Advanced Perl Techniques Day 2

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What We Will Cover

- Profiling and Benchmarking
- Object oriented programming with Moose
- MVC Frameworks
  - Catalyst
- PSGI and Plack

Schedule

- 09:45 – Begin
- 11:15 – Coffee break
- 13:00 – Lunch
- 14:00 – Begin
- 15:30 – Coffee break
- 17:00 – End

Resources

- Slides available on-line
  - http://mag-sol.com/train/public/2011-02/adv
- Also see Slideshare
  - http://www.slideshare.net/davorg/slideshows
- Get Satisfaction
  - http://getsatisfaction.com/magnum

Benchmarking & Profiling

Benchmarking

- Ensure that your program is fast enough
- But how fast is fast enough?
- *premature optimization is the root of all evil*
  - Donald Knuth
  - paraphrasing Tony Hoare
- Don't optimise until you know what to optimise

Benchmark.pm

- Standard Perl module for benchmarking
- Simple usage
- ```
  use Benchmark;
  my %methods = (
      method1 => sub { ... },
      method2 => sub { ... },
  );
  timethese(10_000, \%methods);
  ```
- Times 10,000 iterations of each method

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Benchmark.pm Output

- Benchmark: timing 10000 iterations of method1, method2...

```
method1:  6 wallclock secs \
( 2.12 usr +  3.47 sys =  5.59 CPU) \
  @ 1788.91/s (n=10000)
method2:  3 wallclock secs \
( 0.85 usr +  1.70 sys =  2.55 CPU) \
  @ 3921.57/s (n=10000)
```

Timed Benchmarks

- Passing `timethese` a positive number runs each piece of code a certain number of times
- Passing `timethese` a negative number runs each piece of code for a certain number of seconds

Timed Benchmarks

- ```
  use Benchmark;
  my %methods = (
      method1 => sub { ... },
      method2 => sub { ... },
  );

  # Run for 10,000(!) seconds
  timethese(-10_000, \%methods);
  ```


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Comparing Performance

- Use `cmpthese` to get a tabular output
- Optional export
- ```
  use Benchmark 'cmpthese';
  my %methods = (
      method1 => sub { ... },
      method2 => sub { ... },
  );
  cmpthese(10_000, \%methods);
  ```
  ```

cmpthese Output

- ```
                    Rate method1 method2
  method1 2831802/s      --     -61%
  method2 7208959/s    155%       --
  ```
- method2 is 61% slower than method1
- Can also pass negative number to `cmpthese`

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Benchmarking is Hard

- Very easy to produce lots of numbers
- Harder to ensure that the numbers are meaningful
- Compare code fragments that do the same thing

Bad Benchmarking

```
use Benchmark qw{ timethese };
timethese( 1_000, {
  Ordinary    => sub {
   my @results = sort { -M $a <=> -M $b }
                      glob "/bin/*";
},
  Schwartzian => sub {
        map $_->[0],
        sort { $a->[1] <=> $b->[1] }
        map [$_, -M], glob "/bin/*";
      },
});
```

What to Benchmark

- Profile your code
- See which parts it is worth working on
- Look for code that
  - Takes a long time to run, or
  - Is called many times, or
  - Both

Devel::DProf

- Devel::DProf is the standard Perl profiling tool
- Included with Perl distribution
- Uses Perl debugger hooks
- `perl -d:DProf your_program`
- Produces a data file called tmon.out
- Command line program dprofpp to view results

Sample Output

- ```
  $ perl -d:DProf ./invoice.pl 244
  $ dprofpp
  Total Elapsed Time = 1.173152 Seconds
    User+System Time = 0.963152 Seconds
  Exclusive Times
  %Time ExclSec CumulS #Calls sec/call Csec/c  Name
   6.02   0.058  0.067    482   0.0001 0.0001  Params::Validate::_validate
   5.09   0.049  0.114      7   0.0070 0.0163  Class::DBI::Loader::mysql::BEGIN
   4.15   0.040  0.050     10   0.0040 0.0050  Template::Parser::BEGIN
   4.15   0.040  0.166      7   0.0057 0.0237  DateTime::Locale::BEGIN
   4.05   0.039  0.094     43   0.0009 0.0022  base::import
   3.74   0.036  0.094    449   0.0001 0.0002  DateTime::Locale::_register
   3.11   0.030  0.280      4   0.0074 0.0700  DateTime::Format::MySQL::BEGIN
   2.91   0.028  0.028    170   0.0002 0.0002  Lingua::EN::Inflect::_PL_noun
   2.70   0.026  0.040      1   0.0262 0.0401  Template::Parser::_parse
   2.49   0.024  0.024   1113   0.0000 0.0000  Class::Data::Inheritable::__ANON__
   2.08   0.020  0.020     12   0.0017 0.0017  DBD::mysql::db::_login
   2.08   0.020  0.020      4   0.0050 0.0050  Template::Stash::BEGIN
   2.08   0.020  0.099      9   0.0022 0.0110  Template::Config::load
   2.08   0.020  0.067      9   0.0022 0.0074  Template::BEGIN
   2.08   0.020  0.039      4   0.0049 0.0097  Lingua::EN::Inflect::Number::BEGIN
  ```


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Devel::NYTProf

- New profiling module
- Based on work from the New York Times
- Enhanced by Tim Bunce
- Pretty HTML output
  - “borrowed” from Devel::Cover
- Far more flexible
- Far more powerful

Using NYTProf

- Similar to Devel::DProf
- `$ perl -d:NYTProf ./invoice.pl 244`
- Writes nytprof.out
- `$ nytprofhtml`
- Or
- `$ nytprofcsv`

Conclusions

- Don't optimise until you know you need to optimise
- Don't optimise until you know what to optimise
- Use profiling to find out what is worth optimising
- Use benchmarking to compare different solutions

More Information

- perldoc Benchmark
- perldoc Devel::DProf
- perldoc Devel::NYTProf
- Chapters 5 and 6 of *Mastering Perl*

Benchmarking Examples

- Profile the code that you have been given
- Where do we need to make improvements
- Suggest some alternative implementations
- Benchmark your suggestions

Moose

Moose

- *A complete modern object system for Perl 5*
- Based on experiments with Perl 6 object model
- Built on top of Class::MOP
  - MOP - Meta Object Protocol
  - Set of abstractions for components of an object system
  - Classes, Objects, Methods, Attributes
- An example might help

Moose Example

- ```
  package Point;
  use Moose;

  has 'x' => (isa => 'Int',
              is  => 'ro');
  has 'y' => (isa => 'Int',
              is  => 'rw');

  sub clear {
    my $self = shift;
    $self->{x} = 0;
    $self->y(0);
  }
  ```

  ```

# Understanding Moose

- There's a lot going on here
- `use Moose`
  - Loads Moose environment
  - Makes our class a subclass of Moose::Object
  - Turns on strict and warnings

# Creating Attributes

- `has 'x' => (isa => 'Int',`
  `               is  => 'ro')`
  - Creates an attribute called 'x'
  - Constrainted to be an integer
  - Read-only accessor
- `has 'y' => (isa => 'Int',`
  `               is  => 'rw')`



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# Defining Methods

- ```
  sub clear {
    my $self = shift;
    $self->{x} = 0;
    $self->y(0);
  }
  ```
- Standard method syntax
- Uses generated method to set y
- Direct hash access for x

  ```

# Subclassing

- ```
  package Point3D;
  use Moose;

  extends 'Point';

  has 'z' => (isa => 'Int');

  after 'clear' => sub {
    my $self = shift;
    $self->{z} = 0;
  };
  ```

  ```

# Subclasses

- `extends 'Point'`
  - Similar to use base
  - Overwrites @ISA instead of appending
- `has 'z' => (isa = 'Int')`
  - Adds new attribute 'z'
  - No accessor function - private attribute

# Extending Methods

- ```
  after 'clear' => sub {
    my $self = shift;
    $self->{z} = 0;
  };
  ```
- New clear method for subclass
- Called after method for superclass
- Cleaner than $self->SUPER::clear()

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Creating Objects

- Moose classes are used just like any other Perl class
- `$point = Point->new(x => 1, y => 2);`
-
```
$p3d   = Point3D->new(x => 1,
                      y => 2,
                      z => 3);
```


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More About Attributes

- Use the `has` keyword to define your class's attributes
- `has 'first_name' => ( is => 'rw' );`
- Use `is` to define rw or ro
- Omitting `is` gives an attribute with no accessors

Getting & Setting

- By default each attribute creates a method of the same name.
- Used for both getting and setting the attribute
- `$dave->first_name('Dave');`
- `say $dave->first_name;`

Change Accessor Name

- Change accessor names using reader and writer
- ```
  has 'name' => (
    is => 'rw',
    reader => 'get_name',
    writer => 'set_name',
  );
  ```
- See also MooseX::FollowPBP

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Required Attributes

- By default Moose class attributes are optional
- Change this with `required`
- ```
  has 'name' => (
      is       => 'ro',
      required => 1,
  );
  ```
- Forces constructor to expect a name
- Although that name could be undef

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Attribute Defaults

- Set a default value for an attribute with default
- ```
  has 'size' => (
    is        => 'rw',
    default   => 'medium',
  );
  ```
- Can use a subroutine reference
- ```
  has 'size' => (
    is        => 'rw',
    default   => \&rand_size,
  );
  ```


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More Attribute Properties

- `lazy`
  - Only populate attribute when queried
- `trigger`
  - Subroutine called after the attribute is set
- `isa`
  - Set the type of an attribute
- Many more

More Moose

- Many more options
- Support for concepts like delegation and roles
- Powerful plugin support
  - MooseX::*
- Lots of work going on in this area

Moose Examples

- Write a Moose class that models a person
- Write code which uses that class
- Try out various attribute properties

Catalyst

MVC Frameworks

- MVC frameworks are a popular way to write applications
  - Particularly web applications

M, V and C

- Model
  - Data storage & data access
- View
  - Data presentation layer
- Controller
  - Business logic to glue it all together

MVC Examples

- Ruby on Rails
- Django (Python)
- Struts (Java)
- CakePHP
- Many examples in most languages
- Perl has many options

MVC in Perl

- Maypole
  - The original Perl MVC framework
- CGI::Application
  - Simple MVC for CGI programming
- Jifty
  - Developed and used by Best Practical
- Catalyst
  - Currently the popular choice

Newer MVC in Perl

- Dancer
- Squatting
- Mojolicious

Catalyst

- MVC framework in Perl
- Building on other heavily-used tools
- Model uses DBIx::Class
- View uses Template Toolkit
- These are just defaults
- Can use anything you want

Simple Catalyst App

- Assume we already have model
  - CD database from DBIx::Class section
- Use `catalyst.pl` to create project
- ```
  $ catalyst.pl CD
  created "CD"
  created "CD/script"
  created "CD/lib"
  created "CD/root"
  ... many more ...
  ```

  ```

# What Just Happened?

- Catalyst just generated a lot of useful stuff for us
- Test web servers
  - Standalone and FastCGI
- Configuration files
- Test stubs
- Helpers for creating models, views and controllers

# A Working Application

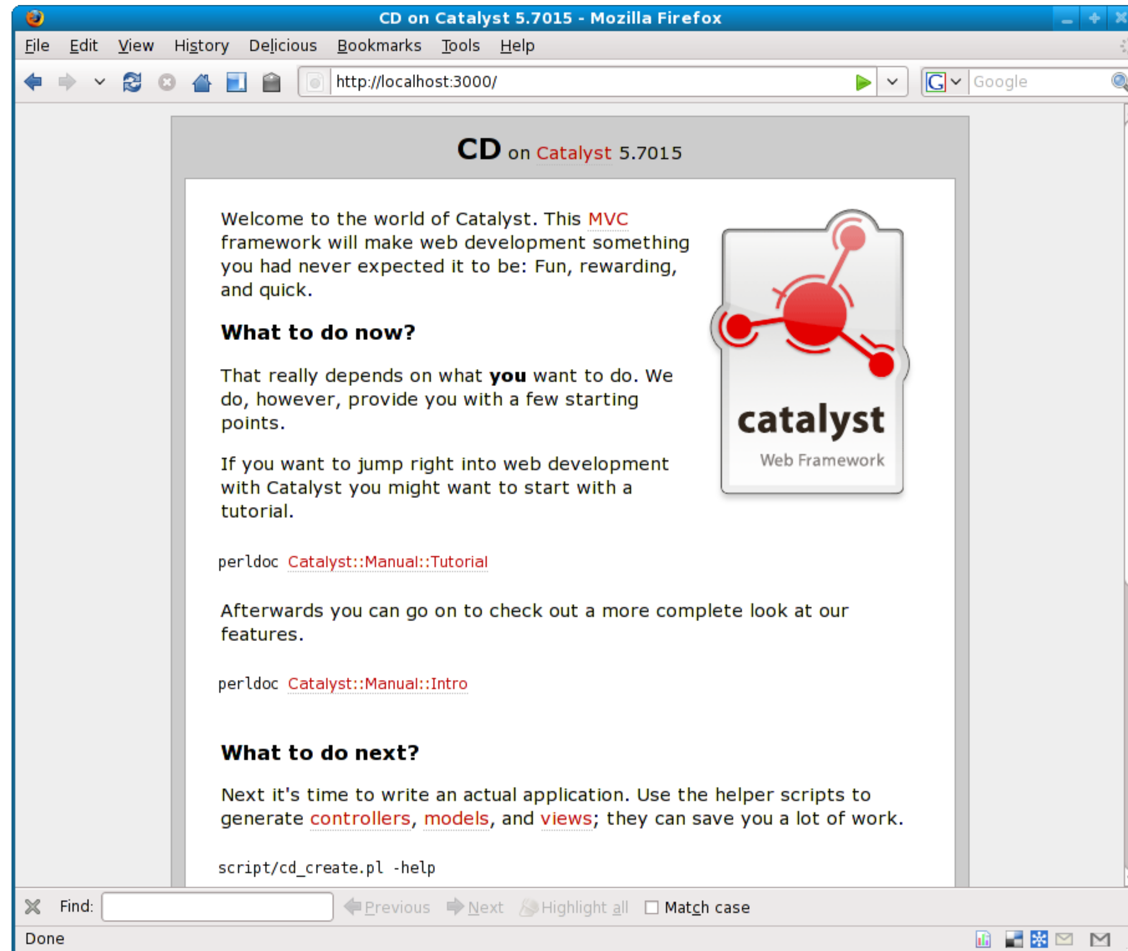
- We already have a working application
- `$ CD/script/cd_server.pl`

```
... lots of output

[info] CD powered by Catalyst 5.7015
You can connect to your server at
http://localhost:3000
```

- Of course, it doesn't do much yet

Simple Catalyst App



Next Steps

- Use various helper programs to create models and views for your application
- Write controller code to tie it all together
- Many plugins to handle various parts of the process
  - Authentication
  - URL resolution
  - Session handling
  - etc...

Create a View

- ```
  $ script/cd_create.pl view Default TT
   exists "/home/dave/training/cdlib/CD/script/../lib/CD/View"
   exists "/home/dave/training/cdlib/CD/script/../t"
  created "/home/dave/training/cdlib/CD/script/../lib/CD/View/Default.pm"
  created "/home/dave/training/cdlib/CD/script/../t/view_Default.t"
  ```

  ```

# Remove Default Message

- In lib/CD/Controller/Root.pm
- ```
  sub index :Path :Args(0) {
      my ( $self, $c ) = @_;

      # Hello World
      $c->response_body($c->welcome_message);
  }
  ```
- Remove response_body line
- Default behaviour is to render index.tt
- Need to create that

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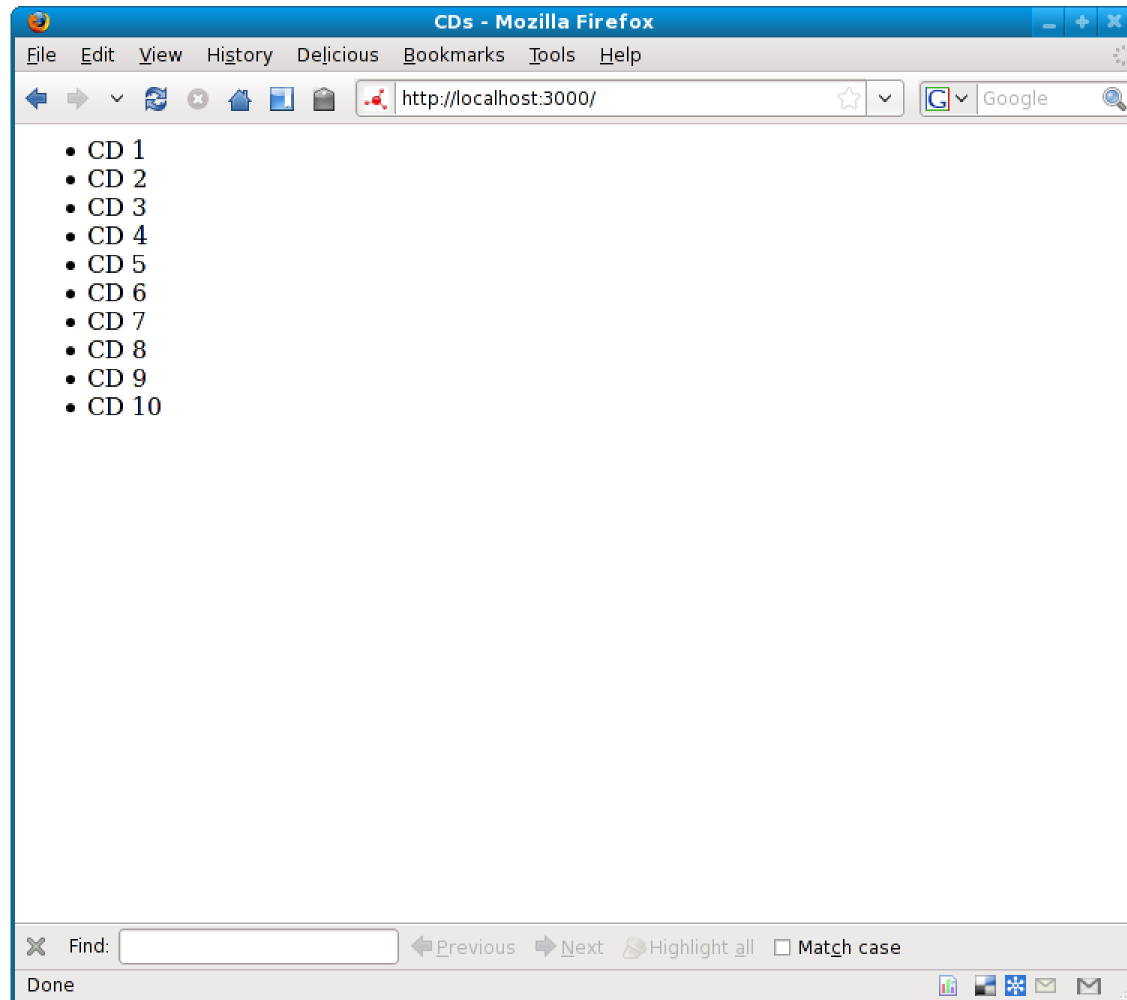
index.tt

- root/index.tt
-
```
<html>
  <head>
    <title>CDs</title>
  </head>
  <body>
    <ul>
[% FOREACH cd IN [ 1 .. 10 ] %]
      <li>CD [% cd %]</li>
[% END %]
    </ul>
  </body>
</html>
```

New Front Page



Adding Data

- Of course that's hard-coded data
- Need to add a model class
- And then more views
- And some controllers
- There's a lot to do
- I recommend working through a tutorial

Easier Catalyst

- A lot of web applications do similar things
- Given a database
- Produce screens to edit the data
- Surely most of this can be automated
- It's called Catalyst::Plugin::AutoCRUD
- (Demo)

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Cat::Plugin::AutoCRUD

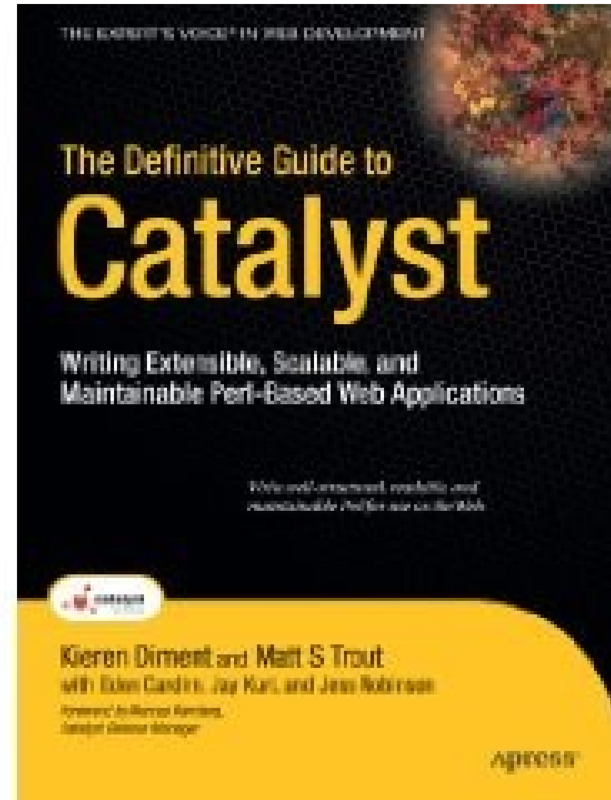
- Does a lot of work
- On the fly
- For every request
- No security on table updates
- So it's not right for every project
- Very impressive though

Conclusions

- There's a lot to bear in mind when writing a web app
- Using the right framework can help
- Catalyst is the most popular Perl framework
- As powerful as any other framework
  - In any language
- Lots of work still going on
- Large team, active development

Recommended Book

- The Definitive Guide to Catalyst
  - Kieren Diment
  - Matt S Trout



Catalyst Examples

- Set up a basic Catalyst project based on the CD database from yesterday
- We will then work together to add some simple controllers and views to the application
- Add Catalyst::Plugin::AutoCRUD to your application

PSGI/Plack

PSGI/Plack

- *"PSGI is an interface between Perl web applications and web servers, and Plack is a Perl module and toolkit that contains PSGI middleware, helpers and adapters to web servers."*
  - http://plackperl.org/

PSGI/Plack

- PSGI is a specification (based on Python's WSGI)
- Plack is a reference implementation (based on Ruby's Rack)

The Problem

- There are many ways to write web applications
- There are many ways to write web applications in Perl
- Each is subtly different
- Hard to move an application between server architectures

Server Architectures

- CGI
- FastCGI
- mod_perl
- etc...

Frameworks

- There are many Perl web application frameworks
- Each creates applications in subtly different ways
- Hard to port applications between them

The Goal

- What if we had a specification that allowed us to easily move web applications between server architectures and frameworks
- PSGI is that specification

PSGI Application

```
• my $app = sub {
    my $env = shift;

    return [
      200,
      [ ‘Content-Type’, ‘text/plain’ ],
      [ ‘Hello World’ ],
    ];
  };
```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PSGI Application

- A code reference
- Passed a reference to an environment hash
- Returns a reference to a three-element array
  - Status code
  - Headers
  - Body

A Code Reference

- ```
  my $app = sub {
    my $env = shift;

    return [
      200,
      [ ‘Content-Type’, ‘text/plain’ ],
      [ ‘Hello World’ ],
    ];
  };
  ```

  ```

# A Code Reference

- ```
  my $app = sub {
    my $env = shift;

    return [
      200,
      [ ‘Content-Type’, ‘text/plain’ ],
      [ ‘Hello World’ ],
    ];
  };
  ```


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  ```

Environment Hash

- ```
  my $app = sub {
      my $env = shift;

      return [
          200,
          [ ‘Content-Type’, ‘text/plain’ ],
          [ ‘Hello World’ ],
      ];
  };
  ```

  ```

# Environment Hash

- ```
  my $app = sub {
    my $env = shift;

    return [
      200,
      [ ‘Content-Type’, ‘text/plain’ ],
      [ ‘Hello World’ ],
    ];
  };
  ```

  ```

# Return Array Ref

```
• my $app = sub {
    my $env = shift;

    return [
      200,
      [‘Content-Type’, ‘text/plain’],
      [‘Hello World’],
    ];
  };
```

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Return Array Ref

- ```
  my $app = sub {
    my $env = shift;

    return [
      200,
      [ ‘Content-Type’, ‘text/plain’ ],
      [ ‘Hello World’ ],
    ];
  };
  ```

  ```

# Running PSGI App

- Put code in app.psgi
- Drop in into a configured PSGI-aware web server
- Browse to URL

# PSGI-Aware Server

- Plack contains a simple test server called plackup
- ```
  $ plackup app.psgi
  HTTP::Server::PSGI: Accepting connections
  at http://localhost:5000/
  ```

  ```

# Plack::Request

- Plack::Request turns the environment into a request object
- ```
  use Plack::Request;
  use Data::Dumper;

  my $app = sub {

    my $req = Plack::Request->new(shift);
    return [
      200,
      [ 'Content-type', 'text/plain' ],
      [ Dumper $req ],
    ];
  }
  ```

  ```

# Plack::Response

- Plack::Response builds a PSGI response object
- ```
  use Plack::Request;
  use Plack::Response;
  use Data::Dumper;

  my $app = sub {
    my $req = Plack::Request->new(shift);
    my $res = Plack::Response->new(200);
    $res->content_type('text/plain');
    $res->body(Dumper $req);
    return $res->finalize;
  }
  ```

  ```

# Middleware

- Middleware wraps around an application
- Returns another PSGI application
- Simple spec makes this easy
- Plack::Middleware::*
- Plack::Builder adds middleware configuration language

# Middleware Example

- ```
  use Plack::Builder;
  use Plack::Middleware::Runtime;

  my $app = sub {
    my $env = shift;

    return [
      200,
      [ 'Content-type', 'text/plain' ],
      [ 'Hello world' ],
    ]
  };

  builder {
    enable 'Runtime';
    $app;
  }
  ```

  ```

# Middleware Example

- ```
  $ HEAD http://localhost:5000
  200 OK
  Date: Tue, 20 Jul 2010 20:25:52 GMT
  Server: HTTP::Server::PSGI
  Content-Length: 11
  Content-Type: text/plain
  Client-Date: Tue, 20 Jul 2010 20:25:52 GMT
  Client-Peer: 127.0.0.1:5000
  Client-Response-Num: 1
  X-Runtime: 0.000050
  ```

  ```

# Middleware Example

- ```
  $ HEAD http://localhost:5000
  200 OK
  Date: Tue, 20 Jul 2010 20:25:52 GMT
  Server: HTTP::Server::PSGI
  Content-Length: 11
  Content-Type: text/plain
  Client-Date: Tue, 20 Jul 2010 20:25:52 GMT
  Client-Peer: 127.0.0.1:5000
  Client-Response-Num: 1
  X-Runtime: 0.000050
  ```

  ```

# Plack::App::*

- Ready-made solutions for common situations
- Plack::App::CGIBin
  - Cgi-bin replacement
- Plack::App::Directory
  - Serve files with directory index
- Plack::App::URLMap
  - Map apps to different paths



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# Plack::App::*

- Many more bundled with Plack
- Configured using Plack::Builder

# Plack::App::CGIBin

- ```
  use Plack::App::CGIBin;
  use Plack::Builder;

  my $app = Plack::App::CGIBin->new(
    root => '/var/www/cgi-bin'
  )->to_app;

  builder {
    mount '/cgi-bin' => $app;
  };
  ```

  ```

# Plack::App::Directory

- ```
  use Plack::App::Directory;

  my $app = Plack::App::Directory->new(
    root => '/home/dave/Dropbox/psgi'
  )->to_app;
  ```

  ```

# Framework Support

- Many modern Perl applications already support PSGI
- Catalyst, CGI::Application, Dancer, Jifty, Mason, Maypole, Mojolicious, Squatting, Web::Simple
- Many more

# Catalyst Support

- Catalyst::Engine::PSGI
- `use MyApp;`

  ```
  MyApp->setup_engine('PSGI');
  my $app = sub { MyApp->run(@_) };
  ```
- Also Catalyst::Helper::PSGI
- `script/myapp_create.pl PSGI`



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# PSGI Server Support

- Many new web servers support PSGI
- Starman, Starlet, Twiggy, Corona, HTTP::Server::Simple::PSGI
- Perlbal::Plugin::PSGI

# PSGI Server Support

- nginx support
- mod_psgi
- Plack::Handler::Apache2

# Plack::Handler::Apache2

- ```
  <Location /psgi>
    SetHandler perl-script
    PerlResponseHandler Plack::Handler::Apache2
    PerlSetVar psgi_app /path/to/app.psgi
  </Location>
  ```

  ```

# PSGI/Plack Summary

- PSGI is a specification
- Plack is an implementation
- PSGI makes your life easier
- Most of the frameworks and server you use already support PSGI
- No excuse not to use it

# Further Information

- perldoc PSGI
- perldoc Plack
- http://plackperl.org/
- http://blog.plackperl.org/
- http://github.com/miyagawa/Plack
- #plack on irc.perl.org

# PSGI/Plack Examples

- Try out some of the simple PSGI examples from the previous slides
- Use plackup to run the applications

# That's all folks

- Any questions?