APPLICATION LOGIC SECURITY

Ilia Alshanetsky

@iliaa

The Usual Suspects

- Cross-Site Scripting (XSS)
- Cross-Site Request Forgery (CSRF)
- Code Injection
- Authentication Issues & Session Management
- Insecure Cryptographic Storage
- Insufficient Transport Layer Protection
- Unvalidated Redirects
- Security Misconfiguration

OWASP Top 10 List

The Usual Suspects

* Cross-Site Scripting (XSS)
* Cross-Site Request Forgery (CSRF)
* Code Injection

Common Topics for Conversation, but not Today

* Authentication Issues & Session Management
* Insecure Cryptographic Storage
* Insufficient Transport Layer Protection
* Unvalidated Redirects
* Security Misconfiguration

OWASP Top 10 List

SO WHAT AM I GOING TO TALK ABOUT?

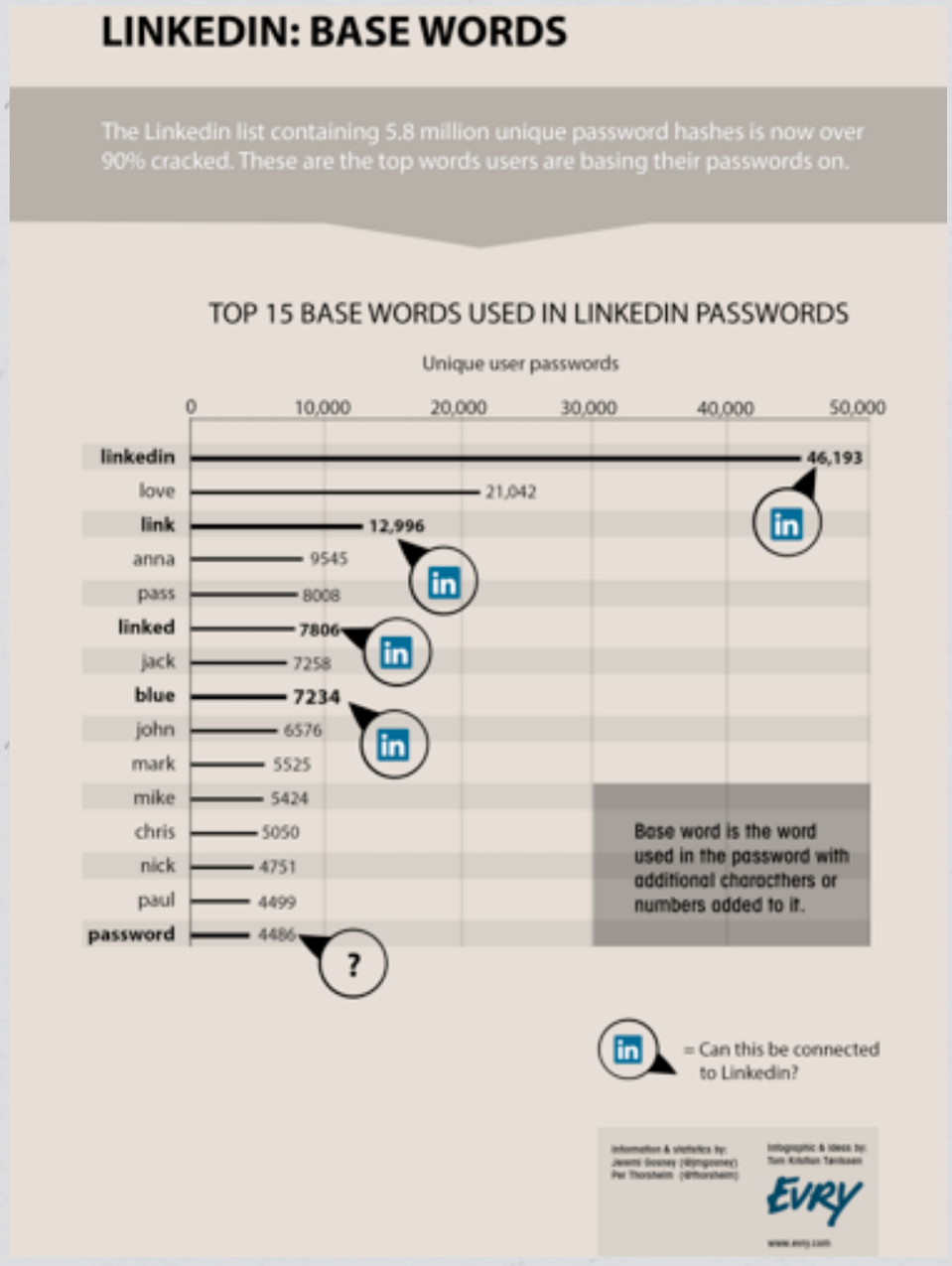
AUTHENTICATION

Require Strong Passwords

* Require password **length of 8** characters
* Enforce Password Complexity (3 of 4 rules):
  * At least one **upper-case letter**
  * At least one **lower-case letter**
  * At least one **number**
  * At least one **special** (non-alphanumeric) **character**

But even that is weak…

* Rainbow Tables
* GPU optimized hash breaking
* AWS ;-)



Secure Password Hashes

```php
$password = "@foo1Bar#";

$passwd = crypt($password,
   '$2y' . // BlowFish base
   '$10$' . // cryptographic complexity
   bin2hex(fread(fopen("/dev/urandom", "r"), 32)) // random bytes
   .'$'
);

if ($passwd === crypt($password, substr($passwd, 0, 29))) {
    // password ok
} else {
    // password check failed
}
```

This will generate a password hash 60 bytes long

PHP 5.5 Makes This Simpler

```php
$hash = password_hash($password,
    PASSWORD_BCRYPT,
    ['cost' => 10]
);


if (password_verify($password, $hash)) {
    // password ok
} else {
    // password check failed
}
```

Prevent Brute Force Attacks

* Limit the number of sequential unsuccessful attempts to 3 - 5
* After that implement one or more of the following:
  * Lockout future attempts for 10-15 minutes
  * Require entry of CAPTCHA for all further attempts
  * Require multi-factor authentication
    * SMS if you have phone number
    * E-mail if you don’t

Prevent Brute Force Attacks

* Implement blocks for multiple failed authentication attempts from the same IP address
* Don’t use the standard “login” and “password” form field names
* Re-authorize attempts when login is successful from an unknown IP address and/or Browser.
* If possible randomly generate the field names for authentication forms

Unpredictable Field Names

```php
<?php
// secret key for encoding form fields
$_SESSION['__form_key'] = $secret =
                bin2hex(openssl_random_pseudo_bytes(16));
?>
<form>
Login: <input type="text"
name="<?= hash_hmac('md5', 'login', $secret); ?>" />
<br />Password: <input type="password"
name="<?= hash_hmac('md5', 'password', $secret); ?>" />
</form>
```

Processing

```
$secret = $_SESSION['__form_key'];
$input = array();

foreach ($field_names as $v) {

    $hashed_name = hash_hmac('md5', $v, $secret);

    if (isset($_POST[$hashed_name])) {
        $input[$v] = $_POST[$hashed_name];
    }
}
```

Post Authentication Paranoia

* Ensure Session Expiry Times are enforced at 24 - 30 mins
* Idle time logout after 10 mins of in-activity (JavaScript)
* For long-term session require re-authentication for key actions
  * Profile Changes
  * E-Commerce activities
* Prevent duplicate logins

SESSION SECURITY

Basic Protections

* Only use cookies

```
ini_set("session.use_only_cookies", true);
```

* Ensure session ID integrity

```
ini_set("session.entropy_file", "/dev/unrandom");
ini_set("session.entropy_length", "32");
ini_set("session.hash_bits_per_character", 6);
```

* Use HTTPOnly cookies for session storage

```
ini_set("session.cookie_httponly", true);
```

* Set Secure session bit (when using SSL/TLS)

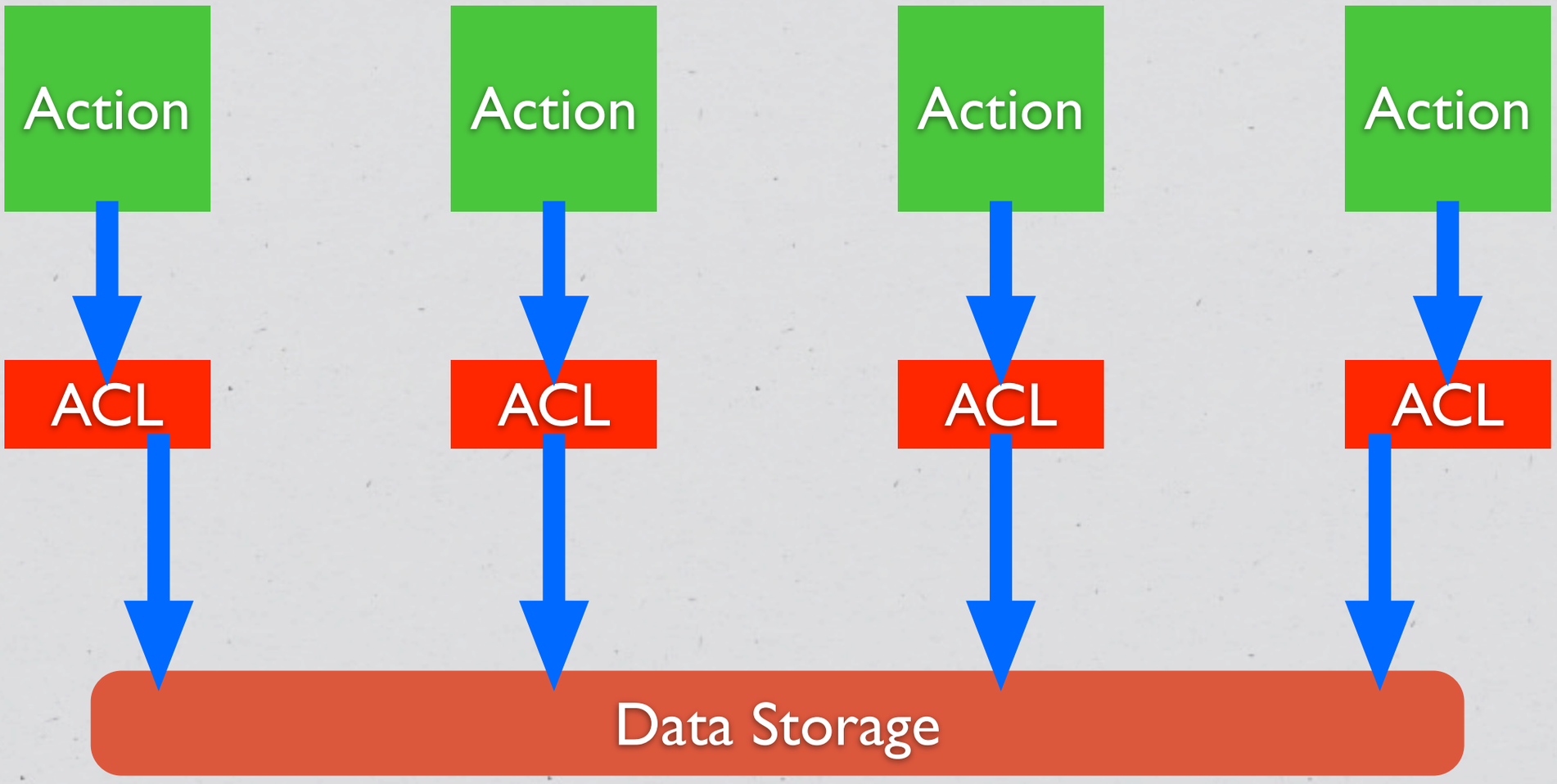
```
ini_set("session.cookie_secure", true);
```

Avoid Session Fixation

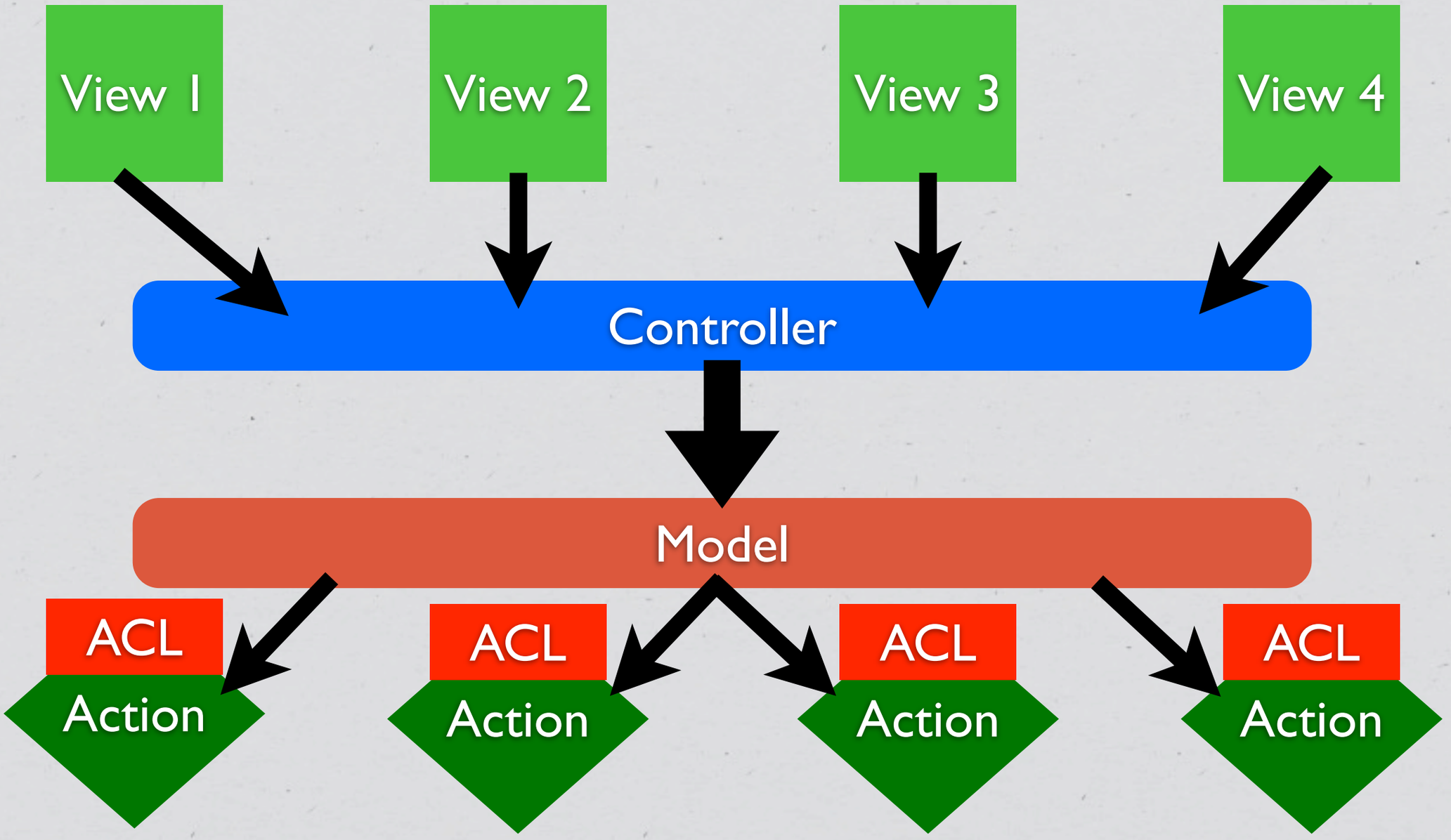
```
ini_set("session.name", "unique name");
session_start();

if (empty($_SESSION['__validated'])) {
     session_regenerate_id(true);
     $_SESSION['__validated'] = 1;
}
```

DATA ACCESS MANAGEMENT

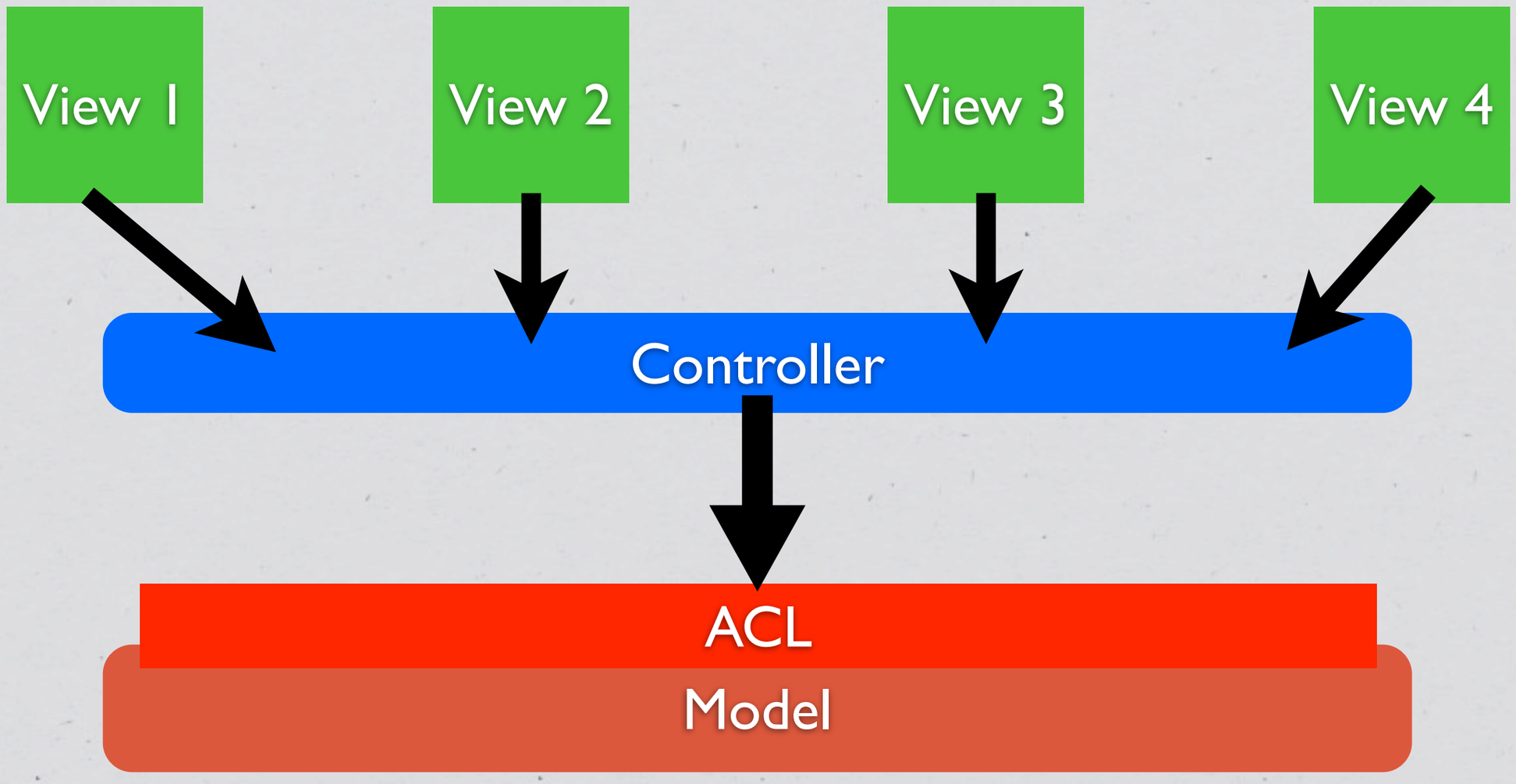
Typical Situation (pre-MVC)



Typical Situation (Post-MVC)



Ideal Approach



```php
class DataModel {
    private $aclRules = array();

    public function __construct() {
        $this->aclRules['user_id'] = $_SESSION['user_id'];

        switch ($_SESSION['role']) {
            case 'admin':
                break;
            case 'user':
                $this->aclRules['public'] = 1;
                break;
            case 'editor':
                $this->aclRules['category'] = $_SESSION['category'];
                break;
        }
    }

    public function ActionName(array $params) {
        $input = array_replace_recursive($params, $this->aclRules);
        $this->runAction($input);
    }
}
```


Leaving a paper trail is hard work.
Time for a nap.
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AUDIT TRAIL

Why?

* Makes tracking down user activity easier when there is a security issue…
* All kinds of uses for debugging purposes
* Allows for pattern analysis for “unusual” activity detection
* Creates a “revert” path, almost versioning

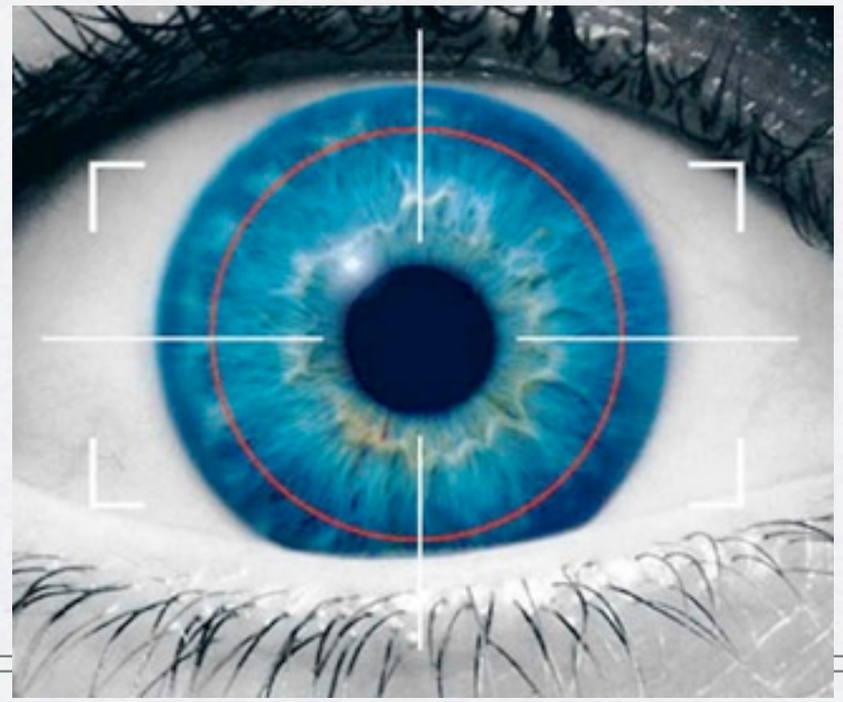
How?

* Should be done at the lowest level possible to avoid creating a possibility of un-audit-able actions.

* **Inside a Model**

* **Inside Database (via triggers)**

```php
class DataModel {
    private function __save() {
        $current = $this->fetch($this->id);
        $changes = array_diff_assoc($this->input, $current);

        $this->pdo->beginTransaction();

        if (($return_val = parent::save())) {
            $this->log(array(
                'user_id'    => $_SESSION['user_id'],
                'when'       => microtime(1),
                'what'       => get_class($this),
                'record'     => $this->id,
                'changes'    => serialize($changes)
            ));

            $this->pdo->commit();
        } else {
            $this->pdo->rollback();
        }

        return $return_val;
    }
}
```



“UNUSUAL” PATTERN ANALYSIS

What does it mean?

* The best application vulnerabilities are the ones no one knows about.

* But even those usually require some “trial & error” to get to the hack

* Reviewing audit trails and access logs often can let you spot something “unusual”, even before knowing what it is…

Patterns to Look For

* Unusually high number of request per session

* Atypical access pattern (late at night, different browser/IP combinations)

* Frequent accesses to same page within very short span of time, especially so if it is a data modification page.

LOW (MODEL) LEVEL INPUT VALIDATION

Application should verify it's own inputs

Even at a low-level of a model, application should verify input for validity

```php
class DataModel {
    private $input_config = array(
     'active' => array(
                 'filter' => FILTER_VALIDATE_BOOLEAN,
                 'flags' => FILTER_REQUIRE_SCALAR),
     'login'  => array(
                 'filter' => FILTER_VALIDATE_REGEXP,
                 'flags' => FILTER_REQUIRE_SCALAR,
                 'options' => array('regexp' => '!^[A-Za-z0-9_]+$!')),
     'id'     => array(
                 'filter' => FILTER_VALIDATE_INT,
                 'flags' => FILTER_REQUIRE_SCALAR,
                 'options' => array('min_range' => 1)),
     'email'  => array(
                 'filter' => FILTER_VALIDATE_EMAIL,
                 'flags' => FILTER_REQUIRE_SCALAR),
      'blog'   => array(
                 'filter' => FILTER_VALIDATE_URL,
                 'flags' => FILTER_REQUIRE_SCALAR)
    );

    public function save() {
        if (!filter_var_array($this->input, $this->input_config)) {
            throw new validationException('Invalid input');
        }
        // proceed as normal
    }
}
```

REMOTE URL ACCESS

Things to Consider

* Whenever possible use the API URL sitting behind HTTPs

* Ensure that Peer and Domain verification is enabled

* If you are using cURL know what your settings mean…

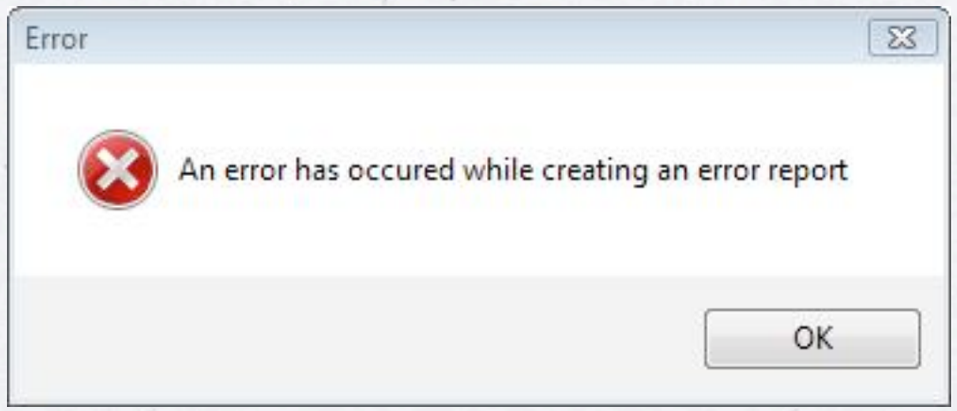
Native PHP

```php
$url = 'https://en.wikipedia.org/w/api.php ...';

$context = array(
    'ssl' => array(
        'verify_peer'    => TRUE,
// wget http://curl.haxx.se/ca/cacert.pem
        'cafile'         => '/usr/share/ssl/cacert.pem',
        'verify_depth'   => 5,
        'CN_match'       => 'en.wikipedia.org'
    ),
    'http' => array(
        'user_agent' => 'My App',
        'ignore_errors' =>  TRUE
    )
);

file_get_contents($url, NULL, stream_context_create($context));
```

With cURL

```
$curlh = curl_init($url);
curl_setopt($curlh, CURLOPT_RETURNTRANSFER, TRUE);
curl_setopt($curlh, CURLOPT_CAINFO,
                    '/usr/share/ssl/cert-bundle.crt');
$data = curl_exec($curlh);
```

* Do not set CURLOPT_SSL_VERIFYPEER to FALSE
* Do not set CURLOPT_SSL_VERIFYHOST to FALSE or 1

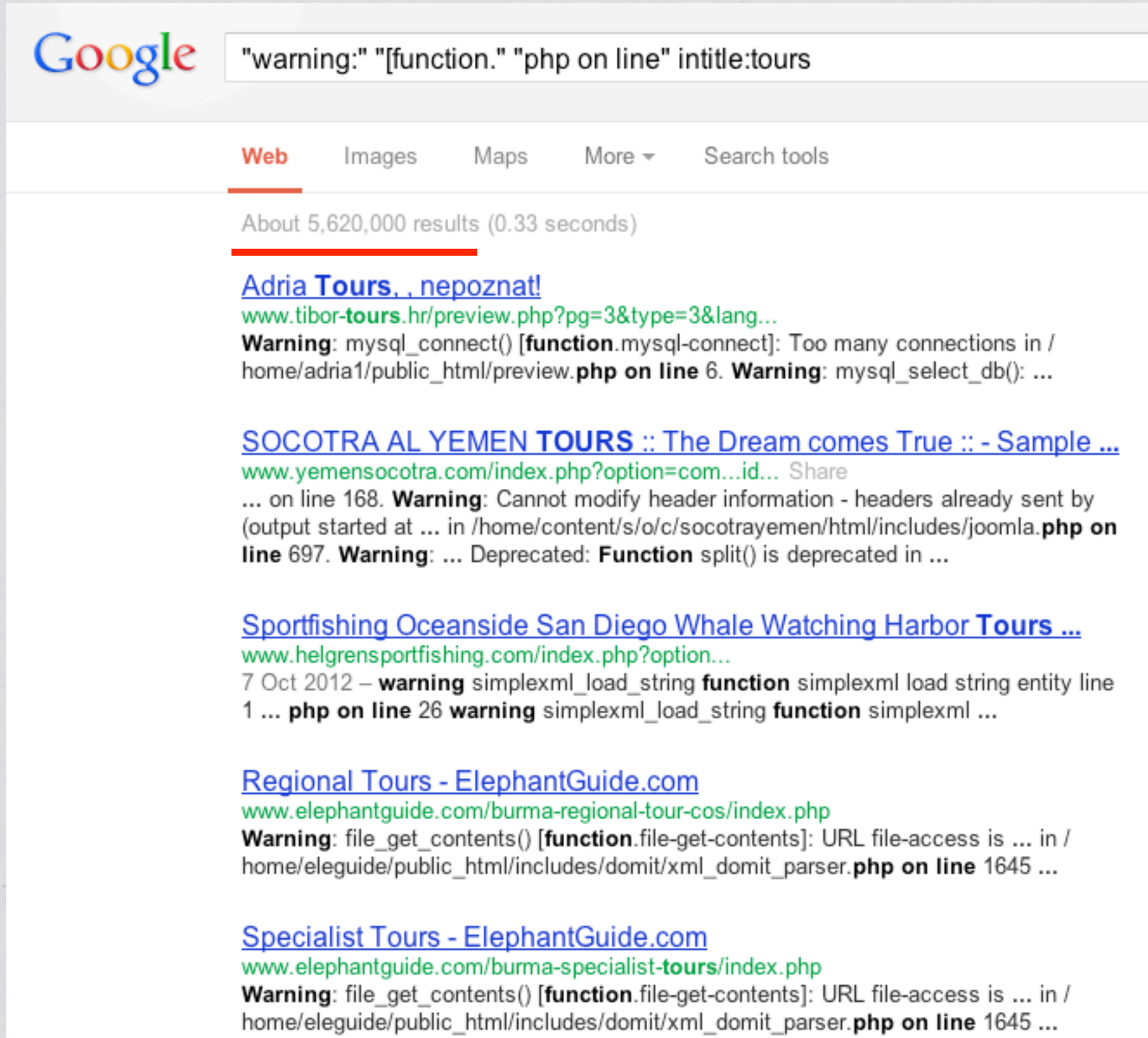


PHP ERROR HANDLING

How to Handle Them?

* Log all errors
* Logging should not have dependencies
  * Disk is a good target
  * So is syslog
* There are no “trivial” errors

```php
ini_set("display_errors", false);
```



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