SELECT statement (7)

Sample database

```
CREATE TABLE Department(
name                VARCHAR2(50),
code                CHAR(5),
total_staff_number  NUMBER(2)              NOT NULL,
chair               VARCHAR2(50),
budget              NUMBER(9,1)            NULL,
CONSTRAINT dept_pkey PRIMARY KEY(name),
CONSTRAINT dept_ckey1 UNIQUE(code),
CONSTRAINT dept_ckey2 UNIQUE(chair),
CONSTRAINT dept_check1
CHECK (total_staff_number BETWEEN 1 AND 50)  );
```

```
CREATE TABLE Course(
c#                  CHAR(7),
title               VARCHAR2(200)          NOT NULL,
credits             NUMBER(1)              NOT NULL,
offered_by          VARCHAR2(50)           NULL,
CONSTRAINT course_pkey PRIMARY KEY(c#),
CONSTRAINT course_check1
        CHECK (credits IN (6, 12) ),
CONSTRAINT course_fkey1 FOREIGN KEY(offered_by)
        REFERENCES Department(name) );
```


Queries with ANY clause

Find the titles of all courses such that their credits are greater than credits of any database course

Course

c# | title | credits | offered by

```
SELECT title
FROM Course
WHERE credits >
        ANY
        ( SELECT credits
          FROM Course
          WHERE title LIKE '%database%');
```


Computational model (queries with ANY clause)

```
SELECT <ATTRIBUTES>
FROM <TABLE_1>
WHERE ATTRIBUTE_1 > ANY
                    (SELECT <ATTRIBUTES_1>
                     FROM <TABLE_2>
                     WHERE <CONDITION_2>);
```

```
forall rows t in <TABLE_2>
      if evaluate(<CONDITION_2>, t) then
         TEMP ← append(t.<ATTRIBUTES_2>)
      endif;
endforall;
forall rows s in <TABLE_1>
      if there exists t in TEMP such that s.ATTRIBUTE_1 > t then
          output(s.<ATTRIBUTES>);
      endif;
endforall;
```


Queries with ALL clause

Find the titles of all courses such that their credits are greater than credits of all (every) database courses

Course

c# | title | credits | offered by

```
SELECT title
FROM Course
WHERE credits >
        ALL
        ( SELECT credits
          FROM Course
          WHERE title LIKE '%database%');
```


Computational model (queries with ALL clause)

```
SELECT <ATTRIBUTES>
FROM <TABLE_1>
WHERE ATTRIBUTE_1 > ANY
                    (SELECT <ATTRIBUTES_1>
                     FROM <TABLE_2>
                     WHERE <CONDITION_2>);
```

```
forall rows t in <TABLE_2>
      if evaluate(<CONDITION_2>, t) then
         TEMP ← append(t.<ATTRIBUTES_2>)
      endif;
endforall;
forall rows s in <TABLE_1>
      if for each t in TEMP (s.ATTRIBUTE_1 > t) then
          output(s.<ATTRIBUTES>);
      endif;
endforall;
```

Queries with multiple column conditions

Find the titles of all courses such that their credits are the same as credits of CSCI235 course and they are offered by the same department as CSCI235 course

```
SELECT title
FROM Course
WHERE (credits, offered_by) =
                    ( SELECT credits, offered_by
                      FROM Course
                      WHERE c# = 'CSCI235' )
      AND c# <> 'CSCI235';
```


Nested queries revisited

Find the titles of all courses such that their credits are the same as credits of any database course and they are offered by the same department as any database course

```
SELECT title
FROM Course
WHERE credits IN
                ( SELECT credits
                  FROM Course
                  WHERE title LIKE '%database%' )
      AND offered_by IN
                ( SELECT offered_by
                  FROM Course
                  WHERE title LIKE '%databases%' );
```

This query is NOT equivalent to a query with multiple column condition !!!

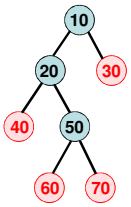
NULLs returned by subqueries

Employee

e# | name | manager#

Find all employees who are not managers

```
e# | name   | manager#
---------------------
10 | John   | NULL
20 | Peter  | 10
30 | Mary   | 10
40 | Mike   | 20
50 | Kate   | 20
60 | Greg   | 50
70 | Phil   | 50
```



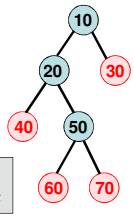
NULLs returned by subqueries

Employee

e# | name | manager#

Find all employees who are not managers

```
SELECT *
FROM Employee
WHERE e#
        NOT IN
                ( SELECT manager#
                  FROM Employee );
```



NULLs returned by subqueries

Find all employees who are not managers

```
SELECT *
FROM Employee
WHERE e# NOT IN
                ( SELECT manager#
                  FROM Employee );
```

```
manager#
--------
NULL !!!
10
10
20
20
50
50
```

No rows selected !!!

NULL value means "any number" !!!

NULLs returned by subqueries

Find all employees who are not managers

```
SELECT *
FROM Employee
WHERE e# NOT IN
                ( SELECT manager#
                  FROM Employee
                  WHERE manager# IS NOT NULL );
```

Queries with three-valued logic

NOT	TRUE	FALSE	UNKNOWN
	FALSE	TRUE	UNKNOWN

OR	TRUE	FALSE	UNKNOWN
TRUE	TRUE	TRUE	TRUE
FALSE	TRUE	FALSE	UNKNOWN
UNKNOWN	TRUE	UNKNOWN	UNKNOWN

AND	TRUE	FALSE	UNKNOWN
TRUE	TRUE	FALSE	UNKNOWN
FALSE	FALSE	FALSE	FALSE
UNKNOWN	UNKNOWN	FALSE	UNKNOWN

Queries with three-valued logic

Employee

e#	name	manager#

e#	name	manager#
10	John	NULL
20	Peter	10
30	Mary	10
40	Mike	20
50	Kate	20
60	Greg	50
70	Phil	50

```
SELECT e#
FROM Employee
WHERE manager# = 10;
```

e#
20
30

```
SELECT e#
FROM Employee
WHERE manager# <> 10;
```

e#
40
50
60
70

Negation of UNKNOWN is equal to UNKNOWN !!!

NVL row function

Find the average number of employees per department

Department NULL → 0

name	code	total staff number	chair	budget

```
SELECT    AVG( NVL(total_staff_number, 0) )
FROM      Department;
```


COALESCE function

Find the average number of employees per department

Department NULL → 0

name	code	total staff number	chair	budget

```
SELECT    AVG( COALESCE(total_staff_number, 0))
FROM      Department;
```

```
COALESCE(exp1, exp2, …, expn)
Return the first non-NULL expression.
```


CASE statement

```
SELECT ename, salary,
 CASE
  WHEN salary < 100 THEN 0
  WHEN salary < 200 THEN 0.2
  WHEN salary < 300 THEN 0.4
  WHEN salary < 400 THEN 0.5
  ELSE 0.7
 END TAX_RATE
FROM   Employee;
```

```
SELECT AVG(
 CASE
  WHEN total_staff_number IS NULL THEN 0
  ELSE total_staff_number
 END )
FROM   Department;
```


How to implement complex queries ?

Find the titles of all courses such that their credits are the same as credits of CSCI235 course and they are offered by the same department as CSCI235 course

```
SELECT title
FROM ( SELECT credits, offered_by
       FROM Course
       WHERE c# = 'CSCI235'
                          ) C235 JOIN Course
        ON C235.credits = Course.credits AND
           C235.offered_by = Course.offered_by
```

How to implement complex queries ?

Find the names of all departments that offer more than 1 course

```
SELECT Grouped.offered_by
FROM ( SELECT offered_by, count(*) total
       FROM Course
       GROUP BY offered_by
                          )Grouped
WHERE Grouped.total > 1;
```


How to implement complex queries ?

Find the names of all departments that have budget higher than 10000 and such that offer at least one 12 credit points course

```
SELECT D1K.name
FROM ( SELECT name
       FROM Department
       WHERE budget > 10000 )D1K JOIN
     ( SELECT offered_by
       FROM Course
       WHERE credits >= 12  )C12
     ON D1K.name = C12.offered_by;
```


References

Elmasri R., Navathe S. B., *Database Systems*, chapter 6

Ramakrishnan R., Gehrke J., *Database Management Systems*, chapter 5.4.3, 5.6,

`https://sai.uow.edu.au/oradocs/`
SQL Reference, `SELECT` statement