



運用不同工具解決數據庫的題目



SQL: 從理論到實踐

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個人簡介



- 自香港高級程度會考 (HKASL) 開始教授資料庫
- 超過 15 年女校 ICT 教學經驗
- 自 2012 年香港中學文憑考試 (DSE) 推行起教授網頁開發，於 2016 年轉為專注教授資料庫課程。
- 以下分享僅為個人感受，旨在與新任教授資料庫的同工產生更多共鳴



挑戰1: 教學時數不足

Revised Curriculum Framework (2025 HKDSE onward)

The Compulsory Part (144 hours)

| | |
|---------------------------------------------|-------------------------------------------------------------|
| A. Information Processing (37 hours) | B. Computer System Fundamentals (20 hours) |
| C. Internet and its Applications (31 hours) | D. Computational Thinking and Programming (48 hours) |
| E. Social Implications (8 hours) | |

+

Databases module (Module A)
76 hours / 2 (i.e. 38 hours)

The Elective Part (76 hours)

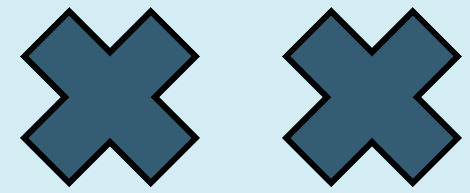
(Choose any two)

| | | |
|------------------------|------------------------------------------|----------------------------------------|
| A. <i>Databases</i> | B. <i>Web Application Development</i> | C. <i>Algorithm and Programming</i> |
|------------------------|------------------------------------------|----------------------------------------|

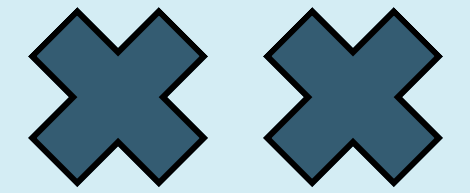
挑戰 2: 教學內容改變

| Addition | Deletion |
|-------------------------------------------|---------------------------------------------------|
| Rollback | Introduction to Databases |
| Denormalisation | Program-data independence |
| Use access rights to achieve data privacy | Export query results |
| | Importance of a good database design |
| | The needs of the three levels of data abstraction |
| | Database Applications, Development and Society |

Reference: https://www.edb.gov.hk/attachment/en/curriculum-development/kla/technology-edu/curriculum-doc/ICT_C&A_Guide_e_final.pdf



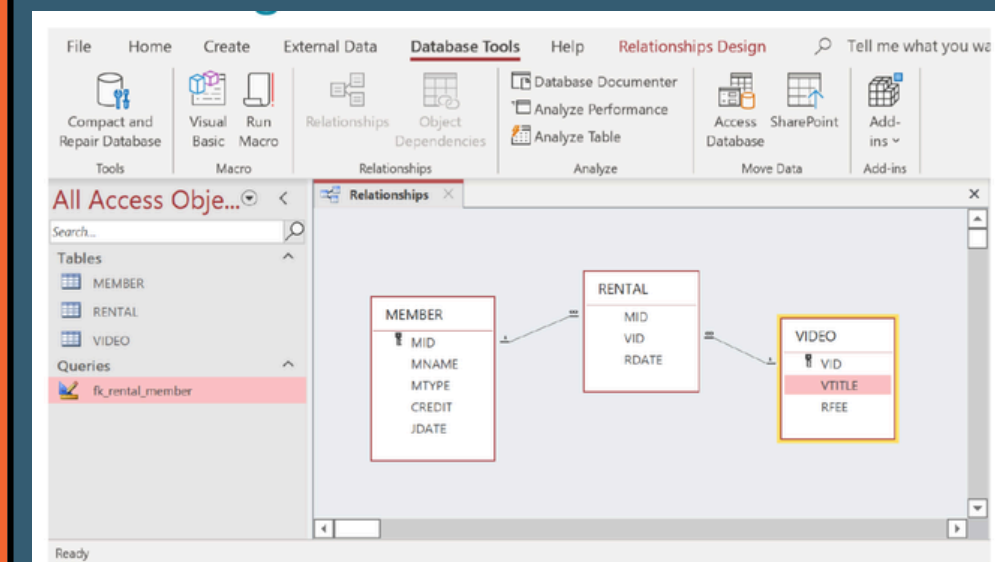
挑戰 3: 教學進程

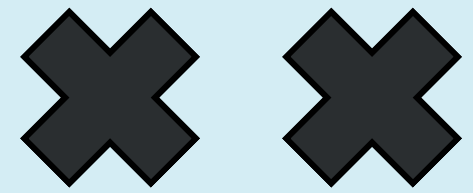


您比較喜歡哪種教學安排？

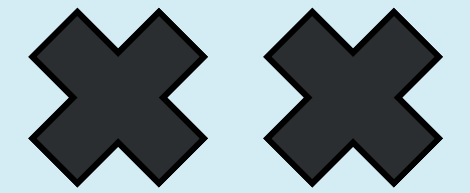
A: ERD (實體關係圖) → 資料庫結構 (Schema) → SQL

B: SQL → ERD (實體關係圖) → 資料庫結構 (Schema)





挑戰 4: SQL 工具



SQLite 的優點:

- 免費使用
- 提供多種 SQL 標準
- 可與網頁瀏覽器配合使用，無需安裝
- 輕量級的數據庫文件

相同限制

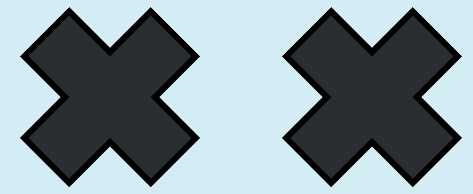
無法使用以下 SQL 語法:

- CREATE VIEW
- FULL OUTER JOIN
- INTERSECT

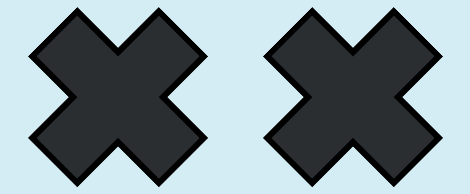


MS Access 的優點:

- 提供功能如 表單 (FORMS) 和 報表 (REPORTS)
- 圖形化使用者介面 (GUI)
- 可以輕鬆顯示數據庫結構和元數據
- 擁有大量可用資源



挑戰5: 課堂練習設計



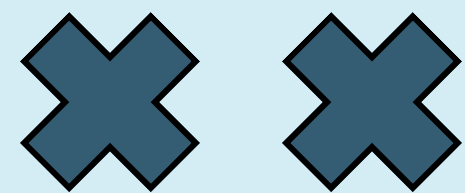
SQL 實際操作 VS 工作紙練習?

我們應該要求學生提交甚麼類型作業?

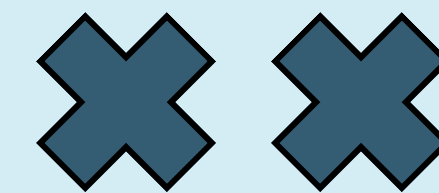
學生的工作紙是否能容易批改?
為什麼?

工作紙 = 收集
學生的學習顯
証

SQL 實際操作
= 讓學生體驗
SQL 趣味

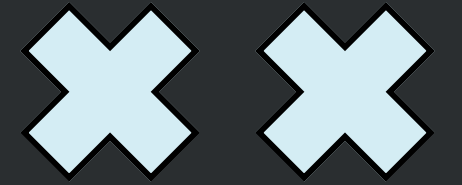


教學進度設計



| | | | |
|---------------|-------------------------------------------------------------------|--------------|---------------------------------------------------|
| S.4 Cycle 14* | Introduction to Database Database Structure Database Design | S.4 Cycle 19 | Advanced SQL - multiple table query (equi-join) |
| S.4 Cycle 15* | Access Object - Form, Report and Query | S.4 Cycle 20 | Advanced SQL - multiple table query (sub-queries) |
| S.4 Cycle 16* | Basic SQL - single table query | Summer | DDL SQL - CREATE TABLE, CREATE VIEW, ..., etc. |
| S.4 Cycle 17* | Basic SQL - single table query with GROUP BY + HAVING | S.5 Cycle 1 | ERD, Database Schema |
| S.4 Cycle 18 | DML SQL- INSERT INTO, UPDATE DELETE | S.5 Cycle 2 | Normalization |

如何解決時間不足問題



善用校本評核 (School-based Assessment)

您對校本評核 (SBA) 的期望是什麼？

您是希望他們完成一份功課？
還是希望他們透過SBA深入
學習 SQL？



透過 SBA 照顧不同學習需要

SCENARIOS

1.1(ii) Geog teacher David Patel wants to add a geog supplementary class for form 4 at 2024-07-30 in period 3.

```
SELECT s.s_name, s.class, s.class_no,
    (SELECT ss.subject
     FROM Subject_student AS ss
     WHERE ss.s_id = s.s_id
     AND ss.subject IN (
         SELECT sc.subject
         FROM Supplementary_class sc
         WHERE sc.date = '2024-07-08'
         AND sc.period_no = 3)) AS subject
FROM Student AS s
WHERE s.s_id IN (
    SELECT s.s_id
    FROM Student AS s, Subject_student AS ss, Supplementary_class AS sc
    WHERE s.s_id = ss.s_id AND ss.subject = sc.subject
    AND sc.date = '2024-07-08'
    AND sc.period_no = 3
    AND s.class LIKE '4%')
INTERSECT
SELECT s.s_id
FROM Student AS s, Subject_student AS ss, Supplementary_class AS sc
WHERE s.s_id = ss.s_id AND ss.subject = sc.subject
AND sc.subject = '5#GEOG');
```

RESULT

| s_name | class | class_no |
|------------|-------|----------|
| John Smith | 4A | 10 |

Database Design

Database Schema

Normalization

1NF

Booking(Date, Period, Venue, TID, Subject, StudentID)
 Teaching_staff(TID, TName, Duty, Password)
 Student(StudentID, StudentName, Class, Classno, Elective, Password)
 Period(Periodno, Time)
It does not contain multi-valued attributes or repeating groups. Therefore, it is a table in 1NF.

2NF

Booking(BookingID, Date, Period, Venue, Subject)
 Teaching_staff(TID, TName, Password)
 Student(StudentID, StudentName, Class, Classno, Password)
 Period(Periodno, Time)

SQL 1. Schedule a booking

This command aims to schedule a supplementary class for a specific student on an available date.

Scenario:
 Mr. Fong would like to schedule an ICT class for student "Abby Au" on 4/12/2024. Assume that the t_ID of Mr. Fong is "T01" and the Std_ID of "Abby Au" is "200001"

The SQL command should be:
 INSERT INTO Booking
 VALUES ('2024/12/4 16:00', T01, '208', 'ICT', 200001);

| Time_Date | Teacher_ID | Std_ID | Room | Subject | Click to Add |
|-----------------|------------|--------|------|---------|--------------|
| 2024/12/4 16:00 | T01 | 200001 | 208 | ICT | |
| | X | 0 | | | |
| | | 0 | | | |

... changes made to convert the table to 2NF.
 ... ed more than students, one a student may studies in more
 ... her may have many duties and teaches in different
 ... nd on the primary key of Booking (Date, Period, Venue),
 ... ary key of Teaching_staff (TID), Elective is depend on the
 ... dentID). Therefore, partial dependence ...
 ... the changes I made, there is not any

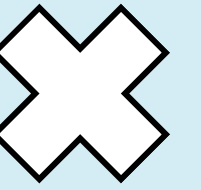
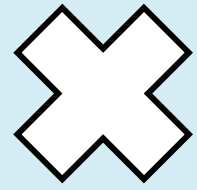
STUDENTS' SBA WORK
 (FOR REFERENCE)

利用 SBA 主題教授 Rollback 概念

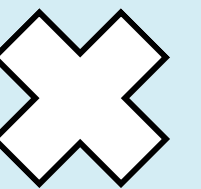
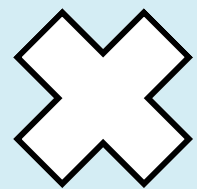
The rollback can be illustration below. Imagine Mr. Fong is scheduling supplementary classes. He starts by booking a class for Student A on August 1, 2024, at 10:00 AM. This operation is successful and the booking is recorded. However, while trying to book another class for the same student at the same date and time, an error occurs because the system prevents duplicate bookings.

| | |
|------------------------------------------------------------------------------|-----------------------------------------------------------------|
| <pre>BEGIN TRANSACTION;</pre> | Start transaction |
| <pre>INSERT INTO bookings VALUES (1, 1, '2024-08-01', '10:00:00');</pre> | Insert a valid booking |
| <pre>INSERT INTO bookings VALUES (2, 1, '2024-08-01', '10:00:00');</pre> | Attempt to insert a duplicate booking (this SQL should fail) |
| <pre>ROLLBACK;</pre> | Because of the error, we rollback the transaction. |

In this example, the ROLLBACK command will undo both the valid and invalid insertions because they are part of the same transaction.



現實情況下，我們不可能在課堂上教授所有教學內容，因此只能教授基礎概念，並透過進行 SBA（校本評核）來加強學生的實踐體驗



例子

| Topic | Learning Outcomes | Remarks |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| a. Relational Databases Concepts (6 hours) | <ul style="list-style-type: none">Describe the basic concepts of relational databases. | It includes entity, relationship, attribute, domain, index, key (such as primary key, foreign key and candidate key), and integrity |

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.



Table

BOOKING

| bk_no | date | period | room | sub_code | t_id | s_id |
|-------|------------|-------------|------|----------|------|-------|
| 1901 | 2024-07-19 | 08:30-10:00 | 101 | 503 | 22 | 19001 |
| 1902 | 2024-07-19 | 08:30-10:00 | 101 | 503 | 22 | 19004 |
| 1903 | 2024-07-19 | 08:30-10:00 | 101 | 503 | 22 | 19010 |
| 1904 | 2024-07-22 | 10:15-11:45 | 410 | 504 | 23 | 19009 |
| 1905 | 2024-07-22 | 10:15-11:45 | 410 | 504 | 23 | 19010 |
| 1906 | 2024-07-22 | 10:15-11:45 | 410 | 504 | 23 | 19005 |
| 1907 | 2024-07-22 | 12:00-13:30 | 307 | 502 | 21 | 19003 |
| 1908 | 2024-07-22 | 12:00-13:30 | 307 | 502 | 21 | 19010 |
| 1909 | 2024-07-22 | 12:00-13:30 | 307 | 502 | 21 | 19004 |
| 1910 | 2024-07-22 | 12:00-13:30 | 307 | 502 | 21 | 19007 |

```
CREATE TABLE BOOKING (
  bk_no INT(4) PRIMARY KEY,
  date DATE NOT NULL,
  period CHAR(20) NOT NULL,
  room CHAR(20) NOT NULL,
  sub_code INT(3) NOT NULL,
  t_id INT(2) NOT NULL,
  s_id INT(5) NOT NULL,
```

```
FOREIGN KEY (sub_code) REFERENCES SUBJECT(sub_code),
FOREIGN KEY (t_id) REFERENCES TEACHER(t_id),
FOREIGN KEY (s_id) REFERENCES STUDENT(s_id)
);
```

```
INSERT INTO BOOKING VALUES
(1001, '2024-07-19', '08:30-10:00', '101', 503, 22, 19001),
(1002, '2024-07-19', '08:30-10:00', '101', 503, 22, 19004),
(1003, '2024-07-19', '08:30-10:00', '101', 503, 22, 19010),
(1004, '2024-07-22', '10:15-11:45', '410', 504, 23, 19009),
(1005, '2024-07-22', '10:15-11:45', '410', 504, 23, 19010),
(1006, '2024-07-22', '10:15-11:45', '410', 504, 23, 19005),
(1007, '2024-07-22', '12:00-13:30', '307', 502, 21, 19003),
(1008, '2024-07-22', '12:00-13:30', '307', 502, 21, 19010),
(1009, '2024-07-22', '12:00-13:30', '307', 502, 21, 19004),
(1010, '2024-07-22', '12:00-13:30', '307', 502, 21, 19007);
```



| Problems | | |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Wrong formatting (Testing 2.) | The system cannot reject the input which does not follow the formatting. It cannot maintain data consistency in the database. (i.e. the student's name inserted in Chinese which should be in English.) | |
| | <table border="1"> <tr> <td>Solution</td> <td>Mention the formality in the user interface or provide a suggested format to let users follow.</td> </tr> </table> | Solution |
| Solution | Mention the formality in the user interface or provide a suggested format to let users follow. | |
| Illogical input (Testing 3.) | The system should not allow users to input some illogic data. (i.e. making a booking which the date is in the past). It will waste the storage of the database. | |
| | <table border="1"> <tr> <td>Solution</td> <td>Send a warning message once the user selects or input some illogical data.</td> </tr> </table> | Solution |
| Solution | Send a warning message once the user selects or input some illogical data. | |
| Domain constraint (Testing 4.) | The online SQL website cannot obey the constraint of domain. (i.e. It allows changing the password that has more than 10 characters). It is violating the domain constraint. | |

The online SQL website cannot obey the constraint of domain. (i.e. It allows changing the password that has more than 10 characters). It is violating the domain constraint.

| | |
|----------|--------------------------------------------|
| Solution | Use Microsoft Access to set up the system. |
|----------|--------------------------------------------|

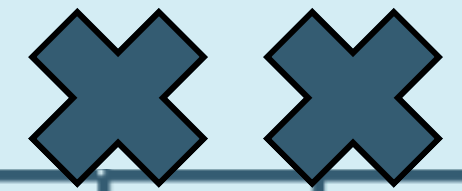


我們應該相信學生具備能力，能夠在 SBA 中充分展現他們的學習成果。

STUDENTS' SBA WORK (FOR REFERENCE)



如何進行課堂練習? 如何呈現學生學習成果?



PRACTICAL WORK

1. Table S1 and S2 are used to collect members' spending in two shopping malls. Create table S1 and S2 in which they have the same table structure as shown below:

| Field name | Field Type | Field Length | Description |
|------------|------------|--------------|--------------------------------------|
| MID | Character | 6 | Member ID |
| SDATE | Date | | Date of spending |
| AMT | Integer | | Total amount of spending on that day |

2. Insert data records to the table:

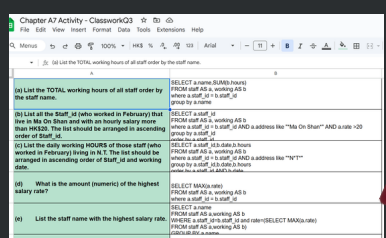
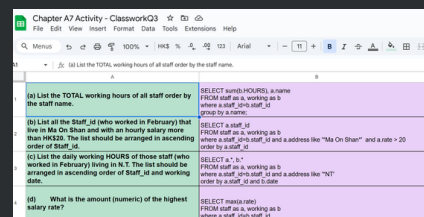
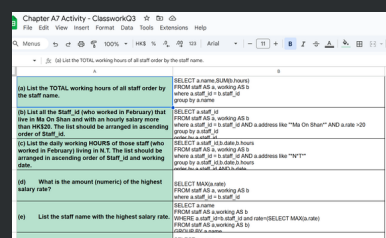
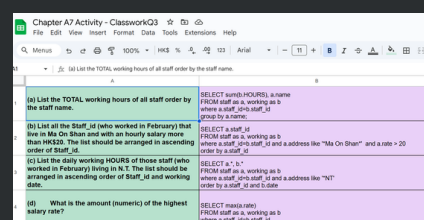
Table S1

| MID | SDATE | AMT |
|---------|------------|-----|
| M12345 | 2019-10-21 | 850 |
| H10040 | 2019-10-21 | 500 |
| P121011 | 2019-10-21 | 400 |
| P98765 | 2019-10-22 | 900 |

Table S2

| MID | SDATE | AMT |
|---------|------------|-----|
| P121011 | 2019-10-21 | 400 |
| R08040 | 2019-10-21 | 500 |
| H10040 | 2019-10-21 | 500 |

從學生學習 顯証了解學 生需要



每位學生將獲發一份 GSheet 工作表完成。他們的學習成果可以通過 GSheet VLOOKUP 匯到總表中。

| Chapter A7 Activity - ClassworkQ3 | | Saved to Drive | |
|---------------------------------------------------------|---------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| File Edit View Insert Format Data Tools Extensions Help | | | |
| Menus | | | |
| fx =INDIRECT(\$D5&"!B1") | | | |
| | D | E | F |
| 1 | ENNAME | (a) List the TOTAL working hours of all staff order by the staff name. | (b) List all the Staff_id (who worked in February) that live in Ma On Shan and with hourly salary more than HK\$20. The list should be arranged in ascending order of Staff_id. |
| | | SELECT SUM(b.hours) From staff as a , working as b WHERE a.staff_id = b.staff_id group by a.name | SELECT a.staff_id From staff as a , working as b WHERE a.staff_id = b.staff_id AND a.address LIKE 'Ma On Shan' GROUP BY a.staff_id |
| | IRIS | SELECT a.name,sum(b.hours) FROM staff AS a,working AS b WHERE a.staff_id=b.staff_id GROUP BY a.name | SELECT a.staff_id From staff as a , working as b WHERE a.staff_id = b.staff_id AND a.address LIKE 'Ma On Shan' GROUP BY a.staff_id |
| | CARMAN | SELECT a.name , sum(b.hours) FROM STAFF AS a, Working AS b WHERE a.staff_id = b.staff_id Group by a.name | select staff_id from staff where address like "'Ma On Shan'" and rate >= 20 order by staff_id |
| | LILIAN | SELECT SUM(b.hours),a.name FROM STAFF AS a,WORKING AS b WHERE a.staff_id=b.staff_id GROUP BY a.NAME | SELECT a.staff_id FROM STAFF AS a,WORKING AS b WHERE a.staff_id=b.staff_id AND rate>20 AND address LIKE 'Ma On Shan' ORDER BY a.staff_id |
| | LILIAN | SELECT sum(b.HOURS), a.name FROM staff as a, working as b where a.staff_id=b.staff_id group by a.name; | SELECT a.staff_id FROM staff as a, working as b where a.staff_id=b.staff_id and a.address like 'Ma On Shan' order by a.staff_id |
| | LEORA | | |
| 7 | ALEXAND | SELECT a.name , SUM(b.hours) FROM staff AS a , working AS b WHERE a.staff_id = b.staff_id GROUP BY a.name | SELECT a.staff_id FROM STAFF AS a , WORKING AS b WHERE a.staff_id=b.staff_id AND a.rate > 20 AND a.address LIKE "'Ma On Shan'" ORDER BY a.staff_id |

3. What is the expected result of the following SQLs?

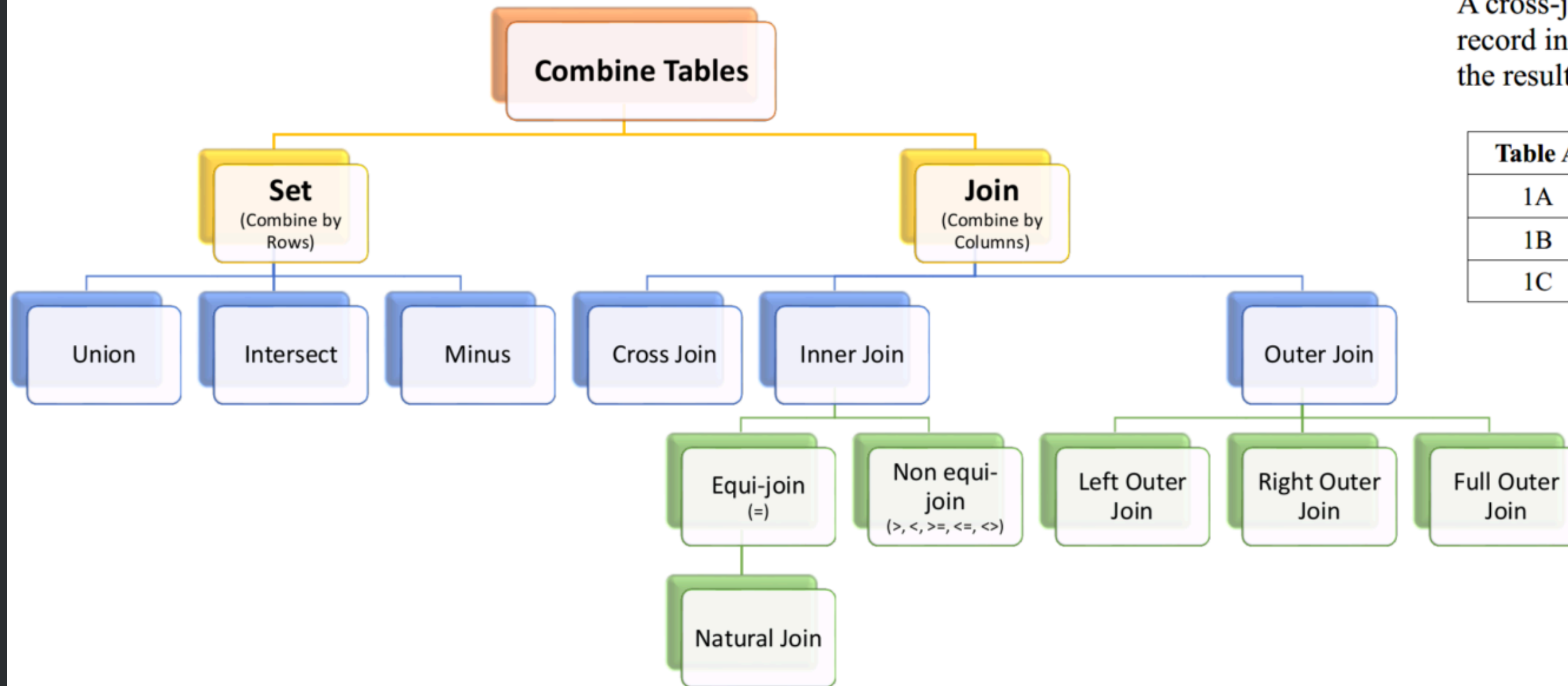
| | |
|--------------------------------------------------------|----------------------------------------------------|
| <pre>SELECT * FROM S1 UNION ALL SELECT * FROM S2</pre> | <pre>SELECT * FROM S1 UNION SELECT * FROM S2</pre> |
| | |

4. What is the expected result of the following SQLs?

| |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>SELECT S1.MID, S1.SDATE, S1.AMT, S2.MID, S2.SDATE, S2.AMT FROM S1 FULL OUTER JOIN S2 ON S1.MID = S2.mid ORDER BY S1.MID, S1.SDATE, S2.SDATE</pre> |
| |

只可以以工作紙解決SQL 在DBMS的限制

視像化所有 SQL Set 和 Join 用法



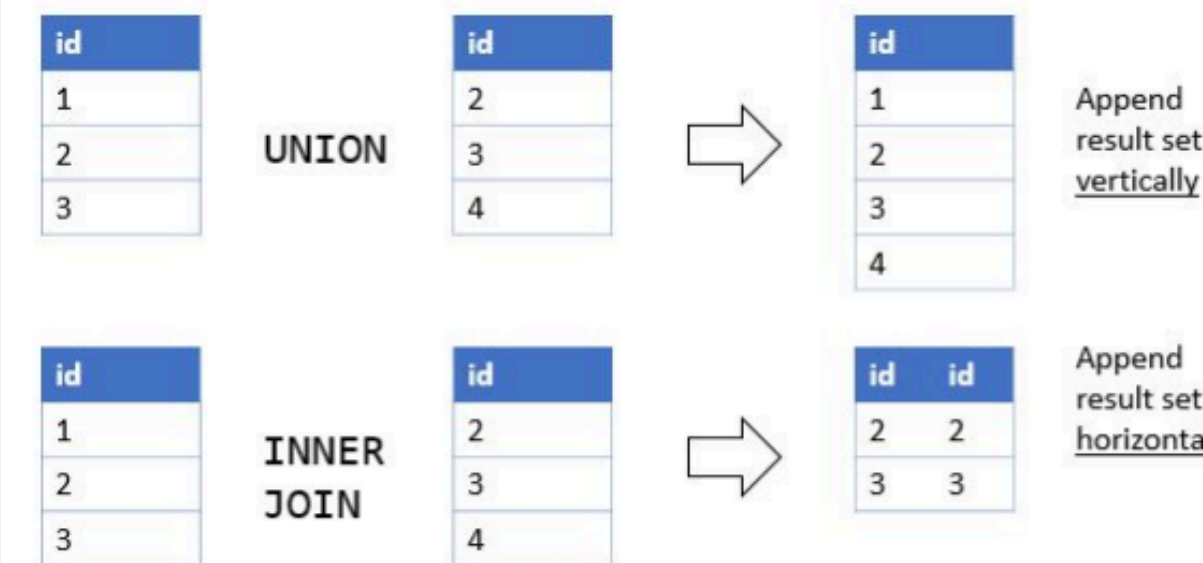
Cross-join

A cross-join is a join without any condition. It will map every record in record in the other table. Therefore, if there are 3 records in Table A and 2 records in Table B, the resulting table will have $3 \times 2 = 6$ records.

| Table A |
|---------|
| 1A |
| 1B |
| 1C |

| Table B |
|---------|
| 6 |
| 7 |

| Table A * Table B |
|-------------------|
| 1A, 6 |
| 1A, 7 |
| 1B, 6 |
| 1B, 7 |
| 1C, 6 |
| 1C, 7 |



Joins in SQL

Joins are everything you'll need when dealing with databases.

圖像化複雜 SQL 概念 (如 correlated subquery)

通過圖像化及課堂上即時互動，可以幫助學生直觀地理解數據表之間的關聯和查詢過程，將抽象的概念轉化為具體的視覺效果。

Note that the table STAFFREC is given a different alias (A and B) in the inner and outer SELECT statements in order to make the test of equality conducted in the inner SELECT statement meaningful. Such a kind of query is known as **correlated subquery**.

An equivalent implementation of the above query is given below.

```
SELECT A.Department, A.Name , A.Salary  
FROM STAFFREC AS A  
WHERE A.Salary IN (SELECT Max(B.Salary)  
                   FROM STAFFREC AS B  
                   WHERE A.Department = B.Department )
```

| | Staff_ID | Name | Salary | Department |
|---------|----------|---------------|----------|------------|
| Table A | 1001 | Jeffery Lee | 50000 | Sales |
| | 1002 | Hugo Cheung | 50000 | Sales |
| | 1003 | Jennifer Wong | 39850 | Sales |
| | 1004 | Melinda Ma | 7783.6 | Purchase |
| | 1005 | Hilda Leung | 45670.5 | Sales |
| | 1006 | Nelly Tam | 4530.8 | Sales |
| | 1007 | Mable Mee | 70000 | Purchase |
| | 1008 | Barnabv Nge | 8327.3 | Account |
| | 1009 | Lauretta Tai | 32445.34 | Account |
| | 1010 | Gregory Tai | 50000 | Purchase |
| | 1011 | Rebecca Wo | 34423.4 | Sales |
| | 1012 | Robert Mee | 5998 | Sales |

| | Staff_ID | Name | Salary | Department |
|---------|----------|---------------|----------|------------|
| Table B | 1001 | Jeffery Lee | 50000 | Sales |
| | 1002 | Hugo Cheung | 50000 | Sales |
| | 1003 | Jennifer Wong | 39850 | Sales |
| | 1004 | Melinda Ma | 7783.6 | Purchase |
| | 1005 | Hilda Leung | 45670.5 | Sales |
| | 1006 | Nelly Tam | 4530.8 | Sales |
| | 1007 | Mable Mee | 70000 | Purchase |
| | 1008 | Barnabv Nge | 8327.3 | Account |
| | 1009 | Lauretta Tai | 32445.34 | Account |
| | 1010 | Gregory Tai | 50000 | Purchase |
| | 1011 | Rebecca Wo | 34423.4 | Sales |
| | 1012 | Robert Mee | 5998 | Sales |

SQL 語法差異問題

SQL ANSI-89

ANSI-89 Wildcard Characters

The following table lists out characters supported by ANSI-89 –

| Character | Description | Example |
|-----------|------------------------------------------------------------------------------------------------|--------------------------------------------|
| * | Matches any number of characters. You can use the asterisk (*) anywhere in a character string. | wh* finds wh and why, but or watch. |
| ? | Matches any single alphabetic character. | B?ll finds bal bill. |

ANSI-89 inner join

```
SELECT column1, column2
FROM table1, table2
WHERE table1.id = table2.id;
```

所有SQL題目，均
依據SQL-92標準
去評核。

SQL ANSI-92

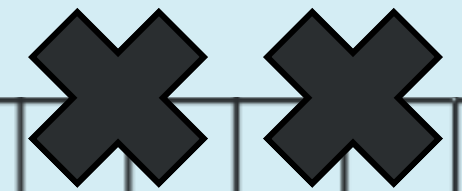
ANSI-92 wildcard characters

The following table lists out characters supported by ANSI-92 –

| Character | Description | Example |
|-----------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| % | Matches any number of characters. It can be used as the first or last character in the character string. | wh% finds what, wh and why, but not aw or watch. |
| _ | Matches any single alphabetic character. | B_ll finds ball, bell, bill. |

ANSI-92 inner join

```
SELECT column1, column2
FROM table1
INNER JOIN table2 ON table1.id = table2.id;
```



透過工作紙設計照顧學習差異

Write down suitable SQL statements for the following tasks.

1. Produce a list showing all the customer codes and their corresponding total number of renting records.

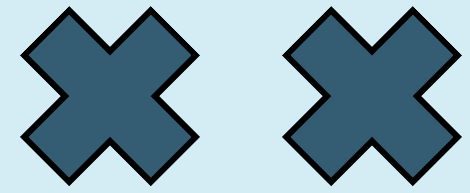
| | |
|-------|---------------------|
| _____ | <i>Select - 1</i> |
| _____ | <i>Joining - 1</i> |
| _____ | <i>Grouping - 1</i> |
| _____ | |
| _____ | |

(3 marks)

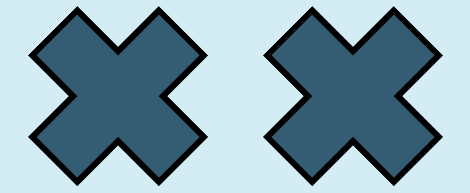
Design a question on your own related to the SQL command **ALTER TABLE** and write down the corresponding answer. (2 marks)

Question:

SQL command:



使用DBMS實踐複雜SQL



(d) What are the results of the following SQL statements? Explain briefly.

| | SQL 1 | SQL2 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| | <pre>SELECT DISTINCT Department FROM STAFFREC WHERE Staff_ID >ANY (SELECT Staff_ID FROM ASSIGNMENT)</pre> | <pre>SELECT DISTINCT Department FROM STAFFREC WHERE Staff_ID <ANY (SELECT Staff_ID FROM ASSIGNMENT)</pre> |
| Result | | |
| Explanation | | |

(2 marks)



結語



學生學習資料庫並不困難，惟老師須多花心思了解學生學習難點

