Database Systems
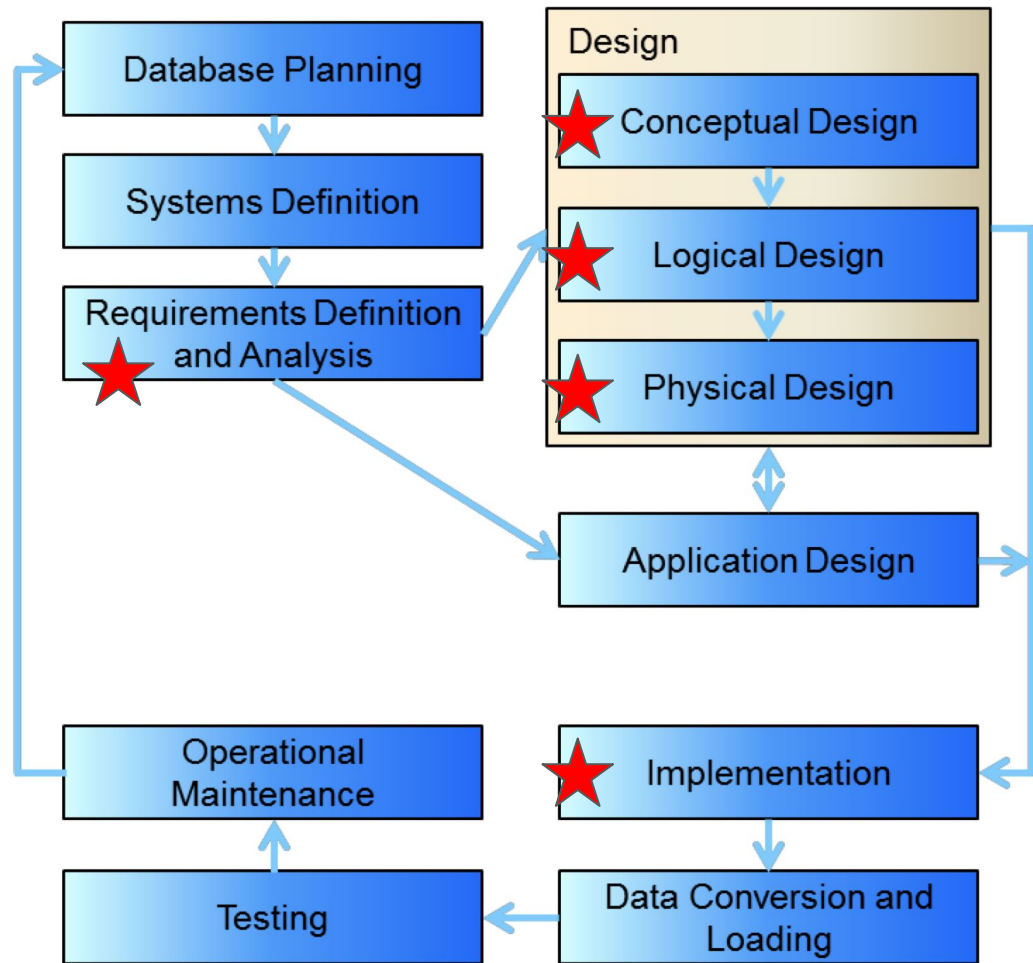
Tutorial Week 2

Objectives

I. Review the Database Development Lifecycle focusing on the design stage (Q1)

II. Case study — identify entities, business rules and attributes (Q2)
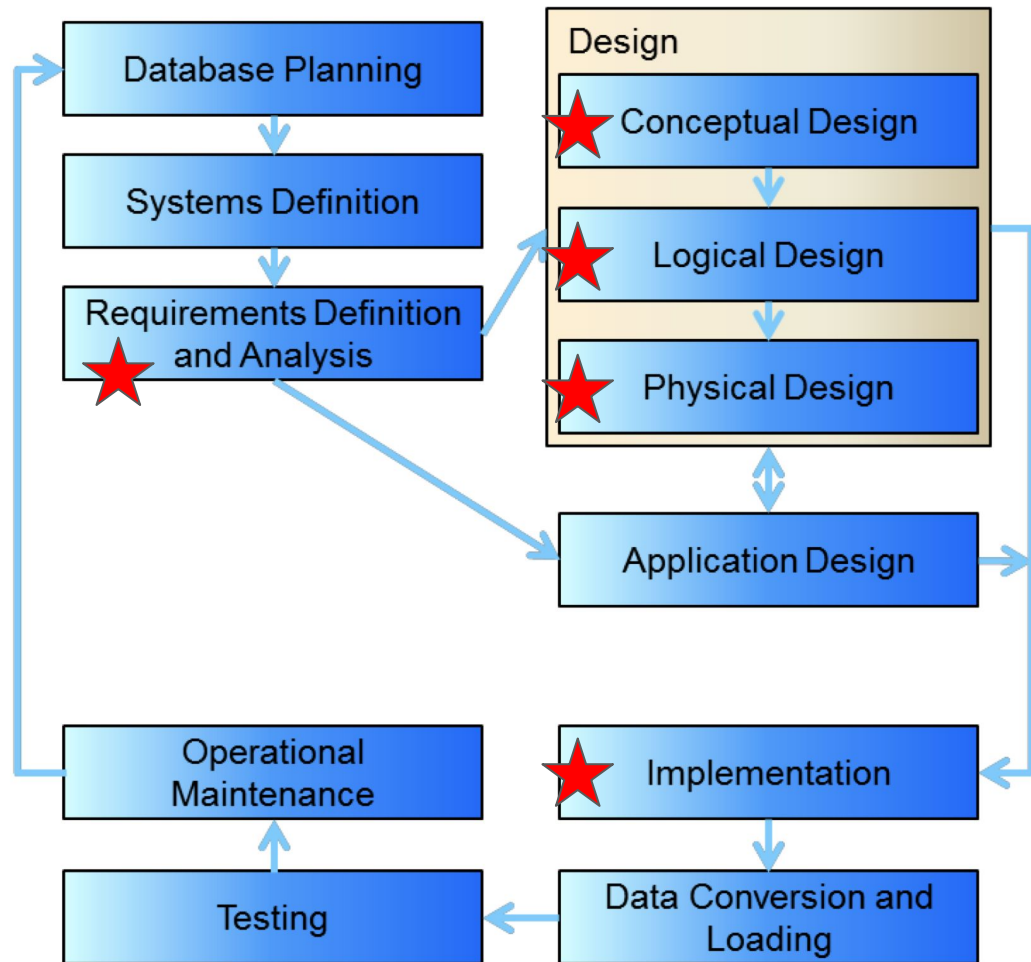
Exercises:

Stages of the Database Development Lifecycle

⭐ = in scope of the subject

Note: designers are often not involved in all stages

Database Planning

Systems Definition

Requirements Definition and Analysis ⭐

Design
- Conceptual Design ⭐
- Logical Design ⭐
- Physical Design ⭐

Application Design

Operational Maintenance

Implementation ⭐

Testing

Data Conversion and Loading
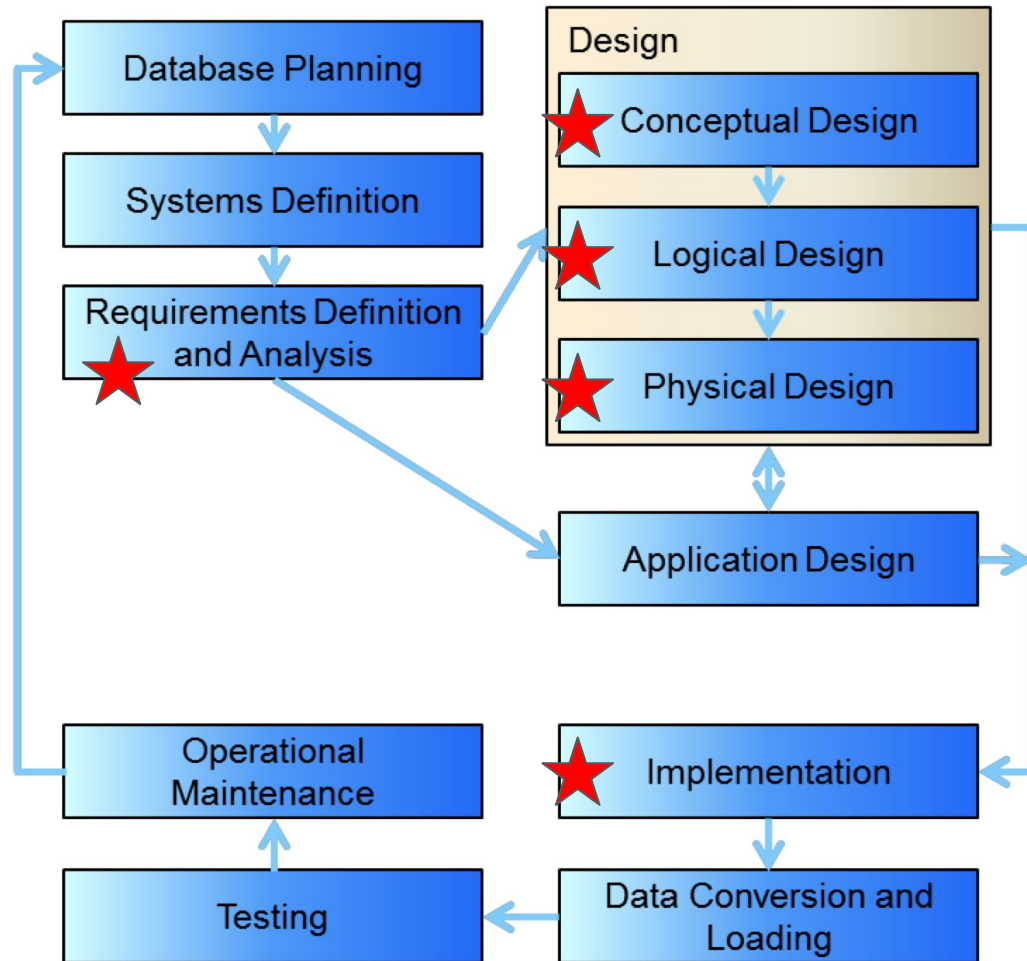
Exercises:

Stages of the Database Development Lifecycle

DISCUSS

1a) What is the purpose of each stage and what do we, as database designers, need to do in each stage? (7 mins)
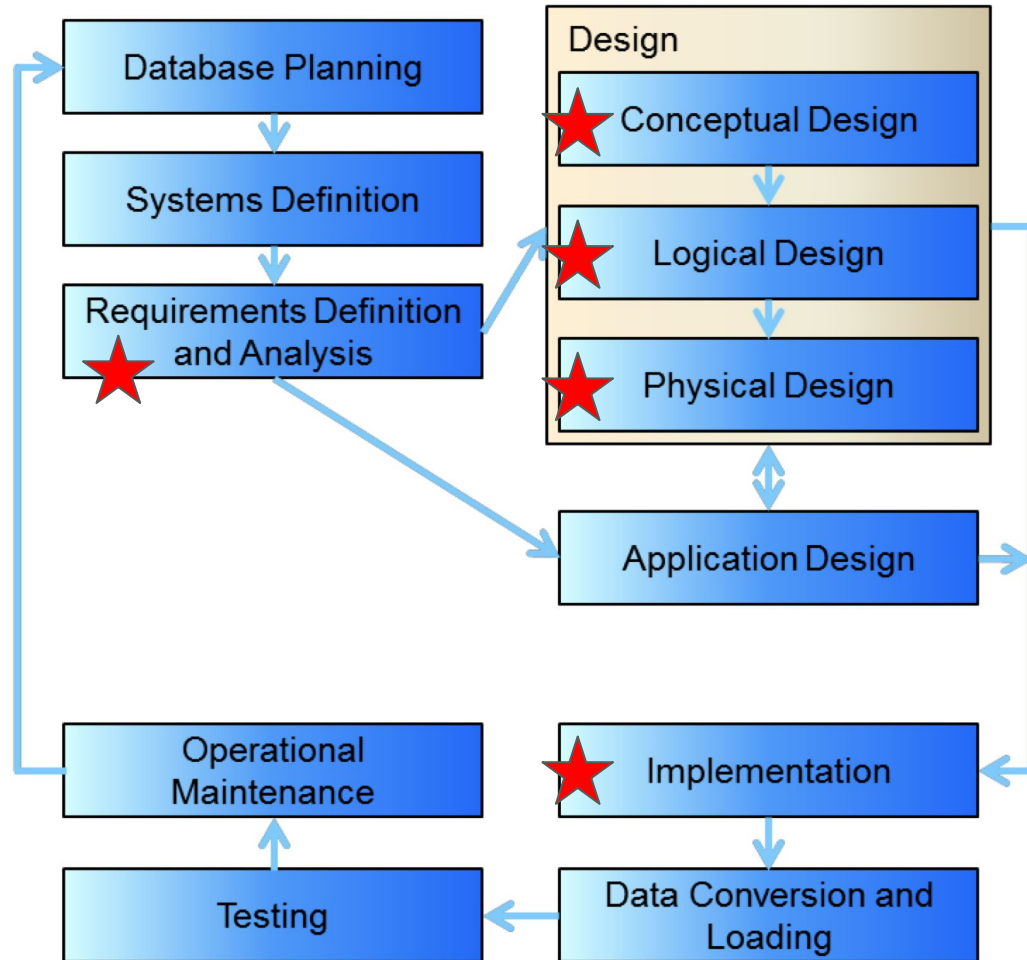
Exercises:

Stages of the Database Development Lifecycle

Database planning:

- Plan how to do the project efficiently and effectively
- Logistics of project — cost? Time?
- Plan a high-level overview of how an organisation / enterprise works for better data modelling
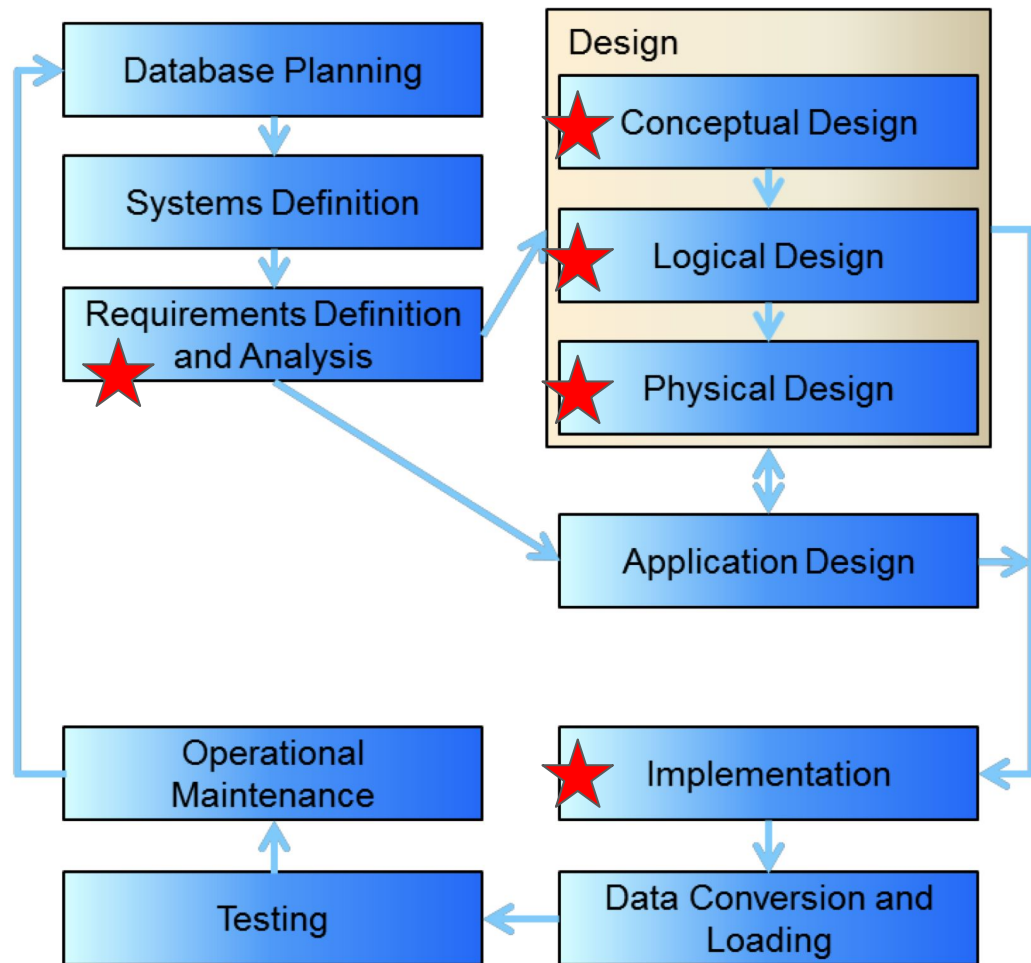
Exercises:

Stages of the Database Development Lifecycle

Systems definition:

- Specify scope and boundaries
- How different users will interact with the system e.g. different job roles

Database Planning

Systems Definition

Requirements Definition and Analysis

Design

⭐ **Conceptual Design**

⭐ **Logical Design**

⭐ **Physical Design**

Application Design

Operational Maintenance

⭐ **Implementation**

Testing

Data Conversion and Loading
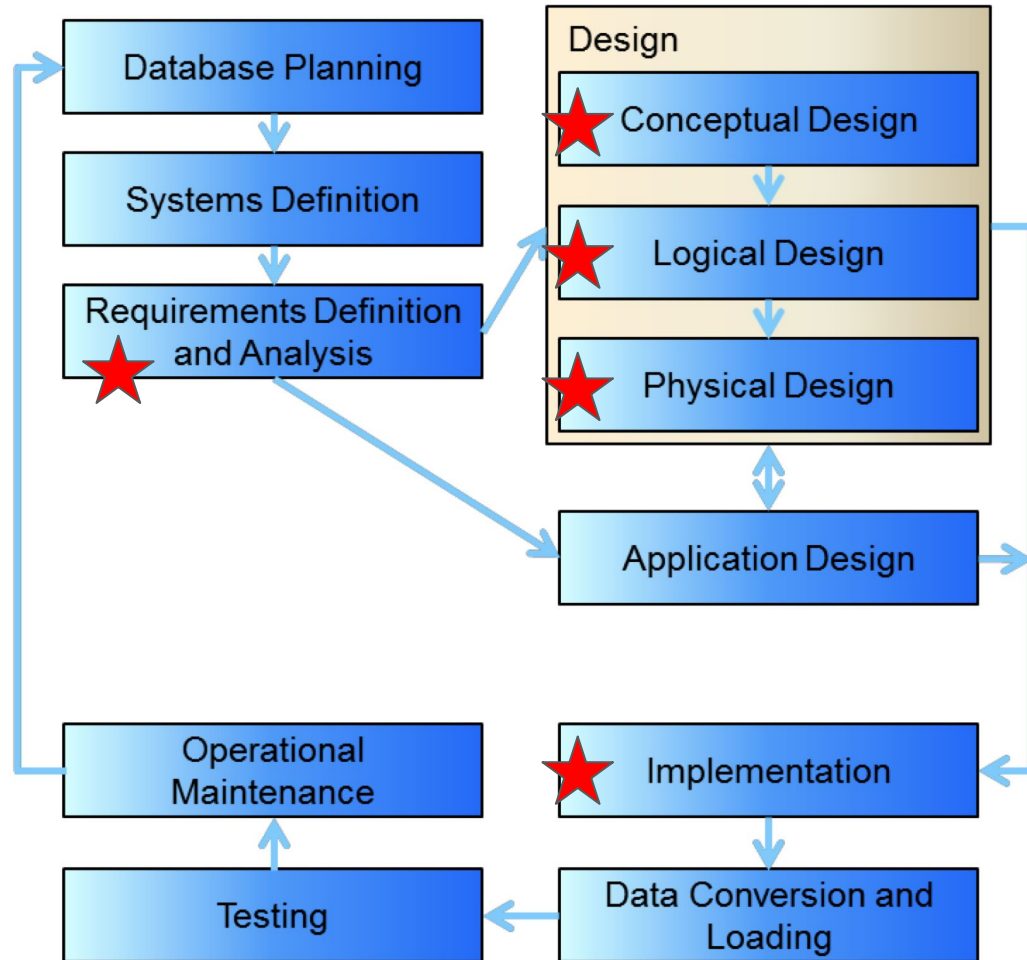
Exercises:

Stages of the Database Development Lifecycle

Requirements definition and analysis:

- Collect and analyse requirements for the database
- Results in "business rules" which a database should fulfil
- Gives you context around what a client wants for a database
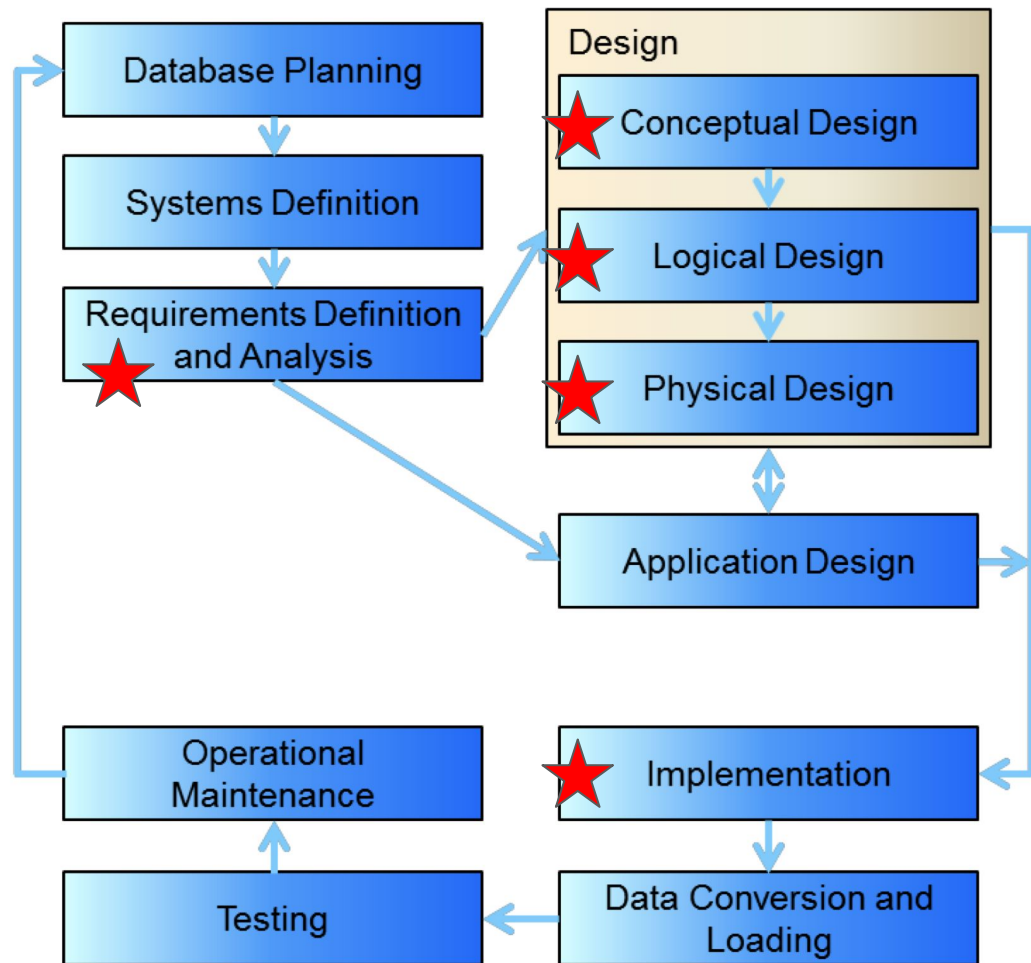
Exercises:

Stages of the Database Development Lifecycle

Conceptual design:

- Identify and model entities and relationships
- Database schema developed and displayed as an ER model
- Don't consider data format e.g. XML, JSON, database
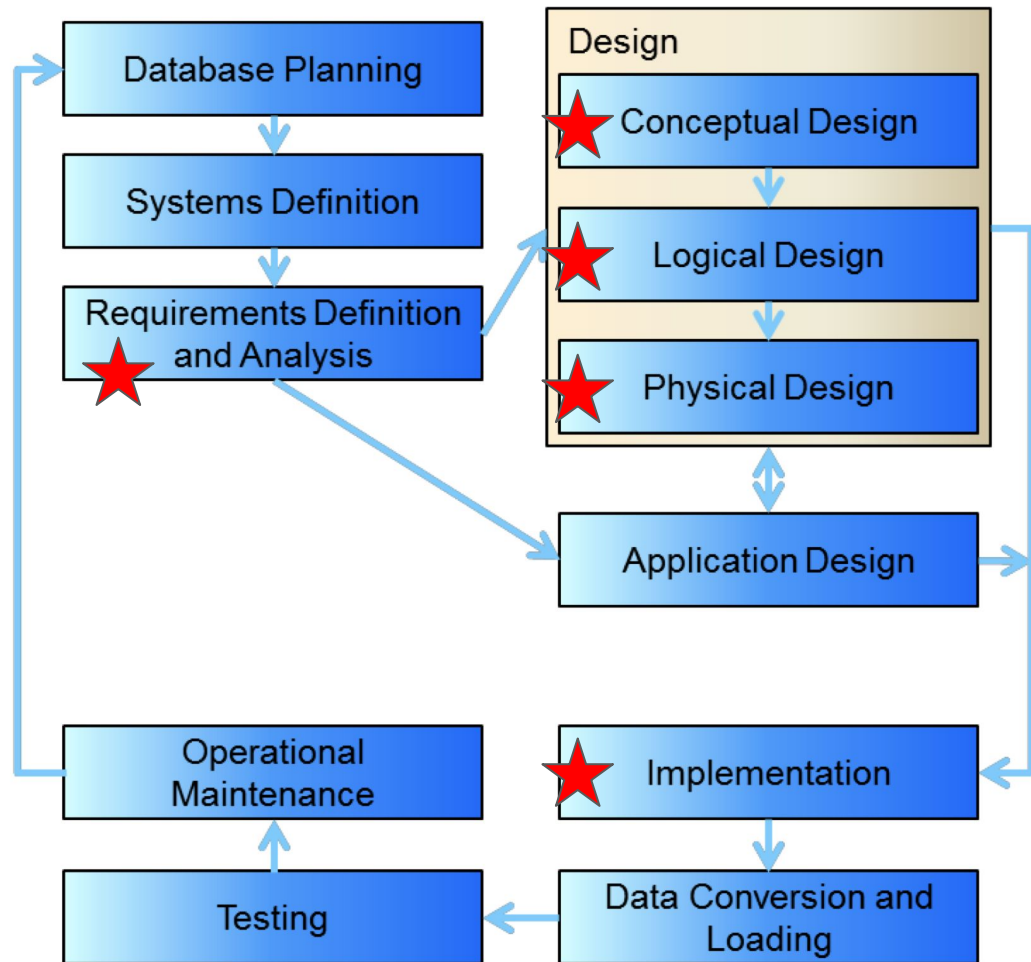
Exercises:

Stages of the Database Development Lifecycle

Logical design:

- Choose a specific data format, e.g. JSON, XML, relational model, NoSQL
- Don't consider DBMS
- Consider constraints e.g. PK, FK
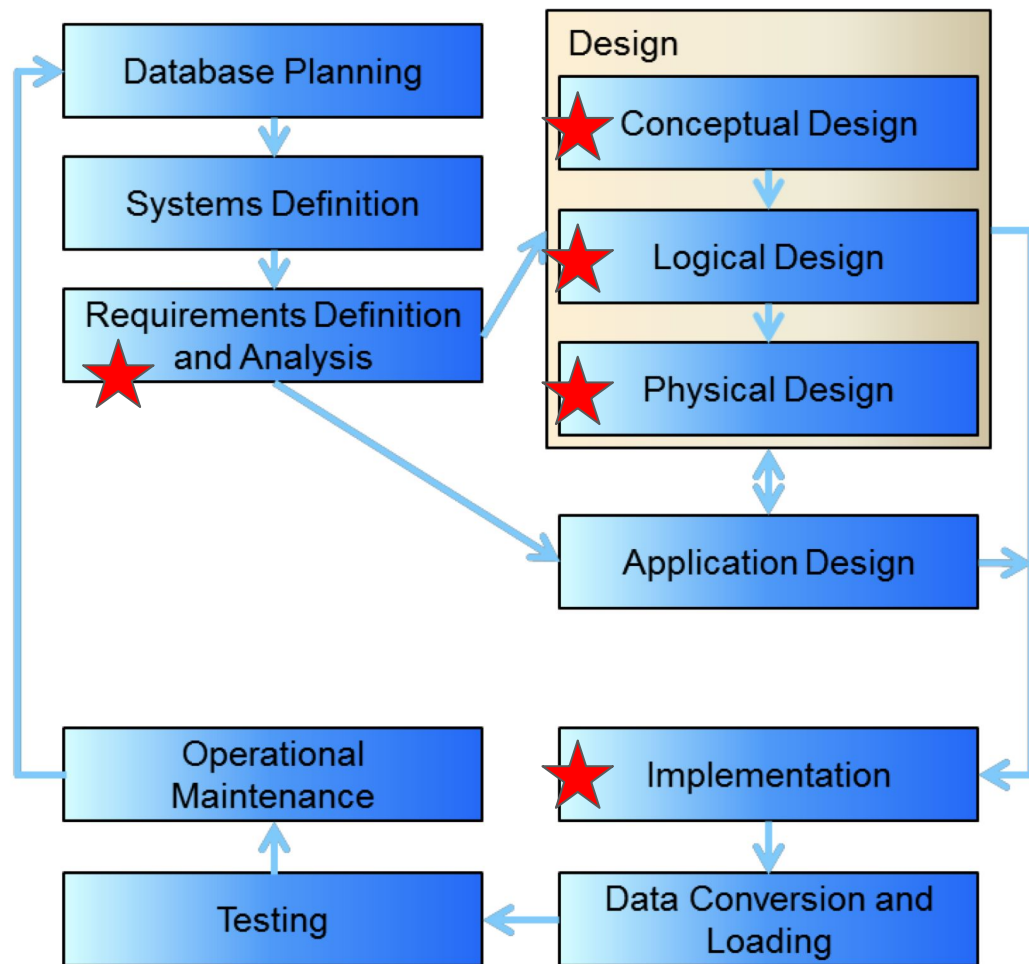- Will focus on logical modelling in upcoming tutes

Exercises:

Stages of the Database Development Lifecycle

Physical design:

- Choose data types for each attribute e.g. decimal or float
- Choose which database system to use e.g. MySQL, Oracle, Microsoft SQL
- Security access/server settings
- How to store data on disk
- Which indices to build to speed up analyses
- Will be covered mainly in labs

Database Planning

Systems Definition

Requirements Definition and Analysis

Design

Conceptual Design

Logical Design

Physical Design

Application Design

Operational Maintenance

Implementation

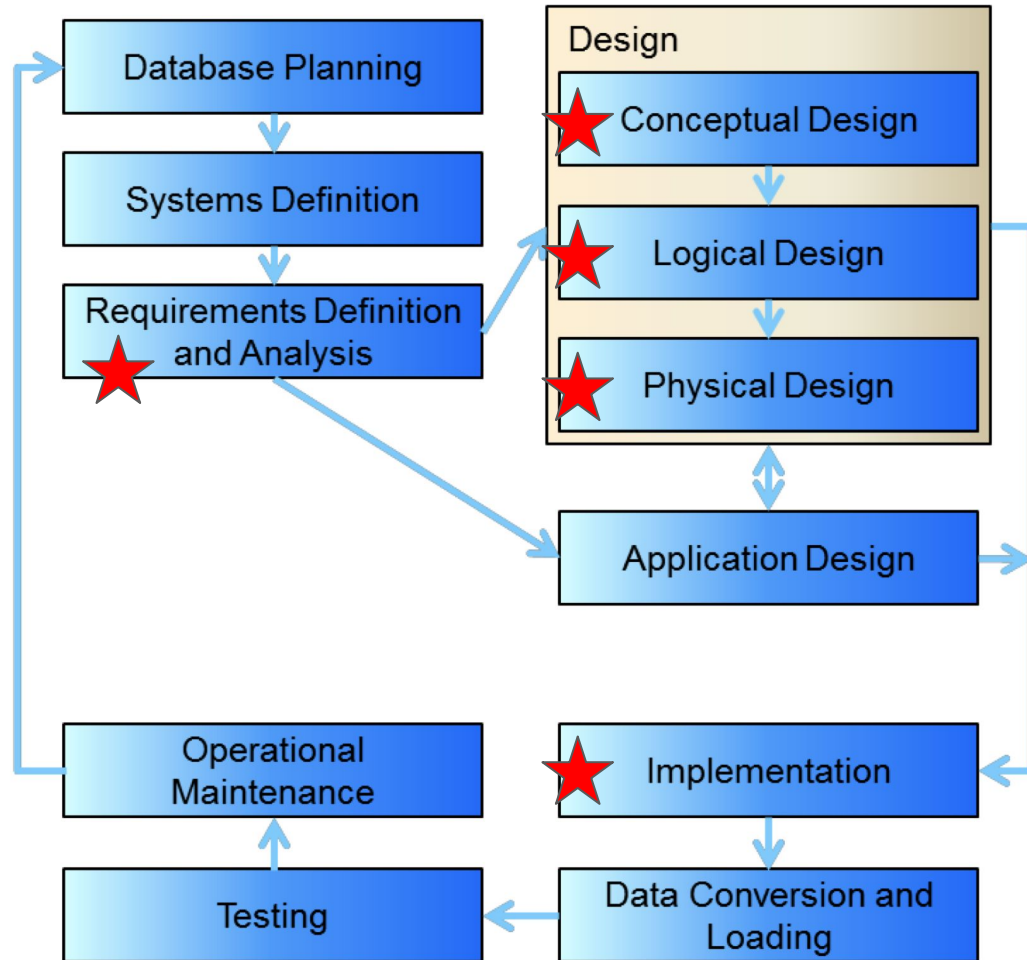Testing

Data Conversion and Loading

Exercises:

Stages of the Database Development Lifecycle

Application design:

- Design UI and application programs that use and process the database (frontend)
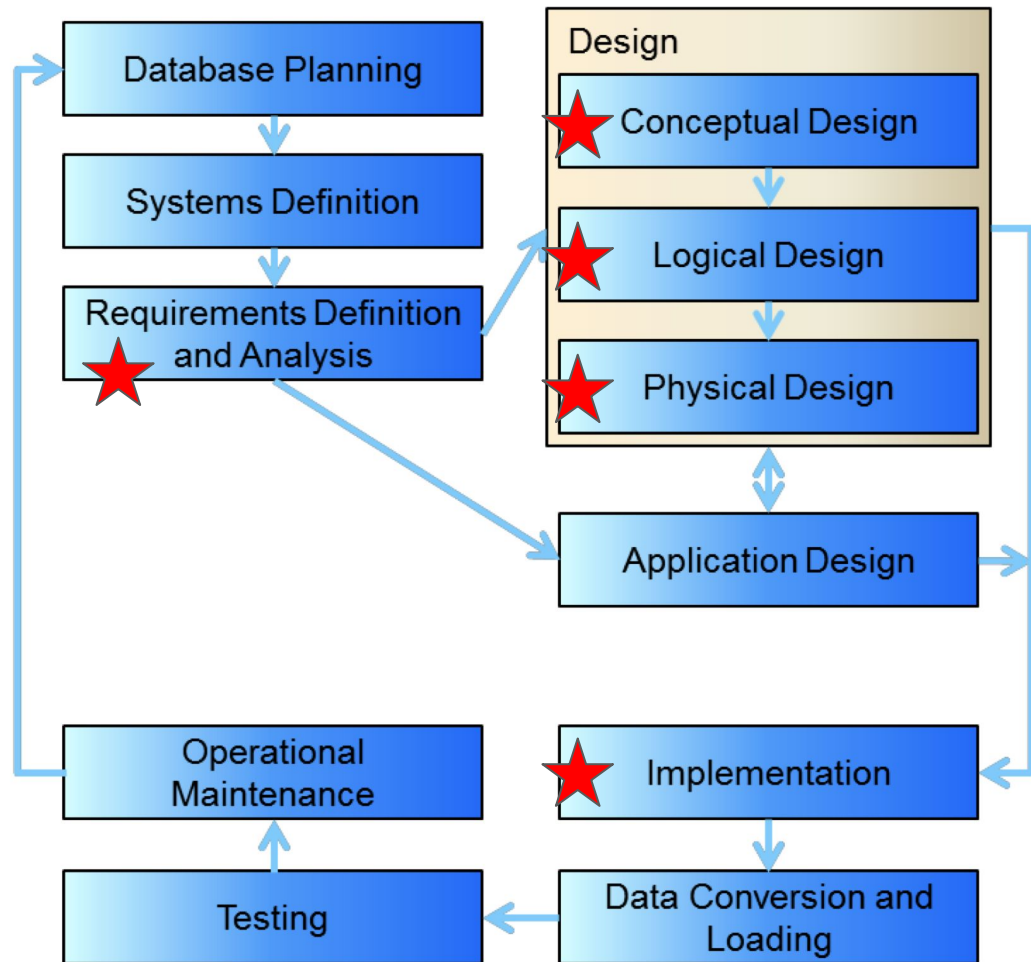
Stages of the Database Development Lifecycle

Implementation:

- Write SQL code
- When run in a specific DBMS, it creates a functional database
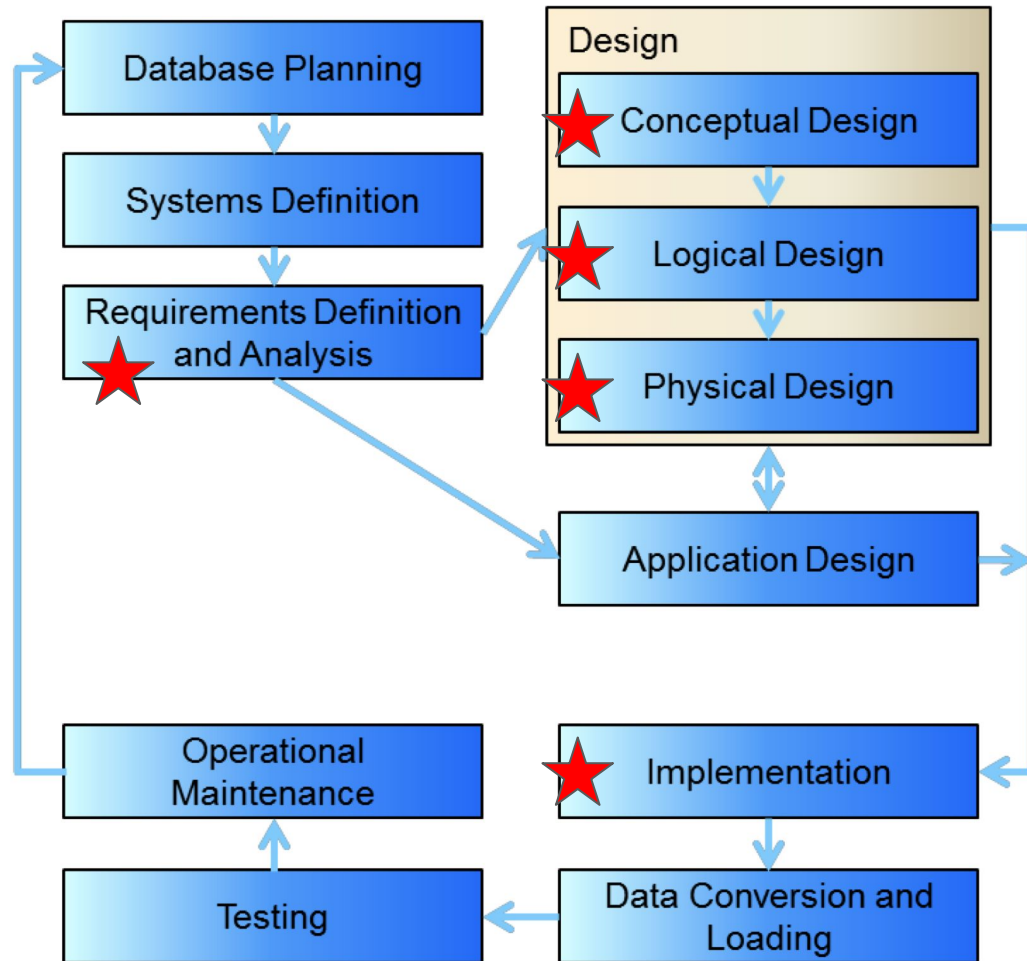- Physical realisation of the database

Exercises:

Stages of the Database Development Lifecycle

Data conversion and loading:

- Transfer existing data into database
- Hard :(

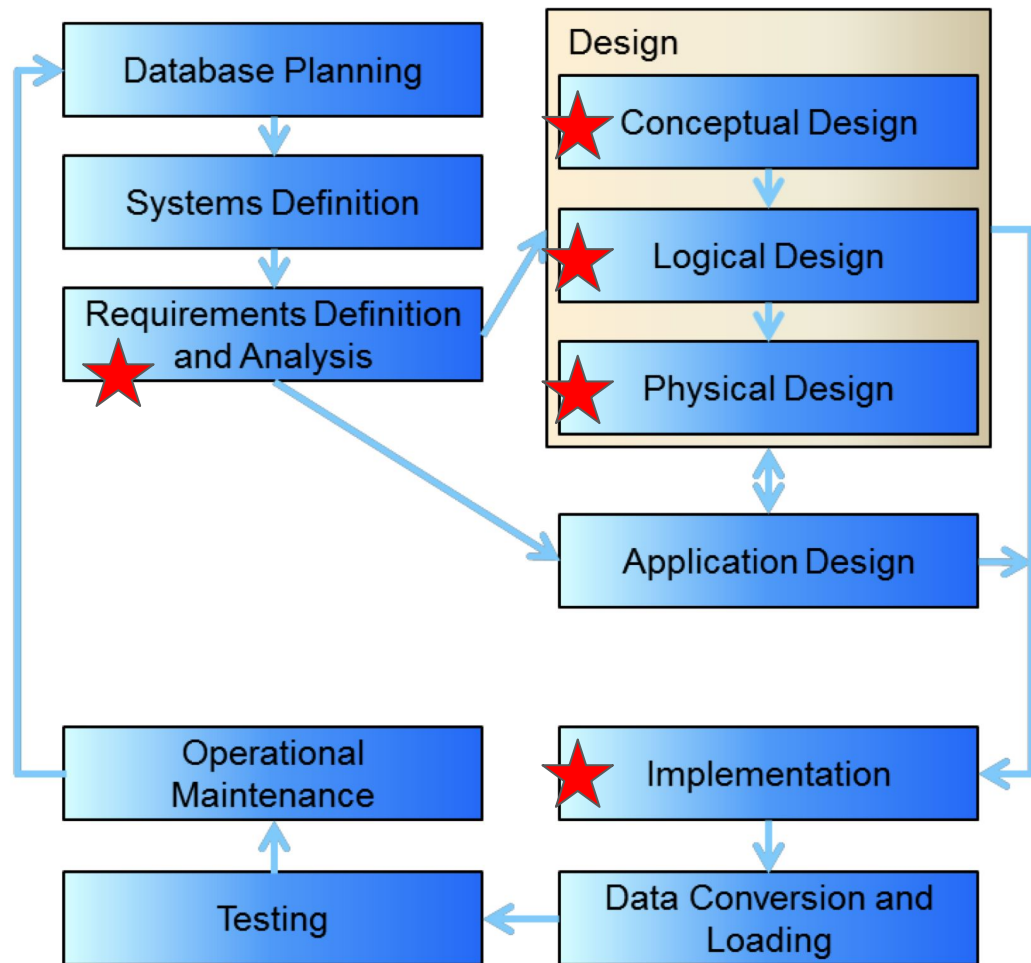# Stages of the Database Development Lifecycle

Testing:

- Find errors in design
- Can it support requirements? Has it been set up correctly?
- Analyse performance, adaptability and robustness

Stages of the Database Development Lifecycle

Operational maintenance:

- Monitor the database's performance
- Might need to tune or reorganise the database
- When new requirements come up, might start lifecycle again

Exercises:
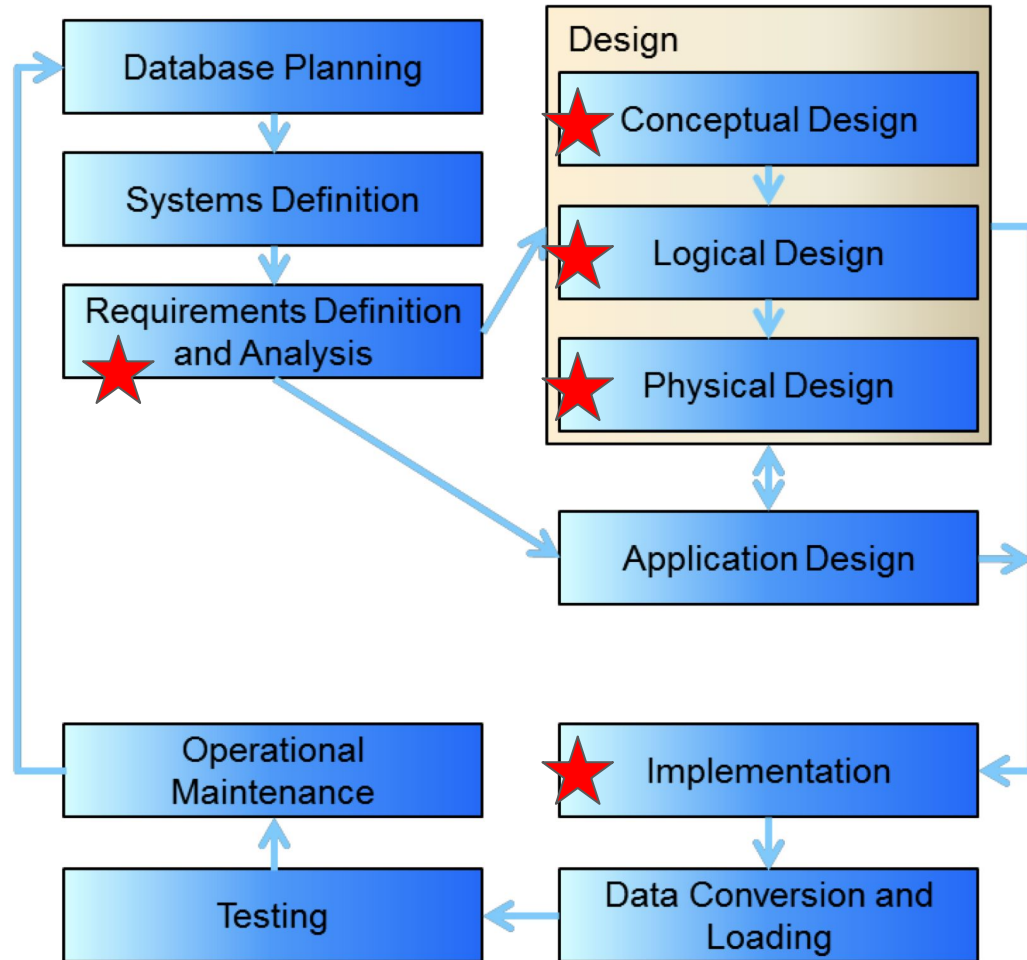
Stages of the Database Development Lifecycle

DISCUSS

1b) Describe the tasks that are performed in the conceptual design stage to generate a conceptual model. (2 mins)

Stages of the Database Development Lifecycle

- Identify entities and attributes
- Identify business rules → relationships, participation constraints
- Use this info to create an ER model

Exercises:
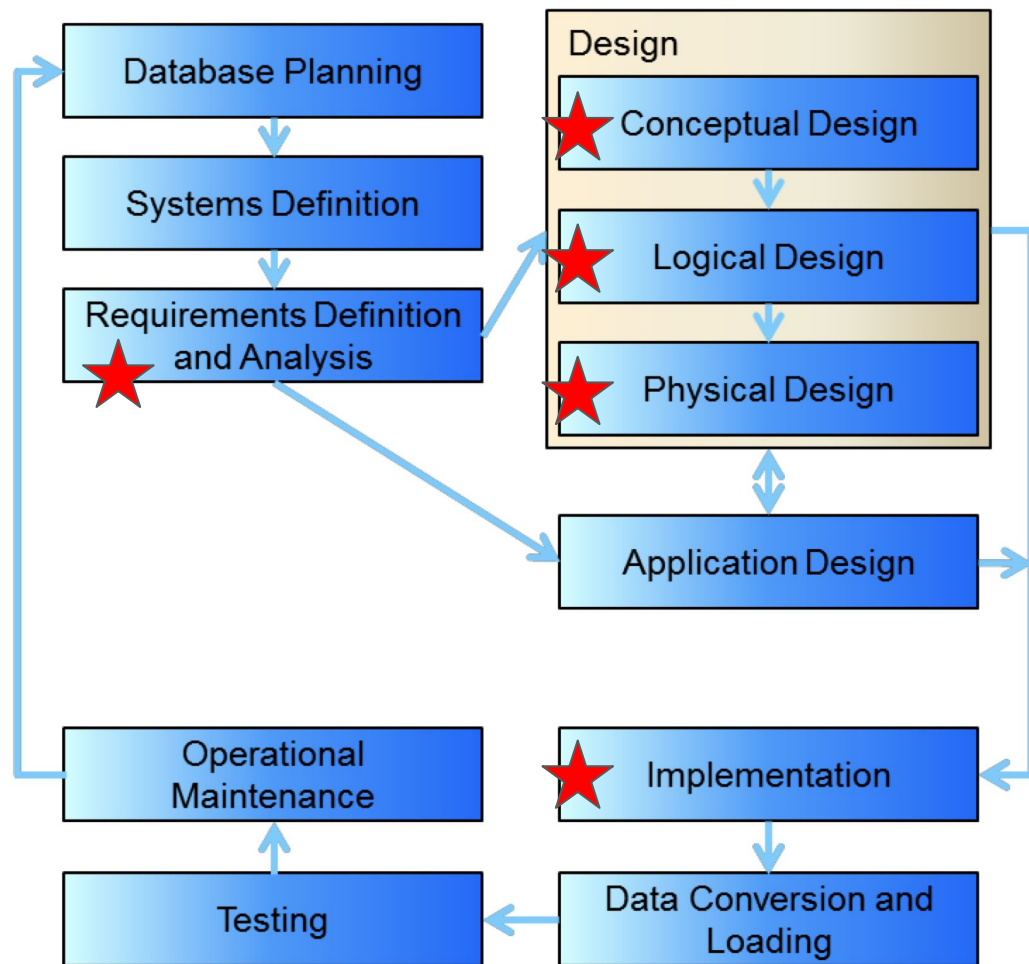
Stages of the Database Development Lifecycle

TAKE HOME QUESTIONS

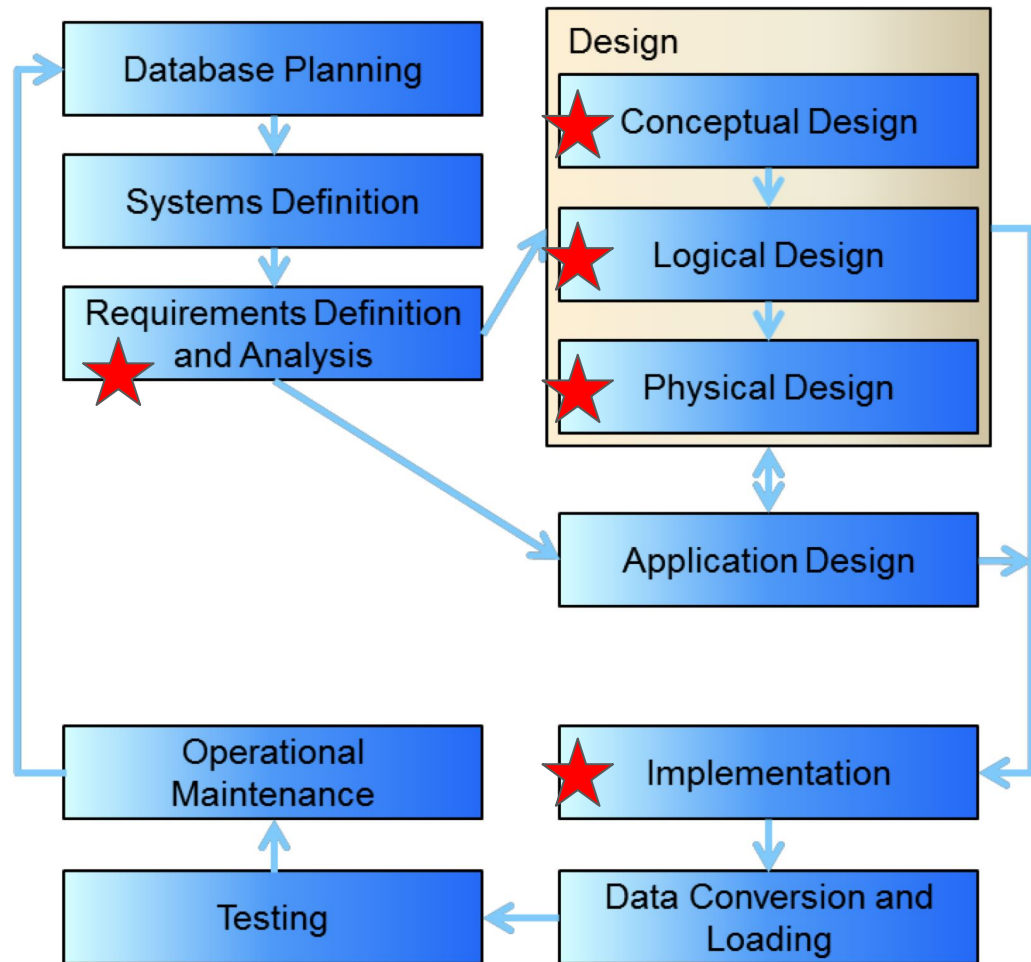1c) How do you refine a conceptual model to convert it to a logical model (Relational)?

1d) What must be done to transform a logical model to a physical model (Relational)?

Diagram boxes:
- Database Planning
- Systems Definition
- Requirements Definition and Analysis ★
- Design
  - Conceptual Design ★
  - Logical Design ★
  - Physical Design ★
- Application Design
- Operational Maintenance
- Implementation ★
- Data Conversion and Loading
- Testing

Recap of Key Terms

- Entities
  - Real-life objects e.g. employees, employers, insurance policies
- Business rules
  - Model constraints — statements that define or constrain aspects of the business
  - Database should fulfil these rules
    - These rules affect the structure of the database
  - E.g. "An investment bank has a number of branches"
- Weak entities
  - Entity that can't be uniquely identified without referring to another entity
  - Entity that relies on another entity
  - E.g. you can't have a **room** without a building
- Attributes
  - A.k.a. features or columns
  - Describes info about entities or relationships
  - E.g. an employee has a **name**, **date of birth**, **address**

✨ Case Study Time ✨

a. Identify the entities.

b. Identify the business rules.

c. For any three identified entities, list the attributes.

(15 mins)

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.

✨ Case Study Time ✨

a. Identify the entities.

- Cinema
- Screen
- Projector
- Movie

✨ Case Study Time ✨

What about "cinema chain"?

Nope! You don't include the business you're modelling, because there's only one

✨ Case Study Time ✨

Are any of these entities "weak entities"?

"Screen" is a weak entity — it can't exist without a cinema

✨ Case Study Time ✨

b. Identify the 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
- The system needs to be able to generate weekly activity reports for the chain's chief operating officer

✨ Case Study Time ✨

c. For any three identified entities, list the attributes.

- Cinema
- "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)

✨ Case Study Time ✨

c. For any three identified entities, list the attributes.

- Screens
- Screens are "… **number**ed 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?)

- Example of a weak entity!

✨ Case Study Time ✨

c. For any three identified entities, list the attributes.

- Projector
- 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)

- Format: Enum datatype — set of values you define beforehand

✨ Case Study Time ✨

c. For any three identified entities, list the attributes.

- Movie
- "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)

✨ Case Study Time ✨

"Last shown"?

Relationship between "movie" and "screen" → "screen shows movie"

"Last shown" is actually an attribute that describes this **relationship**: "descriptive attribute"

Week 2 Lab

- Canvas → Modules → Week 2 → Lab → L02 Modelling (PDF)
- Objectives:
  - Familiarise yourself with MySQL Workbench database modelling tool
  - You'll use this tool for modelling tasks in labs, and for assignment 1
  - In this lab, you'll:
    - Launch the MySQL Workbench modelling tool
    - Create a simple ER model using MySQL Workbench
    - Define relationships between tables
    - Create meaningful relationship labels
- Breakout rooms, "ask for help" button if you need help