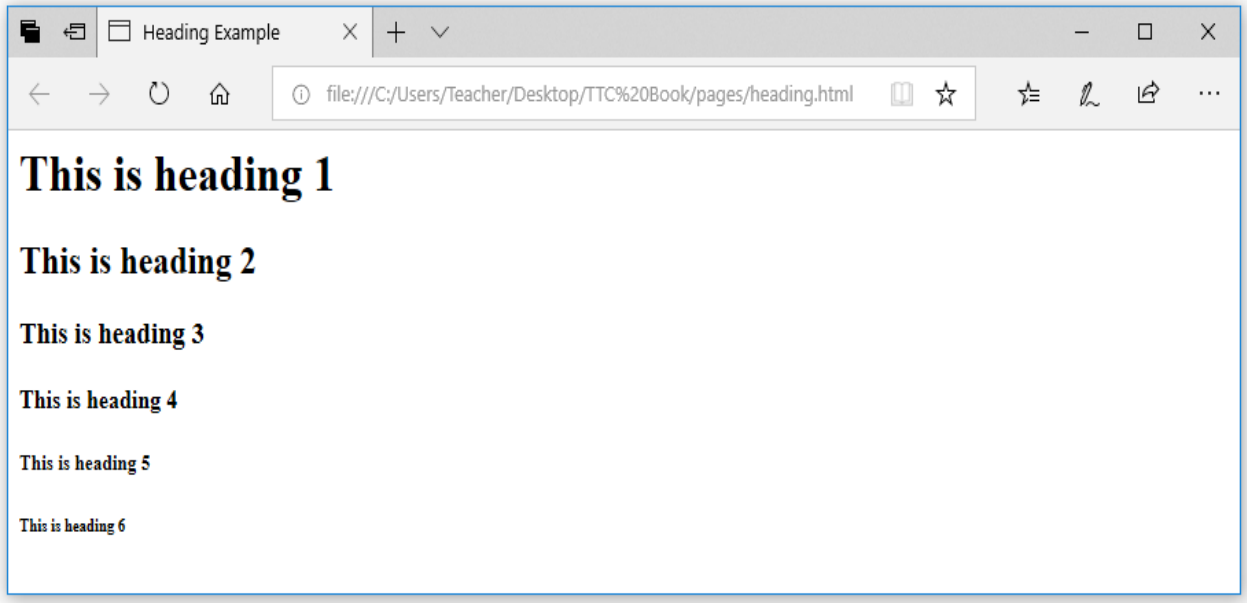


Figure 4.5: Heading levels

c) HTML images

One of the most compelling features of latest HTML standard is the ability to embed images that make a website more attractive. The three types of images supported by HTML4 are **GIF** (Graphics Interchange Format), **JPEG** (Joint Photographic Experts Group) and **PNG** (Portable Network Graphics). To insert an image onto a web page, use the **<img>** tag; img is an abbreviation of the word image. The **<img>** is an empty tag does not require a corresponding closing tag. The general syntax for inserting a graphical object or image is:

******

The **src** in the img tag is an important attribute that specifies the location (source) or URL of the image to insert onto the page.

For example, the following HTML code displays an image called Volcano:

<!DOCTYPE html>

<html>

<head>

<title> Visit Rwanda </title>

</head>

<body>

* <Strong>*

*Visit Volcanoes National Park *

* *

* *

</body>

</html>

The HTML document above produces the following output:

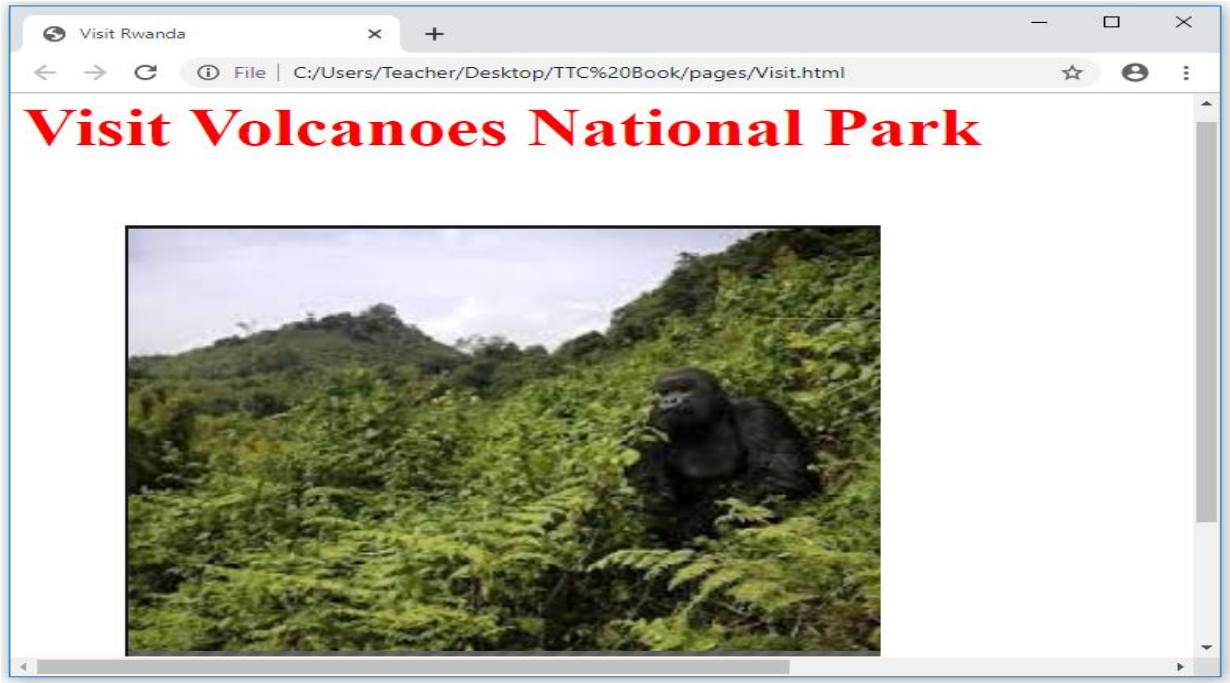


Figure 4.6: HTML image element

NB: use of the **alt** attribute is a good practice to specify alternate text for an image, if the browser cannot display or locate the image.

Setting Image size

It is possible to specify the size using width and height attributes. The two attributes set width and height of the image in terms of pixels or percentage of its actual size. For example, to set the size of the volcano.png to occupy quarter of the screen, use:

Image Alignment

The <img> tag uses the align attribute to align an image on top, bottom, left or right of the browser window. For example, to align the volcano.png on top of the page, use align attribute as follows:

Notice: with HTML it is possible to set **page background color;** bgcolor attribute is used within body element.

For example, the following html code explains how bgcolor attribute is used while setting yellow color as the page background.

```
<! DOCTYPE html>
<html>
<head>
<title>First page</title>
</head>
<body bgcolor="yellow">
<h1><font color="red" size="72">This page has a yellow color as page background! </h1>
</body>
</html>
```

The above html document displays the following web page in a browser:

Figure 4.7: Page background

APPLICATION ACTIVITY 4.6

1. Using heading, paragraph, font and image elements create a page that briefly describes a topic that you would like to cover in your small website known as a blog. The website should contain information such as :

   a) Description about yourself,
   b) academic profile,
   c) Career aspirations in separate paragraphs
   d) Insert your own photo.
2. Discuss the function of the following attributes in <font> tag:
   a) Color attribute
   b) Size attribute
3. Explain the role of **src, alt,** and **align** attributes within <img>tag

4.4.2. Tags that organize web page contents

In this section, we discuss some HTML elements that describe the structure and organize web contents.

A. HTML lists: Ordered and Unordered list

ACTIVITY 4.7

1. Type and execute the HTML code below, observe the output and explain the way page content is organized.

```
<! DOCTYPE html>

 <html>
<head>
 <title>list</title>
</head>
<body bgcolor="yellow">
<p><Strong> Districts of KIGALI City</strong></p>
<ol >
 <li>Gasabo</li>
 <li>Nyarugenge </li>
 <li>Kicukiro</li>
 </ol>
 </body>
```

The information can be displayed in numbered or bulleted list. HTML supports three types of lists namely ordered list, unordered list, and definition list.

- ***Ordered *** list is a container for enumerated items ordered using numbers such as 1, 2, 3.
- ***Unordered list *** is a collection of related items that have no special order or sequence.
- ***Definition list <dl>*** is used for definitions such as glossaries that pair each label with some kind of description.

o Creating ordered list

To create an ordered list, use the <ol>... tags within which to include one or more <li>... (list item) tags.

Example:

```
<!DOCTYPE html>
<html>
<head>
<title>Numbered List</title>
</head>
<body>
<p><Strong><font color=”red” size=72>
Easter African Community (EAC) has 6 Partner States:</font></strong></p>
<ol >
<li>Rwanda</li>
<li>Uganda</li>
<li>Burundi </li>
<li>Kenya</li>
<li>Tanzania</li>
<li>South Sudan</li>
</ol>
</body>
</html>
```

The figure below shows the ordered list of 6 <li> countries after displaying the page on a browser:

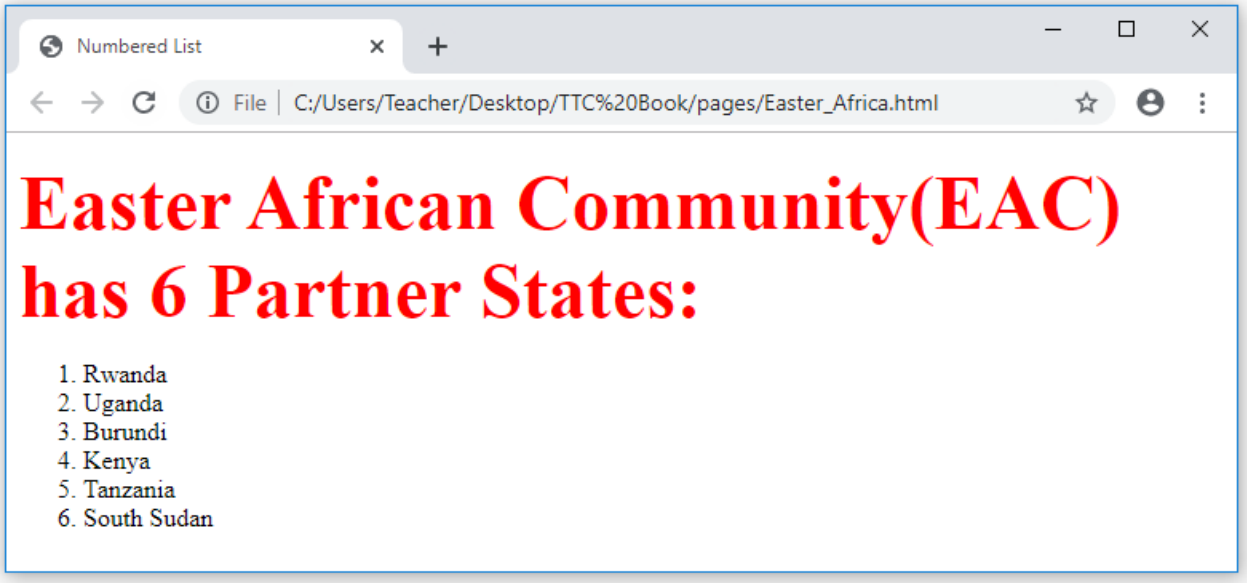


Figure 4.8: An ordered list

It is possible to customize the numbering style of an ordered list using the type attributes as follows:

***<ol type = "counter-type">....
***

Examples

*<ol type = "a"> ...
*
*<ol type = "i"> ...
*

Creating unordered list

Unordered list is similar to ordered list only that the items are listed using bullets. To create unordered list, use <ul>... instead of <ol>.. element

Example:

```
<!DOCTYPE html>
<html>
<head>
<title>Unordered List</title>
</head>
<body>
<p><Strong><font color="purple" size=72>
Rwanda currently has 3 National Parks:</font></strong></p>
<ul >
<li>Volcanoes National Park Rwanda</li>
<li>Nyungwe Forest National Park</li>
<li>Akagera National Park </li>
</ul>
</body>
</html>
```

The Figure below shows the unordered list of 3 Rwanda National Parks when the page is opened using a web browser:

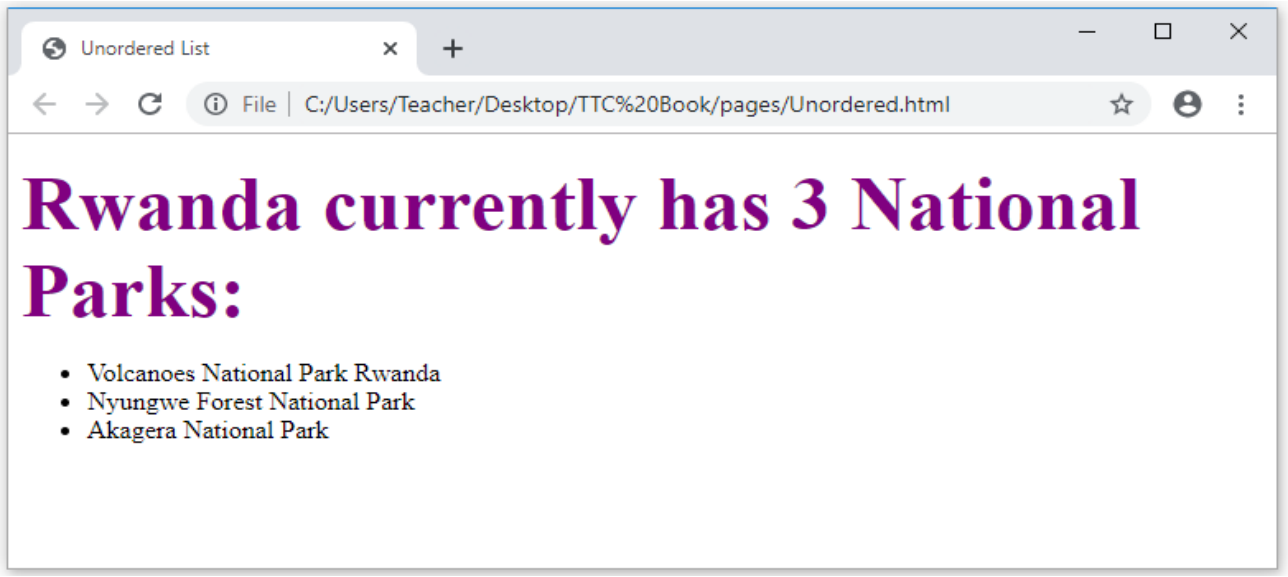


Figure 4.9: Unordered list

It is possible to customize unordered lists using type attribute and values that denote bullet types such as **disc**, **square**, or **circle**. For example, to change the bullets displayed in above figure from round to square, use the following syntax:

***<ul type = "bullet-type">....
***

For example, to display unordered list shown in figure above as a square, bullets, use the style attribute as follows:

*<ul type = "square"> ..
*

APPLICATION ACTIVITY 4.7

Study the following HTML document and answer related questions:

```
<! DOCTYPE html>
<html>
<head>
<title>list</title>
</head>
<body bgcolor="yellow">
<p><Strong> ICT Contents of Senior Four:</strong></p>
<ul >
<li>Unit 2: Computer maintenance </li>
<li>Unit 3: Advanced word processing </li>
<li>Unit 4: Advanced Spreadsheet I </li>
<li>Unit5: Searching the internet </li>
</ul>
</body>
</html>
```

1. Write and execute the above html code then specify the type of a list
2. Write the same html code and change it into unordered list using square

B. HTML lists: Definition and Nested list

ACTIVITY 4.8

Observe the following list of items and give its type

RDB
RDB stands for Rwanda Development Board
RURA
RURA stands for Rwanda Utilities Regulatory Authority
RGB
RGB stands for Rwanda Governance Board
RSB
RSB stands for Rwanda Standards Board

1. How do you call a list which is written inside another list?
2. Using HTML code, write the above list

i. Creating definition list

A definition list is used to present a glossary of terms, or other definition lists like Dictionary and encyclopedia. To create a definition list, use <dl> ...</dl> element in which you place <dt> ... </dt> to mark up the term and <dd> ... </ dd> to mark up the definition part. Therefore, a definition list consists of the following parts:

- <dl> - Defines the start of the list
- <dt> - A term
- <dd> - Term definition
- </dl> - Defines the end of the list

For example, the following HTML document shows a definition list of four terms: <!DOCTYPE

```
<!DOCTYPE html>
<html>
<head>
<title>Definition list </title>
</head>
```

```
<body>
<dl>
<dt><b>ICT </b></dt>
<dd>ICT stands for Information and Communication Technology</dd>
<dt><b>HTML</b></dt>
<dd> HTML stands for Hyper Text Markup Language</dd>
<dt><b>JPEG</b></dt>
<dd>JPEG stands for Joint Photographic Experts Group</dd>
<dt><b>CSS</b></dt>
<dd>CSS stands for Cascading Style Sheet</dd>

</dl>

</body>

</html>
```

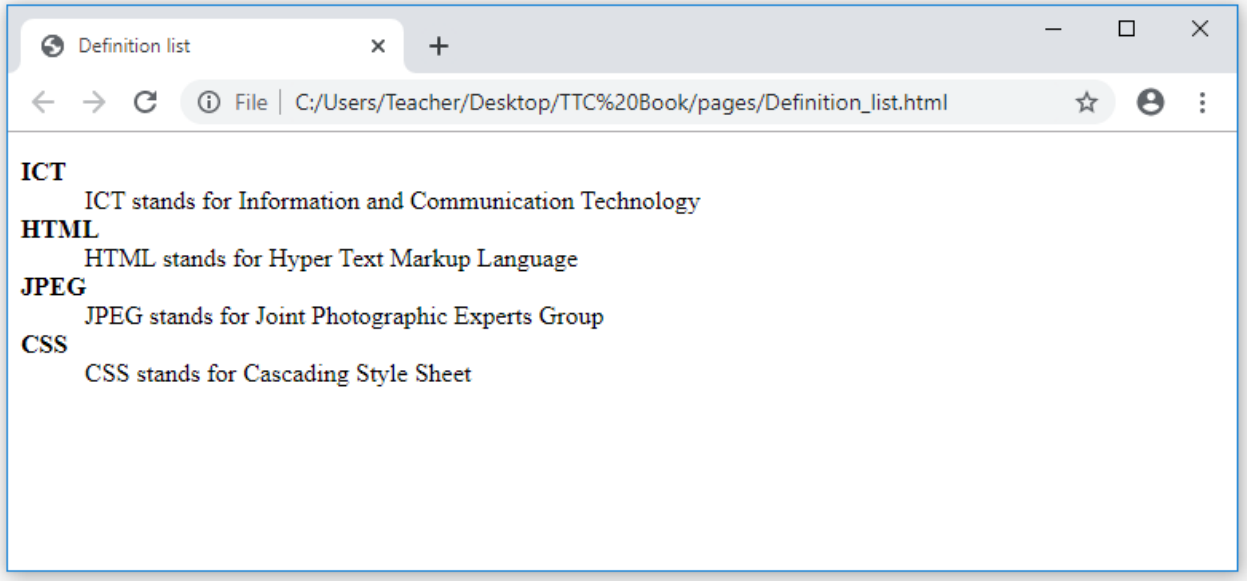


Figure 4.10: Definition list

ii. Creating nested lists

To create a nested list, put the entire list structure inside another list

Example:

```
<!DOCTYPE html>

<html>

<head>

<title>sample Nested List </title>
```

```
</head>
<body>
<p><Strong><font color="blue"size=48>
ICT content for General Education Senior Five and senior Six:</font></strong></p>
<ol type="i">
<li> Advanced Spreadsheet II </li>
<li> Advanced power point presentation </li>
<li> E commerce, social media and online services </li>
<li> Database creation and manipulation </li>
<ul type="circle">
<li>Key terms used in Database </li>
<li> Data type </li>
<li>Opening, saving and closing a database </li>
<li>Create a blank database </li>
</ul>
</li>
<li>Introduction to web designing </li>
<ol type="a">
<li>Introduction to web designing </li>
<li> Introduction to HTML </li>
<li>Importance of using both static web page and dynamic web page </li>
<li>Design a static web page using html tags and hyperlinks </li>
<li> Creation of links </li>
<li> Website creation project </li>
</ol>
</ol>
</body>
</html>
```

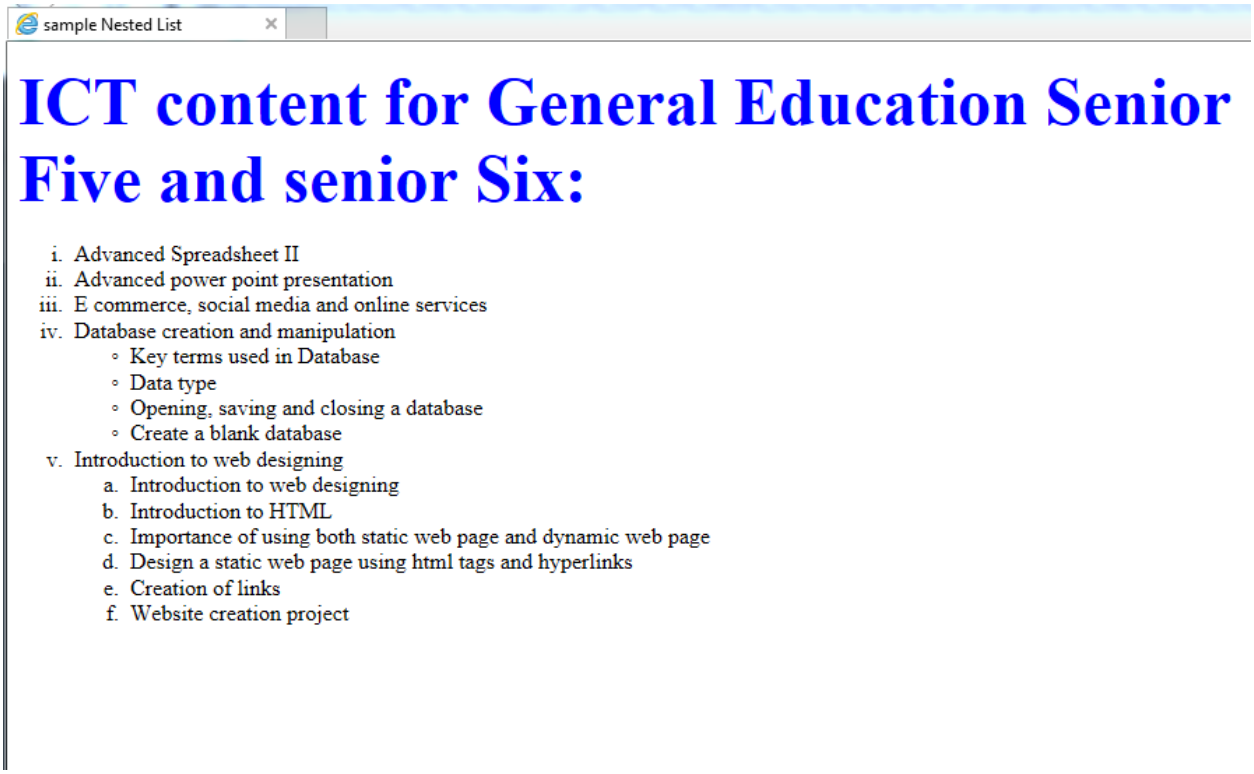
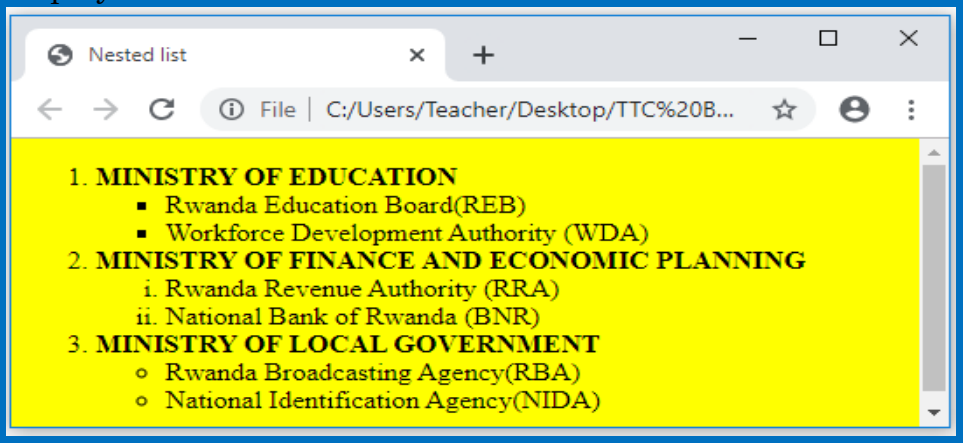


Figure 4.11 Nested List of items

APPLICATION ACTIVITY 4.8

1. Give a clear difference between:
   i. Definition and Nested list
   ii. <dt>…</dt> and <dd>…</dd> tags
2. Study the following web page and then write its HTML code which displays it into browser.



C. HTML Frame and Table tags

ACTIVITY 4.9

1. A web page or a web browser can be divided into different parts so that each part can display content independent of its container. How can you name that part?
2. Write HTML code that display the below table

North Province	East province	West province	South Province
Musanze	Bugesera	Rubavu	Nyanza
Gicumbi	Kirehe	Karongi	Ruhango

- **HTML Frame Tags**

In the context of a web browser, a **frame** is a part of a web page or browser window which displays content independent of its container, with the ability to load content independently. The HTML or media elements that go in a frame may or may not come from the same web site as the other elements of content on display.

Frameset:

In HTML, a **frameset** is a group of named frames to which web pages and media can be directed. The attributes **rows** and **cols** on the opening frameset tag define the dimensions of a grid of frames using comma-separated lists of sizes, specified in either pixels or percentages. Within the frameset, a series of frame elements describe the initial source documents for each frame in the frameset, as well as assigning them names for use as the target of links.

Note that a HTML document would normally contain a head and a body may instead contain a head and a frameset (but not both a body and a frameset).

Example: the HTML document below, is creating three horizontal frames:

```
<! DOCTYPE html>
<html>
<head>
<title>Frames</title>
</head>
<frameset rows="25%,40%,35%">
<frame name="top" src="Unordered.html" />
<frame name="main" src="Visit.html" />
<frame name="bottom" src="Easter_Africa.html" />
</frameset>
</html>
```

The above html code will produce the following result:

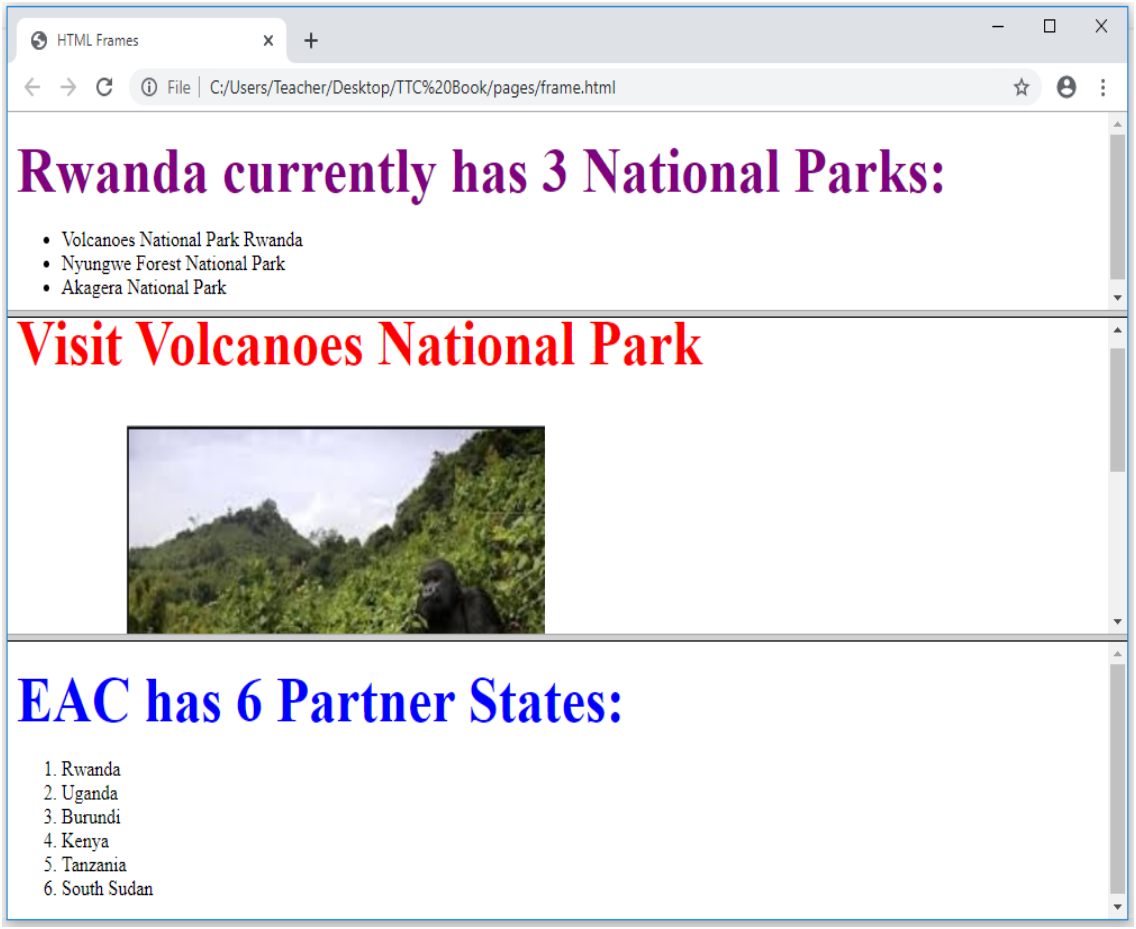


Figure 4.12: HTML Frames

- **HTML Table tags**

Tables are used to organize data such as numbers, text, links and images into rows and columns. An intersection of a row and a column forms data cell in which table data is held

The HTML tables are created using the <table> tag which is a container for <tr> (table row) tag used to create rows and <td> (table data) tag used to create data cells.

Before creating a table, consider the following table-features:

Caption: indicates the type of data presented in the table
Table headings: the row that indicate the data displayed in each column
Table cells intersection of rows and columns in which we insert data
Table data is the data or values in the table

To create a table, we use the <table>…</table> element within which the following elements are nested:
<caption>…</caption> used to create the table caption
<th> ...</th> tag is used to create the table heading
<tr>...</tr> tag is used to create table rows
<td>...</td> tag is used to create data cells

Notice that the table starts with a <table> tag followed by border, cell padding and cell spacing attributes and ends with the closing </table> tag.

For example: the following HTML code produces the table

```
<!DOCTYPE html>
<html>
<head>
<title>Table </title>
</head>
<body>
<table border="2" cellpadding="3" cellspacing="3">
<Caption><b> UMUCYO HOTEL EMPLOYEE'S DATA</b></caption>
<tr>
<th>Employee Name</th>
<th>Department</th>
<th>Salary</th>
</tr>
<tr>
<td>Paul KAMANA</td>
<td>Finance </td>
<td>250000</td>
</tr>
<tr>
<td>Dhalie NIZEYIMANA</td>
<td>Marketing</td>

<td>200000</td>
</tr>
<tr>
<td>Jean Claude UWIHANGANYE</td>
<td>Information Technology </td>
<td>400000</td>
</tr>
</table>
</body>
</html>
```

The HTML document above produces the following table:

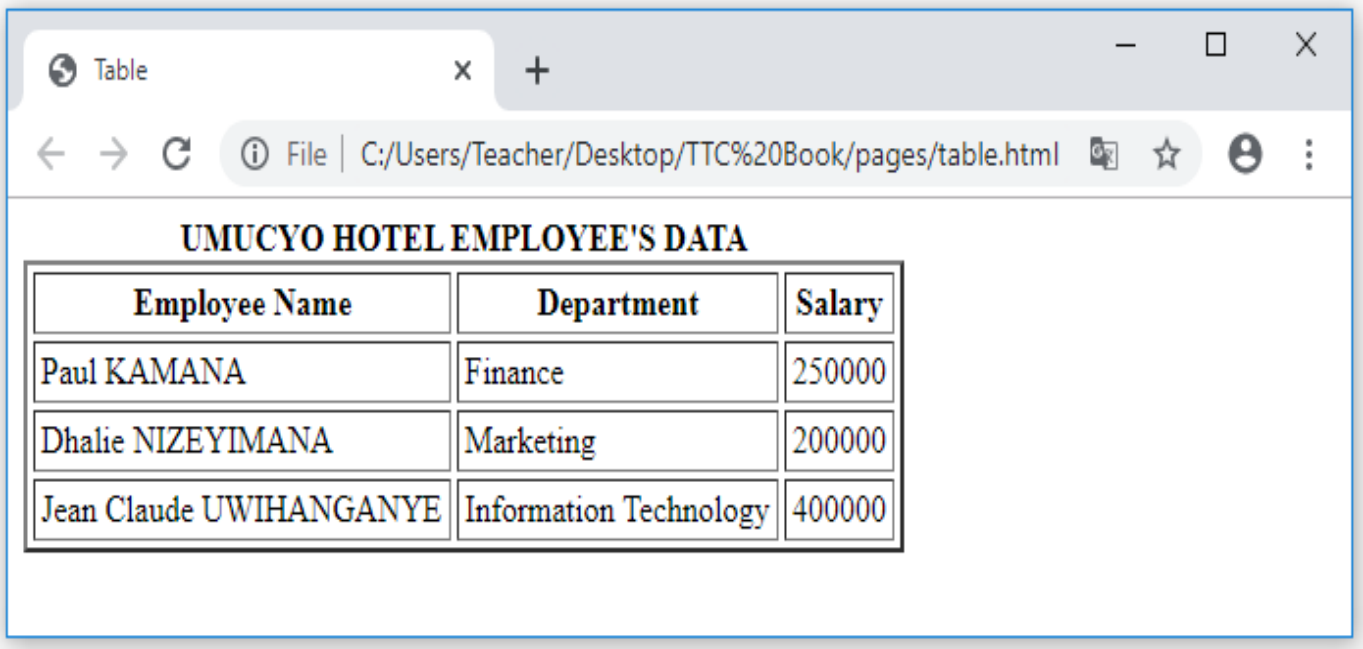


Figure 4.13: Sample HTML table

The following are basic attributes used to define or format a HTML table:

a) Border Attribute

The border attribute takes numeric values that specify thickness of the border that surrounds all the table cells. If 0 is used, the border is invisible while. In our example above, the statement below creates a border of 2-pixel thickness.

<table border=”2” >

b) Height and Width attributes

To set the size of the table, use width and height attributes. The height and width attributes take width or height values in terms of pixels or percentage of the screen. For example, the statement below sets the table size to width of 400 pixels and height of 150 pixels.

<table border=”2” width=”400” height=”150”>

c) Cellpadding Attribute

The cellpadding attribute specifies the space, in pixels, between the cell wall and the cell content.
Note: Do not confuse this with the **cellspacing** attribute, which specifies the space between cells.

Syntax: <table cellpadding=”pixels”>

d) Cellspacing Attribute

The cellspacing attribute specifies the space, in pixels, between cells.

Syntax: <table cellspacing=”pixels”>

Note: The cellspacing attribute of <table> is not supported in HTML5.

Pixels are the space between cells.

e) Table Caption

The caption tag will serve as a title or explanation for the table and it shows up at the top of the table. However, it is important to note that the caption tag is deprecated in newer versions of HTML.

f) Colspan attribute

The colspan attribute in HTML specifies the number of columns a cell should span. It allows the single table cell to span the width of more than one cell or column. It provides the same functionality as "merge cell" in the spreadsheet program like Excel.

Usage: It can be used with <td> and <th> element while creating a HTML table.

- **<td>:** The colspan attribute when used with <td> tag determines the number of standard cells it should span. **Syntax:**
- **<td colspan =**"value"> table content...</td>
- **<th>:** The colspan attribute when used with <th> tag determines the number of header cells it should span. **Syntax:**
- **<th cospan =**"value"> table content...</th>
- The **value** specifies the number of columns that the cell fills. The value must be an integer

g) Rowspan attribute

The rowspan attribute in HTML specifies the number of rows a cell should span. That is if a row spans two rows, it means it will take up the space of two rows in that table. It allows the single table cell to span the height of more than one cell or row. It provides the same functionality as "merge cell" in the spreadsheet program like Excel.

Usage: It can be used with <td> and <th> element in a HTML table.

- **<td>:** The rowspan attribute when used with <td> tag determines the number of standard cells it should span.
  Syntax:
- **<td rowspan =** "value"> table content...</td>
- The **value** specifies the number of rows that the cell fills. The value must be an integer.
- **<th>:** The rowspan attribute when used with <th> tag determines the number of header cells it should span.
  Syntax:
- <th rowspan = "value">table content...</th>
- The **value** specifies the number of rows that the cell fills. The value must be a integer.

Example: The following HTML code explains how to use HTML table attribute discussed above:

<!DOCTYPE html>

```
<html>
<head>
<title>Table attributes </title>
</head>
<body>
<table border="4" cellpadding="3" cellspacing="3" width="400"height="200">
<Caption><b> ECOLE SECONDAIRE DE MUHAMBARA</b></caption>
<tr>
<th colspan=6> Number of studens in E.S.M</th>
</tr>
<tr>
<th colspan=2> O'level</th>
<th colspan=2> A'level</th>
<th colspan=2> Total number</th>
</tr>
<tr>
<th>Boys</th>
<th>Girls</th>
<th>Boys</th>
<th>Girls</th>
<th rowspan="2">605</th>
</tr>
<tr>
<td>120</td>
<td>200</td>
<td>130</td>
<td>155</td>
</tr>
</table>
</body>
</html>
```

The above HTML code produces the output below:

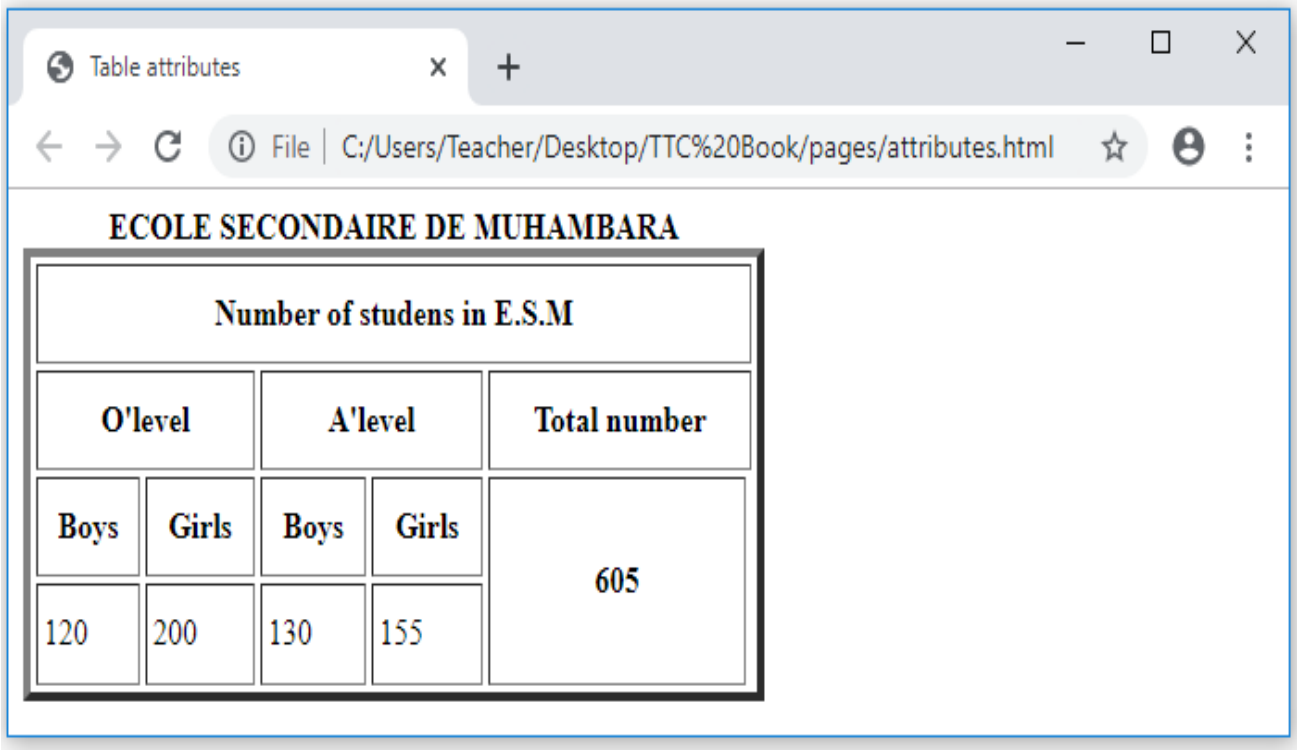


Figure 4.14: HTML table attributes

APPLICATION ACTIVITY 4.9

1. Discuss the use of the following tags and attributes:
   a. <Frameset> tag
   b. <Caption> tag
   c. Colspan attribute
   d. <Th> tag
2. Create an html document which create a web page with three frames named: "Top_Frames ","Main_Frames ",and"Bottom_Frame".
3. Using HTML tags , create a web page that display the below table

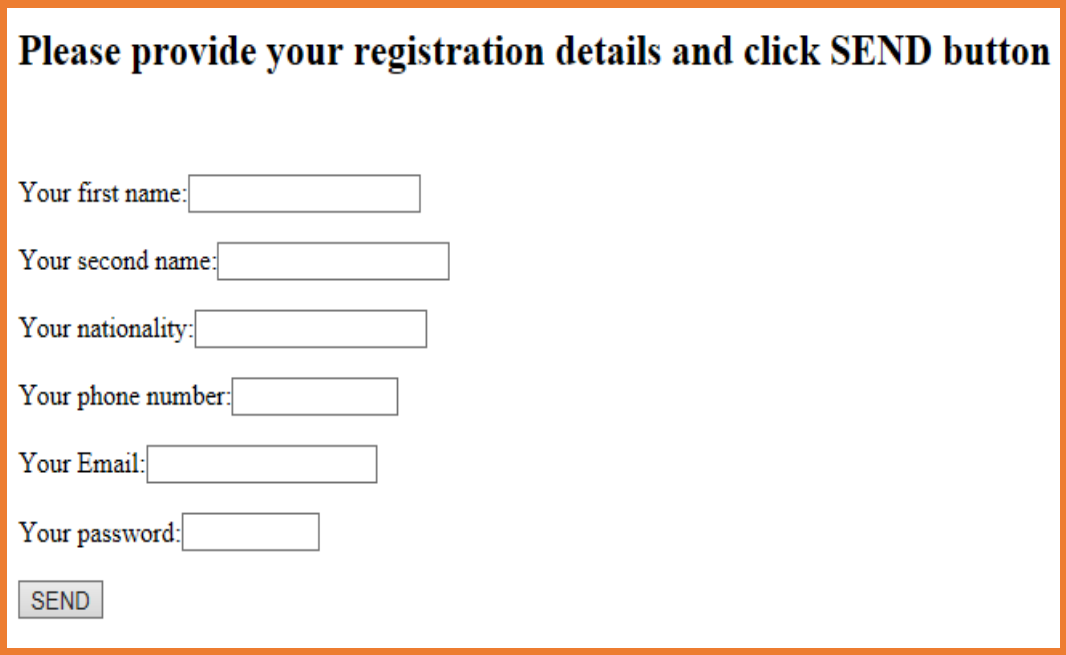
SAVE PARENTS'SCHOOL ADMINISTRATION STAFF

Employee's information						
RegNo	**Firstname**	**Lastname**	**Phone**	**Age**	**Position**	**Salary**
11	Jean Claude	UWIHANGANYE	0783297650	45	Head Teacher	400000Rwf
19	Diedonne	KAYIBANDA	0784298651	55	Head of Studies	300000Rwf
7	Pelagie	MUKANDORI	0784228661	51	Head of Discipline	250000Rwf
12	Dhalie	NIZEYIMANA	0780615775	35	Accountant	200000Rwf

D. HTML Forms

ACTIVITY 4.10

A website is developed with different pages; the page below is created using HTML language. Observe it and answer related questions.



1. What do you understand by HTML form?
2. What is the use of HTML form?
3. . Use HTML code to produce the above page

A person may need to gather information such as student's details and store such information in the server. The most common method for gathering such information is by using a form.
When users fill forms and clicks the submit button, the data keyed into the form is sent (posted) to the web server for processing or storage into a database.

To create HTML forms, we use the **<form> ... <form>** element as follows:

<form action="Script URL"method="GET|POST">

form elements like input, textarea etc.

</form>

HTML forms contain **form elements (form controls)**. There are different types of form controls that you can use to facilitate data collection information using HTML form. The most

common controls include: text, textarea, select, radio buttons, checkboxes, file select, command button and reset buttons.

Let see the use of every form element and basic form attributes

a) **Form Action Attribute**

The <form> tag takes several attributes key among them the action and method attributes used to accomplish the following:

The **action attribute** is used to specify the file on the server that receives data from the form for processing. For example, the action attribute in the form tag below specifies a file named register.php that receives registration details after the user clicks the submit button:

<form **action="register.php**"> </form>

b) **Form Method Attribute**

The **Method** attribute specifies how the data is to be sent to the web server. The **method attribute** specifies the HTTP method (**GET** or **POST**) to be used when submitting the forms:

Get Method: If a "GET" method is used, the data supplied in the form is appended at the end of the URL.

Note that using Get method in login form is not recommended because unauthorized users may see actual username and password.

Post Method:

Unlike the GET method, post method does not display submitted form data on URL because the parameters are passed as body of a HTTP request.

Use POST if the form is updating data, or includes sensitive information (password). POST offers better security because the submitted data is not visible in the page address

The <input> Element

The **<input>** element is the most important **form element**. The <input> element has many variations, depending on the **type** attribute.

c) Text input

Input control is used to capture alphanumeric data such as text.

<input type="text"> defines a one-line input field for **text input**

For example, the following statement defines text input for capturing First name:

First name: <input type="text" name="first" size = "20" />

This is how the HTML code above will be displayed in a browser:

d) Hidden input

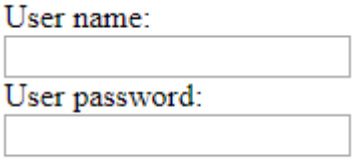
Sometimes it is important to conceal the identity of information entered in the form using the input type. This is achieved by use of hidden input type. To create hidden input, set the input type to hidden as shown below:

<input type="hidden" name="userid" value="321"/>

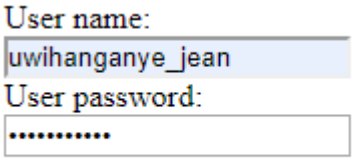
e) Password input

<input type="password"> *defines a* ***password field****:*
Example:
<form>
*User name:
*
*<input type="text" name="username">
*
*User password:
*
<input type="password" name="psw">
</form>

The HTML code above will display the following:



After typing a user name and pass word, input boxes will look like the following:



f) Textarea

Textarea control is a multi-line text input used when the user is required to give details that may be longer than a single sentence.

The attributes used with textarea tag are: name, rows, and cols.

For example, the following statement defines textarea named comment that has 6 rows and 10 columns:

<form >

*Comments:
 <textarea rows="7"cols="25"name="comment"></textarea>*

</form>

This is how the HTML code above will be displayed in a browser:

g) Checkbox

Checkbox controls are input type used when more than one option is required to be selected from a list of check boxes. However, the input type attribute must be set to checkbox value as shown by the following statements:

```
<! DOCTYPE html>
<HTML>
<HEAD><TITLE>Checkbox</TITLE>
</HEAD>
<BODY>
<P><Strong><font color="orange" size=36>Choose your favorite
games</font></strong></p>
<form>
<p><input type="checkbox" name="game" checked="checked"> Football </p>
<p><input type="checkbox" name="game" > Basketball <p>
<p><input type="checkbox" name="game" > Volley Ball<p>
<p><input type="checkbox" name="game" > Net Ball<p>
</form>
</BODY>
</HTML>
```

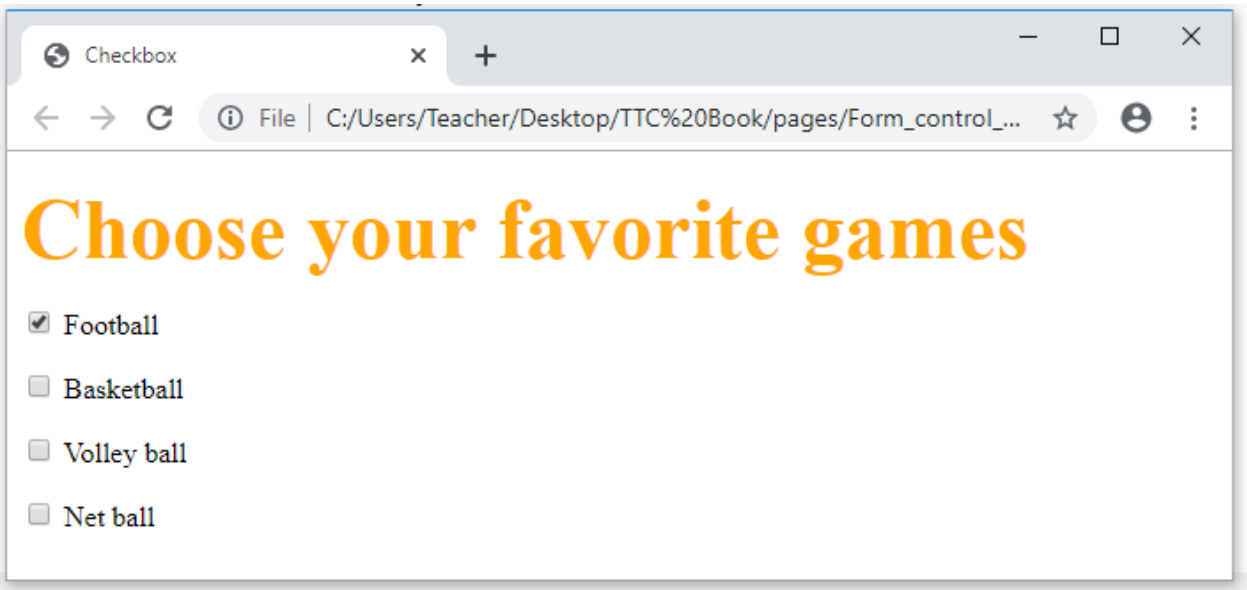


Figure 4.15: HTML Checkbox input type

h) Radio button

Radio buttons let a user select ONLY ONE of a limited number of choices.

<input type="radio"> defines a **radio button**.

Example:

```
<!DOCTYPE html>
<HTML>
<HEAD><TITLE>radio buttons</TITLE>
</HEAD>
<BODY>
<P><Strong><font color="orange" size=36>Select your sex</font></strong></p>
<form>
<input type="radio"name="sex" value="male"checked="checked" > Male </br>
<input type="radio"name="sex" value="female"">Female </br>
</form>
</BODY>
</HTML>
```

The HTML code above will be displayed in a browser as follows:

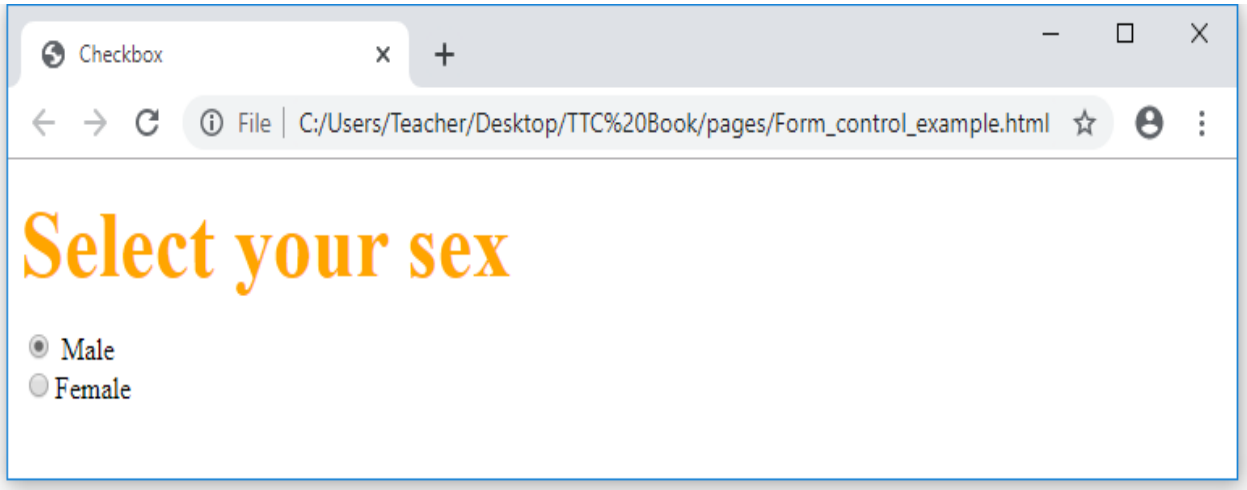


Figure 4.16: HTML Radio input type

i) Select or (Drop-Down List)

The **select** control also known as **dropdown box** provides the user with various options in form of drop-down list, from which a user can select one or more options. For example, the following select defines a dropdown for selecting only one option:

```
<! DOCTYPE html>
<HTML>
<HEAD><TITLE>Dropdown list</TITLE>
</HEAD>
<BODY>
<P><Strong><font color="pink" size=36>
Select your residence province:</font></strong></p>
<form>
<select name="dropdown">
 <option value="Kigali" selected>Kigali City</option>
 <option value="South">South Province</option>
 <option value="North">North Province</option>
 <option value="Easter">East Province</option>
 <option value="West">West Province</option>
 </select>
</form>
</BODY>
</HTML>
```

The HTML document above produces the following webpage:

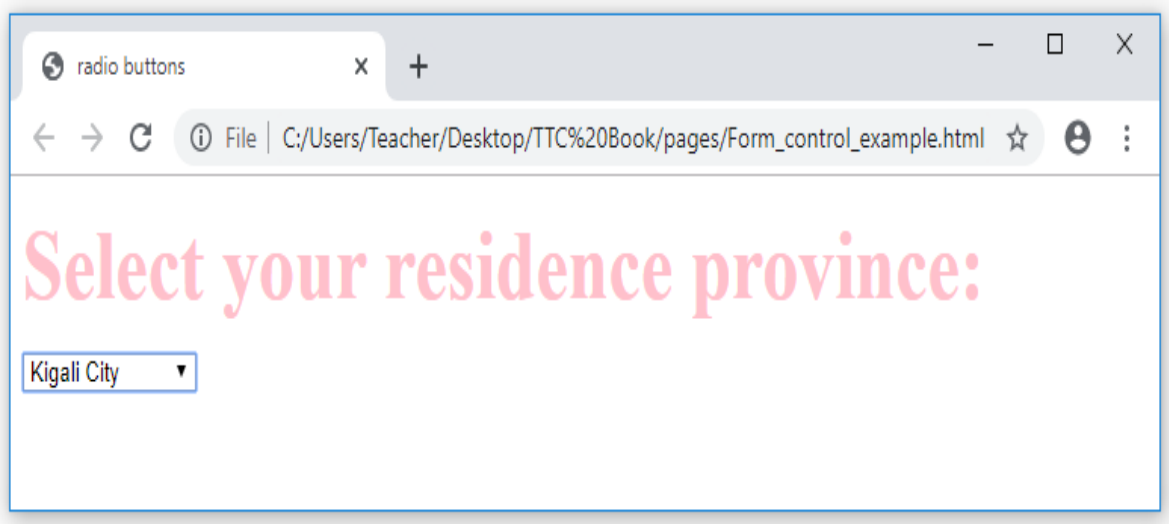


Figure 4.17: HTML select element

When you click on drop down arrow of a box, it will be as follows:

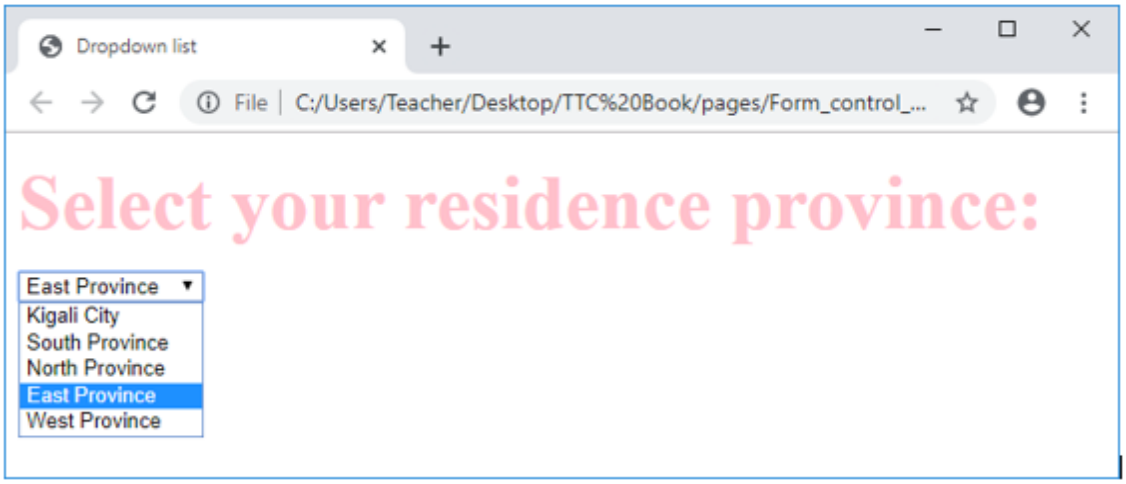


Figure 4.18: Drop down list

j) Submit and Reset Button

Submit input type used to create a button that automatically submits form data to web server. On the other hand, **reset** is used to refresh (reset) form controls to their default values. The following statements creates submit and reset buttons with values set to **Send** and **Reset** respectively:

```
<form>
<input type="submit"name="submit" value="Send" />
<input type="reset" name="reset" value="Reset" />
</form>
```

This is how the HTML code above will be displayed in a browser:

Figure 4.19: Submit and Reset buttons

The following is a HTML document that implements input text box, input password box, checkbox, radio buttons, select, text area and action buttons (Submit and Reset)

```
<!DOCTYPE html>
<HTML>
<HEAD><TITLE>Detailed_form page</TITLE>
</HEAD>
<BODY>
<h2><Font color="green" size=36>Please provide your registration details
</font></h2>
<form action="register.php"method="post">
<p><b>Your first name:</b><input type="text" name="first"size=20></p>
<p><b>Your second name:</b><input type="text" name="second"size=20></p>
<p><b>Your username:</b><input type="text" name="mail"size=13></p>
<p><b>Your password:</b><input type="password" name="pass"size=10 ></p>
<p></u><b>choose your interested subjects:</b></u></p>
 <input type="checkbox" name="check"checked="checked"> Fundamentals of Nursing
<br>
<input type="checkbox" name="check">Biology<br>
<input type="checkbox" name="check">Physiscs<br>
<input type="checkbox" name="check">Chemistry<br>
<p></u><b>Select your sex:</b></u></p>
<input type="radio"name="sex" value="male"checked="checked" > Male
<input type="radio"name="sex" value="female"">Female
<p></u><b>Select your residence district:</b></u>
<select name="dropdown">
 <option value="Gasabo" selected>Gasabo District</option>
 <option value="Nyarugenge">Nyarugenge District</option>
 <option value="Kicukiro">Kicukiro District</option>
 </select></p>
<p><b>Comments:</b><br>
<textarea rows="3"cols="15"name="comment"></textarea>
</p>
<p><b>If you have provided all required information click
<input type="submit"name="submit" value="Send" /></p>
<p><b>If you want to reset your form click
<input type="reset"name="reset" value="Clear" /></p>
</form>
</body>
</html>
```

The above HTML document produces the following web page:

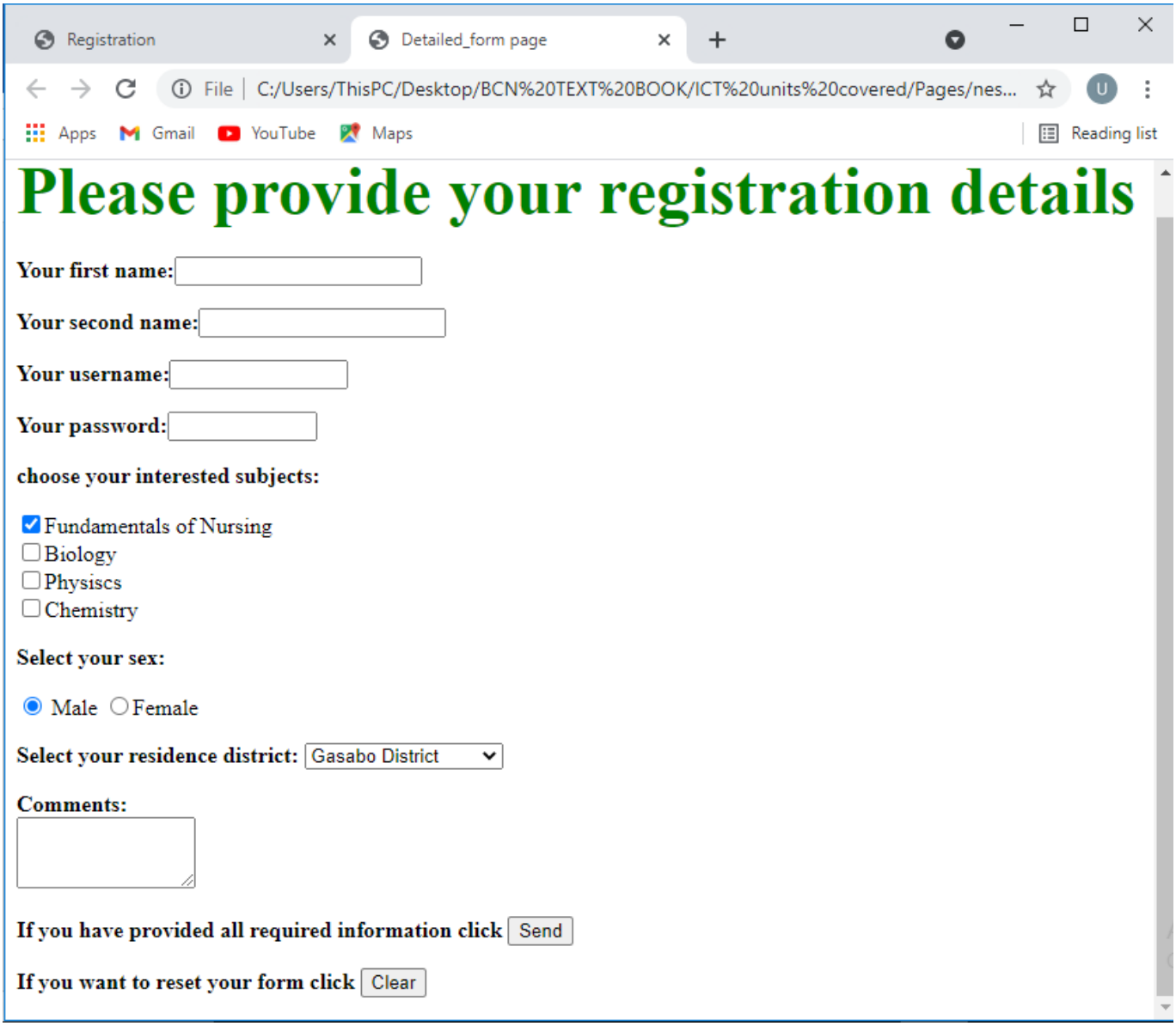


Figure 4.20: Detailed HTML form

Notice:

- It is possible to organize the HTML form elements using a table so that they can be well arranged.

  For example, HTML document below explains how you can insert an html form in a table:

```
<! DOCTYPE html>
 <html>
 <head>
<title> Registration</title>
```

```
</head>
<body>
<center>
<h1> <font color="blue">Please provide the following details</font></h1>
<table><form Action= "register.php" Method= "get" >
<tr><td>First Name:</td> <td><input type= "text" name= "FName"
size="15"></td></tr>
<tr><td>Last Name:</td> <td><input type= "text" name=
"lname"size="15"></td></tr>
<tr><td>Nationality:</td> <td> <input type="text"name= "country"
size="25"></td></tr>
<tr><td>Phone:</td> <td> <input type= "text" name= "phone" size="15"></td></tr>
<tr><td><input type="checkbox" name="subjects" checked="checked"></td> <td>
Computer Science</td></tr>
<tr><td><input type="checkbox" name="subjects" ></td> <td> Physics</td></tr>
<tr><td><input type="checkbox" name="subjects" ></td> <td> Economics</td></tr>
<tr><td><select name="dropdown"> <option value="maths"
selected>Mathematics</option>
 <option value="computer">Computer Science</option> </select> </td></tr>
<tr><td>Comments:</td> <td> <textarea rows="3"cols="10"name="comment">
</textarea></td></tr>
<tr><td><input type="submit" name="submit" value="Send"></td></tr>
</form></table>
</center>
</body>
 </html>
```

The HTML code above displays the following page in a browser:

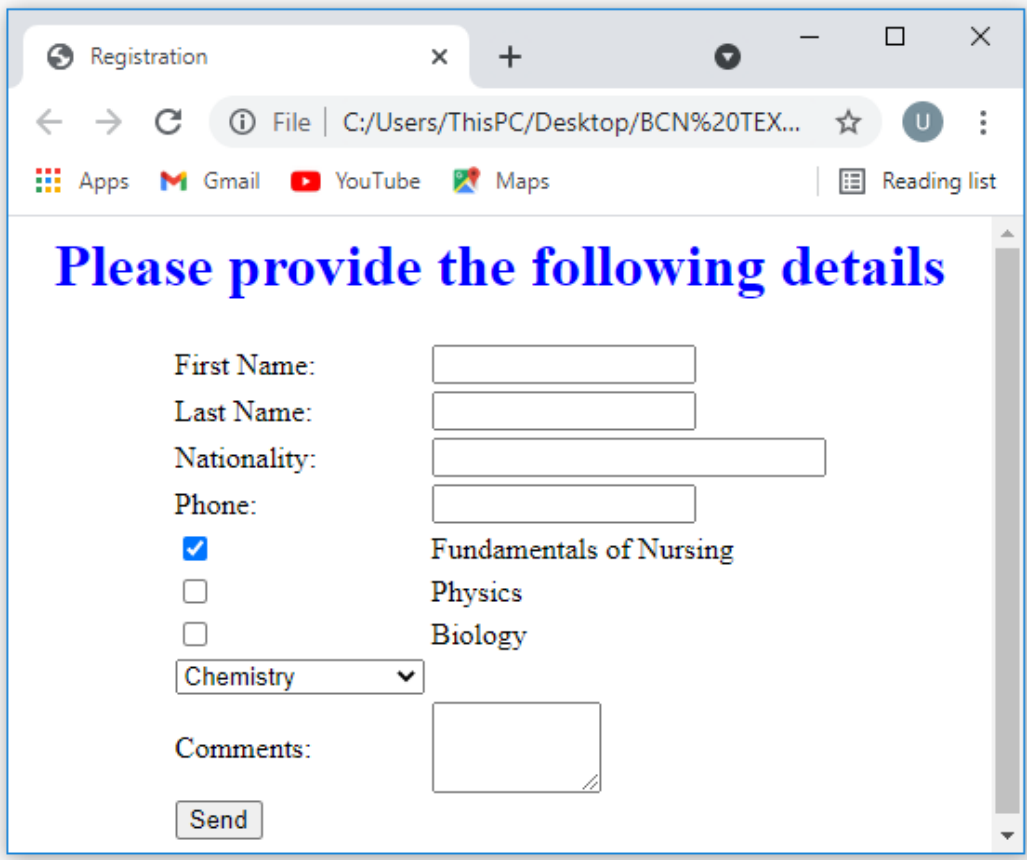
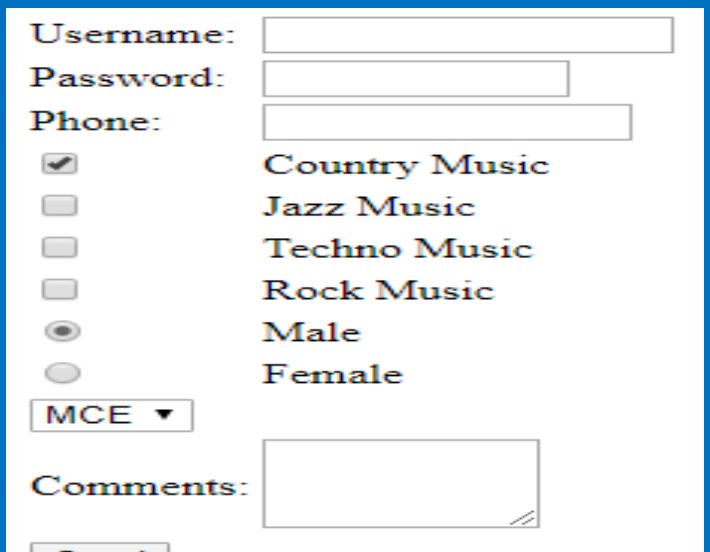


Figure 4.21 HTML form in a Table

APPLICATION ACTIVITY 4.10

1. Explain the following HTML tag and attributes:
    a. Action attribute
    b. Method attribute
    c. Textarea tag
2. Write the syntax of select HTML tag
3. Write the HTML code that displays the form below:



- **Particularities of HTML 5**

ACTIVITY 4.11

1. According to the knowledge you have about previous HTML versions, what do you think HTML5 came to solve?
2. Discuss reasons why HTML5 has taken over other HTML versions
3. Give examples of new input types of HTML5

HTML5 is the fifth revised and newest version of HTML standard offering new features that support multimedia content more effectively than the previous versions.

To be supported by majority of browsers, HTML5 has been developed in collaboration with browser makers. This explains why most browsers are supporting the new HTML5 specification.

HTML5 provides new elements and attributes that allow for backward compatible with current and older browsers.

HTML5 Doctype

DOCTYPEs in previous HTML versions were longer because HTML4 and XHTML required a reference to SGML-based DTD. HTML5 standard is a radical departure from SGML restrictions to new features based on cascading style sheet (CSS) and Javascript. This is why doctype is a short statement written as:

<! DOCTYPE html>

New HTML5 Elements

- **Media elements**: Due to high demand of multimedia content on the web, WC3 introduced new set of media elements in HTML5 to handle different media types without need for additional plugins such as Adobe flash. New media elements include:

Element	Description
<audio>	Defines an audio file.
<video>	Defines video or movie content
<track>	Defines tracks for video and audio content
<progress>	Represents a completion of a task, such as downloading or when performing a series of expensive operations

Table 4.5: HTML 5 Media elements

- **Input elements:** New input types were introduced to address specific form input and formatting requirements for user input such as dates, numbers, and telephone numbers. Examples of new input types include:

Input type	Description
Email	Accepts only valid email addresses. If you try to submit a simple text, it forces to enter only email address is momo@gmail.com format.
Month	Date consisting of a year and a month encoded according to ISO 8601
Date	Date (year, month, day) encoded according to ISO 8601
Datetime	Date and time (year, month, day, hour, minute, second, fractions of a second) encoded according to ISO 8601 with the time zone set to UTC.
Week	Date consisting of a year and a week number encoded according to ISO8601
Time	Time in hour, minute, seconds, fractional seconds) encoded according to ISO8601
Number	Accepts only numerical values. The step attribute specifies the precision, defaulting to 1.
Range	The range typeis used for input fields that should contain a value from a range of numbers.
url	Accepts only valid URL address values. If you try to submit a simple text, it forces you to provide valid URL address in http:// www.example.com format.

Table 4.6: HTML5 new input types

To demonstrate how the new input types and attributes are used, below is sample HTML5 document used to get text, telephone, e-mail, date, time and numbers.

```
<!DOCTYPE html>
<html>
<head>
<title> New HTML5 input types</title>
</head>
<body>
<p><em><strong><font size=36 color="green">This page contains examples of the new input types that can be used in HTML5.
</font></strong></em></p>
<form action="new_input.php" method ="post">
<p> User name:<input type="text"name="user"size=15></p>
<p> User secreet code:<input type="password"name="psw"size=8></p>
<p> Email:<input type="email"name="mail"size=20></p>
<p> Your favorite website:<input type="url"name="site"size=20></p>
<p> Telephone:<input type="tel"name="phone"size=10></p>
<p> Your shoes size:<input type="number"name="num"min=5 max= 15 ></p>
```

* Your info is submitted on:<input type="date"name="date"> at:<input type="time"name="time"> *
*<input type="submit"value="Send"name="button">
*
</form>
</body>
</html>

The above Html code displays the following in a web browser:

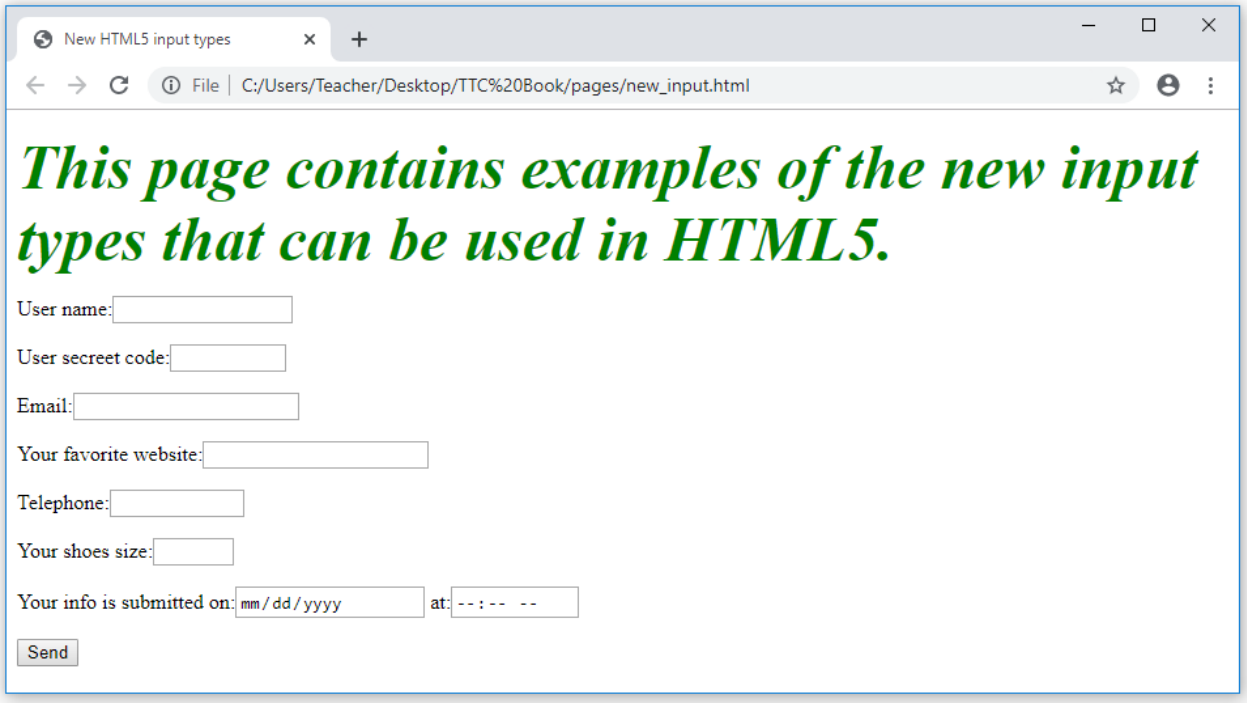


Figure 4.22: HTML new input types

Note that HTML5 implements validation of data. For example, if upon an attempt to submit a wrong email or url, the browser will look for patterns to ensure a valid e-mail and url address have been entered, if it finds that wrong data was entered, the browser goes as far as presenting the user with an error. An illustration of this can be seen in the image below where a screen shows how it looks when leaving the email box with wrong data:

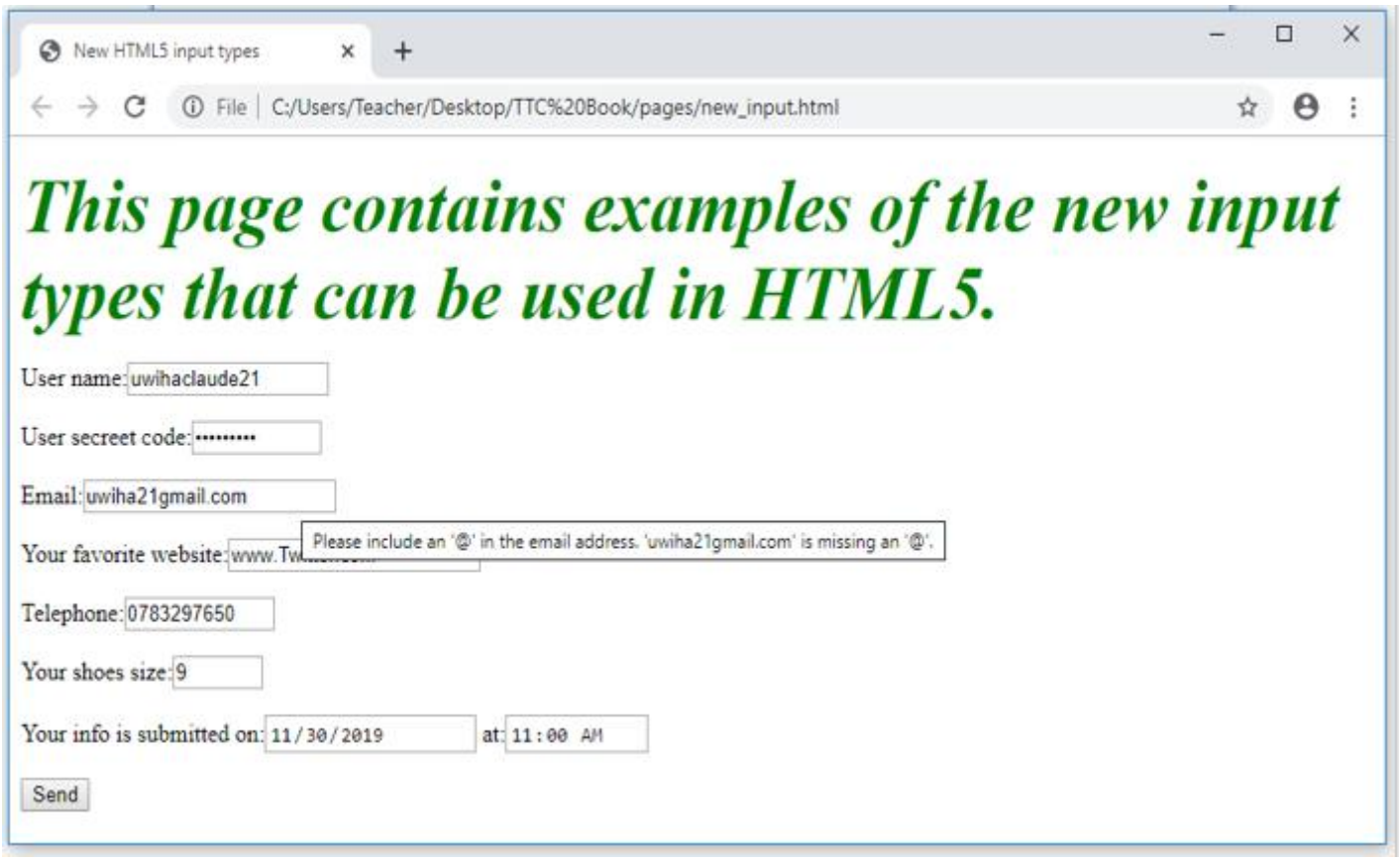


Figure 4.23: Example explaining validation of data in HTML5

This short screen shows how it looks when clicking on Send button:

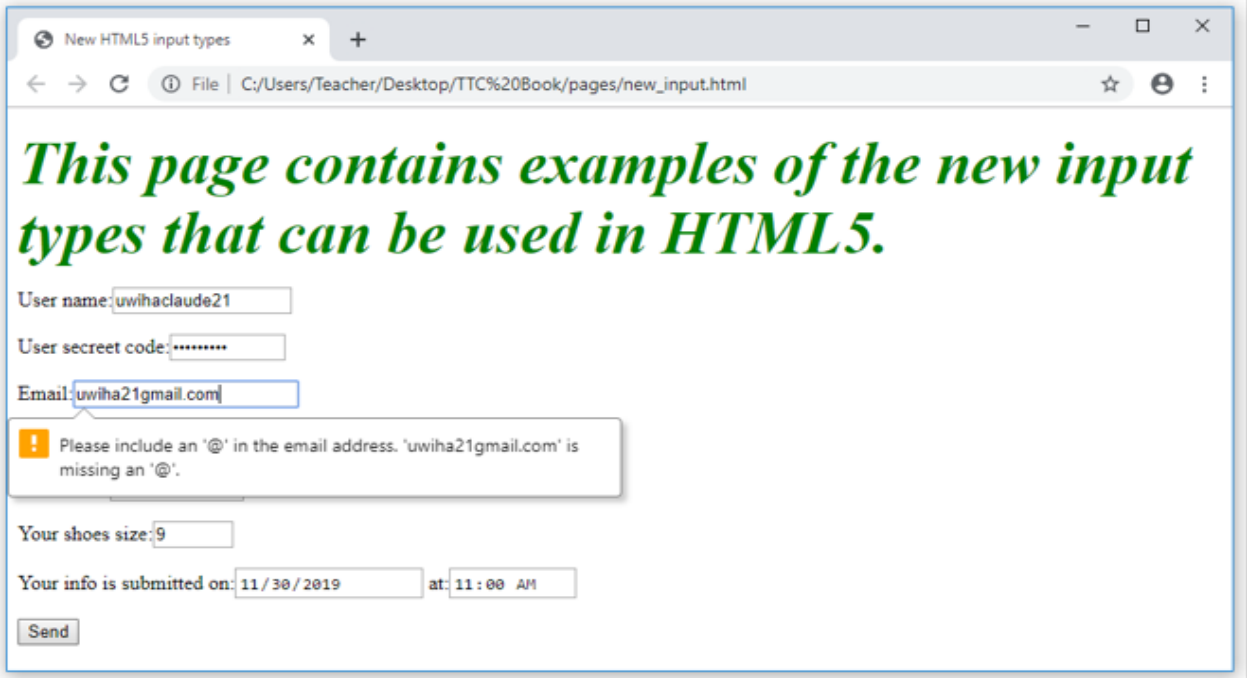


Figure 4.24: Invalid email cannot be submitted

Application Activity 4.11

1. Give a DOCTYPE declaration of HTML5
2. Explain how HTML5 implements validation of data?
3. Discuss about new types below:

a) Email
b) url
c) datetime

4. Debate this argument by supporting it or giving justification why migrating from HTML4 to HTML5 is a brave decision that should not be held back due to few people who are resistant to change!
5. Write a HTML code that creates a form that has input types such as Text, Email, Month, Number

4.4.3 Creation of links

ACTIVITY 4.12

1) A website is a collection of several web pages with information on a subject that are connected (linked) together. What do you understand by a link?
2) What is difference between internal and external link?

A hyperlink is a text, phrase or image that is clicked on in order to go to another web page or a section within the current page or to another website. In most browsers, hyperlinks are often in blue and underlined.

HTML Links – Syntax

To create a hyperlink, use the anchor element**: <a>....** The <a> tag is called an anchor tag because it is used to create anchors for hyperlinks.

link text

Example:

Irembo Official Website

The href (Hypertext Reference) attribute specifies the destination address (http://www.irembo.gov.rw"). The **link text** is the visible part (**Irembo Official Website**). Clicking on the link text, will send the page visitor to the specified address.

Note: The link text does not have to be text. It can be a HTML image or any other HTML element.

Local Links

The example above used an absolute URL (A full web address).

A local (i**nternal**) link (link to the same web site) is specified with a relative URL (without http://www....).

The following code shows how to add text-based hyperlink into a HTML page:

```
<!DOCTYPE html>
<html>
<head>
<title>Hyperlink page</title>
</head>
<body>
<p><font color="orange" size="20"> For getting more information Click following link:
</font></p>
<a href="http://www.tutorpoint.edu">Visit Tutorial Site</a>
</body>
</html>
```

The figure below shows how the link is displayed on the browser

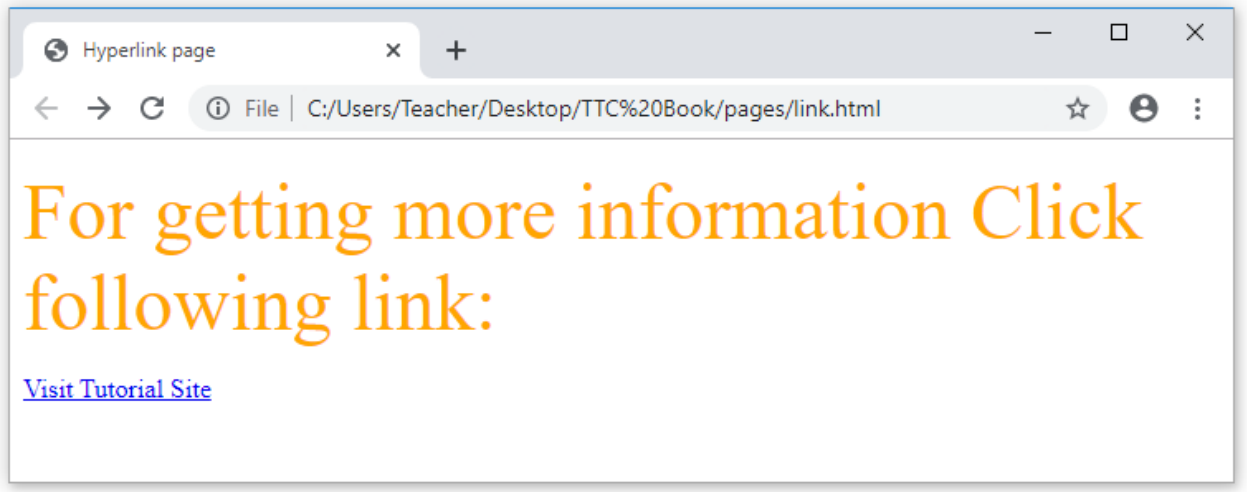


Figure 4.25: External link

In most browsers, a hyperlink is an underlined text and blue in color. In our case, once the visitor clicks on the link, he or she is taken to the web page of the tutorial site as long as it is a valid URL.

Example 2:

```
<! DOCTYPE html>
 <html>
<head>
<title>Hyperlink page</title>
</head>
 <body>
 <p><font color="purple" size="20"> Click following link for more information:
</font></p>
<a href="frame.html">click here</a>
 </body>
 </html>
```

Output of above html code:

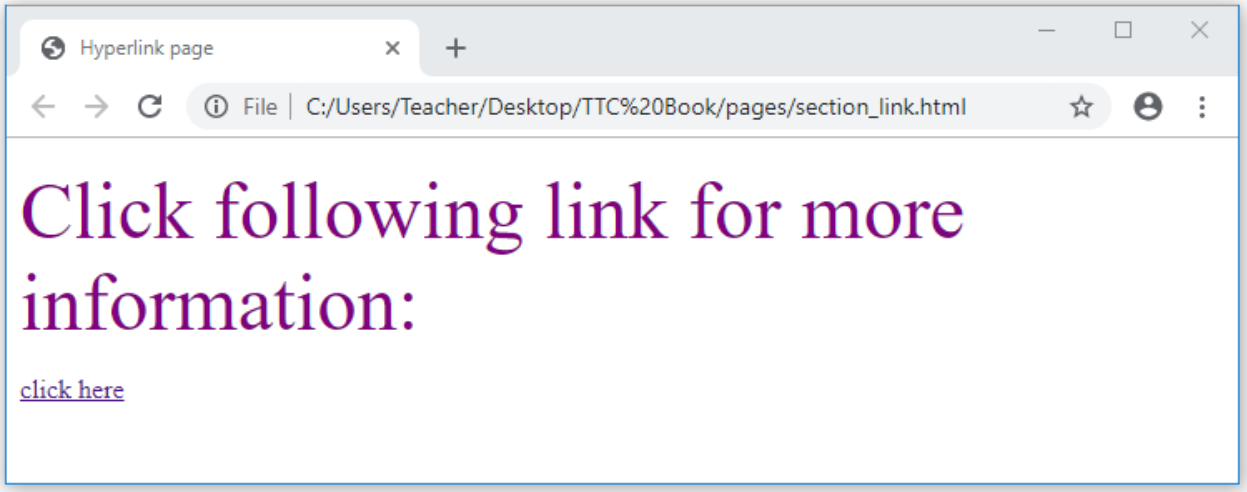


Figure 4.26: Internal link

The **click here** hyperlink fall on the following frame.html page:

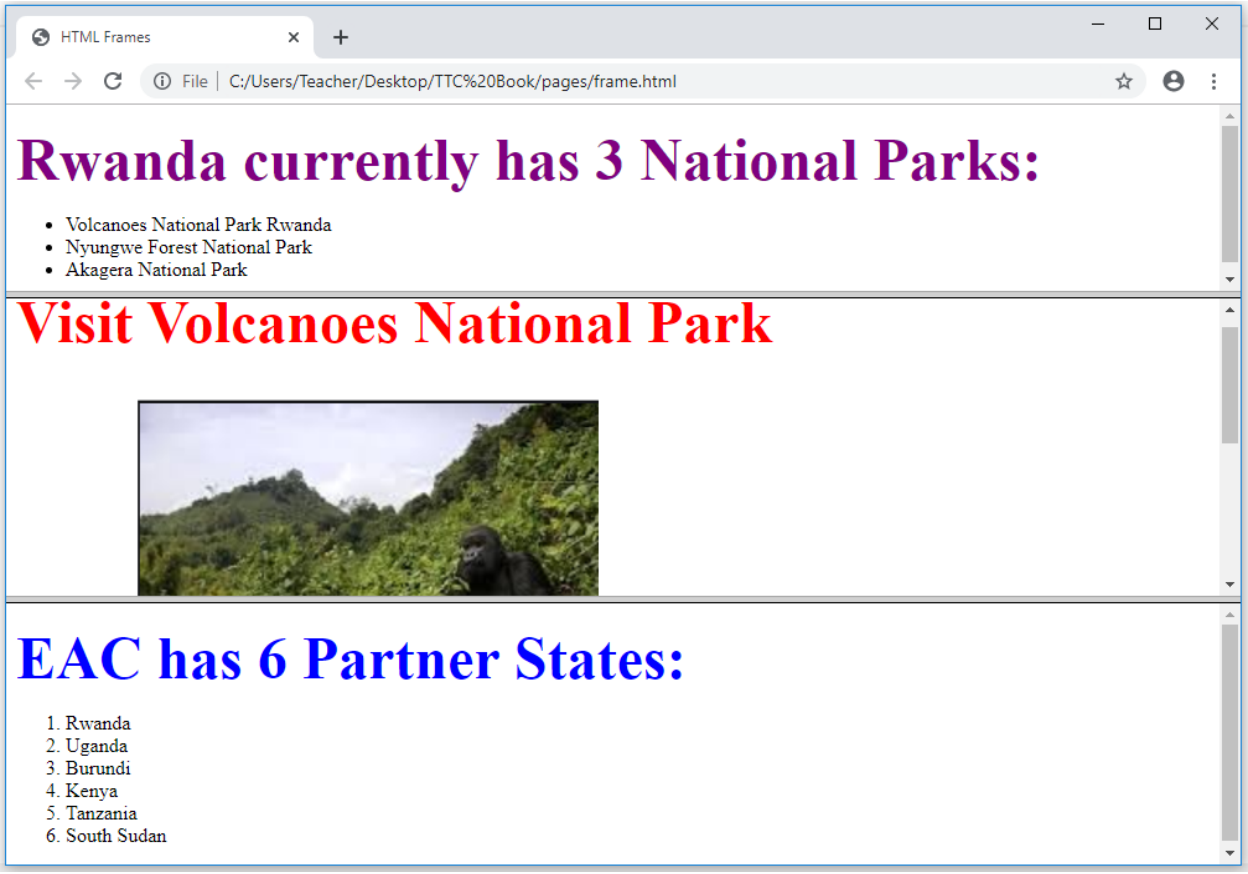


Figure 4.27: Targeted page

APPLICATION ACTIVITY 4.12

1. Define the following terms:
    a. Hyperlink
    b. Hypertext
    c. Href attribute
2. What do you understand by a local link?
3. Explain this statement: image link
4. Create two static web pages and hyperlink called **"next"** which links them.

4.5. Back end vs Front end

ACTIVITY 4.13

With research on internet, discuss the difference between Front end and Back end in the web site design and development process.

Database systems are comprised of a **Front End** and **Back End**. The Back End has the tables that stores data, including the relationships between the tables, data queries and other behind the scenes technology that accepts information from and displays information to the user via the Front End.

For example, when you are requesting for a birth certificate through Irembo there is a number of information you provide through different forms and that information is kept in the Irembo database tables.

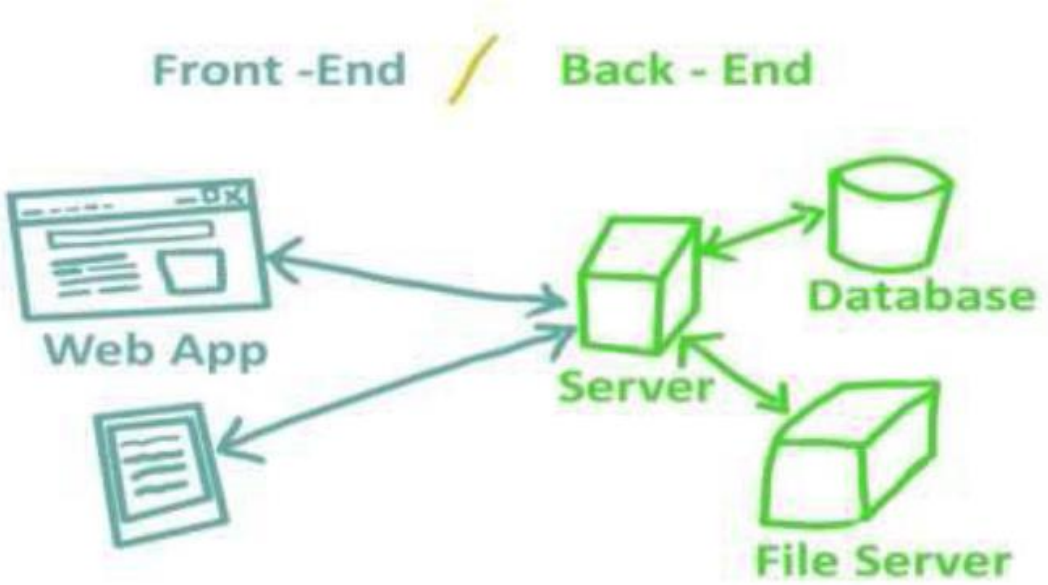


Figure 4.28. Relationship front end-back end

The **front end** is the part of the website, users can see and interact with. **Back end**, on the contrary, is the part of the website users cannot see and interact with.

Front end development is programming which focuses on the coding and creation of the visual elements of a website or app that a user will interact with (the client side). In contrast to ***front end*** development, ***back end*** development focuses on the side of the website users can't see. The back end can also be referred to as the "server side" of a website. As an example, let's say you're running a social media website. You need an accessible place to store all of your users' information. This storage center is called a database and a few widely used examples include Oracle, SQL Server, and MySQL.

Databases are run from a server, which is essentially a remote computer. A back-end developer will help manage this database and the site contents stored on it. This ensures that front end elements on your social media website can continue to function properly as users browse uploaded content and other user profiles.

Note:

- The front end can be created using Visual Basic, HTML, programming languages

The user at the front end of a system does not need to know how data is stored and how it is modified or retrieved.

- The Back ends can be built using different Relational Database Management Systems such as Microsoft Access, SQL Server, Oracle etc.
- Front end developers build elements like:

  - Buttons
  - Layouts

- Navigation
- Images
- Graphics
- Animations
- Content organization

- Back end web developers work on tasks like:

- Building code
- Troubleshooting and debugging web applications
- Database management
- Framework utilization

APPLICATION ACTIVITY 4.13

1. What is difference between Front and back end development
2. Discuss different types of software used in :
   - Front end development
   - Back end development
3. Describe tasks done in Front end and Back end development

End unit assessment

1. Define the terms below:
    a. Web site
    b. Web application
    c. Web server
2. Differentiate between internet and web.
3. A program, such as Mozilla Firefox that lets a user display HTML-developed web pages is referred to as …….
4. Discuss three key factors that a web developer should consider before developing a website
5. Explain four types of image formats that can be inserted into a web page
6. Write sample HTML statements to demonstrate how to insert the following:
    a. An image of a car
    b. Page with four horizontal frames
    c. Table of 5 rows and 8 columns
7. Explain statement: <form action ="login.php" method="post">
8. Differentiate between GET and POST methods used to send form content to a web server.
9. Explain at least four types of controls that are used to create a form object.
10. Differentiate between Hypertext and hyperlink.
11. Giving examples, explain three restrictions that were imposed by XHTML that have been relaxed in HTML5.

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27) https://www.guru99.com/difference-web-application-website.html
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