

# Using different DBMS tools in teaching database concepts

Chu Ka Tim

Principal, Shatin Pui Ying College

Chairman, Hong Kong Association for Computer  
Education



# Electives

Paper 2A, 2B, 2C

- 30 marks @
- Choose TWO out of THREE, 60 marks in total
- All questions in a paper are compulsory
- 3-5 Short questions (~1/2): assess basic knowledge & understanding
- 1 Structured question (~1/2)
- Question book



# Elective 2A: Databases

2022 New Syllabus





# General Teaching Strategies



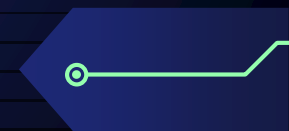


- Practical (SQL)
  - Theory (Database Concepts, ERD, Normalization)
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# New teaching strategies



- Less memorable parts
  - More practical usages → More hands on exercises
  - Further develop the holistic understanding on database design
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# Curriculum and Assessment Guide

## 2.3.2 The Elective Part

The Elective Part comprises three options. Students should take two of them.

### A. *Databases*

#### **Introduction**

This option is designed to provide students with the fundamental concepts of databases and relational database design. Students will learn how to construct simple data models using Entity Relationship (ER) diagrams and to appreciate the importance of good database design. They will also learn to use SQL to construct, manipulate and retrieve information from a relational database. In addition, students will be exposed to database security, integrity, and data privacy issues. Through studying this option, students will acquire a basic understanding of the concepts, skills and applications of databases, and elementary data modelling concepts.

Students should have acquired the necessary knowledge and skills in the Compulsory Part – module A *Information Processing* before progressing to this option.

The sub-topics under topic (a) “Relational Databases Concepts” in the present option are designed as extensions of topic (b) “Data Organisation and Data Control” in the Compulsory Part – module A *Information Processing*.

#### **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.

The time allocation for the option is about 38 hours.

#### **Details**

The option *Databases* comprises three topics: “Relational Databases Concepts”, “SQL”, and “Database Design Methodology”. Details of the three topics are summarised below:

Topic	Learning Outcomes	Remarks
<p>a. <b>Relational Databases Concepts</b> (6 hours)</p>	<ul style="list-style-type: none"> <li>• Describe the basic concepts of relational databases.</li>   <li>• Create a simple relational database.</li>   <li>• Describe the purposes of rollback.</li> </ul>	<p>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.</p> <p>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.</p>



Topic	Learning Outcomes	Remarks
<b>b. SQL (18 hours)</b>	<ul style="list-style-type: none"> <li>• Use SQL to maintain a simple relational database, and manipulate its data or retrieve the required information in at most three tables.</li> </ul>	<p>Skills involved include:</p> <ul style="list-style-type: none"> <li>• modify the structure of the tables</li> <li>• add, delete and modify the data in the tables</li> <li>• view, sort, and select contents by filtering, and create different views</li> <li>• 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</li> <li>• use simple built-in functions such as aggregate and string functions</li> <li>• perform queries on multiple tables, including the use of equi-join, natural join and outer join</li> <li>• perform sub-queries (for one sub-level only)</li> </ul>
<b>c. Database Design Methodology (14 hours)</b>	<ul style="list-style-type: none"> <li>• Be aware of the different types of relationships among entities in a relational database.</li> <li>• Analyse simple scenarios in business, education or other fields and create simple ER diagrams involving binary relationship only in designing databases.</li> </ul>	<p>The resolution of many-to-many relationship into multiple one-to-many relationships should also be introduced.</p>


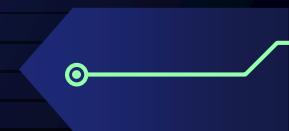
Topic	Learning Outcomes	Remarks
	<ul style="list-style-type: none"><li data-bbox="674 369 1251 467">• Explain the concepts of data redundancy and discuss the methods or measures used to reduce data redundancy.</li><li data-bbox="674 511 1251 576">• Describe the needs and procedures of denormalisation.</li><li data-bbox="674 620 1251 685">• Transform the ER diagrams to tables in relational databases.</li><li data-bbox="674 729 1251 751">• Use access rights to achieve data privacy.</li></ul>	<p data-bbox="1271 369 1765 467">Students should be able to reduce data redundancy through normalisation up to Third Normal Form (3NF).</p>

# Cancelled Sections

- 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···.



# Sections merged with compulsory part



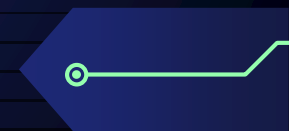
- Data types (integer, decimal, boolean···.)
  - Database elements (fields, records, tables···.)
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# Main idea of the new syllabus

- Database design
  - Real scenarios → ERD → Normalization → Databases
- Data structure
  - Key, index, view...
- Data Query
  - Using SQL in real scenarios



# New Topics in the new syllabus

- Roll back
  - Denormalization
  - Access right to data privacy
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# Focus of New syllabus

## 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 Lists

## 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



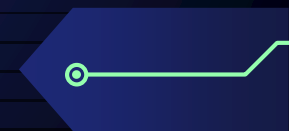


# Learning SQL....

1. SQL Is the Most crucial but hardest part in 2A
2. Students requires lots of practical time to master
3. Teachers have to prepare different types of scenarios and tables
4. The concepts of database design is the prior knowledge



# Choosing a DBMS tool...

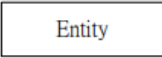
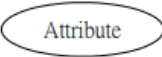
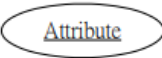
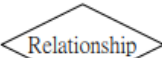
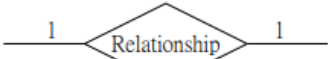
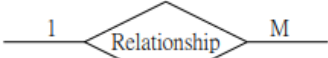

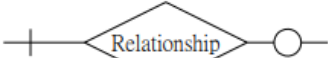
1. Online/offline
  2. Free/paid
  3. User friendliness
  4. Extension/Compatibility
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# Focus of New Syllabus

## ER Diagram:

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

Symbols used in ER diagrams

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

# Practical tools

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



# Sample paper Analysis

## 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)



From scenario to ERD

[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 )
```

- (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

- (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

DDL

[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)



[Modified from DSE 2020 ICT P2A Q.3(d)]

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)

Long scenario

Normalization +  
DB schema

[Modified from DSE 2019 ICT P2A Q.4]

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
DSEI	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)



SQL

(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 again

DDL again



# Tips on preparing your first lesson

## Read

- Curriculum & Assessment guides (EDB)
- Glossary (EDB)
- Past paper & Sample paper (HKEAA)
- Assessment Framework (HKEAA)



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- HKACE membership
  - HKACE events
  - Oracle Academy (Partner with HKACE)
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