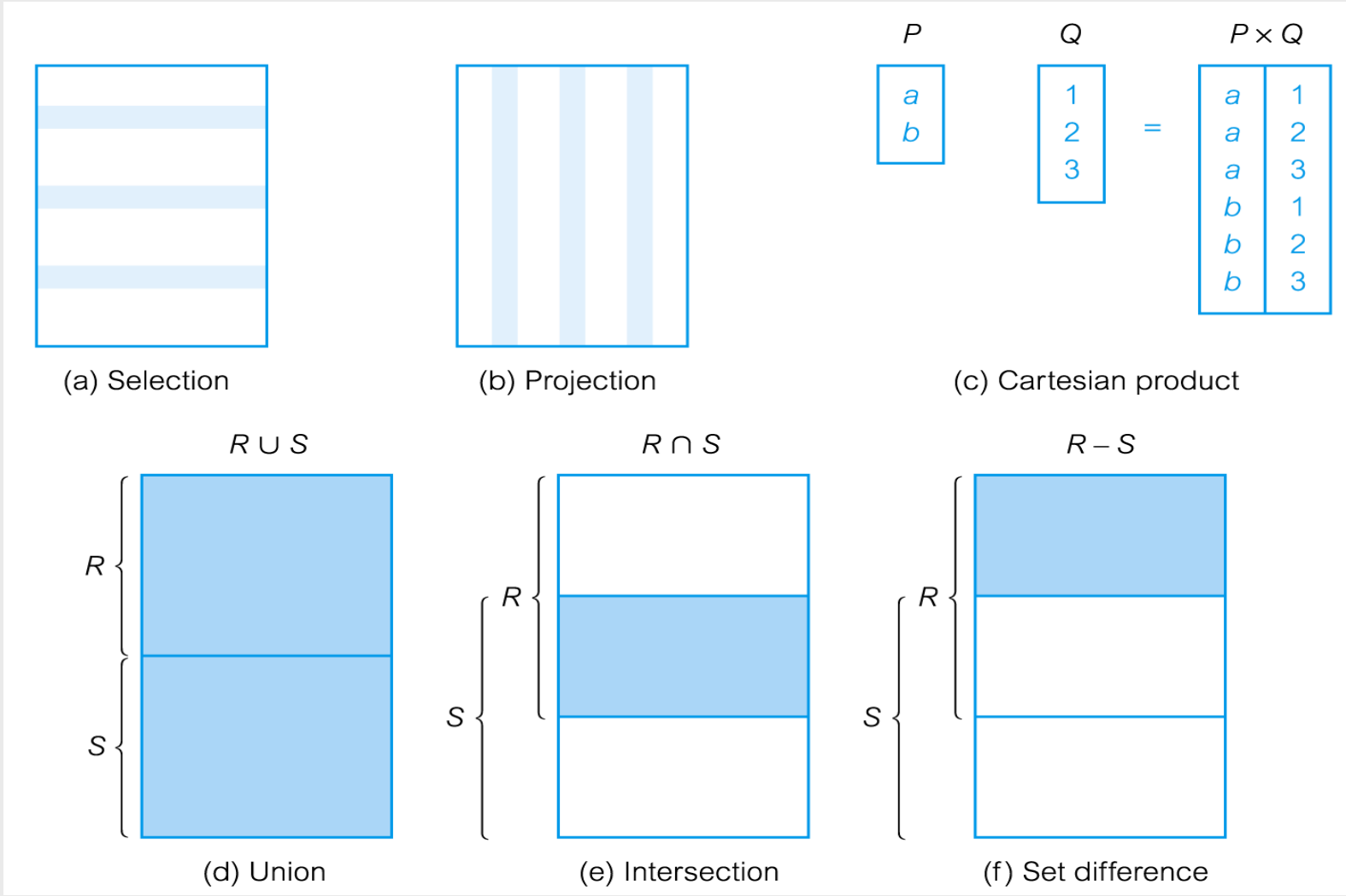
Week10

Relational Algebra & SQL
Unary Operation:
(Selection & Projection)

Objectives

- Unary Operation – Selection & Projection
- SQL : Simple queries

Relational Algebra Operations



Selection (or Restriction)

- $\sigma_{predicate}$ (R)
  - Works on a single relation R and defines a relation that contains only those tuples (rows) of R that satisfy the specified condition (*predicate*).

Example:

Staff

staffNo	fName	lName	position	sex	DOB	salary	branchNo
SL21	John	White	Manager	M	1-Oct-45	30000	B005
SG37	Ann	Beech	Assistant	F	10-Nov-60	12000	B003
SG14	David	Ford	Supervisor	M	24-Mar-58	18000	B003
SA9	Mary	Howe	Assistant	F	19-Feb-70	9000	B007
SG5	Susan	Brand	Manager	F	3-Jun-40	24000	B003
SL41	Julie	Lee	Assistant	F	13-Jun-65	9000	B005

Example - Selection (or Restriction)

- **List all staff with a salary greater than £10,000.**

$$\sigma_{salary > 10000}(Staff)$$

staffNo	fName	lName	position	sex	DOB	salary	branchNo
SL21	John	White	Manager	M	1-Oct-45	30000	B005
SG37	Ann	Beech	Assistant	F	10-Nov-60	12000	B003
SG14	David	Ford	Supervisor	M	24- Mar-58	18000	B003
SG5	Susan	Brand	Manager	F	3-Jun-40	24000	B003

Example : SQL for Selection

List all staff with a salary greater than 10,000.

```
SELECT  *
FROM Staff
WHERE salary > 10000;
```

Projection

- $\Pi_{col1, \ldots, coln}(R)$
  - Works on a single relation R and defines a relation that contains a vertical subset of R, extracting the values of specified attributes and eliminating duplicates.

Example – Projection

- **Produce a list of salaries for all staff, showing only staffNo, fName, lName, and salary details.**

$$\Pi_{staffNo,\ fName,\ lName,\ salary}(Staff)$$

staffNo	fName	lName	salary
SL21	John	White	30000
SG37	Ann	Beech	12000
SG14	David	Ford	18000
SA9	Mary	Howe	9000
SG5	Susan	Brand	24000
SL41	Julie	Lee	9000

Example : SQL for Projection

Example : Produce a list of salaries for all staff, showing only staff number, first and last names, and salary.

```
SELECT staffNo, fName, lName, salary
FROM Staff;
```

Question: Write the RA operation & SQL

- **Produce a list of staff, showing only staffNo, fName, lName, and salary details, for those with salary more than £10,000.**

SELECT Statement

SELECT [DISTINCT | ALL]
{* | [columnExpression [AS newName]] [,...] }
FROM TableName [alias] [, ...]
[WHERE condition]
[GROUP BY columnList] [HAVING condition]
[ORDER BY columnList]

SELECT Statement

FROM	**Specifies table(s) to be used.**
WHERE	**Filters rows.**
GROUP BY	**Forms groups of rows with same column value.**
HAVING	**Filters groups subject to some condition.**
SELECT	**Specifies which columns are to appear in output.**
ORDER BY	**Specifies the order of the output.**

SELECT Statement

- **Order of the clauses cannot be changed.**
- **Only SELECT and FROM are mandatory.**

Example: Select All Columns, All Rows

List full details of all staff.

```
SELECT staffNo, fName, lName, address,
       position, sex, DOB, salary, branchNo
FROM Staff;
```

- **Can use * as an abbreviation for 'all columns':**

```
SELECT *
FROM Staff;
```

Example : Select All Columns, All Rows

staffNo	fName	lName	position	sex	DOB	salary	branchNo
SL21	John	White	Manager	M	1-Oct-45	30000.00	B005
SG37	Ann	Beech	Assistant	F	10-Nov-60	12000.00	B003
SG14	David	Ford	Supervisor	M	24-Mar-58	18000.00	B003
SA9	Mary	Howe	Assistant	F	19-Feb-70	9000.00	B007
SG5	Susan	Brand	Manager	F	3-Jun-40	24000.00	B003
SL41	Julie	Lee	Assistant	F	13-Jun-65	9000.00	B005

Example: Select Specific Columns, All Rows

Produce a list of salaries for all staff, showing only staff number, first and last names, and salary.

```
SELECT staffNo, fName, lName, salary
FROM Staff;
```

Example : Select Specific Columns, All Rows

staffNo	fName	lName	salary
SL21	John	White	30000.00
SG37	Ann	Beech	12000.00
SG14	David	Ford	18000.00
SA9	Mary	Howe	9000.00
SG5	Susan	Brand	24000.00
SL41	Julie	Lee	9000.00

Example: Use of DISTINCT

Viewing

clientNo	propertyNo	comment
CR76	PG4	too remote
CR56	PA14	too small
CR56	PG4	
CR56	PG36	
CR62	PA14	no dining room

Example: Use of DISTINCT

List the property numbers of all properties that have been viewed.

```
SELECT propertyNo
FROM Viewing;
```

propertyNo
PG4
PA14
PG4
PG36
PA14

Example: Use of DISTINCT

- Use DISTINCT to eliminate duplicates:

```
SELECT DISTINCT propertyNo
FROM Viewing;
```

propertyNo
PA14
PG4
PG36

Example : Calculated Fields

Produce list of monthly salaries for all staff, showing staff number, first/last name, and salary.

```
SELECT staffNo, fName, lName, salary/12
FROM Staff;
```

staffNo	fName	lName	col4
SL21	John	White	2500.00
SG37	Ann	Beech	1000.00
SG14	David	Ford	1500.00
SA9	Mary	Howe	750.00
SG5	Susan	Brand	2000.00
SL41	Julie	Lee	750.00

Example : Calculated Fields

- To name column, use AS clause:

```
SELECT staffNo, fName, lName, salary/12
                AS monthlySalary
FROM Staff;
```

staffNo	fName	lName	monthlySalary
SL21	John	White	2500.00
SG37	Ann	Beech	1000.00
SG14	David	Ford	1500.00
SA9	Mary	Howe	750.00
SG5	Susan	Brand	2000.00
SL41	Julie	Lee	750.00

Example : Comparison Search Condition

List all staff with a salary greater than 10,000.

```
SELECT staffNo, fName, lName, position, salary
FROM Staff
WHERE salary > 10000;
```

staffNo	fName	lName	position	salary
SL21	John	White	Manager	30000.00
SG37	Ann	Beech	Assistant	12000.00
SG14	David	Ford	Supervisor	18000.00
SG5	Susan	Brand	Manager	24000.00

Example: Compound Comparison Search Condition

List addresses of all branch offices in London or Glasgow.

```
SELECT *
FROM Branch
WHERE city = 'London' OR city = 'Glasgow';
```

branchNo	street	city	postcode
B005	22 Deer Rd	London	SW1 4EH
B003	163 Main St	Glasgow	G11 9QX
B002	56 Clover Dr	London	NW10 6EU

Example: Range Search Condition

List all staff with a salary between 20,000 and 30,000.

```
SELECT staffNo, fName, lName, position, salary
FROM Staff
WHERE salary BETWEEN 20000 AND 30000;
```

- **BETWEEN test includes the endpoints of range.**

Example: Range Search Condition

staffNo	fName	lName	position	salary
SL21	John	White	Manager	30000.00
SG5	Susan	Brand	Manager	24000.00

Example: Range Search Condition

- Also a negated version NOT BETWEEN.
- BETWEEN does not add much to SQL's expressive power. Could also write:

```
SELECT staffNo, fName, lName, position, salary
FROM Staff
WHERE salary>=20000 AND salary <= 30000;
```

- Useful, though, for a range of values.

Example: Set Membership

List all managers and supervisors.

```
SELECT staffNo, fName, lName, position
FROM Staff
WHERE position IN ('Manager', 'Supervisor');
```

staffNo	fName	lName	position
SL21	John	White	Manager
SG14	David	Ford	Supervisor
SG5	Susan	Brand	Manager

Example: Set Membership

- There is a negated version (NOT IN).
- IN does not add much to SQL's expressive power.

Could have expressed this as:

```
SELECT staffNo, fName, lName, position
FROM Staff
WHERE position='Manager' OR
      position='Supervisor';
```

- IN is more efficient when set contains many values.

Example: Pattern Matching

Find all owners with the string 'Glasgow' in their address.

```
SELECT ownerNo, fName, lName, address, telNo
FROM PrivateOwner
WHERE address LIKE '%Glasgow%';
```

ownerNo	fName	lName	address	telNo
CO87	Carol	Farrel	6 Achray St, Glasgow G32 9DX	0141-357-7419
CO40	Tina	Murphy	63 Well St, Glasgow G42	0141-943-1728
CO93	Tony	Shaw	12 Park Pl, Glasgow G4 0QR	0141-225-7025

Example: Pattern Matching

- SQL has two special pattern matching symbols:
  - %: sequence of zero or more characters;
  - _ (underscore): any single character.
- LIKE '%Glasgow%' means a sequence of characters of any length containing '*Glasgow*'.

Example: NULL Search Condition

List details of all viewings on property PG4 where a comment has not been supplied.

- There are 2 viewings for property PG4, one with and one without a comment.
- Have to test for null explicitly using special keyword IS NULL:

```
SELECT clientNo, viewDate
FROM Viewing
WHERE propertyNo = 'PG4' AND
      comment IS NULL;
```

Example: NULL Search Condition

clientNo	viewDate
CR56	26-May-04

- **Negated version (IS NOT NULL) can test for non-null values.**