More advanced Selection queries

Ordering results

ORDER BY

In a table, the order of the records (rows) cannot be guaranteed – in fact as records are added (to the bottom of the table) and deleted (from the centre of the table) the order becomes even less predictable.

To view a set of ordered records SQL provides the ORDER BY keywords – to see all the records in the EMP table ordered by *empno* use:

```
select *
from emp
order by empno;
```

Order by sorts in 'ascending' order - numeric values will be shown lowest value first, date values will be shown earliest first and character values will be sorted alphabetically.

No equivalent functionality is available in basic Relational Algebra where ordering is not a concept.

The ORDER BY clause is the last statement of the SELECT command. To use sub-ordering, list further column names, separated by commas

```
order by deptno, sal, ename
```

If the DESC keyword is used, sort order will be reversed i.e. highest value first.

```
order by deptno, sal desc
```

Note that empty NULL values will be shown 'before' zeros in ascending order.

The following examples demonstrate variations on the *ORDER BY* statement. Type these queries in and verify that they produce the results indicated.

Examples

Display Department No, Employee No and Hiredate, ordered by Department No

```
select deptno, empno, hiredate
from emp
order by deptno;
```

deptno	empno	hiredate
1	875	09/07/2002
1	818	14/05/2000
1	970	21/11/1997
2	938	05/12/1997
2	824	05/03/2000
2	602	31/10/1997
2	912	04/06/2001
2	405	13/06/1997
3	734	11/06/2002
3	535	15/08/1997
3	880	04/06/2001
3	690	05/12/1997
3	557	26/03/2000
3	936	23/07/2002

You may have a different order in the table for the empno and hiredate columns. Why?

Note that the order by clause can refer to a column not required in the output selection – a query to display Employee No and Hiredate, ordered by Department No:

```
select empno, hiredate
from emp
order by deptno;
```

empno	hiredate
875	09/07/2002
818	14/05/2000
970	21/11/1997
938	05/12/1997
824	05/03/2000
602	31/10/1997
	...etc..

Display all the employee information ordered by department number and salary, with salary in descending order.

```
select *
from emp
order by deptno, sal desc;
```

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO
875	PARKER	PRESIDENT		09/07/2002	60000		1
818	POLLARD	MANAGER	875	14/05/2000	34500		1
970	BLACK	ADMIN	818	21/11/1997	23000		1
938	GIBSON	ANALYST	602	05/12/1997	40000		2
824	REES	ANALYST	602	05/03/2000	40000		2
602	BIRD	MANAGER	875	31/10/1997	39750		2
912	HAYES	ADMIN	824	04/06/2001	21000		2
405	MARCH	ADMIN	938	13/06/1997	18000		2
734	COX	MANAGER	875	11/06/2002	38500		3
535	BYRNE	SALES	734	15/08/1997	26000	300	3
880	TURNER	SALES	734	04/06/2001	25000	0	3
690	AHMAD	SALES	734	05/12/1997	22500	1400	3
557	BELL	SALES	734	26/03/2000	22500	500	3
936	CASSY	ADMIN	734	23/07/2002	19500		3

Display Department No, Job, Employee name and monthly Salary ordered by department number and monthly Salary

```
select deptno, job, ename, sal/12
from emp
order by 1, 4;
```

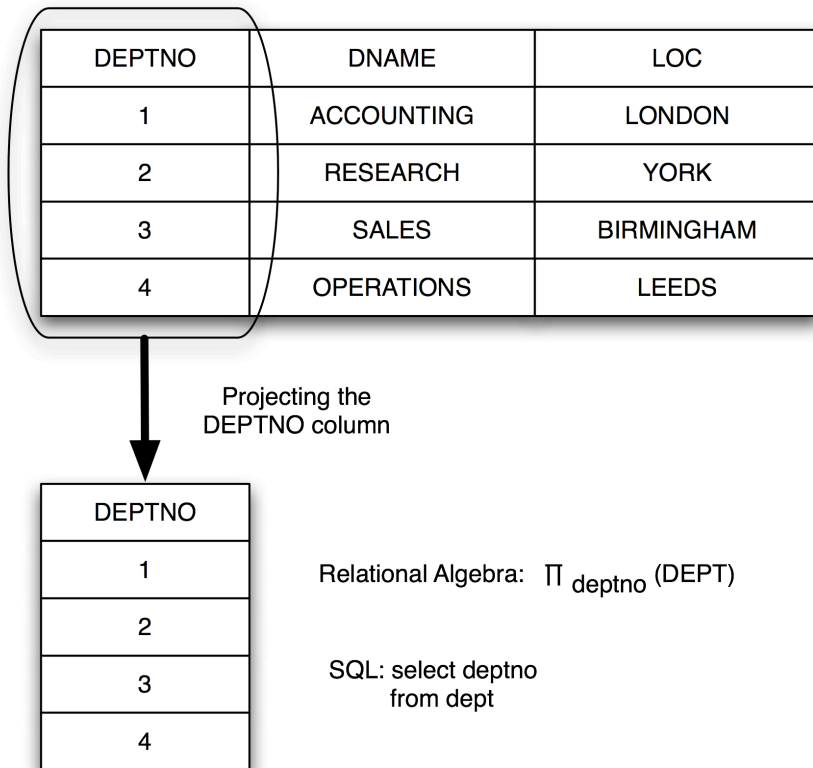| DEPTNO	JOB	ENAME	Expr1003
1	ADMIN	BLACK	1916.6666667
1	MANAGER	POLLARD	2875
1	PRESIDENT	PARKER	5000
2	ADMIN	MARCH	1500
2	ADMIN	HAYES	1750
2	MANAGER	BIRD	3312.5
2	ANALYST	GIBSON	3333.3333333
2	ANALYST	REES	3333.3333333
3	ADMIN	CASSY	1625
3	SALES	AHMAD	1875
3	SALES	BELL	1875
3	SALES	TURNER	2083.3333333
3	SALES	BYRNE	2166.6666667
3	MANAGER	COX	3208.3333333

Here the numbering in the ORDER BY clause refers to the column sequence.

The technique of using column numbers instead of names isn't regarded as good practice – why?
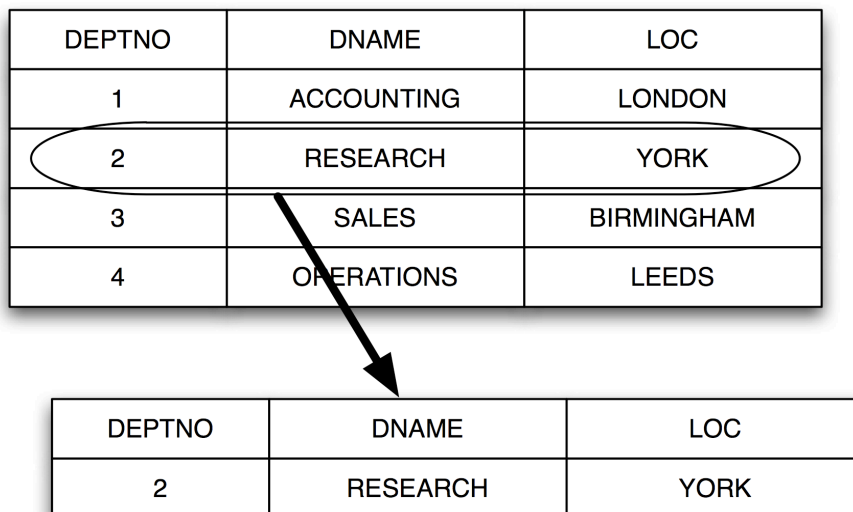
Selecting specific rows

The Selection Operation

Projection can be visualised as providing specific columns in a relation/table:

DEPTNO	DNAME	LOC
1	ACCOUNTING	LONDON
2	RESEARCH	YORK
3	SALES	BIRMINGHAM
4	OPERATIONS	LEEDS

Projecting the
DEPTNO column

DEPTNO
1
2
3
4

Relational Algebra: Π_{deptno} (DEPT)

SQL: select deptno
       from dept

Selection can be used to get specific rows – for example getting all the information about dept no 2:

DEPTNO	DNAME	LOC
1	ACCOUNTING	LONDON
2	RESEARCH	YORK
3	SALES	BIRMINGHAM
4	OPERATIONS	LEEDS

DEPTNO	DNAME	LOC
2	RESEARCH	YORK

A Selection operation uses a *condition* to specify the rows that will be displayed in the resulting table.

Example

Show every row in dept where deptno is 2

A *condition* is always

```
object operator object
```

where object can be any valid *select* object except * or an aggregate function (discussed later). So for deptno is 2

```
deptno = 2
```

The operators can be Boolean or a special SQL operator-

Boolean Operators

=	Equal to	`deptno = 2`
`!= or <>`	Not equal to	`deptno <> 2`
`<`	Less than	`sal < 20000`
`>`	Greater than	`sal > 20000`
`<=`	Less than or equal to	`sal <= 45000`
`>=`	Greater than or equal to	`sal >= 45000`

Special operators

BETWEEN lowest AND highest (values inclusive)	`sal between 30000 and 40000`
IN (value, value, …)	`ename in ("Byrne", "Cox", "Gibson")`
LIKE "FUZZY STRING"	`ename like  "*son"`
IS NULL	`comm is null`
NOT can negate any of the above	`not ename in ("Byrne", "Cox", "Gibson")`

In Relational Algebra a selection is shown using σ with the condition shown in subscript.

Examples

$\sigma_{job="Manager"}$ (emp)   Show rows from the emp relation where the job is manager

$\sigma_{job="Admin" \text{ and } sal > 22000}$ (emp)   Show rows from the emp relation where the job is 'admin' and the sal is greater than £22000

In SQL, selection is achieved by adding a condition to the *where* clause:

```
        select *                           select *
        from emp                           from emp
        where  job="Manager";              where job="Admin" and
                                           sal>22000
```

Activities: Trying various SELECTION queries with a WHERE clause

The following examples demonstrate variations on the *Select* statement. Type these queries in and verify that they produce the results indicated.

Examples

Display the employee information for all managers

```
        select *
        from emp
        where job="Manager";
```

In Relational Algebra:

$\sigma_{job="Manager"}$ (emp)

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO
818	POLLARD	MANAGER	875	14/05/2000	34500		1
734	COX	MANAGER	875	11/06/2002	38500		3
602	BIRD	MANAGER	875	31/10/1997	39750		2

Note that the text part of the condition must be enclosed in double quotes. You may get a differently ordered result set – why?

Display the employees managed by employee number 734

```
        select *
        from emp
        where mgr=734;
```

In Relational Algebra:

$\sigma_{mgr=734}$ (emp)

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	**DEPTNO**
936	CASSY	ADMIN	734	23/07/2002	19500		3
557	BELL	SALES	734	26/03/2000	22500	500	3
690	AHMAD	SALES	734	05/12/1997	22500	1400	3
880	TURNER	SALES	734	04/06/2001	25000	0	3
535	BYRNE	SALES	734	15/08/1997	26000	300	3

Note how number values can just be stated (without quotes).

Display the employees who are Administrators and earn over £22,000

```
select *
from emp
where job="Admin" and sal>22000
```

In Relational Algebra:

σ job="Admin" and sal > 22000 (emp)

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO
970	BLACK	ADMIN	818	21/11/1997	23000		1

Display the employees who are allowed to earn commission

```
select *
from emp
where comm is not null;
```

In Relational Algebra:

σ comm is not null (emp)

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	**DEPTNO**
557	BELL	SALES	734	26/03/2000	22500	500	3
690	AHMAD	SALES	734	05/12/1997	22500	1400	3
880	TURNER	SALES	734	04/06/2001	25000	0	3
535	BYRNE	SALES	734	15/08/1997	26000	300	3

Note that != or <> could be used here instead.

Display the employees who have manager 734 or 875

In Relational Algebra:

σ mgr in (734, 875) (emp)

```
select *
from emp
where mgr in (734, 875);
```

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	**DEPTNO**
936	CASSY	ADMIN	734	23/07/2002	19500		3
557	BELL	SALES	734	26/03/2000	22500	500	3
690	AHMAD	SALES	734	05/12/1997	22500	1400	3
880	TURNER	SALES	734	04/06/2001	25000	0	3
535	BYRNE	SALES	734	15/08/1997	26000	300	3
818	POLLARD	MANAGER	875	14/05/2000	34500		1
734	COX	MANAGER	875	11/06/2002	38500		3
602	BIRD	MANAGER	875	31/10/1997	39750		2

This could be done with the condition *mgr=734 or mgr=875*.

Activities: Writing your own Order As and Selection queries

In the following exercises, the query must be specified to produce the suggested result. There are spaces for you to write the SQL query and Relational Algebra (where appropriate). Use the AS command to get correct column headings in SQL.

1. Display the employee name, employer number and salary information ordered by salary

SQL:

ename	empno	sal
MARCH	405	18000
CASSY	936	19500
HAYES	912	21000
AHMAD	690	22500
BELL	557	22500
BLACK	970	23000
TURNER	880	25000
BYRNE	535	26000
POLLARD	818	34500
COX	734	38500
BIRD	602	39750
GIBSON	938	40000
REES	824	40000
PARKER	875	60000

2. Display the employee name, job and salary, ordered by salary (descending) and hiredate (ascending)

SQL:

ENAME	SAL	JOB
PARKER	60000	PRESIDENT
GIBSON	40000	ANALYST
REES	40000	ANALYST
BIRD	39750	MANAGER
COX	38500	MANAGER
POLLARD	34500	MANAGER
BYRNE	26000	SALES
TURNER	25000	SALES
BLACK	23000	ADMIN
AHMAD	22500	SALES
BELL	22500	SALES
HAYES	21000	ADMIN
CASSY	19500	ADMIN
MARCH	18000	ADMIN

3. Display the employee information for employees who earn more than £35,000
SQL:

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO
734	COX	MANAGER	875	11/06/2002	38500		3
602	BIRD	MANAGER	875	31/10/1997	39750		2
824	REES	ANALYST	602	05/03/2000	40000		2
938	GIBSON	ANALYST	602	05/12/1997	40000		2
875	PARKER	PRESIDENT		09/07/2002	60000		1

In Relational Algebra:

4. Display all the employee details for staff in department 3 who earn more than £25,000
SQL:

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO
535	BYRNE	SALES	734	15/08/1997	26000	300	3
734	COX	MANAGER	875	11/06/2002	38500		3

In Relational Algebra:

5. Display a list of employee names in the Admin department ordered by Name
SQL:

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO
970	BLACK	ADMIN	818	21/11/1997	23000		1
936	CASSY	ADMIN	734	23/07/2002	19500		3
912	HAYES	ADMIN	824	04/06/2001	21000		2
405	MARCH	ADMIN	938	13/06/1997	18000		2

6. Show a list of employees who have earned commission with commission in descending order
SQL:

EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO
690	AHMAD	SALES	734	05/12/1997	22500	1400	3
557	BELL	SALES	734	26/03/2000	22500	500	3
535	BYRNE	SALES	734	15/08/1997	26000	300	3
880	TURNER	SALES	734	04/06/2001	25000	0	3

7. Display the names, jobs and salary of those staff who have a salary more than £25,000 and are in department 2, ordered by name and job.
SQL:

ename	job	sal
BIRD	MANAGER	39750
GIBSON	ANALYST	40000
REES	ANALYST	40000