



# Chapter 9 SQL in a server environment

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- SQL in a Programming Environment
  - embedded SQL
  - persistent stored modules
- Database-Connection Libraries
  - Call-level interface (CLI)
  - JDBC
  - PHP



# Database connection

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- The third approach to connecting databases to conventional languages is to use library calls.
  1. C + CLI
  2. Java + JDBC
  3. PHP + PEAR/DB

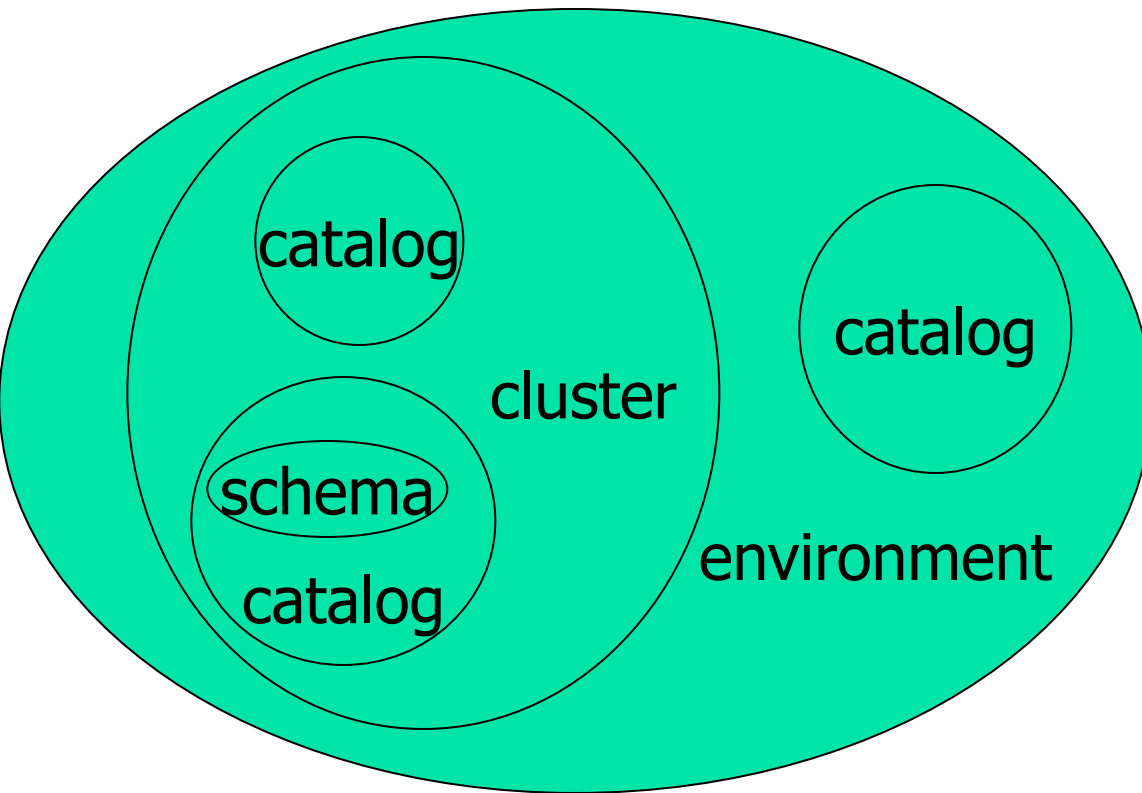


# Three-Tier Architecture

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- A common environment for using a database has three tiers of processors:
  1. *Web servers* --- talk to the user.
  2. *Application servers* --- execute the business logic.
  3. *Database servers* --- get what the app servers need from the database.

**DBMS environment:** the framework under which data may exist and SQL operation on data may be executed.



Schemas: collections of **tables, views, assertions**, domains and so on.

Catalog: collections of schemas, information about all the schemas in the catalog.

Clusters: each user has an associated cluster, so in a sense, a cluster is “**the database**” as seen by a particular user.

# Environments, Connections, Queries



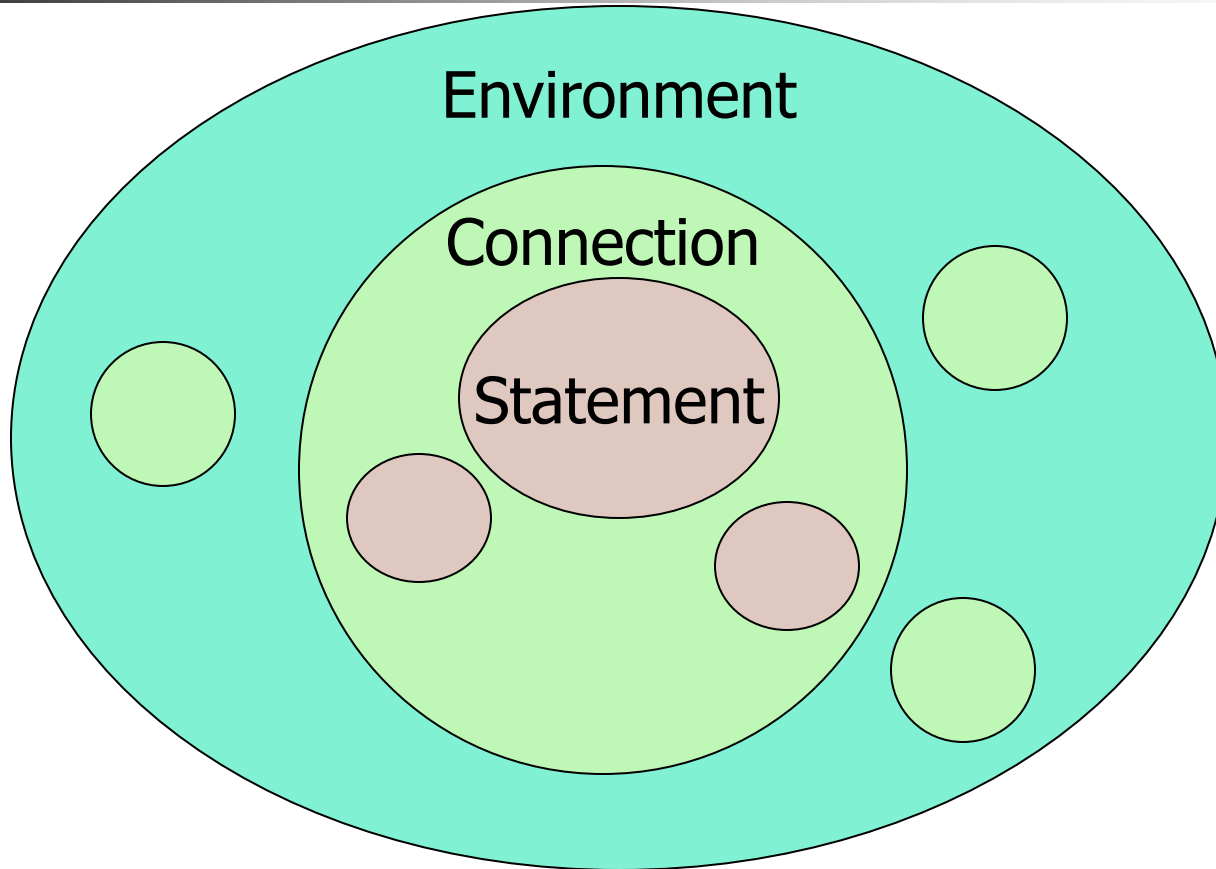
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- The database is, in many DB-access languages, an *environment*.
- Database servers maintain some number of *connections*, so app servers can ask queries or perform modifications.
- The app server issues *statements* : queries and modifications, usually.



# Diagram to Remember

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# JDBC

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- *Java Database Connectivity* (JDBC) is a library similar to SQL/CLI, but with Java as the host language.
- Like CLI, but with a few differences for us to cover.



# Making a Connection

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```
import java.sql.*;  
Class.forName("com.mysql.jdbc.Driver");  
Connection myCon =  
    DriverManager.getConnection(...);
```

The JDBC classes

Loaded by  
forName

URL of the database  
your name, and password  
go here.

The driver  
for mySql;  
others exist





# Statements

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- JDBC provides two classes:
  1. *Statement* = an object that can accept a string that is a SQL statement and can execute such a string.
  2. *PreparedStatement* = an object that has an associated SQL statement ready to execute.



# Creating Statements

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- The Connection class has methods to create Statements and PreparedStatement.

```
Statement stat1 = myCon.createStatement();
```

```
PreparedStatement stat2 =
```

```
myCon.createStatement(
```

```
    "SELECT beer, price FROM Sells " +
```

```
    "WHERE bar = 'Joe's Bar' "
```

```
);
```

`createStatement` with no argument returns a Statement; with one argument it returns a PreparedStatement.



# Executing SQL Statements

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- JDBC distinguishes queries from modifications, which it calls “updates.”
- Statement and PreparedStatement each have methods `executeQuery` and `executeUpdate`.
  - For Statements: one argument: the query or modification to be executed.
  - For PreparedStatements: no argument.



## Example: Update

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- stat1 is a Statement.
- We can use it to insert a tuple as:

```
stat1.executeUpdate(  
    "INSERT INTO Sells " +  
    "VALUES ('Brass Rail', 'Bud', 3.00) "  
);
```



## Example: Query

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- stat2 is a PreparedStatement holding the query "SELECT beer, price FROM Sells WHERE bar = 'Joe's Bar'".
- `executeQuery` returns an object of class ResultSet – we'll examine it later.
- The query:

```
ResultSet menu = stat2.executeQuery();
```



# Accessing the ResultSet

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- An object of type `ResultSet` is something like a cursor.
- Method `next()` advances the “cursor” to the next tuple.
  - The first time `next()` is applied, it gets the first tuple.
  - If there are no more tuples, `next()` returns the value `false`.



# Accessing Components of Tuples

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- When a ResultSet is referring to a tuple, we can get the components of that tuple by applying certain methods to the ResultSet.
- Method `getX(i)`, where  $X$  is some type, and  $i$  is the component number, returns the value of that component.
  - The value must have type  $X$ .

# Example: Accessing Components

- Menu = ResultSet for query "SELECT beer, price FROM Sells WHERE bar = 'Joe' 's Bar' ".
- Access beer and price from each tuple by:

```
while ( menu.next() ) {  
    theBeer = Menu.getString(1);  
    thePrice = Menu.getFloat(2);  
    /*something with theBeer and  
       thePrice*/  
}
```





# PHP (personal home page)

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- A scripting language to be used for actions within HTML text.
- Indicated by `<? PHP code ?>`.
- DB library exists within *PEAR* (PHP Extension and Application Repository).
  - Include with `include (DB.php)`.



# Variables in PHP

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- Must begin with \$.
- OK not to declare a type for a variable.
- But you give a variable a value that belongs to a “class,” in which case, methods of that class are available to it.



# String Values

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- PHP solves a very important problem for languages that commonly construct strings as values:
  - How do I tell whether a substring needs to be interpreted as a variable and replaced by its value?
- PHP solution: **Double** quotes means **replace**; single quotes means don't.



## Example: Replace or Not?

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```
$100 = "one hundred dollars";
```

```
$sue = 'You owe me $100.';
```

```
$joe = "You owe me $100.";
```

- Value of **\$sue** is 'You owe me \$100', while the value of **\$joe** is 'You owe me one hundred dollars'.



# PHP Arrays

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- Two kinds: *numeric* and *associative*.
- Numeric arrays are ordinary, indexed 0,1,...
  - **Example:** `$a = array("Paul", "George", "John", "Ringo");`
    - Then `$a[0]` is "Paul", `$a[1]` is "George", and so on.



# Associative Arrays

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- Elements of an associative array  $a$  are pairs  $x \Rightarrow y$ , where  $x$  is a key string and  $y$  is any value.
- If  $x \Rightarrow y$  is an element of  $a$ , then  $a[x]$  is  $y$ .



# Example: Associative Arrays

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- An environment can be expressed as an associative array, e.g.:

```
$myEnv = array(  
    "phptype" => "oracle",  
    "hostspect" => "www.stanford.edu",  
    "database" => "cs145db",  
    "username" => "ullman",  
    "password" => "notMyPW") ;
```



# Making a Connection

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- With the DB library imported and the array \$myEnv available:

```
$myCon = DB::connect($myEnv);
```

Function connect  
in the DB library

Class is Connection  
because it is returned  
by DB::connect().





# Executing SQL Statements

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- Method **query** applies to a Connection object.
- It takes a string argument and returns a result.
  - Could be an error code or the relation returned by a query.



## Example: Executing a Query

- Find all the bars that sell a beer given by the variable `$beer`.

```
$beer = 'Bud';
```

```
$result = $myConn->query(
```

```
    "SELECT bar FROM Sells"
```

```
    "WHERE beer = $beer ;" );
```

Method  
application

Concatenation  
in PHP

Remember this  
variable is replaced  
by its value.



# Cursors in PHP

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- The result of a query *is* the tuples returned.
- Method **fetchRow** applies to the result and returns the next tuple, or FALSE if there is none.



# Example: Cursors

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```
while ($bar =  
    $result->fetchRow()) {  
    // do something with $bar  
}
```



# Summary

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- Embedded SQL (shared variables, EXEC SQL, Cursor), Dynamic SQL
- SQL/PSM
- Call-level Interface (SQL/CLI)
- JDBC
- PHP