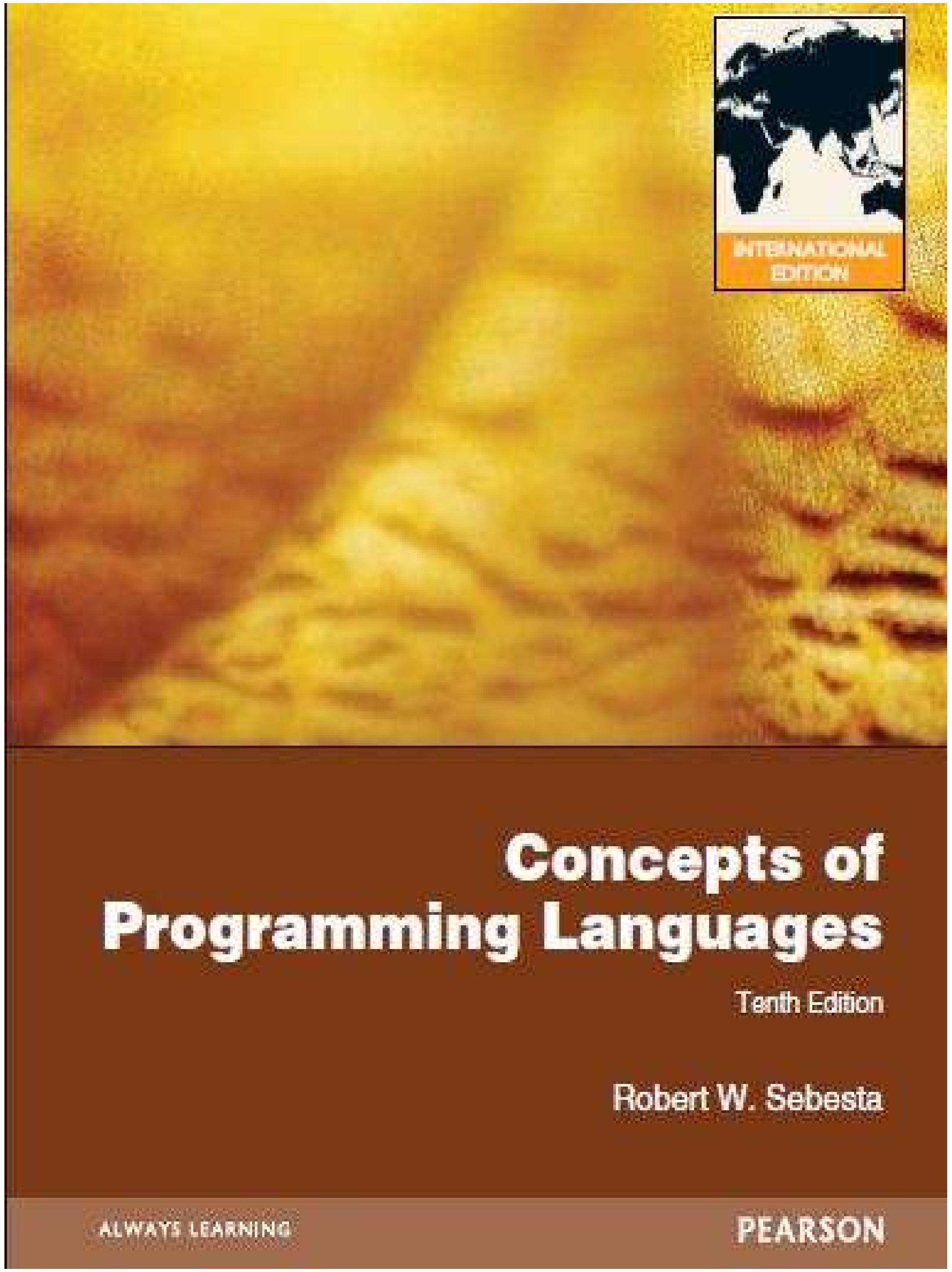
Programming Language

Instructor:
Min-Chun Hu
anita_hu@mail.ncku.edu.tw



Lecture 4
Regular Expression
Perl

Introduction

- Use special symbols to accomplish complex pattern matching tasks such as searching/replacing/deleting strings
- Useful in text processing, especially when dealing with HTML

Introduction

- Examples of regular expression:
  - Use “?” to represent that the previous character can be ignored
    - “color” and “colour” :
  - Use “\b” to represent boundary
    - “port” and “ports”, but not “export” or “important” :
  - Use “[ ]” to represent any element in the bracket
    - airport code such as “TPE”, “BOS”, “LAX” :
  - Use “\d” to represent any element in [0-9]
    - mobile phone number :
  - Use “+” to represent one or multiple occurrence
    - IP address :
  - Use “^”, “$”, “*” and “\s” to represent the start of a line, the end of a line, any number of occurrences, and any blank character [\t\n], respectively
    - Blank line :

Introduction

- Examples of regular expression:
  - Use “?” to represent that the previous character can be ignored
    - “color” and “colour” : colou?r
  - Use “\b” to represent boundary
    - “port” and “ports”, but not “export” or “important” : \bports?\b
  - Use “[ ]” to represent any element in the bracket
    - airport code such as “TPE”, “BOS”, “LAX” : \b[A-Z][A-Z][A-Z]\b
  - Use “\d” to represent any element in [0-9]
    - mobile phone number : 09\d\d-?\d\d\d-?\d\d\d
  - Use “+” to represent one or multiple occurrence
    - IP address : \d+\.\d+\.\d+\.\d+
  - Use “^”, “$”, “*” and “\s” to represent the start of a line, the end of a line, any number of occurrences, and any blank character [\t\n], respectively
    - Blank line : ^\s*$

Perl

- *There's More Than One Way To Do It, but sometimes consistency is not a bad thing either*.
- *Easy things should be easy, and hard things should be possible*.

Perl

- Things Perl can do easily
  - Find out if a string contains some specific pattern.
  - Parse a string
    - Extract components from a string according to some syntactical rules.
  - Replace parts of a string with other strings.
    - Change “abc” to “cde” in an article

Data Type

- Scalar
- Scalar Array
- Hash Array
- References

Variable declaration is optional ~

Scalar

- A scalar variable is declared with a start symbol ‘$’
- A local variable is declared with the syntax “my” or “local”
- Examples:
  - my $x=“anita";
  - my $x=52;
  - my $x=1.67;

String Operators

Operator	Purpose
x	Returns a string consisting of the left operand repeated the number of times specified by the right operand.
.	Concatenates the two strings on both sides of the operator.
eq	Returns True(1) if the two operands are equivalent, False( ) otherwise.
ne	Returns True(1) if the two operands are not equal, False( ) otherwise.
lt	Stringwise less than
le	Stringwise less than or equal
gt	Stringwise greater than
ge	Stringwise greater than or equal
cmp	Returns -1, 0, or 1 if the left operand is stringwise less than, equal to, or greater than the right operand.
++	Increments the string by one alphabetic value.

Example

- What is the result of $x and $Result ?

```
my $x="anita";
my $Result= $x ++;
```

Value Operators

Operator	Operator	Operator
+	<	++
-	>	--
*	< = >	**
/	&&	+=
%	||	-=
==	&	*=
!=	|	>>
<=	^	<<
>=	~	

Scalar Array

- A scalar array variable is declared with a start symbol ‘@’
- Examples:
  - my @array;
  - my @array=qw(a b c);
  - my @array=("a","b","c")
  - $array[0]=“a”; $array[1]=“b”; $array[2]=“c”;
  - for($i=0; $i<=$#array; $i++) {

```
    print "$array[$i]\n";
}
```

Hash Array (Associative Array)

- A hash array variable is declared with a start symbol '%'
- The index of a hash array is a string rather than an integer
- Example:
  - my %hash;
  - my %hash=('i1'=>"aaa", 'i2'=>"bbb", 'i3'=>"ccc");
  - $hash{'i1'}="aaa"; $hash{'i2'}="bbb"; $hash{'i3'}="ccc";
  - foreach $key (keys %hash) {print "$hash{$key}\n";}
  - foreach $value (values %hash)){print "$value\n";}
  - while(($key,$value)=each %hash) {print "$hash{$key}\n";}

Reference (Pointer)

- Obtain the address of a variable and use it :
  - `$scalarRef=\$scalarVar;   print $$scalarRef;`
  - `$arrayRef=\@arrayVar;   print "@$arrayRef";`
  - `$hashRef=\%hashVar;   print $hashRef->{$key};`
  - `$funcRef=\&funcName;   &$funcRef;`

Reference (Pointer)

- Anonymous Array References (2D array):
  - $arrayRef=[[1,2,3,4],'a','b',['w‘,'x','y','z']];

    print "$arrayRef->[3][2]\t$arrayRef->[2]\n";
- Anonymous Hash References:
  - $hashRef={a=>aa,b=>bb,c=>cc};

    print "$hashRef->{a}\t$hashRef->{b}\t$hashRef->{c}\n";

Control Statement

- Conditional Control Statements:
  - if (Expression) {Code Segment}
  - if (Expression) {Code Segment} else {Code Segment}
  - if (Expression) {Code Segment} elsif (Expression) {Code Segment} else {Code Segment}
  - statement if (Expression);
  - statement unless (Expression);

Control Statement

- Loop Control Statements :
  - for($i=0; $i<=10; $i++) {Code Segment}
  - for $i (0..10) {Code Segment}
  - foreach $i (@array) {Code Segment}
  - while($i<=10) {Code Segment}
  - do {Code Segment} while(Expression);
  - while(chomp($i=<STDIN>)) {

```
      next if ($i == 5);
      last unless ($i > 10);
  }
```

Control Statement

- Switch :
  - SWITCH: {

```
        if (/^abc/) { $abc = 1; last SWITCH; }
        if (/^def/) { $def = 1; last SWITCH; }
        if (/^xyz/) { $xyz = 1; last SWITCH; }
        $nothing = 1;
    }
```

Subroutines

- Syntax:
  - sub NAME {code}
- Call a subroutine:
  - &NAME(para1, para2, …)
- Message passing:
  - @_
- Variable Localization
  - “my” or “local”

Example

```
my $s1 = &sum1(11,22,33);
my $s2 = &sum2(22,33,44);
my $s3 = &sum3(11,22,33,44,55);
print ″s1=$s1, s2=$s2, s3=$s3\n″;
sub sum1 {
   (my $first, my $second, my $third) = @_;
    return $first + $second + $third;
}
sub sum2 {
    my $first = $_[0];
    my $second = $_[1];
    my $third = $_[2];
    return $first + $second + $third;
}
```

Example (Cont.)

```
sub sum3 {
    my $s = shift @_;

    foreach ( @_ ) {
        $s = $s + $_;
    }
    return $s;
}
```

File Open/Close

- Syntax:
  - open(FILEHANDLE,"Expression");
  - close(FILEHANDLE);
- Examples:
  - open(FILE, $filename) || die "Can't open file $filename : $!\n";
  - print while(<FILE>);
  - while($_=<FILE>){print "$_";}

Expression in Open Function

Expression	Effect
open(FH, "<filename")	Open filename for reading.
open(FH, ">filename")	Open filename for writing.
open(FH, "+<filename")	Open filename for both reading and writing without truncating it.
open(FH, "+>filename")	Open filename for both reading and writing with truncating it first.
open(FH, ">>filename")	Open a file in append mode. The writing point will be set to the end of the file. (cannot read)
open(FH, “+>>filename")	Open a file in append mode. The writing point will be set to the end of the file. (can read)

Input/Output

- Input
  - `$input=<STDIN>; chomp $input;`
  - `chomp($input=<STDIN>);`
- Output
  - `print "Scalar value is $x\n";`
  - `print "Scalar value is " . $x . "\n";`
  - `print FILE "print $x to a file.";`
  - `print<<XXX;`
  -
    ```
    my $output = "標準輸出";
    print "$output\n";
    print STDOUT "$output\n";
    ```

- Examples:

  -
    ```
    $x="ls -l";
    print "$x";            # Output ls -l
    print "\$x";           # Output $x
    print '$x';            # Output $x
    print `$x`;            # Output files in this directory
    ```

Special Characters

\t	tab	\x1b	hex char
\n	newline	\c[	control char
\r	return	\l	lowercase next char
\f	form feed	\u	uppercase next char
\b	backspace	\L	lowercase till \E
\a	alarm(bell)	\U	uppercase till \E
\e	escape	\E	end case modification
\033	octalchar	\Q	quoteregexp metacharacters till \E

Regular Expression

- Syntax:
  - $string =~ /regular expression/expression modifier
  - $string != /regular expression/expression modifier
- Examples:
  - $sentence =~ /Hello/

modifier	Effect
g	Match globally, i.e. find all occurrences.
i	Makes the search case-insensitive.
m	If the string has new-line characters embedded within it, the metacharacters ^ and $ will not work correctly. This modifier tells Perl to treat this line as a multiple line.
o	Evaluates the expression only once.
s	Allows . to match a new-line character.
x	Allows white space in the expression.

Metacharacter

Metacharacter	Effect
\	Accept the following characters as a regular character; this removes special meanings from any metacharacter.
^	Match the *beginning* of the string, unless /m is used.
.	Match any character except a new line character, unless /s is used.
$	Match the *end* of the string, unless /m is used.
|	Express alternation. This means the expressions will search for multiple patterns in the same string.
( )	Group expressions to assist in alternation and back referencing.
[ ]	Look for a set of characters.

Pattern Quantifier

Quantifier	Effect
*	Matchs 0 or more times.
+	Matchs 1 or more times.
?	Matchs 0 or 1 times.
{n}	Matches exactly n times.
{n,}	Matches at least n times.
{n,m}	Matches at least n times but no more than m times.

```
/b{3}/     #matches three b's
/(ha){3}/  #matches hahaha
```

Examples

```
/abc/
/^abc/
/abc$/
/a|b/
/ab{2,4}c/
/ab*c/
/ab+c/
/a.c/
```

```
/[abc]/
/ \d/
/ \w/
/ \s/
/[^abc]/
/ \*/
/abc/i
/(\d+)\.(\d+)\.(\d+)\.(\d+)/
```

Character Patterns

Character Patten	Usage
\r	Carriage return(CR)
\n	New line
\t	Tab
\w	Matches an *alphanumeric* character.
\W	Matches a nonalphanumeric character. 即 [^A-Za-z0-9_].
\s	Matches a *white space* character. This includes space, tab, FormFeed and CR/LF. 即 [\ \t\f\r\n].
\S	Matches a non-white space character. 即 [^\ \t\f\r\n].
\d	Matches a *digit*. 即 [0-9].
\D	Matches a nondigit character. 即 [^0-9].
\b	Matches a word boundary.
\B	Matches a nonword boundary.
\033	octal char
\x1B	hex char

Match Operator Example

/foo/

- Return true if "foo" is a substring of $_
- Return false is there is no "foo" in $_
- If $_ is "food is great" , return true
- If $_ is “blah foo” , return true

Foofind.pl

```
# read one line at a time into $_
while (<>) {
   # see if the string in $_ contains "foo"
   if (/foo/) {
   # the string matches "foo", so print it
   print “Matched: $_”;
   }
}
```

Special Variables

Special Variable	Effect
$_	The default input and pattern-searching space.
$digit	Contains the subpattern from a successful parentheses pattern match.
$.	The current input line number of last filehandle read.
$!	Contains the current value of errno.
$0	The name of the file of the Perl script.
@ARGV	The command line arguments issued when the script was started.
@_	The parameter array for subroutines.
%ENV	This associative array contains your current environment.

Substitution Operator

- s/PATTERN/REPLACEMENT/;
  - $string =~ s/dog/cat/;
- tr/PATTERN/REPLACEMENT/;
  - $var =~ tr/dog/cat/;

Reference

- http://ind.ntou.edu.tw/~dada/cgi/Perlsynx.htm
- http://perldoc.perl.org/perlrequick.html
- http://www.tutorialspoint.com/perl/perl_regular_expression.htm
- http://docstore.mik.ua/orelly/perl/perlnut/ch04_06.htm
- http://docstore.mik.ua/orelly/perl2/prog/ch05_02.htm

CPAN

- Comprehensive Perl Archive Network
- Via CPAN, you can find plenty softwares/codes written in Perl