

# SCC201: Databases

Week5-Continue: SQL and Advanced SQL Scripts

By

Uraz C Turker



COUNT (\*)
COUNT ( [DISTINCT] A)
SUM ( [DISTINCT] A)
AVG ( [DISTINCT] A)
MAX (A)
MIN (A)

- Significant extension of relational algebra.
- They are used to write statistical queries
- Mainly used for reporting, such as
  - the total sales in 2004,
  - average, max, min income of employees
  - Total number of employees hired/fired in 2004

Lancaster Saluriversity

The total number of sailors in the club?

SELECT COUNT (\*) FROM Sailors S;

| id         | sname      | rating        | age                       | Lanual Ele                | munted         | sid           | bid     | day                    |
|------------|------------|---------------|---------------------------|---------------------------|----------------|---------------|---------|------------------------|
| 22         | Dustin     | 7             | 45.0                      |                           | E E            | 22            | 101     | 10/10/98               |
| 29         | Brutus     | 1             | 33.0                      |                           | reservi        | 22            | 102     | 10/10/98               |
| 31         | Lubber     | 8             | 55.5                      |                           | о утовр        | 22            | 103     | 10/8/98                |
| 32         | Andy       | 8             | 25.5                      |                           | G EXEL B       | 22            | 104     | 10/7/98                |
| 58         | Rusty      | 10            | 35.0                      |                           |                | 31            | 102     | 11/10/98               |
| 34         | Horatio    | 7             | 35.0                      |                           | lare Care      | 31            | 103     | 11/6/98                |
| 71         | Zorba      | 10            | 16.0                      | Dustil                    | 22             | 31            | 104     | 11/12/98               |
| 74         | Horatio    | 9             | 35.0                      |                           | 16 ]           | 64            | 101     | 9/5/98                 |
| 35         | Art        | 3             | 25.5                      |                           |                | 64            | 102     | 9/8/98                 |
|            |            |               |                           |                           |                |               |         |                        |
| ou         | Bob        | 3             | 63.5                      | in property               | Piana.         | 74            | 103     | 9/8/98                 |
| 05<br>gure | ery antimi | Instance S    | 3 of Saild                | ntially the               | Figure         | June<br>De Ex | DI VANI | 9/8/98  Instance R2 of |
| one        | ery antimi | 7.6-1-1-1-1-1 | 3 of Saile                | bname                     | color          | June<br>De Ex | DI VANI | malani di i            |
| one        | ery antimi | 7.6-1-1-1-1-1 | 3 of Saile    bid   101   | bname Interlake           | color blue     | June<br>De Ex | DI VANI | malani di i            |
| one        | ery antimi | 7.6-1-1-1-1-1 | 3 of Sailo  bid  101  102 | bname Interlake Interlake | color blue red | June<br>De Ex | DI VANI | malani di i            |
| one        | ery antimi | 7.6-1-1-1-1-1 | 3 of Saile    bid   101   | bname Interlake           | color blue     | June<br>De Ex | DI VANI | malani di i            |

COUNT (\*)

MAX(A)

MIN (A)

COUNT ([DISTINCT] A)

SUM ([DISTINCT] A) AVG ([DISTINCT] A)

Average age of sailors in the club Whose rating is 10?

SELECT AVG (S.age) FROM Sailors S WHERE S.rating=10;



COUNT (\*)
COUNT ( [DISTINCT] A)
SUM ( [DISTINCT] A)
AVG ( [DISTINCT] A)
MAX (A)
MIN (A)

| sid      | sname   | rating                     | age                            | Lana Fier                 |                          | sid | bid | day                                  |
|----------|---------|----------------------------|--------------------------------|---------------------------|--------------------------|-----|-----|--------------------------------------|
| 22       | Dustin  | 7                          | 45.0                           |                           | E LE                     | 22  | 101 | 10/10/98                             |
| 29       | Brutus  | 1                          | 33.0                           |                           | rviseor i                | 22  | 102 | 10/10/98                             |
| 31       | Lubber  | 8                          | 55.5                           |                           | o wasen                  | 22  | 103 | 10/8/98                              |
| 32       | Andy    | 8                          | 25.5                           |                           | 15X9 99                  | 22  | 104 | 10/7/98                              |
| 58       | Rusty   | 10                         | 35.0                           |                           |                          | 31  | 102 | 11/10/98                             |
| 64       | Horatio | 7                          | 35.0                           |                           | hits/je s                | 31  | 103 | 11/6/98                              |
| 71       | Zorba   | 10                         | 16.0                           | Dusting                   | 22                       | 31  | 104 | 11/12/98                             |
| 74       | Horatio | 9                          | 35.0                           |                           |                          | 64  | 101 | 9/5/98                               |
|          |         |                            |                                |                           |                          |     |     | - 1- 1                               |
| 85       | Art     | 3                          | 25.5                           |                           | E 1                      | 64  | 102 | 9/8/98                               |
| 85<br>95 | Bob     | $\frac{3}{3}$ Instance $S$ | 63.5                           | ors                       | Figur                    | 74  | 103 | 9/8/98<br>9/8/98<br>instance $R2$ of |
| 85<br>95 | Bob     | 3                          | 63.5<br>3 of Saile             | entially the e            | osso al c<br>Burever, ti | 74  | 103 | 9/8/98                               |
| 85<br>95 | Bob     | 3                          | 63.5 3 of Saile                | bname                     | color                    | 74  | 103 | 9/8/98                               |
| 85<br>95 | Bob     | 3                          | 63.5 3 of Saile bid 101        | bname Interlake           | color blue               | 74  | 103 | 9/8/98                               |
| 85<br>95 | Bob     | 3                          | 63.5 3 of Saile  bid  101  102 | bname Interlake Interlake | color                    | 74  | 103 | 9/8/98                               |
| 85<br>95 | Bob     | 3                          | 63.5 3 of Saile bid 101        | bname Interlake           | color blue               | 74  | 103 | 9/8/98                               |

Average distinct ages of sailors Whose rating is 10?

SELECT AVG (DISTINCT S.age) FROM Sailors S WHERE S.rating=10;



COUNT (\*)
COUNT ( [DISTINCT] A)
SUM ( [DISTINCT] A)
AVG ( [DISTINCT] A)
MAX (A)
MIN (A)

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | Dustin  | 7      | 45.0 |
| 29  | Brutus  | 1      | 33.0 |
| 31  | Lubber  | 8      | 55.5 |
| 32  | Andy    | 8      | 25.5 |
| 58  | Rusty   | 10     | 35.0 |
| 64  | Horatio | 7      | 35.0 |
| 71  | Zorba   | 10     | 16.0 |
| 74  | Horatio | 9      | 35.0 |
| 85  | Art     | 3      | 25.5 |
| 95  | Bob     | 3      | 63.5 |

|    | 364 | ora | aug      |
|----|-----|-----|----------|
|    | 22  | 101 | 10/10/98 |
| 2  | 22  | 102 | 10/10/98 |
|    | 22  | 103 | 10/8/98  |
| 34 | 22  | 104 | 10/7/98  |
|    | 31  | 102 | 11/10/98 |
|    | 31  | 103 | 11/6/98  |
|    | 31  | 104 | 11/12/98 |
|    | 64  | 101 | 9/5/98   |
|    | 64  | 102 | 9/8/98   |
|    | 74  | 103 | 9/8/98   |
|    |     |     |          |

sid hid day

Figure 4.15 An Instance S3 of Sailors

Figure 4.16 An Instance R2 of Reserves

| bid | bname     | color |
|-----|-----------|-------|
| 101 | Interlake | blue  |
| 102 | Interlake | red   |
| 103 | Clipper   | green |
| 104 | Marine    | red   |

Figure 4.17 An Instance B1 of Boats

Names of sailors whose rating is equal to the maximum rating in the club.

SELECT S.sname
FROM Sailors S
WHERE S.rating= (SELECT MAX(S2.rating)
FROM Sailors S2);

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COUNT (\*)
COUNT ( [DISTINCT] A)
SUM ( [DISTINCT] A)
AVG ( [DISTINCT] A)
MAX (A)
MIN (A)

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | Dustin  | 7      | 45.0 |
| 29  | Brutus  | 1      | 33.0 |
| 31  | Lubber  | 8      | 55.5 |
| 32  | Andy    | 8      | 25.5 |
| 58  | Rusty   | 10     | 35.0 |
| 64  | Horatio | 7      | 35.0 |
| 71  | Zorba   | 10     | 16.0 |
| 74  | Horatio | 9      | 35.0 |
| 85  | Art     | 3      | 25.5 |
| 95  | Bob     | 3      | 63.5 |

Figure 4.15 An Instance S3 of Sailors

| sid | bid | day      |
|-----|-----|----------|
| 22  | 101 | 10/10/98 |
| 22  | 102 | 10/10/98 |
| 22  | 103 | 10/8/98  |
| 22  | 104 | 10/7/98  |
| 31  | 102 | 11/10/98 |
| 31  | 103 | 11/6/98  |
| 31  | 104 | 11/12/98 |
| 64  | 101 | 9/5/98   |
| 64  | 102 | 9/8/98   |
| 74  | 103 | 9/8/98   |

Figure 4

Figure 4.16 An Instance R2 of Reserves

| bid | bname     | color |
|-----|-----------|-------|
| 101 | Interlake | blue  |
| 102 | Interlake | red   |
| 103 | Clipper   | green |
| 104 | Marine    | red   |

Figure 4.17 An Instance B1 of Boats

COUNT (\*) COUNT ([DISTINCT] A) Lancaster SUM ([DISTINCT] A) University SUM ([DISTINCT] A) AVG ([DISTINCT] A) MAX (A) MIN (A)



**Number of sailors** whose rating is equal to the maximum rating in the club.

> SELECT COUNT(S.sid) FROM Sailors S WHERE S.rating= (SELECT MAX(S2.rating) FROM Sailors S2)

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | Dustin  | 7      | 45.0 |
| 29  | Brutus  | 1      | 33.0 |
| 31  | Lubber  | 8      | 55.5 |
| 32  | Andy    | 8      | 25.5 |
| 58  | Rusty   | 10     | 35.0 |
| 64  | Horatio | 7      | 35.0 |
| 71  | Zorba   | 10     | 16.0 |
| 74  | Horatio | 9      | 35.0 |
| 85  | Art     | 3      | 25.5 |
| 95  | Bob     | 3      | 63.5 |

| igure 4.15 | An | Instance | S3 | of | Sailors |  |
|------------|----|----------|----|----|---------|--|
|------------|----|----------|----|----|---------|--|

| and a | sid | bid | day      |
|-------|-----|-----|----------|
| 88    | 22  | 101 | 10/10/98 |
| 1     | 22  | 102 | 10/10/98 |
| in    | 22  | 103 | 10/8/98  |
| 99    | 22  | 104 | 10/7/98  |
|       | 31  | 102 | 11/10/98 |
|       | 31  | 103 | 11/6/98  |
|       | 31  | 104 | 11/12/98 |
|       | 64  | 101 | 9/5/98   |
|       | 64  | 102 | 9/8/98   |
| 6     | 74  | 103 | 9/8/98   |

| bid | bname     | color |
|-----|-----------|-------|
| 101 | Interlake | blue  |
| 102 | Interlake | red   |
| 103 | Clipper   | green |
| 104 | Marine    | red   |

Figure 4.17 An Instance B1 of Boats

COUNT (\*)
COUNT ( [DISTINCT] A)
SUM ( [DISTINCT] A)
AVG ( [DISTINCT] A)
MAX (A)
MIN (A)



How many different ratings are there in the club?

SELECT COUNT (S.rating)
AS Res FROM Sailors S;

Above query is not correct. Think why!

SELECT COUNT (DISTINCT S.rating) AS Res FROM Sailors S;

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | Dustin  | 7      | 45.0 |
| 29  | Brutus  | 1      | 33.0 |
| 31  | Lubber  | 8      | 55.5 |
| 32  | Andy    | 8      | 25.5 |
| 58  | Rusty   | 10     | 35.0 |
| 64  | Horatio | 7      | 35.0 |
| 71  | Zorba   | 10     | 16.0 |
| 74  | Horatio | 9      | 35.0 |
| 85  | Art     | 3      | 25.5 |
| 95  | Bob     | 3      | 63.5 |

| Figure | 4.15 | An | Instance | S3 | of | Sailors |
|--------|------|----|----------|----|----|---------|
|        |      |    |          |    |    |         |

| sid | bid | day      |
|-----|-----|----------|
| 22  | 101 | 10/10/98 |
| 22  | 102 | 10/10/98 |
| 22  | 103 | 10/8/98  |
| 22  | 104 | 10/7/98  |
| 31  | 102 | 11/10/98 |
| 31  | 103 | 11/6/98  |
| 31  | 104 | 11/12/98 |
| 64  | 101 | 9/5/98   |
| 64  | 102 | 9/8/98   |
| 74  | 103 | 9/8/98   |

Figure 4.16 An Instance R2 of Reserves

| bid | bname     | color |
|-----|-----------|-------|
| 101 | Interlake | blue  |
| 102 | Interlake | red   |
| 103 | Clipper   | green |
| 104 | Marine    | red   |

Figure 4.17 An Instance B1 of Boats

#### Find name and age of the oldest sailor(s)



This query is correct and it is allowed in the SQL/92 standard, but is not

supported in some systems.

SELECT S.sname, S.age
FROM Sailors S
WHERE S.age =
(SELECT MAX (S2.age)
FROM Sailors S2);

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | Dustin  | 7      | 45.0 |
| 29  | Brutus  | 1      | 33.0 |
| 31  | Lubber  | 8      | 55.5 |
| 32  | Andy    | 8      | 25.5 |
| 58  | Rusty   | 10     | 35.0 |
| 64  | Horatio | 7      | 35.0 |
| 71  | Zorba   | 10     | 16.0 |
| 74  | Horatio | 9      | 35.0 |
| 85  | Art     | 3      | 25.5 |
| 95  | Bob     | 3      | 63.5 |

Figure 4.15 An Instance S3 of Sailors

| sid | bid | day      |
|-----|-----|----------|
| 22  | 101 | 10/10/98 |
| 22  | 102 | 10/10/98 |
| 22  | 103 | 10/8/98  |
| 22  | 104 | 10/7/98  |
| 31  | 102 | 11/10/98 |
| 31  | 103 | 11/6/98  |
| 31  | 104 | 11/12/98 |
| 64  | 101 | 9/5/98   |
| 64  | 102 | 9/8/98   |
| 74  | 103 | 9/8/98   |

Figure 4.16 An Instance R2 of Reserves

| bid | bname     | color |
|-----|-----------|-------|
| 101 | Interlake | blue  |
| 102 | Interlake | red   |
| 103 | Clipper   | green |
| 104 | Marine    | red   |

Figure 4.17 An Instance B1 of Boats

#### Find name and age of the oldest sailor(s)



This query is valid for all systems .

SELECT S.sname, S.age FROM Sailors S WHERE (SELECT MAX (S2.age) FROM Sailors S2) = S.age;

| sid      | sname   | rating       | age                     | Tanual Flor           | bestuni      | sid | bid | day                              |
|----------|---------|--------------|-------------------------|-----------------------|--------------|-----|-----|----------------------------------|
| 22       | Dustin  | 7            | 45.0                    |                       | E IE         | 22  | 101 | 10/10/98                         |
| 29       | Brutus  | 1            | 33.0                    |                       | WISSET I     | 22  | 102 | 10/10/98                         |
| 31       | Lubber  | 8            | 55.5                    |                       | O WIENE      | 22  | 103 | 10/8/98                          |
| 32       | Andy    | 8            | 25.5                    |                       | 10X0 99      | 22  | 104 | 10/7/98                          |
| 58       | Rusty   | 10           | 35.0                    |                       |              | 31  | 102 | 11/10/98                         |
| 64       | Horatio | 7            | 35.0                    |                       | bite/je-s    | 31  | 103 | 11/6/98                          |
| 71       | Zorba   | 10           | 16.0                    | Dustin                | 22           | 31  | 104 | 11/12/98                         |
| 74       | Horatio | 9            | 35.0                    |                       | 16 ].        | 64  | 101 | 9/5/98                           |
|          |         |              |                         |                       |              |     |     | 0.10.100                         |
| 85       | Art     | 3            | 25.5                    |                       | ATT I        | 64  | 102 | 9/8/98                           |
| 85<br>95 | Bob     | 3 Instance S | 63.5                    | ors                   | Figur        | 74  | 103 | 9/8/98<br>9/8/98<br>nstance R2 o |
| 85<br>95 | Bob     | 3            | 63.5                    | ors                   | Figur        | 74  | 103 | 9/8/98                           |
| 85<br>95 | Bob     | 3            | 63.5                    | ors bname             | Figure color | 74  | 103 | 9/8/98                           |
| 85<br>95 | Bob     | 3            | 63.5                    | entially the received | esse al c    | 74  | 103 | 9/8/98                           |
| 85<br>95 | Bob     | 3            | 63.5 3 of Saile         | bname                 | color        | 74  | 103 | 9/8/98                           |
| 85<br>95 | Bob     | 3            | 63.5 3 of Saile bid 101 | bname Interlake       | color blue   | 74  | 103 | 9/8/98                           |

#### **GROUP BY and HAVING**



• So far, we've applied aggregate operators to all (qualifying) tuples. Sometimes, we want to apply them to each of several *groups* of tuples.

Consider: Find the age of the youngest sailor for each rating level.

In general, we don't know how many rating levels exist and what the rating values for these levels are!

■ Suppose we know that rating values go from 1 to 10; we can write 10 queries that look like this (!):

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | Dustin  | 7      | 45.0 |
| 29  | Brutus  | 1      | 33.0 |
| 31  | Lubber  | 8      | 55.5 |
| 32  | Andy    | 8      | 25.5 |
| 58  | Rusty   | 10     | 35.0 |
| 64  | Horatio | 7      | 35.0 |
| 71  | Zorba   | 10     | 16.0 |
| 74  | Horatio | 9      | 35.0 |
| 85  | Art     | 3      | 25.5 |
| 95  | Bob     | 3      | 63.5 |

Figure 4.15 An Instance S3 of Sailors

For i = 1, 2, ..., 10:

SELECT MIN (S.age) FROM Sailors S WHERE S.rating = *i* 

#### Queries With GROUP BY and HAVING



SELECT [DISTINCT] target-list
FROM relation-list
WHERE qualification
GROUP BY grouping-list
HAVING group-qualification

The target-list contains (i) attribute list(ii) terms with aggregate operations (e.g., MIN (S.age)).



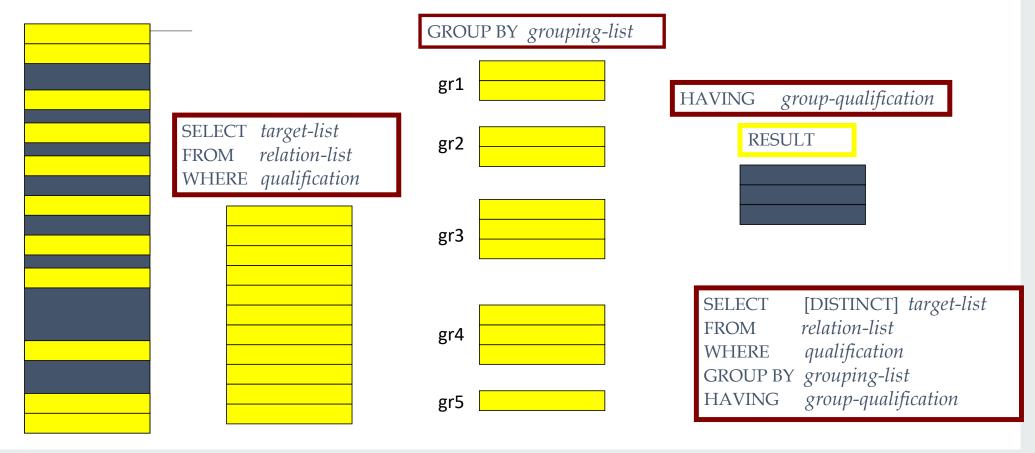


- The cross-product of relation-list is computed, tuples that fail qualification are discarded, `unnecessary' fields are deleted, and the remaining tuples are partitioned into groups by the value of attributes in grouping-list.
- The *group-qualification* is then applied to eliminate some groups. Expressions in *group-qualification* must have a *single value per group*!
- One answer tuple is generated per qualifying group.

SELECT [DISTINCT] target-list FROM relation-list WHERE qualification GROUP BY grouping-list HAVING group-qualification

#### **Conceptual Evaluation**





#### **Conceptual Evaluation**

Find the sailors with age  $\geq$ 18, for each rating with at least 2 <u>such</u> sailors



| Age | = | 20 |
|-----|---|----|
| Age | = | 25 |

Age = 19

Age=70

Age = 60

Age = 40

Age = 33

Age = 32

Age = 18

Age = 22 Age = 39 SELECT S.rating
FROM Sailors S
WHERE S.age >= 18

| Rating = 4 |
|------------|
| Rating =2  |
| Rating =3  |
| Rating=2   |
| Rating=3   |
| Rating=5   |
| Rating=1   |
| Rating=4   |
| Rating=3   |
| Rating=4   |
| Rating=1   |

GROUP BY

S.rating

Rating=1

Rating=1

gr2 Rating=2
Rating=2

gr1

gr3 Rating=3
Rating=3
Rating=3

gr4 Rating=4
Rating=4
Rating=4

gr5 Rating=5

HAVING COUNT (\*) > 1

RESULT

Rating = 1

Rating = 2

Rating = 3 Rating = 4

SELECT S.rating
FROM Sailors S
WHERE S.age >= 18
GROUP BY S.rating
HAVING COUNT (\*) > 1



| <u>sid</u> | sname   | rating | age  |
|------------|---------|--------|------|
| 22         | dustin  | 7      | 45.0 |
| 31         | lubber  | 8      | 55.5 |
| 71         | zorba   | 10     | 16.0 |
| 64         | horatio | 7      | 35.0 |
| 29         | brutus  | 1      | 33.0 |
| 58         | rusty   | 10     | 35.0 |



SELECT S.rating
FROM Sailors S
WHERE S.age >= 18

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | dustin  | 7      | 45.0 |
| 31  | lubber  | 8      | 55.5 |
| 71  | zorba   | 10     | 16.0 |
| 64  | horatio | 7      | 35.0 |
| 29  | brutus  | 1      | 33.0 |
| 58  | rusty   | 10     | 35.0 |



SELECT S.rating
FROM Sailors S
WHERE S.age >= 18
GROUP BY S.rating

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | dustin  | 7      | 45.0 |
| 31  | lubber  | 8      | 55.5 |
| 71  | zorba   | 10     | 16.0 |
| 64  | horatio | 7      | 35.0 |
| 29  | brutus  | 1      | 33.0 |
| 58  | rusty   | 10     | 35.0 |



SELECT S.rating
FROM Sailors S
WHERE S.age >= 18
GROUP BY S.rating
HAVING COUNT(\*)>1

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | dustin  | 7      | 45.0 |
| 31  | lubber  | 8      | 55.5 |
| 71  | zorba   | 10     | 16.0 |
| 64  | horatio | 7      | 35.0 |
| 29  | brutus  | 1      | 33.0 |
| 58  | rusty   | 10     | 35.0 |



SELECT S.rating
FROM Sailors S
WHERE S.age >= 18
GROUP BY S.rating
HAVING COUNT(\*)>1

Minimum AGE?

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | dustin  | 7      | 45.0 |
| 31  | lubber  | 8      | 55.5 |
| 71  | zorba   | 10     | 16.0 |
| 64  | horatio | 7      | 35.0 |
| 29  | brutus  | 1      | 33.0 |
| 58  | rusty   | 10     | 35.0 |



SELECT S.rating
FROM Sailors S
WHERE S.age >= 18
GROUP BY S.rating
HAVING COUNT(\*)>1

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | dustin  | 7      | 45.0 |
| 31  | lubber  | 8      | 55.5 |
| 71  | zorba   | 10     | 16.0 |
| 64  | horatio | 7      | 35.0 |
| 29  | brutus  | 1      | 33.0 |
| 58  | rusty   | 10     | 35.0 |

Minimum AGE?

So, introduce a new attribute in the solution that selects the youngest age..



| SELECT S.rating, Min(age) |
|---------------------------|
| FROM Sailors S            |
| WHERE S.age >= 18         |
| GROUP BY S.rating         |
| HAVING COUNT(*)>1         |

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | dustin  | 7      | 45.0 |
| 31  | lubber  | 8      | 55.5 |
| 71  | zorba   | 10     | 16.0 |
| 64  | horatio | 7      | 35.0 |
| 29  | brutus  | 1      | 33.0 |
| 58  | rusty   | 10     | 35.0 |



SELECT S.rating, Min(age)
FROM Sailors S
WHERE S.age >= 18
GROUP BY S.rating
HAVING COUNT(\*)>1

| <u>sid</u> | sname   | rating | age  |
|------------|---------|--------|------|
| 22         | dustin  | 7      | 45.0 |
| 31         | lubber  | 8      | 55.5 |
| 71         | zorba   | 10     | 16.0 |
| 64         | horatio | 7      | 35.0 |
| 29         | brutus  | 1      | 33.0 |
| 58         | rusty   | 10     | 35.0 |

| rating | age  |
|--------|------|
| 1      | 33.0 |
| 7      | 45.0 |
| 7      | 35.0 |
| 8      | 55.5 |
| 10     | 35.0 |



| SELECT S.rating, MIN (S.age) |
|------------------------------|
| FROM Sailors S               |
| WHERE S.age >= 18            |
| GROUP BY S.rating            |
| HAVING COUNT (*) > 1         |

| Only S.rating and S.age are mentioned in the |
|--|
| SELECT, GROUP BY or HAVING clauses;          |

 2nd column of result is unnamed. (Use AS to name it.)

| <u>sid</u> | sname   | rating | age  |
|------------|---------|--------|------|
| 22         | dustin  | 7      | 45.0 |
| 31         | lubber  | 8      | 55.5 |
| 71         | zorba   | 10     | 16.0 |
| 64         | horatio | 7      | 35.0 |
| 29         | brutus  | 1      | 33.0 |
| 58         | rusty   | 10     | 35.0 |

| rating | age  |
|--------|------|
| 1      | 33.0 |
| 7      | 45.0 |
| 7      | 35.0 |
| 8      | 55.5 |
| 10     | 35.0 |

| rating |      |
|--------|------|
| 7      | 35.0 |



| <u>sid</u> | sname   | rating | age  |
|------------|---------|--------|------|
| 22         | dustin  | 7      | 45.0 |
| 31         | lubber  | 8      | 55.5 |
| 71         | zorba   | 10     | 16.0 |
| 64         | horatio | 7      | 35.0 |
| 29         | brutus  | 1      | 33.0 |
| 58         | rusty   | 10     | 35.0 |

| Only S.rating and S.age are mentioned in the |
|--|
| SELECT, GROUP BY or HAVING clauses;          |

| 2nd column of result is unnamed. | (Use AS to |
|----------------------------------|------------|
| name it.)                        |            |

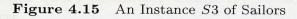
| rating | age  |
|--------|------|
| 1      | 33.0 |
| 7      | 45.0 |
| 7      | 35.0 |
| 8      | 55.5 |
| 10     | 35.0 |

| rating | ag   |
|--------|------|
| 7      | 35.0 |

Answer relation

#### For each red boat, find the number of reservations for this boat

| sid | sname   | rating | age  |
|-----|---------|--------|------|
| 22  | Dustin  | 7      | 45.0 |
| 29  | Brutus  | 1      | 33.0 |
| 31  | Lubber  | 8      | 55.5 |
| 32  | Andy    | 8      | 25.5 |
| 58  | Rusty   | 10     | 35.0 |
| 64  | Horatio | 7      | 35.0 |
| 71  | Zorba   | 10     | 16.0 |
| 74  | Horatio | 9      | 35.0 |
| 85  | Art     | 3      | 25.5 |
| 95  | Bob     | 3      | 63.5 |



| sid | bid | day      |
|-----|-----|----------|
| 22  | 101 | 10/10/98 |
| 22  | 102 | 10/10/98 |
| 22  | 103 | 10/8/98  |
| 22  | 104 | 10/7/98  |
| 31  | 102 | 11/10/98 |
| 31  | 103 | 11/6/98  |
| 31  | 104 | 11/12/98 |
| 64  | 101 | 9/5/98   |
| 64  | 102 | 9/8/98   |
| 74  | 103 | 9/8/98   |

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Figure 4.16 An Instance R2 of Reserves

| bid | bname     | color |
|-----|-----------|-------|
| 101 | Interlake | blue  |
| 102 | Interlake | red   |
| 103 | Clipper   | green |
| 104 | Marine    | red   |

Figure 4.17 An Instance B1 of Boats



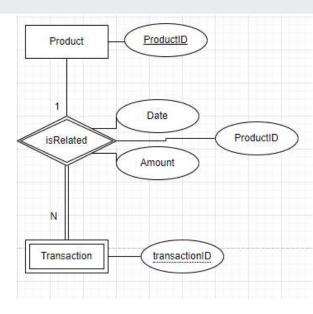
For each red boat, find the number of reservations for this boat

SELECT B.bid, COUNT (\*) AS scount FROM Boats B, Reserves R
WHERE R.bid=B.bid AND B.color='red'
GROUP BY B.bid

#### Exemple



- "We are running an instrument store in Uxbridge, London. We want to create a database that keeps transaction information with transaction date, ProductID (customer purchased), and amount\_purchased, transactionID. Moreover we have products with unique ProductID, and name, price, product picture, and amount\_in\_Store.
- We can issue one transaction per product, and we will not keep records of a transaction if the purchased product is deleted (removed from the store)."
- Draw ERD, Reveal Relational Schema and Integrity Constraints and write SQL code to create the database.



Product(ProductID INTEGER, name TEXT, price REAL, picture BLOB, amount\_in\_Store INTEGER); IC: Primary Key ProductID

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TransactionIsRelated(ProductID INTEGER, Amount REAL, Date TEXT, P\_ProductID INTEGER, TransactionID INTEGER)

IC: Primary Key (P\_PruductID,transactionID)

IC: Foreign Key (P\_ProductID) References Product ON

DELETE CASCADE

CREATE TABLE Product(ProductID INTEGER,... PRIMARY KEY(ProductId));

CREATE TABLE TransactionIsRelated(ProductID INTEGER, Amount REAL, Date TEXT, P\_ProductID INTEGER, TransactionID INTEGER,Primary Key (ProductID,TransactionID), Foreign Key (P\_ProductID) References Product(ProductID) ON DELETE CASCADE

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#### Summary



- SQL is a very powerful declarative scripting language.
- Unfortunately, there are many ways of writing an SQL script for a given query.
  - Bad ones will consume CPU time and memory.
  - Good ones are hardware and time friendly.
    - Relational algebra is the key to deriving optimum SQL queries.

#### Summary



- SQL is a very powerful declarative scripting language.
- Unfortunately, there are many ways of writing an SQL script for a given query.
  - Bad ones will consume CPU time and memory.
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    - Relational algebra is the key to deriving optimum SQL queries.