

# Introduction

**INFS1200 / INFS7900 - Introduction to Information Systems**

# In This Module

- A little about this course.
- What is a database?
- What is a Database Management System (DBMS)?
- What role does a DBMS play in a Database System?
- What are the benefits of the three-schema architecture of modern database systems?



## Course Related Information

Overview of Database Management Systems

# A Little About Me



**Name:** Archie Chapman

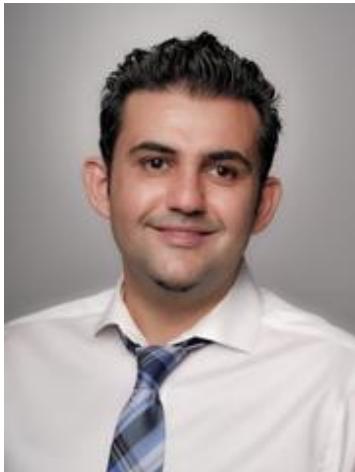
**Email:** [archie.chapman@uq.edu.au](mailto:archie.chapman@uq.edu.au)

**Web:** <https://researchers.uq.edu.au/researcher/24776>

**Teaching:** I've taught data analytics, machine learning, artificial intelligence, game theory and microeconomics to classes large and small, at university and for industry.

**Research:** Using AI, optimisation and machine learning methods to solve problems in power and energy systems and the circular economy.

# A Little About Me



**Name:** Hassan Khosravi

**Email:** [h.khosravi@uq.edu.au](mailto:h.khosravi@uq.edu.au)

**Personal Webpage:** <http://hassan-khosravi.net/>

**Teaching:** 25 offerings of 10 distinct courses in computer and data science to a total of roughly 10000 students.

**Research:** Passionate about the role of AI in the future of education. Development of tools that contribute to personalisation of education.

# A Little About Us

## Students

- INFS1200: 450 students
- INFS7900: 110 students

Course Coordinator & Lecturer	Tutors
<p><b>Dr Archie Chapman</b> <b>Course Coordinator and Lecturer</b> <a href="mailto:archie.chapman@uq.edu.au"><u>archie.chapman@uq.edu.au</u></a></p> <p><b>A/Prof Hassan Khosravi</b> <b>Lecturer</b> <a href="mailto:h.khosravi@uq.edu.au"><u>h.khosravi@uq.edu.au</u></a></p> <p><b>For course admin enquiries, please email</b> <a href="mailto:infs1200@itee.uq.edu.au"><u>infs1200@itee.uq.edu.au</u></a></p>	<p><b>Talia Garrett-Benson</b> <b>Alan Rojan</b> <b>Caroline Stokes</b> <b>Tim Ryall</b> <b>Lucy Ochre</b> <b>Jeewaka Hemawanshage</b></p>

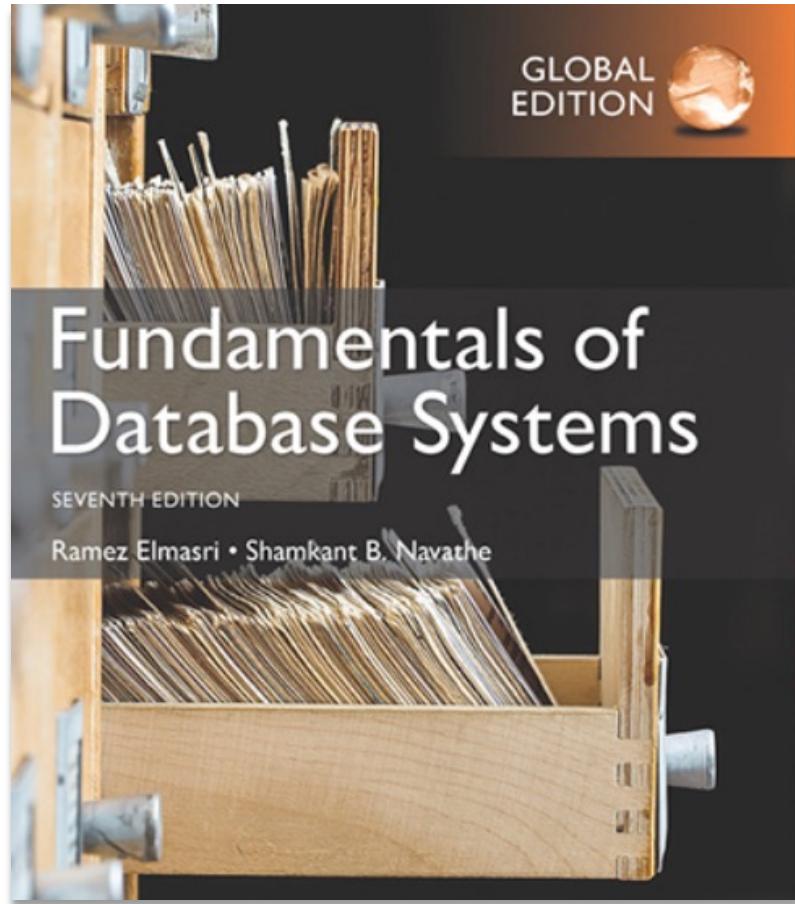
# Primary Goal of this Course

1. Extract information systems requirements to create basic conceptual models
2. Map basic conceptual data models to relational database schema
3. Reason with the logical foundation of the relational data model and the fundamental principles of correct relational database design
4. Express natural language queries using the SQL language
5. Explain key security concepts related to database control measures and SQL injection
6. Construct a small-scale information system in a relational database management system

# Course Textbook

Fundamentals of  
Database Systems

Available online via UQ Library [here](#)



# UQ Graduate Attributes

**Graduate attributes** refer to skills, qualities and understandings that should be acquired by students during their time at a university regardless of their discipline of study.

1. In-depth knowledge & skills in the field of study
2. Effective Communication
3. Independence and Creativity
4. Critical Judgement
5. Ethical and Social Understanding



# Learning Activities

**Lectures:** Provide an introduction to various concepts and techniques in information systems analysis combined with a series of in-class formative exercises.

**Tutorials:** Provide opportunity to practice the techniques introduced in lectures.

**Practicals:** Provide hands on experience in implementing small scale information systems.

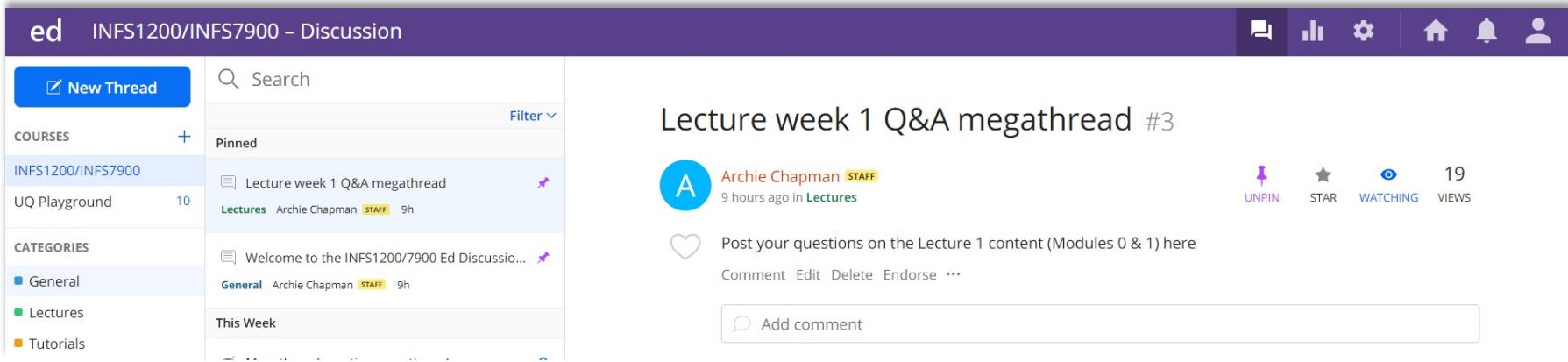
**Assignments:** Provide opportunity to work towards the design of an information system using three summative take-home assignments.

**Learnersourcing and Adaptive Learning:** Provide opportunity to create and evaluate high-quality learning resources and using explainable AI algorithms to receive personalised recommendation for learning resources to engage with.

**Ed Discussions – Discussion Board:** Provide opportunity for you to ask questions and engage with responding to questions posted by your peers. Also, we will use Ed Discussions megathreads for Q&A during lectures!

# Ed Discussion – Discussion Board

- Designed to simulate a live discussion, Ed Discussion allows students and instructors to post and respond to one another's questions.
- Direct all general questions about the course content via public posts to Ed Discussion. If your peers can't give you an answer, attend a tutorial or prac.
- Discuss assignment questions that may reveal part of the solution during tutorials and practicals with tutors. If not possible, use private posts on Ed Discussion
- Direct all personal admin related inquiries also as private posts on Ed Discussion.
- We reserve the right to change the visibility of your posts as appropriate.



The screenshot shows the Ed Discussion platform interface. The top navigation bar includes a search bar, filter options, and various icons for account management and course navigation. On the left, a sidebar displays course and category lists, with 'INFS1200/INFS7900' and 'UQ Playground' being the most prominent. The main content area features a megathread titled 'Lecture week 1 Q&A megathread #3' by Archie Chapman (STAFF). The post was made 9 hours ago in the 'Lectures' category. It has 19 views and is pinned. Below the post, there is a comment section encouraging users to ask questions about Lecture 1 content. A large 'Add comment' input field is at the bottom.

ed INFS1200/INFS7900 – Discussion

New Thread

COURSES +

INFS1200/INFS7900

UQ Playground 10

CATEGORIES

General

Lectures

Tutorials

Pinned

Filter

Search

Lecture week 1 Q&A megathread #3

Archie Chapman STAFF 9 hours ago in Lectures

UNPIN STAR WATCHING VIEWS

Post your questions on the Lecture 1 content (Modules 0 & 1) here

Comment Edit Delete Endorse \*\*\*

Add comment



## RiPPLE

An active, social and personalised learning platform

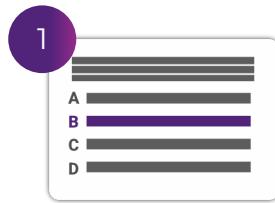
RiPPLE is a UQ developed platform that partners academics and students to create and evaluate high-quality learning resources and, using explainable AI algorithms, recommends personalised activities to students based on their mastery level.

For information about RiPPLE visit [itali.uq.edu.au/ripple](http://itali.uq.edu.au/ripple).

To develop RiPPLE based on data-driven evidence, variations with minor differences of RiPPLE are being used.

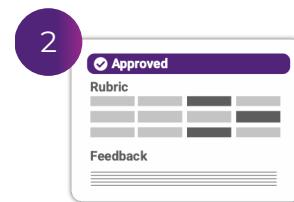
# How RiPPLE Works

RiPPLE leverages the science of learning to enhance student learning and experiences with three interconnected activities:



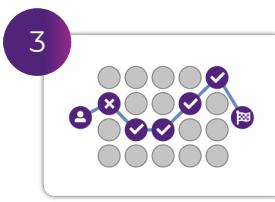
## Creation

Empower students to craft study resources with AI assistance, nurturing their metacognition and critical thinking skills



## Moderation

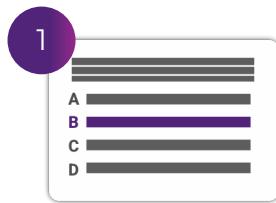
Facilitate peer evaluation of study resources with the support of AI, ensuring an equitable and rigorous review process



## Personalised practice

Help your students thrive as AI generates a unique study plan for each student based on their learning need

# Create in RiPPLE



## Creation

Empower students to craft study resources with AI assistance, nurturing their metacognition and critical thinking skills

 MCQ	 Multiple Answer	 Hotspot
 Short Answer	 Long Answer	 Worked Example
 Flash Card	 Slides	 Project Report
 Research Report	 Reflection	 Note

# Generative AI Integration into Creation

**ENTER STUDENT PREVIEW**   

INFS1200/7900 ▾

**RETURN**  **BOOKMARK**

0 6 Medium

What does the following query do:

```
INSERT INTO Inventory
SELECT id, itemID, stats
FROM Items
CROSS JOIN Player
WHERE id = 002 AND damage > 10
```

**A.** Gives the player with id "002" all items in the game

Explanation

Incorrect

HINT: there is a when condition stating damage > 10

try again

**B.** Gives all players the item with id "002"

Explanation

Incorrect

id references Player and not Items

Try again

**AI Feedback**

AI feedback is in Beta. The feedback provided below is a guide only and may be inaccurate. Please use your domain knowledge to assess whether the feedback is correct.

**Summary**  
The aim of this resource is to test the student's understanding of SQL. It can contribute to student learning by testing their knowledge of CROSS JOIN and WHERE clauses in SQL.

**Positives**

- The question is clear and concise
- The correct answer is informative and well-explained
- The incorrect options provide subtle but common errors that students may make

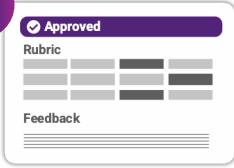
**Suggestions for improvement**

- Option 1 and Explanation 1 can be improved. Instead of just saying "Incorrect" and "Try again," explain why the option is incorrect and provide a hint for the student to help them understand the concept better.
- Option 2 and Explanation 2 can be improved. Instead of just saying "Incorrect" and "Try again," explain why the option is incorrect and provide a hint for the student to help them understand the concept better.
- Option 4 and Explanation 4 should be removed as they do not provide any useful information and can be confusing for the student.

How helpful was this feedback? 

# Moderate in RiPPLE

2



## Moderation

Facilitate peer evaluation of study resources with the support of AI, ensuring an equitable and rigorous review process

### Resource Feedback

Please evaluate the resource based on the following criteria:

<b>Correctness and precision:</b>	Poor	Needs Improvement	Satisfactory	Great	Outstanding
<b>Quality of Question:</b>	?	Poor	Needs Improvement	Satisfactory	Great
<b>Quality of Options:</b>	?	Poor	Needs Improvement	Satisfactory	Great
<b>Quality of Explanation:</b>	?	Poor	Needs Improvement	Satisfactory	Great

### What is good about this resource?

Please list each aspect as a separate dot point and align feedback to the rubric. Be specific & detailed. Use constructive language. Leave blank if not applicable.

- It is a comprehensive resource with a code sample and output.  
covers an important topic
- + Add feedback...

### How can this resource be improved?

Please list each aspect as a separate dot point and align feedback to the rubric. Be specific & detailed. Use constructive language. Leave blank if not applicable.

- It is already a pretty good resource
- + Add suggestion...

### Further comments

keep up the good work



### Decision

Please rate the overall quality of this resource based on the criteria above.

<b>The overall quality of this resource is:</b>	Poor	Needs Improvement	Satisfactory	Great	Outstanding
<b>Rate your confidence in assessing this resource:</b>	Very low	Low	Medium	High	Very High

# Moderate in RiPPLER

**AI Feedback**

The feedback provided below is a guide only and may be inaccurate. Please use your domain knowledge to assess whether the feedback is correct.

Hi there! I am The RiPPLER AI assistant, and I am here to help you with providing effective feedback.

**Suggestions for improvement**

- Instead of saying "I like how you explained your point," you can be more specific about what you liked. For example, you can say "I appreciate how you provided real-life examples to support your argument."
- When mentioning areas of improvement, try to phrase it in a constructive and positive manner. Instead of saying "Your writing is confusing," you can say "Your writing can be clearer if you organize your ideas in a more logical manner."
- Consider providing specific suggestions for improvement. For instance, instead of saying "Your conclusion could be better," you can say "To improve your conclusion, you can summarize your main points and provide a thought-provoking ending."

How helpful was this feedback? 

**SUBMIT**

## Resource Feedback

Please evaluate the resource based on the following criteria:

Correctness and precision:	Poor	Needs Improvement	Satisfactory	Great	Outstanding
Quality of Question:	?	Poor	Needs Improvement	Satisfactory	Great
Quality of Options:	?	Poor	Needs Improvement	Satisfactory	Great
Quality of Explanation:	?	Poor	Needs Improvement	Satisfactory	Great

## What is good about this resource?

Please list each aspect as a separate dot point and align feedback to the rubric. Be specific & detailed. Use constructive language. Leave blank if not applicable.

- It is a comprehensive resource with a code sample and output. covers an important topic
- + Add feedback...

x

## How can this resource be improved?

Please list each aspect as a separate dot point and align feedback to the rubric. Be specific & detailed. Use constructive language. Leave blank if not applicable.

- It is already a pretty good resource
- + Add suggestion...

x

## Further comments

keep up the good work



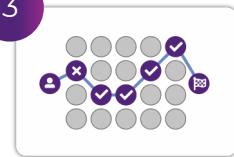
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Please rate the overall quality of this resource based on the criteria above.

The overall quality of this resource is:	Poor	Needs Improvement	Satisfactory	Great	Outstanding
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# Practice in RiPPLEx

3



## Personalised practice

Help your students thrive as AI generates a unique study plan for each student based on their learning need



### Practice

The practice feature allows your class to view & practice with resources that have been created and evaluated by their peers.

Our AI algorithms estimate the ability of your students in each topic and present the resource we think is most appropriate for them given their current level of knowledge

**Quick study session**  
Start a study session based on RIPLEx's recommendations for your learning.

**Create a custom session**  
Choose the topics & resources you want to study with.

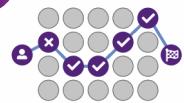
**Browse Repository**  
Browse the full repository of resources.

**My practice history**  
View a log of your practice

**Class practice history**  
Instructor only: View a log of all practice

# Practice in RiPPLER

3



## Personalised practice

Help your students thrive as AI generates a unique study plan for each student based on their learning need

How am I performing on each topic?

Calibrating Novice Proficient Distinguished Class Average

Topic	Rating
Areas & Volume	1120
Probability	1050
Finance	1140
Statistics	970
Geometric Reasoning	990

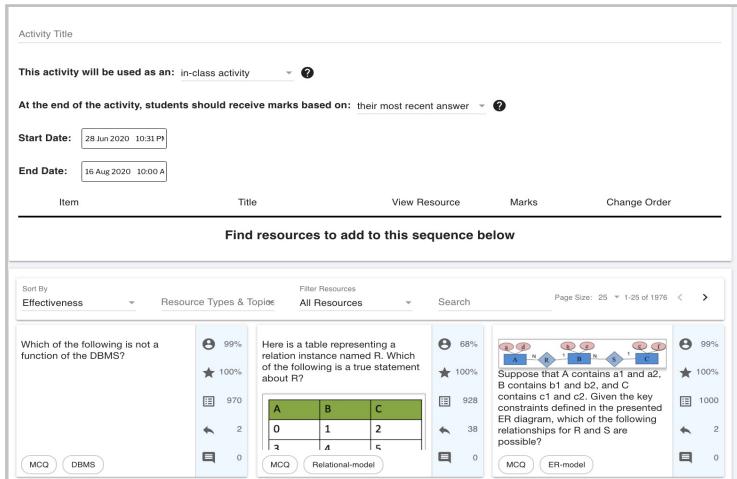
Suggested actions:

- Daily Quest: Answer 10 new resources on any topic correctly on your first attempt. PRACTICE NOW
- Weekly Quest: Rate the effectiveness of 25 resources on any topic. PRACTICE NOW

Sort By: Recommended Filter Resources: Unseen Resources Resource Types Topics Details 1-25 of 28 results

11  15 Note Arcgis Multi-Scale Maps: Population Growth Use the map below to answer the questions found at <a href="#">this link</a> Geometric Reasoning Carol Melia 3 years ago	10  15 Worked Example Step by step solution: Probability Determine the probability of the total when two dice are thrown is less than 7 or even Probability Albie Turnbull 3 years ago	10  15 Note Additional Resources for the curious How to count to 1000 on two hands How to count to 1000 on ... Areas & Volume Statistics Geometric Reasoning Carol Melia 3 years ago
8  14 Note Graphing with DESMOS: Linear Regression Google Chart: Compound Interest vs Simple Interest Calculate the volume of the following composite solid: Google Chart: Compound Interest vs Simple Interest Multiple Choice	11  15 Note Google Chart: Compound Interest vs Simple Interest Calculate the volume of the following composite solid: Google Chart: Compound Interest vs Simple Interest Multiple Choice	

# RiPPLER - Live Formative Quizzes



This activity will be used as an: in-class activity

At the end of the activity, students should receive marks based on: their most recent answer

Start Date: 28 Jun 2020 10:31 PM

End Date: 16 Aug 2020 10:00 AM

Item	Title	View Resource	Marks	Change Order
Find resources to add to this sequence below				

Sort By Effectiveness

Resource Types & Topics All Resources

Search Page Size: 25 1-25 of 1976

Which of the following is not a function of the DBMS?

99% ★ 100% 970 222 100% 0

Here is a table representing a relation instance named R. Which of the following is a true statement about R?

A	B	C
0	1	2
3	4	5

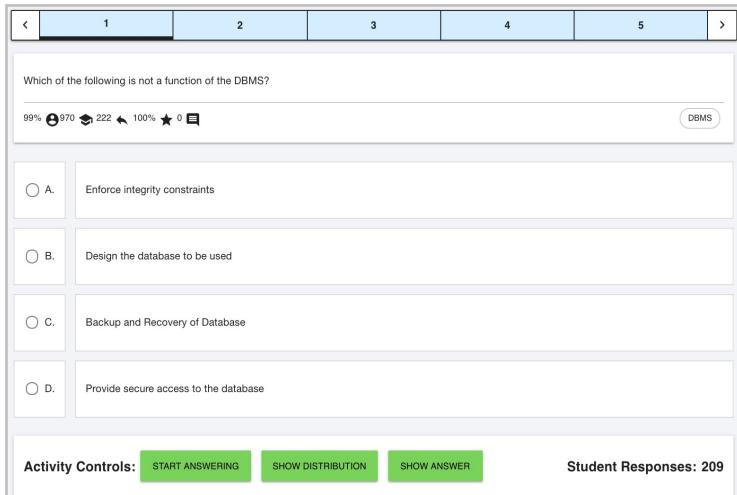
MCQ Relational-model

68% ★ 100% 928 38 100% 1000

Suppose that A contains a1 and a2, B contains b1 and b2, and C contains c1 and c2. Given the key constraints defined in the presented ER diagram, which of the following relationships for R and S are possible?

MCQ ER-model

Instructor sets up quiz



Which of the following is not a function of the DBMS?

99% ★ 970 222 100% 0

A. Enforce integrity constraints

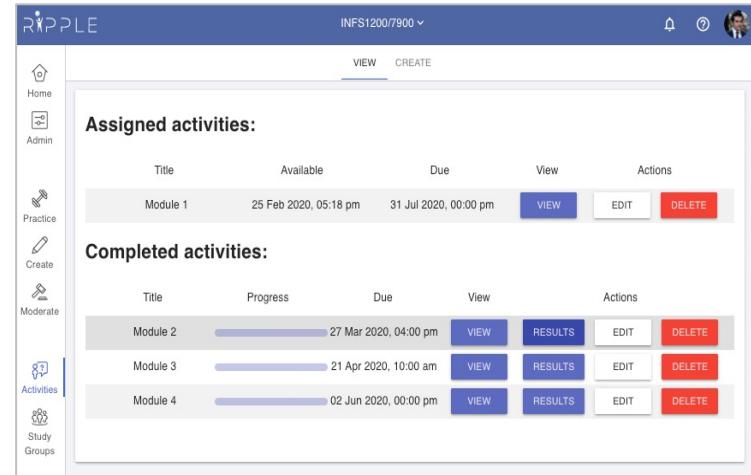
B. Design the database to be used

C. Backup and Recovery of Database

D. Provide secure access to the database

Activity Controls: START ANSWERING SHOW DISTRIBUTION SHOW ANSWER Student Responses: 209

Students respond to questions



RIPLER INF1200/7900

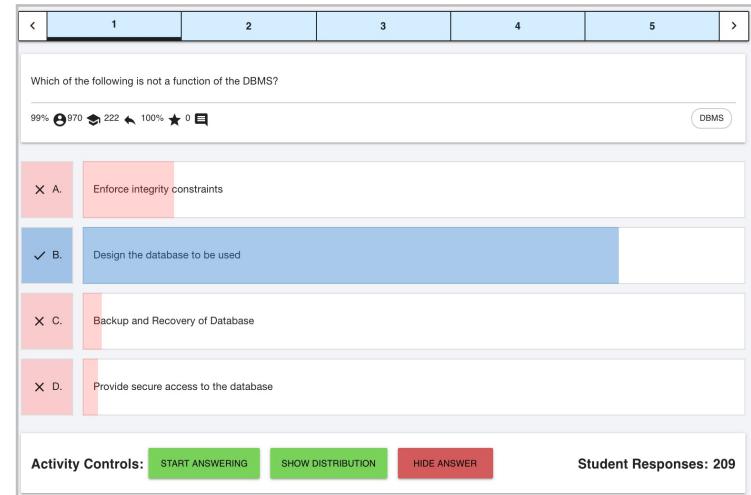
Assigned activities:

Title	Available	Due	View	Actions
Module 1	25 Feb 2020, 05:18 pm	31 Jul 2020, 00:00 pm	VIEW	EDIT DELETE

Completed activities:

Title	Progress	Due	View	Actions
Module 2	27 Mar 2020, 04:00 pm	VIEW RESULTS EDIT DELETE		
Module 3	21 Apr 2020, 10:00 am	VIEW RESULTS EDIT DELETE		
Module 4	02 Jun 2020, 00:00 pm	VIEW RESULTS EDIT DELETE		

Students access quiz via the activity tab



Which of the following is not a function of the DBMS?

99% ★ 970 222 100% 0

A. Enforce integrity constraints

B. Design the database to be used

C. Backup and Recovery of Database

D. Provide secure access to the database

Activity Controls: START ANSWERING SHOW DISTRIBUTION HIDE ANSWER Student Responses: 209

RiPPLER provides feedback in real time

# Questions

Mood barometer: How are you feeling today?

- A. Sleepy 😴
- B. Grumpy 😠
- C. Dopey 😜
- D. Bashful 😊
- E. Sneezy 😵
- F. Happy and excited to be taking INFS1200/7900!!! 😁

# Assessment Summary

**Assignments:** Work towards the design of an information system using three summative take-home assignments.

- **Question Based Tasks:** You will answer questions and complete tasks which align with the learning objectives of the module for which the assignment is based. These questions/take will be similar in style to those attempted in tutorial and practical sessions.
- **Adaptive Learning:** Provide opportunity to create and evaluate high-quality learning resources and using explainable AI algorithms to receive personalised recommendation for learning resources to engage with (via RiPPLE).

**Final Exam:** Provide opportunity for you to demonstrate your knowledge on all of the topics and content delivered during the semester.

# Tentative Weekly Plan

Course Code: INFS1200/INFS7900

Course Title: Intro to Information Systems

Dates	Live Learning Activities			Assessment		Module 1 ER Model  Module 2 Relational Model  Module 3 SQL  Module 4 Functional Dependencies & Normalisation  Module 5 Database Security	
	Lecture	Tutorial	Practical	Assignments and Exam	Progressive		
Week 1 24 July	Introduction + ER Model				Assignment 1 ER Modes and the Relational Model 25% 1 Sept, 4 pm		
Week 2 31 July		ER Model (Basic)	Intro to Course Tools				
Week 3 7 August	Relational Model	ER Model (Advanced)	Case study 1 ER diagrams				
Week 4 14 Aug	Relational Model	ER-Relational	Prac book: Module 2 Labwork overview				
Week 5 21 Aug	SQL	Mapping	Case study 2 Relational models				
Week 6 28 Aug	SQL	SQL: DDL and intro DML	Prac book: Module 3 Working with MySQL				
Week 7 4 Sept	SQL	SQL: Aggregation and Group by	Case study 3.1 SQL: DDL	Assignment 2 SQL 25%			
Week 8 11 Sept	SQL	SQL: Multi-relation queries	Case study 3.2 SQL: DML				
Week 9 18 Sept	FDs and Normalization	SQL: Subqueries	SQL Notebooks Consult				
Break 25 Sept	Mid Semester Break			Online submission 6 Oct, 4pm	Progressive weekly tasks via RiPPLE 10% (best 10 of 12 weeks)		
Week 10 2 Oct	FDs and Normalization	Database design theory (basic)	Case study 4.1 FDs and Normalisation				
Week 11 9 Oct	FDs and Normalization	Database design theory (advanced)	Case study 4.2 FDs and Normalisation				
Week 12 16 Oct	Database Security	FDs and normalisation tutorial revision	Assignment 2 oral assessment in week 12				
Week 13 23 Oct	Revision	Database Security	Revision	Final exam 40%			
Exam Period							

# Academic integrity is:

**Acting with the values of honesty, trust, fairness, respect and responsibility in learning, teaching and research.**

(Universities Australia, 2017)

Academic  
integrity

=

Professional  
integrity

=

Personal  
integrity

# Types of academic misconduct

Staff know that cheating occurs and will be looking for:

Plagiarism	Collusion
Falsification	Fabrication
Impersonation	Contract Cheating

and checking sites like:



<https://www.uq.edu.au/integrity/>

# UQ takes academic misconduct seriously

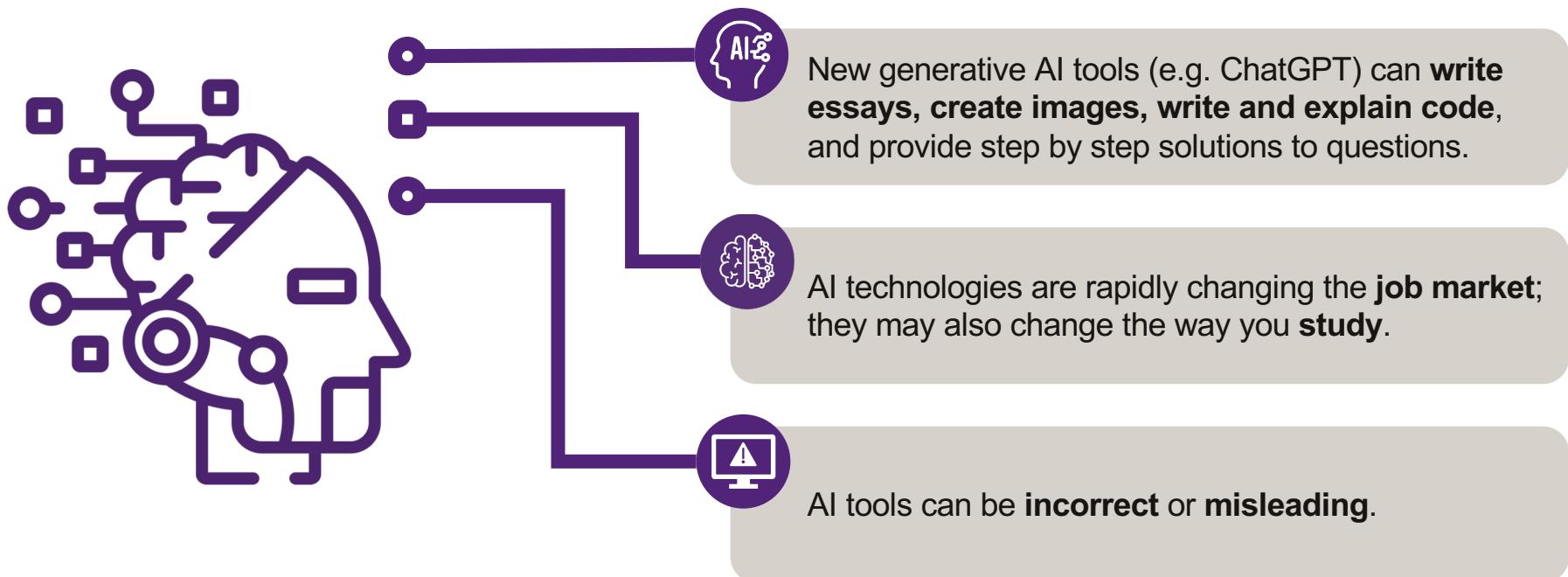
Jan 2017 – Dec 2021: over 9,900 cases of academic misconduct:

Misconduct	Number of incidents
Plagiarism	6 542
Collusion	1 919
Cheating	844
Contract cheating	225
Making a false representation	169
Breaching exam regulations	56
Failing to follow reasonable directions of a University employee	9
Improper use of University facilities	3
Research misconduct	1

Penalties include:

- re-submission of an assessment or zero marks (lower-end offences)
- automatic failure of a course
- suspension or expulsion (more serious and/or repeated misconduct)

# Generative Artificial Intelligence (AI)



- Should you use ChatGPT for your studies? - Library

# Generative AI (ChatGPT) in Assignments

- You may use AI in completing your assignments.
- If you are using AI tools, collate all prompts and responses with the URL and date in a single PDF document as an appendix.
- Not referencing or acknowledging AI use may constitute student misconduct under the (PPL 3.60.01) Student Code of Conduct.
- A note of warning that AI tools can generate incorrect or misleading results so make sure you use them with care and critical judgment.



## Generative AI (ChatGPT) in final exam

This assessment task is invigilated. Use of AI in assessment is not permitted in this exam.

- We recommend you practice in as close to the conditions of exam as possible.
- You will not be permitted to use AI tools in your exam tasks, so practice without these tools.
- Attempted use of AI in these tasks may constitute student misconduct under the (PPL 3.60.01) [Student Code of Conduct](#).



# Academic Integrity

Ignorance is not a defense!



"I don't know what plagiarizing is, so I'm gonna take the easy way out and just copy something off the internet."

Image source: <https://www.pinterest.com.au/wassef87/academic-dishonesty-and-integrity/>

**Get familiar with  
Academic Integrity  
at UQ**

Don't risk getting on the  
academic misconduct  
register

Complete the  
Academic Integrity Modules

Part A is due by 31 August 2022  
Part B is due by 28 October 2022

# Pro Tip: Get Organised!

- Read the course profile
- Make sure that you can access the Blackboard site for the course
- Sign up for a Tutorial and Practical session
- Sign up for Ed Discussions
- Get on to RiPPL E and start using it

## Course Related Information

# Overview of Database Management Systems

# Learning Objectives

After successfully completing this module, you should be able to:

- Explain the purpose of having a database.
- Explain the high-level objectives of having a DBMS.
- Explain the three-schema architecture, separating internal level, conceptual level and external level.
- Explain the concept of physical and logical data independence.

# Data

Data: facts and statistics collected together for reference or analysis, typically digitised

Data is the new fuel for the global economy

*Store it, find it and use it*



The Economist

MAY 6TH-12TH 2017

# The world's most valuable resource

Data and the new rules of competition

Theresa May v Brussels  
Ten years on: banking after the crisis  
South Korea's unfinished revolution  
Biology, but without the cells

# Information and Systems

## What is Information?

- Data put into meaningful and useful context and communicated to recipients who use it to make decisions

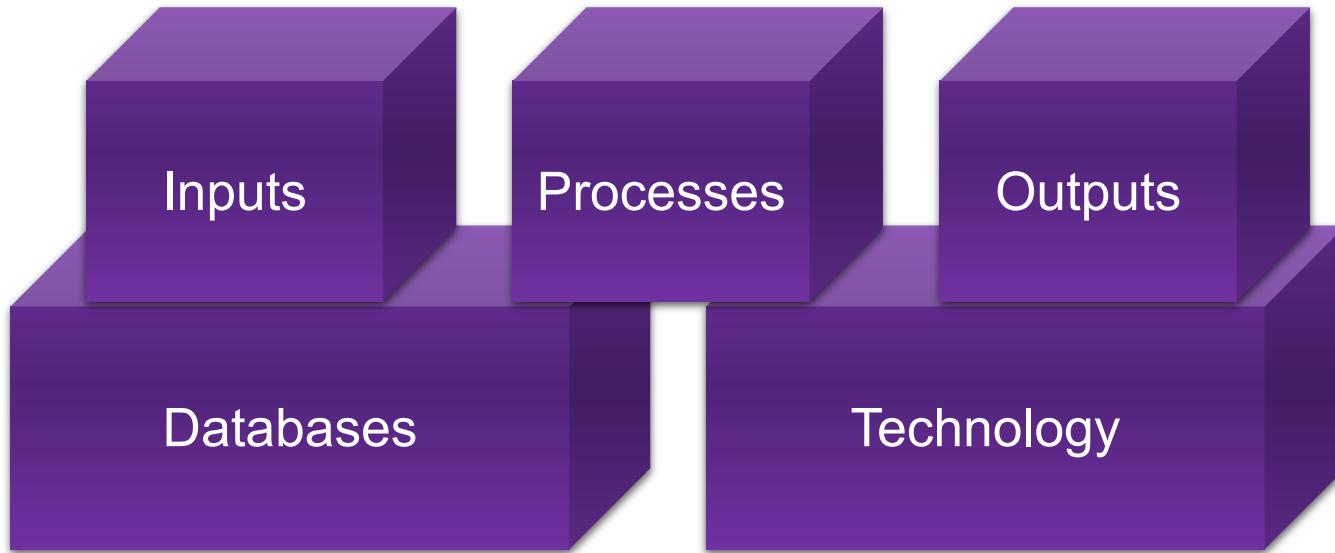
## What is a System?

- A set of components that interact to accomplish some purpose
- Examples: nervous system, legal system, banking system, education system ...

# Information Systems

A system that manages information

Key building blocks:



# Data Management

Data Management is an essential skill for a future workforce. It can be used to capture, store, retrieve, analyse, present and interpret (large amount of) data!

**Banking** is an example of an *application area* where data plays a central role

Can you think of another example of an application in which data plays a central role?



# Data Management Applications

DEMOGRAPHIC ANALYSIS DATING WEBSITES FITNESS DEVICES  
CAMBRIDGE ANALYTICA COLES CUSTOMER REWARDS PROGRAMS  
ANY ACCOUNT ON THE NET GIS COMMONWEALTH LOGISTICS  
ACCOUNTS ON THE INTERNET ALIBABA BANKS DATA FOODORA  
WISH BOOK FLIGHTS NETFLIX YEET ADVERTISING TARGET  
LINKT ADVERTISEMENT APPLE LINKEDIN ALIPAY DATING APPS  
SOCIAL MEDIA GPS LYFT AIRBNB BUSINESS OP.GG  
FDVFBF RIPPLE YOUTUBE EBAY AIR BNB ECOMMERCE  
FARES GAME INSTAGRAM GOOGLE GRINDR  
O-LA UBER AMAZON CAR TESLA DOMINOS  
GOOGLE MAPS FACEBOOK LINKEDIN.  
SEEK POKEMON GO GAMES TINDER ANY SOCIAL NETWORK  
CHROME WECHAT ONLINE DATING BAIRD FOOD DELIVERY  
NASA BOOK FLIGHTSD MYSPACE CYBER-CRIME FORMULA 1  
GUMTREE NEWS

# Impact

## Commerce



Cash management

Pricing

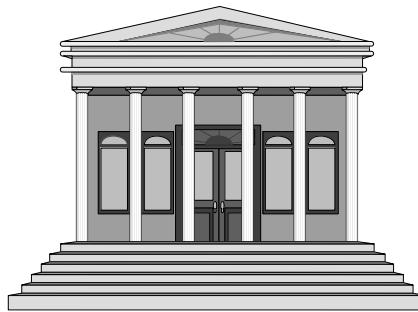
Employee records

Purchasing

Reordering

Trend Analysis

## Government



Law Enforcement

Election Commission

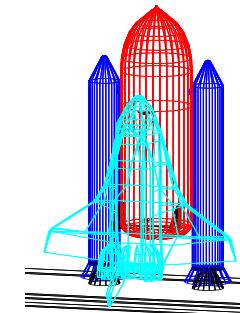
Taxation

Legal Systems

Transport & Utilities

City Councils

## Science and Engineering



Health and Medicine

Space Exploration

Geography (GIS)

Architecture

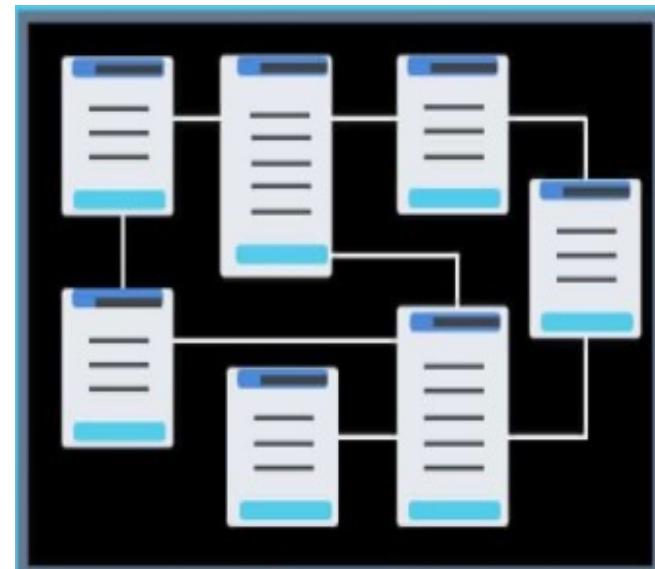
Military and Defense

Telecommunications

# What is a database?

A **database** is a collection of related data or known facts that:

- represents some aspect of the real world, sometimes called the mini-world or the universe of discourse (UoD).
- is a logically coherent collection of data with some inherent meaning.
- is designed, built, and populated with data for a specific purpose for an intended group of users and some preconceived applications.
- can be of any size and complexity.
- may be generated and maintained manually or it may be computerized.



# What is a DBMS?

A **database management system (DBMS)** is a software system that facilitates the processes of defining, constructing, manipulating, and sharing databases among various users and applications.

- **Defining** a database includes specifying the types, structures, and constraints for the data
- **Constructing** the database is the process of storing the data on some storage medium that is controlled by the DBMS.
- **Manipulating** a database includes functions such as querying the database to retrieve specific data, updating the database to reflect changes in the miniworld, and generating reports from the data.
- **Sharing** a database allows multiple users and programs to access the database simultaneously.

# Database System Components

## The Stored Database

- A collection of related information

## The DBMS

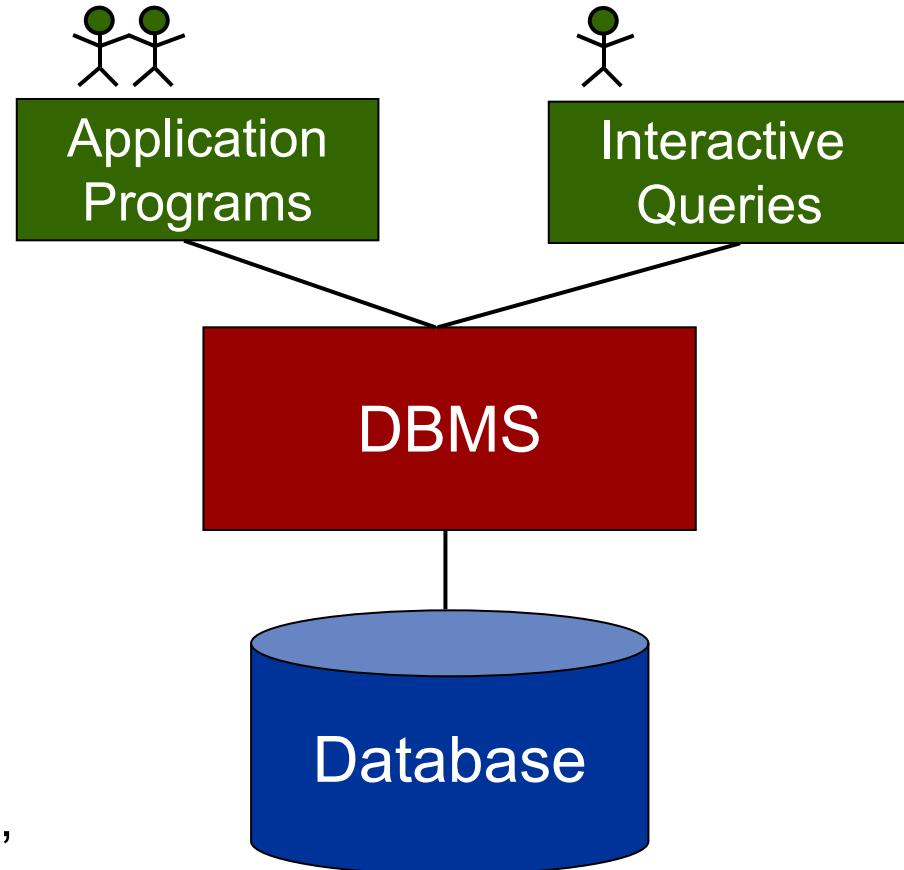
- The software that defines, constructs and manipulates a database

## The Applications

- The programs (in specific languages) that manipulate the database

## The Users

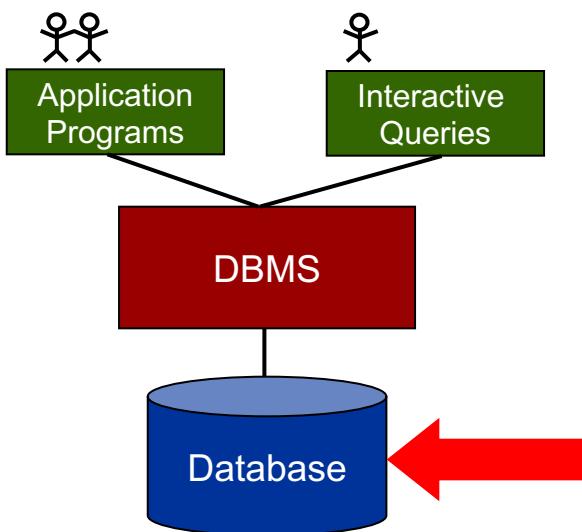
- People who use the database system, through the DBMS interface or through application programs



# The Database

## Database Design

- Conceptual Database Design **Module 1**
- Design Theory and Normalization **Module 4**



## Data Models

- Relational

**Module 2**

## Physical Storage

- Organisation, Hashing, Indexing

**Future INFS courses**

# Conceptual Database Design

Conceptual database design is a very important phase in designing a successful database application.

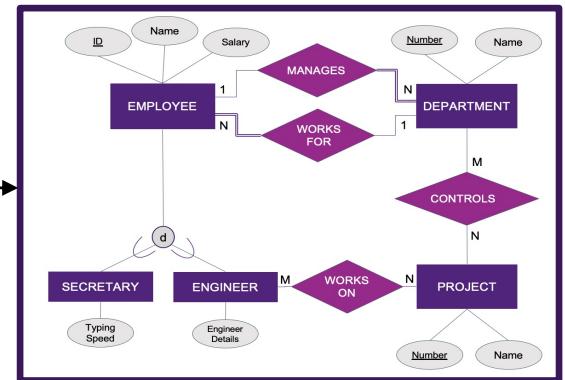
- Step 1: Identify the “Universe of Discourse” (UoD). The database to be built will not model everything in the world, but rather some “mini-world” or “Universe of Discourse”.
- Step 2: Convert the UoD to a data model, which can be captured by a database.

**The World**



Universe  
of Discourse  
(or Mini-World)

**The Data Model**



# Database Design Theory and Normalization

Redundancy occurs when one fact is stored in more than one place

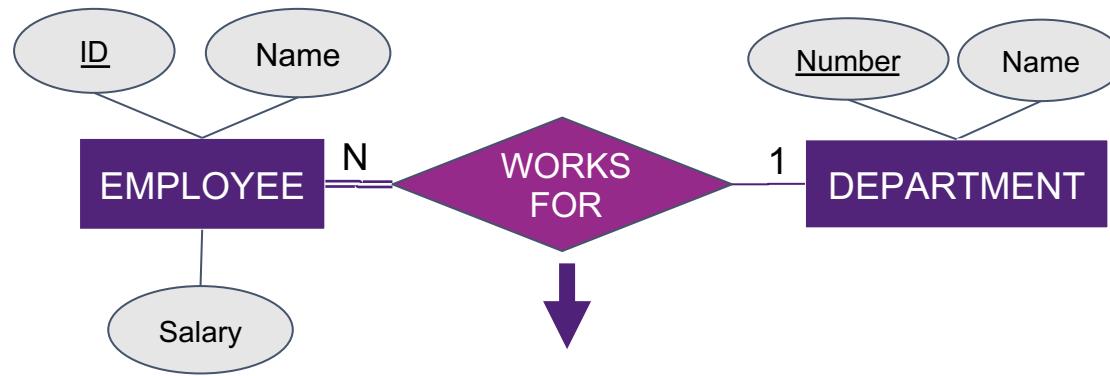
ID	Name	Level
1	Paris	Developer
2	Anna	Manager
3	Ben	Manager

ID	Name	Salary
1	Paris	60,000
2	Anna	70,000
3	Ben	70,000

- Information about ID and name of employees is redundantly stored in two different relations
- Assuming an employee's salary directly corresponds to the level or position they hold, this information will be redundantly captured multiple times in the given design.
- Redundancy can cause **duplication of effort, wastage of storage space and inconsistent data**
- Ideally, we should have a database design that minimises redundancy.

# The Relational Data Model

The relational model represents the database as a collection of relations. This enables a conceptual model to be mapped into set of relations forming a database.

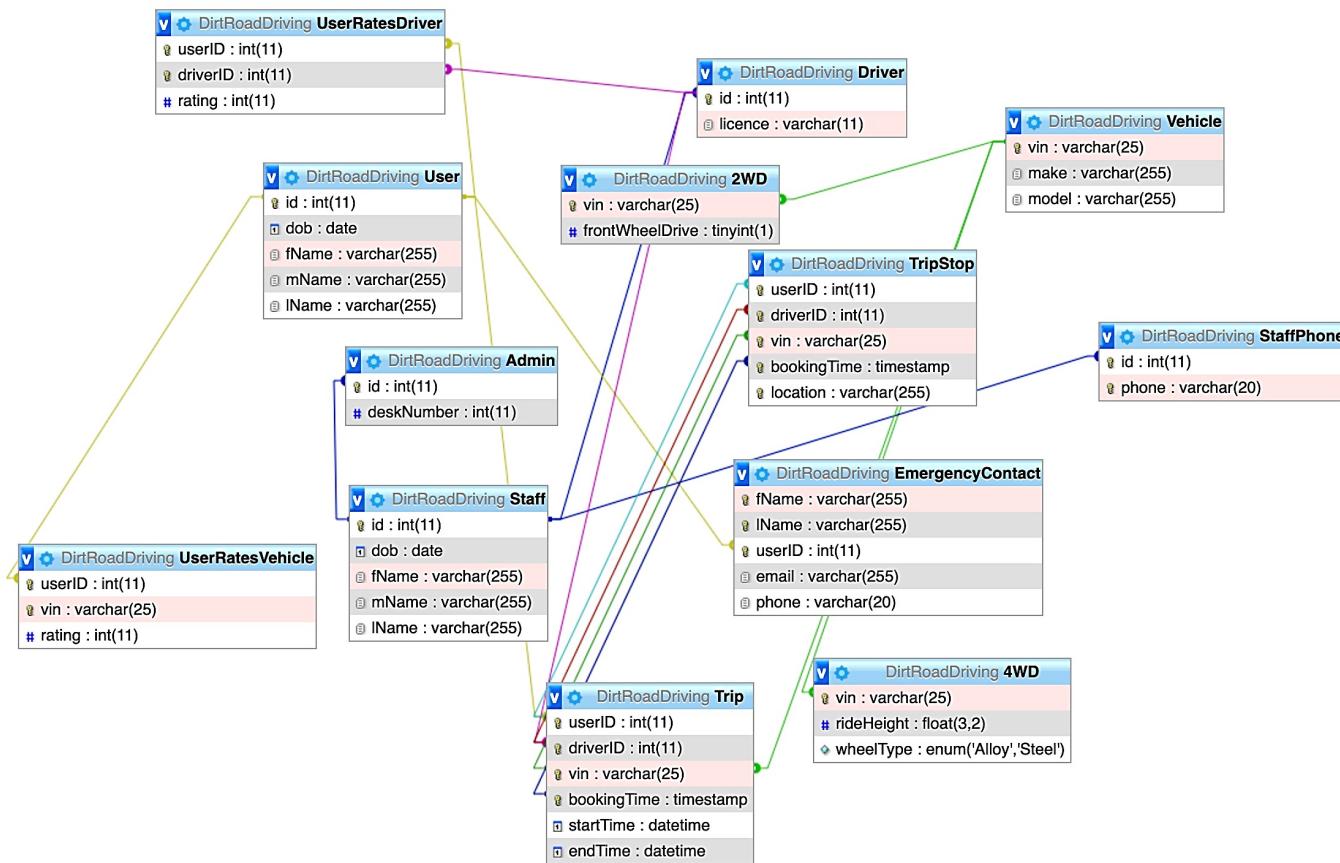


**Employee**

ID	Name	Salary	Department
175	Paris Lane	60,000	2
467	Anna Lee	70,000	1
1023	Ben Cho	70,000	4

# Complex Relationships

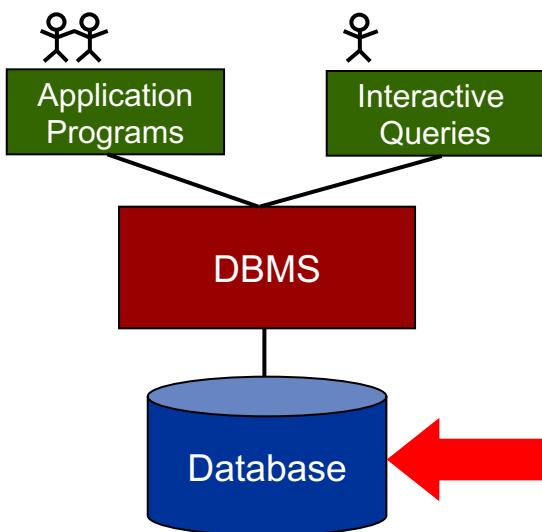
A database has ability to represent complex relationships among the data.



# The Database

## Database Design

- Conceptual Database Design **Module 1**
- Design Theory and Normalization **Module 4**



## Data Models

- Relational

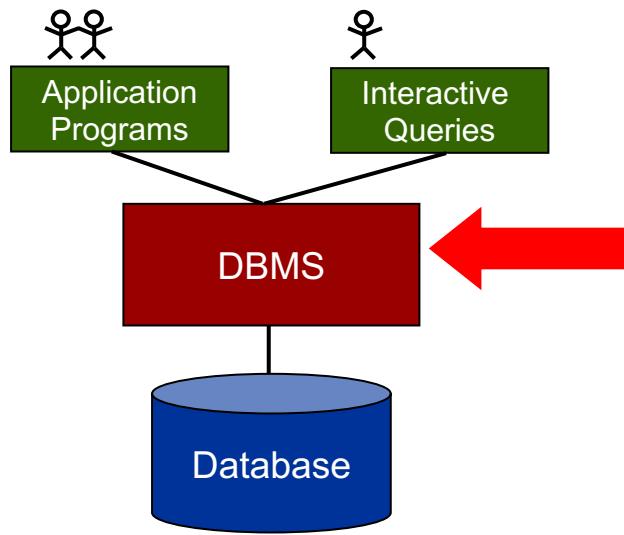
**Module 2**

## Physical Storage

- Organisation, Hashing, Indexing

**Future INFS courses**

# The DBMS



Data Integrity Maintenance **Module 2**

Query Processing **Module 3**

Security Management **Module 5**

Concurrency Control  
**Future INFS courses**  
Backup & Recovery

# Data Integrity Maintenance

The DBMS has the capability to define and enforce integrity constraints which are restrictions placed on the data, based on the **semantics** or meaning of the data

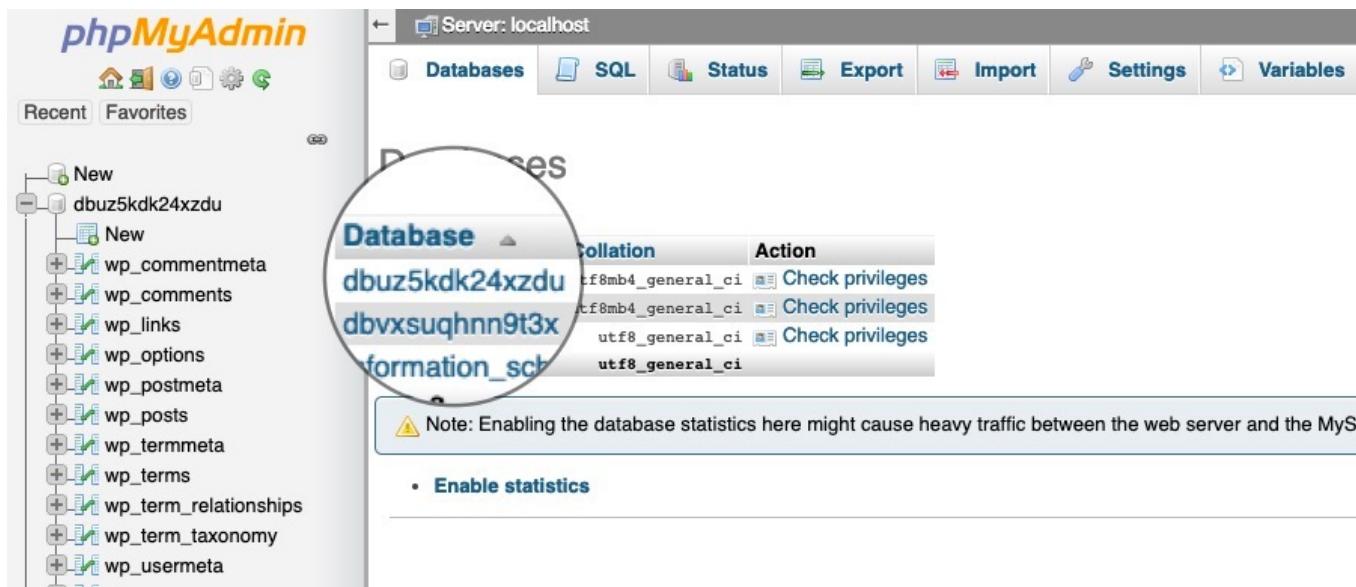
- Every employee must have a unique code.
- Employee codes must be a 4-digit integer.
- An employee must work in an existing department
- An employee cannot work in multiple departments.
- The salary of an employee should not exceed the employee's supervisor's salary.



# Query Processing

A DBMS is equipped with a programming language so simple that you can run queries and return data just in seconds, yet so powerful it can manage millions of tuples of data without worrying about crashing at high speed.

This is the potential of relational query languages such as SQL.



# Security Management

DBMSs provide various measures for securing databases against a variety of threats.



Source: <https://www.pxfuel.com/en/free-photo-qwssm>

# Concurrency Control

DBMS utilises control protocols to handle concurrent access to data files that guarantee serialisability.

**The Stress of Perfection**  
 saved on February 11, 2008 4:13 PM by Ryan McCallum

**File** **Edit** **Insert** **Revisions** **Edit HTML**

**Save** **Save & close** **Discard changes**

**Preview** **Print** **Email** **Share** **Publish**

"No, I don't think it would be hard to plan," said Junior Mark Fennig. "Because you have other people to help you think of ideas of what to do for the Snow Daze week, it's not just you by yourself." This is alot of quotes back to back I would try to distribute them better in the story. -Caitlin Werder 2/8/08 1:01 PM To me, it doesn't really matter if someone doesn't think the week would be hard to plan. If you do a great job of SHOWING the work that's being done, people will understand. Tell the story of the preparation, don't just get people's opinions about the preparation. Be a storyteller. -Ryan McCallum 2/11/08 4:12 PM

Everyone has their own opinion on how hard it would be to plan such a big event like Snow Daze. But most people don't understand that it is very stressful and hard to plan. Show me, don't tell me. -Ryan McCallum 2/11/08 4:13 PM Between planning dress-up days, the theme, the music, AAA activities, and school activities the volunteers have a lot to think about.

Time plays a huge role in the planning as well. New paragraph-Kelly Kiernan 2/10/08 9:22 PM "I think it would be hard because you have to get kids together to plan it that are usually in other activities and you have to get the time to plan it," said Spanish Teacher Elynck. You need the full name, bolded. -Owen Tierney 2/10/08 4:32 PM

As the end of Snow daze approaches, NHS gets ready for the final event, the dance. This is the event that everyone looks forward to and will be the deciding factor of whether the week was a success. That is an opinion, that everyone looks forward to the dance. try not to put in your opinion.-Kelly I agree with Kelly. Some people hate dances. -Ryan McCallum 2/11/08 4:13 PM Kiernan 2/10/08 9:24 PM No matter what the outcome is one thing is certain, a lot of hard work has been put into the week. maybe you could add some more about what snow daze is going to be like. Maybe what the theme and plans are for snow daze. You could also explain who is in charge of planning the snowdaze and what kind of stuff they have to go through. -Caitlin Werder 2/8/08 1:03 PM

First of all, your normal writing should not be Bold. Second off, if you're starting out new as a writer, remember to keep you ENTIRE story in Quote, Transition, Quote, Transition pattern, except for the intro and the ending. And remember to watch for ANY opinion. -Owen Tierney 2/10/08 4:32 PM

Imagine thousands of people editing the same file while assuming they are the only person using it.

# Backup and Recovery

DBMS provides facility to recover from hardware and software failures through its backup and recovery sub-system

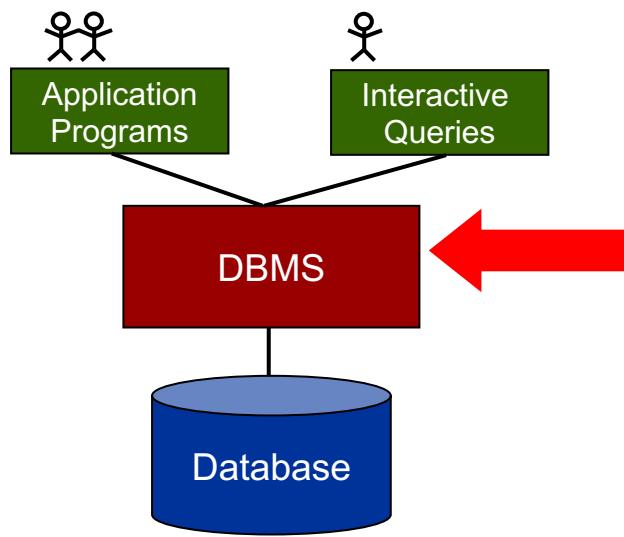
- An update program is executing
- Computer System fails in the middle of the update
- DBMS restores the database to a state prior to the update and restarts the update program

Transfer \$200 from  
account A to B



Deposit not recorded  
in account B

# Typical Functions of a DBMS



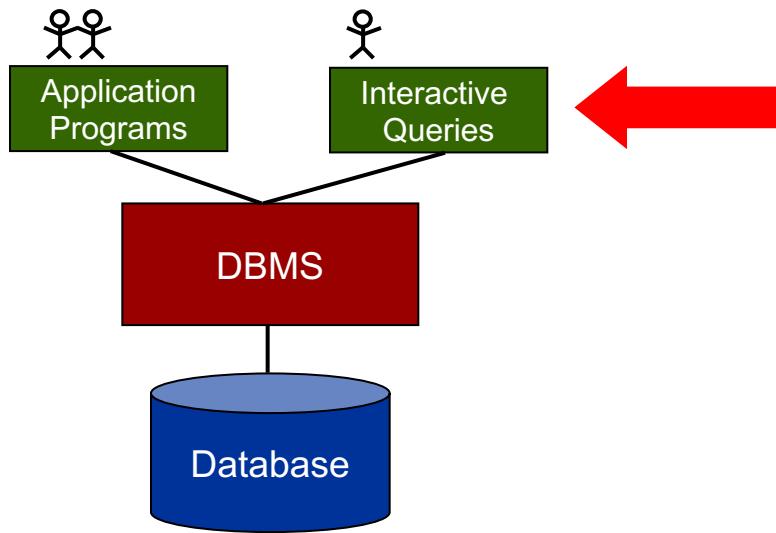
Data Integrity Maintenance **Module 2**

Query Processing **Module 3**

Security Management **Module 5**

Concurrency Control  
**Future INFS courses**  
Backup & Recovery

# The Applications



## Interface

- View Design
- Interactive Querying
- Host Languages
- Human-Computer Interaction

## Application Programs

- Functional Analysis
- Data Flow Diagrams
- Software Engineering

# Multi-user Interfaces

Query languages for casual end-users

Programming language interfaces for application programmers

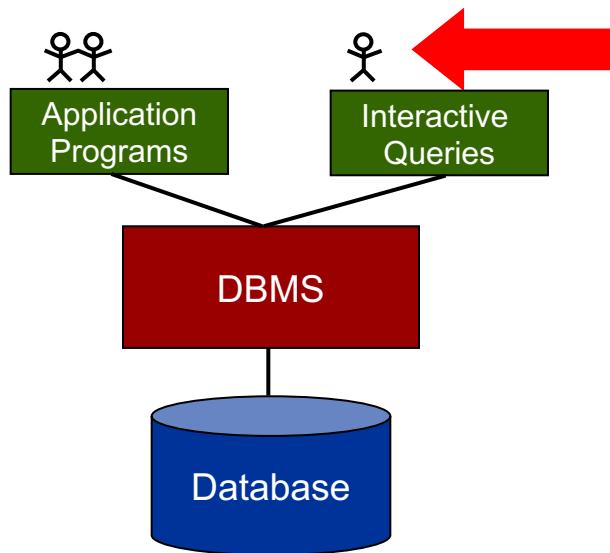
Forms and commands for parametric users

Other types of interfaces

- Graphical User Interfaces (GUI)
- Interface for Web Enabling
- Natural Language Interfaces...
- Speech Input and Output



# The Users



Database Administrators  
Database Designers  
End Users  
Application Programmers

# Questions

Which of the following is not a function of the DBMS

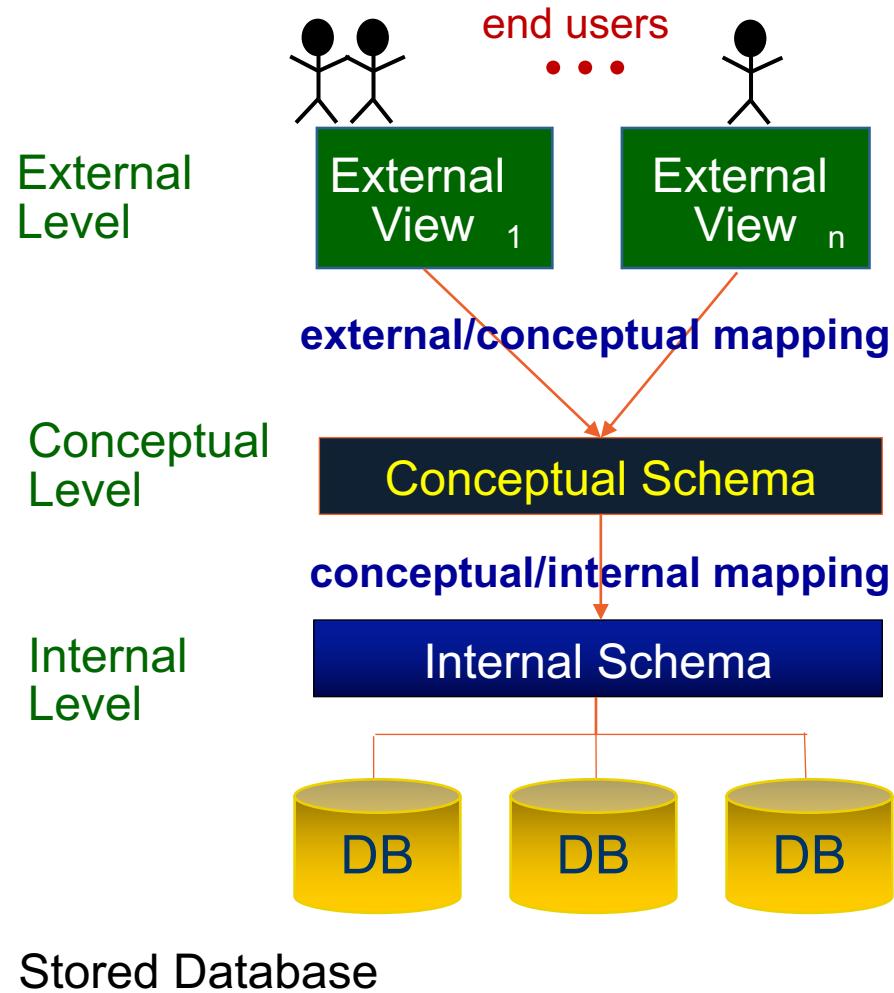
- A. Enforcing integrity constraints
- B. Design a database
- C. Backup and Recovery of Database
- D. Providing secure access to the database

# Three-Schema Architecture

**External Level:** provides access to particular parts of the database to users

**Conceptual Level:** describes the structure of the whole database for a community of users.

**Internal Level:** describes the physical storage structure of the database.

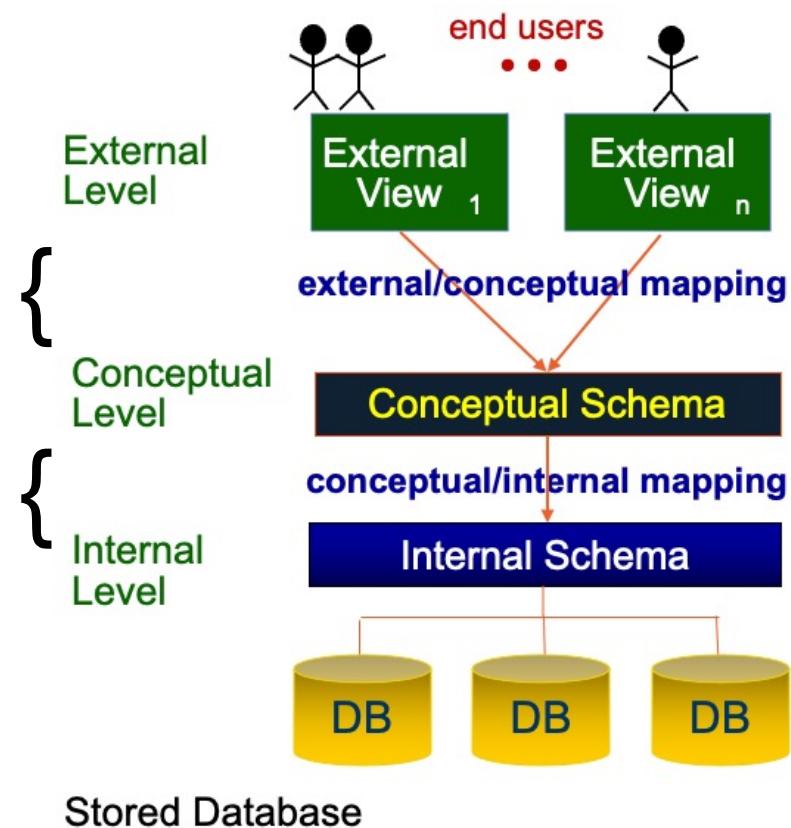


# Data Independence via the Three-Schema Architecture

**Data Independence:** Ability to change the schema at one level of a database system without having to change the schema at the next higher level.

**Logical Data Independence:** Ability to change the conceptual schema without changing external views or applications

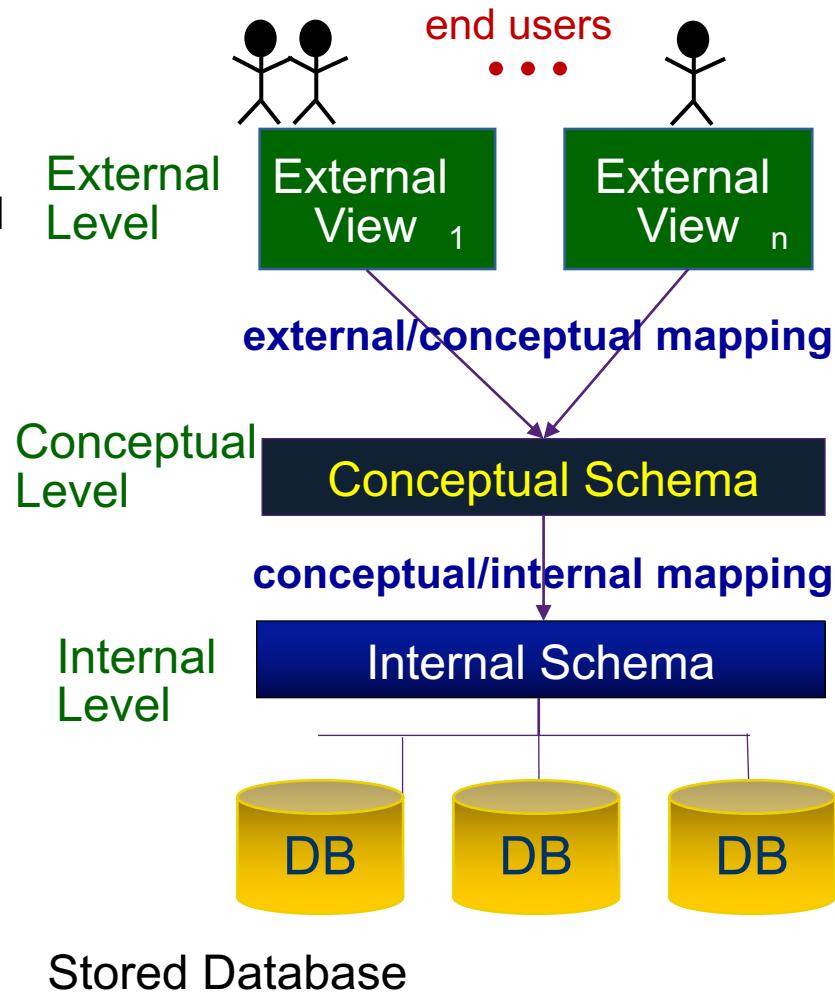
**Physical Data Independence:** Ability to modify physical schema w/o changing conceptual schema



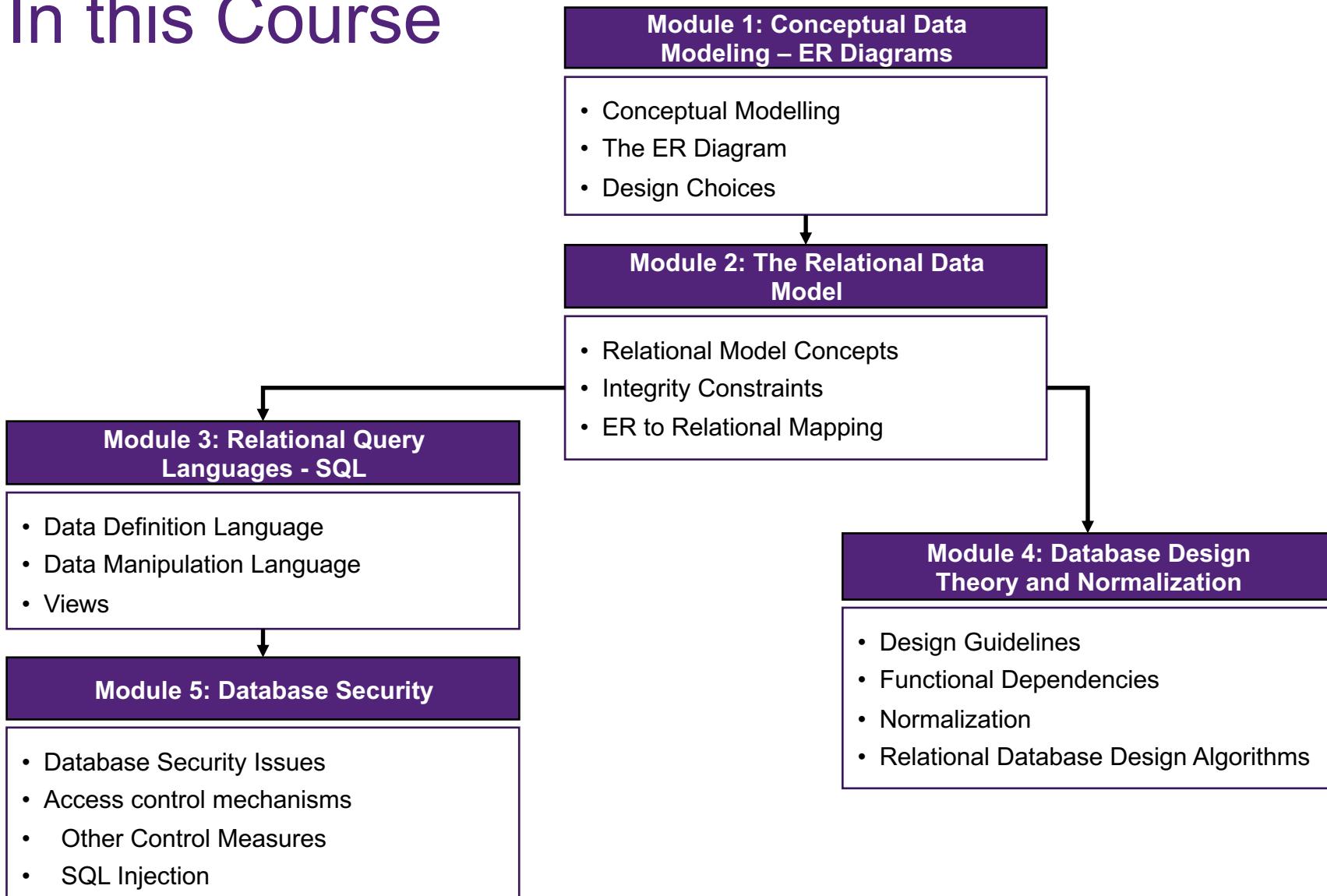
# Question: Three-Schema Architecture

Considering the Three-Schema Architecture, which of the following is correct?

- A. The conceptual level describes the physical storage structure of the database.
- B. Logical data independence provides the ability to move the physical location of where data is stored without making changes to the applications.
- C. Physical data independence provides the ability to modify physical schema without making changes to the logical schema.
- D. The external level provides access to changing the schema of the relations in a database.



# In this Course



# Review

Do you know ...

- What is a database?
- What is a Database Management System (DBMS)?
- What role does a DBMS play in a Database System?
- What are the benefits of the three-schema architecture of modern database systems?

Reading

- Chapters 1 and 2 in Elmasri & Navathe

Next Module

- Module 1: Conceptual Data Modeling – ER Diagrams