PHP Data Objects
Layer (PDO)

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What is PDO

- Common interface to any number of database systems.
- Written in C, so you know it’s FAST!
- Designed to make use of all the PHP 5.1 features to simplify interface.
Why is it needed?

- Current state of affairs:
  - Many native database extensions that are similar but do not provide the same interface.
  - In most cases, very old code that does not even scratch the surface of what PHP can offer.
  - In many instances does not account for all the capabilities offered by the database.
    - Ex. SQLite, MySQL extensions
What Databases are Supported?

- At this time PDO offers the following drivers:
  - MySQL 3,4,5 (depends on client libs)
  - PostgreSQL
  - SQLite 2 & 3
  - ODBC
  - DB2
  - Oracle
  - Firebird
  - FreeTDS/Sybase/MSSQL
Installing PDO

PDO is divided into two components

- CORE (provides the interface)
- DRIVERS (access to particular database)
  - Ex. pdo_mysql

The CORE is enabled by default, drivers with the exception of pdo_sqlite are not.
Actual Install Steps

- **PECL Way**
  - `pecl install pdo_[driver_name]`
  - Update `php.ini` and add
    `extension=pdo_[driver_name].so` (or `.dll` on win32)

- **Built into PHP**
  - `./configure --with-pdo-[driver_name]`

- **For Win32 dlls for each driver are available.**
Using PDO

As is the case with all database interfaces, the 1st step involves establishing a connection.

// MySQL connection
new PDO('mysql:host=localhost;dbname=testdb', $login, $passwd);

// PostgreSQL
new PDO('pgsql:host=localhost port=5432 dbname=testdb user=john password=mypass');

// SQLite
new PDO('sqlite:/path/to/database_file');
As is the case with most native PHP objects, instantiation failure lead to an exception being thrown.

```php
try {
    $db = new PDO(...);
} catch (PDOException $e) {
    echo $e->getMessage();
}
```
Connecting to complex databases like Oracle is a slow process, it would be nice to re-use a previously opened connection.

```php
$opt = array(PDO::ATTR_PERSISTENT => TRUE); try {
    $db = new PDO("dsn", $l, $p, $opt);
} catch (PDOException $e) {
    echo $e->getMessage();
}
```
The DSN string can be an INI setting and you can “name” as many DSNs are you like.

```php
ini_set("pdo.dsn.ilia", "sqlite::memory");
try {
    $db = new PDO("ilia");
} catch (PDOException $e) {
    echo $e->getMessage();
}
```
Let’s Run Some Queries

- Query execution in PDO can be done in two ways
  - Prepared Statements (recommended for speed & security)
  - Direct Execution
Direct Query Execution

- Queries that modify information need to be run via `exec()` method.
  
  ```php
  $db = new PDO("DSN");
  ```

  ```php
  $db->exec("INSERT INTO foo (id) VALUES('bar')");
  ```

  ```php
  $db->exec("UPDATE foo SET id=‘bar’");
  ```

- The return value is the number of rows affected by the operation or FALSE on error.
In some cases “change” queries may not affect any rows and will return 0, so type-sensitive compare is essential in avoiding false positives!

```php
$res = $db->exec("UPDATE foo SET id='bar'");

if (!$res) // Wrong

if ($res !== FALSE) // Correct
```
Retrieving Error Information

- PDO Provides 2 methods of getting error information:
  - `errorCode()` – SQLSTATE error code
    - Ex. 42000 == Syntax Error
  - `errorInfo()` – Detailed error information
    - Ex. array(
          
          [0] => 42000,
          [1] => 1064
          [2] => You have an error in your SQL syntax; …
       )
Better Error Handling

- It stands to reason that being an OO extension PDO would allow error handling via Exceptions.

```php
$db->setAttribute(
    PDO::ATTR_ERRMODE,
    PDO::ERRMODE_EXCEPTION
);
```

- Now any query failure will throw an Exception.
Direct Execution Cont.

- When executing queries that retrieve information the `query()` method needs to be used.

```
$res = $db->query("SELECT * FROM foo");
// $res == PDOStatement Object
```

- On error FALSE is returned
Perhaps one of the biggest features of PDO is its flexibility when it comes to how data is to be fetched.

- Array (Numeric or Associated Indexes)
- Strings (for single column result sets)
- Objects (stdClass, object of given class or into an existing object)
- Callback function
- Lazy fetching
- Iterators
- And more!
Array Fetching

```php
$res = $db->query("SELECT * FROM foo");
while ($row = $res->fetch(PDO::FETCH_NUM)){
    // $row == array with numeric keys
}

$res = $db->query("SELECT * FROM foo");
while ($row = $res->fetch(PDO::FETCH_ASSOC)){
    // $row == array with associated (string) keys
}

$res = $db->query("SELECT * FROM foo");
while ($row = $res->fetch(PDO::FETCH_BOTH)){
    // $row == array with associated & numeric keys
}
```
Many applications need to fetch data contained within just a single column.

```php
$u = $db->query("SELECT users WHERE login='login' AND password='password'");
// fetch(PDO::FETCH_COLUMN)
if ($u->fetchColumn()) {
    // returns a string
    // login OK
} else {
    /* authentication failure */
}
```
You can fetch a row as an instance of stdClass where column name == property name.

```
$res = $db->query("SELECT * FROM foo");

while ($obj = $res->fetch(PDO::FETCH_OBJ)) {
    // $obj == instance of stdClass
}
```
PDO allows the result to be fetched into a class type of your choice.

```php
$res = $db->query("SELECT * FROM foo");
$res->setFetchMode(
    PDO::FETCH_CLASS,
    "className",
    array('optional'='Constructor Params'));
while ($obj = $res->fetch()) {
    // $obj == instance of className
}
```
PDO allows the query result to be used to determine the destination class.

```php
$res = $db->query("SELECT * FROM foo");
$res->setFetchMode(
    PDO::FETCH_CLASS | PDO::FETCH_CLASSTYPE
);

while ($obj = $res->fetch()) {
    // $obj == instance of class who’s name is found in the value of the 1st column
}
```
PDO even allows retrieval of data into an existing object.

```php
$u = new userObject;

$res = $db->query("SELECT * FROM users");
$res->setFetchMode(PDO::FETCH_INTO, $u);

while ($res->fetch()) {
    // will re-populate $u with row values
}
```
PDOStatement implements Iterator interface, which allows for a method-less result iteration.

```php
$res = $db->query(
    "SELECT * FROM users",
    PDO::FETCH_ASSOC
);
foreach ($res as $row) {
    // $row == associated array representing
    // the row’s values.
}
```
Lazy Fetching

Lazy fetches returns a result in a form object, but holds off populating properties until they are actually used.

```php
$res = $db->query(
    "SELECT * FROM users",
    PDO::FETCH_LAZY
);
foreach ($res as $row) {
    echo $row['name']; // only fetch name column
}
```
fetchAll()

- The fetchAll() allows retrieval of all results from a query right away. (handy for templates)

```php
$qry = "SELECT * FROM users";
$res = $db->query($qry)->fetchAll(PDO::FETCH_ASSOC);
// $res == array of all result rows, where each row is an associated array.
```

- Can be quite memory intensive for large results sets!
PDO also provides a fetch mode where each result is processed via a callback function.

```php
function draw_message($subject,$email) { … } 

$res = $db->query("SELECT * FROM msg");

$res->fetchAll(
    PDO::FETCH_FUNC,
    "draw_message"
);
Direct Query Problems

- Query needs to be interpreted on each execution can be quite waste for frequently repeated queries.

- Security issues, un-escaped user input can contain special elements leading to SQL injection.
Escaping in PDO

- Escaping of special characters in PDO is handled via the `quote()` method.

```php
$qry = "SELECT * FROM users WHERE login='$_POST['login']' AND passwd='$_POST['pass']';"
```

Prepared Statements

- Compile once, execute as many times as you want.
- Clear separation between structure and input, which prevents SQL injection.
- Often faster then `query()`/`exec()` even for single runs.
$stmt = $db->prepare("SELECT * FROM users WHERE id=?");

$stmt->execute(array($_GET['id']));

$stmt->fetch(PDO::FETCH_ASSOC);
**Bound Parameters**

- Prepared statements parameters can be given names and bound to variables.

```php
$stmt = $db->prepare(
    "INSERT INTO users VALUES(:name,:pass,:mail)"
);

foreach (array('name','pass','mail') as $v) {
    $stmt->bindParam(':'.$v,$$v);
}

$fp = fopen('./users', "r");
while (list($name,$pass,$mail) = fgetcsv($fp,4096)) {
    $stmt->execute();
}
```
Bound Result Columns

- Result columns can be bound to variables as well.

```
$qry = "SELECT :type, :data FROM images LIMIT 1";
$stmt = $db->prepare($qry);

$stmt->bindColumn(':type',$type);
$stmt->bindColumn(':type',STDOUT,PDO::PARAM_LOB);
$stmt->execute(PDO::FETCH_BOUND);

header("Content-Type: ".$type);
```
Partial Data Retrieval

In some instances you only want part of the data on the cursor. To properly end the cursor use the `closeCursor()` method.

```php
$res = $db->query("SELECT * FROM users");
foreach ($res as $v) {
    if ($res['name'] == 'end') {
        $res->closeCursor();
        break;
    }
}
```
Transactions

- Nearly all PDO drivers talk with transactional DBs, so PDO provides handy methods for this purpose.

```php
$db->beginTransaction();
if ($db->exec($qry) === FALSE) {
    $db->rollback();
}
$db->commit();
```
Like most native database interfaces PDO provides means of accessing query metadata.

```php
$res = $db->query($qry);

(ncols = $res->columnCount();
for ($i=0; $i < $ncols; $i++) {
    $meta_data = $stmt->getColumnMeta($i);
}
```
getColumnMeta() Result

- native_type – PHP data type
- driver:decl_type - The data type of the column according to the database.
- flags – will return any flags particular to this column in a form of an array.
- name – the name of the column as returned by the database without any normalization.
- len – maximum length of a string column, may not always be available, will be set to -1 if it isn’t.
- precision - The numeric precision of this column.
- pdo_type - The column type according to PDO as one of the PDO_PARAM constants.
lastInsertId()

- Many databases have unique identifier assigned to each newly inserted row. PDO provides access to this value via lastInsertId() method.

```php
if ($db->exec("INSERT INTO ...")) {
    $id = $db->lastInsertId();
}
```

- Can take optional sequence name as parameter.
  - Useful for PostgreSQL
Some connection information can be obtained via the `getAttribute()` PDO method.

```php
$db->getAttribute(PDO::ATTR_SERVER_VERSION);
// Database Server Version
$db->getAttribute(PDO::ATTR_CLIENT_VERSION);
// Client Library Server Version
$db->getAttribute(PDO::ATTR_SERVER_INFO);
// Misc Server information
$db->getAttribute(PDO::ATTR_CONNECTION_STATUS);
// Connection Status
```
class DB extends PDO {

    function query($qry, $mode=NULL) {
        $res = parent::query($qry, $mode);
        if (!$res) {
            var_dump($qry, $this->errorInfo());
            return null;
        } else {
            return $res;
        }
    }
}