1.1.2.8.6

Intermediate Perl – Session 5

- modules
- CPAN

modules

- modules breathe life into Perl
  - limitlessly expand built-in functionality
  - allow anyone to contribute to Perl
    - centralized and mirrored module repository
    - comprehensive Perl archive network (CPAN)
  - limit code repetition
  - written in Perl, C/C++ or a combination
    - C modules add the raw speed of C to Perl

- modules typically contain
  - functions
    - many per module
  - classes (code designed to be used in an object oriented fashion)
    - usually one per module

- modules are available
  - as bundles – multiple modules which are related (e.g. Bundle::LWP, bioperl)
  - as individual classes – modules which perform a single task (e.g. Math::Round)

@INC - location of modules

- perl binary will look in the list of paths stored in @INC for modules
- by default, @INC is populated with several paths that are dependent on
  - version of perl
  - architecture/OS of the machine that compiled perl
- you can see the default @INC contents by checking compile settings with perl -V

```
> perl -V
...
@INC:
  /home/martink/perl/5.8.7/lib/5.8.7/i686-linux-ld
  /home/martink/perl/5.8.7/lib/5.8.7
  /home/martink/perl/5.8.7/lib/site_perl/5.8.7/i686-linux-ld
  /home/martink/perl/5.8.7/lib/site_perl/5.8.7
  /home/martink/perl/5.8.7/lib/site_perl
  .
```

modifying @INC

- set PERL5LIB environment variable

```
> export PERL5LIB=/home/martink/modules
> perl -V
...
%ENV:
  PERL5LIB="/home/martink/modules"
@INC:
  /home/martink/perl/5.8.7/lib/5.8.7/i686-linux-ld
  /home/martink/perl/5.8.7/lib/5.8.7
  /home/martink/perl/5.8.7/lib/site_perl/5.8.7/i686-linux-ld
  /home/martink/perl/5.8.7/lib/site_perl/5.8.7
  /home/martink/perl/5.8.7/lib/site_perl
  .
```

- use -Idir for each directory at runtime

```
> perl -I/home/martink/modules -I/home/martink/othermodules script.pl
```

modifying @INC

- employ the `lib` pragma in your script

```
#!/usr/bin/perl

use lib "/home/martink/modules";
...
```

- typically, you do not have permission to write into the default module locations
  - e.g. `/usr/lib` or `/usr/local/lib`

- install to a location of your choice and then modify `@INC` to include that location in the search path

module compatibility

- each perl binary has its own @INC

- depending on the module
  - cross-version compatibility (e.g. perl 5.6 vs 5.10) is not assured
  - cross-platform compatibility (e.g. systems with different versions of libc) is not assured

- modules written entirely in Perl tend to be relatively compatible
  - if you download and compile a module written in Perl and install it into `/your/module/directory`, chances are good it will with 5.6, 5.8 and 5.10, unless you are using features specific to a version (e.g. regex engine features)
  - modules with components written in C are less compatible and it is safe to assume that they will not work across multiple versions

module compatibility

- when you compile a module that contains components written in C, system libraries may be dynamically linked into the module and the module may not work on a Linux install significantly older/newer than the system which compiled the module

- multiple versions of the same module are not natively supported
  - you can use `only.pm` module from CPAN for this

creating a basic module

- a module is typically a package (namespace) with function and/or object definitions
- the most basic module is one with only variable and/or function definitions
- below is a module that defines a single function, `square`

```
package MyModule;

sub square {
  my $num = shift;
  return $num**2;
}

1;
```

- the module file should be the same as the package name with `.pm` suffix
  - `MyModule.pm`

creating a basic module

- place the module file in your module directory

```
> cp MyModule.pm /home/martink/modules/.
```

- import and use the module in your script

```
use lib "/home/martink/modules";
use MyModule;

print MyModule::square(5);
```

creating a basic module

- to export the module's square function into the current namespace use `Exporter` and define the list of symbols to be automatically exported in `@EXPORT`

```
package MyModule;
@ISA=qw(Exporter);
@EXPORT=qw(square);

sub square {
  my $num = shift;
  return $num**2;
}

1;
```

- whenever you use the module, `square` is exported into the main namespace and available directly

```
use lib "/home/martink/modules";
use MyModule;

print square(5);
```

creating a basic module

- to define symbols that can be exported explicitly set @EXPORT_OK

```
package MyModule;
@ISA=qw(Exporter);
@EXPORT=();              # nothing is exported by default
@EXPORT_OK=qw(square);   # symbols that can be exported by request

sub square {
  my $num = shift;
  return $num**2;
}

1;
```

- now you must ask to export square

```
use lib "/home/martink/modules";
use MyModule qw(square);

print square(5);
```

creating an object module

- modules provide encapsulation and interfaces
  - encapsulation – hide implementation specifics from user
  - interface – provide a stable set of functions to create and manipulate data

- when perl modules are described, object-oriented terminology is frequently used

object-oriented	perl
class	package
object	reference blessed into a package
method	subroutine in a class
class method	method designed to be called using a class
object method	method that expects to be called using a class
constructor	class method that returns a new object

creating an object module

- let's create a counter object which implements the following methods
  - new – creates a counter and sets it to 0
  - increment – adds 1 to a counter, and returns new value
  - decrement – subtracts 1 from a counter, and returns new value
  - reset – resets the counter value to zero
  - value – returns current value

```
use MyCounter;

my $counter = MyCounter->new();
$counter->increment;
print $counter->value;          # 1
$counter->reset;
$counter->decrement;
$counter->decrement;
print $counter->value;          # -2
```

creating an object module

```
package MyCounter;

sub new {
  my ($pkg) = @_;          # the package (MyCounter) is automatically passed as the first argument
  my $self  = {value=>0}; # this is the object - commonly implemented as a hash reference
  bless ($self,$pkg);      # bless tells perl that $self is an object in the package $pkg
  return $self;
}
sub increment {              # when $counter->increment is called, first argument to increment() is $counter
  my ($self) = @_;           # get the object from the argument stack
  return $self->{value}++;  # adjust and return its variable - remember $self is just a hash ref with magic sauce
}
sub decrement {
  my ($self) = @_;
  return $self->{value}--;
}
sub reset {
  my ($self) = @_;
  return $self->{value}=0;
}
sub value {
  my ($self) = @_;
  return $self->{value};
}

1;
```

extending the object module

- in addition to previous functionality,
  - initial counter value can be set
  - increase/decrease step can be set and changed

```
package MyCounter;

sub new {
  my ($pkg,$value,$step) = @_;
  my $self  = {value=>$value,step=>$step||1};
  bless ($self,$pkg);
  return $self;
}

sub increment {
  my ($self) = @_;
  return $self->{value} += $self->{step};
}

sub decrement {
  my ($self) = @_;
  return $self->{value} -= $self->{step};
}
```

```
sub reset {
  my ($self) = @_;
  return $self->{value}=0;
}

# set a new step value, if the argument is provided
sub step {
  my ($self,$step) = @_;
  if(defined $step) {
    $self->{step} = $step;
  }
  return $self->{step};
}

sub value {
  my ($self) = @_;
  return $self->{value};
}

1;
```

extending the object module

- now the counter has more functionality

```
use MyCounter;

my $c = MyCounter->new(10);

$c->increment();
print $c->value,$c->step;    # 11 1
$c->reset();
$c->step(5);
print $c->value,$c->step;    # 0 5
$c->decrement();
$c->decrement();
print $c->value;             # -10

print ref($c);               # MyModule
```

- if the module is in the same directory as the script, it will be found

- if not, then `use lib "/path/to/module/directory"`

www.cpan.org

- the first and last stop for modules is CPAN
  - thousands of modules by thosands of authors
  - code is available, authors can be contacted, community is open

CPAN: String Language Text Processing

- clicking on String Language Text Processing

module names

- many modules contain `::`
  - `File::Find`
  - `File::Find::Closures`
  - `File::Flock`
- on the file system `::` corresponds to a directory delimiter
  - `File::Find` would be `File/Find.pm`
  - `File::Find::Closures` would be `File/Find/Closures.pm`
- similarity in names does not imply a functional relationship
  - `File::Find::Closures` may have nothing to do with `File::Find`
    - but both have something to do with finding files
  - `MyModule::Utils` does not necessarily inherit from `MyModule`

Number::Format

- documentation follows a convention
  - NAME
  - SYNOPSIS
  - DESCRIPTION
  - METHODS
  - various sections
  - HISTORY
  - BUGS
  - AUTHOR
  - SEE ALSO
- the SYNOPSIS is for the impatient
  - informative enough to start

CPAN

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in All CPAN Search

William R Ward > Number-Format-1.45 > Number::Format

Module Version: 1.45 Source

NAME
SYNOPSIS
REQUIRES
DESCRIPTION
EXPORTS
METHODS
BUGS
AUTHOR
SEE ALSO

NAME

Number::Format - Perl extension for formatting numbers

SYNOPSIS

```
use Number::Format;
my $x = new Number::Format %args;
$formatted = $x->round($number, $precision);
$formatted = $x->format_number($number, $precision, $trailing_zeroes);
$formatted = $x->format_negative($number, $picture);
$formatted = $x->format_picture($number, $picture);
$formatted = $x->format_price($number, $precision);
$formatted = $x->format_bytes($number, $precision);
$number    = $x->unformat_number($formatted);

use Number::Format qw(:subs);
$formatted = round($number, $precision);
$formatted = format_number($number, $precision, $trailing_zeroes);
$formatted = format_negative($number, $picture);
$formatted = format_picture($number, $picture);
$formatted = format_price($number, $precision);
$formatted = format_bytes($number, $precision);
$number    = unformat_number($formatted);
```

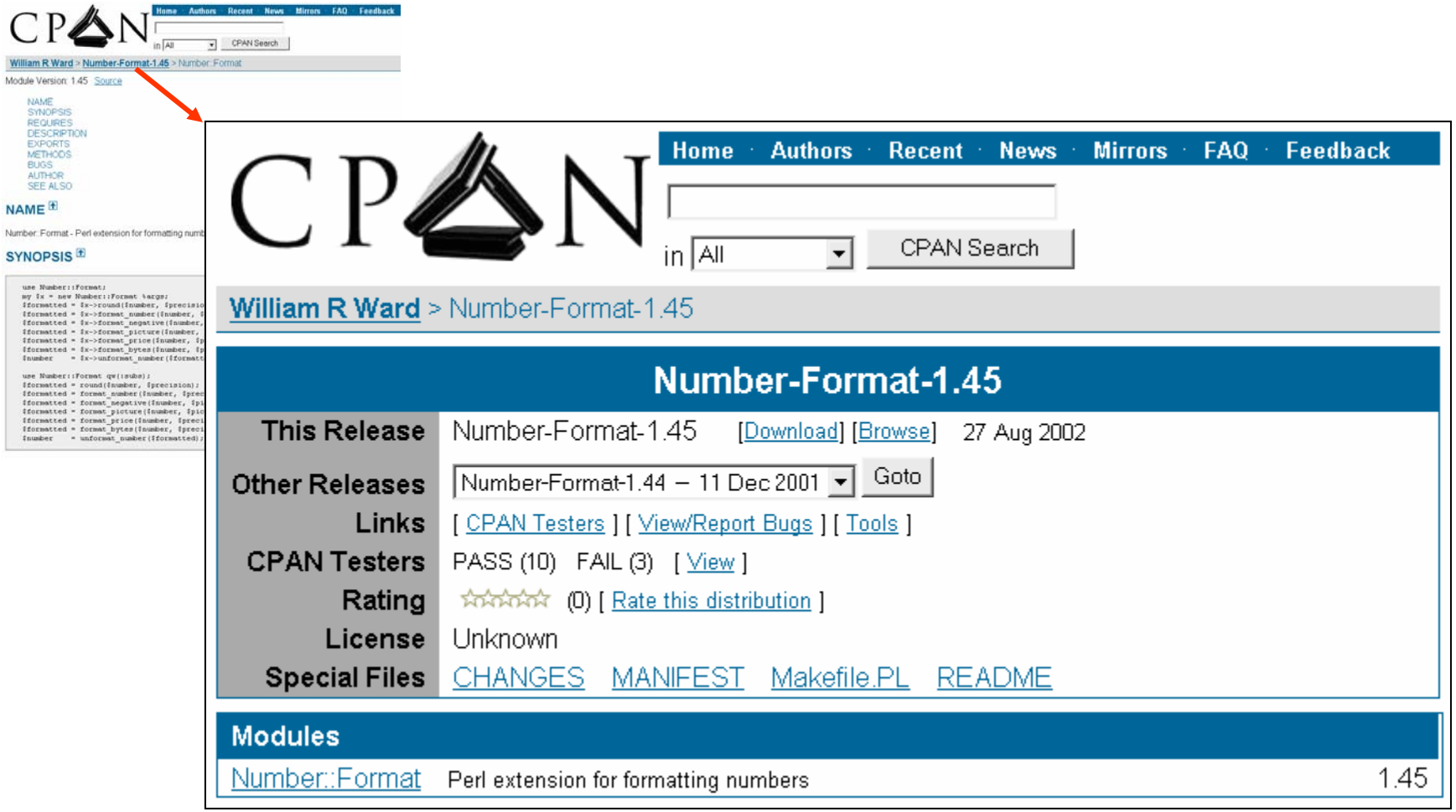
Number::Format has both OOP and functional API

- the SYNOPSIS section for this module shows

```
use Number::Format;
my $x = new Number::Format %args;
$formatted = $x->round($number, $precision);
$formatted = $x->format_number($number, $precision, $trailing_zeroes);
$formatted = $x->format_negative($number, $picture);
$formatted = $x->format_picture($number, $picture);
$formatted = $x->format_price($number, $precision);
$formatted = $x->format_bytes($number, $precision);
$number    = $x->unformat_number($formatted);


use Number::Format qw(:subs);
$formatted = round($number, $precision);
$formatted = format_number($number, $precision, $trailing_zeroes);
$formatted = format_negative($number, $picture);
$formatted = format_picture($number, $picture);
$formatted = format_price($number, $precision);
$formatted = format_bytes($number, $precision);
$number    = unformat_number($formatted);
```

Downloading Modules



Downloading Modules

- download the module from CPAN as .tar.gz
  - usually named ModuleName-x.xx.tar.gz

```
> ls
-rw-r--r--    1 martink  users       14084 2004-03-18 14:22 Number-Format-1.45.tar.gz
```

- unpack the tarball
  - the module usually comes in its own directory

```
> tar xvfz Number-Format-1.45.tar.gz
Number-Format-1.45/
Number-Format-1.45/README
...
Number-Format-1.45/t/object.t
Number-Format-1.45/Makefile.PL
Number-Format-1.45/TODO
```

Installing Modules

- you now have a directory in which into which the module files have been unpacked

```
> ls
drwxr-x---    3 martink  users        4096 2002-08-27 17:16 Number-Format-1.45/
-rw-r--r--    1 martink  users       14084 2004-03-18 14:22 Number-Format-1.45.tar.gz

> cd Number-Format-1.45/

> ls
-rw-r--r--    1 martink  users        5137 2001-12-10 16:39 CHANGES
-rw-r--r--    1 martink  users       28294 2002-08-27 16:11 Format.pm
-rw-r--r--    1 martink  users         194 2001-12-10 12:35 MANIFEST
-rw-r--r--    1 martink  users         239 1997-11-08 10:58 Makefile.PL
-rw-r--r--    1 martink  users        3261 2002-08-27 17:16 README
-rw-r--r--    1 martink  users         953 2001-12-10 12:35 TODO
drwxr-x---    2 martink  users        4096 2002-08-27 17:16 t/
```

perl Makefile.pl ; make ; make test ; make install

```
# set PREFIX to specify where the module should be installed
> perl Makefile.PL PREFIX=/home/martink/lib
Checking if your kit is complete...
Looks good
Writing Makefile for Number::Format

> make
mkdir blib
mkdir blib/lib
...
Manifying blib/man3/Number::Format.3

> make test
PERL_DL_NONLAZY=1 /usr/local/bin/perl -Iblib/arch -Iblib/lib -I/usr/local/lib/perl5/5.00503/i686-
linux -I/usr/local/lib/perl5/5.00503 -e 'use Test::Harness qw(&runtests $verbose); $verbose=0;
runtests @ARGV;' t/*.t
...
All tests successful.
Files=9, Tests=64,  1 wallclock secs ( 0.40 cusr +  0.14 csys =  0.54 CPU)

> make install
```

Using the Installed Module

- once installed, cast the appropriate `use lib` call and then `use` the module

```
#!/usr/local/bin/perl

use lib "/home/martink/lib";
use Number::Format;

# now use the module
```

- modules may have dependencies
  - you'll need module A to install and use module B
  - if A is installed in your personal space, modify `@INC` before attempting to install B

```
> perl -I/home/martink/lib Makefile.PL PREFIX=/home/martink/lib
```

using CPAN.pm to install modules

- you can query and install from CPAN interactively

```
> perl -MCPAN -e shell
cpan shell -- CPAN exploration and modules installation (v1.83)
ReadLine support enabled
cpan>
```

- a help menu is provided with ?

```
cpan> ?
Display Information
 command  argument          description
 a,b,d,m  WORD or /REGEXP/  about authors, bundles, distributions, modules
 i        WORD or /REGEXP/  about any of the above
 r        NONE              report updatable modules
 ls       AUTHOR or GLOB    about files in the author's directory
    (with WORD being a module, bundle or author name or a distribution
    name of the form AUTHOR/DISTRIBUTION)
...
```

using CPAN.pm to install modules

- to list currently installed modules in @INC, use autobundle

```
> autobundle

Package namespace         installed    latest  in CPAN file
Algorithm::Cluster             1.30      1.42  MDEHOON/Algorithm-Cluster-1.42.tar.gz
AnyDBM_File                    1.00      1.00  RGARCIA/perl-5.10.0.tar.gz
AnyData                        0.10      0.10  JZUCKER/AnyData-0.10.tar.gz
AnyData::Format::Base         undef     undef  JZUCKER/AnyData-0.10.tar.gz
AnyData::Format::CSV           0.05      0.05  JZUCKER/AnyData-0.10.tar.gz
...
version                        0.48      0.76  JPEACOCK/version-0.76.tar.gz
version::vxs                   0.48      0.76  JPEACOCK/version-0.76.tar.gz
vmsish                         1.01      1.02  RGARCIA/perl-5.10.0.tar.gz
warnings                       1.03      1.06  RGARCIA/perl-5.10.0.tar.gz
warnings::register             1.00      1.01  RGARCIA/perl-5.10.0.tar.gz

Wrote bundle file
    /home/martink/.cpan/Bundle/Snapshot_2008_09_16_00.pm
```

using CPAN.pm to install modules

- once you're in the shell, you can
  - list CPAN modules, bundles and authors
  - fetch the README file from a module
  - download and install the module

```
cpan> m /number::format/
Module          Number::Format  (W/WR/WRW/Number-Format-1.60.tar.gz)
Module          Number::Format::Calc (H/HO/HOLLI/Number-Format-Calc-0.01.tar.gz)
Module          Template::Plugin::Number::Format (D/DA/DARREN/Template-Plugin-Number-Format-
1.02.tar.gz)
3 items found

cpan> m Number::Format
Module id = Number::Format
    DESCRIPTION  Package for formatting numbers for display
    CPAN_USERID  WRW (William R Ward <bill@wards.net>)
    CPAN_VERSION 1.60
    CPAN_FILE    W/WR/WRW/Number-Format-1.60.tar.gz
    DSLI_STATUS  RdpO (released,developer,perl,object-oriented)
    INST_FILE    (not installed)
```

using CPAN.pm to install modules

```
> readme Number::Format

Number::Format - Convert numbers to strings with pretty formatting

Version: 1.60

WHAT IS IT

Number::Format is a library for formatting numbers.  Functions are
provided for converting numbers to strings in a variety of ways, and
to convert strings that contain numbers back into numeric form.  The
output formats may include thousands separators - characters inserted
between each group of three characters counting right to left from the
decimal point.  The characters used for the decimal point and the
thousands separator come from the locale information or can be
specified by the user.

...
```

using CPAN.pm to install modules

- set CPAN configuration values with `o conf`
- `install` module
  - downloads, makes, tests and installs

```
> o conf makepl_arg PREFIX=/home/martink/modules
    makepl_arg          [PREFIX=~/tmp]

# this installs the latest Number::Format
> install Number::Format

# this installs some other version of Number::Format
# recall the output of m Number::Format
#    CPAN_FILE    W/WR/WRW/Number-Format-1.60.tar.gz
> install WRW/Number-Format-1.52.tar.gz

# to remember changes to configuration
> o conf commit
```

1.1.2.8.6

Introduction to Perl – Session 6

- functional and object modules
- install modules manually
- using CPAN