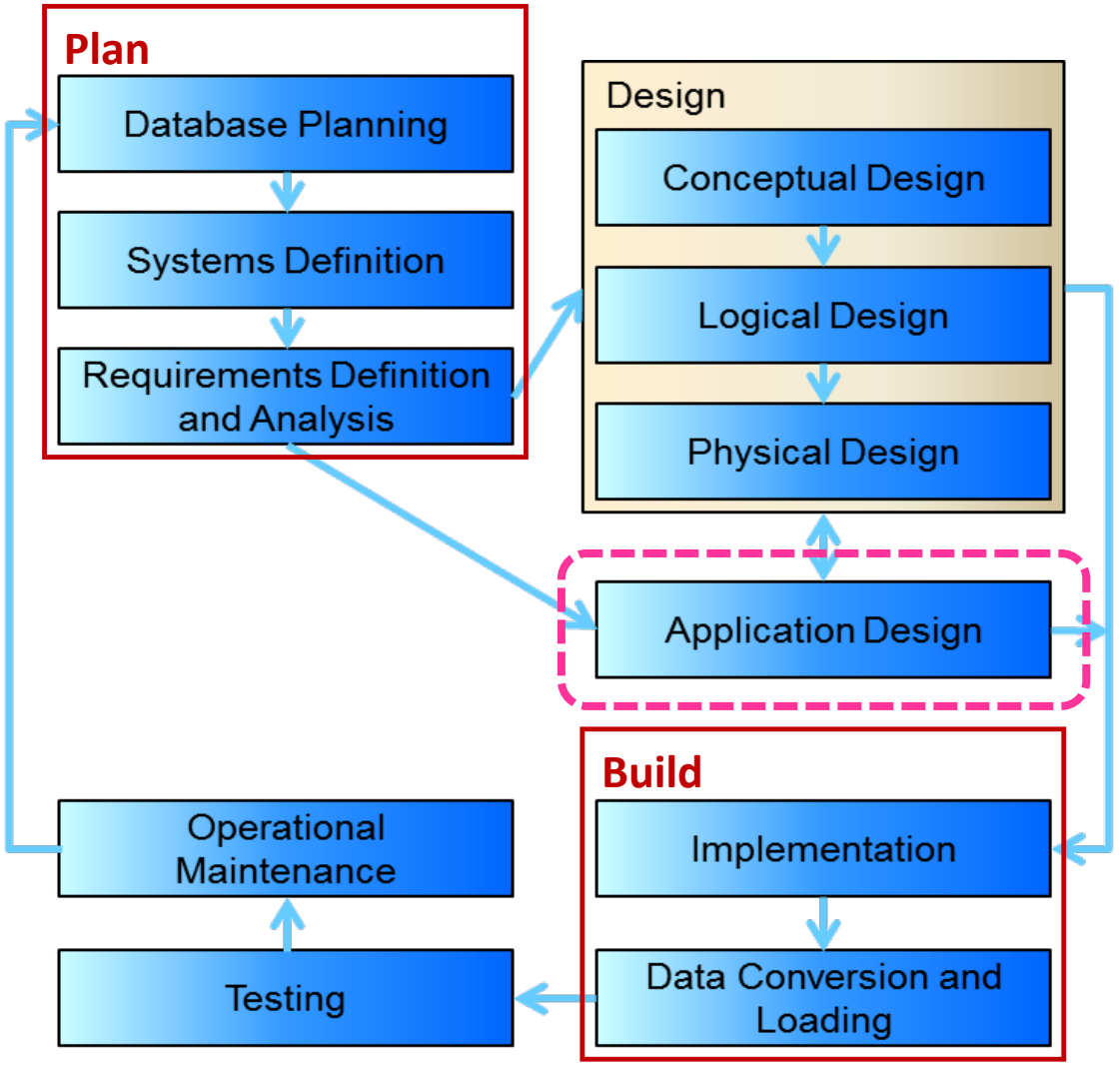
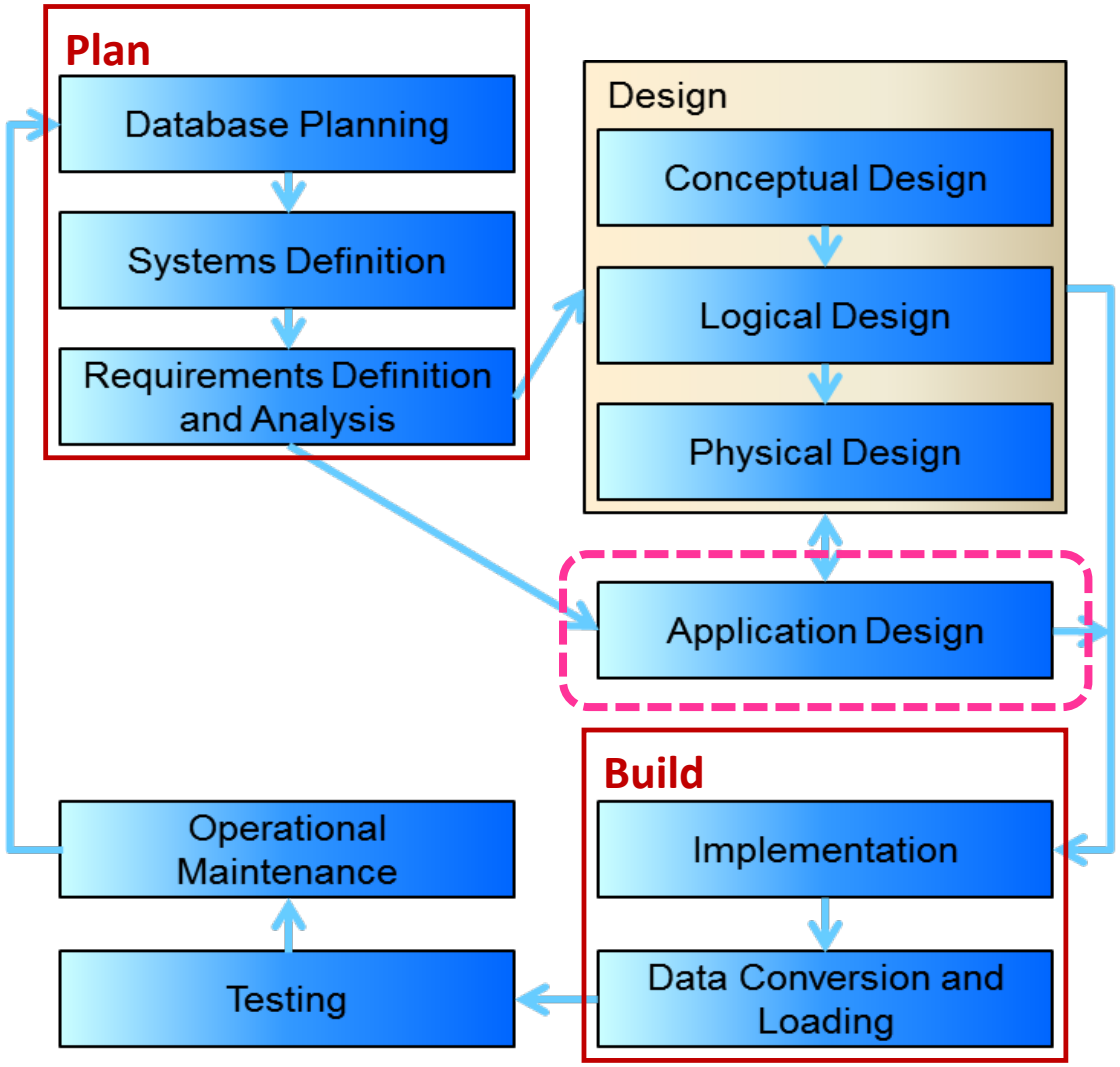
# INFO20003 Database Systems

Week 2

# Database Development Lifecycle



# Q1a)




What is the purpose of each stage and what do we, as database designers, need to do in each stage?

# Plan – Database Planning *

- Planning how to do the project
- Planning how the stages can be completed efficiently and effectively

- Need to do:
  - understanding how the **enterprise** works

# Plan – System Definition *

- Specifying scope and boundaries
  - how the system will operate from different perspective
  - how it interfere in other organisational systems

- Need to do:
  - study different user views or job roles
  - Study how the database application will be linked with the other information systems of the organization

# Plan - Requirements Definition and Analysis

- Collection and analysis of requirements

- Aiming to have:
  - description of the data used or generated
  - data dictionary

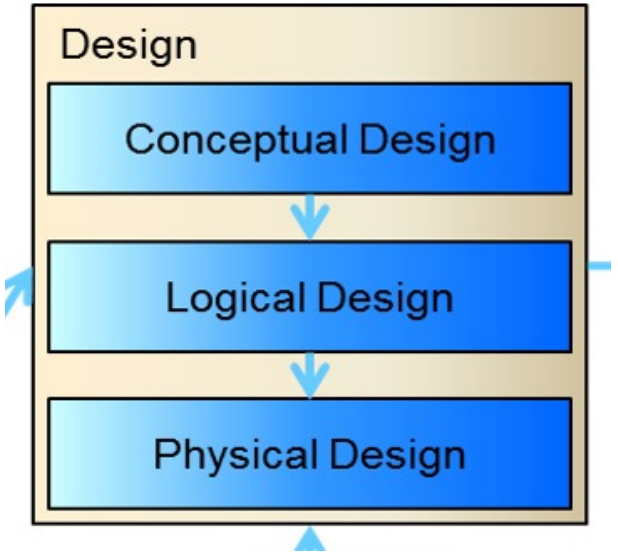
You will be given a case study containing all the requirements during this course whenever a database design is required

# Data dictionary

| Key | Attribute | Data Type | Not Null | Unique | Description |
|---|---|---|---|---|---|
| PK | StaffID | Integer | Y | Y | ID number of the staff member, should be 5 in length. This is the primary identifier (key) of the table. |
| | FirstName | VarChar | | | The first given name of the staff member, up to 100 characters. |
| | LastName | VarChar | Y | | The family name of the staff member, up to 100 characters. This must exist for every staff member |
| | Gender | ENUM | Y | | The gender of the staff member, valid values are only “Male” or “Female” (???). An enumerated data type should be used if possible. This should be limited in applications using this field also. |
| | DateOfBirth | DateTime | Y | | This is when the staff member was born. Needs dd/mm/yyyy format. |
| | ... | | | | |

# Design

- Conceptual Design
- Logical Design
- Physical Design



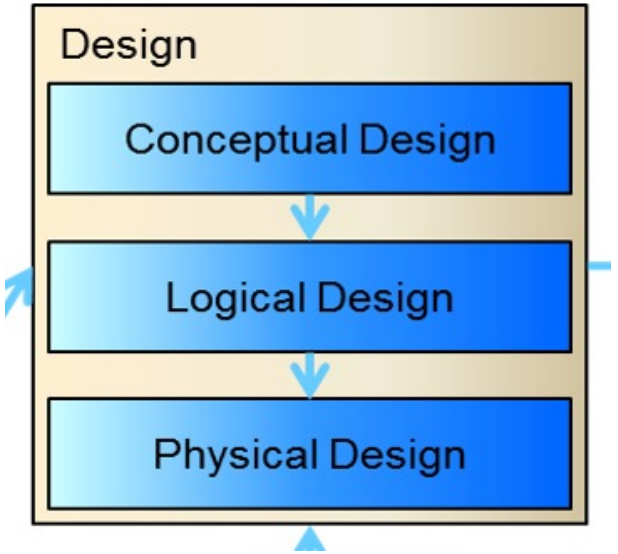
# Conceptual Design

- Construction of a model of the DATA
- **ER** diagrams

- independent of database model & all physical considerations

# Design

- Conceptual Design
- Logical Design
- Physical Design

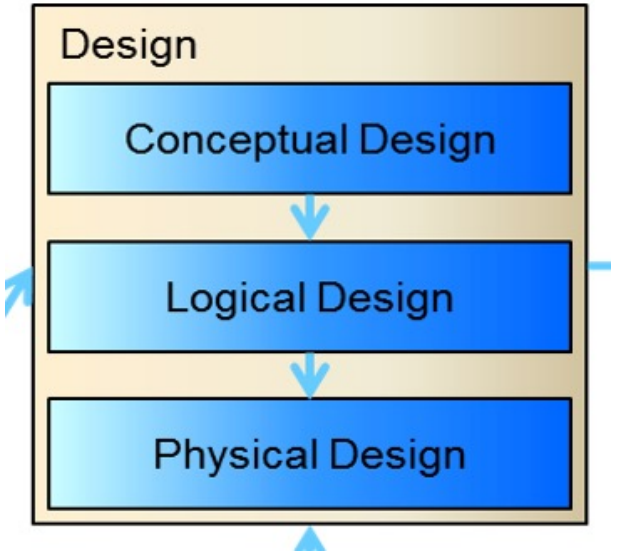


# Logical Design

- The model of the data is now based on a specific database model
- but independent of a particular database management system

# Design

- Conceptual Design
- Logical Design
- Physical Design



# Physical Design

- Target a specific DBMS

- Describes:
  - **data types**
  - Indexing & file organisations
  - etc

# Application Design *

- design of the **user interface**
- Design **application programs** that use and process the database
- (done in conjunction with model design)

# Implementation

- the physical realization of the database and application designs
- the programming phase of the systems development

# Data conversion and loading *

- needed when a new database is replacing an old system
- existing data will be transferred into the new database

# Testing *

- Running the database to find errors in the design/setup

- Analyze:
  - Performance
  - Robustness
  - Adaptability etc

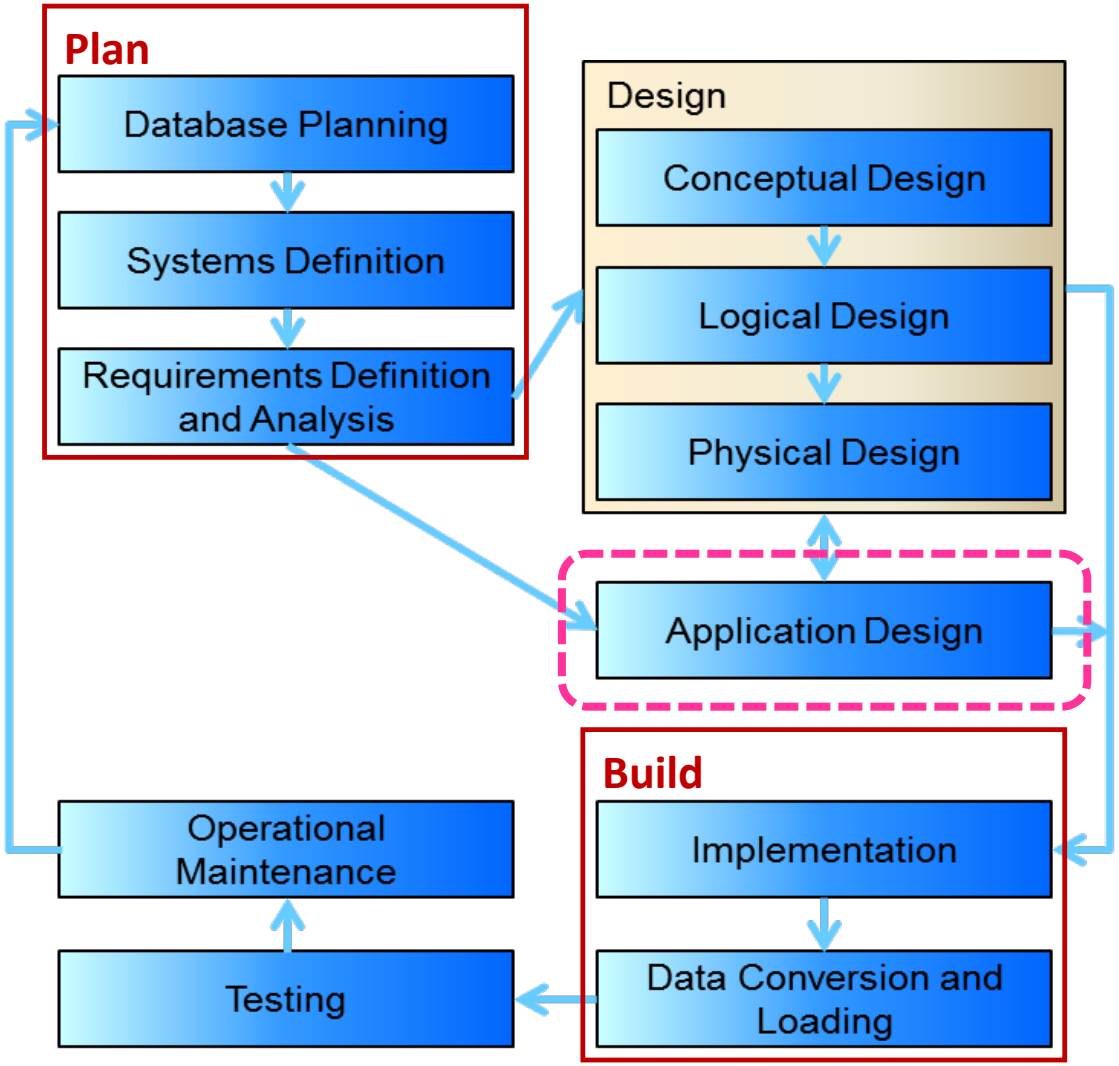
- ! The goal is not to prove the software is working well

# Operational Maintenance *

- **Monitoring**: the performance of the system is observed
  - tuning or reorganization of the database may be required

- **Maintaining** and **upgrading** database system
  - when new requirements arise, the new development lifecycle will be done

# Q1b)




Describe the tasks that are performed in the conceptual design stage to generate a conceptual model

# Conceptual Design

Identify:

- entities & relationships
- constraints
- attributes for entities & relationships

Develop a database schema, and display as an ER model

# Q1c)

## How do you refine a conceptual model to convert it to a logical model (Relational)?

- **Resolve multi-valued attributes**
  - Flatten if there is a small finite number of values
  - Otherwise split into another table
- **Resolve composite attributes**
  - Redrawing the component parts as separate attributes
- **Resolve Relationships**

- Name changed to **CamelCase**

# Resolving Relationships

- **Resolve many-to-many relationships**
  - Create an associative entity
- **Resolve one-to-many relationships**
  - Add FK to the ‘one’ side
- **Resolve one-to-one relationships**
  - Add FK to the total participation end (bold line) to have less NULL value
  - if both partial participation → arbitrarily choose any

# Q1d)

What must be done to transform a logical model to a physical model (Relational)?

- Choose data types
- Add Null/Not Null constraints
- etc

# Business rules from the requirements

From the requirements definition, we can extract business rules

Business rules are statements that **define** or **constrain** aspects of the business's data:

- "Vehicles included in a policy have their Model recorded" – defines data
- "A vehicle can be related to only one policy" – constrains the data

# Q2

**2. Consider the following case study:**

A cinema chain operates a number of cinemas. Each cinema has several screens, numbered starting from 1. The chain keeps track of the size (in feet) and seating capacity of every screen, as well as whether the screen offers the Gold Class experience.

The cinema chain owns hundreds of movie projectors – both film projectors (16 mm and 35 mm) and digital projectors (2D and 3D). The chain stores key information about each projector, namely its serial number, model number, resolution and hours of use. Each movie screen has space for a single projector; technicians must be able to identify which screen each projector is currently projecting onto.

A wide range of movies are shown at these cinemas. The system should keep track of the last time a movie was shown on a particular screen. The marketing department needs to know the movie's title and year of release, along with the movie's rating (G, PG, M, MA15+ or R18+).

Each cinema has a numeric ID, name and address. For cinemas that are not owned outright, the business also keeps track of yearly rent. The system needs to be able to generate weekly activity reports for the chain's chief operating officer.

a. Identify the **entities**.
b. Identify the **business rules**.
c. For any three identified entities, list the **attributes**.

a. entities
b. Attributes for 3 entities
c. Additional business rules (constraints)

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# Entities

- Cinema
- Screen
- Projector
- Movie

"Cinema chain" is **not** an entity in this scenario. You do not normally include the actual business or company whose business processes you are modelling. This is because there is only one instance of this company, and there is no data to store about it in any case.

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# Attributes

- “Each cinema has a **numeric ID**, **name** and **address**. For cinemas that are not owned outright, the business also keeps track of **yearly rent**.”

Cinema (ID, name, address, yearly rent)

# Attributes

- Screens are "… **numbered starting from 1**. The chain keeps track of the **size** (in feet) and **seating capacity** of every screen, as well as **whether the screen offers the Gold Class experience**."

Screen (number, size, seating capacity, has Gold Class?)

# Attributes

- There are "… **film projectors (16 mm and 35 mm) and digital projectors (2D and 3D)**. The chain stores key information about each projector, namely its **serial number**, **model number**, **resolution** and **hours of use**."

Projector (format [16 mm film/35 mm film/2D digital/3D digital], serial number, model number, resolution, hours of use)

# Attributes

- “The marketing department needs to know the movie’s **title** and **year of release**, along with the movie’s **rating** (G, PG, M, MA15+ or R18+).”

Movie (title, year of release, rating)

# Attributes

- **Cinema** (ID, name, address, yearly rent)
- **Screen** (number, size, seating capacity, has Gold Class?)
- **Projector** (format [16 mm film/35 mm film/2D digital/3D digital], serial number, model number, resolution, hours of use)
- **Movie** (title, year of release, rating)

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A cinema chain operates a number of cinemas. Each cinema has several screens, numbered starting from 1. The chain keeps track of the size (in feet) and seating capacity of every screen, as well as whether the screen offers the Gold Class experience.

One to many key constraint

The cinema chain owns hundreds of movie projectors – both film projectors (16 mm and 35 mm) and digital projectors (2D and 3D). The chain stores key information about each projector, namely its serial number, model number, resolution and hours of use. Each movie screen has space for a single projector; technicians must be able to identify which screen each projector is currently projecting onto.

One to one key constraint

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lastTimeShown Relationship attribute

Each cinema has a numeric ID, name and address. For cinemas that are not owned outright, the business also keeps track of yearly rent. The system needs to be able to generate weekly activity reports for the chain's chief operating officer.

a. Identify the **entities**.
b. Identify the **business rules**. (statements that define or constrain aspects of the business)
c. For any three identified entities, list the **attributes**.

# Additional Business Rules

- Each cinema has several screens, numbered starting from 1
- Each movie screen has space for a single projector
- Technicians must be able to identify which screen each projector is currently projecting onto.
- The system should keep track of the last time a movie was shown on a particular screen

# Tutorial Slides

- https://github.com/AngieYYF/INFO20003_2024_S2
- Uploaded on Friday