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

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

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
Dr Archie Chapman **Course Coordinator and Lecturer** archie.chapman@uq.edu.au **A/Prof Hassan Khosravi** **Lecturer** h.khosravi@uq.edu.au **For course admin enquiries, please email infs1200@itee.uq.edu.au**	**Talia Garrett-Benson** **Alan Rojan** **Caroline Stokes** **Tim Ryall** **Lucy Ochre** **Jeewaka Hemawanshage**

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

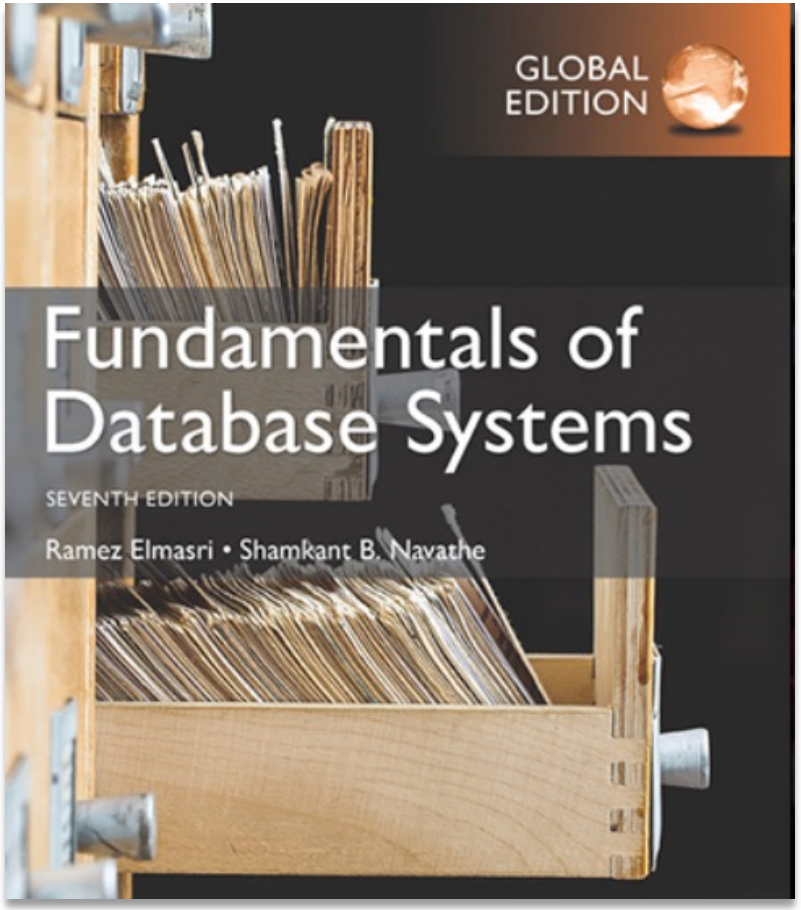
5. Explain key security concepts related to database control measures and SQL injection

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.

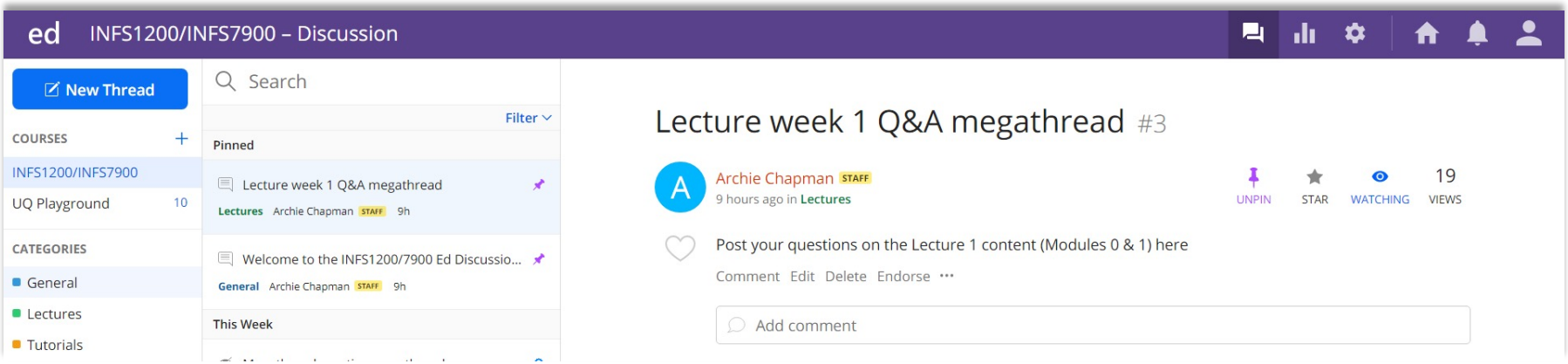
Assignments: Provide opportunity to work towards the design of an information system using three summative take-home assignments.

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 inquires also as private posts on Ed Discussion.
- We reserve the right to change the visibility of your posts as appropriate.



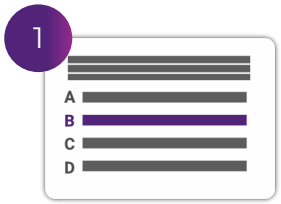
RiPPLE is a UQ developed platform that partners academics and students to create and evaluate high-quality learning resources and, using explainable AI algorithms, recommends personalised activities to students based on their mastery level.

For information about RiPPLE visit **itali.uq.edu.au/ripple.**

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

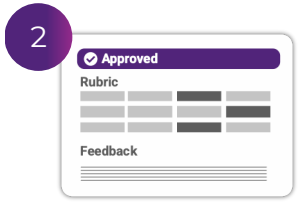
How RiPPLE Works

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



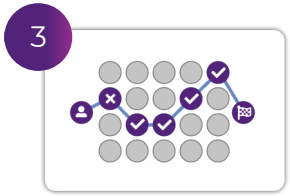
Creation

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



Moderation

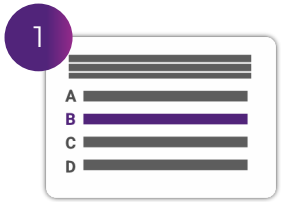
Facilitate peer evaluation of study resources with the support of AI, ensuring an equitable and rigorous review process



Personalised practice

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

Create in RiPPLE



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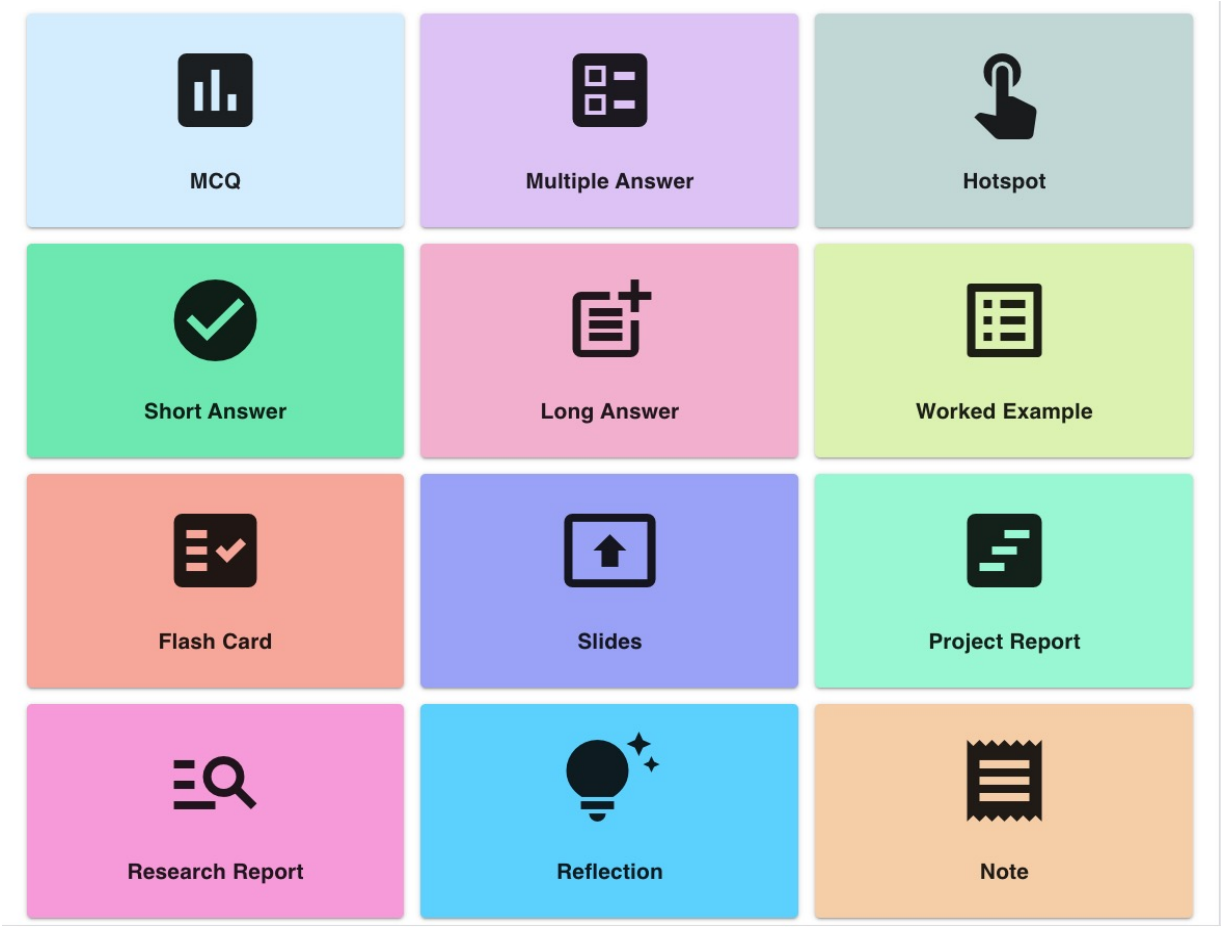
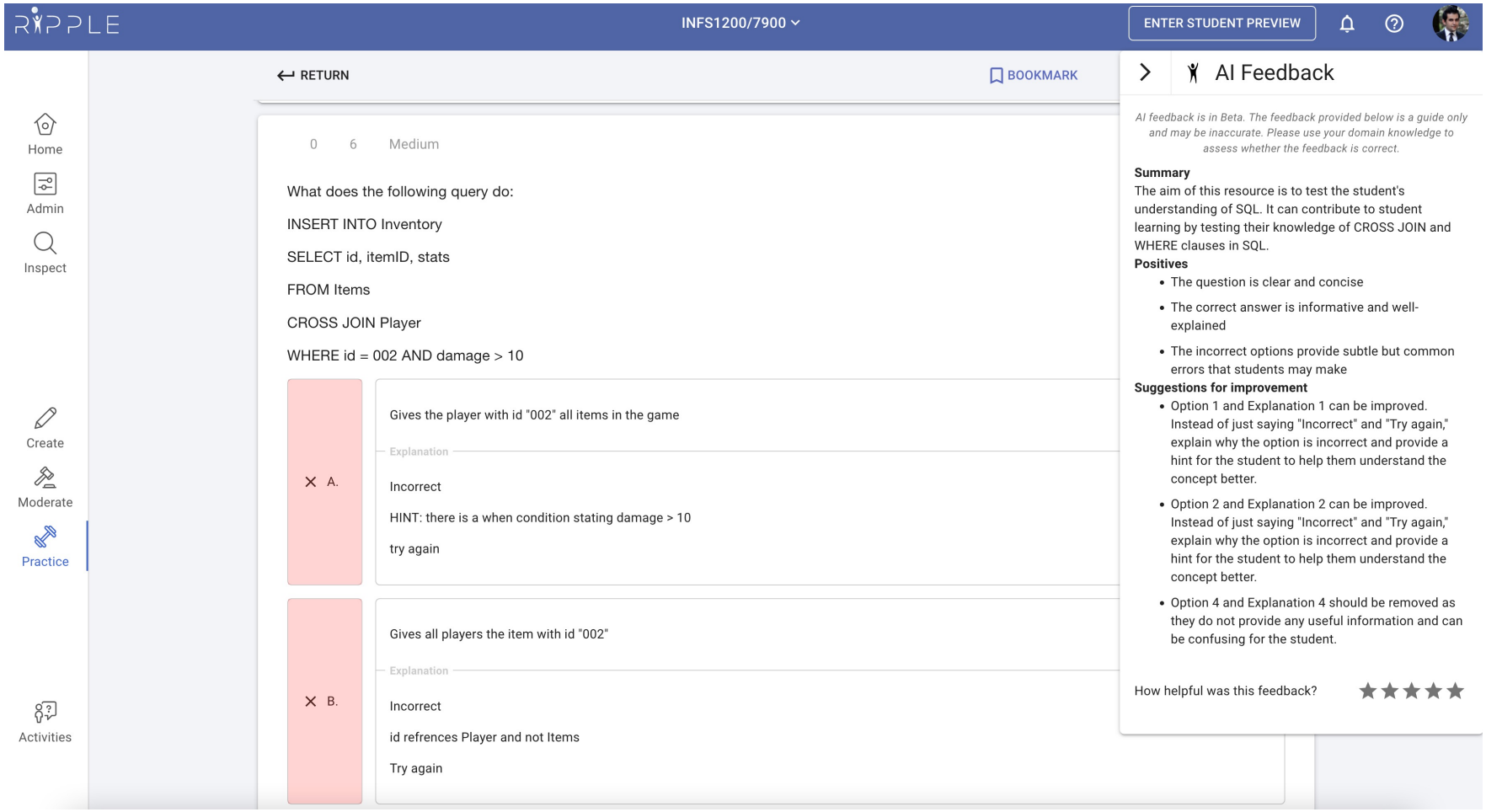
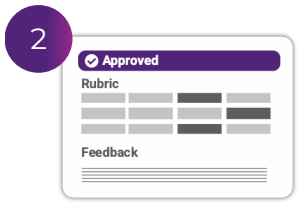


Generative AI Integration into Creation



Moderate in RiPPLE



Moderation

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

I don't want to moderate this resource

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	Outstanding
Quality of Options:	Poor	Needs Improvement	Satisfactory	Great	Outstanding
Quality of Explanation:	Poor	Needs Improvement	Satisfactory	Great	Outstanding

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

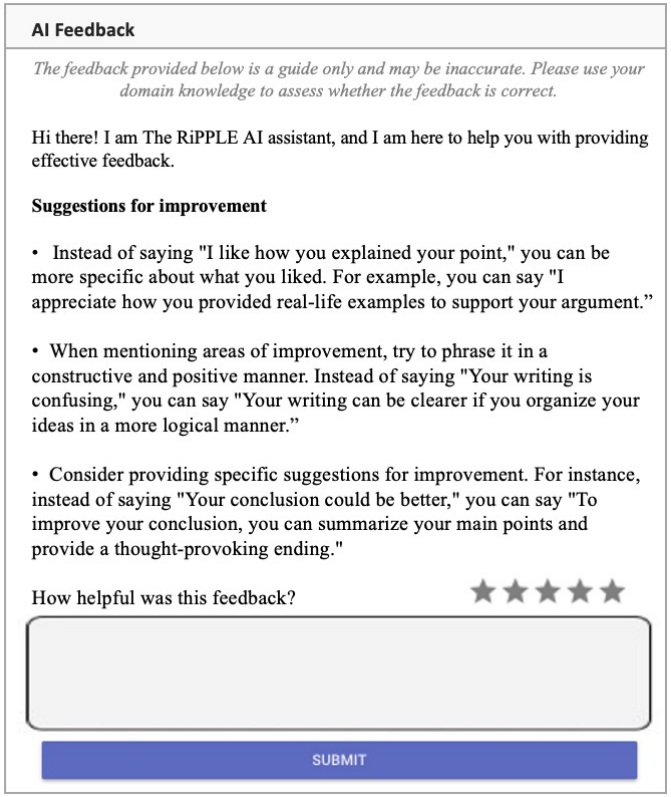
keep up the good work

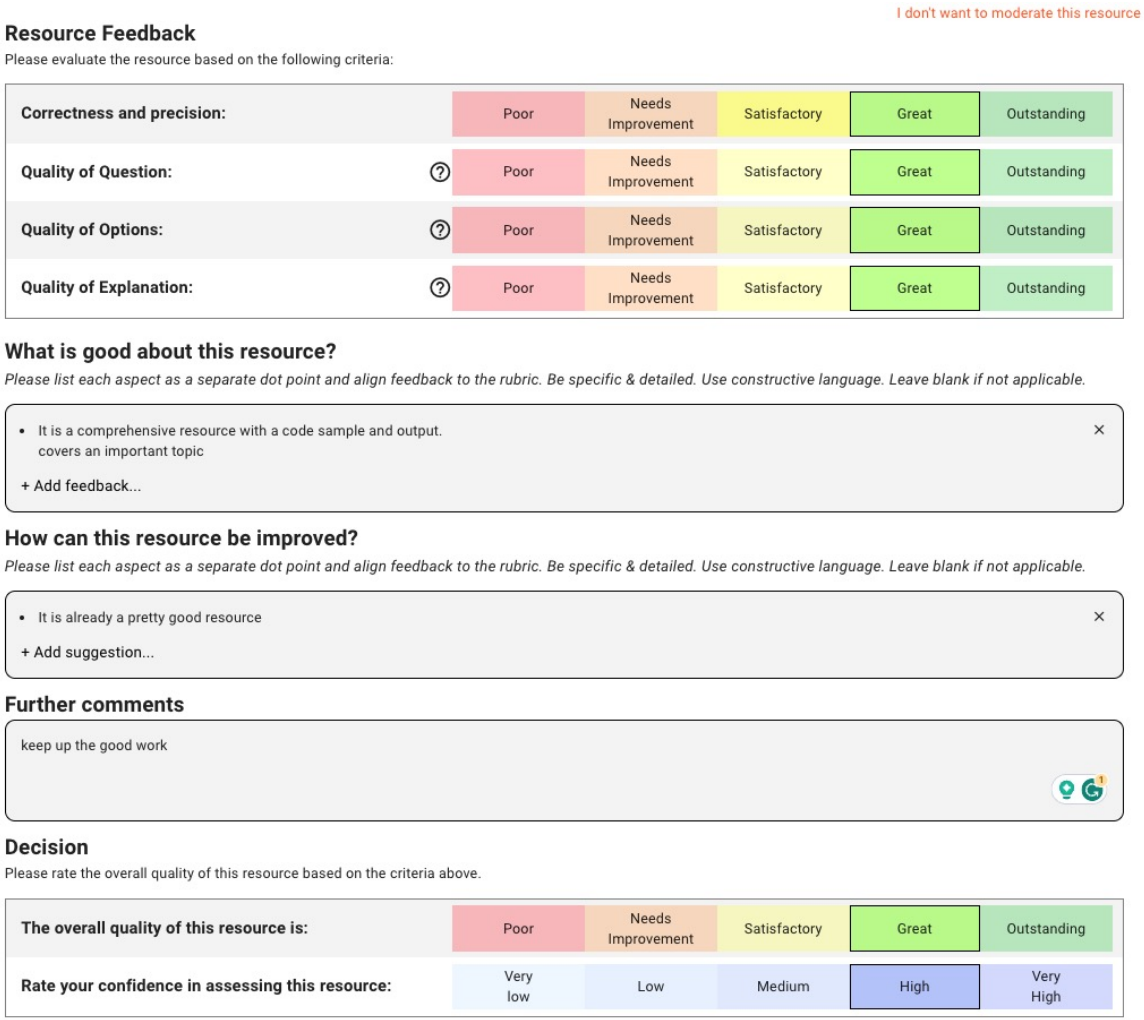
Decision

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

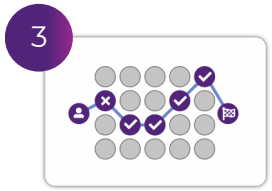
The overall quality of this resource is:	Poor	Needs Improvement	Satisfactory	Great	Outstanding
Rate your confidence in assessing this resource:	Very low	Low	Medium	High	Very High

Moderate in RiPPLE



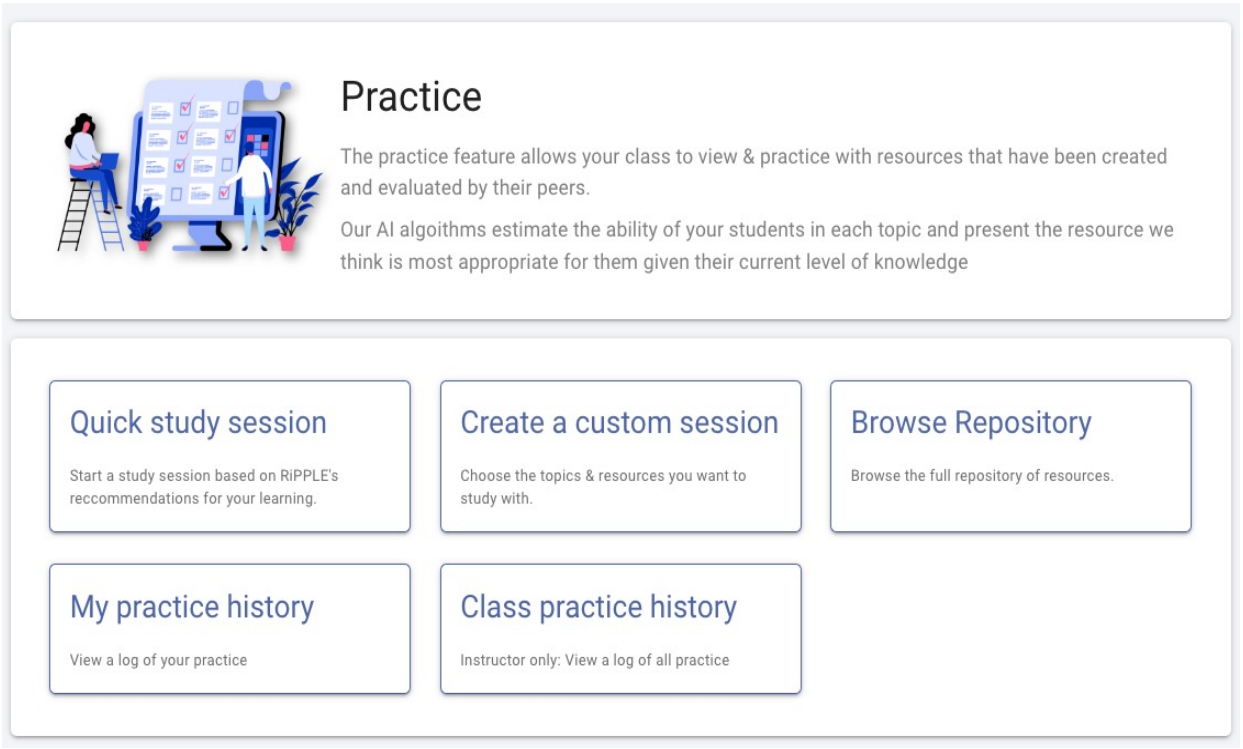


Practice in RiPPLE

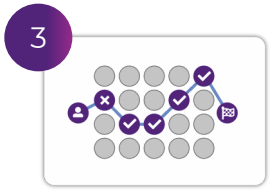


Personalised practice

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



Practice in RiPPLE



Personalised practice

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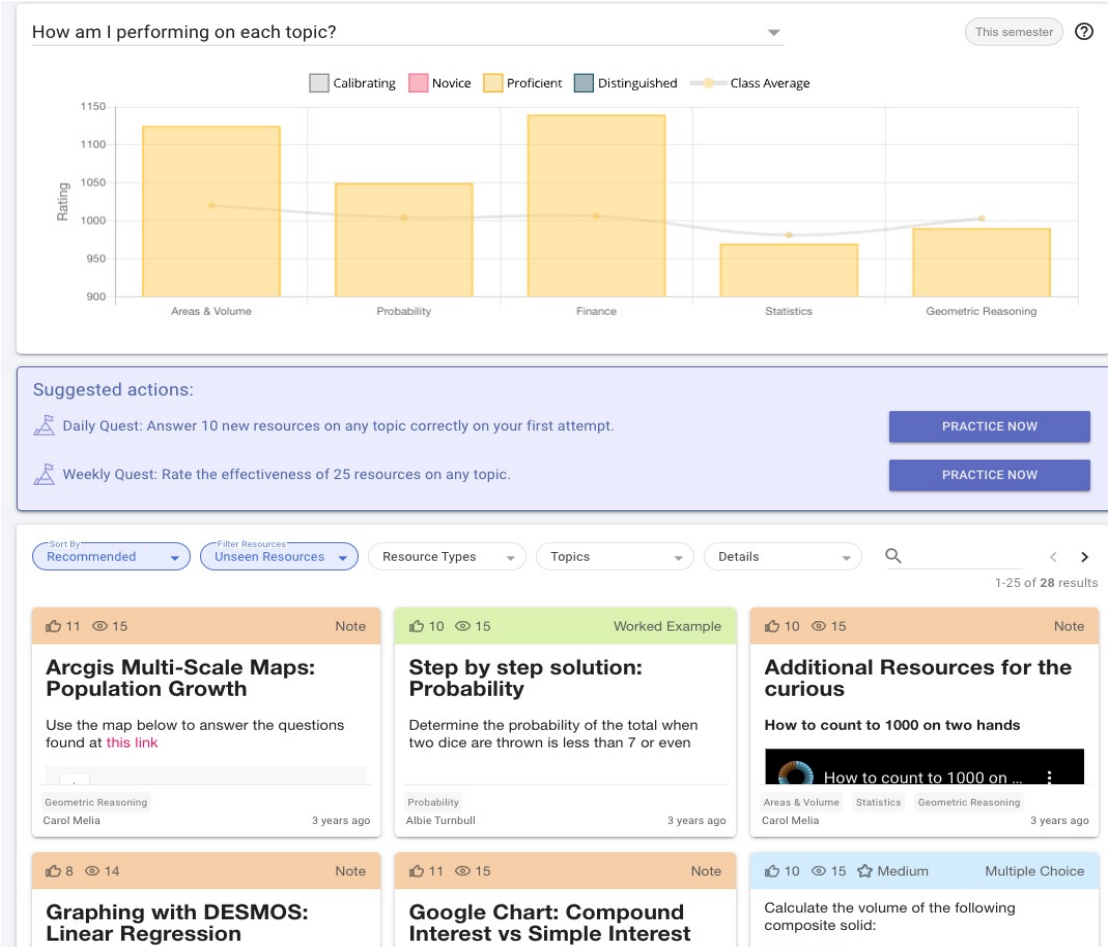
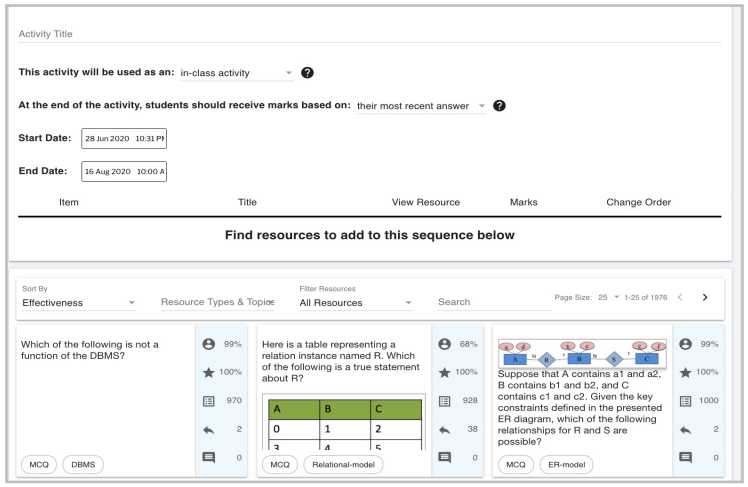
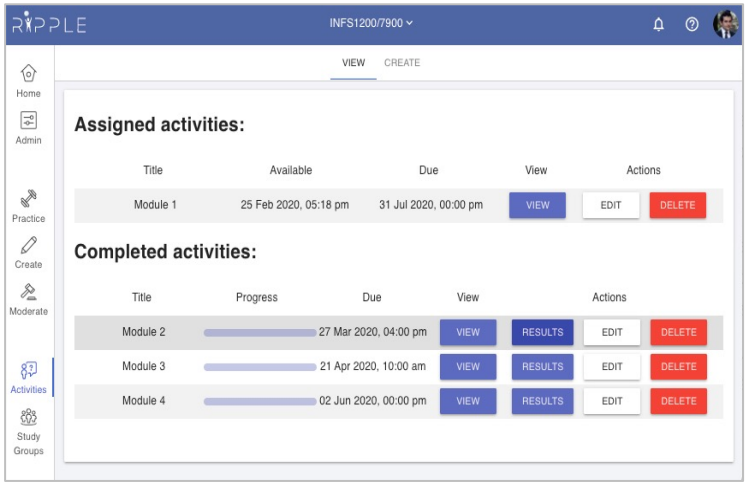


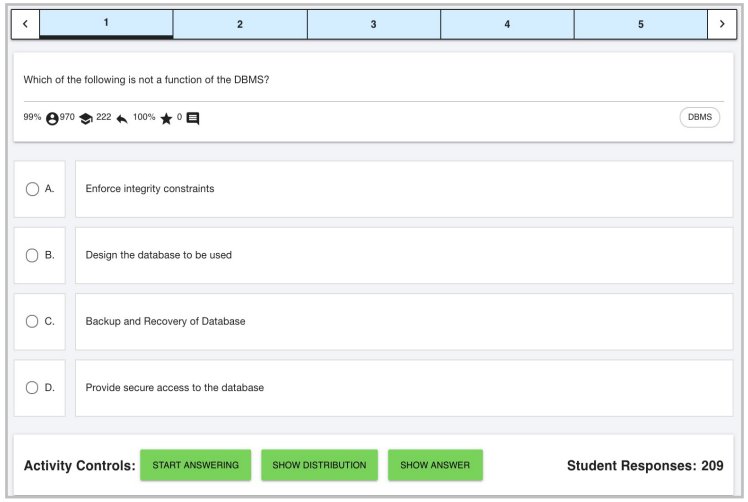
RiPPLE - Live Formative Quizzes



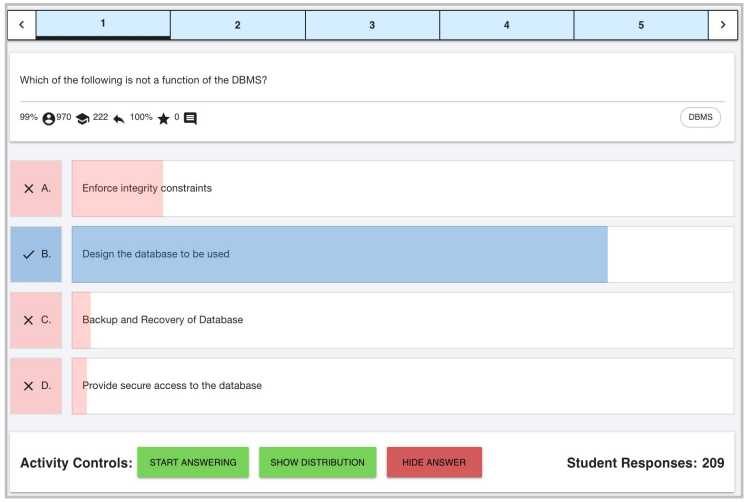
Instructor sets up quiz



Students access quiz via the activity tab



Students respond to questions



RiPPLE 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	
	Lecture	Tutorial	Practical	Assignments and Exam	Progressive
Week 1 24 July	Introduction + ER Model				
Week 2 31 July		ER Model (Basic)	Intro to Course Tools	Assignment 1 ER Modes and the Relational Model 25% 1 Sept, 4 pm	Progressive weekly tasks via RiPPLE 10% (best 10 of 12 weeks)
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				
Week 10 2 Oct	FDs and Normalization	Database design theory (basic)	Case study 4.1 FDs and Normalisation	Online submission 6 Oct, 4pm	
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		
Exam Period				Final exam 40%	

Module 1 ER Model

Module 2 Relational Model

Module 3 SQL

Module 4 Functional Dependencies & Normalisation

Module 5 Database Security

Available on the Learning Resources page on Blackboard

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:

Course Hero

Chegg

thinkswap

STUDENTVIP

StuDocu

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)

New generative AI tools (e.g. ChatGPT) can **write essays, create images, write and explain code**, and provide step by step solutions to questions.

AI technologies are rapidly changing the **job market**; they may also change the way you **study**.

AI tools can be **incorrect** or **misleading**.

- 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 RiPPLE 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

Information and Systems

What is Information?

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

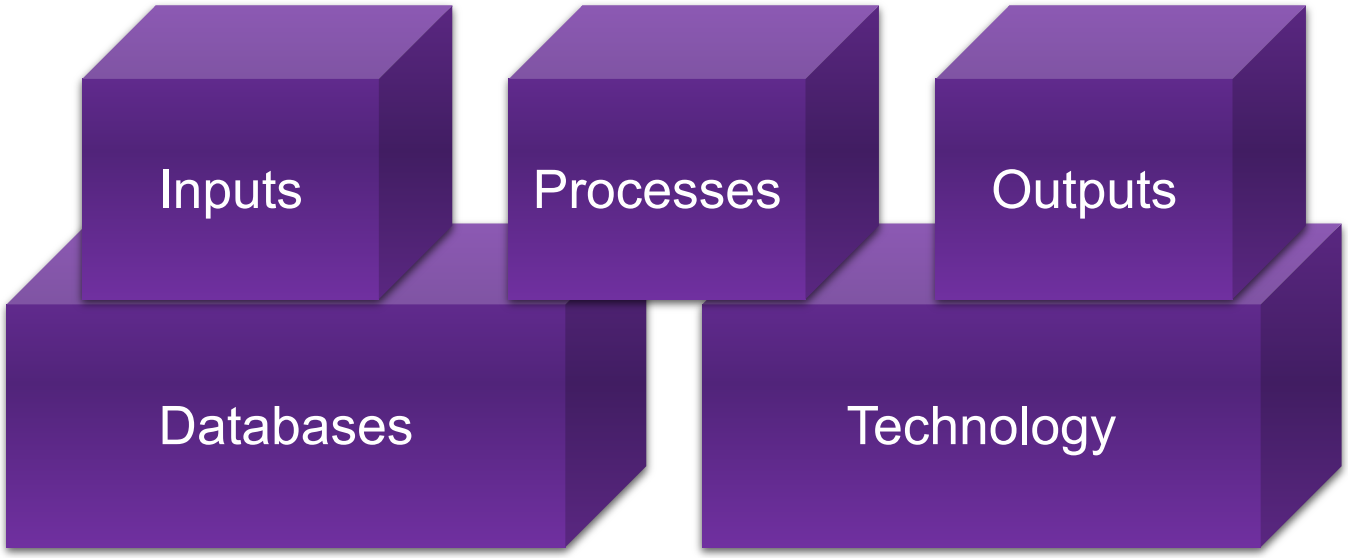
What is a System?

- 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?

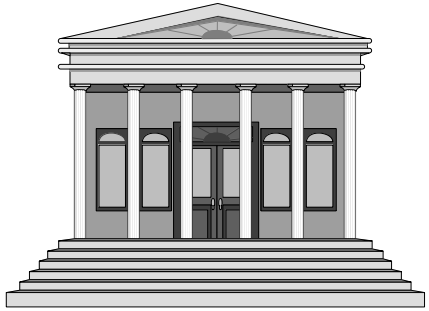
Data Management Applications

Impact

Commerce

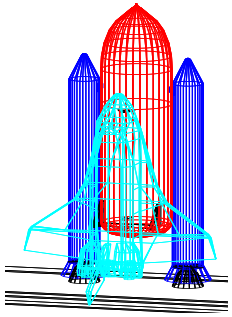
- Cash management
- Pricing
- Employee records
- Purchasing
- Reordering
- Trend Analysis

Government



- Law Enforcement
- Election Commission
- Taxation
- Legal Systems
- Transport & Utilities
- City Councils

Science and Engineering

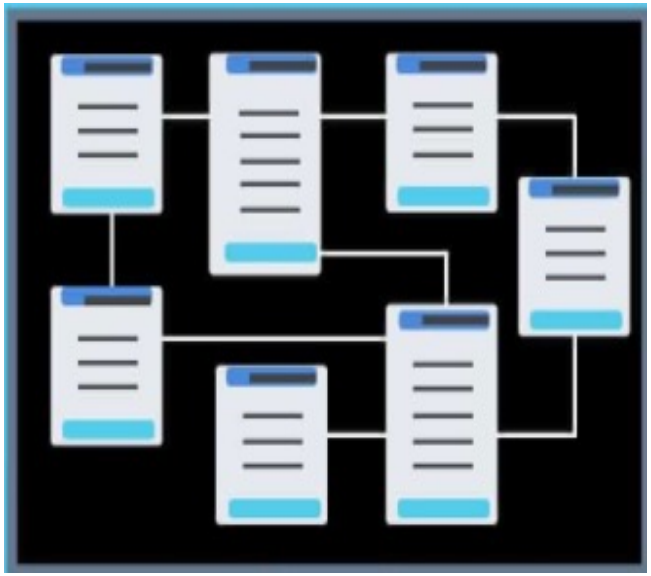


- Health and Medicine
- Space Exploration
- Geography (GIS)
- Architecture
- Military and Defense
- Telecommunications

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

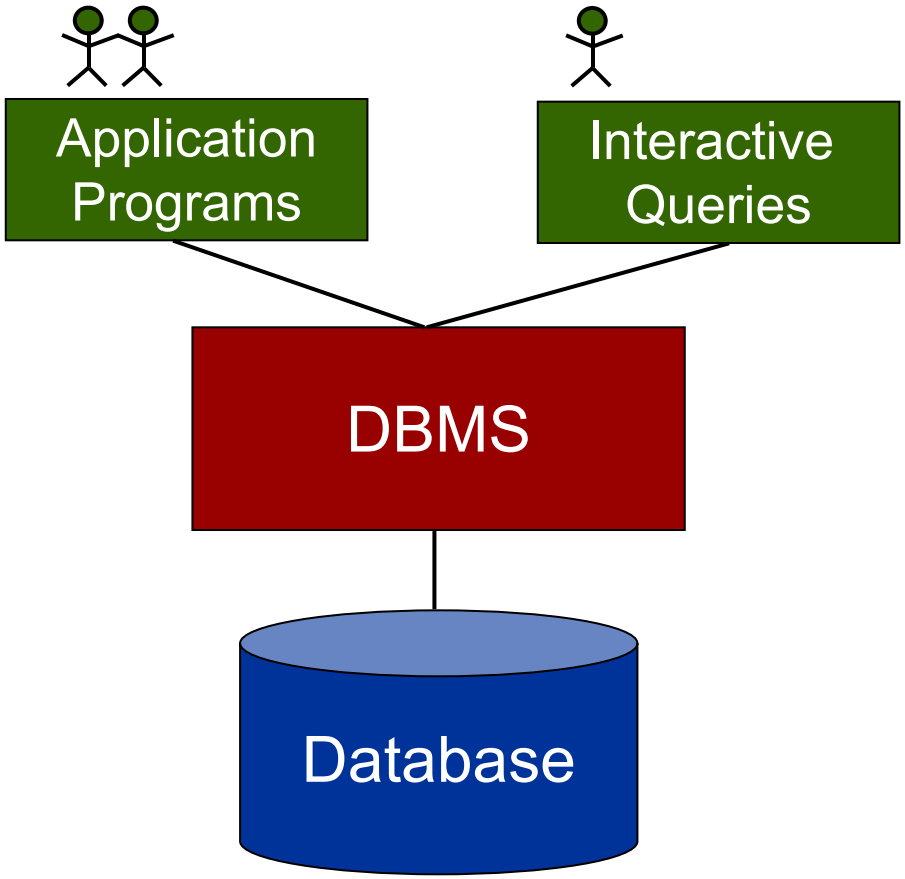
- The software that defines, constructs and manipulates a database

The Applications

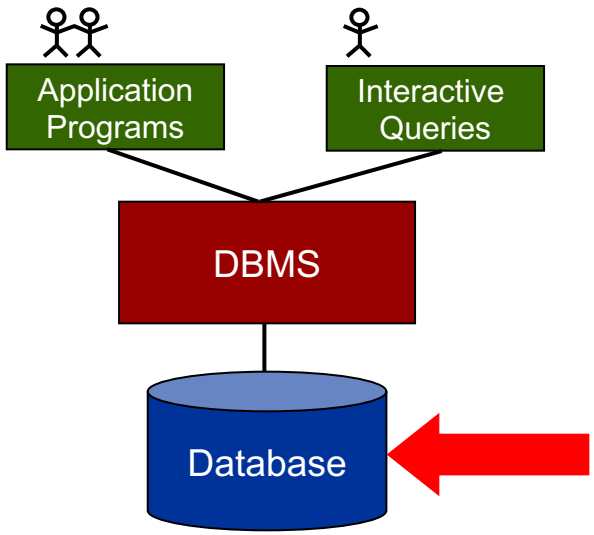
- The programs (in specific languages) that manipulate the database

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 **Module 2**

- Relational

Physical Storage **Future INFS courses**

- Organisation, Hashing, Indexing

Conceptual Database Design

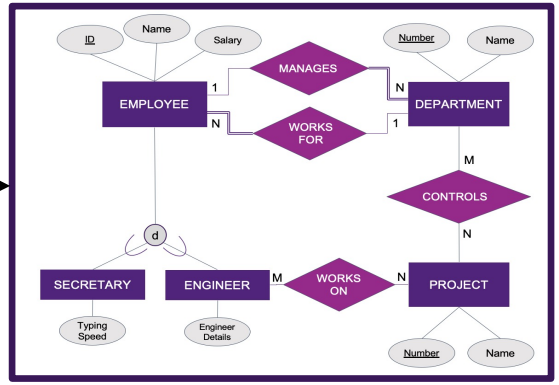
Conceptual database design is a very important phase in designing a successful database application.

- 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

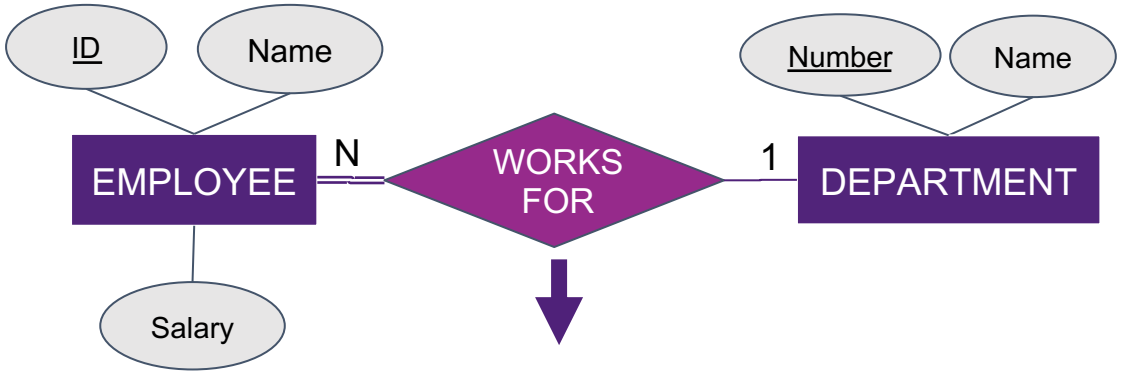
ID	Name	Level
1	Paris	Developer
2	Anna	Manager
3	Ben	Manager

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.

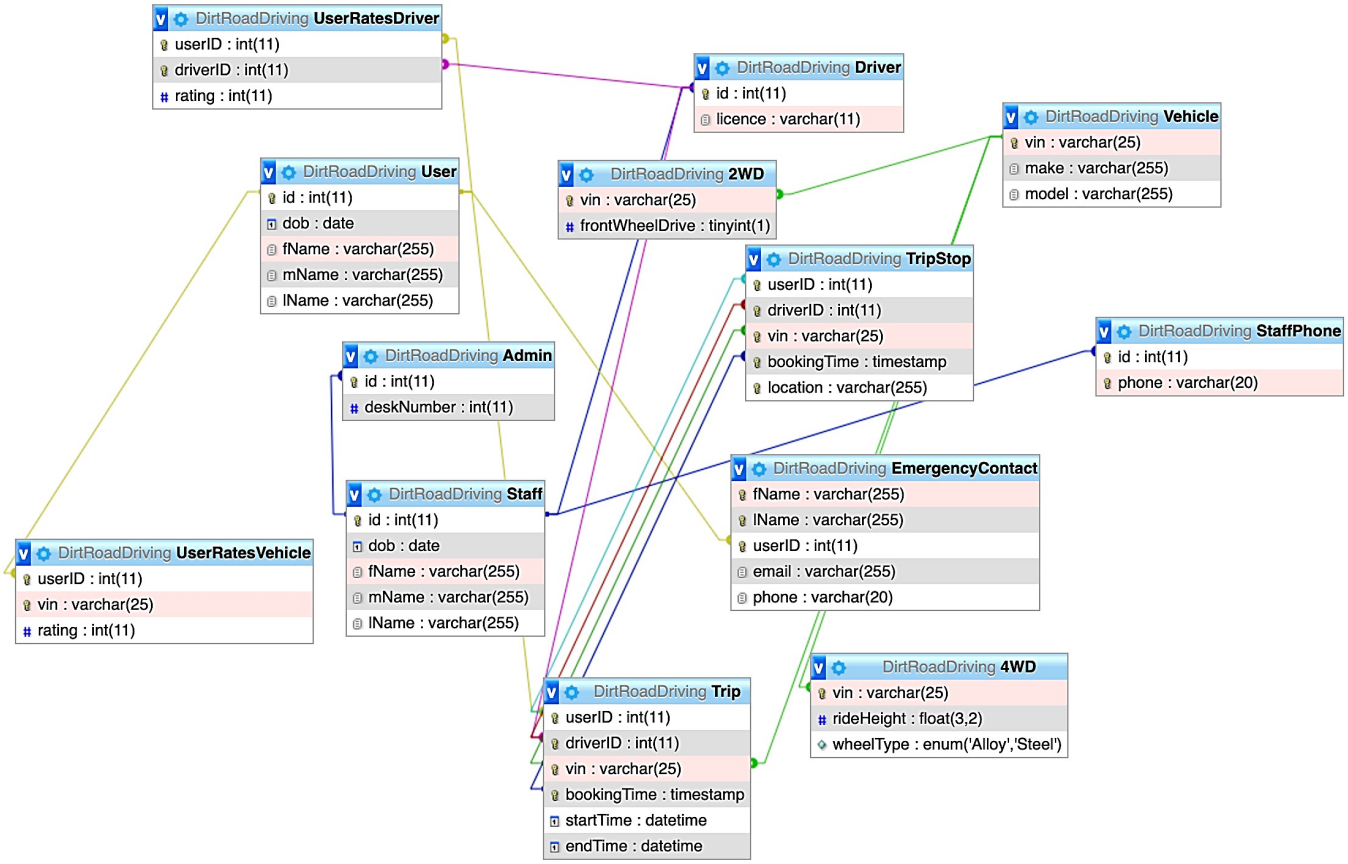


Employee

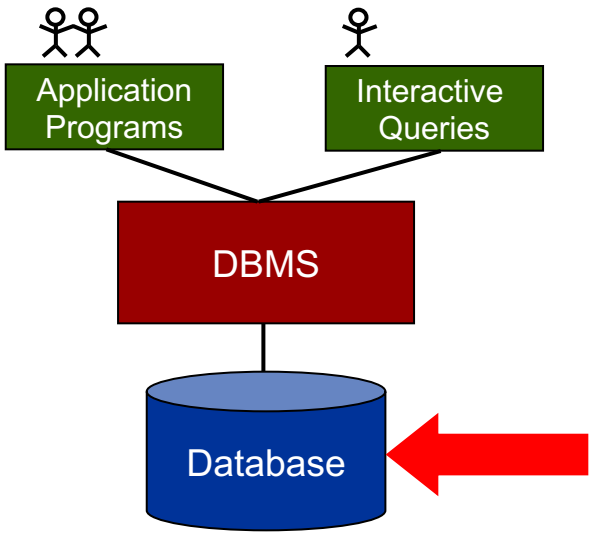
ID	Name	Salary	Department
175	Paris Lane	60,000	2
467	Anna Lee	70,000	1
1023	Ben Cho	70,000	4

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**

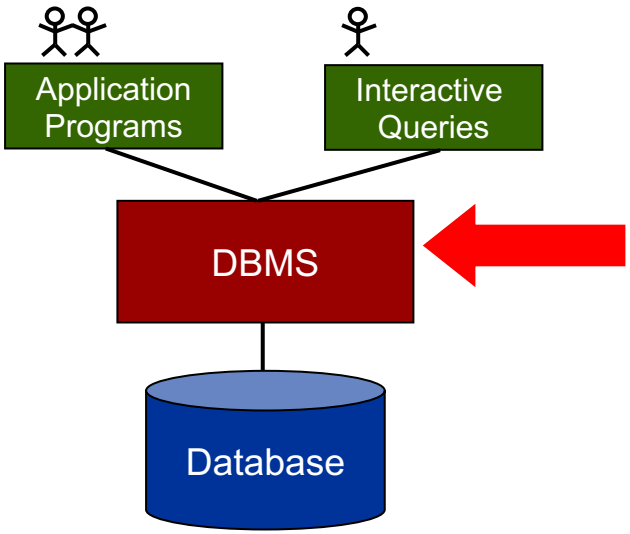
Data Models **Module 2**

- Relational

Physical Storage **Future INFS courses**

- Organisation, Hashing, Indexing

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.

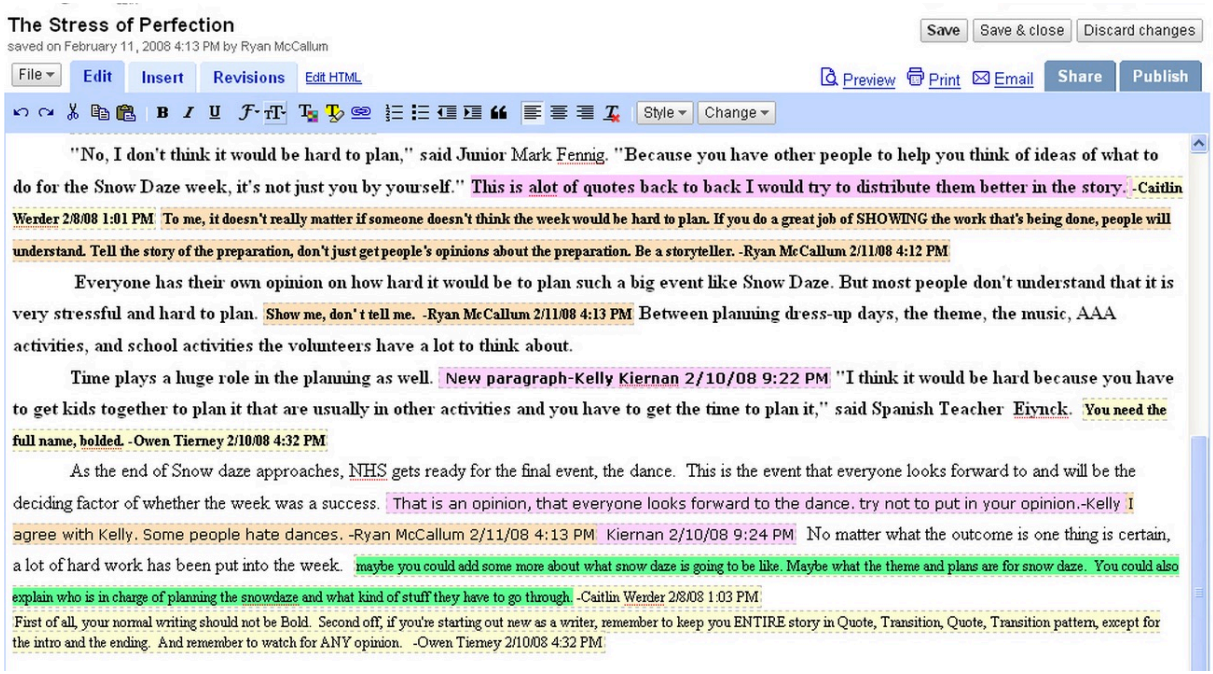
Security Management

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.

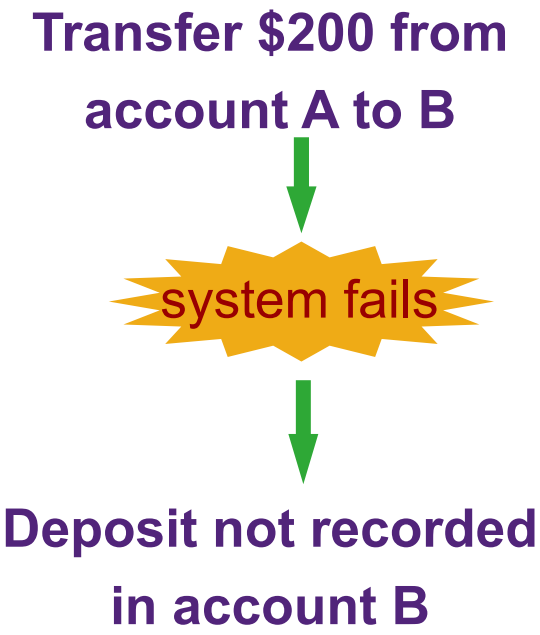


Imagine thousands of people editing the same file while assuming they are the only person using it.

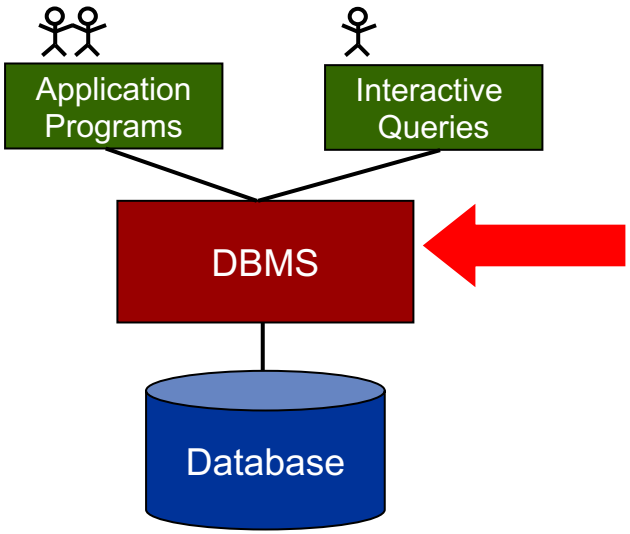
Backup and Recovery

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



Typical Functions of a DBMS



Data Integrity Maintenance **Module 2**

Query Processing **Module 3**

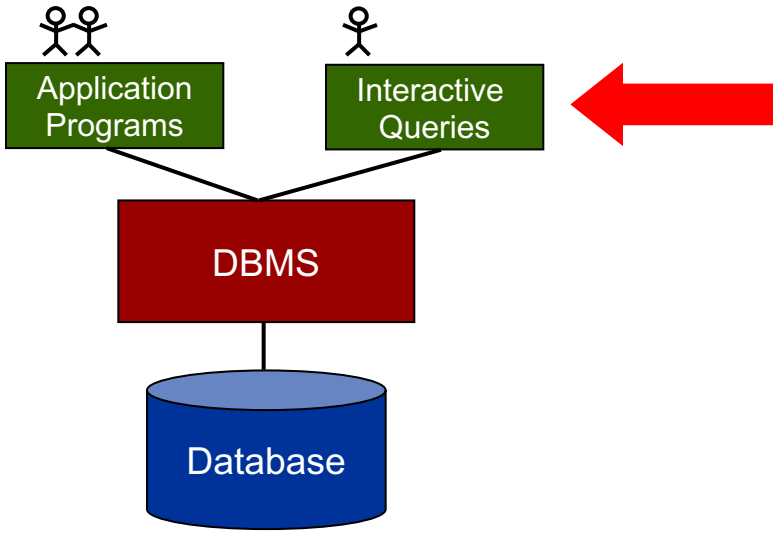
Security Management **Module 5**

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

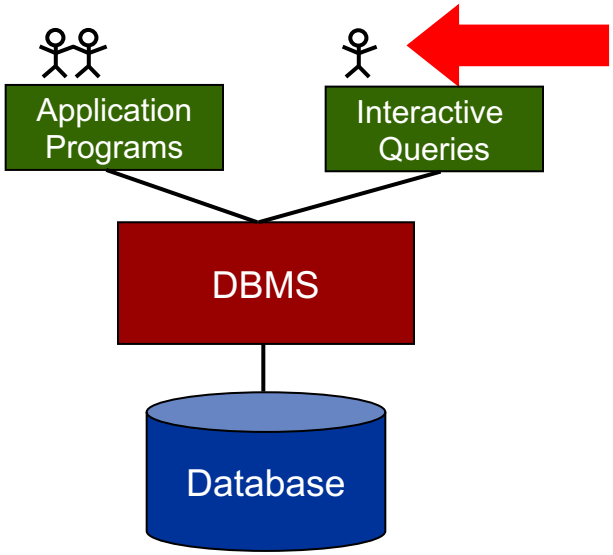
Programming language interfaces for application programmers

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

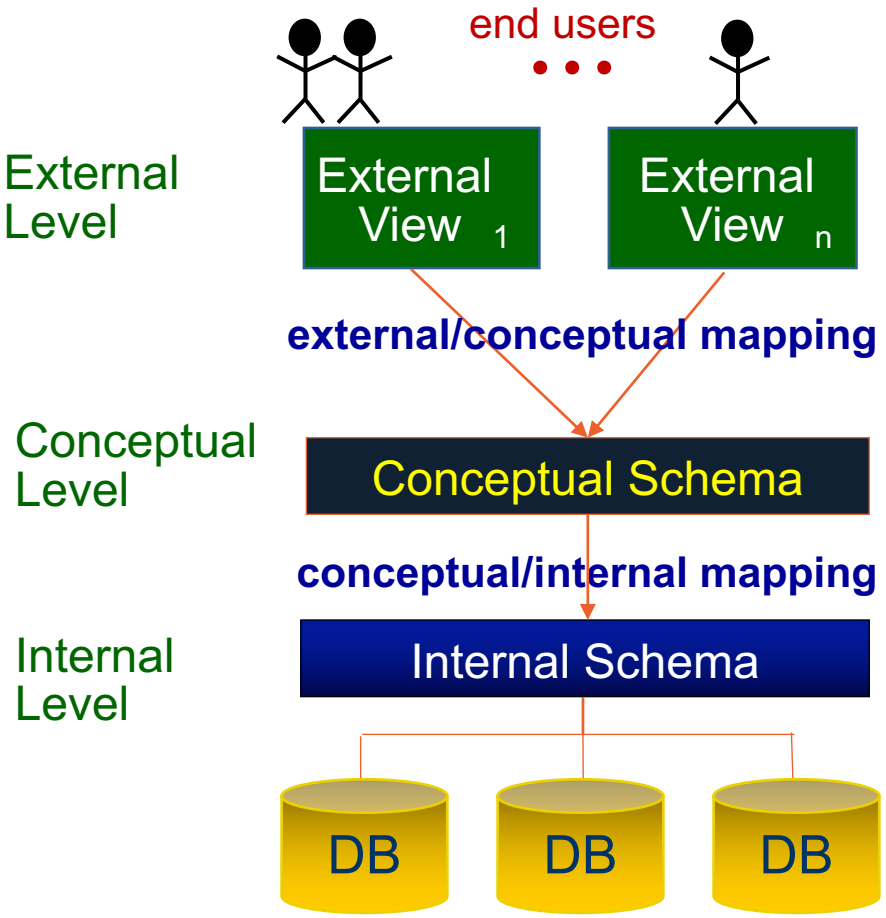
A. Enforcing integrity constraints
B. Design a database
C. Backup and Recovery of Database
D. Providing secure access to the database

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.

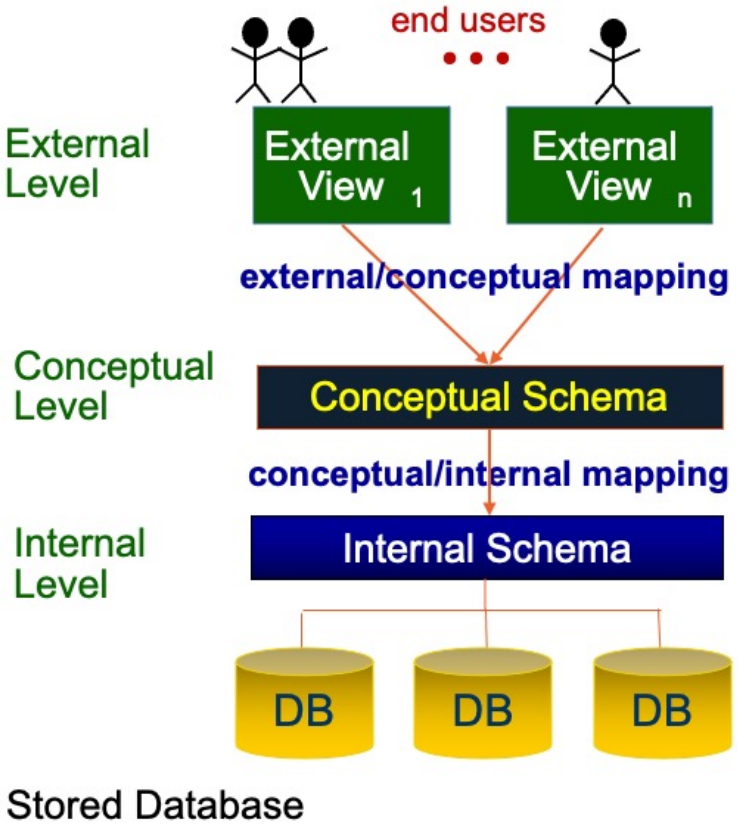


Data Independence via theThree-Schema Architecture

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

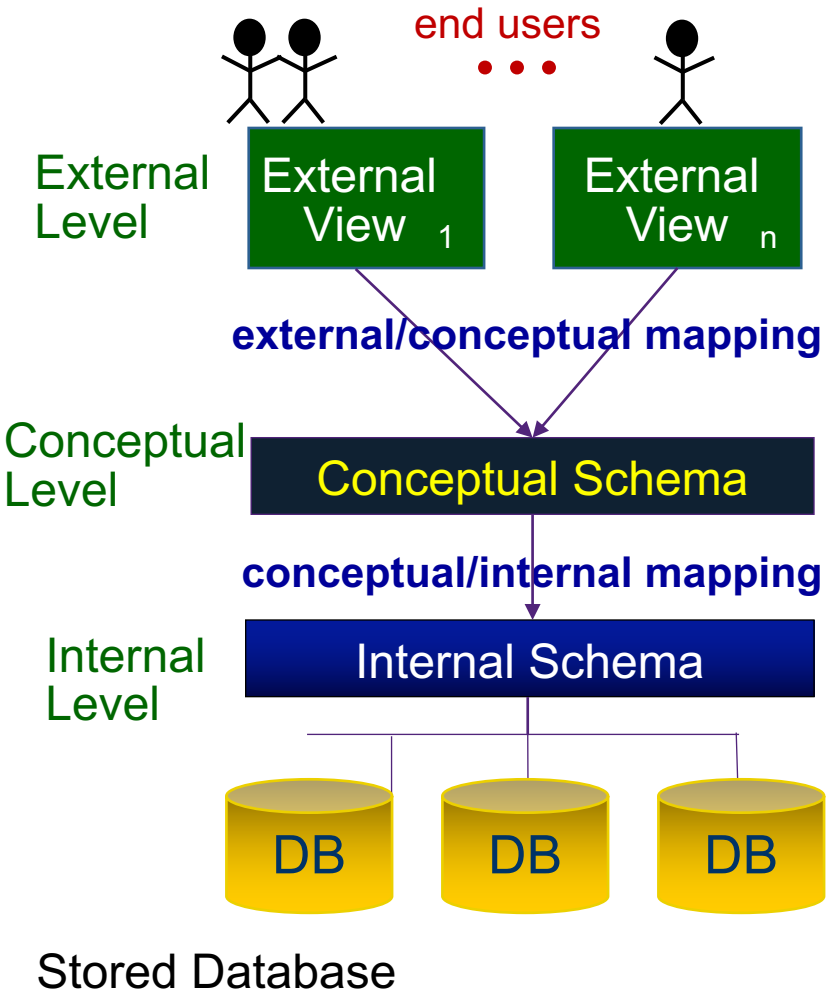
Considering the Three-Schema Architecture, which of the following is correct?

A. The conceptual level describes the physical storage structure of the database.

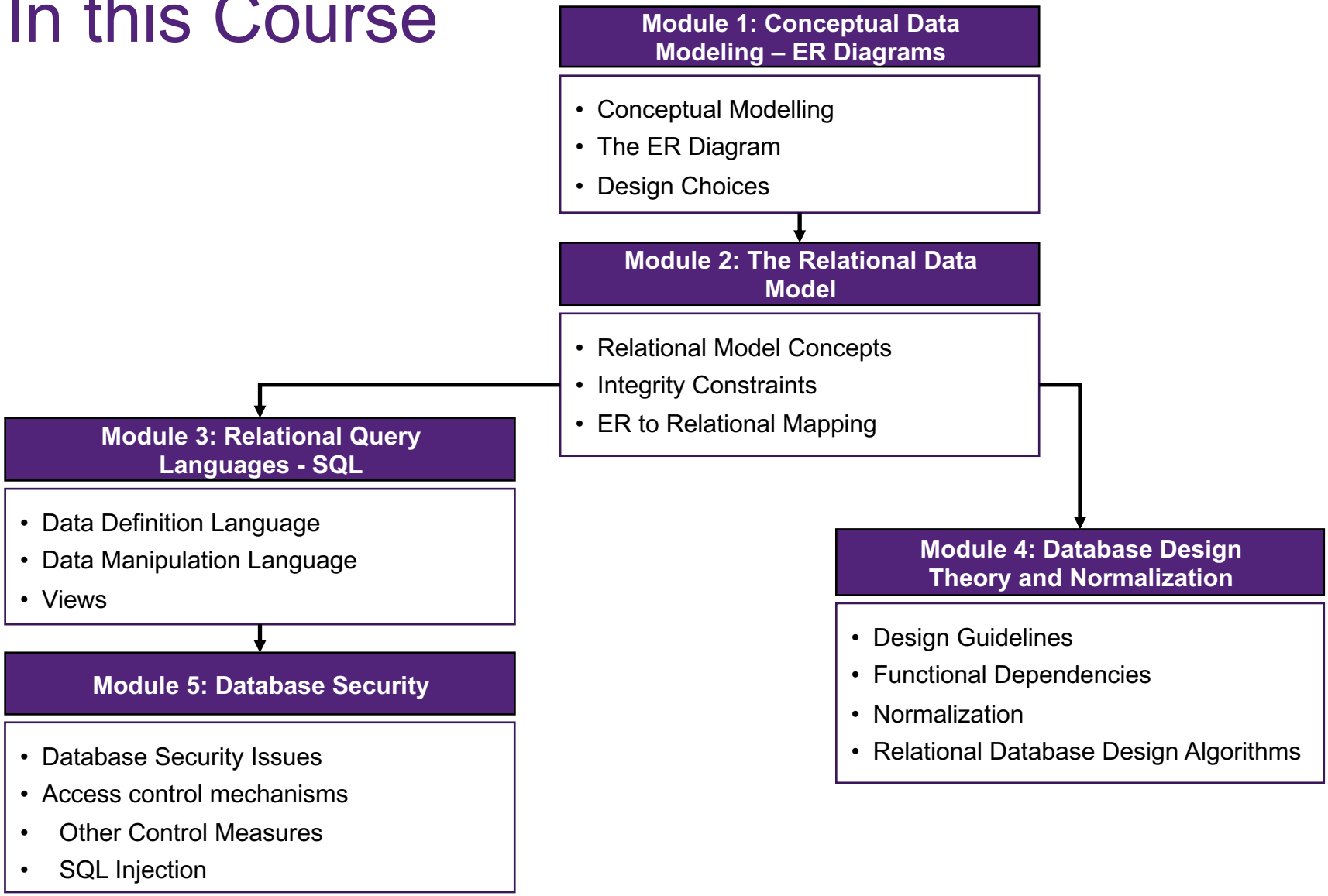
B. Logical data independence provides the ability to move the physical location of where data is stored without making changes to the applications.

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