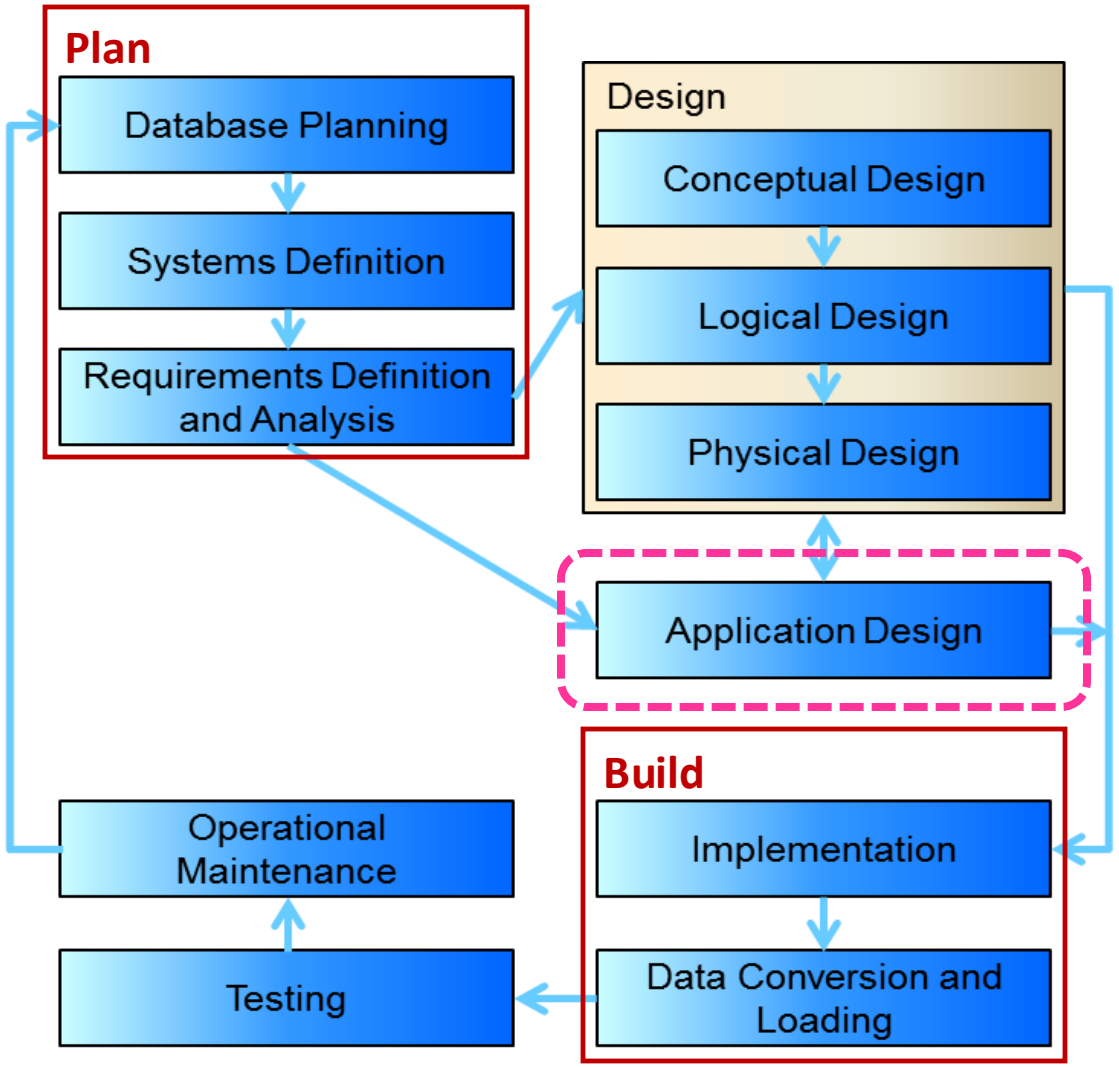
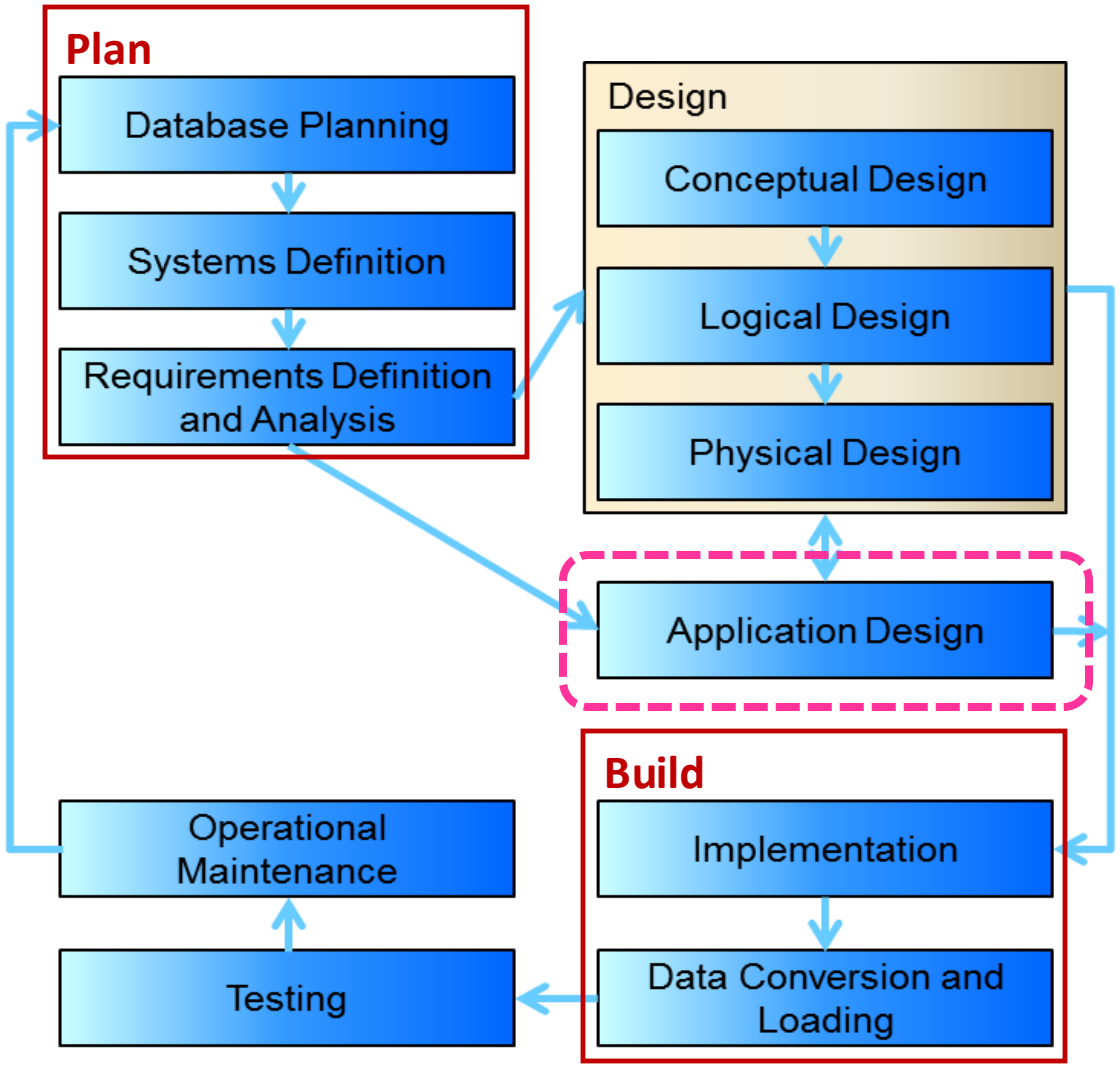
INFO20003 Database Systems

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 (metadata)
  - data dictionary to store the metadata

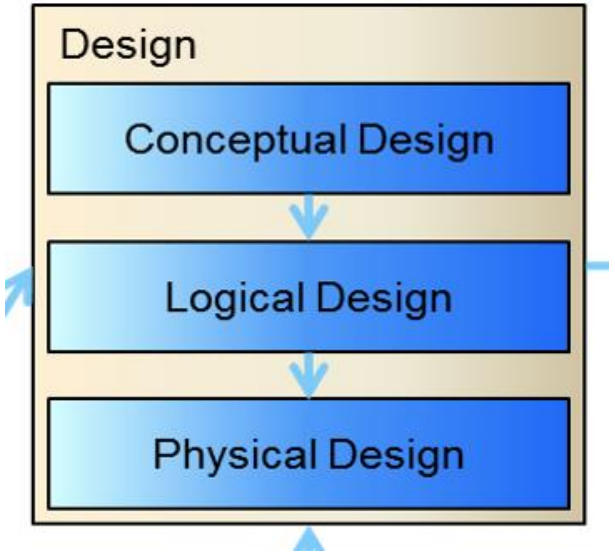
You will be given a case study containing all the requirements during this course whenever a database design is required

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

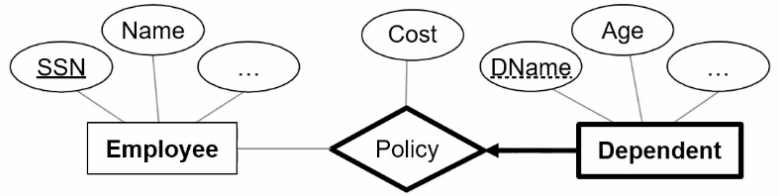
- Conceptual Design
- Logical Design
- Physical Design



Conceptual Design

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

Example ER diagram
(entities, attributes, relationships)



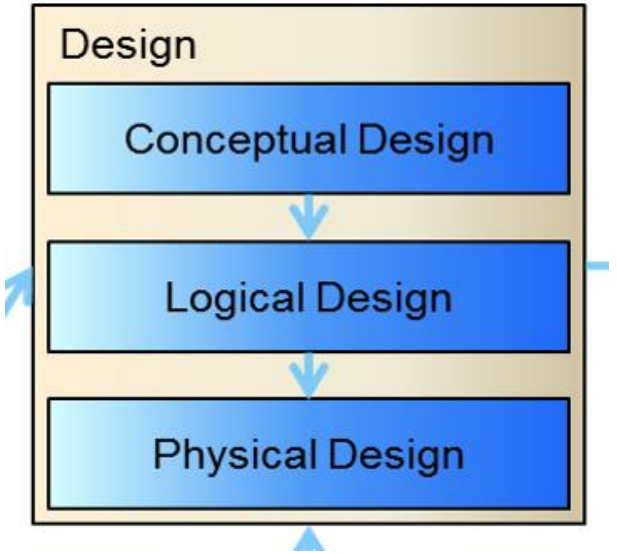
- independent of database model & all physical considerations

Model of **DATA**: data stored in the database and their relationships, displayed using an ER model.
(e.g. entities, attributes, relationships)

Database model: structure of the database / format of storing the data (e.g. relational database uses table format)

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

Enrolled

sid	cid	grade
53666	Carnatic101	5
53666	Reggae203	5.5
53650	Topology112	6
53666	History105	5

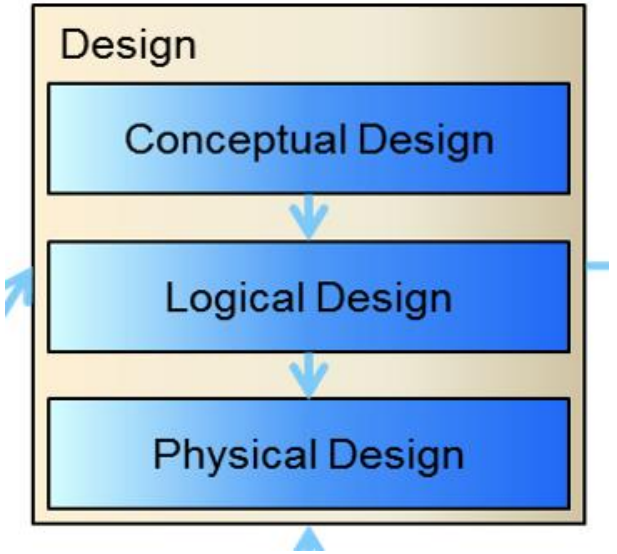
Students

sid	name	login	age	gpa
53666	Jones	jones@cs	18	5.4
53688	Smith	smith@eecs	18	4.2
53650	Smith	smith@math	19	4.8

Relational database model: data stored in form of tables, with relationships/links recorded using FKs (e.g. sid in Enrolled)

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

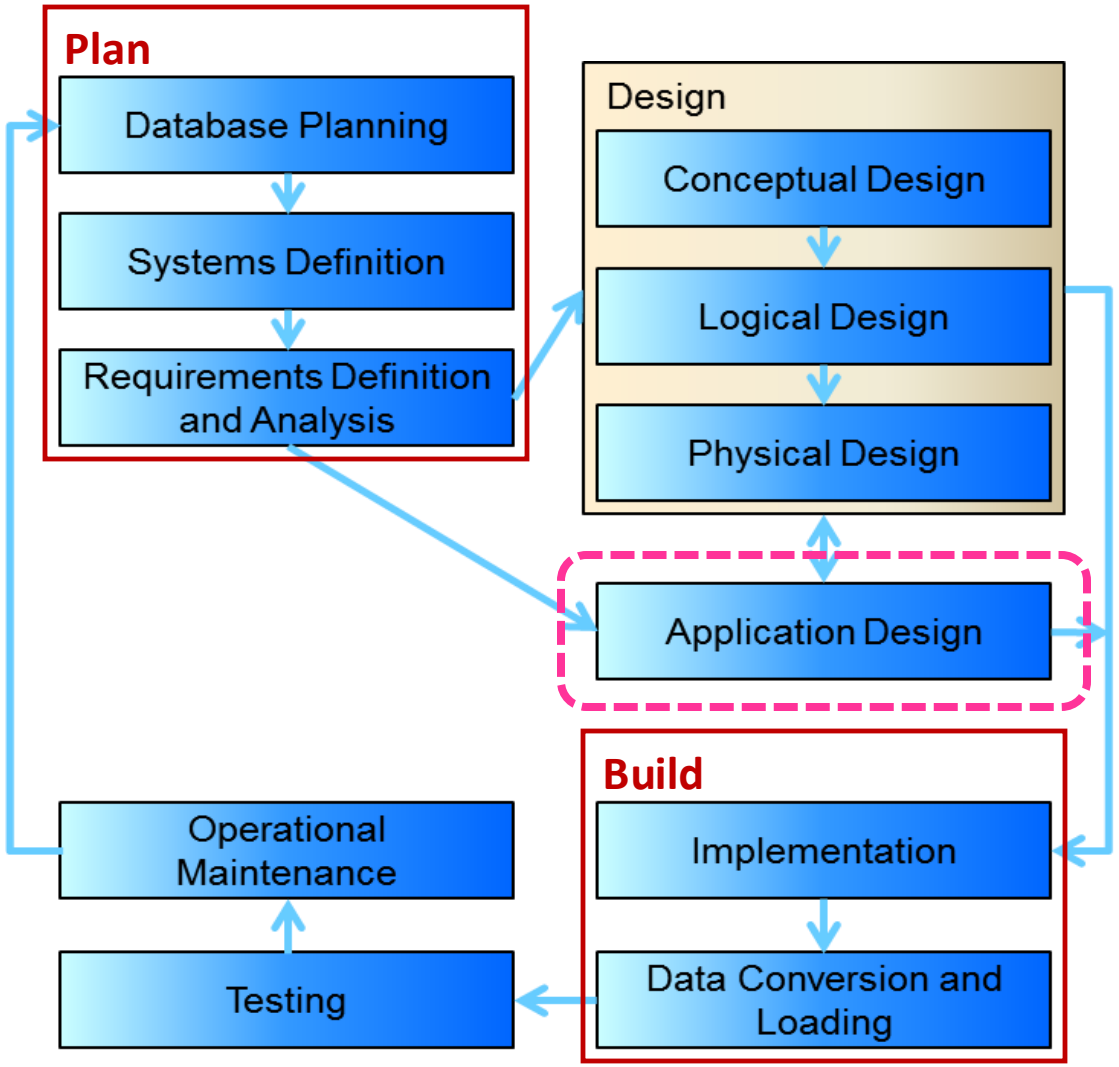
- ! The goal is not to prove the software is working well

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: An entity is a real-world object or concept distinguishable from other objects or concepts
- Relationships between entities
- Constraints on relationship, including key & participation constraints
- attributes to describe 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 (with arrow coming out of it)
- **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

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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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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

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+).

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_2025_S2
- Uploaded on Friday/Weekend