MONASH University

MONASH
INFORMATION
TECHNOLOGY

Week 7 - Structured Query Language (SQL) – Part 1

FIT2094 - FIT3171 Databases
Clayton Campus S1 2019.

GROUP OF EIGHT AUSTRALIA

Overview

- **Hour 1**
  - –SQL SELECT
    - •Basics
    - •Predicate
    - •Math
    - •Refining the query results...

… then COFFEE BREAK!

- **Hour 2**
  - –SQL SELECT cont'd
    - •Joining
    - •Oracle Dates
  - **–Actual practice**

[Clayton] Audience Q&A

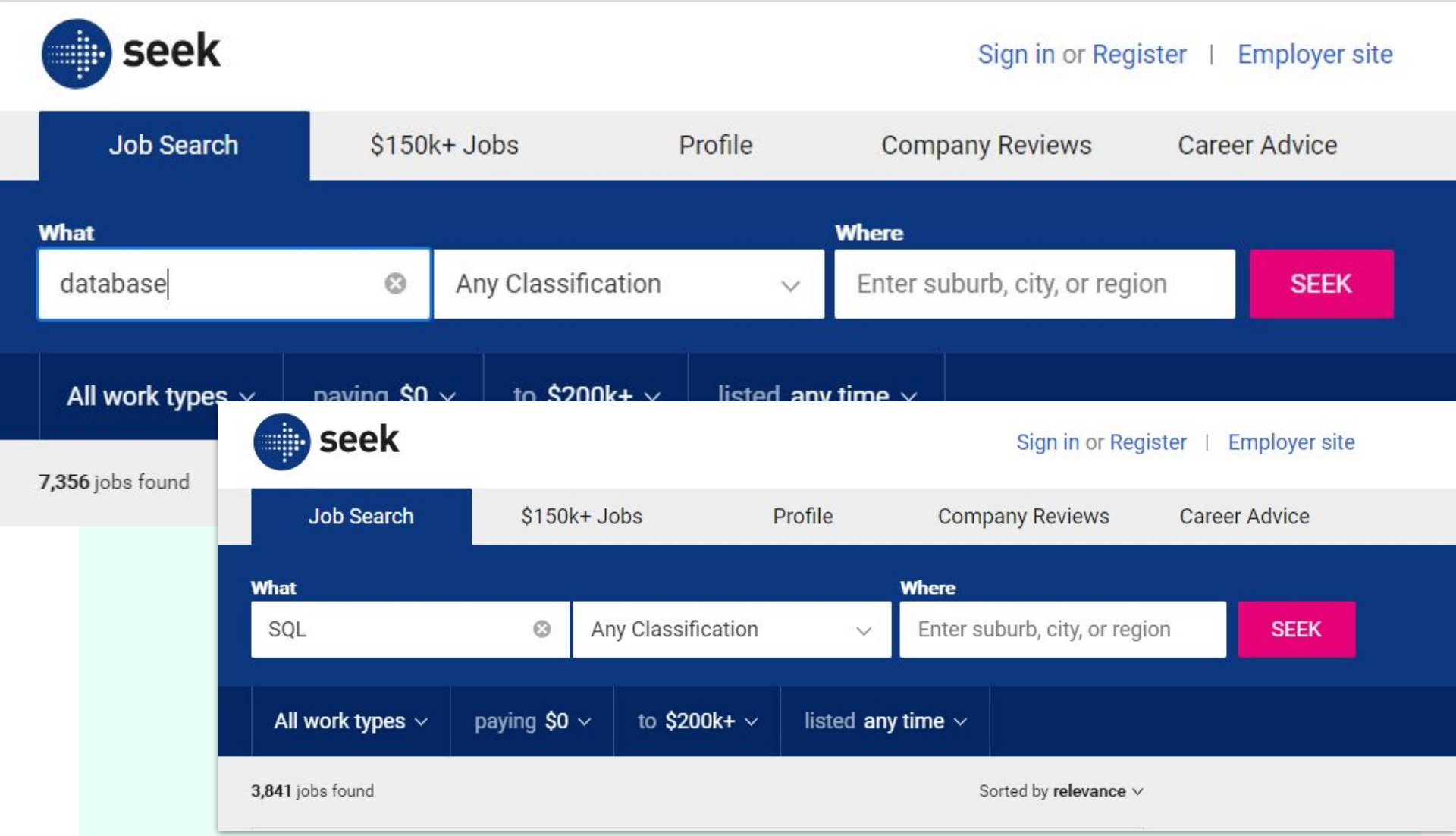
Next week is the MSB

Have a good break, but remember not to forget about your A1b!

Clayton public holidays: Good Friday, Easter Sunday/Monday/Tuesday, ANZAC Day.
(i.e. University is closed)

Hence - please make good use of the forums for discussion. Also, consultations on the 2 days where we don't have public holidays.

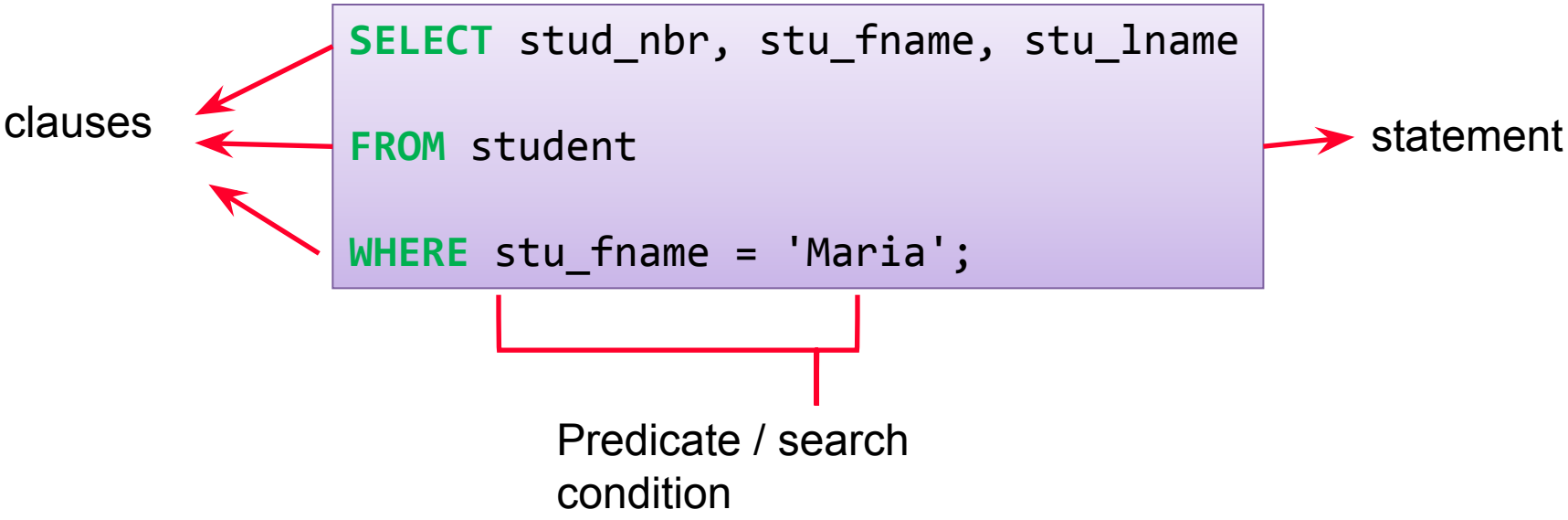
[Clayton] Marc's anecdote



SELECT...
(the DQL part of SQL)

Img src: @samuelzeller at Unsplash /

Anatomy of an SQL SELECT Statement



SQL SELECT Statement - Usage

What table(s) the data come from?

What column/s to display

```
SELECT stud_nbr, stu_fname,
stu_lname

FROM student

WHERE stu_fname = 'Maria';
```

What row/s to retrieve – the RESTRICTION on the select

[Clayton] Q&A - recall relational algebra? PI (project) and SIGMA (select) -- note that SIGMA "select" is NOT EXACTLY the same as the diagram/code shown.
So what is the actual algebraic expr.?

[Clayton] Audience Q&A

Remember: some of the SQL statement syntaxes in the unit are ORACLE SPECIFIC

These are transferable skills to other DBMS 'brands'...
… however code might not work 'out of the box' for other 'brands'.

Refer to Coronel & Morris for examples of how certain syntax differs from 'brand' to 'brand' e.g. Oracle vs MySQL

SQL Predicates or Search Conditions

- The search conditions are applied on each row, and the row is returned if the search conditions are evaluated to be TRUE for that row.
- **Comparison**
  - Compare the value of one expression to the value of another expression.
  - Operators (note: = not the same as prog. lang.'s double ==)
    - =, < >, <, >, !=, <=, >=
  - Example: `salary > 5000`
- **Range**
  - Test whether the value of an expression falls within a specified range of values.
  - Operators:
    - BETWEEN
  - Example: `salary BETWEEN 1000 AND 3000` (both are inclusive)

SQL Predicates or Search Conditions

- **Set Membership**
  - To test whether the value of expression equals one of a set of values.
  - Operator:
    - IN
  - Example : `city IN ('Melbourne', 'Sydney')`
- **Pattern Match**
  - To test whether a string (text) matches a specified pattern.
  - Operator:
    - LIKE
  - Patterns:
    - % character represents any sequence of zero or more character.
    - _ character represents any single character.
  - Example:
    - `WHERE city LIKE 'M%'`
    - `WHERE unit_code LIKE 'FIT20__'`

[Clayton] Q&A - note that % and _ are different from, say, your OS wildcards or RegEx (? *)

SQL Predicates or Search Conditions

- **NULL**
  - To test whether a column has a NULL (unknown) value.
  - Example: `WHERE grade IS NULL`
- Use in subquery (**to be discussed in the future**)
  - `ANY, ALL (... subquery ...)`
  - `EXISTS (... subquery ...)`

What row will be retrieved?

- Predicate evaluation is done using three-valued logic.
  - **TRUE**, **FALSE** and **UNKNOWN**
- DBMS will evaluate the predicate against each row.
- Row that is evaluated to be **TRUE** will be retrieved.
- NULL is considered to be UNKNOWN.

	STU_NBR	UNIT_CODE	ENROL_YEAR	ENROL_SEMESTER	ENROL_MARK	ENROL_GRADE
1	11111111	FIT1001	2012	1	78	D
2	11111111	FIT1002	2013	1	(null)	(null)
3	11111111	FIT1004	2013	1	(null)	(null)
4	11111112	FIT1001	2012	1	35	N
5	11111112	FIT1001	2013	1	(null)	(null)
6	11111113	FIT1001	2012	2	65	C
7	11111113	FIT1004	2013	1	(null)	(null)
8	11111114	FIT1004	2013	1	(null)	(null)

Q1. Consider the predicate "`enrol_mark >= 50`", what row(s) will be selected for this predicate by the DBMS?

a. 1, 4 and 6

b. All rows

c. 1 and 6

d. All rows except row 4

Combining Predicates

- Logical operators
  - AND, OR, NOT
- Rules:
  - An expression is evaluated LEFT to RIGHT.
  - Sub-expression in brackets are evaluated first.
  - NOTs are evaluated before AND and OR
  - ANDs are evaluated before OR.
  - NB: similar to many prog. languages.

Truth Table

- **AND** is evaluated to be TRUE if and only if **both** conditions are TRUE
- **OR** is evaluated to be TRUE if and only if **at least one** of the conditions is TRUE

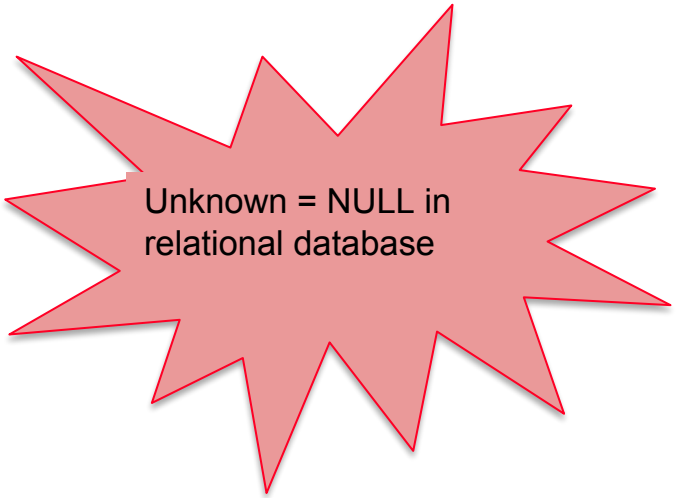
AND

A \ B	T	U	F
T	T	U	F
U	U	U	F
F	F	F	F

OR

A \ B	T	U	F
T	T	T	T
U	T	U	U
F	T	U	F

T = TRUE
F = FALSE
U = Unknown



Q2. What row will be retrieved when the WHERE clause predicate is written as

```
V_CODE = 21344 AND V_CODE = 24288
```

	V_CODE
1	21344
2	20001
3	24288
4	20001
5	24288

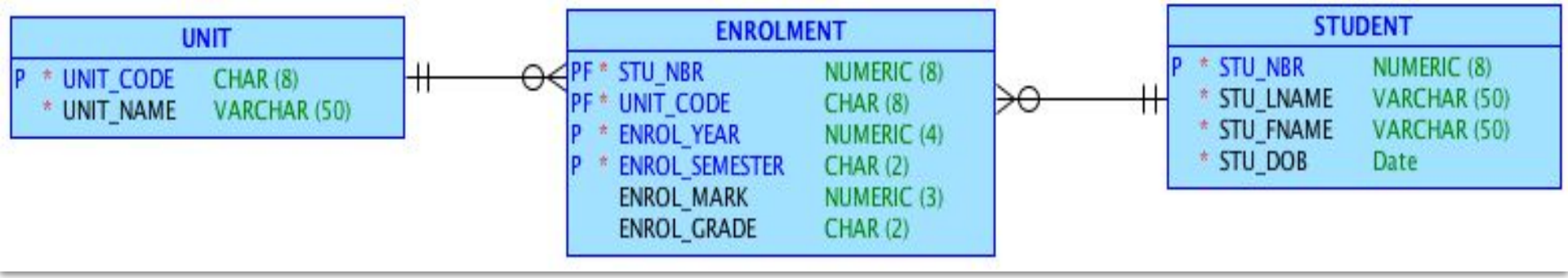
a. 1,3,5
b. 1
c. 3,5
d. No rows will be retrieved

Q3. What row will be retrieved when the WHERE clause predicate is written as

```
V_CODE <> 21344 OR  V_CODE <> 24288
```

	V_CODE
1	21344
2	20001
3	24288
4	20001
5	24288

a. 1,3,5
b. 2,4
c. 3,5
d. 1,2,3,4,5




```
SELECT * FROM UNIT;
```

Script Output | Query Result

SQL | All Rows Fetched: 3 in 0.015 seconds

	UNIT_CODE	UNIT_NAME
1	FIT1001	Computer Systems
2	FIT1002	Computer Programming
3	FIT1004	Database

```
SELECT * FROM STUDENT;
```

Script Output | Query Result

SQL | All Rows Fetched: 4 in 0.022 seconds

	STU_NBR	STU_LNAME	STU_FNAME	STU_DOB
1	11111111	Bloggs	Fred	01/JAN/90
2	11111112	Nice	Nick	10/OCT/94
3	11111113	Wheat	Wendy	05/MAY/90
4	11111114	Sheen	Cindy	25/DEC/96

```
SELECT * FROM ENROLMENT;
```

Script Output | Query Result

SQL | All Rows Fetched: 8 in 0.016 seconds

	STU_NBR	UNIT_CODE	ENROL_YEAR	ENROL_SEMESTER	ENROL_MARK	ENROL_GRADE
1	11111111	FIT1001	2012	1	78	D
2	11111111	FIT1002	2013	1	(null)	(null)
3	11111111	FIT1004	2013	1	(null)	(null)
4	11111112	FIT1001	2012	1	35	N
5	11111112	FIT1001	2013	1	(null)	(null)
6	11111113	FIT1001	2012	2	65	C
7	11111113	FIT1004	2013	1	(null)	(null)
8	11111114	FIT1004	2013	1	(null)	(null)

	STU_NBR	UNIT_CODE	ENROL_YEAR	ENROL_SEMESTER	ENROL_MARK	ENROL_GRADE
1	11111111	FIT1001	2012	1	78	D
2	11111111	FIT1002	2013	1	(null)	(null)
3	11111111	FIT1004	2013	1	(null)	(null)
4	11111112	FIT1001	2012	1	35	N
5	11111112	FIT1001	2013	1	(null)	(null)
6	11111113	FIT1001	2012	2	65	C
7	11111113	FIT1004	2013	1	(null)	(null)
8	11111114	FIT1004	2013	1	(null)	(null)

Q4. What is the correct SQL predicate to retrieve those students who have passed and also those students who have not been awarded any mark?

a. `enrol_mark >= 50 AND enrol_mark IS NULL`
b. `enrol_mark >= 50 OR enrol_mark IS NULL`
c. `enrol_mark >= 50 AND enrol_mark IS NOT NULL`
d. `enrol_ mark >= 50 OR enrol_mark IS NOT NULL`
e. None of the above

Arithmetic Operations

- Can be performed in SQL.
- For example:

```
SELECT stu_nbr, enrol_mark/10
FROM enrolment;
```

	STU_NBR	ENROL_MARK/10
1	11111111	7.8
2	11111111	(null)
3	11111111	(null)
4	11111112	3.5
5	11111112	(null)
6	11111113	6.5
7	11111113	(null)
8	11111114	(null)

Oracle NVL function

- It is used to replace a NULL with a value.

```
SELECT stu_nbr,
    NVL(enrol_mark,0),
    NVL(enrol_grade,'WH')
FROM enrolment;
```

	STU_NBR	NVL(ENROL_MARK,0)	NVL(ENROL_GRADE,'WH')
1	11111111	78	D
2	11111111	0	WH
3	11111111	0	WH
4	11111112	35	N
5	11111112	0	WH
6	11111113	65	C
7	11111113	0	WH
8	11111114	0	WH

[Clayton] Audience Q&A

ADVANCED question...

	STU_NBR	UNIT_CODE	ENROL_YEAR	ENROL_SEMESTER	ENROL_MARK	ENROL_GRADE
1	11111111	FIT1001	2012	1	78	D
2	11111111	FIT1002	2013	1	(null)	(null)
3	11111111	FIT1004	2013	1	(null)	(null)
4	11111112	FIT1001	2012	1	35	N
5	11111112	FIT1001	2013	1	(null)	(null)
6	11111113	FIT1001	2012	2	65	C
7	11111113	FIT1004	2013	1	(null)	(null)
8	11111114	FIT1004	2013	1	(null)	(null)

Time to put it all together.
In a single SELECT statement, how do you produce -- the student number, unit code, and mark MINUS 5 -- for all FAILED students, and all students who don't have marks should get exactly 1 mark.
Sample output →

11111111	FIT1002	1
11111111	FIT1004	1
11111112	FIT1001	30
11111112	FIT1001	1
11111113	FIT1004	1
11111114	FIT1004	1

AS - Column Aliases

	STU_NBR	NVL(ENROL_MARK,0)	NVL(ENROL_GRADE,'WH')
1	11111111	78	D

- Note column headings with functions - not intuitive!
- Use the word "AS" to specify a **column alias**
  - New column name in " " to maintain case or spacing
  - One limitation in the next few slides.
- Example…

```
SELECT stu_nbr, enrol_mark/10 AS new_mark
FROM enrolment;

SELECT stu_nbr, enrol_mark/10 AS "New Mark"
FROM enrolment;
```

Sorting Query Result

- "ORDER BY" clause – *tuples have no order*
  - Must be used if more than one row may be returned
- Order can be ASCending or DESCending. The default is ASCending.
  - NULL values can be explicitly placed first/last using "NULLS LAST" or "NULLS FIRST" command
- Sorting can be done for multiple columns.
  - order of the sorting is specified for each column.
- Example:

```
SELECT stu_nbr, enrol_mark
FROM enrolment
ORDER BY enrol_mark DESC
```

	STU_NBR	ENROL_MARK
1	11111111	(null)
2	11111111	(null)
3	11111114	(null)
4	11111112	(null)
5	11111113	(null)
6	11111111	78
7	11111113	65
8	11111112	35

	STU_NBR	UNIT_CODE	ENROL_YEAR	ENROL_SEMESTER	ENROL_MARK	ENROL_GRADE
1	11111111	FIT1001	2012	1	78	D
2	11111111	FIT1002	2013	1	(null)	(null)
3	11111111	FIT1004	2013	1	(null)	(null)
4	11111112	FIT1001	2012	1	35	N
5	11111112	FIT1001	2013	1	(null)	(null)
6	11111113	FIT1001	2012	2	65	C
7	11111113	FIT1004	2013	1	(null)	(null)
8	11111114	FIT1004	2013	1	(null)	(null)

Q5. What will be the output of the following SQL statement?

```
SELECT stu_nbr
FROM enrolment
WHERE enrol_mark IS NULL
ORDER BY stu_nbr ASC NULLS FIRST;
```

a.

11111111
11111112
11111113
11111114

b.

11111111
11111111
11111112
11111113
11111114

c.

11111111
11111112
11111113

d.

(null)
(null)
(null)
(null)
(null)

[Clayton] Audience Q&A

COMMON PROBLEM - take note!

	STU_NBR	UNIT_CODE	ENROL_YEAR	ENROL_SEMESTER	ENROL_MARK	ENROL_GRADE
1	11111111	FIT1001	2012	1	78	D
2	11111111	FIT1002	2013	1	(null)	(null)
3	11111111	FIT1004	2013	1	(null)	(null)
4	11111112	FIT1001	2012	1	35	N
5	11111112	FIT1001	2013	1	(null)	(null)
6	11111113	FIT1001	2012	2	65	C
7	11111113	FIT1004	2013	1	(null)	(null)
8	11111114	FIT1004	2013	1	(null)	(null)

```
SELECT stu_nbr AS alias_id, (year-2000) AS alias_short_year
FROM enrolment
WHERE alias_short_year > 09 AND alias_short_year < 13
ORDER BY alias_id DESC;
-- assume we want students from the graduate class of '10, '11, '12 only.
```

This SQL code will FAIL!
Why?
A column alias (`AS`) can be used in `ORDER BY...`,
but cannot be used in `WHERE`...
Quick fix: subqueries (seen in future)

Removing Duplicate Rows in the Query Result

- Use "DISTINCT" as part of SELECT clause.

```
SELECT DISTINCT stu_nbr
FROM enrolment
WHERE enrol_mark IS NULL;
```

	STU_NBR
1	11111114
2	11111111
3	11111112
4	11111113

Coffee break - see you in 10 minutes.

Img src: Jazmin Quaynor @jazminantoinette at Unsplash

SQL JOIN: simplified example

STUDENT

sno	name
1	alex
2	maria
3	bob

QUALIFICATION

sno	degree	year
1	bachelor	1990
1	master	2000
2	PhD	2001

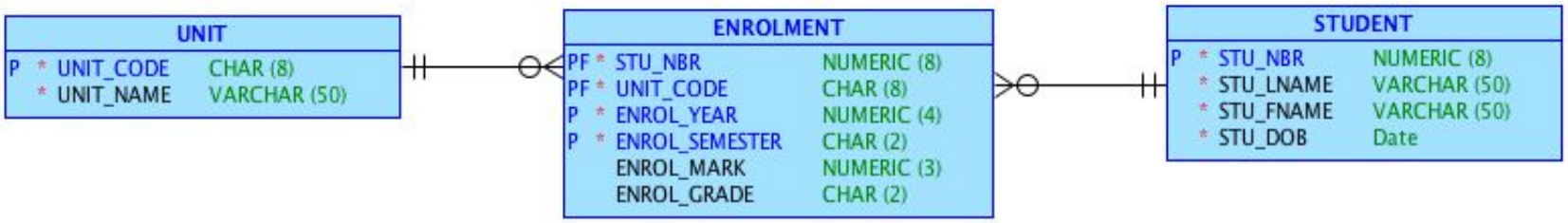
```
SELECT *
FROM student JOIN qualification
             ON student.sno = qualification.sno
ORDER BY student.sno
```

sno	name	degree	year
1	alex	bachelor	1990
1	alex	master	2000
2	maria	PhD	2001

JOIN-ing Multiple Tables

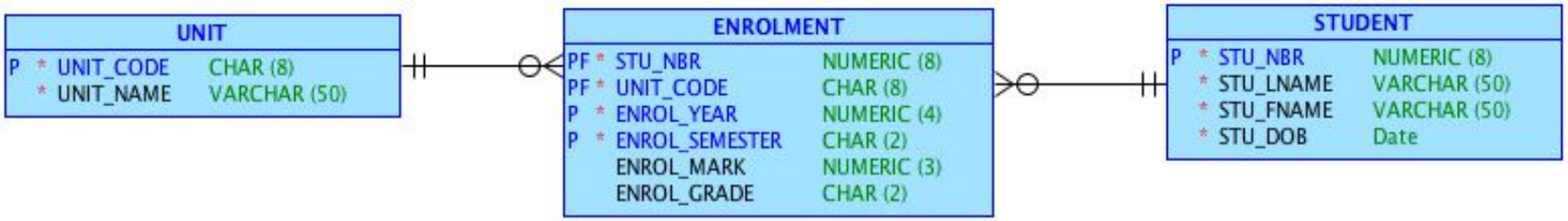
Pair the PK and FK in the JOIN condition

Note table aliasing e.g. `unit u` in FROM clause




```
SELECT s.stu_nbr, s.stu_lname, u.unit_name
FROM ((unit u JOIN enrolment e ON u.unit_code=e.unit_code)
            JOIN student s ON e.stu_nbr=s.stu_nbr)
ORDER BY s.stu_nbr, u.unit_name;
```

JOIN-ing Multiple Tables - Step by Step



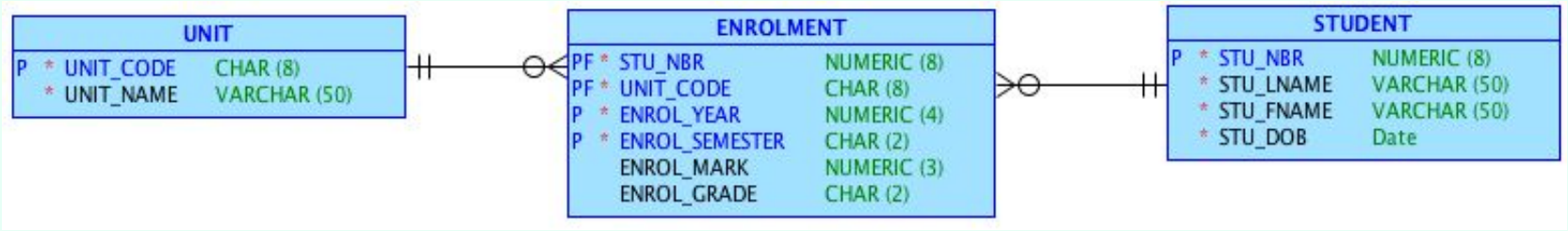

```
SELECT s.stu_nbr, s.stu_lname, u.unit_name
```

unit is now called 'u' as a table alias same goes for enrolment 'e'

```
FROM ((unit u JOIN enrolment e ON u.unit_code=e.unit_code)
            JOIN student s ON e.stu_nbr=s.stu_nbr)
```

```
ORDER BY s.stu_nbr, u.unit_name;
```

[Clayton] Audience Q&A




```
SELECT s.stu_nbr, s.stu_lname, u.unit_name
FROM ((unit u JOIN enrolment e ON u.unit_code=e.unit_code)
              JOIN student s ON e.stu_nbr=s.stu_nbr)
ORDER BY s.stu_nbr, u.unit_name;
```

Time to put it all together.

1. **What happens to a new unit (without any enrolments)?**
2. **What happens to a newly-registered student but who hasn't enrolled in a unit (e.g. pending fees paid)?**
3. **Any NULLs anywhere?**
4. **What happens if we do ONLY the first join (`unit u JOIN enrolment e`) without the second join (student s…)**

Oracle Reference: Date Data Type

Img src: @curtismacnewton at Unsplash

SQL Standard vs Oracle

- Dates are stored differently from the SQL standard
- SQL's standard uses two different types: **date** and **time**
- Oracle uses one type: `DATE`
  - Stored in internal format contains date and time
  - Output is controlled by formatting
  - ```
    select to_char(sysdate,'dd-Mon-yyyy')
    from dual;
    ```
    Result: 14-Apr-2018

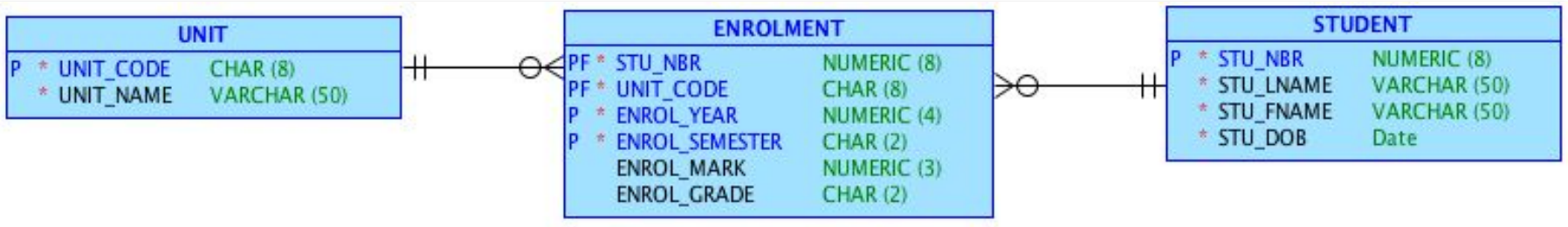
  - ```
    select to_char (sysdate,'dd-Mon-yyyy
    hh:mi:ss PM') from dual;
    ```
    Result: 14-Apr-2018 02:51:24 PM

[Clayton] Q&A - why select from dual? https://en.wikipedia.org/wiki/DUAL_table is a built in 'dummy table' "suitable for use in selecting a pseudo column such as **SYSDATE** or USER." (Wikipedia). BTW, sysdate is the current Oracle `DATE`, more later.

Oracle: DATE data type

- DATE data type should be formatted with **TO_CHAR** when selecting for **display**.
- Text representing date **must be formatted** with **TO_DATE** when **comparing** or **inserting/updating.**
- Example:

```
SELECT stu_nbr, stu_fname, stu_lname,
       to_char(stu_dob,'dd-Mon-yyyy') as text_dob
FROM   student
WHERE  stu_dob > to_date('01-Apr-1991','dd-Mon-yyyy')
ORDER BY stu_dob;
```

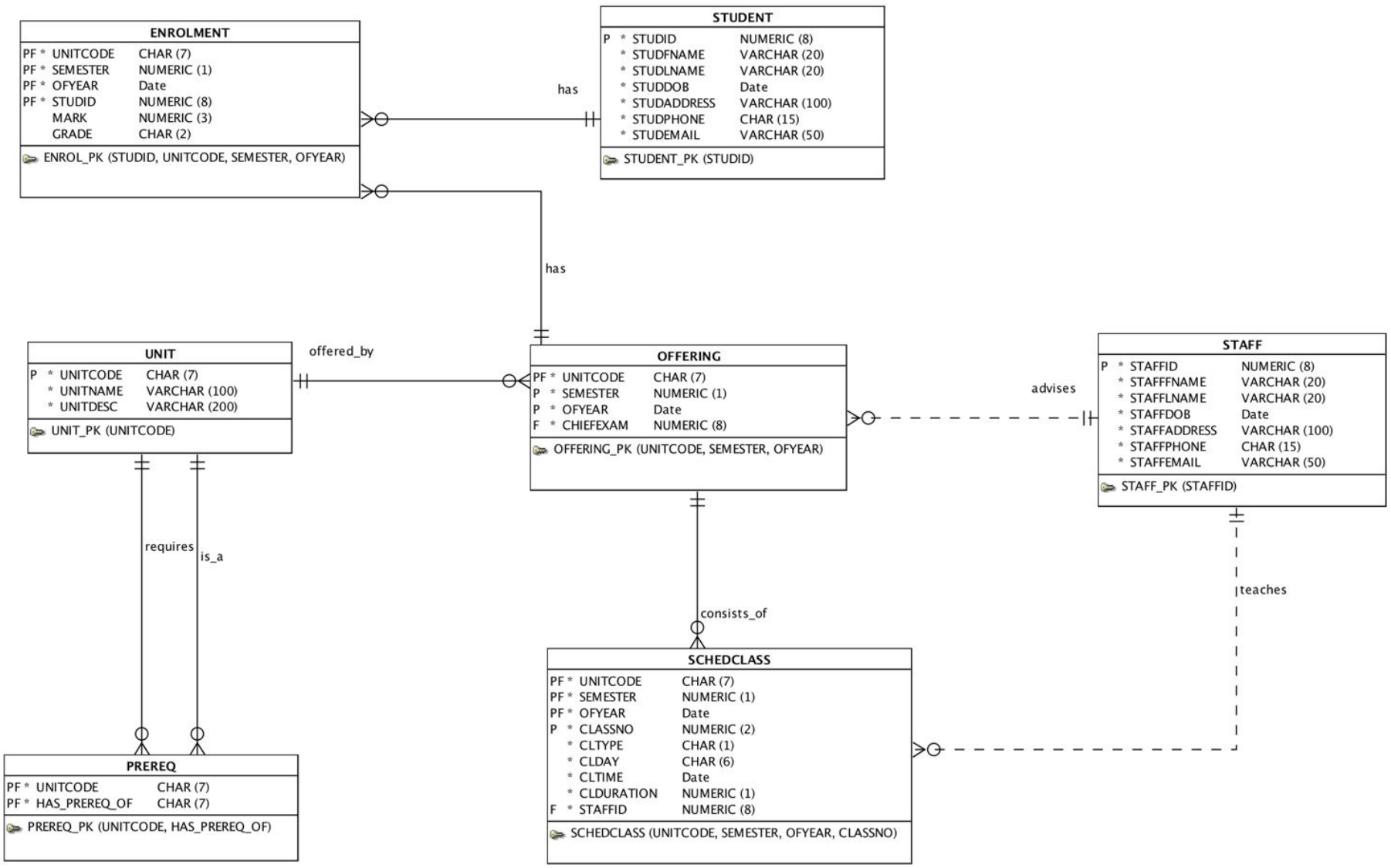


Oracle: Current Date

- Current date can be queried from the DUAL table using the **`SYSDATE`** attribute.
  - `SELECT sysdate FROM dual;`

- Oracle internal attributes include:
  - **`sysdate`**: current date/time
  - **`systimestamp`**: current date/time as a timestamp
  - **`user`**: current logged in user

Practice



Uni data model

Practice

- Show the unit codes that have lectures (type = L) scheduled on Mondays (Mon)
- Show names of students and their DOBs where DOB is displayed as something like "01-JAN-1999"
- Show the first name and last name of the students who got HD in FIT1004
- Show unit name, and the names of the students who got HD in any unit that contains the word 'Data' in its name
- Show the names of the unit that have lectures scheduled on Mondays
- Show the names of all students who come to university to attend a lecture on Mondays. We assume an ideal world where a student never misses the scheduled lectures of any unit he/she is enrolled in :P

Summary

- SQL statement, clause, predicate.
- Writing SQL predicates.
  - Comparison, range, set membership, pattern matching, is NULL
  - Combining predicates using logic operators (AND, OR, NOT)
- Arithmetic operation.
  - NVL function
- Column alias.
- Ordering (Sorting) result.
- Removing duplicate rows.
- JOIN-ing tables
- Oracle Dates
- **Have a good MSB 2019!**