Phil Spector

Introduction to SQL

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What is SQL?

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- Used as front end to many databases (mysql, postgresql, oracle, sybase)
- ▶ Three Subsystems: data description, data access and privileges
- ▶ Optimized for certain data arrangements
- The language is case-sensitive, but I use upper case for keywords.

```
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When do you need a Database?

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- ▶ Data changes on a regular basis
- Large data sets where you only need some observations/variables
- ▶ Share huge data set among many people
- ▶ Rapid queries with no analysis
- ▶ Web interfaces to data, especially dynamic data

Uses of Databases

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Newer uses:

- Storage data is extracted and analyzed in another application
- Backends to web sites
- ▶ Traditional rules may not be as important

```
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- ▶ PROC SQL in SAS

Some Relational Database Concepts

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- ▶ Databases are collections of tables
- Tables are two-dimensional with rows (observations) and columns (variables)
- Limited mathematical and summary operations available
- Very good at combining information from several tables

Finding Your Way Around the Server

Finding Your Way Around the Server

Since a single server can support many databases, each containing many tables, with each table having a variety of columns, it's easy to get lost when you're working with databases. These commands will help figure out what's available:

▶ SHOW DATABASES;

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- SHOW COLUMNS IN table;
- DESCRIBE table; shows the columns and their types

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- FLOAT(p) floating point number with p binary digits of precision

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CREATE TABLE kids(id CHAR(6), race SMALLINT, age DECIMAL(6,3), height DECIMAL(7,3), weight DECIMAL(7,3), sex SMALLINT);

Entering observations into a table

We could now enter individual items with the INSERT command:

```
INSERT INTO kids VALUES(100011,2,10.346,
148.5,38.95,1);
```

This quickly gets tedious. We can automate the process using the LOAD DATA command:

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LOAD DATA INFILE 'kids.tab' INTO TABLE kids FIELDS TERMINATED BY '\t';

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LOAD DATA INFILE 'kids.tab'
INTO TABLE kids
FIELDS TERMINATED BY '\t';
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This will read an entire tab-separated file into the database in one command.

Comparison Operators

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- ▶ RLIKE operator allows regular expressions
- \blacktriangleright Use AND(&&) and OR(||) to combine conditions

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UPDATE kids SET weight=weight + 1 WHERE id='101311' AND age BETWEEN 9 and 10;

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UPDATE kids SET weight=weight + 1
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age BETWEEN 9 and 10;
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Be careful with UPDATE, because if you don't provide a WHERE clause, all the rows of the table will be changed.

The SELECT statement

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> SELECT columns or computations FROM table WHERE condition GROUP BY columns HAVING condition ORDER BY column [ASC | DESC] LIMIT offset,count;

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Other functions (ABS(), FLOOR(), ROUND(), SQRT(), etc.) may also be available.

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SELECT sex, race, count(*) AS n, 
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FROM kids GROUP BY sex, race;
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The ${\tt SUM}$ function can count logical expressions:

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The SUM function can count logical expressions: SELECT race,SUM(height > 150)/COUNT(*) FROM kids GROUP BY race;

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Get all information about ids that have exactly ten observations:

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GROUP BY id HAVING COUNT(*) = 10;

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GROUP BY id HAVING COUNT(*) < 2;
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Get all information about ids that have exactly ten observations:

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This doesn't work - it only gives the first observation for each id.

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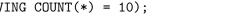
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This is considerably faster than the previous query.
```

Subqueries (cont'd)

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```
SELECT k.id,k.sex,k.race,k.age,
    k.weight,k.height FROM kids AS k,
    (SELECT sex,race,max(weight) AS weight from
    kids) AS m WHERE k.sex=m.sex AND
    k.race=m.race AND k.weight=m.weight;
```

Making Tables from Queries

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CREATE TEMPORARY TABLE young LIKE kids;

Making Tables from Queries

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CREATE TABLE young LIKE kids; INSERT INTO young SELECT * FROM kids WHERE age < 15;

Such a table will stay on the database – to create a temporary one:

CREATE TEMPORARY TABLE young LIKE kids;

Alternatively, you can DROP the table when you're done:

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DROP TABLE young;

Music Collection Example

Traditionally, redundancy is the enemy of database design, because it wastes storage space and increase data entry errors. For this reason, may traditional databases have a separate table for each attribute of importance. For example, suppose we have a collection of songs, organized into albums. Rather than store each song as a row with the album title and artist, we would create three tables: one for songs(tracks), one for albums, and one for artists.

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Album		Artist		Track	
alid	INT	aid	INT	tid	INT
aid	INT	name	VARCHAR(40)	alid	INT
title	VARCHAR(60)			time	INT
				title	VARCHAR(40)
				filename	VARCHAR(14)

A Look at the Tables

mysql> select * from album limit 1,5; +----+ | alid | aid | title 140 | 102 | Ugetsu 150 | 109 | Born To Be Blue 151 | 109 | Connecticut Jazz Party 152 | 109 | Easy Does It 153 | 109 | In Person ____ 5 rows in set (0.03 sec) mysql> select * from artist limit 1,5; ----+------------------+ | aid | name -----+-----------------+ 109 | Bobby Timmons 134 | Dizzy Gillespie 140 | Elmo Hope | 146 | Erroll Garner 159 | Horace Silver ----+ 5 rows in set (0.03 sec) mysql> select * from track limit 1,5; _____ | tid | alid | time | title filename | 1713 | 139 | 413 | Sincerely Diane (alternate take) | 1077698286.mp3 | | 1714 | 139 | 384 | Yama | 1077698288.mp3 | | 1715 | 139 | 404 | When your lover has gone | 1077698290.mp3 | 2276 1 139 1 398 | So tired | 1077699502.mp3 | 408 | Sincerely Diana | 1077702347.mp3 3669 | 139 | 5 rows in set (0.03 sec)

SELECT with multiple tables

Produce a list of album titles along with artist:

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SELECT a.title,r.name
FROM album AS a, artist AS r
WHERE a.aid = r.aid;
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ORDER BY duration DESC:



Unfortunately, all we have are the album ids, not the names

SELECT with multiple tables(cont'd)

To improve our previous example, we need to combine the track information with album and artist information. Suppose we want to find the 10 longest albums in the collection:

```
Introduction to
SQL
```

SELECT with multiple tables(cont'd)

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```
SELECT a.title,r.name,

SUM(time) AS duration

FROM track AS t, album as a, artist as r

WHERE t.alid = a.alid AND a.aid = r.aid

GROUP BY t.alid ORDER BY duration DESC

LIMIT 1,10;
```

```
Introduction to
SQL
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SELECT with multiple tables(cont'd)

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As powerful as SQL is, we can use it as a data store without having to use all of the SQL features.

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As powerful as SQL is, we can use it as a data store without having to use all of the SQL features.

- Don't hesitate to use familiar programs to do the hard work
- ▶ Repeated SELECT queries in loops can do wonders
- ▶ Load up data structures with entire tables
- ▶ Use as little or as much pure SQL as you like These ideas are illustrated using the music collection data, R, python, and perl

```
Introduction to
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Using SQL in R

```
library(RMySQL)
drv = dbDriver("MySQL")
con = dbConnect(drv,dbname="dbname",user="user",pass="pass")
rs = dbSendQuery(con,statement="select * from album")
album = fetch(rs.n=-1)
rs = dbSendQuery(con,statement="select * from track")
track = fetch(rs.n=-1)
rs = dbSendQuery(con,statement="select * from artist")
artist = fetch(rs.n=-1)
tracks = data.frame(
         album = factor(track$alid,levels=album$alid,
                                   labels=album$title).
         artist = factor(merge(track[,"alid",drop=FALSE],
                           album[,c("alid","aid")],by="alid")$aid,
                           levels=artist$aid,
                           labels=artist$name).
         time = track$time)
res = aggregate(tracks$time,
                 list(album=tracks$album,artist=tracks$artist),sum)
res = res[order(res$x,decreasing=TRUE),]
print(res[1:10,])
```

```
Introduction to SQL
```

Using SQL in python

```
#!/usr/bin/python
from MySQLdb import *
con = connect(user='user',passwd='pass',db='dbname')
cursor = con.cursor()
cursor.execute('select * from track')
tracks = cursor.fetchall()
durations = \{\}
for t in tracks:
    durations[t[1]] = durations.get(t[1],0) + t[2]
alids = durations.keys()
alids.sort(lambda x,y:cmp(durations[y],durations[x]))
for i in range(10):
    cursor.execute(
     'select title, aid from album where alid = %d' % alids[i])
    title,aid = cursor.fetchall()[0]
    cursor.execute('select name from artist where aid = %d', % aid)
    name = cursor.fetchall()[0][0]
    print '%s\t%s\t%d' % (title,name,durations[alids[i]])
```

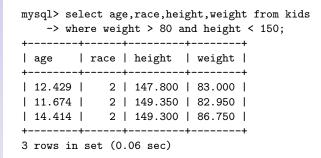
```
Introduction to SQL
```

Using SQL in perl

```
#!/usr/bin/perl
use DBI:
$dbh = DBI->connect('DBI:mysql:dbname:localhost','user','pass');
$sth = $dbh->prepare('select * from album');
$sth->execute():
while((@row) = $sth->fetchrow()){
     $album{$row[0]} = $row[2];
     $aartist{$row[0]} = $row[1];
     }
$sth = $dbh->prepare('select * from artist');
$sth->execute();
$artist{$row[0]} = $row[1] while((@row) = $sth->fetchrow());
$sth = $dbh->prepare('select * from track');
$sth->execute():
$duration{$row[1]} += $row[2] while((@row) = $sth->fetchrow());
@salbum = sort({$duration{$b} <=> $duration{$a}} keys(%duration));
foreach $i (0..9){
   print
       "$album{$salbum[$i]}\t$artist{$salbum[$i]}}\t",
       "$duration{$salbum[$i]}\n"
   }
```

<pre>mysql> select * from kids; ++</pre>							
	race		height	weight	sex		
++	•			+	++		
100011	2	10.346	148.500	38.950	1		
100011	2	11.282	157.100	44.100	1		
100011	2	14.428	165.950	57.800	1		
100011	2	15.321	167.050	59.650	1		
100031	1	10.920	158.000	63.700	1		
100031	1	11.917	161.000	68.500	1		
100031	1	13.007	162.750	85.950	1		
308091	1	9.460	138.000	39.000	1		
308091	1	10.740	147.500	53.100	1		
308091	1	11.359	151.750	57.050	1		
308101	1	9.800	152.350	38.500	2		
308101	1	10.781	159.335	48.235	2		
308101	1	11.701	164.285	51.700	2		
++	+	4		+	++		
20704 rows in set (0.18 sec)							





 $\P{\rm Return}$

<pre>mysql> select * from kids order by height desc; ++</pre>										
id	I	race	I	age	I	height	Ι		I	sex
	941							83.820		2
300	861	2	T	17.804	Ι	201.850	Ι	126.610	Т	2
302	941	2	T	16.572	Ι	201.795	Ι	76.670	Τ	2
300	861	2	T	14.833	Ι	201.520	Ι	124.245	Т	2
300	861	2	T	18.781	Ι	201.520	Ι	123.310	Τ	2
302	941	2	L	18.611	Ι	201.410	Τ	83.710	Τ	2
107	061	2	T	17.626	Ι	201.300	Τ	82.005	T	2
302	941	2	L	15.537	Ι	201.190	Τ	72.820	Τ	2
304	441	1	T	17.946	Ι	201.190	Τ	67.430	T	2
116	741	1	T	17.338	I	201.025	Ι	72.710	Т	2
+	+		+-		+-		-+-		+-	+

10 rows in set (0.10 sec)

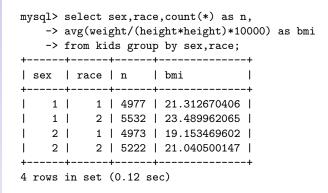


```
mysql> select * from kids
    -> where age between 17 and 18
    -> and weight between 180 and 185;
+-----+---+----+----+----+----+
| id | race | age | height | weight | sex |
+-----+---+----+----+----+----+----+
| 304741 | 1 | 17.875 | 194.150 | 184.250 | 2 |
+-----+---+----+----+----+----+----+
1 row in set (0.03 sec)
```



```
mysql> select max(height) from kids
    -> where age between 10 and 11 and race = 1;
+-----+
| max(height) |
+-----+
| 178.750 |
+-----+
1 row in set (0.06 sec)
```

• Return



▲ Return

```
mysql> select race,sum(height > 150)/count(*)
    -> from kids group by race;
+----+
| race | sum(height > 150)/count(*) |
+----+
| 1 | 0.85 |
| 2 | 0.89 |
+----+
2 rows in set (0.05 sec)
```



```
mysql> select id from kids
             group by id having count(*) < 2;
    ->
+----+
 id
1
+----+
 101051 |
 103181
  103191 |
 107231 |
  109001 |
  . . .
 207291
| 207961 |
| 302241 |
 304561
 307081 |
+---+
22 rows in set (0.10 sec)
```



mysql> select * from kids group by id having count(*)=10; | id | race | age | height | weight | sex 100031 | 10.920 | 158.000 | 63.700 L 1 | 1 | | 100041 | 10.070 2 | 1 | 159.500 | 51.700 | | 100071 | 2 | 10.630 | 139,700 | 37,500 | 1 | | 100081 | 2 | 9.110 | 152.130 | 36.795 | 2 | | 100091 | 2 | 9.200 | 148.250 | 54.150 | 1 | 308021 1 | 9.330 | 157.850 | 41.470 | 2 1 308041 1 | 10.810 | 157.025 | 38.060 | 2 1 308061 10.120 I 2 1 1 | 156.200 | 32.780 | 308071 1 | 10.990 | 138.500 | 29.450 | 1 | 308081 1 | 9.920 | 152.900 | 31.130 | 2 1 _____+ 1303 rows in set (0.11 sec)



<pre>mysql> select * from kids where id in -> (select id from kids group by id -> having count(*)=10); +++</pre>						
id	race	age	height	weight	sex	
100011			148.500			
100011	2	11.282	157.100	44.100	1	
100011	2	12.336	163.900	51.150	1	
100011	2	13.388	166.450	57.400	1	
100011	2	14.428	165.950	57.800	1	
308081	1	14.803	183.700	55.935	2	
308081	1	15.780	183.590	54.780	2	
308081	1	16.865	184.195	58.905	2	
308081	1	17.864	184.580	56.320	2	
308081	1	18.631	184.195	56.100	2	
+	++	4	+	+	++	
13030 rows in set (35 min 33.96 sec)						



mysql> select * from kids inner join (select id from kids group by id having count(*)=10) -> -> as a using(id); _____+ | height | weight id | race | age sex ___+ _____ 100011 | 2 10.346 | 148.500 | 38.950 l 1 100011 | 2 | 11.282 157.100 l 44.100 L 1 | 100011 L 2 1 12.336 163.900 51.150 | 1 | 100011 | 13.388 | 166.450 l 57.400 l 1 | 2 | 100011 | 2 1 14.428 | 165.950 | 57.800 l 1 | 308081 I 14.803 | 183.700 | 55.935 l 2 | 1 | 2 | 308081 | 15.780 183.590 54.780 l 1

184.195 |

184.580 l

+-----

58.905 l

56.320 l

56.100 L

2 1

2 1

2 1

13030 rows in set (11.89 sec)

1 |

1 |

1 |

16.865

17.864 |

Т

18.631 | 184.195 |

308081 I

308081 |

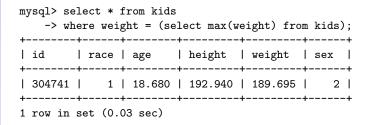
308081 L



```
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```

```
mysql> select * from kids
    -> having weight = max(weight);
Empty set (0.00 sec)
```

 $\P{\rm Return}$



◀ Return

```
mysql> select k.id,k.sex,k.race,k.age,k.weight,k.height
   -> from kids as k, (select sex,race,max(weight) as weight
   -> from kids group by sex, race) as m
   \rightarrow where k sex = m sex and k race = m race and
   -> k.weight = m.weight;
id
       | sex | race | age | weight | height
 _____+
 207201 L
          2 |
                2 | 19.405 | 173.360 | 191.565 |
          1 | 2 | 19.674 |
 207931
                          151.200 | 164.900 |
          1 | 1 | 18.633 | 128.500 |
 208171
                                 168.100 l
          21
 304741
                1 | 18,680 | 189,695 | 192,940 |
  4 rows in set (0.34 \text{ sec})
```

▲ Return

mysql> select a.title,r.name from album as a,artist as r where a.aid = r.aid;

+	++			
title	name			
+				
	Art Blakey & Jazz Messengers			
Ugetsu	Art Blakey & Jazz Messengers			
Born To Be Blue	Bobby Timmons			
Connecticut Jazz Party	Bobby Timmons			
Easy Does It	Bobby Timmons			
In Person	Bobby Timmons			
Moanin' Blues	Bobby Timmons			
The Prestige Trio Sessions	Bobby Timmons			
Soul Man Soul Food	Bobby Timmons			
Soul Time	Bobby Timmons			
Workin' Out	Bobby Timmons			
1945-1950 Small Groups	Dizzy Gillespie			
Live at the Circle Room and Mo	Nat King Cole			
Birth of the Cole 1938-1939	Nat King Cole			
Rockin' Boppin' & Blues	Nat King Cole			
WWII Transcriptions	Nat King Cole			
Oscar Peterson And Clark Terry	Oscar Peterson			
A Tribute To My Friends	Oscar Peterson			
The Oscar Peterson Trio Live At Zardi's - Disc One	Oscar Peterson			
The Oscar Peterson Trio Live At Zardi's - Disc Two	Oscar Peterson			
Skol	Oscar Peterson			
Oscar Peterson and Dizzy Gillespie	Oscar Peterson			
Overseas	Tommy Flanagan			
The Tommy Flanagan Trio	Tommy Flanagan			
Trio & Sextet	Tommy Flanagan			
+				

72 rows in set (0.02 sec)



<pre>mysql> select alid,sum(time) as duration -> from track group by alid order by duration desc;</pre>
++
alid duration
++
150 6057
286 5664
264 5028
156 4764
158 4674
343 2031
263 1865
281 1749
280 1611
287 1519
203 1061
++
72 rows in set (0.04 sec)



<pre>mysql> select a.title,r.name,sum(time) as duration</pre>		
title	name	duration
<pre>My Funny Valentine I Trio Voltantian Soul Food Workin' Out I The All-Stars Sessions The Oscar Peterson Trio Live At Zardi's - Disc Two Memories Of You Elmo Hope WWII Transcriptions The Oscar Peterson Trio Live At Zardi's - Disc One </pre>	<pre> Miles Davis Kenny Drew Bobby Timmons Bobby Timmons Elmo Hope Oscar Peterson Erroll Garner Elmo Hope Nat King Cole Oscar Peterson</pre>	5664 1 5028 1 4764 1 4674 1 4676 1 4536 1 4536 1 4536 1 4456 1

