SQL

Structured Query Language

Introduction to SQL

What is SQL?

- When a user wants to get some information from a database file, he can issue a ***query***.
- A query is a user–request to retrieve data or information with a certain condition.
- SQL is a query language that allows user to specify the conditions. (instead of algorithms)

Introduction to SQL

Concept of SQL

- The user specifies a certain condition.
- The program will go through all the records in the database file and select those records that satisfy the condition.(searching).
- Statistical information of the data.
- The result of the query will then be stored in form of a table.

Introduction to SQL

How to involve SQL in FoxPro

- Before using SQL, the tables should be opened.
- The SQL command can be entered directly in the Command Window
- To perform ***exact matching***, we should SET ANSI ON

Basic structure of an SQL query

General Structure	SELECT, ALL / DISTINCT, *, AS, FROM, WHERE
Comparison	IN, BETWEEN, LIKE "% _"
Grouping	GROUP BY, HAVING, COUNT( ), SUM( ), AVG( ), MAX( ), MIN( )
Display Order	ORDER BY, ASC / DESC
Logical Operators	AND, OR, NOT
Output	INTO TABLE / CURSOR TO FILE [ADDITIVE], TO PRINTER, TO SCREEN
Union	UNION

The Situation: Student Particulars

field	type	width	contents
id	numeric	4	student id number
name	character	10	name
dob	date	8	date of birth
sex	character	1	sex: M / F
class	character	2	class
hcode	character	1	house code: R, Y, B, G
dcode	character	3	district code
remission	logical	1	fee remission
mtest	numeric	2	Math test score

General Structure

SELECT ..... FROM ..... WHERE .....

SELECT [ALL / DISTINCT] *expr1* [AS *col1*], *expr2* [AS *col2*] ;

FROM *tablename* WHERE *condition*

General Structure

SELECT [ALL / DISTINCT] *expr1* [AS *col1*], *expr2* [AS *col2*] ;
FROM *tablename* WHERE *condition*

- The query will select rows from the source ***tablename*** and output the result in table form.
- Expressions ***expr1***, ***expr2*** can be :
  - (1) a column, or
  - (2) an expression of functions and fields.
- And ***col1***, ***col2*** are their corresponding column names in the output table.

General Structure

SELECT [ALL / DISTINCT] *expr1* [AS *col1*], *expr2* [AS *col2*] ;
FROM *tablename* WHERE *condition*

DISTINCT will eliminate duplication in the output while ALL will keep all duplicated rows.

- ***condition*** can be :
  - (1) an inequality, or
  - (2) a string comparison
  - using logical operators AND, OR, NOT.

General Structure

Before using SQL, open the student file:

USE student

eg. 1 List all the student records.

SELECT * FROM student

Result

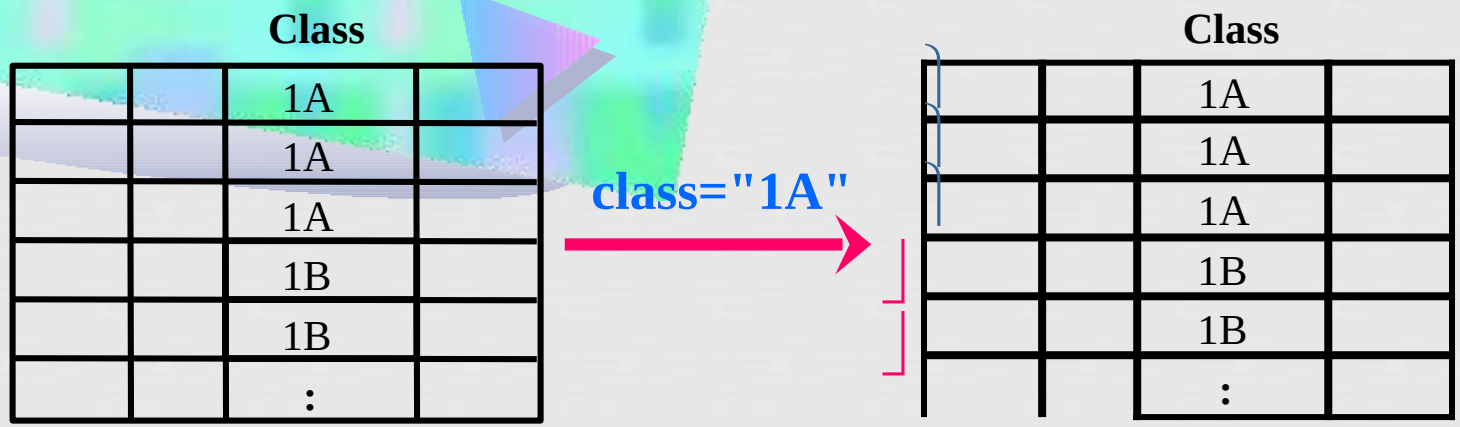
id	name	dob	sex	class	mtest	hcode	dcode	remission
9801	Peter	06/04/86	M	1A	70	R	SSP	.F.
9802	Mary	01/10/86	F	1A	92	Y	HHM	.F.
9803	Johnny	03/16/86	M	1A	91	G	SSP	.T.
9804	Wendy	07/09/86	F	1B	84	B	YMT	.F.
9805	Tobe	10/17/86	M	1B	88	R	YMT	.F.
:	:	:	:	:	:	:	:	:

General Structure

eg. 2 List the names and house code of 1A students.

SELECT name, hcode, class FROM student ;

WHERE class="1A"



General Structure

eg. 2 List the names and house code of 1A students.

Result

name	**hcode**	**class**
Peter	R	1A
Mary	Y	1A
Johnny	G	1A
Luke	G	1A
Bobby	B	1A
Aaron	R	1A
:	:	:

General Structure

eg. 3 List the residential district of the Red House members.

SELECT DISTINCT dcode FROM student ;

WHERE hcode="R"

Result

dcode
HHM
KWC
MKK
SSP
TST
YMT

General Structure

eg. 5 List the names, id of 1A students with no fee remission.

SELECT name, id, class FROM student ;

WHERE class="1A" AND NOT remission

Result

name	**id**	**class**
Peter	9801	1A
Mary	9802	1A
Luke	9810	1A
Bobby	9811	1A
Aaron	9812	1A
Ron	9813	1A
Gigi	9824	1A
:	:	:

Comparison

expr IN (*value1*, *value2*, *value3*)

expr BETWEEN *value1* AND *value2*

expr LIKE "%_"

Comparison

eg. 6 List the students who were born on Wednesday or Saturdays.

```
SELECT name, class, CDOW(dob) AS bdate ;
FROM student ;
WHERE DOW(dob) IN (4,7)
```

Result

name	**class**	**bdate**
Peter	1A	Wednesday
Wendy	1B	Wednesday
Kevin	1C	Saturday
Luke	1A	Wednesday
Aaron	1A	Saturday
:	:	:

Comparison

eg. 7 List the students who were not born in January, March, June, September.

SELECT name, class, dob FROM student ;

WHERE MONTH(dob) NOT IN (1,3,6,9)

Result

name	**class**	**dob**
Wendy	1B	07/09/86
Tobe	1B	10/17/86
Eric	1C	05/05/87
Patty	1C	08/13/87
Kevin	1C	11/21/87
Bobby	1A	02/16/86
Aaron	1A	08/02/86
:	:	:

Comparison

eg. 8 List the 1A students whose Math test score is between 80 and 90 (incl.)

```
SELECT name, mtest FROM student ;
WHERE class="1A" AND ;
mtest BETWEEN 80 AND 90
```

Result

name	**mtest**
Luke	86
Aaron	83
Gigi	84

Comparison

eg. 9 List the students whose names start with "T".

SELECT name, class FROM student ;

WHERE name LIKE "T%"

Result

name	**class**
~~Tobe~~	1B
Teddy	1B
Tim	2A

Comparison

eg. 10 List the Red house members whose names contain "a" as the 2nd letter.

SELECT name, class, hcode FROM student ;

WHERF name LIKE "_a%" AND hcode="R"

name	**class**	**hcode**
Aaron	1A	R
Janet	1B	R
Paula	2A	R

Grouping

SELECT ..... FROM ..... WHERE *condition* ;
GROUP BY *groupexpr* [HAVING *requirement*]

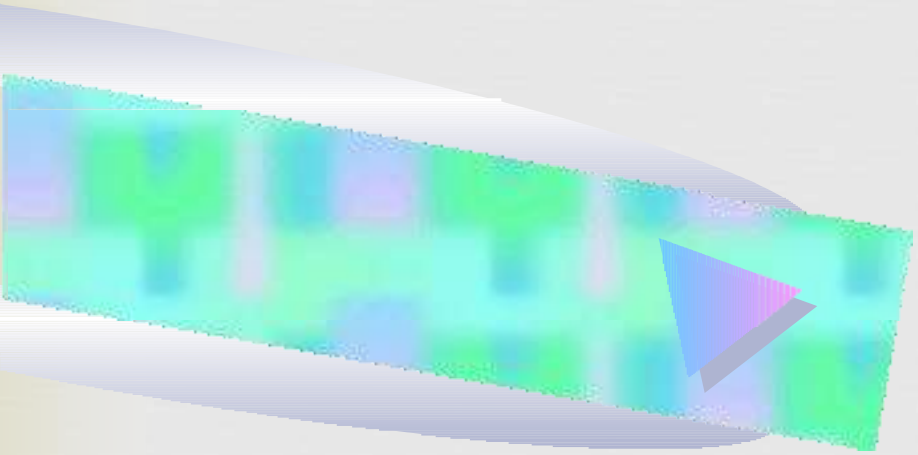
Group functions:

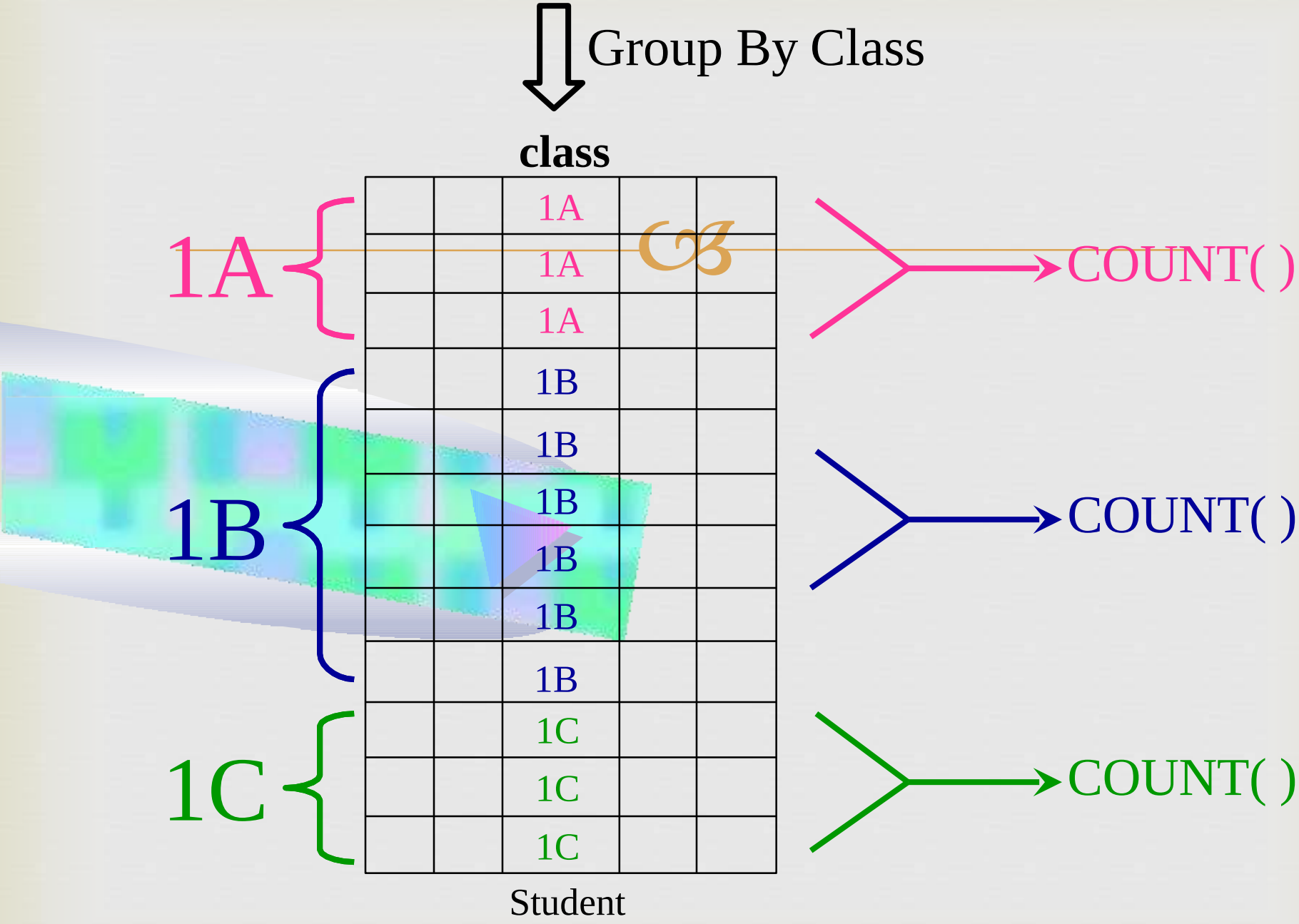
COUNT( ), SUM( ), AVG( ), MAX( ), MIN( )

- ***groupexpr*** specifies the related rows to be grouped as one ~~entry~~. Usually it is a column.
- WHERE ***condition*** specifies the condition of individual rows before the rows are group. HAVING ***requirement*** specifies the condition involving the whole group.

Grouping

eg. 11 List the number of students of each class.




Group By Class
class
1A
1A
1A
1A
1B
1B
1B
1B
1B
1B
1C
1C
1C
1A
1B
1C
COUNT( )
COUNT( )
COUNT( )
Student

Grouping

eg. 11 List the number of students of each class.

SELECT class, COUNT(*) FROM student ;

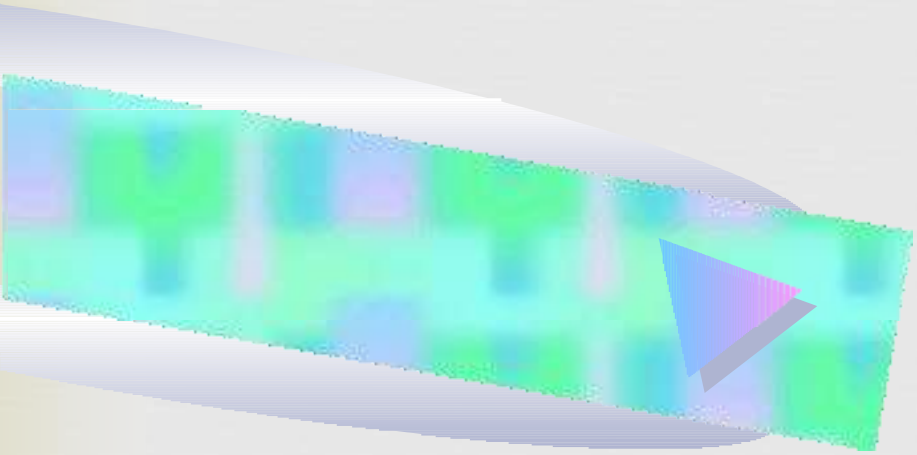
GROUP BY class

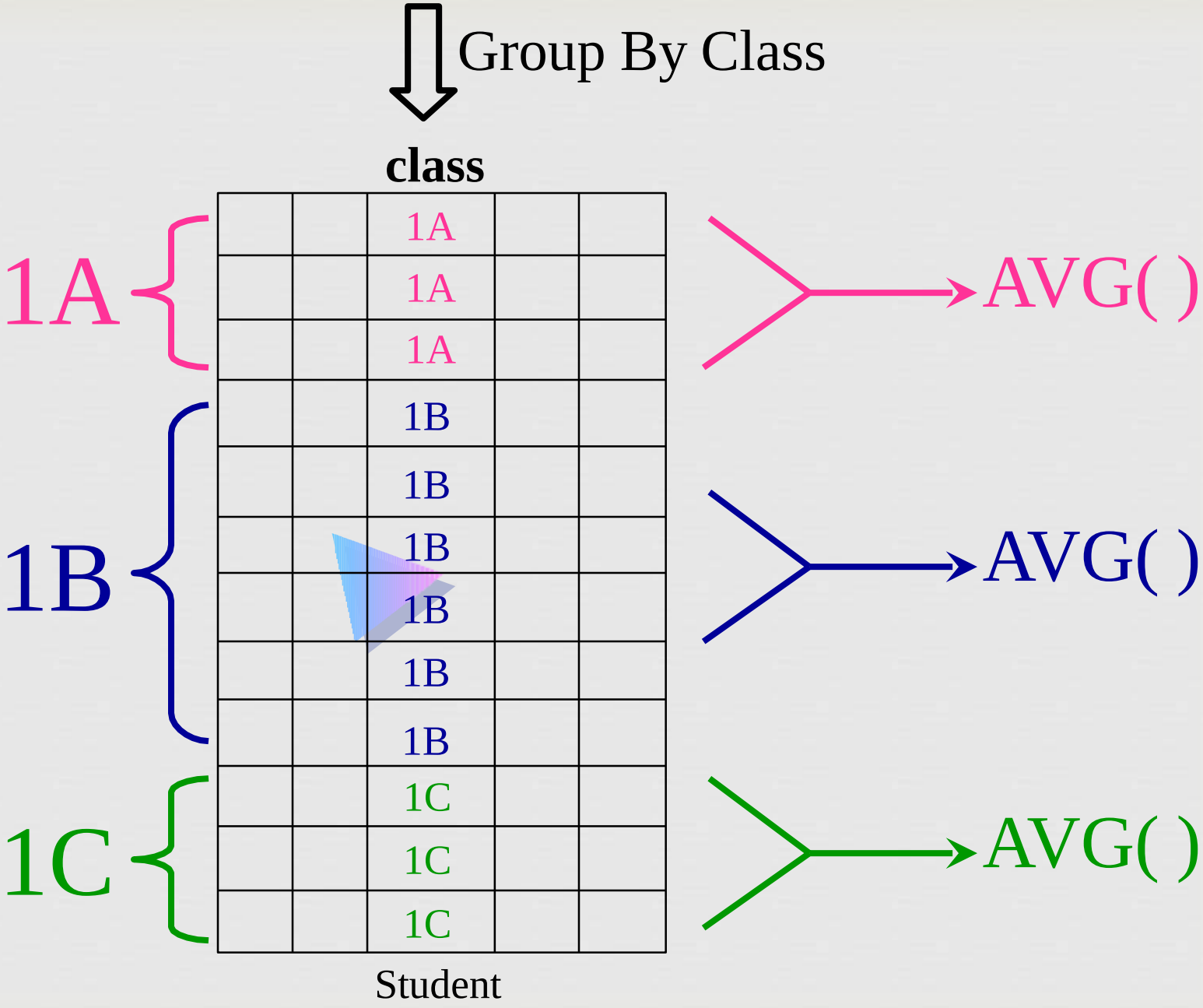
Result

class	**cnt**
1A	10
1B	9
1C	9
2A	8
2B	8
2C	6

Grouping

eg. 12 List the average Math test score of each class.




Group By Class
class
1A
1A
1A
1B
1B
1B
1B
1B
1B
1C
1C
1C
1A
1B
1C
AVG( )
AVG( )
AVG( )
Student

Grouping

eg. 12 List the average Math test score of each class.

SELECT class, AVG(mtest) FROM student ;
GROUP BY class

Result

class	avg_mtest
1A	85.90
1B	70.33
1C	37.89
2A	89.38
2B	53.13
2C	32.67

Grouping

eg. 13 List the number of girls of each district.

SELECT dcode, COUNT(*) FROM student ;

WHERE sex="F" GROUP BY dcode

Result

dcode	cnt
HHM	6
KWC	1
MKK	1
SSP	5
TST	4
YMT	8

Grouping

eg. 14 List the max. and min. test score of Form 1 students of each district.

```
SELECT MAX(mtest), MIN(mtest), dcode ;
FROM student ;
WHERE class LIKE "1_" GROUP BY dcode
```

Result

max_mtest	min_mtest	dcode
92	36	HHM
91	19	MKK
91	31	SSP
92	36	TST
75	75	TSW
88	38	YMT

Grouping

eg. 15 List the average Math test score of the boys in each class. The list should not contain class with less than 3 boys.

```
SELECT AVG(mtest), class FROM student ;
WHERE sex="M" GROUP BY class ;
HAVING COUNT(*) >= 3
```

Result

avg_mtest	class
86.00	1A
77.75	1B
35.60	1C
86.50	2A
56.50	2B

Display Order

SELECT ..... FROM ..... WHERE .....

GROUP BY ..... ;

ORDER BY *colname* ASC / DESC

Display Order

eg. 16 List the boys of class 1A, order by their names.

SELECT name, id FROM student ;

WHERE sex="M" AND class="1A" ORDER BY name

name	id
Peter	9801
Johnny	9803
Luke	9810
Bobby	9811
Aaron	9812
Ron	9813

Result

ORDER BY

dcode

name	id
Aaron	9812
Bobby	9811
Johnny	9803
Luke	9810
Peter	9801
Ron	9813

Display Order

eg. 17 List the 2A students by their residential district.

SELECT name, id, class, dcode FROM student ;

WHERE class="2A" ORDER BY dcode

Result

name	**id**	**class**	**dcode**
Jimmy	9712	2A	HHM
Tim	9713	2A	HHM
Samual	9714	2A	SHT
Rosa	9703	2A	SSP
Helen	9702	2A	TST
Joseph	9715	2A	TSW
Paula	9701	2A	YMT
Susan	9704	2A	YMT

Display Order

eg. 18 List the number of students of each district (in desc. order).

SELECT COUNT(*) AS cnt, dcode FROM student ;
GROUP BY dcode ORDER BY cnt DESC

Result

cnt	docode
11	YMT
10	HHM
10	SSP
9	MKK
5	TST
2	TSW
1	KWC
1	MMK
1	SHT

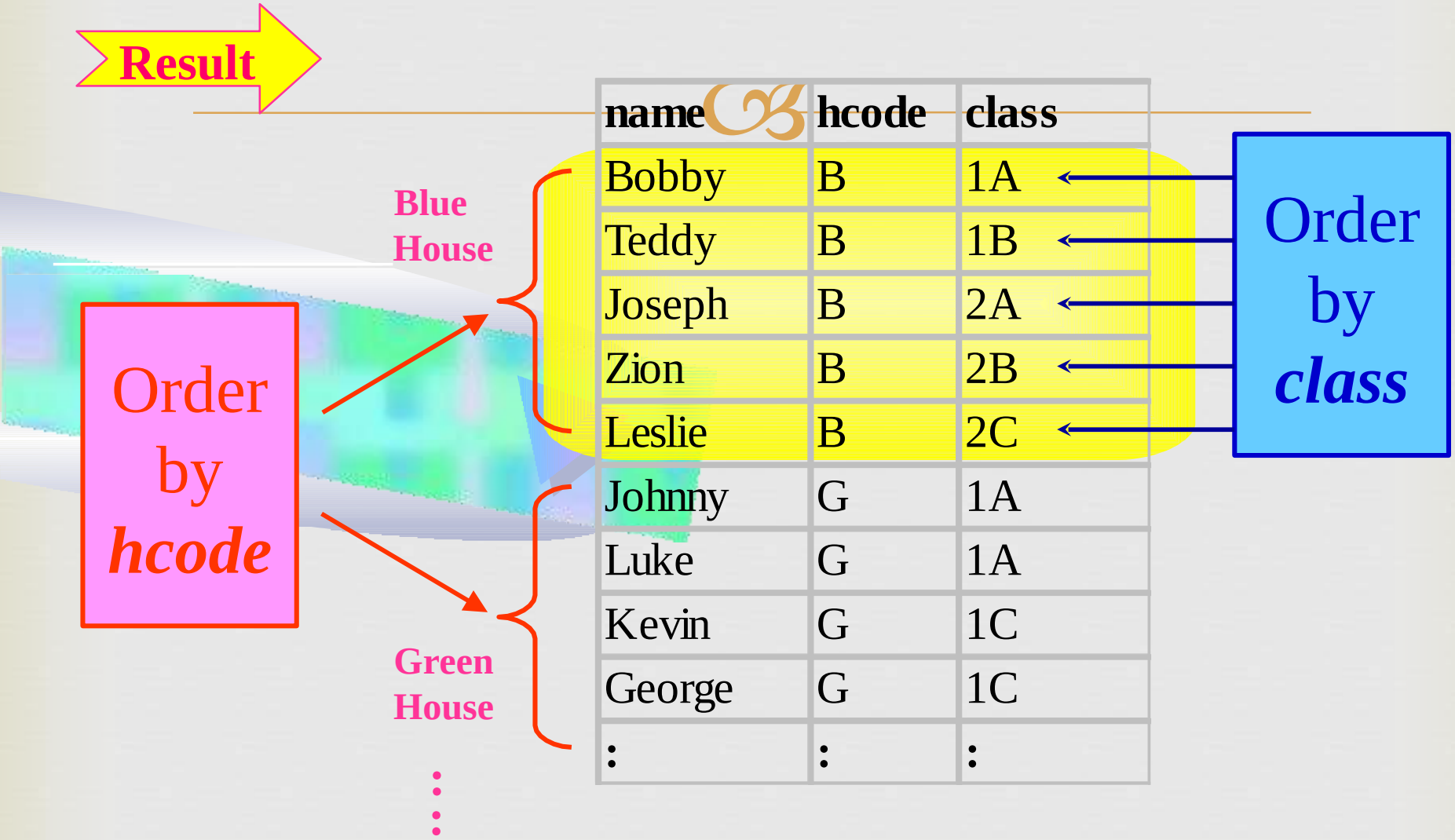
Display Order

eg. 19 List the boys of each house order by the classes. (2-level ordering)

SELECT name, class, hcode FROM student ;

WHERE sex="M" ORDER BY hcode, class

Display Order



name	hcode	class
Bobby	B	1A
Teddy	B	1B
Joseph	B	2A
Zion	B	2B
Leslie	B	2C
Johnny	G	1A
Luke	G	1A
Kevin	G	1C
George	G	1C
:	:	:

Output

INTO TABLE *tablename*	the output table is saved as a database file in the disk.
INTO CURSOR *temp*	the output is stored in the working memory temporarily.
TO FILE *filename* [ADDITIVE]	output to a text file. (additive = append)
TO PRINTER	send to printer.
TO SCREEN	display on screen.

Output

eg. 20 List the students in desc. order of their names and save the result as a database file name.dbf.

SELECT * FROM student ;

ORDER BY name DESC INTO TABLE name.dbf

Result

id	name	dob	sex	class	mtest	hcode	dcode	remission
9707	Zion	07/29/85	M	2B	51	B	MKK	.F.
9709	Yvonne	08/24/85	F	2C	10	R	TST	.F.
9804	Wendy	07/09/86	F	1B	84	B	YMT	.F.
9819	Vincent	03/15/85	M	1C	29	Y	MKK	.F.
9805	Tobe	10/17/86	M	1B	88	R	YMT	.F.
9713	Tim	06/19/85	M	2A	91	R	HHM	.T.
9816	Teddy	01/30/86	M	1B	64	B	SSP	.F.
:	:	:	:	:	:	:	:	:

Output

eg. 21 Print the Red House members by their classes, sex and name.

SELECT class, name, sex FROM student ;

WHERE hcode="R" ;

ORDER BY class, sex DESC, name TO PRINTER

Result

class	**name**	**sex**
1A	Aaron	M
1A	Peter	M
1A	Ron	M
1B	Tobe	M
1B	Janet	F
1B	Kitty	F
1B	Mimi	F
:	:	:

Union, Intersection and Difference of Tables

```
SELECT ...... FROM ..... WHERE ..... ;
UNION ;
SELECT ..... FROM ..... WHERE .....
```

eg. 22 The two clubs want to hold a joint party. Make a list of all students. (Union)

Result

```
SELECT * FROM bridge ;
UNION ;
SELECT * FROM chess ;
ORDER BY class, name INTO TABLE party
```

Union, Intersection and Difference of Tables

SELECT ..... FROM *table1* ;

WHERE *col* IN (SELECT *col* FROM *table2*)

eg. 23 Print a list of students who are members of both clubs. (Intersection)

Result

SELECT * FROM bridge ;

WHERE id IN (SELECT id FROM chess) ;

TO PRINTER

Union, Intersection and Difference of Tables

SELECT ..... FROM *table1* ;

WHERE *col* NOT IN (SELECT *col* FROM *table2*)

eg. 24 Make a list of students who are members of the Bridge Club but not Chess Club. (Difference)

Result

SELECT * FROM bridge ;

WHERE id NOT IN (SELECT id FROM chess) ;

INTO TABLE diff

Multiple Tables:

- SQL provides a convenient operation to retrieve information from multiple tables.
- This operation is called **join**.
- The join operation will **combine** the tables into one large table with all possible combinations (Math: Cartesian Product), and then it will filter the rows of this combined table to yield useful information.

The Situation: Music Lesson

Each student should learn a musical instrument.
Two database files: ***student.dbf*** & ***music.dbf***
The common field: student id

field	type	width	contents
id	numeric	4	student id number
type	character	10	type of the music instrument

```
SELECT A
USE student
SELECT B
USE music
```

A **Natural Join** is a join operation that joins two tables by their common column. This operation is similar to the setting relation of two tables.

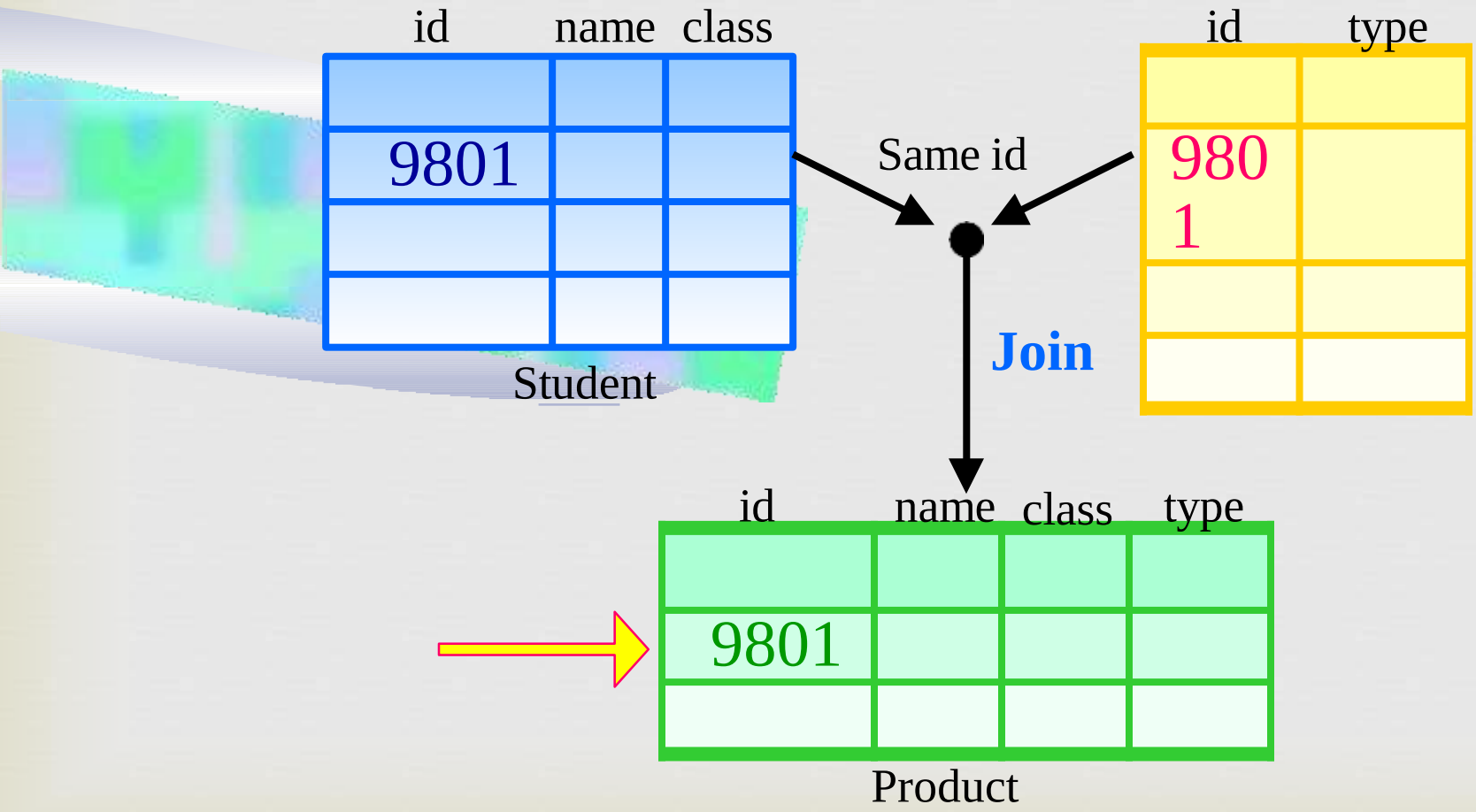
SELECT a.comcol, a.*col1*, b.*col2*, *expr1*, *expr2* ;

FROM *table1* a, *table2* b ;

WHERE a.*comcol* = b.*comcol*

Natural Join

eg. 25 Make a list of students and the instruments they learn. (Natural Join)



Natural Join

eg. 25 Make a list of students and the instruments they learn.

(Natural Join)

SELECT s.class, s.name, s.id, m.type ;

FROM student s, music m ;

WHERE s.id=m.id ORDER BY class, name

Result

class	**name**	**id**	**type**
1A	Aaron	9812	Piano
1A	Bobby	9811	Flute
1A	Gigi	9824	Recorder
1A	Jil	9820	Piano
1A	Johnny	9803	Violin

Natural Join

eg. 26 Find the number of students learning piano in each class.

Three Parts :

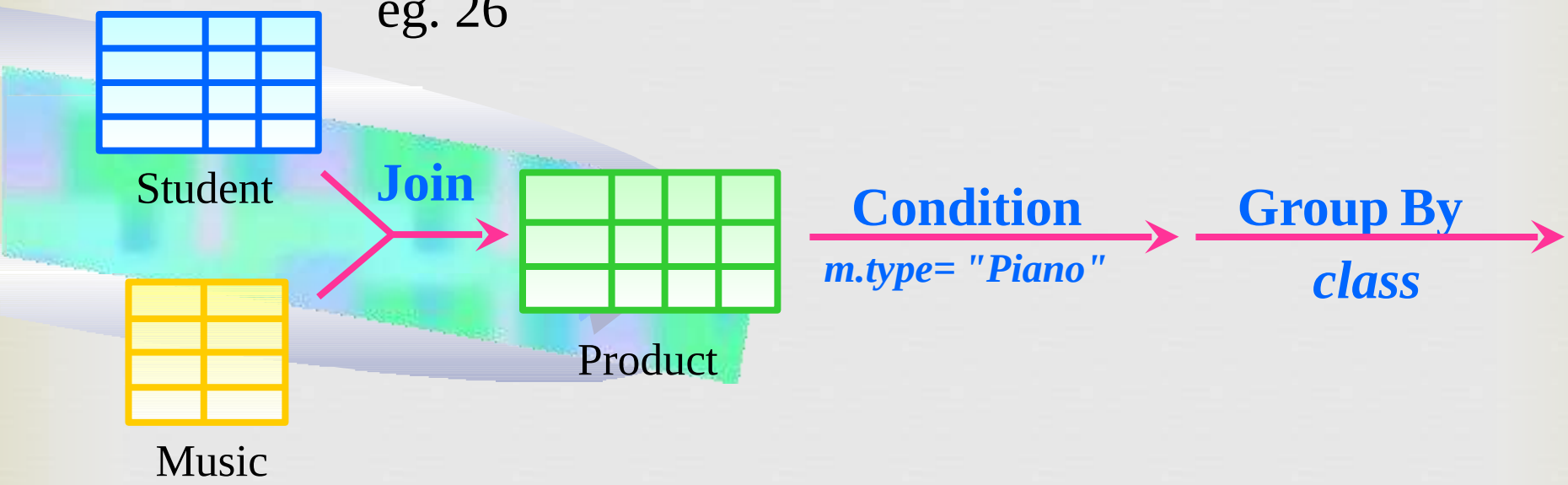
(1) Natural Join.

(2) Condition: *m.type="Piano"*

(3) GROUP BY class

Natural Join

eg. 26



Natural Join

eg. 26 Find the number of students learning piano in each class.

```
SELECT s.class, COUNT(*) ;
FROM student s, music m ;
WHERE s.id=m.id AND m.type="Piano" ;
GROUP BY class ORDER BY class
```

Result

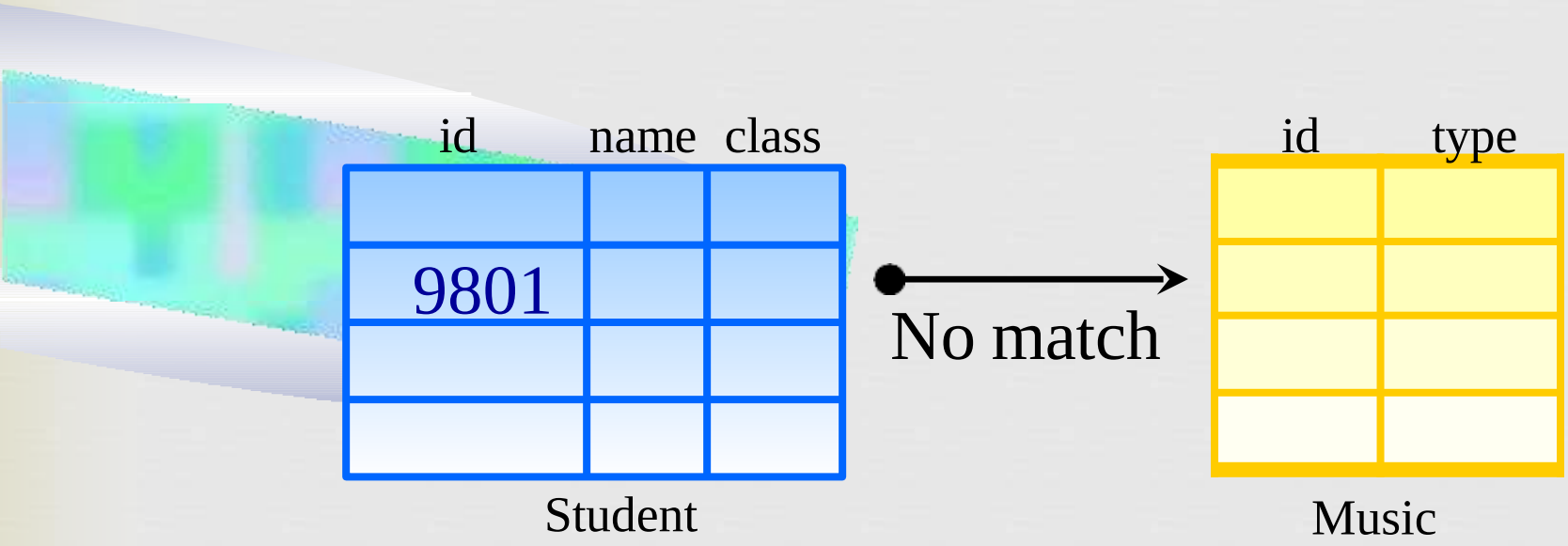
class	cnt
1A	4
1B	2
1C	1

Outer Join

An **Outer Join** is a join operation that includes rows that have a match, plus rows that do not have a match in the other table.

Outer Join

eg. 27 List the students who have not yet chosen an instrument. (No match)



Outer Join

eg. 27 List the students who have not yet chosen an instrument. (No match)

```
SELECT class, name, id FROM student ;
WHERE id NOT IN ( SELECT id FROM music ) ;
ORDER BY class, name
```

Result

class	name	id
1A	Mandy	9821
1B	Kenny	9814
1B	Tobe	9805
1C	Edmond	9818
1C	George	9817
:	:	:

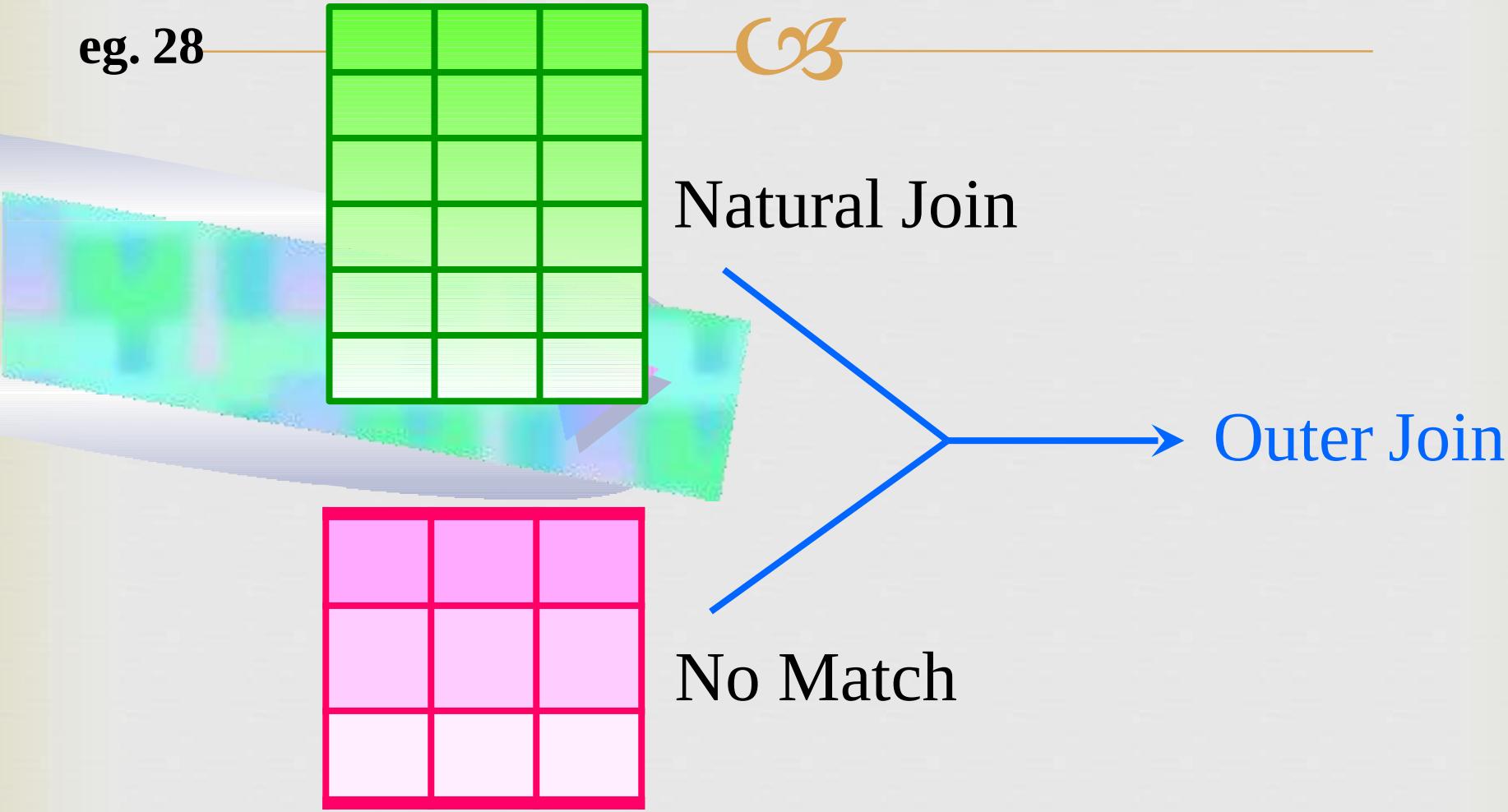
Outer Join

eg. 28 Make a checking list of students and the instruments they learn. The list should also contain the students without an instrument.

(Outer Join)

Outer Join

eg. 28



Outer Join

eg. 28

```
SELECT s.class, s.name, s.id, m.type ;
FROM student s, music m ;
WHERE s.id=m.id ;

UNION ;
SELECT class, name, id, "" ;
FROM student ;
WHERE id NOT IN ( SELECT id FROM music ) ;
ORDER BY 1, 2
```

Outer Join

class	name	id	type
1A	Aaron	9812	Piano
1A	Bobby	9811	Flute
1A	Gigi	9824	Recorder
1A	Jil	9820	Piano
1A	Johnny	9803	Violin
1A	Luke	9810	Piano
1A	Mary	9802	Flute
:	:	:	:

Natural Join

class	name	id
1A	Mandy	9821
1B	Kenny	9814
1B	Tobe	9805
1C	Edmond	9818
1C	George	9817
:	:	:

No Match

class	name	id	type
1A	Aaron	9812	Piano
1A	Bobby	9811	Flute
1A	Gigi	9824	Recorder
1A	Jil	9820	Piano
1A	Johnny	9803	Violin
1A	Luke	9810	Piano
1A	Mandy	9821	
1A	Mary	9802	Flute
1A	Peter	9801	Piano
1A	Ron	9813	Guitar
1B	Eddy	9815	Piano
1B	Janet	9822	Guitar
1B	Kenny	9814	
1B	Kitty	9806	Recorder
:	:	:	:

empty

Outer Join