# Relational Databases, SQL and ADO.NET in 75 minutes

## **Relational Databases**

• Data is organized into tables with rows and columns

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- A row is a single instance of a record
- Columns are the attributes of a record
- Tables can be linked in relationships

**Keys / Indexes** 

- Keys are columns or groups of columns that are "Indexed" to make find / sorting them faster
- Index can be unique or allow duplicates
- One key (one or more columns) can be "primary," must be unique

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- How data (tables, rows, columns) are organized in a database is its "schema"
- Data is organized best when it is organized in a "normal form"
  - You will be given existing tables so understanding normal forms is not necessary
  - Please take CS 564 for more information

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### **Relationships**

- Only type of relationship discussed here is a "link" where rows / records in two tables share a common column / attribute
- Table 1: UID, Name
- Table 2: UID, Grade1
  - UID, Grade2 etc.
- Find Joe's name and grades where the UID in both tables refers to Joe.

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## SQL

- Structured Query Language
- A few words that impact your life every day
- We will focus on 4 commands
  - Select
  - Insert
  - Update
  - Delete

#### Quotation

- Specifying data in SQL commands are very fragile with respect to use of quotation marks
- If specifying SQL commands from a program use "parameterized" arguments to avoid the problem
- Parameterized arguments are discussed later

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#### select

- Select columns from tables where certain conditions are true plus some options
- Select all columns, all records:
   select \* from t:
- Select all columns, some records
  - select \* from t where age > 21;
- Select all columns, some records, w/ options
  - select \* from t where age > 21 order by lastname;

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#### select

- Select some columns
- select firstname, lastname from t;
- Select on more than one condition
  - select \* from t where age > 21 and age < 75;</li>
- Usual logical operators for conditions
- String columns can be pattern matched
  - select firstname where firstname like '%th%';

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#### select

- Select (and summarize) by group
  - select count(state), state from t group by state;
- Select unique values
- select distinct state from t order by state;
- See:
  - http://dev.mysql.com/doc/refman/5.1/en/sql-syntax.html

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# Selecting from more than one table - Join

- There are several types of joins. We only look at the "inner join" (simply use "," between table names)
- Cross product of two tables (hopefully) limited by some constraint
  - select id, name, ordernumber from customers, orders where customers.id = orders.customerid order by id;
- If there is a column with the same name in two tables, you must disambiguated explicitly

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#### insert

- insert into tbl set columnname=value;
- Multiple columns can be set separated by ","
- Value can be "default" if column has a default
- If there is a collision of a "unique" key, an error results
- Use "ignore" syntax if you don't care
  insert ignore into t set id=29;
- See
- http://dev.mysql.com/doc/refman/5.1/en/insert.html

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#### update

- update [ignore] tbl set id=9 where id=6
- Multiple columns may be set separated by ","
- Compound "where" conditions may be used
- Note the optional "ignore" if you are changing a key value that is supposed to be unique and a collision occurs
- See http://dev.mysql.com/doc/refman/5.1/en/insert.html

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#### delete

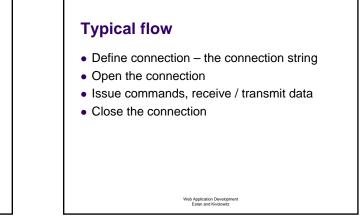
- delete [ignore] from tbl where id=9;
- Don't leave out the where condition unless you want to delete all records (not in this class)
- Note optional "ignore" to ignore errors
- Multiple where conditions may be specified
- See
  - http://dev.mysql.com/doc/refman/5.1/en/delete.html

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### ADO.NET

- Active Data Objects for .NET
- Object oriented wrapper to database methods and data structures
- We will use ODBC version of methods
  - Open Database Connectivity
  - Independent of database backend

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## Connection string

- MySQL version
  - DRIVER={MySQL ODBC 3.51 Driver};
  - SERVER=oberon.cs.wisc.edu;
  - PORT=3400;
  - DATABASE=databaseName;
  - USER=userName;
  - PASSWORD=myPassword;
  - OPTION=3;"
- One long string

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## {MySQL ODBC 3.51 Driver};

- Refers to the MySQL connector which must be installed on your system
- Will be preloaded on instructional machines
- Found here:
  - http://dev.mysql.com/downloads/connector/odbc/3.51.html

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## **Connection object**

- Instantiate an OdbcConnection
- · Pass connection string to constructor
- Will use:
  - Methods
    - Open open the connection
    - CreateCommand create command objects
    - Close close the connection
  - Attributes
    - State

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#### **Connection object**

- Remember to close an open connection
  - Nice use of "finally"
  - Or web page's "Unload" function discussed in future lecture
- Use open / close judiciously as operation is high overhead

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## **Command object**

- Instantiate OdbcCommand object either by constructor or connection object CreateCommand
- If you use the constructor, you need to specify the connection object to the Connection attribute
- Specify command in CommandText
- Use parameterized queries!
  - Command.Parameters.AddWithValue()

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#### **Parameterized queries**

- If any part of a SQL command can come from user input, avoid SQL injection attacks by using parameterized queries
- Example: select c2 from t where c1 = \_\_\_; substitute
  - 1; drop table t
- What happens?

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#### Parameterized queries

- Cleaner looking code
- · Eliminates the headache of proper quoting

commond.CommondText = String.Format(
 "select firstname from students where id = '(0)';", id
);

command.CommandText = "select firstname from students where id = ?;"; command.Parameters.AddWithValue("id", id);

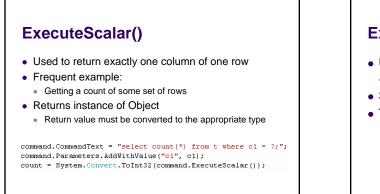
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## ExecuteNonQuery()

- Used for executing SQL commands which do not return a row or rows of data such as:
  - insert
  - delete
  - update

command.CommandText = "update t set c2=? where c1=?;"; command.Parameters.AddWithValue("@c2", c2); command.Parameters.AddWithValue("@c1", c1); command.ExecuteNonQuery();

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## ExecuteReader()

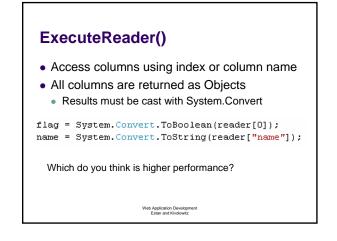
Used to retrieve a row or rows one at a time
Uses little memory

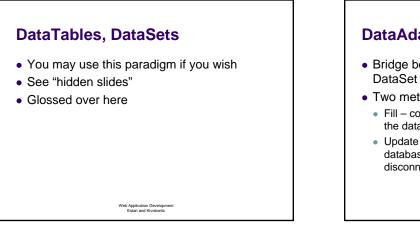
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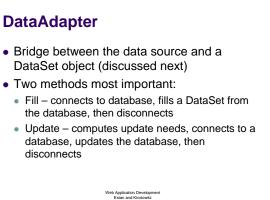
- Sequential forward-only access
- Ties up connection as long as it is open

ExecuteReader()

try
{
 reader = command.ExecuteReader();
 while (reader.Read())
 (
 )
}
finally
{
 if (reader != null && reader.IsClosed == false)
 (
 reader.Close();
 )
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 Example Volument
 Exa









- Memory-resident object oriented representation of a database
- Being memory-resident:
  - is fast
  - can be randomly accessed
  - potentially large memory cost
- Perhaps overkill for many web applications?

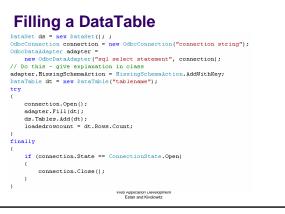
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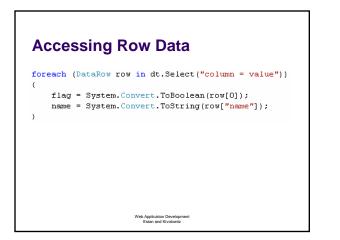
#### DataTable

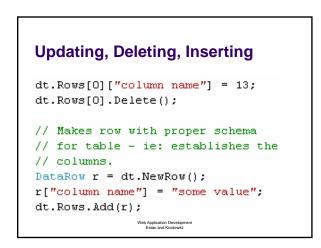
- Made up of DataRows (Rows) and DataColumns (Columns)
- Rows can be accessed by index
- Column data can be accessed by index or name
- Column data are of type Object must be converted with System.Convert
- Has select capability (but different syntax)

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## **Changes Not Committed Yet!**



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## Summary Reader Vs. Set

- DataReader
  - One way, sequential
  - Memory efficient
- DataSet
  - · Memory resident view of database
  - Fast random access
  - Can be expensive
- Permits definition of table relationships (not covered in this course)

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## Important subject not covered!

- I have not covered concurrency issues at all
- Should not be an issue because each of you get your own database

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