Exercise – EMPLOYEE table

- list last name of all employees with **ia** in their first names

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

Exercise – EMPLOYEE table

- list emp_num of all employees with job codes 501, 502, 503

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

Exercise – EMPLOYEE table

- list all emps with job codes 501 who were hired before 1990

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

Exercise – EMPLOYEE table

- list all emps sorted by their job codes in descending order and then by their hire dates in ascending order

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

Exercise – Your Questions

Write at least 2 questions that you would like to be answered using the data from this table.

(for now limited only to topics covered!)

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

Topics Covered Today

- Listing unique items
- SQL aggregate functions
- Grouping data
- How to formulate queries

Listing Unique Values

- How many unique JOB_CODEs are represented in the EMPLOYEE table?

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

SQL Aggregate Functions

- SQL can perform various mathematical summaries on data using aggregate functions

SOME BASIC SQL AGGREGATE FUNCTIONS

FUNCTION	OUTPUT
COUNT	The number of rows containing non-null values
MIN	The minimum attribute value encountered in a given column
MAX	The maximum attribute value encountered in a given column
SUM	The sum of all values for a given column
AVG	The arithmetic mean (average) for a specified column

COUNT

- List how many employees have a JOB_CODE of 501

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

COUNT

- What will the following queries return?

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

MAX and MIN

- SELECT MIN(EMP_LNAME) FROM EMPLOYEE;

Alonzo

- SELECT MAX(EMP_HIREDATE) FROM EMPLOYEE;

22-Jun-04

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

MAX and MIN

- List all EMP_LNAMEs who have the highest JOB_CODE

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIREDATE	JOB_CODE
101	News	John	G	08-Nov-00	502
102	Senior	David	H	12-Jul-89	501
103	Arbough	June	E	01-Dec-96	500
104	Ramoras	Anne	K	15-Nov-87	501
105	Johnson	Alice	K	01-Feb-93	502
106	Smithfield	William		22-Jun-04	500
107	Alonzo	Maria	D	10-Oct-93	500
108	Washington	Ralph	B	22-Aug-91	501
109	Smith	Larry	W	18-Jul-97	501

SUM

- Find total price of all products on hand from PRODUCT table

P_CODE	P_DESCRIPT	P_INDATE	P_QOH	P_MIN	P_PRICE	P_DISCOUNT	V_CODE
11QER/31	Power painter, 15 psi., 3-nozzle	03-Nov-15	8	5	109.99	0.00	25595
13-Q2/P2	7.25-in. pwr. saw blade	13-Dec-15	32	15	14.99	0.05	21344
14-Q1/L3	9.00-in. pwr. saw blade	13-Nov-15	18	12	17.49	0.00	21344
1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15-Jan-16	15	8	39.95	0.00	23119
1558-QW1	Hrd. cloth, 1/2-in., 3x50	15-Jan-16	23	5	43.99	0.00	23119
2232/QTY	B&D jigsaw, 12-in. blade	30-Dec-15	8	5	109.92	0.05	24288
2232/QWE	B&D jigsaw, 8-in. blade	24-Dec-15	6	5	99.87	0.05	24288
2238/QPD	B&D cordless drill, 1/2-in.	20-Jan-16	12	5	38.95	0.05	25595
23109-HB	Claw hammer	20-Jan-16	23	10	9.95	0.10	21225
23114-AA	Sledge hammer, 12 lb.	02-Jan-16	8	5	14.40	0.05	
54778-2T	Rat-tail file, 1/8-in. fine	15-Dec-15	43	20	4.99	0.00	21344
89-WRE-Q	Hicut chain saw, 16 in.	07-Feb-16	11	5	256.99	0.05	24288
PVC23DRT	PVC pipe, 3.5-in., 8-ft	20-Feb-16	188	75	5.87	0.00	
SM-18277	1.25-in. metal screw, 25	01-Mar-16	172	75	6.99	0.00	21225
SW-23116	2.5-in. wd. screw, 50	24-Feb-16	237	100	8.45	0.00	21231
WR3/TT3	Steel matting, 4'x8'x1/6", .5" mesh	17-Jan-16	18	5	119.95	0.10	25595

AVG

List the average price of all products

- List all products with prices more than the average price

P_CODE	P_DESCRIPT	P_QOC	P_PRIC	V_COI
89-WRE-Q	Hicut chain saw, 16 in.	11	256.99	24288
WR3/TT3	Steel matting, 4'x8'x1/6", .5" mesh	18	119.95	25595
11QER/31	Power painter, 15 psi., 3-nozzle	8	109.99	25595
2232/QTY	B&D jigsaw, 12-in. blade	8	109.92	24288
2232/QWE	B&D jigsaw, 8-in. blade	6	99.87	24288

Grouping Data

- Aggregate functions summarize data across all rows of the table
  - What to do if you want to summarize data across data groups rather than the whole table
  - Example:
    You want to know the average price of all products supplied by each vendor
- GROUP BY clause can be used in this scenario
  - GROUP BY generally used when attribute columns are combined with aggregate functions in the SELECT statement

Grouping Data

List each vendor and the average price of all products supplied by that vendor

Vendc	"Avg Price"
	10.134999752045
21225	8.469999791917
21231	8.449999809265
21344	12.489999771118
23119	41.970001220703
24288	155.59333038330
25595	89.629998524984

Exercise – GROUP BY

- List the number of products supplied by each vendor in the PRODUCT table, arranged by vendor in Ascending order

V_CO	NUM_PRODS
	2
21225	2
21231	1
21344	3
23119	2
24288	3
25595	3

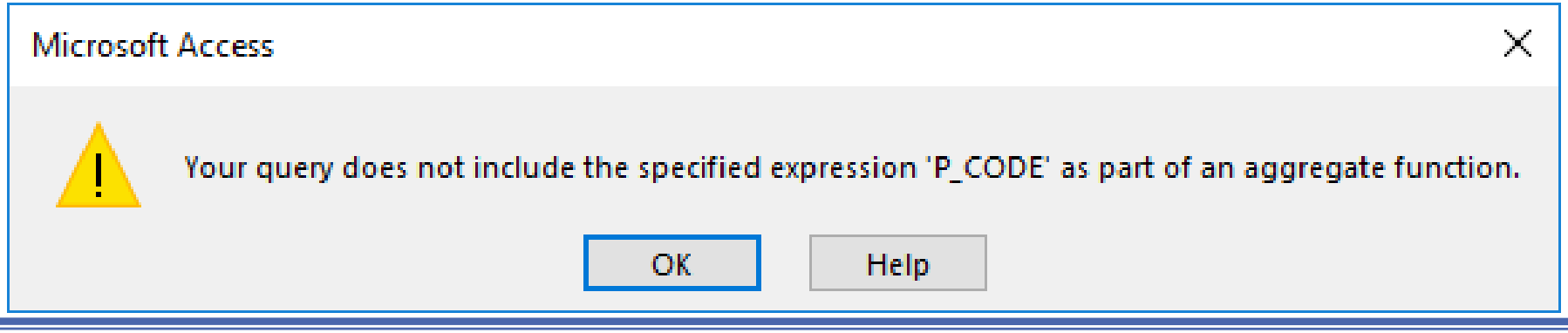
Exercise – GROUP BY

- Identify what is wrong with the following statement?

```
SELECT      V_CODE, P_CODE, COUNT(P_CODE), SUM(P_PRICE)
  FROM      PRODUCT
  GROUP BY  V_CODE;
```

Attribute columns need to be combined with aggregate functions in the SELECT statement for GROUP BY to work

Note: Not all DBMS' will complain – (see next slide)



Exercise – GROUP BY

```
SELECT      V_CODE, P_CODE, COUNT(P_CODE), SUM(P_PRICE)
  FROM      PRODUCT
  GROUP BY  V_CODE;
```

Note: MySQL will perform the aggregate, and return the values for the first items only, in that group

V_CODE	P_CODE	count(P_CODE)	sum(P_PRICE)
NULL	23114-AA	2	20.27
21225	23109-HB	2	16.94
21231	SW-23116	1	8.45
21344	13-Q2/P2	3	37.47
23119	1546-QQ2	2	83.94
24288	2232/QTY	3	466.78
25595	11QER/31	3	268.89
26000	PD-101-Q	1	99.99

Exercise – GROUP BY

- What is wrong with the following query?

```
SELECT      V_CODE, P_PRICE, AVG(P_PRICE)
   FROM     PRODUCT
   GROUP BY      V_CODE;
```

Conditional Restrictions in GROUP BY

- Used in conjunction with the GROUP BY clause to set conditional restrictions
  - Similar to WHERE clause
- While WHERE applies to columns and expressions for individual rows, HAVING applies to the output of GROUP BY

Grouping Data

- Frequency distributions created by **GROUP BY** clause within **SELECT** statement
- Syntax - SELECT *columnlist*

  FROM *tablelist*

  [WHERE *conditionlist*]

  [GROUP BY *columnlist*]

  [HAVING *conditionlist*]

  [ORDER BY *columnlist* [ASC | DESC]];

HAVING Clause

- Extension of GROUP BY feature
- Applied to output of GROUP BY operation
- Used in conjunction with GROUP BY clause in second SQL command set
- Similar to WHERE clause in SELECT statement

Example – HAVING

```
SELECT      V_CODE, COUNT(P_CODE), AVG(P_PRICE)
  FROM      PRODUCT
  GROUP BY  V_CODE
  HAVING    AVG(P_PRICE < 10)
  ORDER BY  V_CODE;
```

V_CODE	COUNT(P_CODE)	AVG(P_PRICE)
21225	2	8.470000
21231	1	8.450000

Exercise – HAVING

- For each vendor, list the vendor code and cumulative price of all products on hand in the PRODUCT table supplied by that vendor that have a cumulative price of more than 500.

V_CODE	TOTCOST
21344	1009.07
NULL	1218.76
21225	1431.13
23119	1611.02
21231	2002.65
25595	3506.42
24288	4305.47
26000	7999.20

Exercise

- For the table shown below, write a SQL statement to list the vendor code and the maximum price of the product supplied by each vendor whose V_CODE starts with 21, and whose maximum price of any product does not exceed 10. Order the results by descending value of maximum price

P_CODE	P_DESCRIPT	P_INDATE	P_QOH	P_MIN	P_PRICE	P_DISCOUNT	V_CODE
11QER/31	Power painter, 15 psi., 3-nozzle	03-Nov-15	8	5	109.99	0.00	25595
13-Q2/P2	7.25-in. pwr. saw blade	13-Dec-15	32	15	14.99	0.05	21344
14-Q1/L3	9.00-in. pwr. saw blade	13-Nov-15	18	12	17.49	0.00	21344
1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15-Jan-16	15	8	39.95	0.00	23119
1558-QW1	Hrd. cloth, 1/2-in., 3x50	15-Jan-16	23	5	43.99	0.00	23119
2232/QTY	B&D jigsaw, 12-in. blade	30-Dec-15	8	5	109.92	0.05	24288
2232/QWE	B&D jigsaw, 8-in. blade	24-Dec-15	6	5	99.87	0.05	24288
2238/QPD	B&D cordless drill, 1/2-in.	20-Jan-16	12	5	38.95	0.05	25595
23109-HB	Claw hammer	20-Jan-16	23	10	9.95	0.10	21225
23114-AA	Sledge hammer, 12 lb.	02-Jan-16	8	5	14.40	0.05	
54778-2T	Rat-tail file, 1/8-in. fine	15-Dec-15	43	20	4.99	0.00	21344
89-WRE-Q	Hicut chain saw, 16 in.	07-Feb-16	11	5	256.99	0.05	24288
PVC23DRT	PVC pipe, 3.5-in., 8-ft	20-Feb-16	188	75	5.87	0.00	
SM-18277	1.25-in. metal screw, 25	01-Mar-16	172	75	6.99	0.00	21225
SW-23116	2.5-in. wd. screw, 50	24-Feb-16	237	100	8.45	0.00	21231
WR3/TT3	Steel matting, 4'x8'x1/6", .5" mesh	17-Jan-16	18	5	119.95	0.10	25595

How to Form a Query

- What to display (SELECT clause)
  - Vendor code, Maximum price of product supplied by each vendor
- What table(s) to use? (FROM clause)
  - PRODUCT
- What are the conditions? (WHERE)
  - V_CODE starts with 21 AND
  - maximum price of any product does not exceed 10
- Is there any aggregation or grouping? (GROUP BY clause)
  - Maximum price by vendor → V_CODE

How to Form a Query

- Which of the conditions above are on an aggregate function or a group? (HAVING clause)
  - Maximum price
- Is there any ordering required (ORDER BY clause)
  - Maximum price in Descending order

How to Form a Query

- Forming the Query:

```
SELECT      V_CODE, MAX(P_PRICE)
    FROM    PRODUCT
    WHERE   V_CODE BETWEEN 21000 AND 21999
    GROUP BY V_CODE
    HAVING  MAX(P_PRICE) <= 10
    ORDER BY MAX(P_PRICE) DESC;
```