COMP284 Scripting Languages
Lecture 13: PHP (Part 5)
Handouts

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Contents

Defining and Instantiating a Class

- PHP is an object-oriented language with classes
- A class can be defined as follows:

```
class identifier {
    property_definitions
    function_definitions
}
```

  - The class name *identifier* is case-sensitive
  - The body of a class consists of property definitions and function definitions
  - The function definitions may include the definition of a constructor
- An object of a class is created using

```
new identifier(arg1,arg2,...)
```

where `arg1,arg2,...` is a possibly empty list of arguments passed to the constructor of the class *identifier*

A Closer Look at Class Definitions

In more detail, the definition of a class typically looks as follows

```
class identifier {
  # Properties
  vis $attrib1
  ...
  vis $attribN = value

  # Constructor
  function __construct(p1,...) {
      statements
  }
  # Methods
  vis function method1(p1,...) {
     statements
  }
  vis function methodN(p1,...) {
     statements
  }
}
```

- Every instance obj of this class will have attributes attrib1,... and methods method1(), ... accessible as obj->attrib1 and obj->method1(a1...)
- __construct is the constructor of the class and will be called whenever new identifier(a1,...) is executed
- vis is a declaration of the visibility of each attribute and method

A Closer Look at Class Definitions

- The pseudo-variable `$this` is available when a method is called from within an object context and is a reference to the calling object
- Inside method definitions, `$this` can be used to refer to the properties and methods of the calling object
- The object operator `->` is used to access methods and properties of the calling object


```
class Rectangle {
  protected $height;
  protected $width;

  function __construct($height,$width) {
     $this->width  = $width;
     $this->height = $height;
  }
}
```

Visibility

- Properties and methods can be declared as

  `public` accessible everywhere

  `private` accessible only within the same class

  `protected` accessible only within the class itself and by inheriting and parent classes

- For properties, a visibility declaration is required
- For methods, a visibility declaration is optional
  - ⇝ by default, methods are `public`
- Accessing a `private` or `protected` property / method outside its visibility is a fatal error


```
class Vis {
  public    $public    = 1;
  private   $private   = 2;
  protected $protected = 3;
  protected function proFc() {}
  private   function priFc() {}
}
$v = new Vis();
echo $v->public;    # prints 1
echo $v->private;   # Fatal Error
echo $v->protected; # Fatal Error
echo $v->priFc();   # Fatal Error
echo $v->proFc();   # Fatal Error
```

Constants

- Classes can have their own constants and constants can be declared to be public, private or protected
  - ↝ by default, class constants are public

```
vis const identifier = value;
```

- Accessing a private or protected constant outside its visibility is a fatal error ↝ execution of the script stops
- Class constants are allocated once per class, and not for each class instance
- Class constants are accessed using the scope resolution operator ::

```
class MyClass {
  const SIZE = 10;
}
echo MyClass::SIZE;   # prints 10
$o = new MyClass();
echo $o::SIZE;        # prints 10
```

Static Properties and Methods

- Class properties or methods can be declared static
- Static class properties and methods are accessed (via the class) using the scope resolution operator ::
- Static class properties cannot be accessed via an instantiated class object, but static class methods can
- Static class method have no access to $this


```
class Employee {
  static $totalNumber = 0;
  public $name;

  function __construct($name) {
    $this->$name = $name;
    Employee::$totalNumber++;
} }
$e1 = new Employee("Ada");
$e2 = new Employee("Ben");
echo Employee::$totalNumber   # prints 2
```

Destructors

- A class can have a destructor method `__destruct` that will be called as soon as there are no other references to a particular object


```
class Employee {
  static $totalNumber = 0;
  public $name;

  function __construct($name) {
    $this->name = $name;
    Employee::$totalNumber++;
  }
  function __destruct() {
    Employee::$totalNumber--;
  }
}
$e1 = new Employee("Ada");
$e2 = new Employee("Ben");
echo Employee::$totalNumber   # prints 2
$e1 = null;
echo Employee::$totalNumber   # prints 1
```

Inheritance

- In a class definition it is possible to specify one parent class from which a class inherits constants, properties and methods:

```
class identifier1 extends identifier2 { ... }
```


- The constructor of the parent class is not automatically called it must be called explicitly from the child class

- Inherited constants, properties and methods can be overridden by redeclaring them with the same name defined in the parent class
- The declaration `final` can be used to prevent a method from being overriden

- Using `parent::` it is possible to access overridden methods or static properties of the parent class
- Using `self::` it is possible to access static properties and methods of the current class

Inheritance: Example

```
class Rectangle {
  protected $height;
  protected $width;
  function __construct($height,$width) {
     $this->width  = $width;
     $this->height = $height;
  }
  function area() {
     return $this->width * $this->height;
} }

class Square extends Rectangle {
  function __construct($size) {
    parent::__construct($size,$size);
} }

$rt1 = new Rectangle(3,4);
echo "\$rt1 area = ",$rt1->area(),"\n";
$sq1 = new Square(5);
echo "\$sq1 area = ",$sq1->area(),"\n";
```

```
$rt1 area = 12
$sq1 area = 15
```

Interfaces

- Interfaces specify which methods a class must implement without providing an implementation
- Interfaces are defined in the same way as a class with the keyword `class` replaced by `interface`
- All methods in an interface must be declared public
- A class can declare that it implements one or more interfaces using the `implements` keyword


```
interface Shape {
  public function area();
}
class Rectangle implements Shape {
  ...
}
```

Introspection Functions

There are functions for inspecting objects and classes:

```
bool class_exists(string class)
returns TRUE iff a class class exists
class_exists('Rectangle')     # returns TRUE
```

```
string get_class(object obj)
returns the name of the class to which an object belongs
get_class($sq1)               # returns 'Square'
```

```
bool is_a(object obj, string class)
returns TRUE iff obj is an instance of class named class
is_a($sq1,'Rectangle')        # returns TRUE
```

```
bool method_exists(object obj,string method)
returns TRUE iff obj has a method named method
method_exists($sq1,'area')    # returns TRUE
```

Introspection Functions

There are functions for inspecting objects and classes:

```
bool property_exists(object obj,string property)
```
returns TRUE iff object has a property named property

```
property_exists($sq1,'size')  # returns FALSE
```

```
get_object_vars(object)
```
returns an array with the accessible non-static properties of object mapped to their values

```
get_object_vars($e2)
# returns ["name" => "Ben"]
```

```
get_class_methods(class)
```
returns an array of method names defined for class

```
get_class_methods('Square')
# returns ["__construct", "area"]
```

The PDO Class

- The PHP Data Objects (PDO) extension defines an interface for accessing databases in PHP
- Various PDO drivers implement that interface for specific database management systems
  - `PDO_MYSQL` implements the PDO interface for MySQL 3.x to 5.x
  - `PDO_SQLSRV` implements the PDO interface for MS SQL Server and SQL Azure

Connections

- Before we can interact with a DBMS we need to establish a connection to it
- A connection is established by creating an instance of the PDO class
- The constructor for the PDO class accepts arguments that specify the database source (DSN), username, password and additional options

```
$pdo = new PDO(dsn, username, password, options);
```

- Upon successful connection to the database, the constructor returns an instance of the PDO class
- The connection remains active for the lifetime of that PDO object
- Assigning NULL to the variable storing the PDO object destroys it and closes the connection

```
$pdo = NULL
```

Connections: Example

```
# Connection information for the Departmental MySQL Server
$host    = "mysql";
$user    = "ullrich";
$passwd  = "--------";
$db      = "ullrich";
$charset = "utf8mb4";
$dsn     = "mysql:host=$host;dbname=$db;charset=$charset";

# Useful options
$opt = array(
  PDO::ATTR_ERRMODE            => PDO::ERRMODE_EXCEPTION,
  PDO::ATTR_DEFAULT_FETCH_MODE => PDO::FETCH_ASSOC,
  PDO::ATTR_EMULATE_PREPARES   => false
);

try {
 $pdo = new PDO($dsn,$user,$passwd,$opt);
} catch (PDOException $e) {
 echo 'Connection failed: ',$e->getMessage();
}
```

Queries

- The `query()` method of PDO objects can be used to execute an SQL query

```
$result = $pdo->query(statement)
$result = $pdo->query("SELECT * FROM meetings")
```

- `query()` returns the result set (if any) of the SQL query as a PDOStatement object
- The `exec()` method of PDO objects executes an SQL statement, returning the number of rows affected by the statement

```
$rowNum = $pdo->exec(statement)
$rowNum = $pdo->exec("DELETE * FROM meetings")
```

Processing Result Sets

- To get a single row as an array from a result set stored in a `PDOStatement` object, we can use the `fetch()` method
- By default, PDO returns each row as an array indexed by the column name and 0-indexed column position in the row

```
$row = $result->fetch()
array('slot' => 1,
      'name' => 'Michael North',
      'email' => 'M.North@student.liverpool.ac.uk',
      0 => 1,
      1 => 'Michael North',
      2 => 'M.North@student.liverpool.ac.uk')
```

- After the last call of `fetch()` the result set should be released using

```
$rows = $result->closeCursor()
```

- The get all rows as an array of arrays from a result set stored in a `PDOStatement` object, we can use the `fetchAll()` method

```
$rows = $result->fetchAll()
```

Processing Result Sets

- We can use a while-loop together with the `fetch()` method to iterate over all rows in a result set

```
while ($row = $result->fetch()) {
  echo "Slot:  ",$row["slot"], "<br>\n";
  echo "Name:  ",$row["name"], "<br>\n";
  echo "Email: ",$row["email"],"<br><br>\n";
}
```

- Alternatively, we can use a foreach-loop

```
foreach($result as $row) {
  echo "Slot:  ",$row["slot"], "<br>\n";
  echo "Name:  ",$row["name"], "<br>\n";
  echo "Email: ",$row["email"],"<br><br>\n";
}
```

Processing Result Sets

- Using `bindColumn()` we can bind a variable a particular column in the result set from a query
  - columns can be specified by number (starting with 1!)
  - columns can be specified by name (matching case)
- Each call to `fetch()` and `fetchAll()` will then update all the variables that are bound to columns
- The binding needs to be renewed after each query execution


```
$result->bindColumn(1, $slot);          # bind by column no
$result->bindColumn(2, $name);
$result->bindColumn('email', $email);   # bind by column name
while ($row = $result->fetch(PDO::FETCH_BOUND)) {
  echo "Slot:  ",$slot, "<br>\n";
  echo "Name:  ",$name, "<br>\n";
  echo "Email: ",$email,"<br><br>\n";
}
```

Prepared Statements

- The use of parameterised prepared statements is preferable over queries
- Prepared statements are are parsed, analysed, compiled and optimised only once
- Prepared statements can be executed repeatedly with different arguments
- Arguments to prepared statements do not need to be quoted and binding of parameters to arguments will automatically prevent SQL injection
- PDO can emulate prepared statements for a DBMS that does not support them
- MySQL supports prepared statements natively, so PDO emulation should be turned off

```
$pdo->setAttribute(PDO::ATTR_EMULATE_PREPARES, FALSE );
```

Prepared Statements: SQL Templates

- An SQL template is an SQL query (as a string) possibly containing either
  - named parameters of the form :*name* where *name* is a PHP identifier, or
  - question marks ?

  for which values will be substituted when the query is executed

```
$tpl1 = "select slot from meetings where
    name=:name and email=:email";
$tpl2 = "select slot from meetings where name=?";
```

- The PDO method `prepare()` turns an SQL template into prepared statement (by asking the DBMS to do so)
  - on success, a PDOStatement object is returned
  - on failure, `FALSE` or an error will be returned

```
$stmt1 = $pdo->prepare($tpl1);
$stmt2 = $pdo->prepare("select * from fruit where col=?");
```

Prepared Statements: Binding

- We can bind the parameters of a PDOStatement object to a value using the `bindValue()` method
  - Named parameters are bound by name
  - Question mark parameters are bound by position (starting from 1!)
  - the datatype of the value can optionally be declared (to match that of the corresponding database field)
  - the value is bound to the parameter at the time `bindValue()` is executed

```
$stmt1->bindValue(':name','Ben',PDO::PARAM_STR);
$email = 'bj1@liv.ac.uk';
$stmt1->bindValue(':email',$email);
$stmt2->bindValue(1,20,PDO::PARAM_INT);
```

Prepared Statements: Binding

- We can bind the parameters of a PDOStatement object to a variable using the `bindParam()` method
  - Named parameters are bound by name
  - Question mark parameters are bound by position (starting from 1!)
  - the datatype of the value can optionally be declared (to match that of the corresponding database field)
  - the variable is bound to the parameter as a reference
  - a value is only substituted when the statement is executed

```
$name  = 'Ben';
$stmt1->bindParam(':name',$name,PDO::PARAM_STR);
$stmt1->bindParam(':email',$email);
$email = 'bj1@liv.ac.uk';
$slot  = 20;
$stmt2->bindParam(1,$slot,PDO::PARAM_INT);
```

- It is possible to mix `bindParam()` and `bindValue()`

Prepared Statements: Execution

- Prepared statements are executed using `execute()` method
- Parameters must
  - previously have been bound using `bindValue()` or `bindParam()`, or
  - be given as an array of values to `execute`
    - ⇝ take precedence over previous bindings
    - ⇝ are bound using `bindValue()`
- `execute()` returns `TRUE` on success or `FALSE` on failure
- On success, the `PDOStatement` object stores a result set (if appropriate)

```
$stmt1->execute();
$stmt1->execute(array(':name' => 'Ive', ':email' => $email));
$stmt2->execute(array(10));
```

Transactions

- There are often situations where a single 'unit of work' requires a sequence of database operations
  ⇝ e.g. bookings, transfers
- By default, PDO runs in "auto-commit" mode
  ⇝ successfully executed SQL statements cannot be 'undone'
- To execute a sequence of SQL statements whose changes are
  - only committed at the end once all have been successful or
  - rolled back otherwise,

  PDO provides the methods
  - `beginTransaction()`
  - `commit()`
  - `rollBack()`

Transactions

To support transactions, PDO provides the methods

`beginTransaction()`
- turns off auto-commit mode; changes to the database are not committed until `commit()` is called
- returns `TRUE` on success or `FALSE` on failure
- throws an exception if another transaction is already active

`commit()`
- changes to the database are made permanent; auto-commit mode is turned on
- returns `TRUE` on success or `FALSE` on failure
- throws an exception if no transaction is active

`rollBack()`
- discard changes to the database; auto-commit mode is restored
- returns `TRUE` on success or `FALSE` on failure
- throws an exception if no transaction is active

Transactions: Example

```php
$pdo = new PDO('mysql:host=...;dbname=...','...','...',
       array(PDO::ATTR_ERRMODE => PDO::ERRMODE_EXCEPTION,
             PDO::ATTR_EMULATE_PREPARES => false));
$pdo->beginTransaction();
try{
  $userId = 1;          $paymentAmount = 10.50;

  //Query 1: Attempt to insert a payment record
  $sql = "INSERT INTO payments (user_id, amount) VALUES (?, ?)";
  $stmt = $pdo->prepare($sql);
  $stmt->execute(array($userId,$paymentAmount));

  //Query 2: Attempt to update the user's account
  $sql = "UPDATE accounts SET balance = balance + ? WHERE id = ?";
  $stmt = $pdo->prepare($sql);
  $stmt->execute(array($paymentAmount,$userId));

  // Commit the transaction
  $pdo->commit();
} catch(Exception $e){
  echo $e->getMessage();
  //Rollback the transaction
  $pdo->rollBack();
}
```

Based on http://thisinterestsme.com/php-pdo-transaction-example/

Revision

Read

- Language Reference: Classes and Objects
  `http://php.net/manual/en/language.oop5.php`
- The PDO Class
  `http://php.net/manual/en/class.pdo.php`

of M. Achour, F. Betz, A. Dovgal, et al. PHP Manual. The PHP Group, 2017. `http://uk.php.net/manual/en` [accessed 07 Dec 2017]