

高中資訊及通訊科技修訂課程詮釋講座

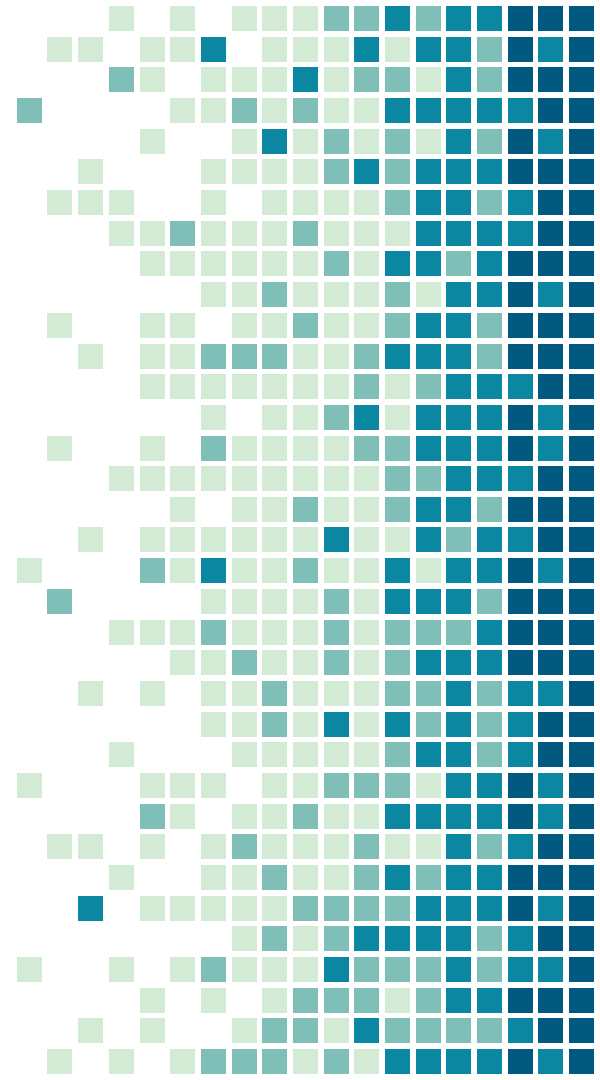
Revised Senior Secondary Information and Communication Technology (ICT) Curriculum

Core Part & Elective Option A:
Teaching database concept and SQL
commands by various DBMS

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1.

Overview



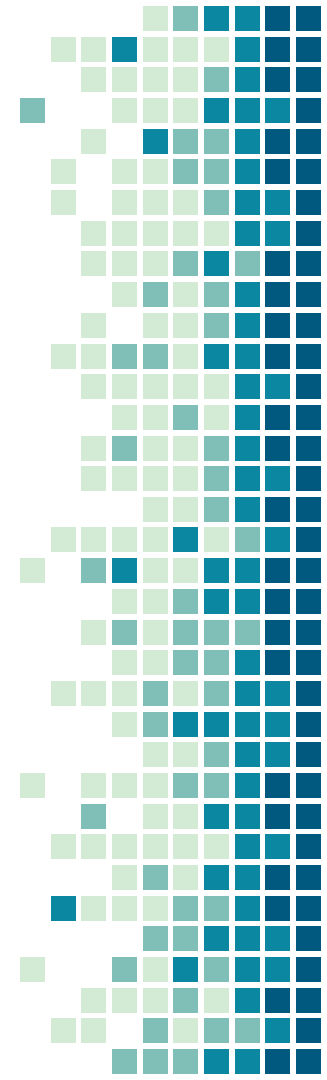
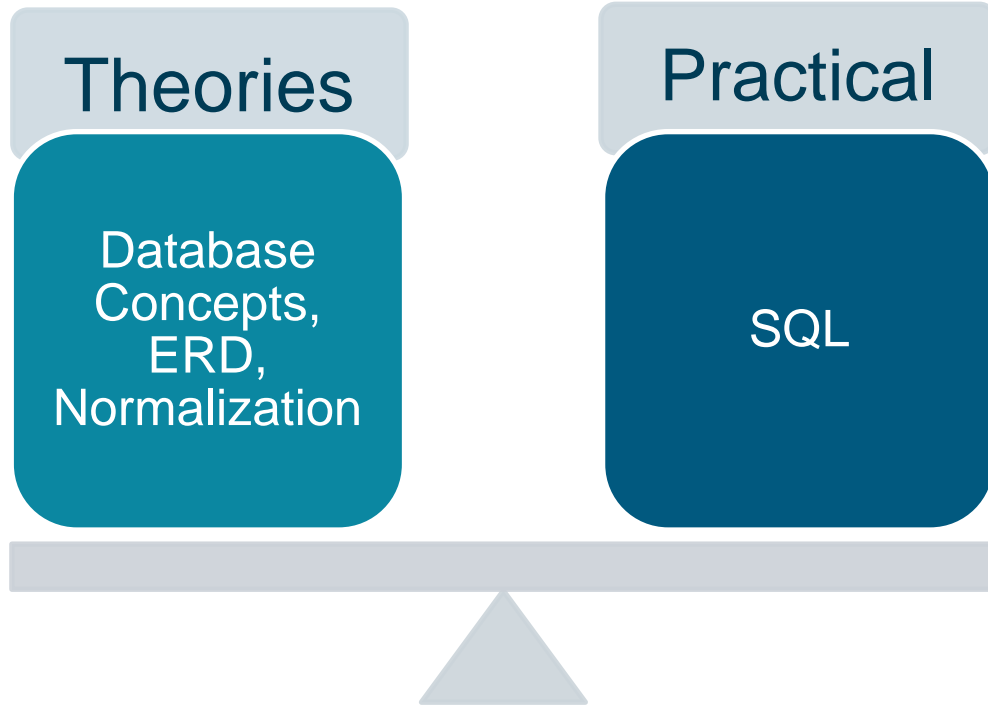
Learning Objectives

Students will learn about:

- **concepts** and **applications** related to **databases** and the **DBMS**;
- the basic concepts of a relational database, and the construction, manipulation and extraction of information from a relational database using **SQL**;
- the construction of simple data models using the **ER diagrams** methodology;
- the importance of good **database design** as a blueprint for the development of a database management system; and
- the importance of **data privacy** and measures for its improvement.

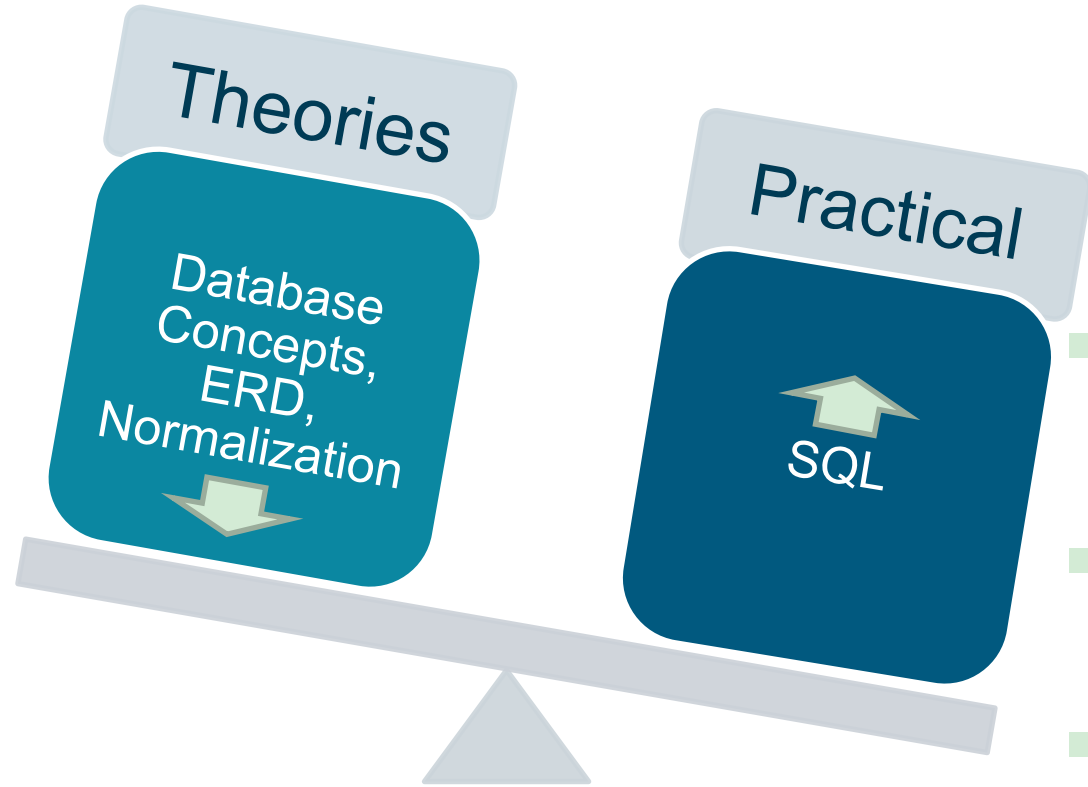
Time allocation: ~38 hours

Changes in Teaching Strategies

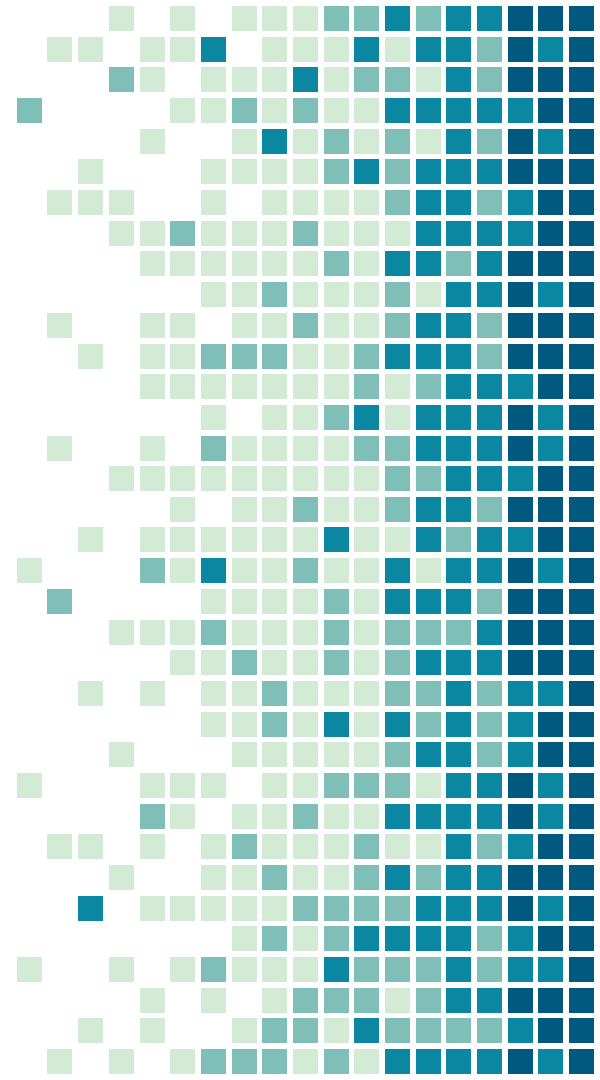


Changes in Teaching Strategies

- Less memorable parts
- More practical hands-on
- Holistic understanding on database design



2. Curriculum and Assessment Guide



Curriculum updates (Core)

Core (Section A, Information Processing) [C&A Guide, 2015 Revised]

Topic	Learning Outcomes	Remarks
Data Organisation and Data Control (4 hours)	<ul style="list-style-type: none">Identify data, records, fields, files and databases in the hierarchical organization of data.Explain how records can be organised, stored and retrieved. State the advantages, disadvantages and applications of the two types of file access: direct access and sequential access.Discuss the needs of data control.Describe how errors can be detected by using validation and parity checking, and prevented by verification and validation.	

Core (Section A, Information Processing) [C&A Guide, 2022]

Topic	Learning Outcomes	Remarks
Data Organisation and Data Control (4 hours)	<ul style="list-style-type: none">Identify data, records, fields, files and databases in the hierarchical organization of data.Explain how records can be organised, stored and retrieved. State the advantages, disadvantages and applications of the two types of file access: direct access and sequential access.Discuss the needs of data control.Describe how errors can be detected by using validation and parity checking, and prevented by verification and validation.	



No
Change!

Curriculum updates (Core)

Core (Section A, Information Processing) [C&A Guide, 2015 Revised]

Topic	Learning Outcomes	Remarks
The Use of Office Automation Software (28 hours)
	<ul style="list-style-type: none">Apply the concepts of data organisation to create and maintain a simple database using a Database Management Systems (DBMS) tool.Create and use a form for data entryPractise data extraction and manipulation by querying a database and create reports.	This includes the selection, filtering and sorting of data using query in a single database table. Students should be able to trace and interpret simple SQL statements . Though sophisticated reports are not required, they should create and format reports for intended users / audience.

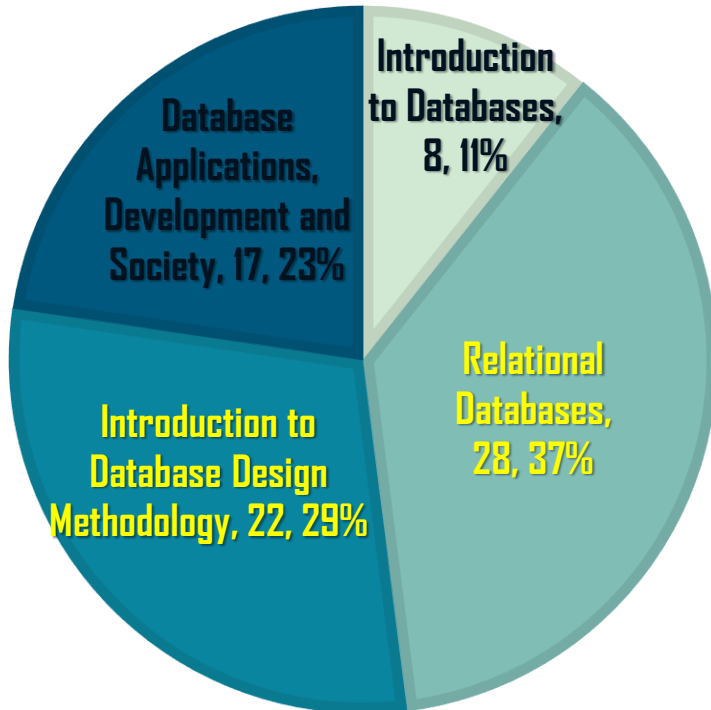
Core (Section A, Information Processing) [C&A Guide, 2022]

Topic	Learning Outcomes	Remarks
Data Manipulation and Analysis (20 hours)
	<ul style="list-style-type: none">Apply the concepts of data organisation to create and maintain a simple database using a Database Management Systems (DBMS) tool.Create and use a form for data entry.Practise data extraction and manipulation by querying a database and create reports.	This includes the selection, filtering and sorting of data using query in a single database table. Students should be able to trace and interpret simple SQL statements . Though sophisticated reports are not required, they should create and format reports for intended users / audience.

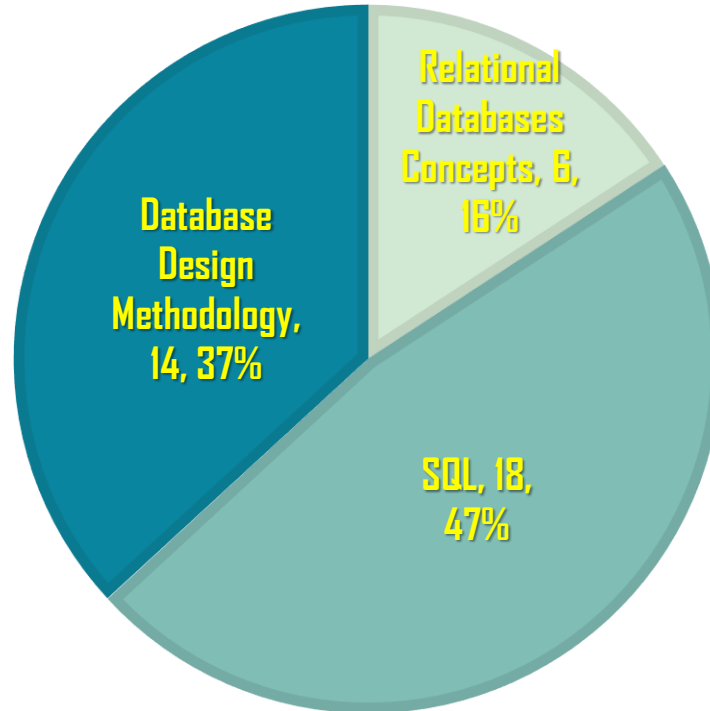
No Change!

Curriculum updates (Elective Option A)

OLD



NEW



New Curriculum

- Relational Databases Concepts (6 hours)

Core (Section A, Information Processing) [C&A Guide, 2022]

Topic	Learning Outcomes	Remarks
Relational Databases Concepts (6 hours)	<ul style="list-style-type: none">Describe the basic concepts of relational databases.Create a simple relational database.Describe the purposes of rollback.	<ul style="list-style-type: none">It includes entity, relationship, attribute, domain, index, key (such as primary key, foreign key and candidate key), and integrity (such as entity integrity, referential integrity and domain integrity). Students should be able to identify these basic elements in examples taken from everyday applications.Students should know how to organise data differently but sensibly in a relational database and be able to establish the required relationships among the tables.

Extensions of topic (b) “Data Organisation and Data Control” in the Compulsory Part – module A Information Processing.

New Curriculum

- SQL (18 hours)

Core (Section A, Information Processing) [C&A Guide, 2022]

Topic	Learning Outcomes	Remarks
SQL (18 hours)	<ul style="list-style-type: none">• Use SQL to maintain a simple relational database, and manipulate its data or retrieve the required information in at most three tables.	<p>Skills involved include:</p> <ul style="list-style-type: none">• modify the structure of the tables• add, delete and modify the data in the tables• view, sort, and select contents by filtering, and create different views• use appropriate operators and expressions such as arithmetic operators and expressions, comparison operators, logical operators and the in, between and like operators to perform specific operations• use simple built-in functions such as aggregate and string functions• perform queries on multiple tables, including the use of equi-join, natural join and outer join• perform sub-queries (for one sub-level only)

Rollback

Below illustrates how a rollback may be conducted in conjunction with a Transaction Log:



New Curriculum

- Database Design Methodology (14 hours)

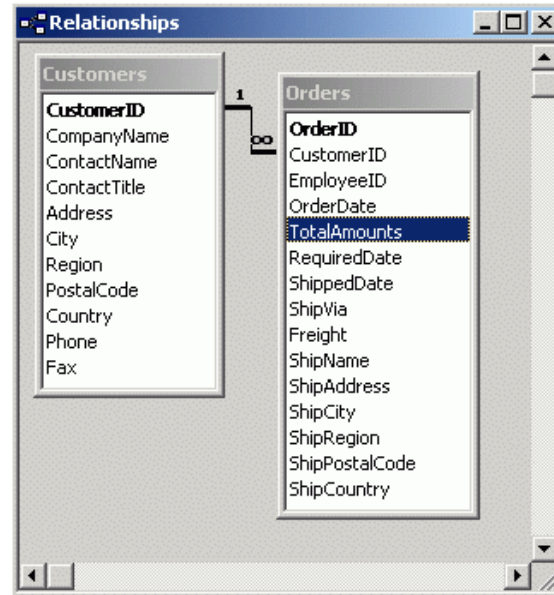
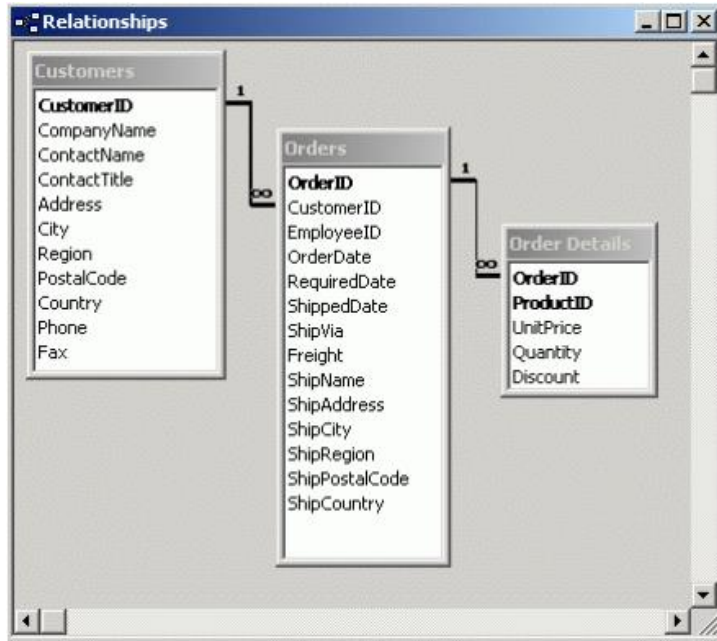
Core (Section A, Information Processing) [C&A Guide, 2022]

Topic	Learning Outcomes	Remarks
Database Design Methodology (14 hours)	<ul style="list-style-type: none">Be aware of the different types of relationships among entities in a relational database.Analyse simple scenarios in business, education or other fields and create simple ER diagrams involving binary relationship only in designing databases.Explain the concepts of data redundancy and discuss the methods or measures used to reduce data redundancy.Describe the needs and procedures of denormalisation.Transform the ER diagrams to tables in relational databases.Use access rights to achieve data privacy.	<ul style="list-style-type: none">The resolution of many-to-many relationship into multiple one-to-many relationships should also be introduced.Students should be able to reduce data redundancy through normalisation up to Third Normal Form (3NF).

From old curriculum:
(d). Database Applications, Development and Society

Denormalisation

- 3NF vs Performance



Summary

Cancelled

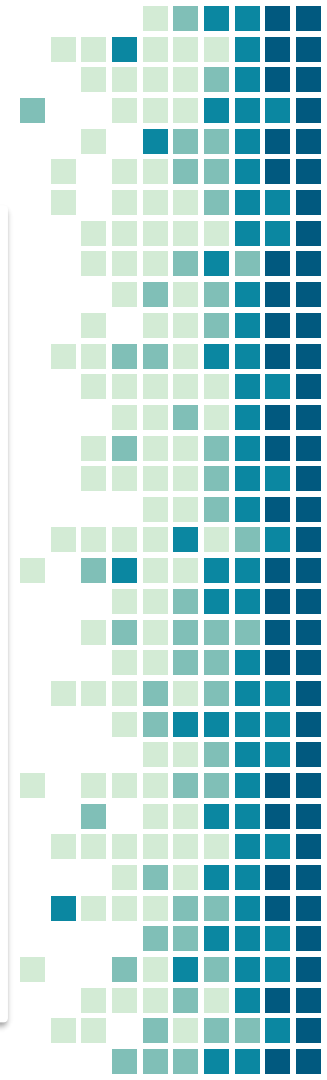
- Data model (hierarchical database model, network database model...)
- Data dictionary
- Level of data abstractions
- SQL: exporting query
- Database Application, Development and Society
 - Database development lifecycle, data mining....

Merged

- Data types (integer, decimal, boolean....)
- Database elements (fields, records, tables...)

New

- Rollback
- Denormalization



Main ideas

Database design

Real scenarios

→ ERD

→ Normalization

→ Databases

Database structure

Key, index,
view....

Data Queries

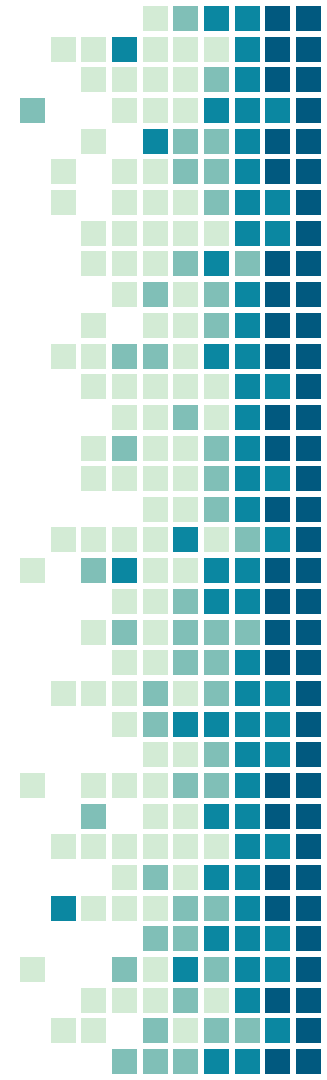
Using SQL in
real scenarios



New Focuses

1. SQL

- Core part to demonstrate students' knowledge in this elective
- All SQL commands in reserved word list
 - Most difficult parts: table join & sub-queries
 - DDL(Insert into, drop.): always poor
- Hands on practice on different database scenarios



Reserved Words Lists

For Core,

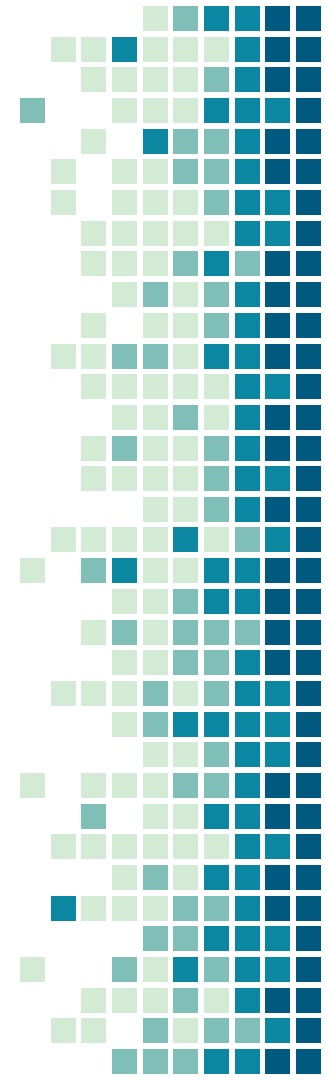
Database (SQL commands)

Constants	TRUE, FALSE
Operators	+, -, *, /, >, <, =, >=, <=, <>, %, _, ', AND, NOT, OR
SQL	AVG, MAX, MIN, SUM, AS, BETWEEN, BY, ASC, DESC, DISTINCT, FROM, GROUP, HAVING, LIKE, NULL, ORDER, SELECT, WHERE

For Elective Option A,

Database (SQL commands - based on SQL-92 Standard)

Constants	FALSE, TRUE
Operators	+, -, *, /, >, <, =, >=, <=, <>, %, _, ', AND, NOT, OR
SQL	ABSOLUTE (ABS), AVG, INT, MAX, MIN, SUM, COUNT ASC, AT, CHAR (CHR), CHAR_LENGTH (LEN), LOWER, TRIM, SPACE, SUBSTRING (SUBSTR/MID), UPPER, VALUE (VAL) DATE, DAY, MONTH, YEAR ADD, ALL, ALTER, ANY, AS, ASC, BETWEEN, BY, CREATE, DELETE, DESC, DISTINCT, DROP, EXISTS, FROM, GROUP, HAVING, IN, INDEX, INNER JOIN, INSERT, INTEGER, INTERSECT, INTO, LEFT [OUTER] JOIN, LIKE, MINUS, NULL, RIGHT [OUTER] JOIN, FULL [OUTER] JOIN, ON, ORDER, SELECT, SET, TABLE, TO, UNION, UNIQUE, UPDATE, VALUES, VIEW, WHERE


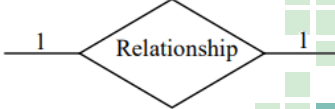
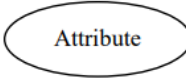

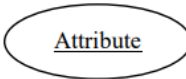





New Focuses

2. ER Diagram

- Common sense
→ built up from frequent practices
- Cardinality →
Difficult to extract the meanings from the scenarios

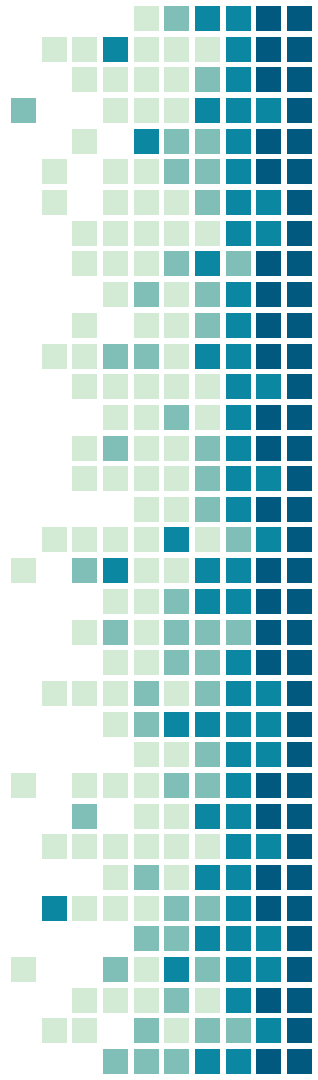
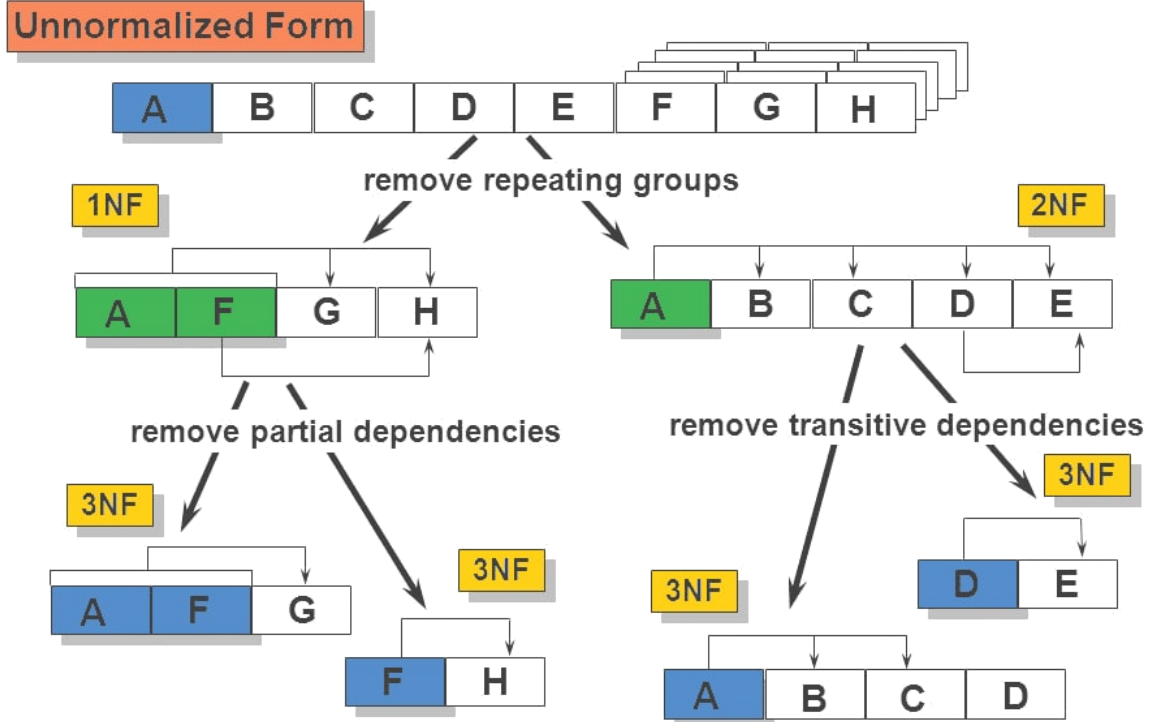
Symbols Used in Entity-Relationship Diagrams

Meaning	Symbol	Meaning	Symbol
Entity		One-to-One Relationship	
Attribute		One-to-Many Relationship	
Key Attribute		Many-to-Many Relationship	
Relationship		Participation constraints: Use on Mandatory side Use ○ on Optional side	

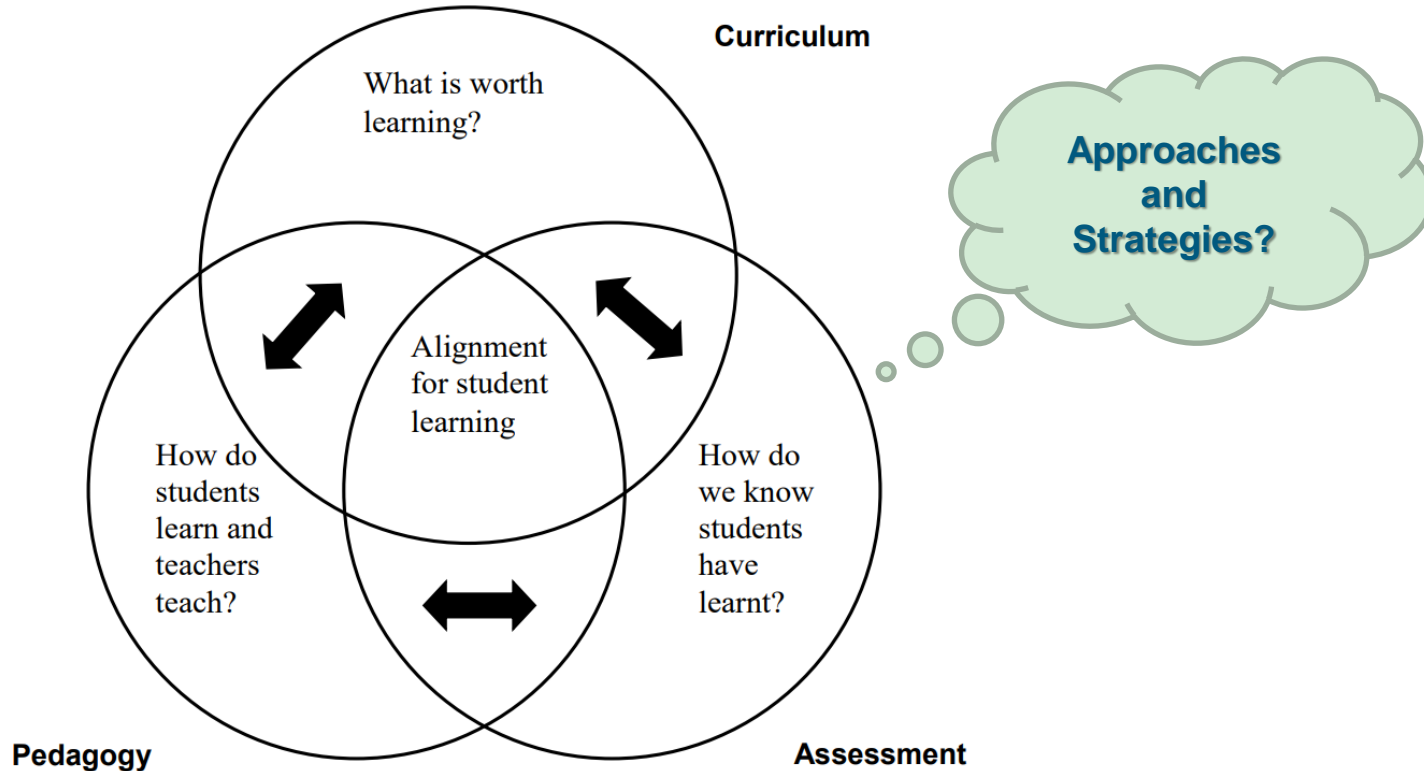
New Focuses

3. Normalization

- 1NF
- 2NF
- 3NF



“Trinity” of student learning in schools



Integration of Generic Skills

Elective Part Option: A Databases

(C&A Guide: P.69–77, 103, 104)

Topic: b Relational Databases Concepts

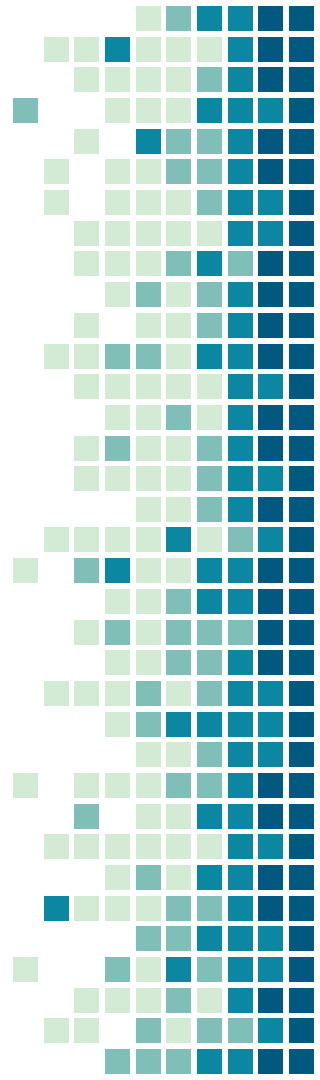
Theme: A database for a library book reservation system

Students are asked to create a simple relational database for a computerised library book reservation system for their schools. In this task, students investigate their schoolmates' needs and provide solutions for the relational database.

In the process of developing the solutions, students may interview their schoolmates, the library helpers and the librarian to collect information. After that, they filter the information and identify the attributes; and they also have to use their intuition/imagination to create some relevant attributes. Creativity is cultivated when students design a prototype of the database.

Students then analyse critically the relationship among all the attributes, and have to formulate the relational database to serve this purpose. They appraise the various aspects of the relational database against the design specifications. Students' critical thinking skills are nurtured through the whole process – from the conceptualising of initial ideas to the realisation of the final design.

Finally, students create a relational database for the book reservation system. In doing so, they have developed their problem-solving skills by gathering the necessary information, identifying the attributes and formulating the database.



Practical tools

- Microsoft Access
- MySQL
- MySQL Workbench
- Cloud-based SQL tools
 - <https://sqliteonline.com/>
 - <http://sqlfiddle.com/>
- Oracle Academy

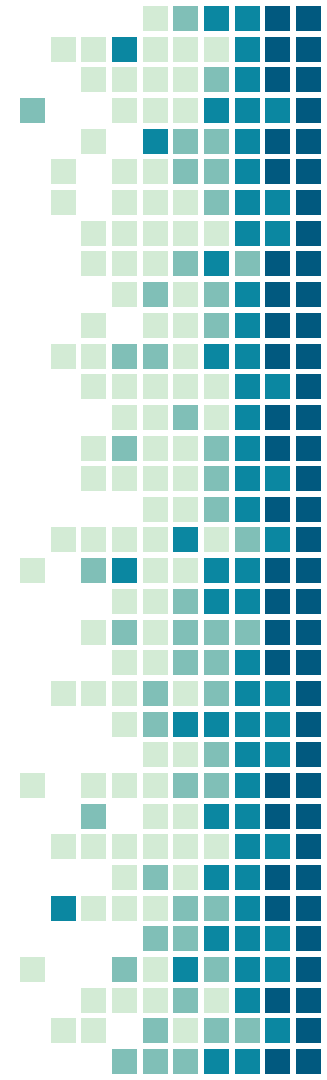


Upcoming Event

高中資訊及通訊科技修訂課程選修單元A - 運用
不同工具教授數據庫及SQL工作坊

ICT Curriculum Elective Module A - Using
different DBMS tools / platforms in teaching
database concept ad SQL commands

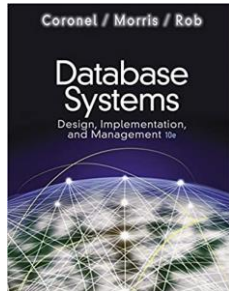
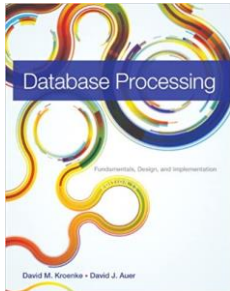
JUN 2022



References

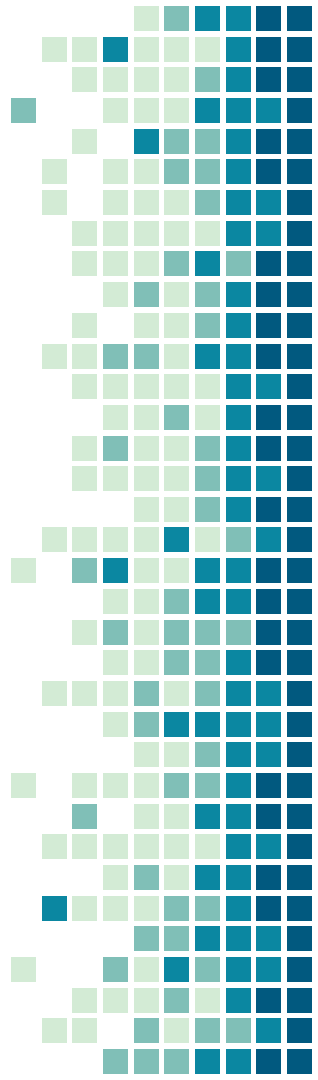
Reference Books

1. Auer, D. and Kroenke, D. (2013). Database processing (Thirteenth edition). USA: Prentice Hall.
2. Coronel, C, Morris, S. and Rob, P. (2012). Database systems: Design, implementation and management (Tenth edition). USA.

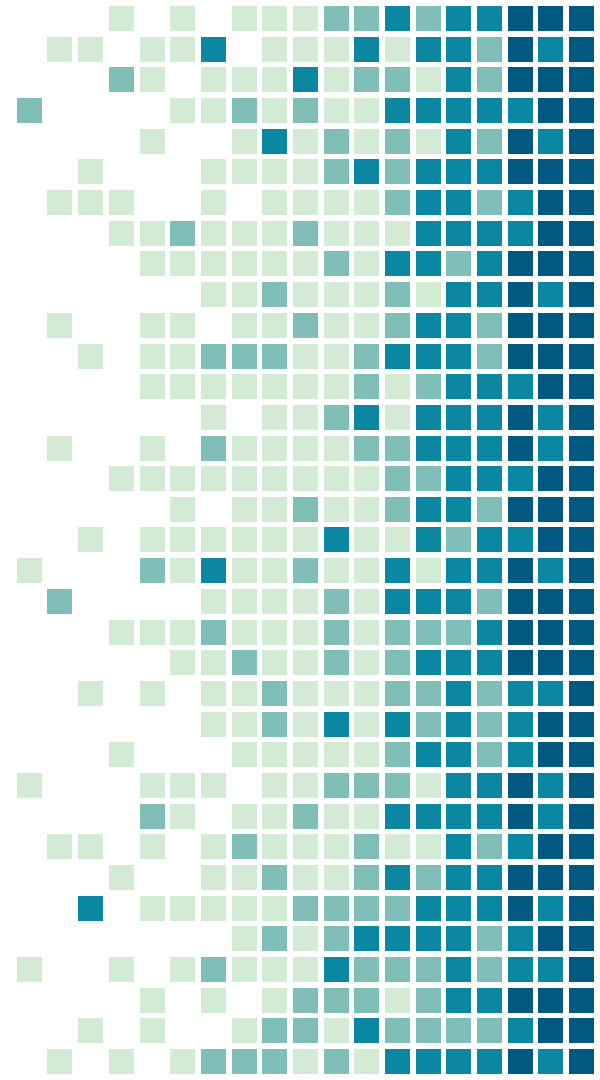


Websites

1. Art Branch, Inc. (2004). SQL tutorial - Learn SQL. Retrieved 12 August, 2015 from <http://www.sql-tutorial.net>.
2. Chapple, M. (2015). Database normalization basics. Retrieved 12 August, 2015 from <http://databases.about.com/od/specificproducts/a/normalization.htm>.



3. Sample Papers



Section A Databases

[DSE 2020 ICT P2A Q.2(b)]

1. Peter designs a database to store information on delivery riders, customers and orders. The requirements of the database are described below:

The company hires a lot of delivery riders to deliver food to customers. Each customer places one order or multiple orders. Each delivery rider delivers zero or multiple orders. Each order must be delivered by one delivery rider only.

Draw the ER diagram for this database with the given entities below. It is not necessary to draw attributes. (4 marks)



[Modified from ASCA 2004 Q.1]

2. A database table is created with the following SQL command to store the transaction record of an online shoe store including transaction ID (TRANID), the type of shoes sold (TYPE) and the size of shoes sold (SIZE).

```
CREATE TABLE TRAN (  
    TRANID CHAR(7) _____,  
    TYPE INTEGER,  
    SIZE INTEGER )
```

SQL:
CREATE TABLE

- (a) Give the missing part in the above SQL command so that two records with the same transaction ID cannot be input into TRAN. (1 mark)

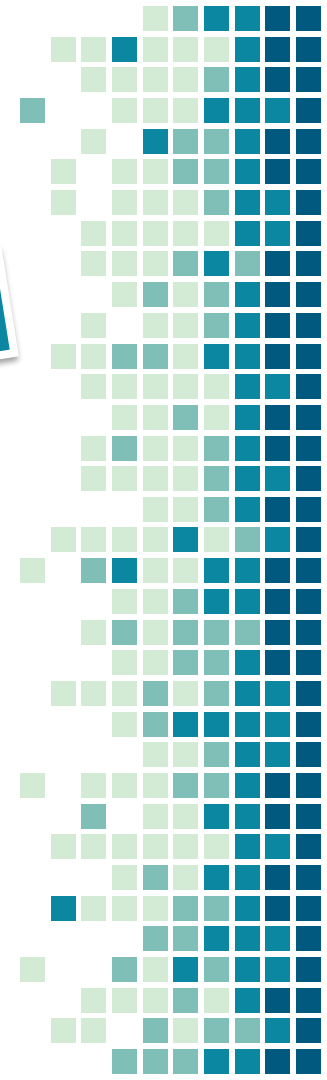
- (b) (i) Write an SQL command to input the following transaction record into TRAN. (2 marks)

Transaction number: 0206833
Type of shoes sold: 3
Size of shoes sold: 42

DDL:
INSERT

- (ii) After the SQL command in (i) is executed, it is found that the required shoes are out of stock and hence the transaction is cancelled. What action on the database should be taken? Briefly describe the purpose of the action. (2 marks)

Rollback



[New question]

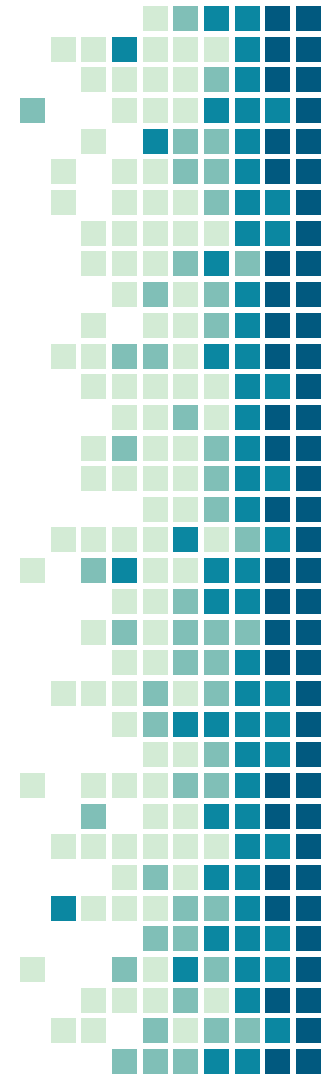
3. A database table `STAFF` stores the attributes `DOB` (Date of Birth) and `AGE` (age).

(a) Explain why `AGE` is a derived attribute.

(1 mark)

(b) Give **two** disadvantages of using this derived attribute.

(2 marks)



4. The structure of a database table `STUDENT` which stores the student records for the school year 2019-2020 is given below.

`STUDENT`

Field name	Description	Example
<code>SID</code>	Student identity code	S117001
<code>NAME</code>	Name	Chan Tai Man
<code>SEX</code>	Sex (M – Male, F – Female)	M
<code>CL</code>	Class name	3A
<code>CLNO</code>	Class number (1 – 36)	20

Primary key: `SID`

Extra-curricular activities in the school are classified into different types. The first three types are:

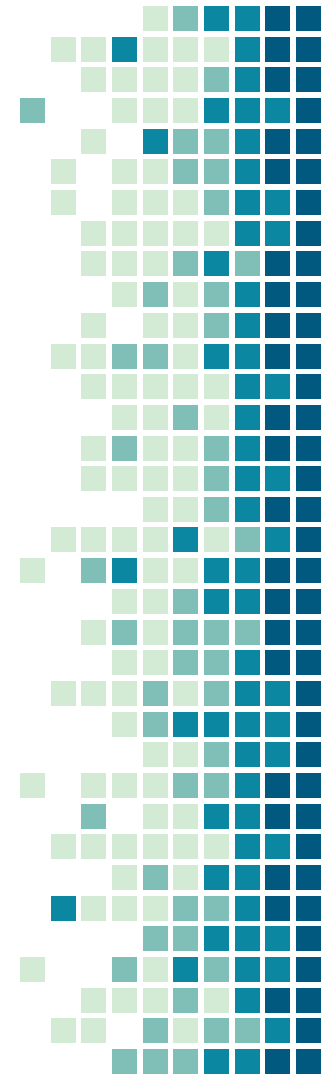
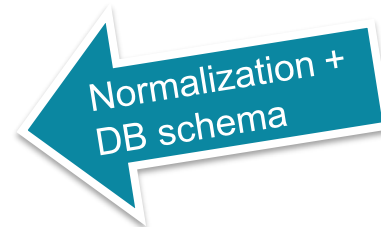
- 1 Music
- 2 Sports
- 3 Visits

Students receive a summary report on the activities they have attended, as shown in the following sample report:

Extra-curricular Activities Report	
Name: Chan Tai Man Sex: M Student ID: S117001 Class: 3A Class number: 20	
Date: 22/09/2019 Activity: Basketball practice Type: 2	Date: 22/09/2019 Activity: Volleyball team meeting Type: 2
Date: 28/01/2020 Activity: Ocean Park visit Type: 3	

Based on `STUDENT` and the information in the sample report above, create a database schema in Third Normal Form. Identify the corresponding primary keys and foreign keys, or write 'N/A' if not applicable.

(5 marks)



5. A bus company uses three database tables `BROUTE`, `EMPLOYEE` and `DRIVER` to store information on buses, employees and drivers. `DRIVER` stores information on the drivers and the bus routes they can drive.

`BROUTE`

Field name	Type	Description	Example
BID	Character	The bus route	1A
BNO	Integer	Number of buses on this bus route	20

Primary Key: BID

`EMPLOYEE`

Field name	Type	Description	Example
EID	Character	Identity code of the employee	A00038
ENAME	Character	Name of the employee	John Li
SALARY	Integer	Salary of the employee	20000
DSEER	Date	First day of work	21/3/2010

Primary Key: EID

`DRIVER`

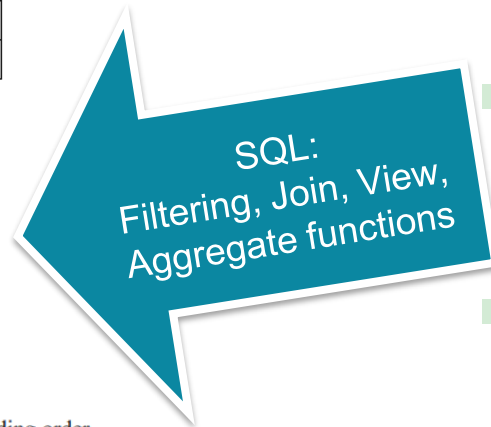
Field name	Type	Description	Example
EID	Character	Identity code of the employee	A00038
BID	Character	The bus route that the employee can drive	1A

Primary key: EID + BID

Foreign key: EID , BID

Write SQL commands to complete tasks (a) to (c) below.

- List the names and identity codes of the employees who can drive bus route '1A' in descending order of their salary. (2 marks)
- List the names and identity codes of the employees who cannot drive any bus route. (2 marks)
- For some bus routes, the number of drivers is smaller than the number of buses. List those bus routes. (3 marks)



(d) Consider the following views:

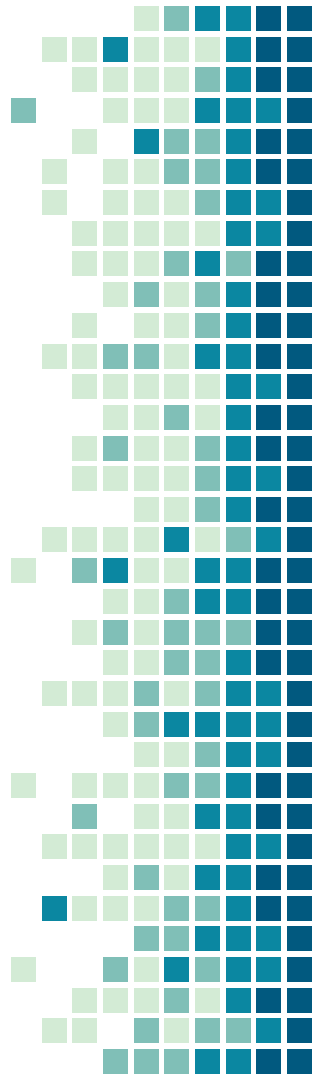
```
CREATE VIEW V1 AS
SELECT AVG(SALARY) AS AVG1 FROM EMPLOYEE
WHERE EID IN
  (SELECT DRIVER.EID FROM DRIVER
   WHERE DSER < '1/1/2005')
```

```
CREATE VIEW V2 AS
SELECT AVG(SALARY) AS AVG2 FROM EMPLOYEE
WHERE EID IN
  (SELECT DRIVER.EID FROM DRIVER
   WHERE DSER >= '1/1/2005')
```

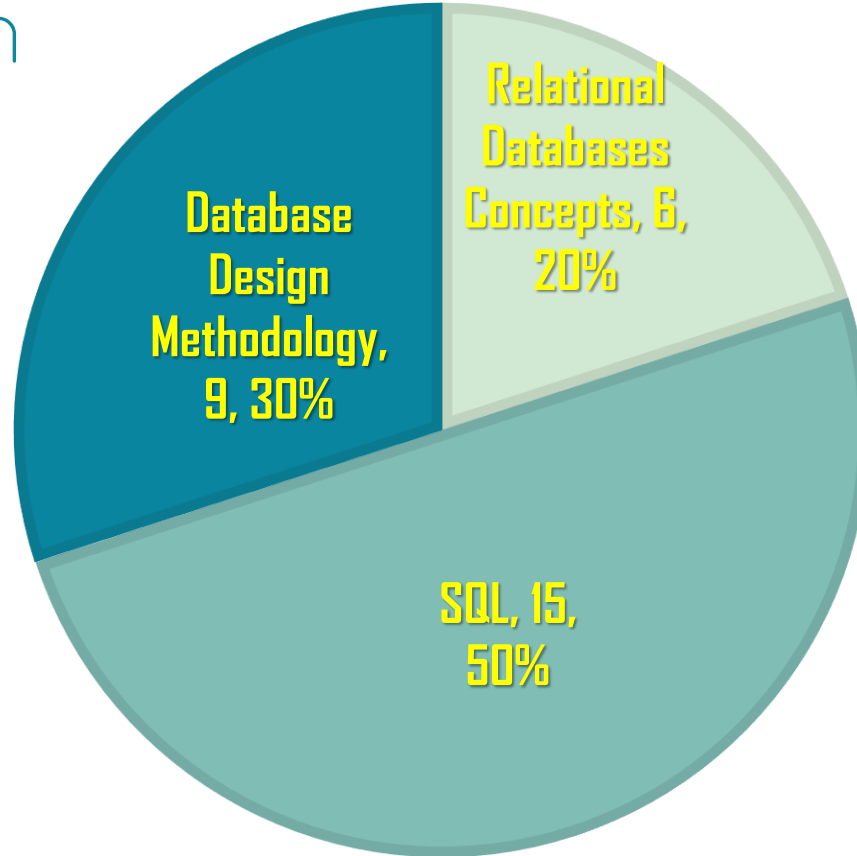
- (i) What is the purpose of V1? (2 marks)
- (ii) Write a SQL command to find (AVG1 - AVG2). (2 marks)
- (e) A field BUSID is added to DRIVER to record the car plate number of the bus driven by an employee. The car plate number contains at most 6 characters. Write a SQL command to add the field. (2 marks)

SQL:
View, Sub-query

DDL:
ALTER TABLE



Mark Distribution



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