WEBD 236

Web Information Systems Programming

Week 3

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Agenda

- This week's expected outcomes
- This week's topics
- This week's homework
- Upcoming deadlines
- Solutions to homework 1
- Questions and answers

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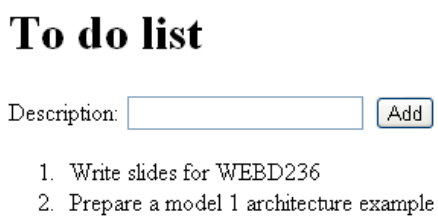
Week 3 Outcomes

- Distinguish between Model 1 and Model 2 architecture web applications
- Employ the Model-View-Controller design pattern in web development
- Utilize RESTful URLs for clean design
- List the advantages to unit testing

Web Architecture

- Model 1 architecture
  - Code for application, database, and display logic is intermixed in a single monolithic page
  - A very tangled set of interactions.
    - Ex: To do application



Using PHP with SQL

```php
<?php
global $db;
try {
    $db = new PDO('sqlite:ToDoList.db3');
} catch (PDOException $e) {
    die("Could not open database. " . $e -> getMessage());
}

if (isset($_POST['description'])) {
    $desc = htmlentities($_POST['description']);
    $statement = $db->prepare("INSERT INTO todo (description,
done) values (?, 0)");
    $statement -> bindParam(1, $desc);
    $statement -> execute();
}
```

Some logic to handle the database

Some simple validation and security logic

Web Architecture

```php
$statement = $db -> prepare("SELECT * FROM todo WHERE done = 0
ORDER BY id");
$statement -> execute();
$rows = $statement -> fetchAll();
?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html>
  <head>
    <title>To do list</title>
  </head>
```

Some logic to generate our list

Some static output

Web Architecture

```
  <body>
    <h1>To do list</h1>
    <form action="index.php" method="post">
      <label for="description">Description:</label>
      <input type="text" id="description" name="description" />
      <input type="submit" value="Add" />
    </form>
    <ol>
<?php foreach ($rows as $row) : ?>
      <li><?php echo $row['description']; ?></li>
<?php endforeach; ?>
    </ol>
  </body>
</html>
```

Some logic to display output.

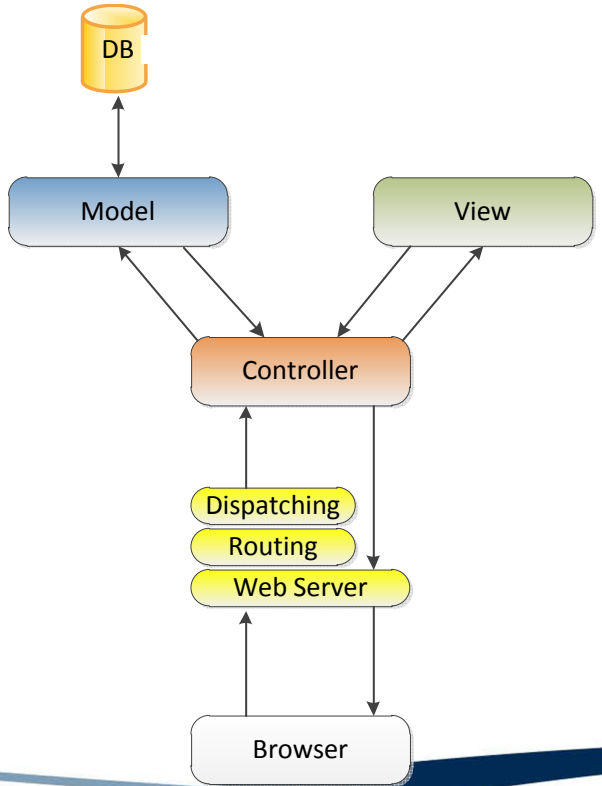
Web Architecture

- Model 1 architecture
  - Works fine for simple applications
  - Becomes horribly messy when
    - Application logic is complicated
    - Error/security reporting is robust
    - You need to debug or make changes
  - Problem: solving three issues in one place.
  - Solution: separate three issues into three places.

MVC-based Architecture

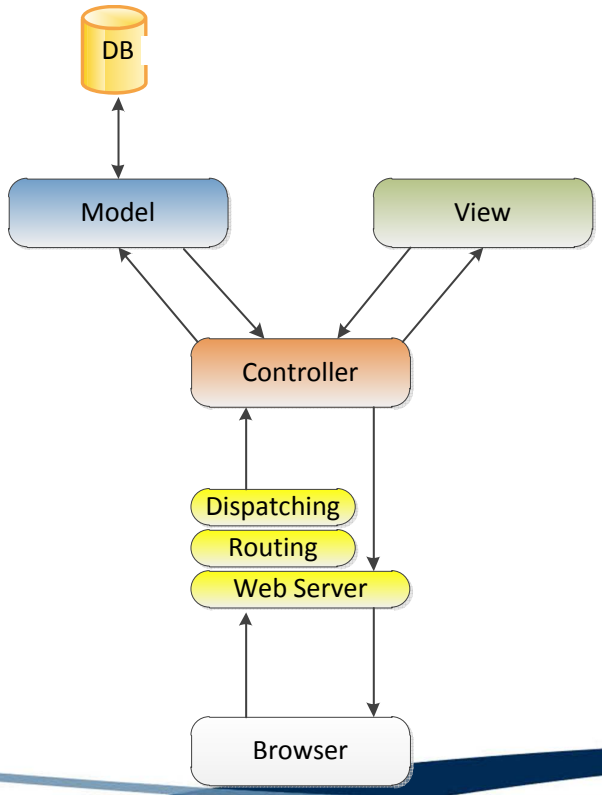
- Model 2:
  - Model-View-Controller (MVC)
    - Model: interacts with the database
    - View: presents data to the user
    - Controller: encapsulates “business logic”
  - Flow of a web request
    - URL maps into a controller
    - Controller updates or retrieves data via model
    - Controller forwards request to a view

MVC-based Architecture



- Browser sends a request to a web server
- Web server fires a routing script to determine what other script (based on URL) should handle the request.
- Routing script dispatches the request to the appropriate controller.
- Controller invokes data-oriented actions on the model

MVC-based Architecture

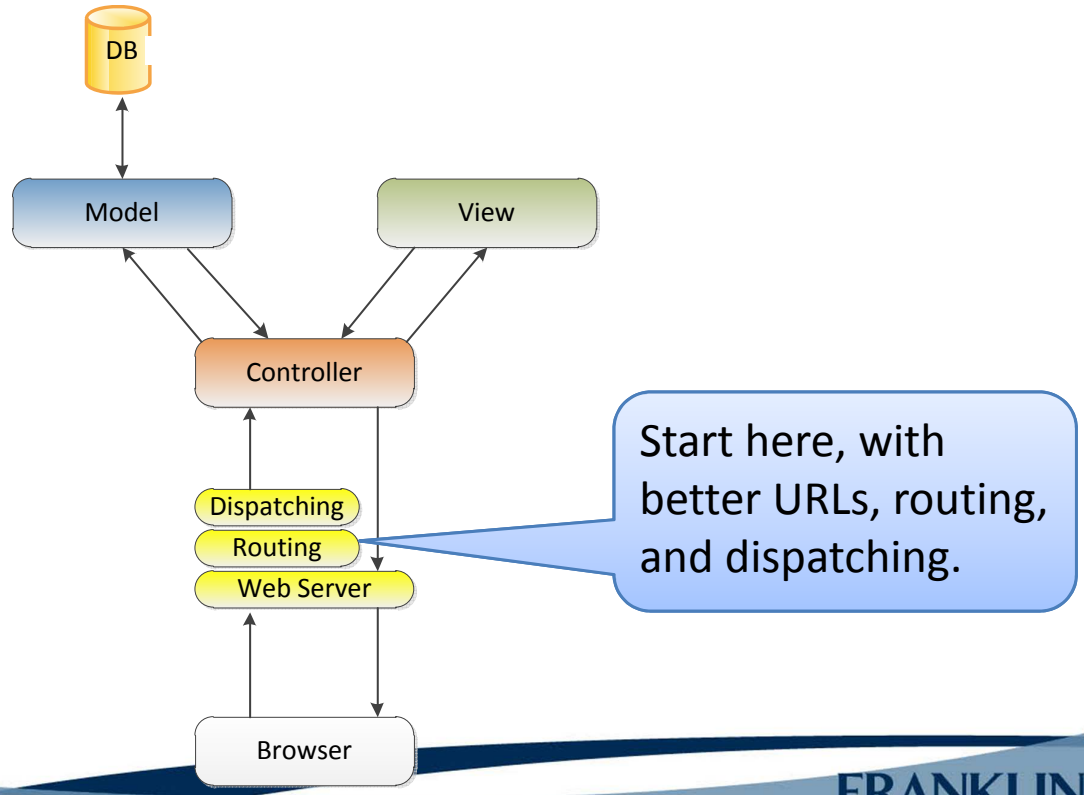


- Model updates/queries the database
- Model returns results to the controller.
- Controller takes results, applies business logic, and forwards results to the view.
- View renders the HTML and returns it to the controller.
- Controller returns HTML to web server and then to browser.

MVC-based Architecture

- We've already done some of this last week:
  - Separation of DB instantiation into db.inc
  - Separation of model into model_student.inc
  - Separation of view into view_student.php
- But, we need to structure this better!

MVC-based Architecture



Running example – To Do List

To Do List

Description: Add

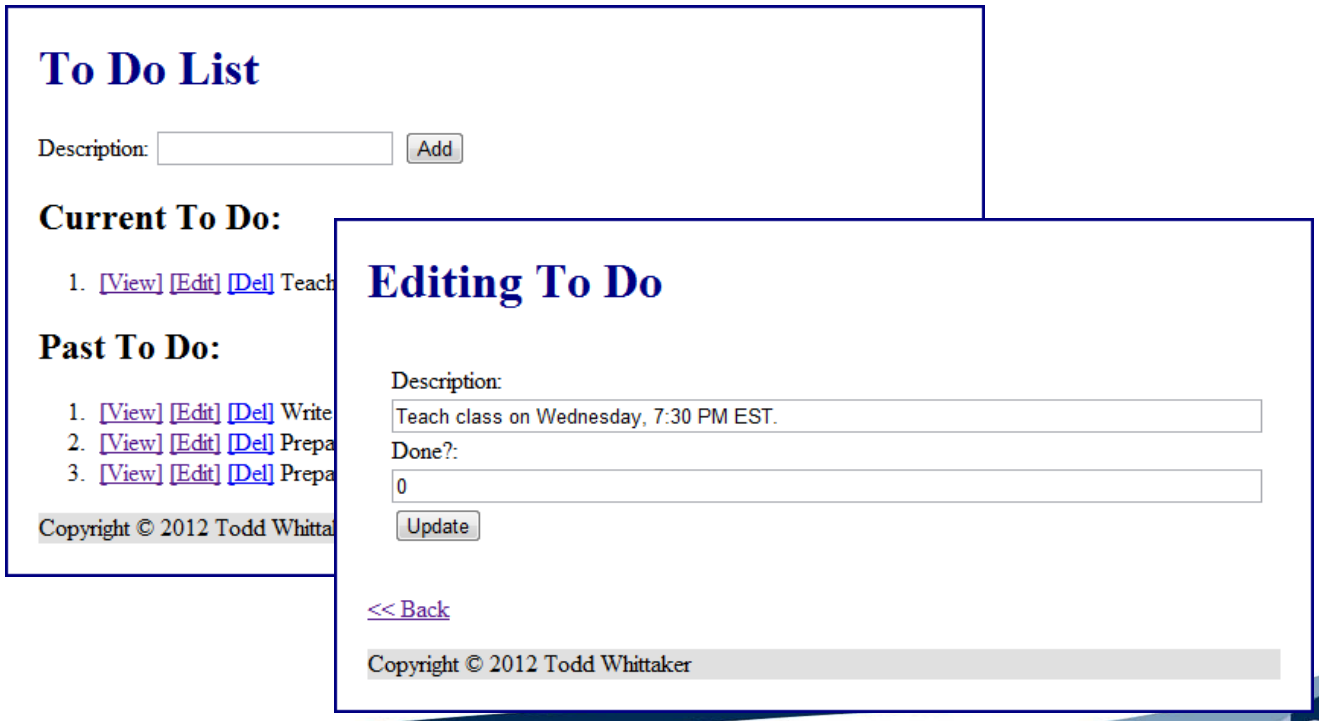
Current To Do:

1. [View] [Edit] [Del] Teach class on Wednesday, 7:30 PM EST.

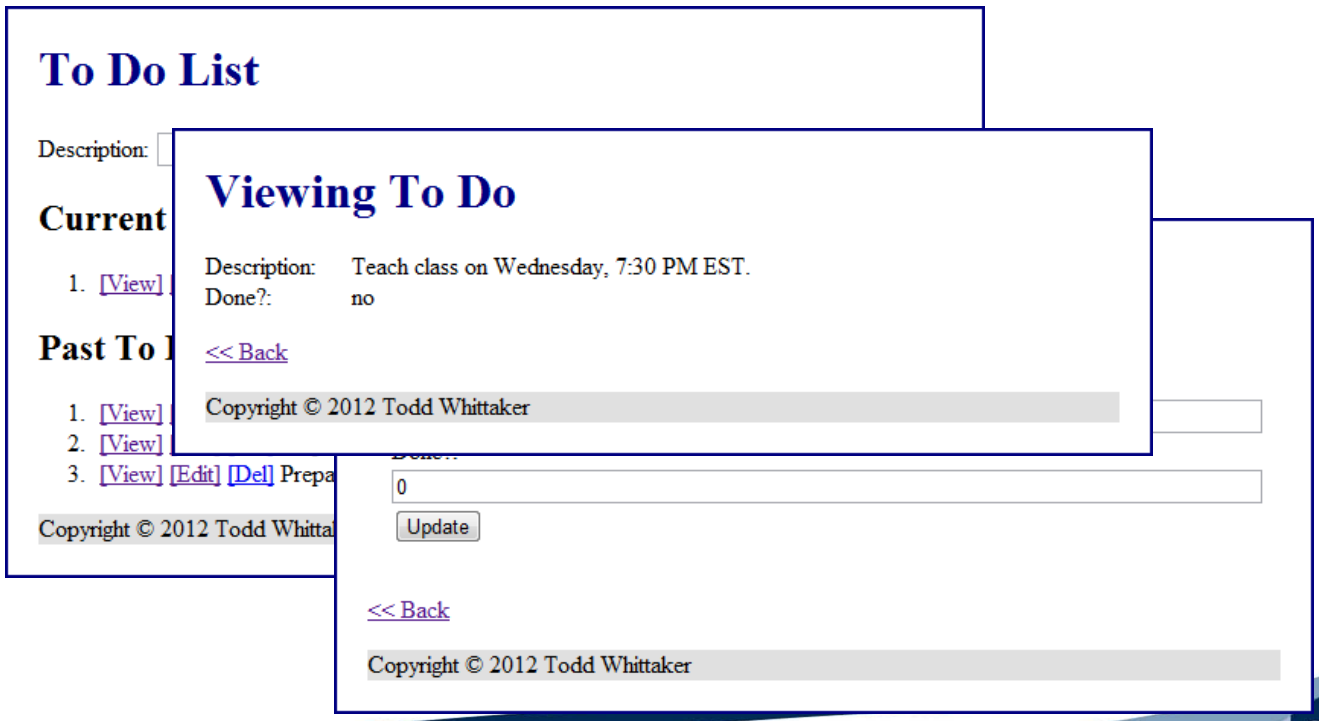
Past To Do:

1. [View] [Edit] [Del] Write slides for WEBD236
2. [View] [Edit] [Del] Prepare a model 1 architecture example
3. [View] [Edit] [Del] Prepare a model 2 architecture example

Running example – To Do List



Running example – To Do List



Pretty URLs, Routing, Dispatching

- GET-based URLs can be ugly

```
http://localhost/app/view_todo.php?id=23
```

- "RESTful" URLs are much prettier

```
http://localhost/app/todo/view/23
```

Entity Action Parameter

Pretty URLs, Routing, Dispatching

- GET-based URLs can be ug

```
http://localhost/app/view_todo.php?id=
```

But, this URL doesn't specify a script file to execute! How do we map this into a script?

- "RESTful" URLs are much pre er

```
http://localhost/app/todo/view/23
```

Entity Action Parameter

Pretty URLs, Routing, Dispatching

- `.htaccess` file
  - Place this in the root of your application folder (i.e. `c:\xampp\htdocs\app`)

```
Options +FollowSymLinks
IndexIgnore */*
# Turn on the RewriteEngine
RewriteEngine On
#  Rules
RewriteCond %{REQUEST_FILENAME} !-f
RewriteCond %{REQUEST_FILENAME} !-d
RewriteRule . urlrouter.php
```


Pretty URLs, Routing, Dispatching

- `.htaccess` file
  - Place this in the ro
    (i.e. `c:\xampp\htdoc`

Must "allow overrides" in the Apache configuration in `c:\xamp\apache\conf\httpd.conf`

```
Options +FollowSymLinks
IndexIgnore */*
# Turn on the RewriteEngine
RewriteEngine On
#  Rules
RewriteCond %{REQUEST_FILENAME} !-f
RewriteCond %{REQUEST_FILENAME} !-d
RewriteRule . urlrouter.php
```

Pretty URLs, Routing, Dispatching

- `.htaccess` file

Must "allow overrides" in the Apache configuration in

```
<Directory "C:/xampp/htdocs">
    Options Indexes FollowSymLinks Includes ExecCGI
    AllowOverride All
    Order allow,deny
    Allow from all
</Directory>
```

Permits the rewrite engine to be active on a per-directory basis.

```
RewriteEngine On
#  Rules
RewriteCond %{REQUEST_FILENAME} !-f
RewriteCond %{REQUEST_FILENAME} !-d
RewriteRule . urlrouter.php
```


Pretty URLs, Routing, Dispatching

- URL routing and dispatching
  - Three critical pieces of information for a URL like `http://localhost/app/todo/view/5`

```
print_r($_SERVER['REQUEST_METHOD']);
print_r($_SERVER['REQUEST_URI']);
print_r($_SERVER['SCRIPT_NAM
```

```
GET
/app/todo/view/5
/app/urlrouter.php
```

Can use this to figure out the directory (app), the entity (todo), the action (view) the ID (5) and the method (GET).

Pretty URLs, Routing, Dispatching

- urlrouter.php

```php
<?php
function routeUrl() {
    $method = $_SERVER['REQUEST_METHOD'];
    $requestURI = explode('/', $_SERVER['REQUEST_URI']);
    $scriptName = explode('/', $_SERVER['SCRIPT_NAME']);

    for ($i = 0; $i < sizeof($scriptName); $i++) {
        if ($requestURI[$i] == $scriptName[$i]) {
            unset($requestURI[$i]);
        }
    }
    # continued...
```


Pretty URLs, Routing, Dispatching

- urlrouter.php

```php
<?php
function routeUrl() {
    $method = $_SERVER['REQUEST_METHOD'];
    $requestURI = explode('/', $_SERVER[
    $scriptName = explode('/', $_

    for ($i = 0; $i < sizeof($scriptN
        if ($requestURI[$i] == $scriptN
            unset($requestURI[$i]);
        }
    }
    # continued...
```

explode(): convert string to array:

```
Array
(
    [0] =>
    [1] => app
    [2] => todo
    [3] => view
    [4] => 5
)
```

Pretty URLs, Routing, Dispatching

- urlrouter.php

```php
<?php
function routeUrl() {
    $method = $_SERVER['REQUEST_METHOD'];
    $requestURI = explode('/', $_SERVER['REQUEST_URI']);
    $scriptName = explode('/', $_SERVER['SCRIPT_NAME']);

    for ($i = 0; $i < sizeof($scriptName); $i++) {
        if ($requestURI[$i] == $scriptName[$i]) {
            unset($requestURI[$i]);
        }
    }
    # continued...
```


Pretty URLs, Routing, Dispatching

- urlrouter.php

```php
    $command = array_values($requestURI);
    $controller = 'controllers/' . $command[0] . '.inc';
    $func = strtolower($method) . '_' .
        (isset($command[1]) ? $command[1] : 'index');
    $params = array_slice($command, 2);

    # continued...
```

Pretty URLs, Routing, Dispatching

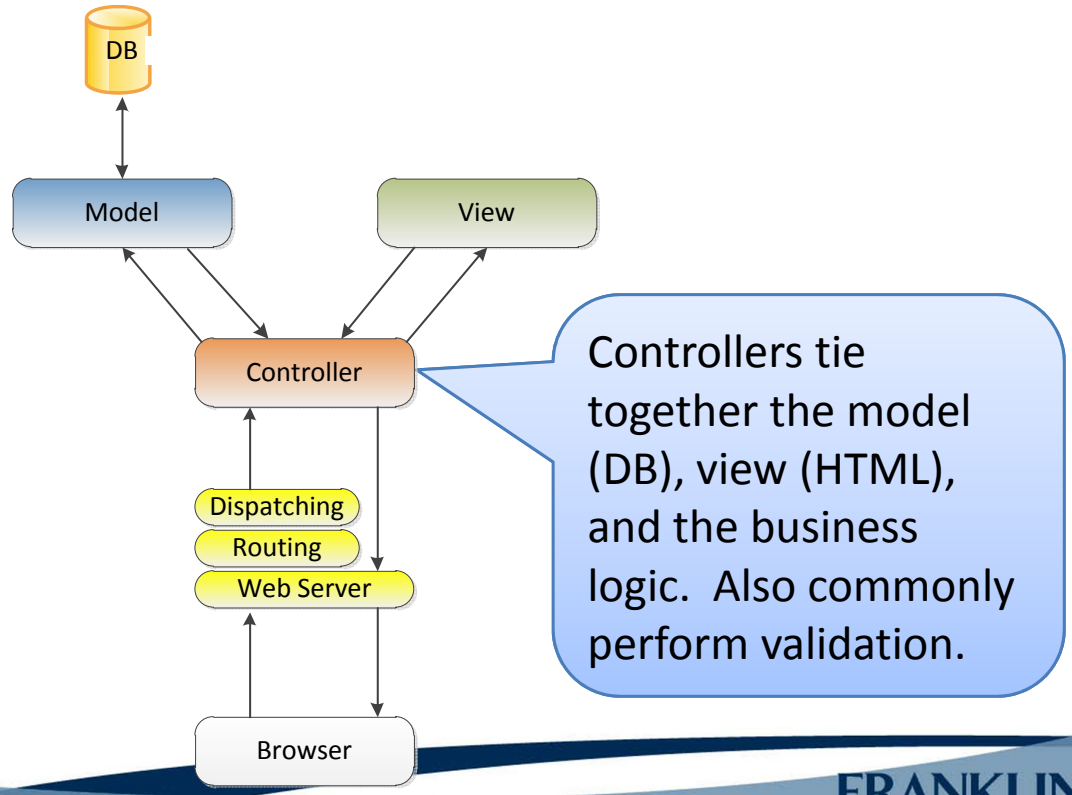
- `urlrouter.php`

```
    if (file_exists($controller)) {
        require $controller;
        if (function_exists($func)) {
            $func($params);
            exit();
        }
        else {
            die("Command '$func' doesn't exist.");
        }
    } else {
        die("Controller '$controller' doesn't exist.");
    }
}
routeURL();
```


Pretty URLs, Routing, Dispatching

- What we've done:
  - Given a URL `http://localhost/app/todo/view/5`
    - Included the file '`controllers/todo.inc`'
    - Called the function '`get_view`' with a parameter array containing the value '5' at index 0.
  - What should `get_view` do?
    - It's a controller.
      - Validate parameters
      - Query the model
      - Render the view

Controllers



Controllers

- controllers/todo.inc

```php
<?php
include_once "include/util.inc";
include_once "models/todo.inc";

function safeParam($arr, $index, $default) {
    if ($arr && isset($arr[$index])) {
        return $arr[$index];
    }
    return $default;
}

# continued ...
```

Controllers

- controllers/todo.inc

```php
<?php
include_once "include/util.inc";
include_once "models/todo.inc";

function safeParam($arr, $index, $default) {
    if ($arr && isset($arr[$index])) {
        return $arr[$index];
    }
    return $default;
}

# continued ...
```

Models contain functions that interact with the database.

Controllers

- controllers/todo.inc

```php
function get_view($params) {
    $id = safeParam($params, 0, false);
    if ($id === false) {
        die("No todo id specified");
    }
    $todo = findToDoById($id);
    if (!$todo) {
        die("No todo with id $id found.");
    }
    renderTemplate(
        "views/todo_view.inc",
        array(
            'title' => 'Viewing To Do',
            'todo' => $todo));
}
```

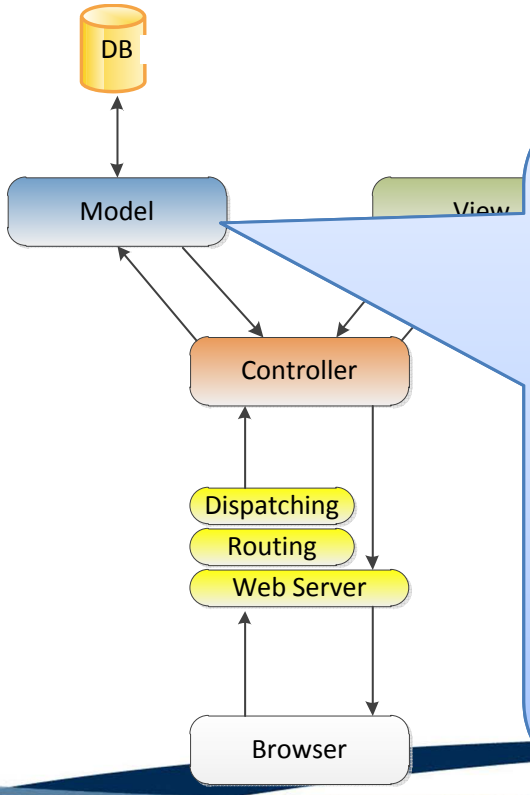
Controllers

- `controllers/todo.inc`

```
function get_view($params) {
    $id = safeParam($params, 0, fals
    if ($id === false) {
        die("No todo id spec
    }
    $todo = findToDoById($id);
    if (!$todo) {
        die("No todo with id $id fo
    }
    renderTemplate(
        "views/todo_view.inc",
        array(
            'title' => 'Viewing To Do',
            'todo' => $todo));
}
```

There are more controllers in this file, i.e. `get_list`, `get_edit`, `post_add`, `post_edit`, etc.

Models



Models abstract the access to the database. Handle create, read, update, delete (CRUD) of rows. Frequently contain many `findByXXX()` functions one update, one insert, one delete function.

Models

- models/todo.inc

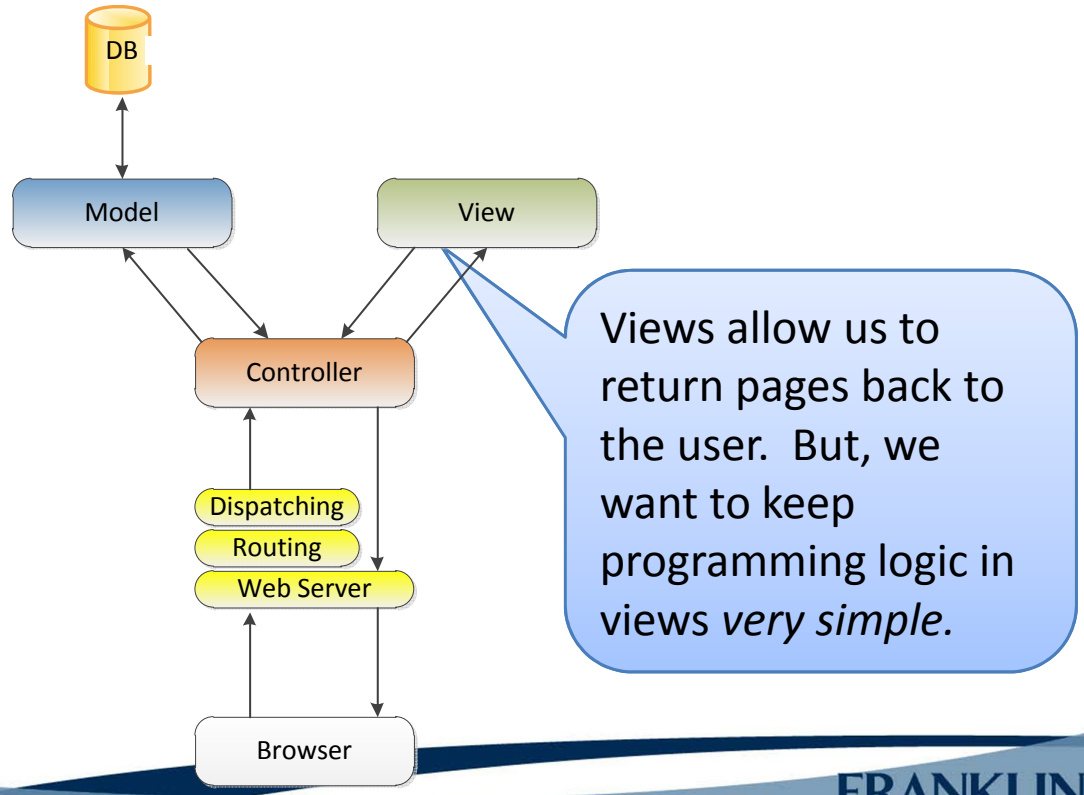
```
<?php
include_once 'models/db.inc';

function findToDoById($id) {
    global $db;
    $st = $db -> prepare('SELECT * FROM todo WHERE id = ?');
    $st -> bindParam(1, $id);
    $st -> execute();
    return $st -> fetch(PDO::FETCH_ASSOC);
}
?>
```


Models

- models/db.inc

```
<?php
global $db;
try {
    $db = new PDO('sqlite:ToDoList.db3');
} catch (PDOException $e) {
    die("Could not open database. " . $e->getMessage());
}
?>
```

Views



Views

- Programming logic in views
  - We don't want any validation, business rules, etc. in our views
  - Only want *display-based* logic, i.e. a loop over the rows in a result set
- Templating
  - Can use includes in PHP to pull in sections but…
  - PHP is an ugly templating language

Views

- Programming logic in views
  - We don't want [illegible]c. in our views
  - Only want *displ* [illegible]e rows in a result
- Templating
  - Can use includes i[illegible]HP to pull in sections but…
  - PHP is an ugly templating language

Ugly code just to render the value of a variable:
<?php echo $someVar **?>**
This would be nicer:
{{$someVar}}

Views

- Solution: build a simple templating engine

```
%% views/header.html %%
<h1>{{$title}}</h1>
<div class='display'>
    <label>Description:</label>
    <div class='value'>{{$todo['description']}}</div>
    <label>Done?:</label>
    <div class='value'>{{$todo['done'] ? 'yes' : 'no'}}</div>
</div>
<p><a href="@@index@@"><< Back</a></p>
%% views/footer.html %%
```

Views

- Solution: build a simple templating engine

```
%% views/header.html %%
<h1>{{$title}}</h1>
<div class='display'>
    <label>Description:</label>
    <div class='value'>{{$todo['description']}}</div>
    <label>Done?:</label>
    <div class='value'>{{$todo['done'] ? 'yes' : 'no'}}</div>
</div>
<p><a href="@@index@@"><< Back</a></p>
%% views/footer.html %%
```

Things enclosed in %% %% are imported.

Things enclosed in {{ }} are variables to echo to output.

Things enclosed in @@ @@ are "relative" URLs.

Standard PHP can be enclosed in [[ ]]. (not shown)

Views

- Solution: build a simple templating engine

```
%% views/header.html %%
<h1>{{$title}}</h1>
<div class='display'>
    <label>Description:</label>
    <div class='value'>{{$todo['description']}}</div>
    <label>Done?:</label>
    <div class='value'>{{$todo['done'] ? 'yes' : 'no'}}</div>
</div>
<p><a href="@@index@@"><< Back</a></p>
%% views/footer.html %%
```

This becomes...

Views

- Solution:

```
%% views/head
<h1>{{$title}
<div class='d
    <label>De
    <div clas
    <label>Do
    <div clas
</div>
<p><a href="@
%% views/todo
```

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html>
    <head>
        <title><?php echo($title); ?></title>
        <link rel="stylesheet" href="/app/static/style.css" />
    </head>
    <body>
        <div class="content">
<h1><?php echo($title); ?></h1>
<div class='display'>
    <label>Description:</label>
    <div class='value'><?php echo($todo['description']); ?></div>
    <label>Done?:</label>
    <div class='value'><?php echo($todo['done'] ? 'yes' : 'no'); ?></div>
</div>
<p><a href="/app/index"><< Back</a></p>
        <div class="footer">
            Copyright &copy; 2012 Todd Whittaker
        </div>
        </div><!-- content div -->
    </body>
</html>
```


Views

- Solution:

```
%% views/head
<h1>{{$title}
<div class='d
    <label>De
    <div clas
    <label>Do
    <div clas
</div>
<p><a href="@
%% views/todo
```

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html>
    <head>
        <title><?php echo($title); ?></title>
        <link rel="stylesheet" href="/app/static/style.css" />
    </head>
    <body>
        <div class="content">
<h1><?php echo($title); ?></h1>
<div class='display'>
    <label>Description:</label>
    <div class='value'><?php echo($todo['desc
    <label>Done?:</label>
    <div class='value'><?php echo($todo['done']
</div>
<p><a href="/app/index"><< Back</a></p>
        <div class="footer">
            Copyright &copy; 2012 Todd Whittaker
        </div>
        </div><!-- content div -->
    </body>
</html>
```

But, where do variables like `$title` come from?

Views

- S

From the array of variables passed into renderTemplate from the controller.

But, where do variables like $title come from?

```
renderTemplate(
    "views/todo_view.inc",
    array(
        'title' => 'Viewing To Do',
        'todo' => $todo
    )
);
```


Views

renderTemplate pseudo-code. Working code in include/util.inc

```
if the template doesn't exist:
   die
if there is a cached version of the view:
   load cached version
else:
   load the template into contents string
   resolve any %% template %% imports recursively
   replace any @@ URL @@ with an absolute URL
   replace any "{{" with "<?php echo("
   replace any "}}" with "); ?>"
   replace any "[[" with "<?php "
   replace any "]]" with "?>"
   write out the new contents to a cache file
extract the array of template parameters
make PHP interpret the contents
echo the interpreted contents
```

Views

```
if the template doesn't exist:
   die
if there is a cached version of the view:
   load cached version
else:
   load the template into contents string
   resolve any %% template %% imports recursively
   replace any @@ URL @@ with an absolute URL
   replace any "{{" wit  "<?php echo("
   replace any "}}" with
   replace any "[["
   replace any "]]"
   write out the ne
extract the array c
make PHP interpret
echo the interprete
```

Plain relative URLs don't work because accessing "`todo/delete/5`" in the browser from the page "`/app/todo/view/1`" would resolve to "`app/todo/view/todo/delete/5`"

Last Words on MVC

- Remember the flow:
  - Router/dispatcher loads the controller and calls the right function
  - Controller function invokes the model for data access or update and then returns a View by:
    - Rendering a template (for GET requests)
    - Redirecting to a URL (for a POST request)

Testing and Debugging

- Three kinds of errors
  - Syntax errors: show up as  in Aptana. Relatively easy to fix (missing semi-colons, quotation marks, parentheses, curly braces, etc). Also show up as parse errors if you try to run the bad script:

> **Parse error**: syntax error, unexpected T_FUNCTION in **C:\xampp\htdocs\model2\include\util.inc** on line **8**

Testing and Debugging

- Three kinds of errors
  - Runtime errors: only show up when you're running the code (i.e. clicking 'refresh'). Some are fatal, others are warnings. Also relatively easy to fix.

> **Warning**: include() [function.include]: Failed opening 'foo.inc' for inclusion (include_path='.;C:\xampp\php\PEAR') in **C:\xampp\htdocs\model2\include\util.inc** on line **7**

Testing and Debugging

- Three kinds of errors
  - Logic errors: The silent killers; very difficult to find and fix. Your algorithm doesn't do what you think it should do. Now you need to debug.
    - Use `echo`, `print`, and `print_r` in conjunction with your browser's "view source" option to see the values of variables.

Testing and Debugging

- There is an easier way.
  - Write testing code to make sure that your production code works like it should.
  - Can be very simple, or you can use a testing framework.

Testing and Debugging

```php
<?php
function assertEquals($expected, $actual) {
    if ($expected != $actual) {
        die("Expected: $expected but got $actual");
    }
}
function calcGasMileage($milesDriven, $gallonsUsed) {
    return $milesDriven / $gallonsUsed;
}
function testCalcGasMileage() {
    $miles = 300;
    $gallons = 15;
    assertEquals(20, calcGasMileage($miles, $gallons));
}
testCalcGasMileage();
print("Everything is fine!");
?>
```


Testing and Debugging

```php
<?php
function assertEquals($expected,
    if ($expected != $actual) {
        die("Expected: $expected
    }
}
function calcGasMileage($milesDriven, $gallonsUsed) {
    return $milesDriven / $gallonsUsed;
}
function testCalcGasMileage() {
    $miles = 300;
    $gallons = 15;
    assertEquals(20, calcGasMileage($miles, $gallons));
}
testCalcGasMileage();
print("Everything is fine!");
?>
```

This should actually be in an included file. Why?

Testing and Debugging

```
<?php
function assertEquals($expected, $act
    if ($expected != $actual) {
        die("Expected: $expected but
    }
}
function calcGasMileage($milesDr
    return $milesDriven / $ga
}
function testCalcGasMileage() {
    $miles = 300;
    $gallons = 15;
    assertEquals(20, calcGasMileage($miles, $gallons));
}
testCalcGasMileage();
print("Everything is fine!");
?>
```

Called a "unit test" since we're testing a single small unit of code (one function in this case). What other numbers should we try?

Testing and Debugging

- Advantages of unit testing
  - Tests run on the server for your business logic
  - Tests build confidence that you are building the system right
  - Tests can be rerun after every change you make to ensure that they still pass.
  - Writing testable code is similar to writing code others can easily read.

Testing and Debugging

- Some PHP unit testing frameworks
  - PHPUnit: https://github.com/sebastianbergmann/phpunit
  - SimpleTest: http://www.simpletest.org/
- Note, testing your JavaScript or GUI is vastly different
  - Jasmine for JavaScript
  - Selinium for GUIs/request-response

Upcoming Deadlines

- Readings for next week
  - Chapters 7 and 8 in *PHP and MySQL*
- Assignments
  - Homework 2 due January 22
  - Lab 1 due January 22
- Next week:
  - Forms and data, control statements

Solutions to HW 1

General Q & A

- Questions?
- Comments?
- Concerns?