

**CIS 560 – Database System Concepts**

**Lecture 2**

# SQL

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## CIS mySQL accounts

- CIS mySQL accounts created (“insecurepassword”)
  - Please login to make sure your account is active and change your password ASAP
  - Information on connecting to the server can be found on the support wiki:  
[http://support.cis.ksu.edu/  
FrequentlyAskedQuestions#FrequentlyAskedQuestions.2BAC8-  
Misc.HowdolconnecttoMySQL.3F](http://support.cis.ksu.edu/FrequentlyAskedQuestions#FrequentlyAskedQuestions.2BAC8-Misc.HowdolconnecttoMySQL.3F)

# Outline

Today:

- Data in SQL
- Simple Queries in SQL (Section 6.1)
- Queries with more than one relation (Section 6.2)
- Subqueries (Section 6.3)

Next lecture:

- Subqueries (Section 6.3)
- Aggregations (Sections 6.4.3 - 6.4.6)
- Nulls (Sections 6.1.6 - 6.1.7)
- Outer joins (Section 6.3.8)

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# Review

What is a database?

- A collection of files storing related data

What is a DBMS?

- *A big program written by someone else that allows us to manage efficiently a large database and allows it to persist over long periods of time*

# SQL

- Data Definition Language (DDL)
  - Create/alter/delete tables and their attributes
  - Following lectures...
- Data Manipulation Language (DML)
  - Query one or more tables – discussed next!
  - Insert/delete/modify tuples in tables

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The diagram shows a table titled "Product" with the following structure and data:

<u>PName</u>	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks
SingleTouch	\$149.99	Photography	Canon
MultiTouch	\$203.99	Household	Hitachi

Annotations in the diagram:

- Table name:** Points to the word "Product" in blue text above the table.
- Key:** Points to the underlined attribute "PName" in the header row.
- Attribute names:** Points to the header row containing "PName", "Price", "Category", and "Manufacturer".
- Tuples or rows:** Points to the data rows of the table.

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## Data Types in SQL

- Atomic types:
  - Characters: CHAR(20), VARCHAR(50)
  - Numbers: INT, BIGINT, SMALLINT, FLOAT
  - Others: DATE, TIME, ...
- Record (aka tuple)
  - Has atomic attributes
- Table (relation)
  - A set of tuples

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## Simple SQL Query

Product

PName	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks
SingleTouch	\$149.99	Photography	Canon
MultiTouch	\$203.99	Household	Hitachi

```
SELECT *  
FROM Product  
WHERE category='Gadgets'
```



“selection”

PName	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks

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## Simple SQL Query

Product

PName	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks
SingleTouch	\$149.99	Photography	Canon
MultiTouch	\$203.99	Household	Hitachi

```
SELECT PName, Price, Manufacturer
FROM   Product
WHERE  Price > 100
```



“selection” and  
“projection”

PName	Price	Manufacturer
SingleTouch	\$149.99	Canon
MultiTouch	\$203.99	Hitachi

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## Details

- Case insensitive:  
SELECT = Select = select  
Product = product  
BUT: 'Seattle' ≠ 'seattle'
- Constants:  
'abc' - yes  
"abc" - no

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## Eliminating Duplicates

PName	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks
SingleTouch	\$149.99	Photography	Canon
MultiTouch	\$203.99	Household	Hitachi

```
SELECT DISTINCT category  
FROM Product
```

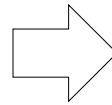
Compare to:

```
SELECT category  
FROM Product
```

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## Eliminating Duplicates

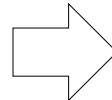
```
SELECT DISTINCT category  
FROM Product
```



Category
Gadgets
Photography
Household

Compare to:

```
SELECT category  
FROM Product
```



Category
Gadgets
Gadgets
Photography
Household

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## Ordering the Results

```
SELECT pname, price, manufacturer
FROM Product
WHERE category='gizmo' AND price > 50
ORDER BY price, pname
```

Ties are broken by the second attribute on the ORDER BY list.

Ordering is ascending, unless you specify the DESC keyword.

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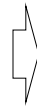
PName	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks
SingleTouch	\$149.99	Photography	Canon
MultiTouch	\$203.99	Household	Hitachi

```
SELECT DISTINCT category
FROM Product
ORDER BY category
```



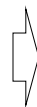
?

```
SELECT Category
FROM Product
ORDER BY PName
```



?

```
SELECT DISTINCT category
FROM Product
ORDER BY PName
```

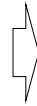


?

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PName	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks
SingleTouch	\$149.99	Photography	Canon
MultiTouch	\$203.99	Household	Hitachi

```
SELECT DISTINCT category
FROM Product
ORDER BY PName
```



			category
<input type="checkbox"/>			Gadgets
<input type="checkbox"/>			Household
<input type="checkbox"/>			Photography

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## Keys and Foreign Keys

### Company

<u>CName</u>	StockPrice	Country
GizmoWorks	25	USA
Canon	65	Japan
Hitachi	15	Japan

Key

### Product

<u>PName</u>	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks
SingleTouch	\$149.99	Photography	Canon
MultiTouch	\$203.99	Household	Hitachi

Foreign key

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# Joins

Product (pname, price, category, manufacturer)

Company (cname, stockPrice, country)

Find all products under \$200 manufactured in Japan;  
return their names and prices.

```
SELECT PName, Price
FROM Product, Company
WHERE Manufacturer=CName AND Country='Japan'
AND Price <= 200
```

Join  
between Product  
and Company

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# Joins

Product

PName	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks
SingleTouch	\$149.99	Photography	Canon
MultiTouch	\$203.99	Household	Mitachi

Company

Cname	StockPrice	Country
GizmoWorks	25	USA
Canon	65	Japan
Hitachi	15	Japan

```
SELECT PName, Price
FROM Product, Company
WHERE Manufacturer=CName AND Country='Japan'
AND Price <= 200
```



PName	Price
SingleTouch	\$149.99


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## Tuple Variables


Person(pname, address, worksfor)  
Company(cname, address)

Which  
address ?

```
SELECT DISTINCT pname, address
FROM   Person, Company
WHERE  worksfor = cname
```



```
SELECT DISTINCT Person.pname, Company.address
FROM   Person, Company
WHERE  Person.worksfor = Company.cname
```



```
SELECT DISTINCT x.pname, y.address
FROM   Person AS x, Company AS y
WHERE  x.worksfor = y.cname
```

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## In Class

Product (pname, price, category, manufacturer)  
Company (cname, stockPrice, country)

Find all Chinese companies that manufacture  
products in the 'toy' category

```
SELECT  cname

FROM

WHERE
```

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## In Class

Product (pname, price, category, manufacturer)

Company (cname, stockPrice, country)

Find all Chinese companies that manufacture products both in the 'electronic' and 'toy' categories

```
SELECT cname  
  
FROM  
  
WHERE
```

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## Meaning (Semantics) of SQL Queries

```
SELECT a1, a2, ..., ak  
FROM R1 AS x1, R2 AS x2, ..., Rn AS xn  
WHERE Conditions
```

```
Answer = {}  
for x1 in R1 do  
  for x2 in R2 do  
    .....  
    for xn in Rn do  
      if Conditions  
        then Answer = Answer ∪ {(a1, ..., ak)}  
return Answer
```

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## Using the Formal Semantics

What do these queries compute ?

```
SELECT DISTINCT R.A  
FROM R, S  
WHERE R.A=S.A
```

Returns  $R \cap S$

```
SELECT DISTINCT R.A  
FROM R, S, T  
WHERE R.A=S.A OR R.A=T.A
```

If  $S \neq \emptyset$  and  $T \neq \emptyset$   
then returns  $R \cap (S \cup T)$   
else returns  $\emptyset$

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## Joins Introduce Duplicates

Product (pname, price, category, manufacturer)

Company (cname, stockPrice, country)

Find all countries that manufacture some product in the 'Gadgets' category.

```
SELECT Country  
FROM Product, Company  
WHERE Manufacturer=CName AND Category='Gadgets'
```

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## Joins Introduce Duplicates

Product

Name	Price	Category	Manufacturer
Gizmo	\$19.99	Gadgets	GizmoWorks
Powergizmo	\$29.99	Gadgets	GizmoWorks
SingleTouch	\$149.99	Photography	Canon
MultiTouch	\$203.99	Household	Hitachi

Company

Cname	StockPrice	Country
GizmoWorks	25	USA
Canon	65	Japan
Hitachi	15	Japan

```
SELECT Country
FROM Product, Company
WHERE Manufacturer=CName AND Category='Gadgets'
```



Duplicates !  
Remember to  
add DISTINCT

Country
USA
USA

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## Subqueries

- A *subquery* is another SQL query nested inside a larger query
- Such inner-outer queries are called *nested queries*
- A subquery may occur in:
  1. A SELECT clause
  2. A FROM clause
  3. A WHERE clause

Rule of thumb: avoid writing nested queries when possible;  
keep in mind that sometimes it's impossible

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