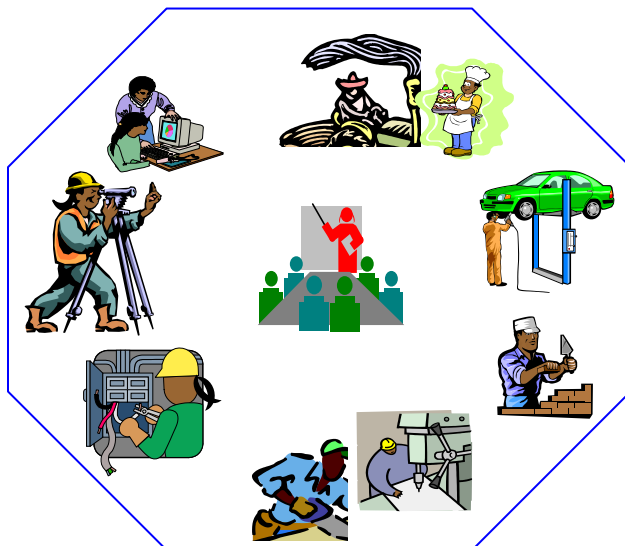# DATABASE ADMINISTRATION LEVEL III

Based on August, 2011, Version 3 Occupational Standards (OS) and Curriculum

Module Title: Modeling Data Objects

LG Code: EIS DBA3 M08 1220 LO (1-3) LG (30-32)

TTLM Code: EIS DBA3 TTLM08 1220v1

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Bishoftu, Ethiopia

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LG#30	LO #1: Identify entities and relationships

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Analyzing business data to understand operations
- Identifying boundaries of the system
- Identifying entities, attributes, data types and relationships of data
- Reviewing business rules to determine impact
- Documenting relationships in an entity relationship diagram

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Analyze business data to understand operations
- Identify boundaries of the system
- Identify entities, attributes, data types and relationships of data
- Review business rules to determine impact
- Document relationships in an entity relationship diagram

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the "Self-checks" which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If you earned a satisfactory evaluation proceed to "Operation sheets"
6. If your performance is satisfactory proceed to the next learning guide,

1.1 Analyzing business data to understand operations

Business Data analysis is defined as a process of cleaning, transforming, and modeling data to discover useful information for business decision making. The purpose of Data Analysis is to extract useful information from data and taking the decision based upon the data analysis.

A simple example of Data analysis is whenever we take any decision in our day-to-day life is by thinking about what happened last time or what will happen by choosing that particular decision. This is nothing but analyzing our past or future and making decisions based on it. For that, we gather memories of our past or dreams of our future. Major Data Analysis methods are:

- Text Analysis
- Statistical Analysis
- Diagnostic Analysis
- Predictive Analysis
- Prescriptive Analysis
- ✓ Text Analysis

Text Analysis is also referred to as Data Mining. It is one of the methods of data analysis to discover a pattern in large data sets using databases or data mining tools. It used to transform raw data into business information. Business Intelligence tools are present in the market which is used to take strategic business decisions. Overall it offers a way to extract and examine data and deriving patterns and finally interpretation of the data.

✓ Statistical Analysis

Statistical Analysis includes collection, Analysis, interpretation, presentation, and modeling of data. It analyses a set of data or a sample of data.

✓ Diagnostic Analysis

Diagnostic Analysis shows "Why did it happen?" by finding the cause from the insight found in Statistical Analysis. This Analysis is useful to identify behavior patterns of data. If a new problem arrives in into the business process, then you can look into this Analysis to find similar patterns of that problem. And it may have chances to use similar prescriptions for the new problems.

✓ Predictive Analysis

Predictive Analysis shows "what is likely to happen" by using previous data. The simplest data analysis example is like if last year I bought two dresses based on my savings and if this year my salary is increasing double then I can buy four dresses.

This Analysis makes predictions about future outcomes based on current or past data. Forecasting is just an estimate. Its accuracy is based on how much detailed information you have and how much you dig in it.

✓ Prescriptive Analysis

Prescriptive Analysis combines the insight from all previous Analysis to determine which action to take in a current problem or decision. Most data driven companies are utilizing Prescriptive Analysis because predictive analysis are not enough to improve data performance. Based on current situations and problems, they analyze the data and make decisions.

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. Data Mining example of
   - A. Diagnostic Analysis
   - B. Predictive Analysis
   - C. Text Analysis
   - D. Prescriptive Analysis

2. A method of data analysis which analyses a set of data or a sample of data is:
   - A. Diagnostic Analysis
   - B. Statistical Analysis
   - C. Prescriptive Analysis
   - D. Predictive Analysis

Part II fills the blank space

1. Explain Business Data analysis (3 pt)

   _____

   _____

   _____

2. What is the purpose of Data Analysis (1pt)

   _____

   _____

   _____

3. List all data analysis methods (5pt)

   _____

   _____

   _____

                                         _____

   _____

Answer the following question!

Note: Satisfactory rating 13 points   Unsatisfactory - below 13 points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

Score = _____
Rating: _____

Name: _____   Date: _____

Information Sheet 2: Identifying boundaries of the system

1.2 Identifying boundaries of the system

A system is a group of interrelated entities that form a unified whole to achieve some common objective. It is surrounded and influenced by its environment, is described by its boundaries, structure and purpose and expressed in its functioning.

Source: [https://en.wikipedia.org/wiki/System]

Constraints of a System

- A system must have some structure and behavior which is designed to achieve a predefined objective.
- Interconnectivity and interdependence must exist among the system components.
- The objectives of the organization have a higher priority than the objectives of its subsystems.

Example

- Traffic management system,
- Payroll system,
- Automatic library system,
- Human resources information system.

Properties of a System

- Organization

Organization implies structure and order. It is the arrangement of components that helps to achieve predetermined objectives.

- Interaction

It is defined by the manner in which the components operate with each other.

Example

In an organization, purchasing department must interact with production department and payroll with personnel department.

- Interdependence

Interdependence means how the components of a system depend on one another. For proper functioning, the components are coordinated and linked together according to a specified plan. The output of one subsystem is the required by other subsystem as input.

- Integration

Integration is concerned with how system components are connected together. It means that the parts of the system work together within the system even if each part performs a unique function.

- Central Objective

The objective of system must be central. It may be real or stated. It is not uncommon for an organization to state an objective and operate to achieve another.

The users must know the main objective of a computer application early in the analysis for a successful design and conversion.

Elements of a System

- Outputs and Inputs

✓ The main aim of a system is to produce an output which is useful for its user.

✓ Inputs are the information that enters into the system for processing.

✓ Output is the outcome of processing.

- Processor(s)

✓ The processor is the element of a system that involves the actual transformation of input into output.

✓ It is the operational component of a system. Processors may modify the input either totally or partially, depending on the output specification.

✓ As the output specifications change, so does the processing. In some cases, input is also modified to enable the processor for handling the transformation.

- Control

✓ The control element guides the system.

✓ It is the decision making subsystem that controls the pattern of activities governing input, processing, and output.

✓ The behavior of a computer System is controlled by the Operating System and software.

- Feedback

✓ Feedback provides the control in a dynamic system.

✓ Positive feedback is routine in nature that encourages the performance of the system.

✓ Negative feedback is informational in nature that provides the controller with information for action.

- Environment

✓ The environment is the "super system" within which an organization operates.
✓ It is the source of external elements that strike on the system.
✓ It determines how a system must function.

- Boundaries and Interface

✓ A system should be defined by its boundaries. Boundaries are the limits that identify its components, processes, and interrelationship when it interfaces with another system.
✓ Each system has boundaries that determine its sphere of influence and control.
✓ The knowledge of the boundaries of a given system is crucial in determining the nature of its interface with other systems for successful design.

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. The properties of system implies structure and order is

   A. Integration　　　　　　　　　　C. Organization
   B. Interaction　　　　　　　　　　D. All can be

2. In system components of a system depend on one another is called

   A. Interdependence　　　　　　　C. Integration
   B. Central Objective　　　　　　　D. None

Part II Fill the blank space

1. What is system(2pts)

   _____

   _____

2. Write at least three example of system(3pts)

   _____

   _____

   _____

3. Write all elements of system(5pts)

   1_____2_____3_____

   _____4._____5_____6_____

   _____

Answer the following question!

Note: Satisfactory rating 14 points　　　　　　　Unsatisfactory - below 14 points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

Score = _____
Rating: _____

Name: _____　　　　Date: _____

3.1 Identifying entities, attributes, data types and relationships of data

In database administration, an entity can be a single thing, person, place, or object about which the data should be captured and stored in the form of properties, workflow and tables. Data can be stored about such entities. A design tool that allows database administrators to view the relationships between several entities is called the entity relationship diagram (ERD). Database entity is the key element in all relational databases.

Entity Attributes

An attribute defines the information about the entity that needs to be stored. If the entity is an employee, attributes could include name, employee ID, health plan enrollment, and work location. An entity will have zero or more attributes, and each of those attributes apply only to that entity.

Example

The employee ID of 123456 belongs to that employee entity alone.

The domain of an entity describes the possible values of attributes. In the entity, each attribute will have only one value, which could be blank or it could be a number, text, a date, or a time.

Examples of entity types and domains:

> Name: Keresa Gadisa
>
> Employee ID: 123456
>
> Health Plan Enrollment: Normal
>
> Work Location: Nekemte, Ethiopia

The key is the unique identifier that identifies the entity. A key is also a domain because it will have values. These values are unique to each record, and so it's a special type of domain.

Data type

Data type refers to the format of data storage that can hold a distinct type or range of values. When computer programs store data in variables, each variable must be designated a distinct data type. There are programming languages that require the programmer to determine the data type of a variable before attaching a value to it. While some programming languages can automatically attach a data type to a variable based on the initial data assigned to the variable. Database fields require distinct type of data to be entered.

Common Data Types

- **Integer** is a whole number that can have a positive, negative or zero value. It cannot be a fraction nor can have decimal places.
- **Character** refers to any number, letter, space or symbol that can be entered in a computer. Each character occupies one byte of space.
- **String** is used to represent text. It is composed of a set of characters that can have spaces and numbers. Strings are enclosed in quotation marks to identify the data as string and not a variable name nor a number.
- **Floating Point Number** is a number that contains decimals. Numbers that contain fractions are also considered as floating point numbers.
- **Varchar** as the name implies is variable character as the memory storage has variable length.
- **Boolean** – is used for creating true or false statements. To compare values the following operators are being used: AND, OR, XOR, and NOT.

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. Entity will have zero or more attributes
   A. False
   B. True

2. Which one is Entity?
   A. Name   C. Sex
   B. Age   D. Employee

3. All are data type Except
   A. Integer   C. String
   B. ID number   D. Character

Part II Fill the blank space

1. Explain Entity with example(3pts)

   _____
   _____

2. What is attribute (2pts)

   _____

   _____

3. What is Data type (3pts)

   _____
   _____

Answer the following question!

Note: Satisfactory rating 13 points   Unsatisfactory - below 13points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

| Score = _____ |
| Rating: _____ |

Name: _____   Date: _____

4.1 Business rules are reviewed to determine impact

A business rule is a statement that imposes some form of constraint on a specific aspect of the database, such as the elements within a field specification for a particular field or the characteristics of a given relationship. Business rules can apply to people, processes, corporate behavior and computing systems in an organization, and are put in place to help the organization achieve its goals. Also Business rules describe the business policies that apply to the data stored on a company's databases.

There are certain constraints that designers apply to ensure that a database honors a company's business rules. These constraints help preserve data integrity. Business-rules constraints fall into two categories:

1. Field constraints within tables, and
2. Relationship constraints between tables.

- Field constraints within tables

Rules used to limit the type of data that can go into a table, to maintain the accuracy and integrity of the data inside table. Constraints are used to make sure that the integrity of data is maintained in the database.

- Relationship constraints between tables

A foreign key is a field in one table that references the primary key in another table. The data in the fields from both tables is exactly the same, and the table with the primary key record must have existing records before the table with the foreign key record has the related records. Like primary keys, you can define foreign keys in the table declaration by using the constraint clause.

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. Business rules can apply to
   - A. People
   - B. Processes
   - C. Computing systems
   - D. All can be

2. Business-rules constraints fall into two categories:
   - A. Field constraints
     - A. Relationship constraints
     - B. Both A & B

Part II Fill the blank space

1. What is business rule context to database? (2pts)

   _____
   _____
   _____

Answer the following question!

Note: Satisfactory rating 6 points   Unsatisfactory - below 6 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____   Date: _____

1.5 Documenting relationships in an entity relationship diagram

An entity-relationship diagram (ERD) is a data modeling technique that graphically illustrates an information system's entities and the relationships between those entities. It is a conceptual and representational model of data used to represent the entity framework infrastructure. An entity in this context is an object, a component of data. An entity set is a collection of similar entities. These entities can have attributes that define its properties. By defining the entities, their attributes, and showing the relationships between them, an ER diagram illustrates the logical structure of databases. An ER diagram is a means of visualizing how the information a system produces is related.

ERD Symbols

Entities represented by rectangles. An entity is an object or concept about which you want to store information.

A weak entity is an entity that must defined by a foreign key relationship with another entity as it cannot be uniquely identified by its own attributes alone.

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			December 2020

Actions which are represented by diamond shapes show how two entities share information in the database. In some cases, entities can be self linked. For example, employees can supervise other employees.

Attributes which are represented by ovals. A key attribute is the unique, distinguishing characteristic of the entity. For example, an employee's social security number might be the employee's key attribute.

A multi valued attribute can have more than one value. For example, an employee entity can have multiple skill values.

A derived attribute is based on another attribute. For example, an employee's monthly salary is based on the employee's annual salary.

Connecting lines, solid lines that connect attributes to show the relationships of entities in the diagram.

Cardinality specifies how many instances of an entity relate to one instance of another entity.
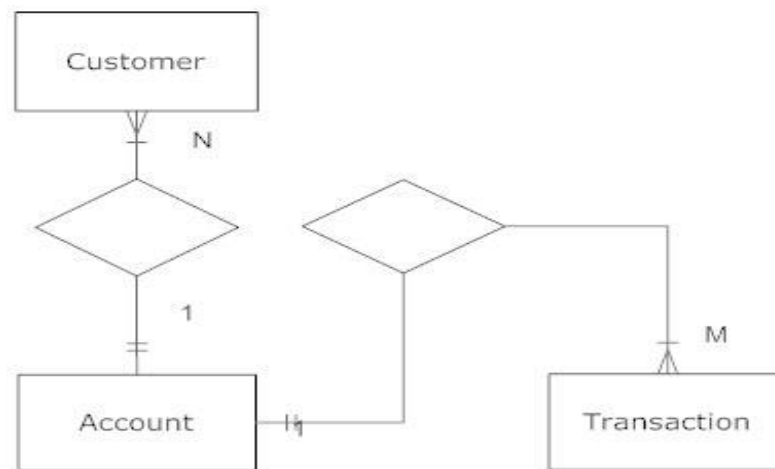
Fig 5.1 ERD sample example

Consider the following business rules for a patient appointment system:

A doctor can be scheduled for many appointments, but may not have any scheduled at all. Each appointment is scheduled with exactly 1 doctor. A patient can schedule 1 or more appointments. One appointment is scheduled with exactly 1 patient. An appointment must generate exactly 1 bill; a bill is generated by only 1 appointment. One payment is applied to exactly 1 bill, and 1 bill can be paid off over time by several payments. A bill can be outstanding, having nothing yet paid on it at all. One patient can make many payments, but a single payment is made by only 1 patient. Some patients are insured by an insurance company. If they are insured, they can only carry insurance with one company. An insurance company can have many patients carry

their policies. For patients that carry insurance, the insurance company will make payments; each single payment is made by exactly 1 insurance company.

Given the above information, the following ERD can be drawn:
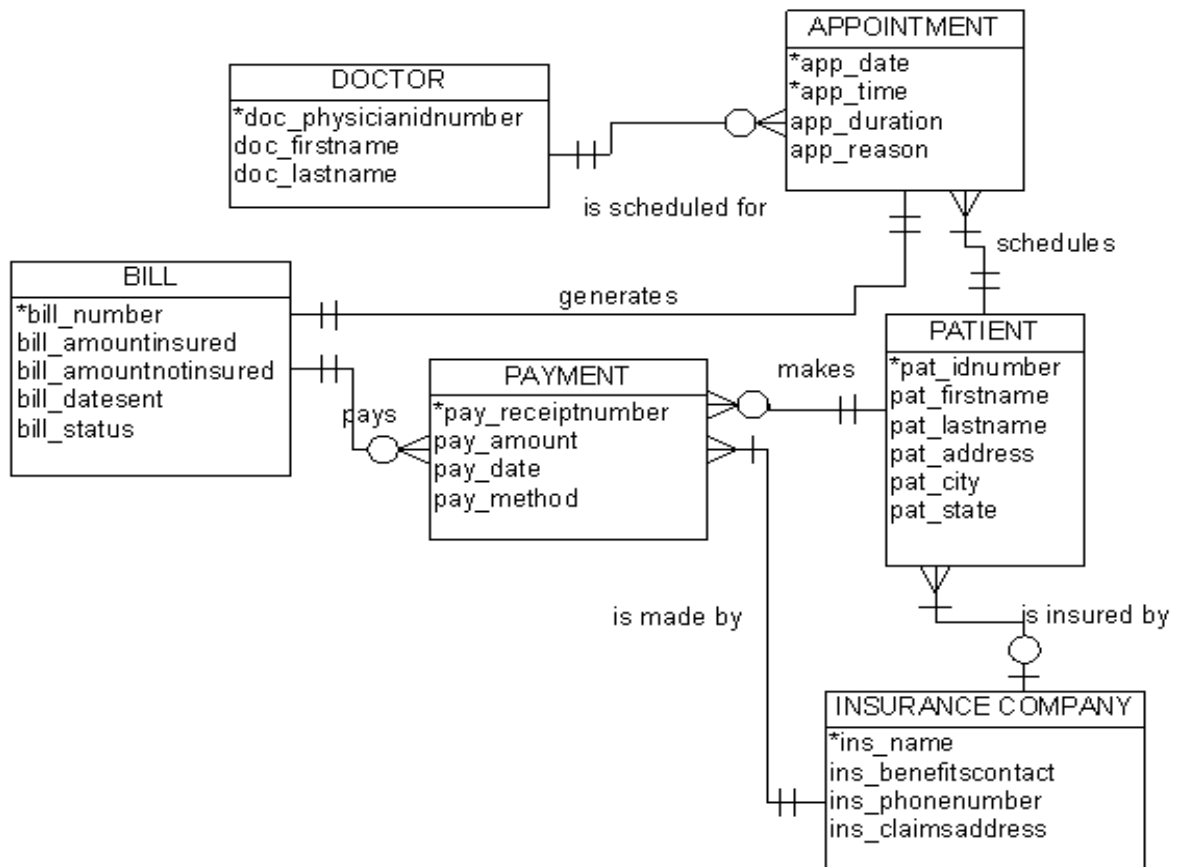
Fig 5.2 ERD of patient appointment system

Self-Check 5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. Entity Relationship diagram is visualizing information.

   A. False

   B. True

2. In ERD rectangles represent

   A. Relationship   C. Entity

   B. Attribute   D. All can be

3. Which Entity type has not sufficient attributes (even primary key)

   A. Strong entity   C. Entity set

   B. Weak entity   D. None

Part II Fill the blank space

1. Define entity relationship diagram (ERD (2pts)

_____
_____

2. Write the basic ER Diagram components (3pt)

_____
_____

Answer the following question!

Note: Satisfactory rating 11 points   Unsatisfactory - below 11 points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

Name: _____   Date: _____

		Score = _____
		Rating: _____

Operation sheet #1	LO1: Identify entities and relationships

Operation Title: - Data modeling

Purpose:

- The trainee's will be able to follows necessary steps.
- The trainee's will be able to identify entities, attributes and relationships.
- The trainee's will be able to perform data modeling properly.

Conditions for operation: - Have a clean workspace with all necessary ICT equipments.

Equipment and Tools: - ICT room, computer and installed MS-Visio.

Procedure: - 1.

1. Click on start button → All program→Microsoft office→Microsoft

   Visio→File→New→Software Database→Database Model Diagram (US units)→

   select Entity under shape
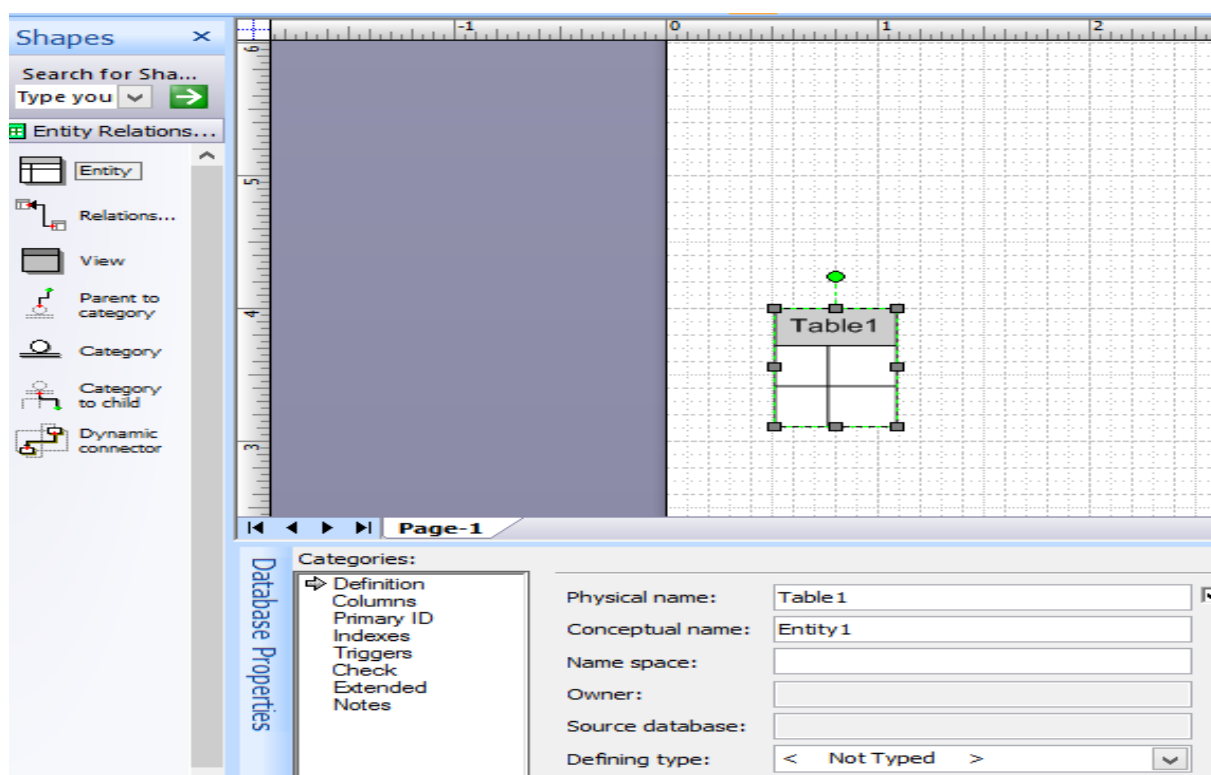
Procedure: - 2. Add table and columns

Click on Entity shape "Table1" →click on Physical Name and rename to table name Eg. "Employee"

To add column click on "columns" under categories and assign physical name and data types and other constraints such as (primary key and foreign keys)

- Database schema

Employee Table

Column name	Data type	size	Constraints	Key
Empid	char	10	Not null	Primary key
FullName	char	50		
Sex	char	10		
Address	char	5		

To change the size of data type of employee "FullName" from default one (10) to 50 please follows following procedures.

Click on Data type of required data (Full Name)→Edit→select data type→ Length then write number of size→ok

Also we can add columns as the below procedures

To set primary key

Click on primary ID under categories→

Procedure- 3 Add related table and identify cardinality ratios

We can add other Entities

Database schema

Department Table

Column name	Data type	size	Constraints	Key
DeptID	char	10	Not null	Primary key
DeptName	char	50		
EmpID	char	10		Foreign key

To create relationship between both Employee and Department follow procedures

Select relationship under shape→
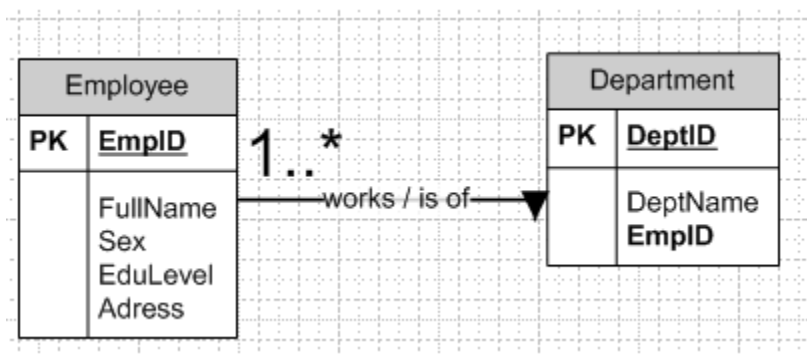
After creation of relationship we have check cardinality ratios

Click on Arrow between both tables→click on Name under categories to set relationship which is by (word)

To check cardinality ratios

Click on →Miscellaneous →

Procedure-4 To add necessary information under relation such as (words, cardinality ratios) follow the following procedures.

Select Database (from menu bar)→Option→Document→Relationship→Ok

The output of the procedure is looks like the below figure.
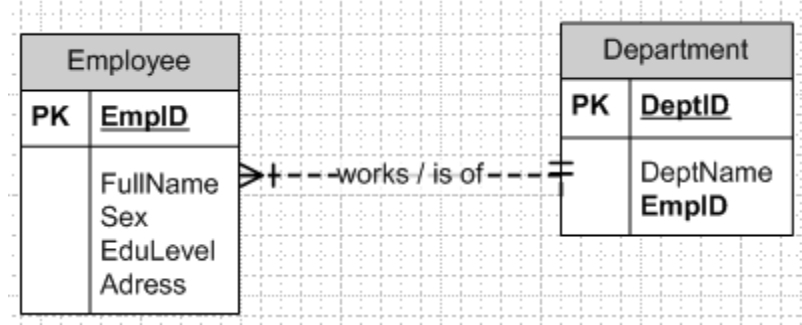
Group Work

An Instructor set a group of trainee into (1-5) and shares the following projects and gives any corrections accordingly.

The Instructor expect from trainee as they:-

- Identify entities and attributes
- Identify relationship and assign
- Data modeling using Visio or other data modeling applications
- Normalize data if any

Project work

1. University database
2. Hospital database
3. Bank database
4. Hotel database
5. Airport database

LAP TEST #1	Practical Demonstration

Name: _____ Date: _____

Time started: _____Time finished: _____

Instructions: You are required to perform the following individually with the presence of your Instructor.

1. How to browse and start-up data modelling software?
2. The trainees identify entities, attributes and relationships?
3. The trainee model data according to required?

- Your Instructor will evaluate your activities either satisfactory or unsatisfactory.
  If Not satisfactory, your Instructor shall advice you on additional work. But if satisfactory, you can proceed to the next topic.

LG#31	**LO #2: Develop normalization**

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- undertaking normalization of business data and Documenting results
- Comparing normalization results with entity relationship diagram
- Reconciling differences between data

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Undertake normalization of business data and Documenting results
- Compare normalization results with entity relationship diagram
- Reconcile differences between data

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the "Self-checks" which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If you earned a satisfactory evaluation proceed to "Operation sheets
6. If your performance is satisfactory proceed to the next learning guide,

Information sheet 1: Undertaking normalization of business data and Documenting results

1.1 Undertaking normalization of business data and Documenting results

Database Normalization is a technique of organizing the data in the database. It is a systematic approach of decomposing tables to eliminate data redundancy (repetition) and undesirable characteristics like Insertion, Update and Deletion Anomalies. It is a multi step process that puts data into tabular form, removing duplicated data from the relation tables.

Normalization is used for mainly two purposes:

- Eliminating redundant data.
- Ensuring data dependencies make sense i.e data is logically stored.

Data Anomalies

Anomalies are problems that can occur in poorly planned, un-normalized databases where all the data is stored in one table (a flat-file database).

There are three types of anomalies that occur when the database is not normalized. These are Insertion, update and deletion anomaly.

Insertion Anomaly adding new rows forces user to create duplicate data adding new rows forces user to create duplicate data.

Example

If a tuple is inserted in referencing relation and referencing attribute value is not present in referenced attribute, it will not allow inserting in referencing relation. For Example, If we try to insert a record in STUDENT_COURSE with STUD_NO =7, it will not allow.

STUDENT

STUD_NO	STUD_NAME	STUD_PHONE	STUD_STATE	STUD_COUNTRY	STUD_AGE
1	RAM	9716271721	Haryana	India	20
2	RAM	9898291281	Punjab	India	19
3	SUJIT	7898291981	Rajsthan	India	18
4	SURESH		Punjab	India	21

Table 1

STUDENT_COURSE

STUD_NO	COURSE_NO	COURSE_NAME
1	C1	DBMS
2	C2	Computer Networks
1	C2	Computer Networks

Table 2

Fig 1.2 Insertion anomaly

Deletion Anomaly deleting rows may cause a loss of data that would be deleting rows may cause a loss of data that would be needed for other future rows

Updating Anomaly changing data in a row forces changes to other changing data in a row forces changes to other rows because of duplication

Deletion and Updation anomaly: If a tuple is deleted or updated from referenced relation and referenced attribute value is used by referencing attribute in referencing relation, it will not allow deleting the tuple from referenced relation. For Example, If we try to delete a record from STUDENT with STUD_NO =1, it will not allow. To avoid this, following can be used in query:

- **ON DELETE/UPDATE SET NULL:** If a tuple is deleted or updated from referenced relation and referenced attribute value is used by referencing attribute in referencing relation, it will delete/update the tuple from referenced relation and set the value of referencing attribute to NULL.
- **ON DELETE/UPDATE CASCADE:** If a tuple is deleted or updated from referenced relation and referenced attribute value is used by referencing attribute in referencing relation, it will delete/update the tuple from referenced relation and referencing relation as well

Types of normal forms:
1. First normal form(1NF)
2. Second normal form(2NF)
3. Third normal form(3NF)
4. Boyce & Codd normal form (BCNF)

1. First normal form (1NF)

 The rule of first normal form, an attribute of a table cannot hold multiple values. It should hold only atomic values.

mp_id	emp_name	emp_address	emp_mobile
101	Herschel	New Delhi	8912312390
102	Jon	Kanpur	8812121212 9900012222
103	Ron	Chennai	7778881212
104	Lester	Bangalore	9990000123 8123450987

Two employees (Jon & Lester) are having two mobile numbers so the company stored them in the same field as you can see in the table above.

This table is **not in 1NF** as the rule says "each attribute of a table must have atomic (single) values", the emp_mobile values for employees Jon & Lester violates that rule.

To make the table complies with 1NF we should have the data like this:

mp_id	emp_name	emp_address	emp_mobile
101	Herschel	New Delhi	8912312390
102	Jon	Kanpur	8812121212
102	Jon	Kanpur	9900012222
103	Ron	Chennai	7778881212
104	Lester	Bangalore	9990000123
104	Lester	Bangalore	8123450987

2. Second normal form (2NF)

A table is said to be in 2NF if both the following conditions hold:

- Table is in 1NF (First normal form)
- No non-prime attribute is dependent on the proper subset of any candidate key of table.

An attribute that is not part of any candidate key is known as non-prime attribute.

Example: Suppose a school wants to store the data of teachers and the subjects they teach. They create a table that looks like this: Since a teacher can teach more than one subjects, the table can have multiple rows for a same teacher.

eacher_id	Subject	teacher_age
111	Maths	38
111	Physics	38
222	Biology	38
333	Physics	40
333	Chemistry	40

Candidate Keys: {teacher_id, subject}
Non prime attribute: teacher_age

The table is in 1 NF because each attribute has atomic values. However, it is not in 2NF because non prime attribute teacher_age is dependent on teacher_id alone which is a proper subset of candidate key. This violates the rule for 2NF as the rule says "**no** non-prime attribute is dependent on the proper subset of any candidate key of the table".

To make the table complies with 2NF we can break it in two tables like this:

teacher_details table:

eacher_id	teacher_age
111	38
222	38
333	40

teacher_subject table:

teacher_id	subject
111	Maths
111	Physics
222	Biology
333	Physics
333	Chemistry

Now the tables comply with Second normal form (2NF).

Third Normal form (3NF)

A table design is said to be in 3NF if both the following conditions hold:

- Table must be in 2NF
- Transitive functional dependency of non-prime attribute on any super key should be removed.

An attribute that is not part of any candidate key is known as non-prime attribute.

In other words 3NF can be explained like this: A table is in 3NF if it is in 2NF and for each functional dependency X-> Y at least one of the following conditions hold:

- X is a super key of table
- Y is a prime attribute of table

An attribute that is a part of one of the candidate keys is known as prime attribute.

Example: Suppose a company wants to store the complete address of each employee, they create a table named **employee_details** that looks like this:

emp_id	emp_name	emp_zip	emp_state	emp_city	emp_district
1001	John	282005	UP	Agra	Dayal Bagh
1002	Ajeet	222008	TN	Chennai	M-City
1006	Lora	282007	TN	Chennai	Urrapakkam
1101	Lilly	292008	UK	Pauri	Bhagwan
1201	Steve	222999	MP	Gwalior	Ratan

Super keys: {emp_id}, {emp_id, emp_name}, {emp_id, emp_name, emp_zip}…so on

Candidate Keys: {emp_id}

Non-prime attributes: all attributes except emp_id are non-prime as they are not part of any candidate keys.

Here, emp_state, emp_city & emp_district dependent on emp_zip. And, emp_zip is dependent on emp_id that makes non-prime attributes (emp_state, emp_city & emp_district) transitively dependent on super key (emp_id). This violates the rule of 3NF.

To make this table complies with 3NF we have to break the table into two tables to remove the transitive dependency:

Employee table:

mp_id	emp_name	emp_zip
1001	John	282005
1002	Ajeet	222008
1006	Lora	282007
1101	Lilly	292008
1201	Steve	222999

employee_zip table:

emp_zip	emp_state	emp_city	emp_district
282005	UP	Agra	Dayal Bagh
222008	TN	Chennai	M-City
282007	TN	Chennai	Urrapakkam
292008	UK	Pauri	Bhagwan
222999	MP	Gwalior	Ratan

3. Boyce Codd normal form (BCNF)

Boyce Codd Normal Form (BCNF) is based on functional dependencies that take into account all candidate keys in a relation; however, BCNF also has additional constraints compared with the general definition of 3NF.

Example: Suppose there is a company wherein employees work in **more than one department**. They store the data like this:

Emp_id	emp_nationality	emp_dept	dept_type	dept_no_of_emp
1001	Austrian	Production and planning	D001	200
1001	Austrian	Stores	D001	250
1002	American	design and technical support	D134	100
1002	American	Purchasing department	D134	600

Functional dependencies in the table above

emp_id -> emp_nationality

emp_dept -> {dept_type, dept_no_of_emp}

Candidate key: {emp_id, emp_dept}

The table is not in BCNF as neither emp_id nor emp_dept alone are keys.

To make the table comply with BCNF we can break the table in three tables like this:

emp_nationality table

emp_id	emp_nationality
1001	Austrian
1002	American

emp_dept table

emp_dept	dept_type	dept_no_of_emp
Production and planning	D001	200
Stores	D001	250
design and technical support	D134	100
Purchasing department	D134	600

Emp_dept_mapping table

emp_id	emp_dept
1001	Production and planning

1001	Stores
1002	design and technical support
1002	Purchasing department

Functional dependencies:

emp_id -> emp_nationality

emp_dept -> {dept_type, dept_no_of_emp}

Candidate keys:

For first table: emp_id

For second table: emp_dept

For third table: {emp_id, emp_dept}

This is now in BCNF as in both the functional dependencies left side part is a key.

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. In which normal form a table cannot hold multiple values
   - A. 3NF
   - B. 2NF
   - C. 1NF
   - D. BNCF

2. In which Normal form the existence of Transitive functional dependency
   - A. BNCF
   - B. 2NF
   - C. 1NF
   - D. 3NF

3. A function that has no partial functional dependencies is in _____form?
   - A. 3NF
   - B. 2NF
   - C. 1NF
   - D. BNCF

4. Every Boyees-codd normal form is in
   - A. 1NF
   - B. 2NF
   - C. 3NF
   - D. ALL

Part II Fill the blank space

1. Define database anomalies (3pts)

_____

2. Write all types of normalization (4pt)

_____

Answer the following question!

Note: Satisfactory rating 15 points   Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

Score = _____
Rating: _____

Name: _____   Date: _____

Information sheet 2: Comparing normalization results with entity relationship diagram

Comparison of ERD modeling and Normalization

ERD modeling	Database normalization
Focus on Conceptual view (abstract)	Goal is to control redundancy, Existence of relationships makes it impossible to eliminate
Top to down approach	Focus is table definition and construction • Entities type tables, Tables subsequently create additional relationships
Be able to identify & construct key components • Entity, Relationship, Connectivity, Cardinality, Bridge entity, Weak entity • Works in complimentary fashion with normalization	Bottom-up approach (detailed to abstract)

Focus is entity definition and the proof that they belong in database	Guidelines
• Proof is the relationship • Rules based on model M:M OK at first but not allowed in Relational model • Types of relations Unary , Binary and Ternary	**1NF** First normal form identifies the key(s) • Prime attributes = keys • Non-prime attributes = non key values In keys: eliminate nulls & repeating groups **2NF** Only applies when there is a composite key Goal here is to eliminate partial dependencies Typically results in creating new tables **3NF** • Realistic end point in traditional normalization • Elimination of transitive dependencies • Dependencies of non-prime to non-prime • Look to resolve issues with atomicity & derived attributes BCNF Largely theoretical

Table 2.1 Comparison of ERD and database normalization

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I fill the blank space

1. Compare ERD and database normalization (10 pts)

_____
_____
_____
_____
_____

Answer the following question!

Note: Satisfactory rating 5 and 10 points   Unsatisfactory - below 5 and 10 points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

| Score = _____ |
| Rating: _____ |

Name: _____   Date: _____

Information sheet 3: Reconciling differences between data

Data reconciliation (DR) is a term typically used to describe a verification phase during a data migration where the target data is compared against original source data to ensure that the migration architecture has transferred the data correctly. Data validation and reconciliation (DVR) means a technology that uses mathematical models to process information.
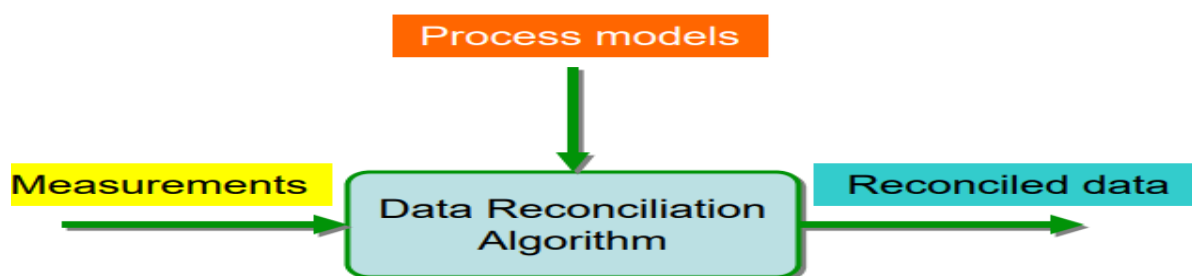
Fig 1.3 Data reconciliation

Purpose of Data Reconciliation

In the data migration process, it is possible for mistakes to be made in the mapping and transformation logic. Issues like run time failures like network dropouts or broken transactions can corrupt data.

This kind of errors can lead to data being left in an invalid state. These may create a range of issues like:

- Missing records
- Missing values
- Incorrect values
- Duplicated records
- Badly formatted values
- Broken relationships across tables or systems

Important for using Data Reconciliation Process:

- The use of Data Reconciliation helps you for extracting accurate and reliable information about the state of industry process from raw measurement data.
- It also helps you to produces a single consistent set of data representing the most likely process operation.
- It also leads to inaccurate insight and issues with customer service.
- Reconciliation of data is also important for enterprise-control integration.

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I fill the blank space

2. Define Data reconciliation (DR) (3 pts)

_____
_____
_____
_____
_____

3. Write the consequences of data reconciliation problems /factors(4pts)

_____
_____
_____
_____
_____

Answer the following question!

Note: Satisfactory rating 7 points   Unsatisfactory - below 7 points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

| Score = _____ |
| Rating: _____ |

Name: _____   Date: _____

Operation sheet #1	LO2: Develop normalization

Operation Title: - Developing database normalization

Purpose:

- The trainee's will be able to follows necessary steps.
- The trainee's will be able to identify tables, records and any constraints.
- The trainee's will be able to perform data normalization properly.

Conditions for operation: - Have a clean workspace with all necessary ICT equipments.

Equipment and Tools: - ICT room, computer and installed MS-Excel, MSSQL server and A4 paper and pen/pencil.

Procedure: - 1.

Based on the give information from trainers you can develop database normalization.

Recommendation tools

MS-Excel or paper (you can normalize the given database either on MS-excel or on paper , after you have completed the procedures you can implement on MSSQL server for confirmation of data redundancy/ the created relationship between tables is 1:M)
Given
Un Normalized table was given as the below table

Company ID	Company Name	Product ID	Product Name	Product Quantity
		101	Beauty Soap	120
1	Iqra Enterprises	102	Tooth Brush	100
2	Shahid Enterprises	103	Polish	140
3	Khalid Enterprises	103	Polish	250

Step 1: Develop First Normal Form

In first normal form, the duplicate columns are removed.

Company ID	Company Name	Product ID	Product Name	Product Quantity
1	Iqra Enterprises	101	Beauty Soap	120
1	Iqra Enterprises	102	Tooth Brush	100
2	Shahid Enterprises	103	Polish	140
3	Khalid Enterprises	103	Polish	250

Step 2: Develop Second Normal Form

In case of second normal form, it contains step of first normal form in addition to removal of duplicate data which is placed in a child table and spilt tables into sections.

Company Table:

Company ID	Company Name
1	Iqra Enterprises
1	Iqra Enterprises
2	Shahid Enterprises
3	Khalid Enterprises

Product Table:

Product ID	Product Name	Product Quantity
101	Beauty Soap	120
102	Tooth Brush	100
103	Polish	140
103	Polish	250

Company-Product Table

Company ID	Product ID
1	101
1	102
2	103
3	103

Step 3 Develop Third Normal Form

The third normal form includes 2nd normal form and further steps are carried out. In this form the columns are removed which are not dependent on primary key columns.

Company Table:

Company ID	Company Name
1	Iqra Enterprises
2	Shahid Enterprises
3	Khalid Enterprises

Product Table:

Product ID	Product Name	Product Quantity
101	Beauty Soap	120
102	Tooth Brush	100
103	Polish	140
103	Polish	250

Company_Product Table

Company ID	Product ID
1	101
1	102
2	103
3	103

Step 4 Develop SQL queries for understand it's relationship as the given database was normalized or not.

After importing the created database under MS-Excel to MSSQL server you can view the following un normalized record even on MSSQL server, which applied on query analyzer.

The "NULL" record under CampanyID and Campany Name shows as there was no data normalization under this topic.

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Step 5 Develop SQL queries (Recreate the normalized 3 tables under) your database, then view the created relationships between all tables and indicate the relationship types (i.e 1:M).


```
create database TVET
use TVET
select * from Sheet1$
create table Company(CompanyID Char(20) primary key not null, CompanyName char(30))
create table Product(ProductID Char(20) primary key not null, ProductName char(30),ProcutQuantity int)

create table Company_Product(CompanyID Char(20) foreign key references company(CompanyID) ,ProductID
Char(20) foreign key references Product(ProductID) on delete cascade on update cascade)
```

Step 6 you can view the normalized database as the following picture.
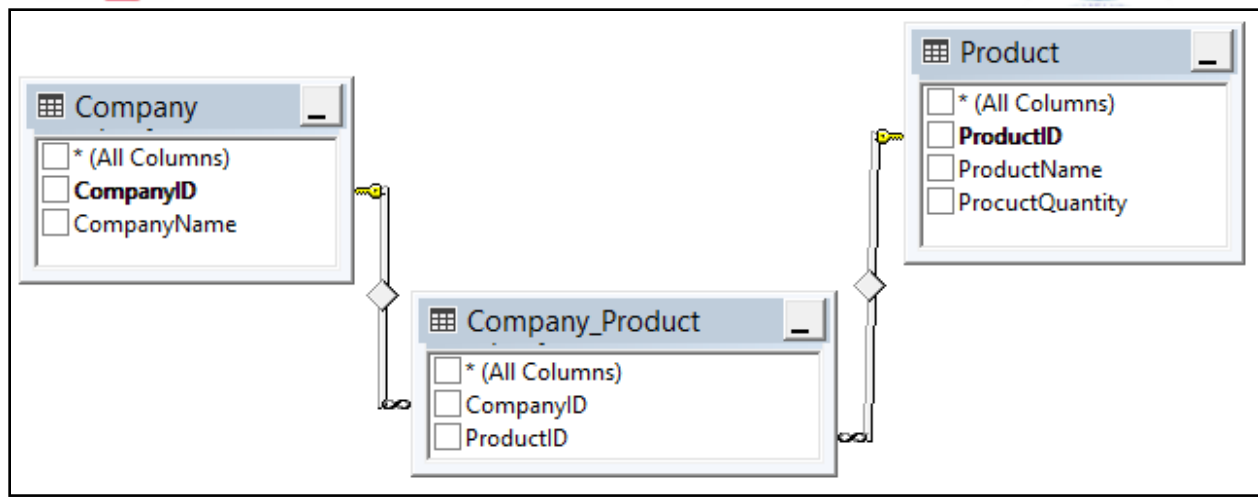
LAP TEST #1	Practical Demonstration

Name: _____ Date: _____

Time started: _____Time finished: _____

Instructions: You are required to perform the following individually with the presence of your Instructor.

Follow the given un normalized table below and normalize the data then implement using SQL server , the cardinality ratio must be(1:M)

StudentID	Name	Address	CourseID	CTitle	Grade
101	Chala	Ambo	ICT102	DBMS	A
102	Kedir	Nekemte	ICT101	Intro.IT	B
103	Zufan	Asela	ICT101	IntroIT	A-
103	Zufan	Asela	ICT104	OOP	A
104	Lewis	Adama	ICT103	MIS	A
104	Lewis	Adama	ICT104	OOP	C

- Your Instructor will evaluate your activities either satisfactory or unsatisfactory.

  If Not satisfactory, your Instructor shall advice you on additional work. But if satisfactory, you can proceed to the next topic.

LG#32	LO #3: Validate model

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Validating data model
- Resolving arising Issues or recommendations
- Documenting completed data model
- Submitting for final approval

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Validate data model
- Resolve arising Issues or recommendations
- Document completed data model
- Submit for final approval

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the "Self-checks" which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If your performance is satisfactory proceed to the next learning guide,

Information sheet 1: Validating data model

Introduction

Database model defines the logical design and structure of a database and defines how data will be stored, accessed and updated in a database management system. While the Relational Model is the most widely used database model, there are other models too:

- Hierarchical Model
- Network Model

- Entity-relationship Model
- Relational Model

Hierarchical Model

This database model organizes data into a tree-like-structure, with a single root, to which all the other data is linked. The hierarchy starts from the Root data, and expands like a tree, adding child nodes to the parent nodes. In this model, a child node will only have a single parent node.

In hierarchical model, data is organized into tree-like structure with one one-to-many relationship between two different types of data, for example, one department can have many courses, many professors and of-course many students.
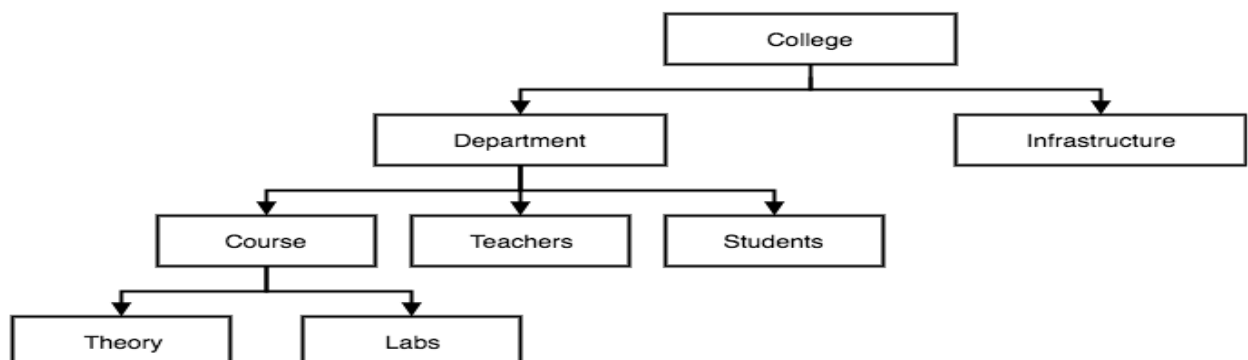

Fig 1.1 Hierarchical data modeling

Network Model

In this model data is organized more like a graph, and are allowed to have more than one parent node. In this database model data is more related as more relationships are established in this database model. Also, as the data is more related, hence accessing the data is also easier and fast. This database model was used to map many-to-many data relationships.

This was the most widely used database model, before Relational Model was introduced.

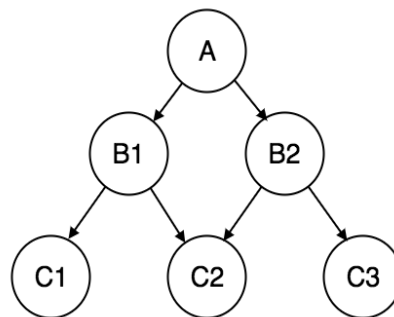
Fig 1.2 Network Model data modeling

Entity-relationship Model

In this database model, relationships are created by dividing object of interest into entity and its characteristics into attributes. Different entities are related using relationships. This model is good to design a database, which can then be turned into tables in relational model.
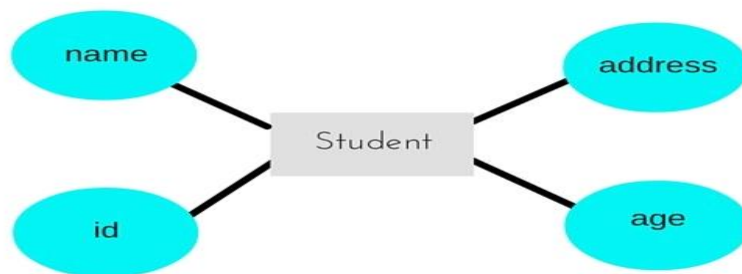
Fig 1.3 Entity-relationship data modeling

Relational Model

In this model, data is organized in two-dimensional **tables** and the relationship is maintained by storing a common field. This model was introduced by E.F Codd in 1970, and since then it has been the most widely used database model, in fact, we can say the only database model used around the world. The basic structure of data in the relational model is tables. All the information related to a particular type is stored in rows of that table.

Hence, tables are also known as **relations** in relational model.

student_Id	name	age
1	Akon	17
2	Bkon	18
3	Ckon	17
4	Dkon	18

subject_Id	name	teacher
1	Java	Mr. J
2	C++	Miss C
3	C#	Mr. C Hash
4	Php	Mr. P H P

student_Id	subject_Id	marks
1	1	98
1	2	78
2	1	76
3	2	88
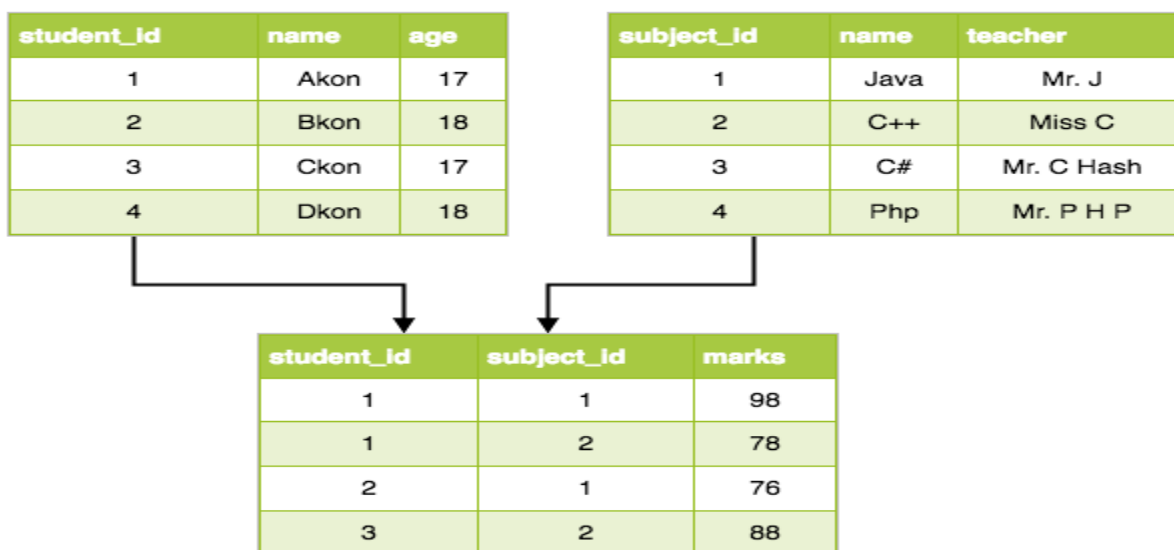
Fig 1.4 Relational data modeling

Source:[https://www.studytonight.com/dbms/database-model.php]

Model validation is defined within the regulatory guidance as "the set of processes and activities intended to verify that models are performing as expected, in line with their design objectives, and business uses to identify potential limitations and assumptions, and assesses their possible impact."

Therefore, during model validation we verify that the model executes correctly. A typical validation process consists of the following aspects:

- Verifying that the model input and model output is clean (i.e. does not missing data). In addition, verifying that sufficient controls are in place to deal with occasional data quality issues as well as with light missing inputs.

- Checking that the model input is stable and representative, meaning that e.g. the dataset on which a model is trained is representative of the data on which the model is executed.

- Verifying the model implementation, which means that we are testing the model expectations

- Comparing the model with alternatives to analyze the impact of changing model assumptions

- Analyzing the stability of the model as well as robustness of the standardize procedure.

Validation and verification are the two steps in any simulation project to validate a model.

- **Validation** is the process of comparing two results. In this process, we need to compare the representation of a conceptual model to the real system. If the comparison is true, then it is valid, else invalid.

- **Verification** is the process of comparing two or more results to ensure its accuracy. In this process, we have to compare the model's implementation and its associated data with the developer's conceptual description and specifications.
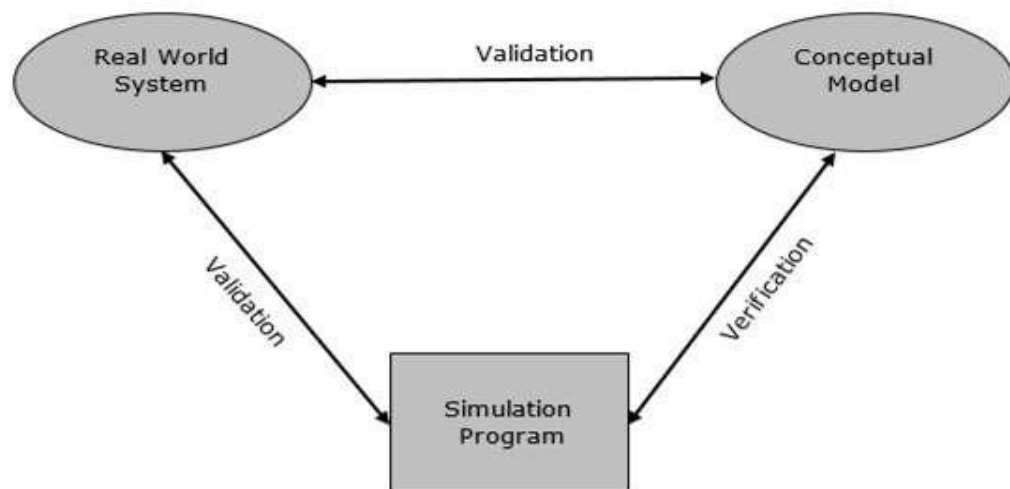

Fig 3.1 Validation and verification data model

Techniques to Perform Validation of data Model

Step 1 Design a model with high validity. This can be achieved using the following steps:-

- The model must be discussed with the system experts while designing.
- The model must interact with the client throughout the process.
- The output must supervised by system experts.

Step 2 Test the model at assumptions data. This can be achieved by applying the assumption data into the model and testing it quantitatively. Sensitive analysis can also be performed to observe the effect of change in the result when significant changes are made in the input data.

Step 3 Determine the representative output of the Simulation model. This can be achieved using the following steps:-

- Determine how close the simulation output with the real system output.
- Comparison can be performed using the Turing Test. It presents the data in the system format, which can be explained by experts only.
- Statistical method can be used for compare the model output with the real system output.

Validating the first time model

Consider we have to describe a proposed system which doesn't exist at the present nor has existed in the past. Therefore, there is no historical data available to compare its performance with. Hence, we have to use a hypothetical system based on assumptions. Following useful pointers will help in making it efficient.

- **Subsystem Validity** A model itself may not have any existing system to compare it with, but it may consist of a known subsystem. Each of that validity can be tested separately.

- **Internal Validity** A model with high degree of internal variance will be rejected due to its internal processes will hide the changes in the output for input changes.

- **Sensitivity Analysis** It provides the information about the sensitive parameter in the system to which we need to pay higher attention.

- **Face Validity** When the model performs on opposite logics, then it should be rejected even if it works like the real system.

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. The process of comparing two results in data modeling is:-
   - A. Verification
   - B. Validation
   - C. Testing
   - D. All can be

2. During model validation we verify that the model executes incorrectly.
   - A. True
   - B. False

Part II Fill the blank space

1. Define Model validation (2pts)

_____

2. Write the basic steps / Techniques to Perform Validation of data Model (4pt)

_____

_____

_____

Answer the following question!

Note: Satisfactory rating 6 points   Unsatisfactory - below 6 points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

Name: _____   Date: _____

Score = _____

Rating: _____

Information sheet 2: Resolving arising issues or recommendations

Recommendations should be secured in the conclusions of an evaluation report, with proper cross referencing. Recommendations are actionable proposals on how to resolve concrete problems affecting the project or the sustainability of its results. They should be feasible to implement within the time-frame and resources available, specific in terms of who would do what and when, and set a measurable performance target. In some cases, it might be useful to propose options, and briefly analyze the pros and cons of each option.

Recommendations should be SMART: -

- Specific,
- Measurable,
- Achievable,
- Result-oriented and
- Time-bound.

For each recommendation, the implementation plan should specify the following information:

- How the recommendation will be implemented;
- Who is responsible for its implementation;
- Expected completion date and;
- What actions have already been taken (if any).

Skills resolve recommendations of clients

Problem-solving skills help you determine the source of a problem and find an effective solution. Although problem solving is often identified as its own separate skill, there are other related skills that contribute to this ability.

Problem-solving skills include:

- Active listening
- Analysis
- Research
- Communication
- Dependability
- Decision making
- Team-building

Problem-solving skills are important in every career at every level. As a result, effective problem solving may also require industry or job-specific technical skills.

Example

A registered nurse will need active listening and communication skills when interacting with patients but will also need effective technical knowledge related to diseases and medications. In many cases, a nurse will need to know when to consult a doctor regarding a patient's medical needs as part of the solution.

Problem-solving skills examples

To solve a problem effectively, you will likely use a few different skills. Here are a few examples of skills you may use when solving a problem:

- Research

Researching is an essential skill related to problem solving. As a problem solver, you need to be able to identify the cause of the issue and understand it fully. You can begin to gather more information about a problem by brainstorming with other team members, consulting more experienced colleagues.

- Analysis

The first step to solving any problem to analyze the situation. Your analytical skills will help you understand problems and effectively develop solutions. You will also need analytical skills during research to help distinguish between effective and ineffective solutions.

- Decision-making

Ultimately, you will need to make a decision about how to solve problems that arise. At times and with industry experience you may be able to make a decision quickly.

- Communication

When identifying possible solutions, you will need to know how to communicate the problem to others. You will also need to know what communication channels are the most appropriate when seeking assistance. Once you find a solution, communicating it clearly will help reduce any confusion and make implementing a solution easier.

- Dependability

Dependability is one of the most important skills for problem-solvers. Solving problems in a timely manner is essential. Employers highly value individuals they can trust to both identify and then implement solutions as fast and effectively as possible.

- Active listening

Active listening refers to a pattern of listening that keeps you engaged with your conversation partner in a positive way. It is the process of listening attentively while someone else speaks, paraphrasing and reflecting back what is said, and withholding judgment and advice.

- Team building

Team building is the process of turning a group of individual contributing employees into a cohesive team a group of people organized to work together to meet the needs of their customers by accomplishing their purpose and goals.

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. Which one is not the behavior of recommendation?

   A. Measurable   C. Time bounded

   B. Specific   D. Criticism

2. Recommendation should be specific in terms of who would do what and when, and set a measurable performance target.

   A. True   B. False

Part II Fill the blank space

1. Define Recommendation (2pts)

_____

2. Write the 4 basic Problem-solving in workplace (4pt)

_____

_____
_____

Answer the following question!

Note: Satisfactory rating 5 and 10 points   Unsatisfactory - below 5 and 10 points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

Score = _____
Rating: _____

Name: _____   Date: _____

Information sheet 3: Documenting completed data model

Document databases don't require the same predefined structure as a relational database, but you do have to define the feature of how you plan to organize your data. It is a type of non relational database that is designed to store and query data as JSON (JavaScript Object Notation), like documents. Document databases make it easier for developers to store and query data in a database by using the same document model format they use in their application code. The flexible, semi structured, and hierarchical nature of documents and document databases allows them to evolve with applications' needs. The document model works well with use cases such as catalogs, user profiles, and content management systems where each document is unique and evolves over time.

The document database is more sensitive for a developer to update an application as the requirements evolve. In addition, if the data model needs to change, only the affected documents need to be updated. No schema update is required and no database downtime is necessary to make the changes.

Using a document database, each product's attributes can be described in a single document for easy management and faster reading speed. Changing the attributes of one product won't affect others.

Document Based Store NoSQL

In this type of database, the record and its associated data are stored in a single document. So this model is not completely unstructured but it is a kind of Semi-structured data. While a SQL database is made up of one or more tables and each table is made up of one or more columns, a NoSQL document store is essentially a single container. Every document that is added to the store is added to this one container. Records in a SQL database are retrieved by means of queries, while a NoSQL document store employs views.

Example

Assume we are getting the details of employees in three different documents namely, Personal_details, Contact and Address; you can embed all the three documents in a single one as shown below.

```
{
        Id:
        Emp_ID: "10025AE336"
        Personal_details:{
                First_Name: "Radhika",
                Last_Name: "Sharma",
                Date_Of_Birth: "1995-09-26"
        },
        Contact: {
                e-mail: "radhika_sharma.123@gmail.com",
                phone: "9848022338"
        },
        Address: {
                city: "Hyderabad",
                Area: "Madapur",
                State: "Telangana"
        }
}
```

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. Which one are document data model use cases?

   A. Catalogs   C. User profiles

   B. Content management   D. All can be
      systems

2. The document database is not sensitive for a developer to update an application as the requirements evolve.

   A. False   B. True

3. In NoSQL database, the record and its associated data are stored in a single document.

   A. False   B.True

Part II Fill the blank space

1. Compare and contrast SQL database and NoSQL database document (4pts)

_____

_____

_____

Answer the following question!

Note: Satisfactory rating 10 points   Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

| Score = _____ |
| Rating: _____ |

Name: _____   Date: _____

Information sheet 4: Submitting for final approval

3.3 Document approval

Document approval procedures in document locator make it easy to know which files are final and approved, who made the approvals, and the complete document approval history. Approval processes support the accurate recording of acceptance or agreement in business documents, policies, work instructions, handbooks, and more.

Document approval steps are designed to support business requirements for efficient reviews. Automatically route notifications and documents to one or more people for their acceptance and sign-off. As files are electronically routed, approvals are recorded in the system. Approval routing actions can be configured to automate tasks based on approval status. Everything is recorded in an audit trail that can be reviewed and analyzed in reports.

Approvals are a core component of workflow, and a foundation of effective process management. Combined with version control, a complete history of prior approved documents is maintained supporting retention regulations and limiting legal liability.

The approval by the client describes the acceptance by the client of the result obtained at the end of a project.
It denotes the successful delivery of the product, goods or services which meets the requirements established at the beginning of the project.
The delivery of the agreed goods or services immediately after production is exactly what the customer expects.

A delivery that completes the order according to the requirements agreed at the time of the design. The approval is therefore a fundamental milestone in the project. The approval means the verification of the product, where the client determines if the designer has delivered an asset that satisfies the agreed goals or not.

Without the verification, and consequently the approval, a project is not completed correctly. This applies even if it has been completed within the time frame and / or the set budget. By accepting the deliverables of the project, the client acknowledges that the product or service delivered is complete, which means that it can be used for the intended purpose. However, verification and final approval are not the only tests that can occur in the project

Advantages of acceptance documentation:

- Managing the expectations between the client and the project team.
- Modifications while maintaining clear communication.
- Maintaining maximum responsibility for each phase of the project.

The criteria for verification and acceptance of an output by the client represent a specific and defined list of conditions that must be met before a project can be considered completed and the final results of the project are accepted by the customer.

Verification criteria are criteria that include performance requirements and essential conditions that must necessarily be met before project deliverables are accepted.

They set specific circumstances under which the client will accept the final output of the project. They must be measurable criteria through which it is possible to demonstrate that the project has been successfully completed. The goal of the PM (project management) is to ensure that at the end of the project, the client verifies and positively accepts the deliverables produced.

Missing verification and acceptance criteria can lead to low levels of client satisfaction, missed delivery dates and / or development costs being exceeded.

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I choose the best answer (each 2 point)

1. The approval by the client describes the acceptance by the client of the result obtained at the end of a project.
   A. False   B. True

2. Verification and final approval are the only tests that can occur in the project
   A. False   B. True

3. Missing verification and acceptance criteria can lead to low levels of client satisfaction
   A. False   B. True

Part II Fill the blank space

1. Write three advantages of acceptance documentation (3pts)

_____

_____

_____

Answer the following question!

Note: Satisfactory rating 9 points   Unsatisfactory - below 9 points

You can ask you teacher for the copy of the correct answers.
Answer Sheet

Score = _____
Rating: _____

Name: _____   Date: _____

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This TTLM developed on December 2020 at Bishoftu, Ethiopia.

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Answer Key

Module Title: Modeling Data Objects

LO #1- Identify entities and relationships	
Self-Check1	**Written Test**

Part I

1. C
2. B

Part II

1. Business Data analysis is defined as a process of cleaning, transforming, and modeling data to discover useful information for business decision making.
2. To extract useful information from data and taking the decision based upon the data analysis.
3. ext Analysis

   Statistical Analysis

   Diagnostic Analysis

   Predictive Analysis

   Prescriptive Analysis

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I

1. C
2. A

Part II

1. System is a group of interacting or interrelated entities that form a unified whole to achieve some common objective.

2. Traffic management system,

   Payroll system,

   Automatic library system,

3. Outputs and Inputs

   Processor(s)

   Control

   Feedback

   Environment

   Boundaries and Interface

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I

1. B
2. D
3. B

Part II

1. Entity can be a single thing, person, place, or object about which the data should be captured and stored in the form of properties, workflow and tables.
2. Attribute defines the information about the entity that needs to be stored.
3. The format of data storage that can hold a distinct type or range of values

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I
1. D
2. B
Part II

1. A business rule is a statement that imposes some form of constraint on a specific aspect of the database, such as the elements within a field specification for a particular field.

Self-Check 5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I

1. B
2. C
3. B

Part II

1. An entity-relationship diagram (ERD) is a data modeling technique that graphically illustrates an information system's entities and the relationships between those entities
2. Entities
   Relationships
   Attributes

LO #2 Develop normalization

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I

1. B
2. C
3. B

Part II

1. An entity-relationship diagram (ERD) is a data modeling technique that graphically illustrates an information system's entities and the relationships between those entities
2. Entities
   Relationships
   Attributes

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I

1. C
2. D
3. B
4. D

Part II

1. Insertion anomalies
   Deletion anomalies
   Update anomalies
2. First normal form
   Second normal form
   Third normal form
   BNCF

Self-Check 3	Written Test

Part I

2. Data reconciliation (DR) is a term typically used to describe a verification phase during a data migration where the target data is compared against original source data to ensure that the migration architecture has transferred the data correctly.

3. Missing records

   Missing values

   Incorrect values

   Duplicated records

LAP TEST #1
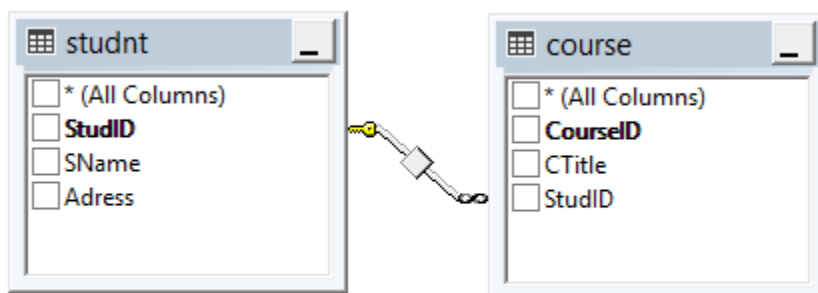
LO #3 Validate model	
Self-Check 1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I

1. B
2. B

Part II

1. Model validation is defined within the regulatory guidance as "the set of processes and activities intended to verify that models are performing as expected.

2. **Step 1** Design a model with high validity.
   Step 2 Test the model at assumptions data.
   Step 3 Determine the representative output of the Simulation model

Self-Check 2	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I

1. D
2. A

Part II

1. Recommendations are actionable proposals on how to resolve concrete problems affecting the project or the sustainability of its results.

2. Active listening

   Analysis

   Research

   Communication

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I

1. D
2. A
3. B

Part II

1. NoSQL database the record and its associated data are stored in a single document.

   SQL database is made up of one or more tables and each table is made up of one or more columns.

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I

1. B
2. A
3. B

Part II

1. Managing the expectations between the client and the project team.

   Modifications while maintaining clear communication.

   Maintaining maximum responsibility for each phase of the project.