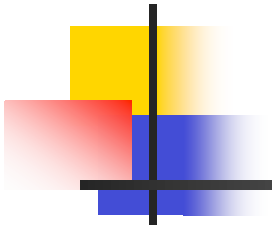
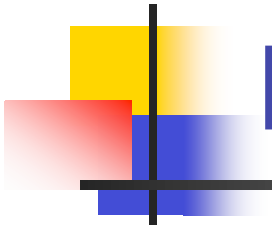


ICT336 Internet Systems Programming

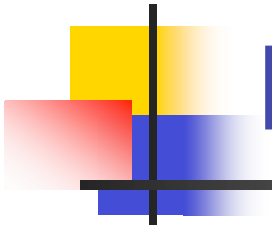
Introduction to Perl Programming

(Week 2 Lecture 2)



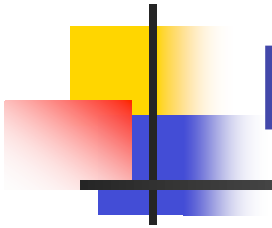
Lecture Objectives

- Introduction to the Perl programming language
  - Assumption: you know what programming is.



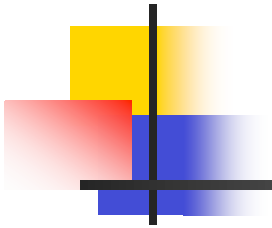
Lecture Objectives

- Relevance to unit objectives:
  - Learning objective 2: Writing software
- Relevance to assessments:
  - Most of your programming in this unit will be in the Perl programming language
    - labs
    - assignments 1 and 2



Lecture Outline

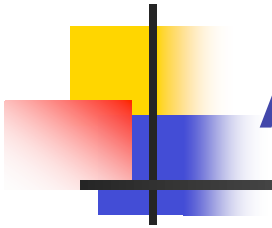
- Why use Perl for this unit?
- Perl basic language features
- Perl object-oriented features
- How to get up to speed with Perl



Introduction to Perl

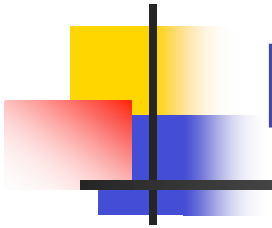
- This lecture will **NOT** be a general “Introduction to Programming” lecture.
  - You should already be familiar with programming from previous units like B102.

- The purpose of this lecture is to point out special features of Perl
  - To start you on the road in using the language.
  - Please read Unit Reader 2 for a more complete introduction to the language’s syntax.
  - Your will need to refer to language references at the end of this lecture when you start doing your programming exercises.



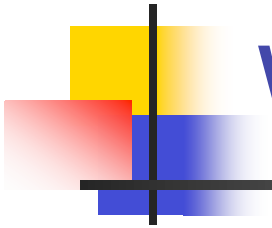
Advantages of Perl

- The main advantages for using Perl are:
  - Rapid development - can have very terse code.
  - There are literally hundreds of ways to do any one thing - programmers develop their own unique (most efficient?) way of doing things.
  - Powerful text handling facilities.
  - Hash as a fundamental data type.



Disadvantages of Perl

- Unfortunately, some of its biggest strengths are also its weaknesses
  - Because it is terse
    - Code can be completely undecipherable by non-Perl programmers
    - Less experienced programmers tend to write really bad code.
  - Because there are so many ways to do the same thing, no one can agree on the standard way
    - Hard in team work situations.
  - Perl programmers may have concentrated on text-handling at the expense, other more complex data-type development.



Why Perl in this Unit?

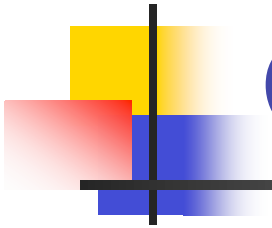
- Arguments about the technical strengths and weaknesses of a programming language are always endless and never conclusive.
  - So don't ever try justifying a language choice based on language features alone.
- The REAL reasons for using Perl in this unit are:
  - String manipulation features (for manipulating HTTP message text, and XML documents)
  - Importance of Perl in some development community (especially open-source and in Linux)
  - Another alternative language (besides JAVA) to expand your repertoire.

A Basic Perl Script

```
#!/usr/bin/perl

print "Hello!" ;
```

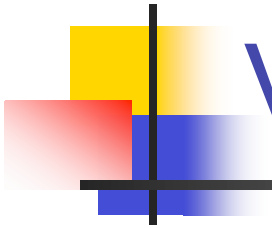
Indicates where the perl interpreter can be found. This “shebang” line must be at the beginning of every script.

A statement to print something to the the standard output.



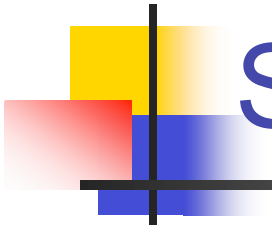
Comments and Statements

- When a # symbol is encountered, anything from the # to the end of the line is ignored (with the exception of the first line).
  - To comment multiple lines, use a # on each line.
- All statements in Perl end with a semicolon.
- There is no separate “main” function in Perl.
  - The statements starting from the second line gets executed from top to bottom, unless they are functions/subroutines.



Variables

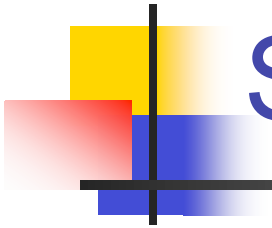
- The 3 main forms of variables in Perl are:
  - Scalars - single values
  - Arrays - a list of values
  - Hashes - collection of values indexed using “keys”
- The “my” keyword indicates that a variable is a local variable.



Scalar Variables

- A scalar variable is represented by a name with the $ symbol in front of it.
- A scalar variable can hold a single string and or a number.
- You do not have to declare whether a scalar is a string or a number.
- Eg.

```
$num = 21 ;
$str = 'a string' ;
my $var = 21 + 48 ;
my $var = 'a' . 'string' ;
```



Some Common Operations

Arithmetic operators:

```
$a = 1 + 2;       # Add 1 and 2 and store in $a
$a = 3 - 4;       # Subtract 4 from 3 and store in $a
$a = 5 * 6;       # Multiply 5 and 6
$a = 7 / 8;       # Divide 7 by 8 to give 0.875
$a = 9 ** 10;     # Nine to the power of 10
$a = 5 % 2;       # Remainder of 5 divided by 2
$a++;             # Return $a and then increment it
$a--;             # Return $a and then decrement it
```

String Operations:

```
$a = $b . $c;     # Concatenate $b and $c
$a = $b x $c;     # $b repeated $c times
```

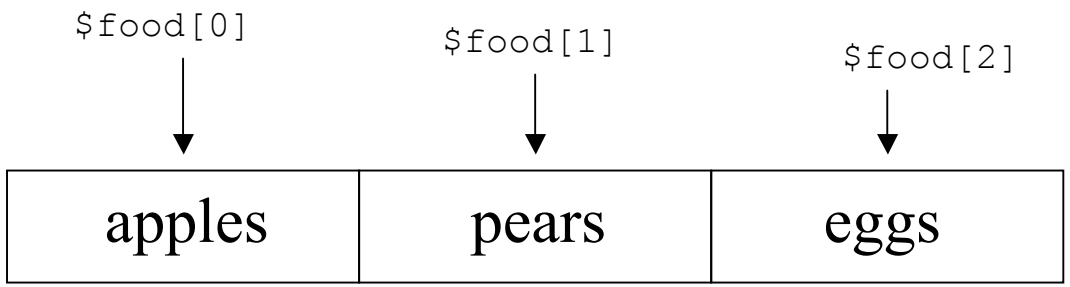
Assignments:

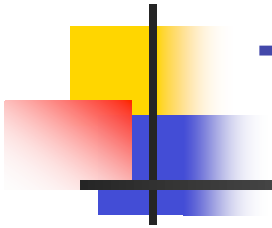
```
$a = $b;          # Assign $b to $a
$a += $b;         # Add $b to $a
$a -= $b;         # Subtract $b from $a
$a .= $b;         # Append $b onto $a
```

Array Variables

- Arrays are lists of scalars (ie numbers and strings).
- An array name have an @ symbol in front of it.
- Eg.

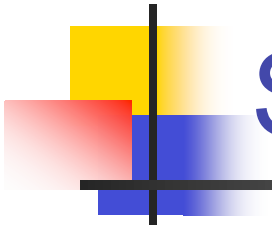
```
@food = ("apples", "pears", "eggs");
my @numbers = (1,2,3,4) ;
```





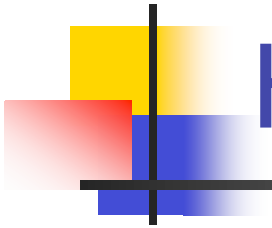
The confusion between $ and @

- Note that in the previous example we use use `$food[0]` instead of `@food[0]`.
- This is because the element is a scalar.
- Remember: use $ when referring to the scalar elements of an array.



Some Common Array Operations

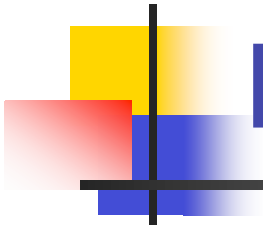
```
push(@food, "eggs");                # add "eggs" to the end of the array @food.
push(@food, "eggs", "lard");        # add 2 more to the end of the array @food.
$grub = pop(@food);                 # take the last element out of array, and
                                    # assign to $grub

$f = @food;                         # assigns the length of @food
$f = "@food";                       # turns the list into a string with a space
                                    # between each element.

($a, $b) = ($c, $d);                # Same as $a=$c; $b=$d;
($a, $b) = @food;                   # $a and $b are the first two items of @food.
($a, @somefood) = @food;            # $a is the first item of @food
                                    # @somefood is a list of the others.
(@somefood, $a) = @food;            # @somefood is @food and
                                    # $a is undefined.


print @food;                        # display the list.
```



Hashes

- Perl also allows us to create arrays which are accessed by a string rather than a number. These are called *hashes* (or *associative arrays*).
- A hash is prefixed by a % symbol.
- Eg.

```
%ages = ("Michael Caine" => 39,
         "Dirty Den" => 34,
         "Angie" => 27,
         "Willy" => "21 in dog years",
         "The Queen Mother" => 108);
```

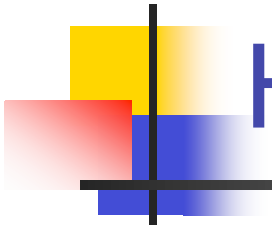


Hashes

- From the previous example:

```
$ages{"Michael Caine"}   returns 39
$ages{"Dirty Den"} returns 34
$ages{"Angie"} returns 27
$ages{"Willy"} returns "21 in dog years"
$ages{"The Queen Mother"} returns 108
```

- Note again the use of the symbol $ instead of % to access the elements.



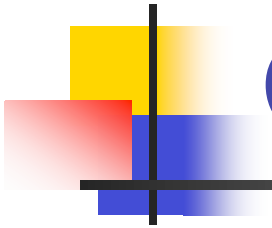
Hashes

- All the strings used to do the indexing are called *keys*.
- The function `keys` can be used to get all the keys in a hash. Eg.

```
keys(%ages)
```

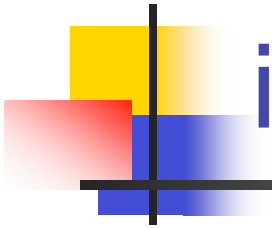
gives

```
("Michael Caine", "Dirty Den", "Angie",
     "Willy", "The Queen Mother")
```



Control Structures

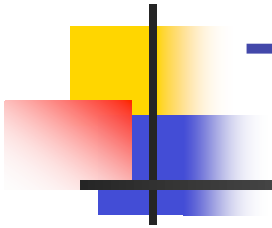
- Like most other languages, Perl has control structures for conditionals and looping
- Examples of common ones:
  - if…elsif…else
  - foreach
  - for
  - while
  - do…while



if statements

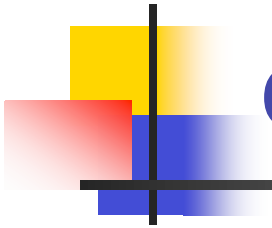
- For executing statements based on a condition
- Eg.

```
if ($a == $b) {
        print "The numbers are equal\n";
} else {
        print " The numbers are not equal\n";
}
```



Test Operators

```
$a == $b        # Is $a numerically equal to $b?
                # Beware: Don't use the = operator.
$a != $b        # Is $a numerically unequal to $b?
$a eq $b        # Is $a string-equal to $b?
$a ne $b        # Is $a string-unequal to $b?

($a && $b)      # Is $a and $b true?
($a || $b)      # Is either $a or $b true?
!($a)           # is $a false?
```

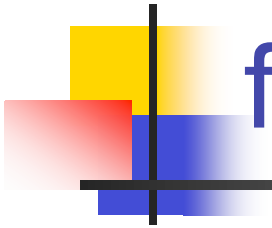


elsif

- If more than one condition:

```
if (!$a) {
    print "The string is empty\n";
} elsif (length($a) == 1) {                # If above fails, try this
    print "The string has one character\n";
} elsif (length($a) == 2) {                # If that fails, try this
    print "The string has two characters\n";
} else {                                   # Now, everything has failed
    print "The string has lots of characters\n";
}
```

- Note that “elsif” is NOT spelled “elseif”!

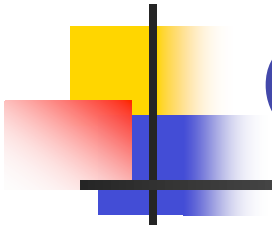


foreach loop

- To go through each line of an array or other list-like structure (such as lines in a file)
- Eg.

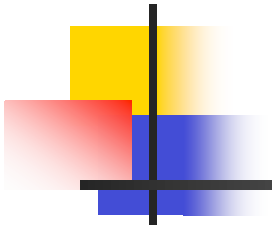
```
foreach $yum (@food) {    # Visit each item in turn and call it $yum
        print "$yum\n";
}
```

```
foreach $name (keys %ages) {
        print "$name $ages{$name}\n";
}
```



Curly brackets

- Unlike most programming languages, even when your control block has only one statement (examples previous page), you MUST still put the curly brackets {…}.



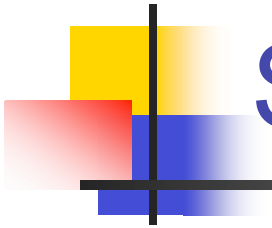
for loops

- General form:

```
for (initialise; test; inc) {

        first_action;
        second_action;
        etc

}
```

- Eg.

```
for ($i = 0; $i < 10; ++$i)          # Start with $i = 1
                                     # Do it while $i
{                                    # Increment $i before repeating

        print "$i\n";

}
```



Subroutines

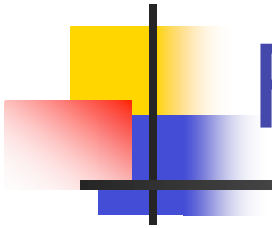
- In Perl, we define encapsulated blocks of code by using **subroutines**
  - We sometimes call them **functions** in Perl as well.

- You may place subroutines anywhere in the code.
  - But we usually have the “main” statements at the beginning, and place all subroutines at the end.

Example Subroutines

```
#!/usr/bin/perl

&mysubroutine;    # Call the subroutine

sub mysubroutine {
         print "Not a very interesting routine\n";
         print "This does the same thing every time\n";
}
```

```
#!/usr/bin/perl

print &add(1,2);  # Call the subroutine with parameters and
                  # print the result


sub add {

         my ($a, $b) = @_ ; # read in the parameters into $a and $b
         return $a + $b ;
}
```



File Handling

- The simplest way to do file handling is to open a file and read the whole content into an array as strings. We can then process that array.

- Eg. Reading from a file

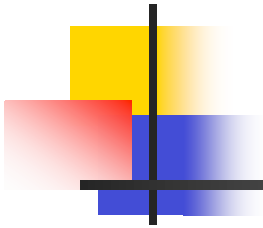
```
open(INFO, 'passwd.txt');          # Open the file
@lines = <INFO>;                   # Read it into an array
close(INFO);                       # Close the file
...
```

Other Example File Handling

```
open(INFO, 'passwd.txt');          # Open the file
while ($lines = <INFO>) {          # Read one line at a time
        ...                        # Note: $line and not @lines

}
close(INFO);                       # Close the file
```

```
$file = 'data.txt' ;
open(INFO, ">$file");                                  # Open for output
print INFO "This line goes to the file.\n";            # Overwrite the file
```

```
$file = 'data.txt' ;
open(INFO, ">>$file");                          # Open for appending
print INFO "This line goes to the file.\n"; # Append to the end of the
                                            # file
```



Brackets or no-brackets

- There are two basic ways passing parameters to standard functions.
- The following are equivalent:

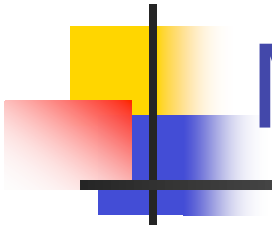
```
print INFO "This is a line" ;
print(INFO "This is a line") ;
```

```
split /:/, $info ;
split(/:/, $info) ;
```

• Note that there is a comma in the no-bracket version of `split`, but not in `print`. Lesson: check the function syntax - don't just remove all commas when you remove the brackets.

String Processing in Perl

- One of the most powerful features of Perl is it's ability to processing text strings.
- It was originally created to do do string extraction and processing of text documents.
  - The word "Perl" is an acronym for "Practical Extraction and Reporting Language".
- The power of the string processing is tied to it's use of *regular expressions* (REs).

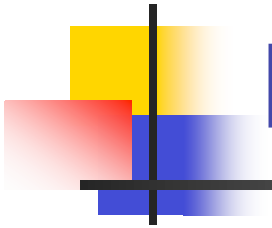


More Regular Expressions

- It is the special characters appearing in REs that gives the string processing its power (and also confusion).

- Some special characters used in REs:

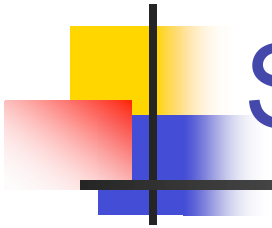
```
.       # Any single character except a newline
^       # The beginning of the line or string
$       # The end of the line or string
*       # Zero or more of the last character
+       # One or more of the last character
?       # Zero or one of the last character
```



More Regular Expressions

- Some example simple matches:

```
t.e       # t followed by anything followed by e
          # This will match          the
          #                          tre
          #                          tle
          # but not         te
          #                 tale
^f        # f at the beginning of a line
^ftp      # ftp at the beginning of a line
e$        # e at the end of a line
tle$      # tle at the end of a line
und*      # un followed by zero or more d characters
          # This will match          un
          #                          und
          #                          undd (etc)
.*        # Any string without a newline. This is because
          # the . matches anything except a newline and
          # the * means zero or more of these.
^$        # A line with nothing in it.
```



Special Characters

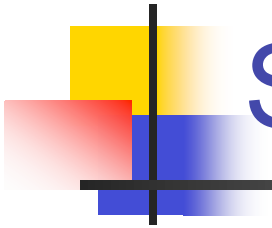
- Some general special characters used in strings:

```
\n      # A newline
\t      # A tab
\s      # Any whitespace character: space, tab, newline, etc
```

- Example usage:

```
print "Hello!\n" ;        # print the word "Hello!" followed by a new line
```

```
if ($sentence =~ /\t/) {          # if there is a tab in $sentence
        print ”There a tab in the sentence!\n" ;
}
```

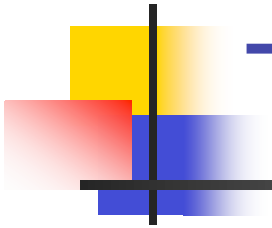


Substitutions

- As well as matching regular expressions, Perl can make substitutions based on those matches.

- Eg. to replace occurrences of “london” with “London” in $sentence:

```
$sentence =~ s/london/London/ ;    # replace first occurrence

$sentence =~ s/london/London/g ;   # replace all occurrences
                                   # - global substitution

$sentence =~ s/london/London/i ;   # ignore case of "london”
                                   # Means will replace "lOnDon",
                                   # "LONDON", "lONdon", etc.
```



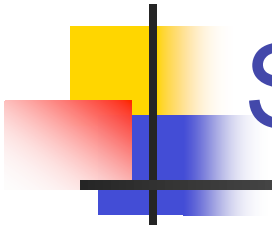
Translation

- The `tr` function does a character-by-character translation.
- Eg. to replace ‘a’ with ‘e’, ‘b’ with ‘f’, and ‘c’ with ‘g’ in $sentence:

```
$sentence =~ tr/abc/efg/ ;
```

- Eg. to replace all lower case with upper case in $sentence:

```
$sentence =~ tr/a-z/A-Z/ ;
```



Splitting a string

- A very useful function for doing string processing in Perl is the `split` function.
- Eg.

```
$info = "January:February:March";
@months = split /:/, $info ;
```

@months now has the array (“January”,”February”,”March”)

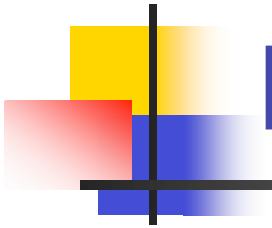
```
$info = "January February March";
foreach $month ( split /\s/, $info) ) {
    ...
}
```

Same as above; “\s” means blank space.

The $_ special variable

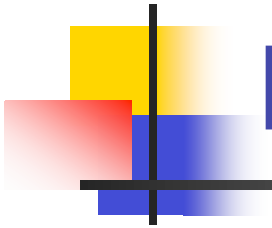
- One of the potential confusion aspects of Perl syntax is that in many situations in Perl, functions defaults to using the $_ variable if no other variable is specified.
- Eg.

```
split(/&/) ;                    # is the same as split(/&/,$_);
print ;                         # is the same as print $_ ;
foreach (@food) ...             # is the same as foreach $_ (@food) ...
if (/blah/) ...                 # is the same as if ($_ =~ /blah/) ...
```



Packages in Perl

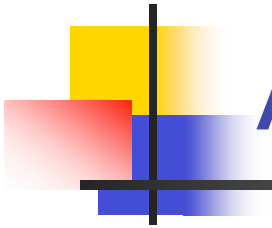
- A ***package*** in Perl is a set of data and operations that belongs together.
  - Object-oriented (OO) programming in Perl is done using packages.
- To access anything within a certain package (or in a module), we do two things:
  - Load the package using **use** or **require**.
  - Use the double colon to refer to package.



Packages in Perl

- Eg.

```
use MyPackage ;
$x = MyPackage::my_subroutine ;
$y = MyPackage::$my_variable ;
```



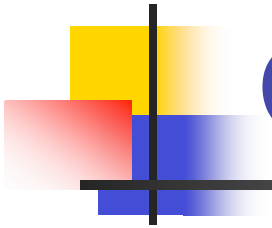
Accessing Elements in Packages

- Sometimes you may see multiple levels of dereferencing:

```
MyPackage::ASubPackage::mysubroutine ;
```

- A ***module*** is basically a package where the file name is the same as the package name (eg. the module MyPackage is stored in MyPackage.pm) .

- A ***library*** is a more generic term which could mean a package, a module, a set of modules, etc.

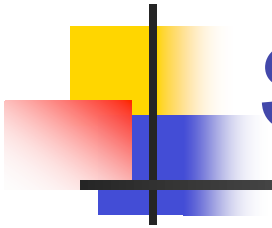


Classes and OO in Perl

- The predefined classes in Perl are stored as packages.

- So, to access a class in one of those packages, we use something like:

```
MyPackage::MyClass
```



Syntax for OO in Perl

- Perl object-oriented features are built up from packages and subroutines.
  - Classes basically comes in packages.
  - A method is basically a subroutine in a package.

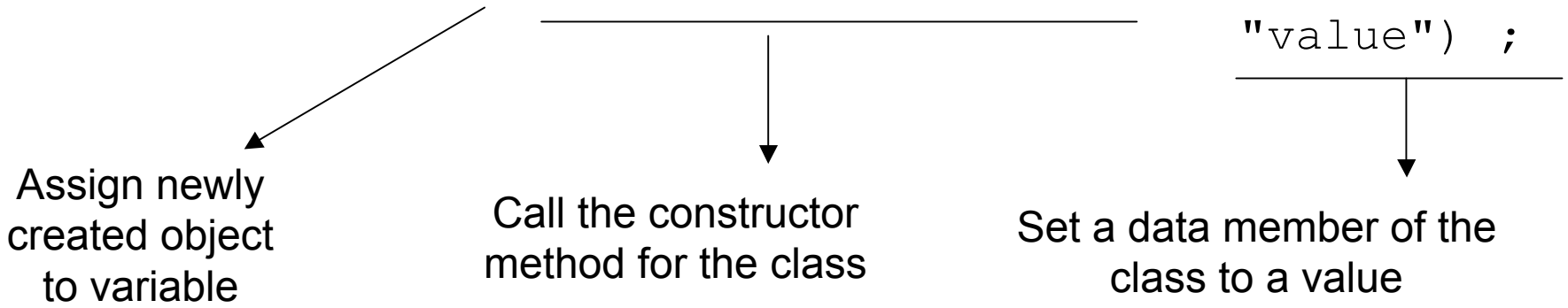
Creating Objects in Perl

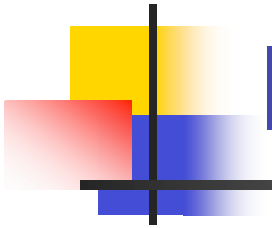
- To create a new object from a class, we use:

```
$new_obj = MyPackage::MyClass->new ;
```

or

```
$new_obj = MyPackage::MyClass->new (init_data =>
"value") ;
```

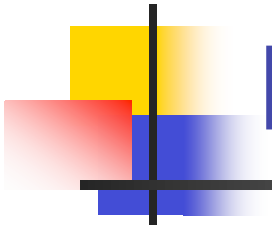




Invoking Methods of Objects

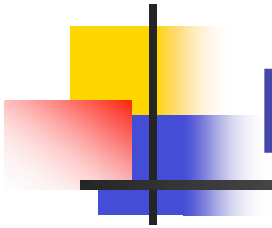
- To get an object to perform one of its methods, we use something like:

```
MyPackage::MyClass->my_method(param1 => "value");
```



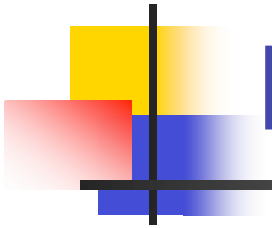
Further Reading

- This lecture do NOT cover the Perl language comprehensively.
- Required Reading
  - Unit Reader 2: Programming in Perl 5
- Perl books
  - See available online books in the *Unit Information>Readings* page on the web site.
  - The book "Programming Perl (3rd Ed)" is particularly comprehensive.



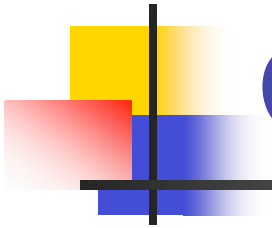
Leverage your existing programming skills

- To get up to speed with Perl is:
  - Be familiar with the Perl documentation.
  - Remember: use $ instead of @ or % for accessing array elements.
  - Use hashes for creative indexing instead of boring arrays with numerical index.
  - Understand special variables like $_ and @_.
  - Look at lots of examples of regular expressions.



Language References

- The documentation that comes with your Perl installation should have the official Perl manpages (ie. manual pages)
  - The man pages takes a bit of getting used to initially.
  - You need to know which page to refer to in the first place before you can find anything. Search facility for official docs is minimal.
  - Eg.
    - perlsyn - documentation on perl syntax (eg. if statements)
    - perlfunc - documentation on perl functions
    - perlre - documentation on perl regular expressions
    - Etc.



CPAN

- Comprehensive Perl Archive Network
- Main Perl site on the web
  - http://www.cpan.org/.
  - You will need this site to find specific information on non-core modules (eg the ones we will use later like LWP, XML::DOM, etc).