RDBMS:- Is used to manage Relational database. **Relational database** is a collection of organized set of tables from which data can be accessed easily. Relational Database is most commonly used database. It consists of number of tables and each table has its own primary key.

What is Table?

In Relational database, a **table** is a collection of data elements organized in terms of rows and columns. A table is also considered as convenient representation of **relations**. But a table can have duplicate tuples while a true **relation** cannot have duplicate tuples. Table is the simplest form of data storage. Below is an example of Employee table.

ID	Name	Age	Salary
1	Adam	34	13000
2	Alex	28	15000
3	Stuart	20	18000
4	Ross	42	19020

What is a Record?

A single entry in a table is called a **Record** or **Row**. A **Record** in a table represents set of related data. For example, the above **Employee** table has 4 records. Following is an example of single record.

1	Adam	34	13000

What is Field?

A table consists of several records(row), each record can be broken into several smaller entities known as **Fields**. The above **Employee** table consists of four fields, **ID**, **Name**, **Age** and **Salary**.

What is a Column?

In **Relational** table, a column is a set of value of a particular type. The term **Attribute** is also used to represent a column. For example, in Employee table, Name is a column that represents names of employee.

Name
Adam
Alex
Stuart
Ross

- ***Database Keys***

1- Introduction

For the purposes of clarity we will refer to keys in terms of RDBMS tables but the same definition, principle and naming applies equally to Entity Modeling and Normalization.

Keys are, as their name suggests, a key part of a relational database and a vital part of the structure of a table. They ensure each record within a table can be uniquely identified by one or a combination of fields within the table. They help enforce integrity and help identify the relationship between tables. There are three main types of keys, candidate keys, primary keys and foreign

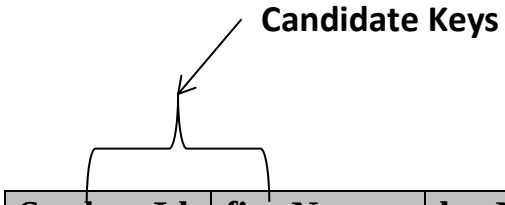
keys. There is also an alternative key or secondary key that can be used, as the name suggests, as a secondary or alternative key to the primary key

- **Super Key**

A Super key is any combination of fields within a table that uniquely identifies each record within that table.

- **Candidate Key**

A candidate is a subset of a super key. A candidate key is a single field or the least combination of fields that uniquely identifies each record in the table. The least combination of fields distinguishes a candidate key from a super key. Every table must have at least one candidate key but at the same time can have several.



Student Id	firstName	lastName	courseId
L0002345	Jim	Black	C002
L0001254	James	Harradine	A004
L0002349	Amanda	Holland	C002
L0001198	Simon	McCloud	S042
L0023487	Peter	Murray	P301
L0018453	Anne	Norris	S042

As an example we might have a student_id that uniquely identifies the students in a student table. This would be a candidate key. But in the same table we might have the student's first name and last name that also, when combined, uniquely identify the student in a student table. These would both be candidate keys.

In order to be eligible for a candidate key it must pass certain criteria.

- It must contain unique values
- It must not contain null values
- It contains the minimum number of fields to ensure uniqueness
- It must uniquely identify each record in the table

Once your candidate keys have been identified you can now select one to be your primary key

- **Primary Key**

A primary key is a candidate key that is most appropriate to be the main reference key for the table. As its name suggests, it is the primary key of reference for the table and is used throughout the database to help establish relationships with other tables. As with any candidate key the primary key must contain unique values, must never be null and uniquely identify each record in the table.

As an example, a student id might be a primary key in a student table, a department code in a table of all departments in an organisation. This module has the code DH3D 35 that is no doubt used in a database somewhere to identify RDBMS as a unit in a table of modules. In the table below we have selected the candidate key student_id to be our most appropriate primary key.

primary key
↓

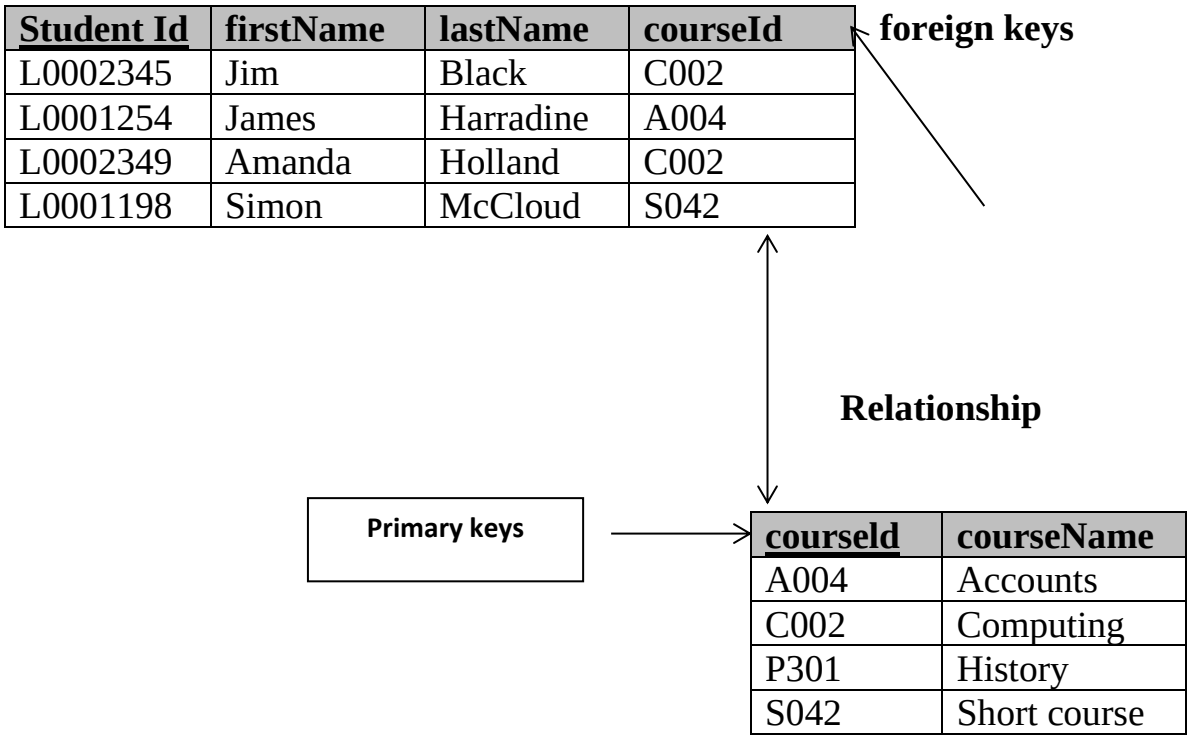
Student Id	**firstName**	**lastName**	**courseId**
L0002345	Jim	Black	C002
L0001254	James	Harradine	A004
L0002349	Amanda	Holland	C002
L0001198	Simon	McCloud	S042
L0023487	Peter	Murray	P301
L0018453	Anne	Norris	S042

Primary keys are mandatory for every table each record must have a value for its primary key. When choosing a primary key from the pool of candidate keys always choose a single simple key over a composite key.

- **Foreign Key**

A foreign key is generally a primary key from one table that appears as a field in another where the first table has a relationship to the second. In other words, if we had a table A with a primary key X that linked to a table B where X was a field in B, then X would be a foreign key in B.

An example might be a student table that contains the course_id the student is attending. Another table lists the courses on offer with course_id being the primary key. The 2 tables are linked through course_id and as such course_id would be a foreign key in the student table.



Student Id	firstName	lastName	courseId
L0002345	Jim	Black	C002
L0001254	James	Harradine	A004
L0002349	Amanda	Holland	C002
L0001198	Simon	McCloud	S042

courseId	courseName
A004	Accounts
C002	Computing
P301	History
S042	Short course

- **Secondary Key or Alternative Key**

A table may have one or more choices for the primary key. Collectively these are known as candidate keys as discuss earlier. One is selected as the primary key. Those not selected are known as secondary keys or alternative keys.

For example in the table showing candidate keys above we identified two candidate keys, studentId and firstName + lastName. The studentId would be the most appropriate for a primary key leaving the other candidate key as secondary or alternative key. It should be noted for the other key to be candidate keys, we are assuming you will never have a person with the same first and last name combination. As this is unlikely we might consider fistName+lastName to be a suspect candidate key as it would be restrictive of the data you might enter. It would seem a shame to not allow John Smith onto a course just because there was already another John Smith.

- **Simple Key**

Any of the keys described before (ie primary, secondary or foreign) may comprise one or more fields, for example if firstName and lastName was our key this would be a key of two fields where as studentId is only one. A simple key consists of a single field to uniquely identify a record. In addition the field in itself cannot be broken down into other fields, for example, studentId, which uniquely identifies a particular student, is a single field and therefore is a simple key. No two students would have the same student number.

- **Compound Key**

A compound key consists of more than one field to uniquely identify a record. A compound key is distinguished from a composite key because each field, which makes up the primary key, is also a simple key in its own right. An example might be a table that represents the modules a student is attending. This table has a studentId and a moduleCode as its primary key. Each of the fields that make up the primary key are simple keys because each represents a unique reference when identifying a student in one instance and a module in the other.

- **Composite Key**

A composite key consists of more than one field to uniquely identify a record. This differs from a compound key in that one or more of the attributes, which make up the key, are not simple keys in their own right. Taking the example from compound key, imagine we identified a student by their firstName + lastName. In our table representing students on modules our primary key would now be firstName + lastName + moduleCode. Because firstName + lastName represent a unique reference to a student, they are not each simple keys, they have to be combined in order to uniquely identify the student. Therefore the key for this table is a composite key.

➢ ***Database Schema***

When we talk about a database, we must differentiate between the **database schema**, which is the logical design of the database, and a **database instance**, which is a snapshot of the data in the database at a given instant in time.
The concept of a relation corresponds to the programming-language notion of a variable. The concept of a **relation schema** corresponds to the programming-language notion of type definition.

It is convenient to give a name to a relation schema, just as we give names to type definitions in programming languages. We adopt the convention of using lowercase names for relations, and names beginning with an uppercase letter for relation schemas. Following this notation, we use *Account-schema* to denote the relation schema for relation *account*. Thus,

***Account-schema* = (*account-number, branch-name, balance*)**

We denote the fact that *account* is a relation on *Account-schema* by *account*(*Account-schema*)

In general, a relation schema consists of a list of attributes and their corresponding domains.

The concept of a **relation instance** corresponds to the programming language notion of a value of a variable. The value of a given variable may change with time; similarly the contents of a relation instance may change with time as the relation is updated. However, we often simply say "relation" when we actually mean "relation instance."

As an example of a relation instance, consider the *branch* relation of Figure 3.3. The schema for that relation is

***Branch-schema* = (*branch-name, branch-city, assets*)**

Note that the attribute *branch-name* appears in both *Branch-schema* and *Accountschema*.

This duplication is not a coincidence. Rather, using common attributes in relation schemas is one way of relating tuples of distinct relations. For example, suppose we wish to find the information about all of the accounts maintained in branches

Branch-name	Branch-city	Assets
Brighton	Brooklyn	7100000
Downtown	Brooklyn	9000000
Mianus	Horseneck	400000
Northtown	Rye	3700000
Perryridge	Horseneck	1700000
Powanl	Bennington	300000
Redwood	Paloalto	2100000
Round hill	Horseneck	8000000

Figure (8): The *branch* relation.

located in Brooklyn. We look first at the *branch* relation to find the names of all the branches located in Brooklyn. Then, for each such branch, we would look in the *account* relation to find the information about the accounts maintained at that branch.

This is not surprising—recall that the primary key attributes of a strong entity set appear in the table created to represent the entity set, as well as in the tables created to represent relationships that the entity set participates in.

Let us continue our banking example. We need a relation to describe information about customers. The relation schema is

***Customer-schema* = (*customer-name*, *customer-street*, *customer-city*)**

Figure 3.4 shows a sample relation *customer* (*Customer-schema*). Note that we have omitted the *customer-id* attribute, which we used Chapter 2, because now we want to have smaller relation schemas in our running example of a bank database. We assume that the customer name uniquely identifies a customer—obviously this may not be true in the real world, but the assumption makes our examples much easier to read.

Customer-name	Customer-street	Customer-city
Adams	Spring	Pitsfield
Brooks	Senator	Brooklyn
Curry	North	Rye
Glenn	Sandhill	Woodside