Perl Short Course: Third Session

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Aside: A better way to run Perl Programs

- We have seen that when we want to run a Perl program called **eg1**, we say: `perl eg1`.
- Wouldn't it be better if we could just type eg1 to run our program?
- Then we could install our own Perl programs in a public place and let our friends run them - without them caring what language the programs are written in!

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

- This is a special line interpreted by Unix when it executes a non-machine code program.
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- Perl starts up, reads eg1 and proceeds to run it - and then ignores the first line because it's a comment!

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- Unix executes the named program (the Perl interpreter) with the script eg1 as a command line argument.
- Perl starts up, reads eg1 and proceeds to run it - and then ignores the first line because it's a comment!
- Now, run **eg1** by `eg1` (if `.` is on your path), or `./eg1` if not.

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- An array may be built up piece by piece:

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- Assigning to an element beyond the current end of the array (eg. `$fred[10]=42`) causes the array to be silently extended. All intervening elements are made the undefined value (looks just like 0).

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- If you have a list of single words, for example:

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my @fred = ( "hello", "there", "how", "are", "you" );
```

- Perl provides the following syntactic sugar:

```
my @fred = qw(hello there how are you);
```

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- Tupling gives you a very easy swap operation:

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( $x, $y ) = ( $y, $x );
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which takes `y` and `x`, forms them into a two-element list, and assigns the first two elements of that list back into `x` and `y`.

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  which takes `y` and `x`, forms them into a two-element list, and assigns the first two elements of that list back into `x` and `y`.
- In summary, Perl arrays act as dynamic arrays, tuples, lists, and stacks and queues (as we'll see later).

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  - Assigning an array to a scalar, eg `$count = @y`, means *set* `$count` *to the number of elements in* `@y`.
- You can force a scalar context when you're not sure what Perl would do by wrapping an expression in the function `scalar()`.

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- A hash literal can be written as a list of pairs with the `key => value` syntax:

```
my %roomno = (
  "dcw"   => "225",
  "ldk"   => "225",
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- You can think of a hash as a two-column database table (but stored in memory), indexed on the key:

Key	Value
dcw	225
ldk	225
sza	226
mjw03	228
....	....

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- Our original hash literal example could be written as:

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- The keys do not come out in any predefined order - certainly not alphabetical order, or insertion order! They come out in an efficient internal order! Because of this, you often see:

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```

- Very occasionally, you only need the **values**:

```
foreach my $value (values(%roomno))
{
  print "room value $value\n";
}
```

- If you need both keys and values, use the **each()** function and a **while** loop to iterate over all the *(key, value)* pairs:

```
while( my($key,$value) = each(%roomno) )
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  print "$key in room $value\n";
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- Note: **keys(), values()** and **each()** produce results in **whatever order Perl likes**.
- Exercise: build a Perl program storing `(username,roomno)` pairs in a hash, which then reads usernames - from stdin, or a text file, as you like - until the end-of-input is reached, and prints the name and corresponding room number for each.
- Then replace the set of names and their associated room numbers with an external data file, reading them in and then building the in-memory hash. (At this early stage in your Perl knowledge, you might need to store usernames and room numbers on adjacent lines in the file).
- Next, replace the hash with a dbm file (with an initialization program that reads the names and room numbers from a text file, and stores them in the dbm-tied hash).

Perl has many special variables (see `perldoc perlvar` for a complete list). Here are a few of the most useful:

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- As usual, `@ARGV` evaluated in a scalar context gives the number of elements (in the example, 3).
- The array function `shift()` can be used on `@ARGV`:

```
my $arg = shift @ARGV;
```

  This sets `$arg` to element 0 of the array, and removes that element from the array, shifting the other elements down one.

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- If they are filenames to be opened and processed, the *open and process every line in every file* idiom is often used:

```
foreach my $arg (@ARGV)
{
  my $in = new IO::File( $arg ) || next;
  while( my $line = <$in> )
  {
    chomp $line;
    # now process $line
  }
  $in->close;
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```

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- The above pattern (processing several files, not caring where one ends and the next begins), is so common that Perl has a special shorthand:

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while( my $line = <> )
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  {
    chomp $line;
    # now process $line
  }
  $in->close;
}
```

- The above pattern (processing several files, not caring where one ends and the next begins), is so common that Perl has a special shorthand:

```
while( my $line = <> )
{
  chomp $line;
  # now process $line
}
```

- Exercise: generalise one of the earlier `STDIN` or single-file processing programs to take one or more command line arguments using either of these idioms.

- You may find a puzzling shorthand, as in eg2:

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while( <> )
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- `$_` is the *implicit variable*: the *default argument* to many functions:
  - The default variable where <> stores its input line.
  - The default variable that `chop` and `chomp` modify.
  - The default variable to match a regex against.
  - The default value to print if none is given.
  - The default foreach variable, as in `foreach (@ARGV)`.
  - .. and many more cases.

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- To see the current set of environment variables, type `env` at the command line. A list of `NAME=value` pairs fly past.
- Once set, environment variables are passed around automatically to every Unix process in the current session. Perl makes these variables accessible via a single hash called `%ENV`.
- For example, an important environment variable is `HOME` (the pathname of your home directory). Get this by:

```
my $home = $ENV{HOME} || die "no home?\n";
```

- Other platforms – such as Windows – also have environment variables, Perl on those platforms can access environment variables in the same way, but of course what environment variables exist and what they mean) are different.

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- A whole regex is (usually) placed inside a pair of '`/`' signs. Within the slashes, characters are interpreted pretty much like in a double-quoted string. In particular, **variables are interpolated** before pattern-matching occurs.
- A regex is made up of *single character patterns*, *grouping patterns*, *alternation patterns*, *anchoring patterns* and *bracketing patterns*. We'll look at each in turn.

- ‘ . ’ matches any single character.

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- If a set starts with a '`^`' character (eg. `[^a-z#%]`), the set is negated - the pattern matches any character NOT in the set.
- Several useful character classes are predefined:

Digit	`\d`	`[0-9]`
Non-digit	`\D`	`[^0-9]`
Word	`\w`	`[a-zA-Z0-9_]`
Non-word	`\W`	`[^a-zA-Z0-9_]`
Whitespace	`\s`	space or tab
Non-whitespace	`\S`	not space or tab

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- A regex can contain several of these operators: eg: `/h[uea]*l+o/` matches '`hlo`', '`hullo`', '`hulllllo`', '`heeelo`', '`heuaueaaeuellllllo`' etc.

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There are two main ways of using regexes:

- To check whether **a string matches a regex**. We specify the string to match against using the =~ operator, or the *not match* operator !~:

```
print "<$str> matches\n" if $str =~ /h[eua]*l+o/;
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  If a regex match is followed by i, as in /h[eua]*l+o/i, the matching is done case insensitively.
- Secondly, a regex can be used to **search and replace** all occurrences of a regex within a string (again, we specify the string to modify using the =~ operator):

```
$str =~ s/[aeiou]+/a/g;
```

  The trailing g makes Perl replace ALL vowel sequences in $str with 'a'. Without the g Perl would only replace the first match.

- As a general way of testing regular expressions, I recommend a program like **eg3**:

```
#!/usr/bin/perl
#
# eg3: regex test harness..
#
print "Please enter a string: ";
my $str = <STDIN>;
chomp $str;
print "\nat start  : <$str>\n";

# test search and replace:
$str =~ s/^\s+//;
print "\nafter s///: <$str>\n";

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- This whole program exists in order to let you test search and replace and/or pattern matches using a string entered at the keyboard. By the way, `s/^\s+//` is a useful regex - worth committing to memory - that removes any leading whitespace. Similarly, the regex `s/\s+$//` removes trailing whitespace.

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- I strongly recommend that you use this program to test lots of different regexes and their behaviour against various strings.

- A regex of the form `/h[eua]*llo|wo+tcha/` matches *either* `/h[eua]*llo/` or `/wo+tcha/`. Note that `/a|b|c|g/` should be written as `/[abcg]/` instead for efficiency.

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- Brackets have another useful side effect: they tell Perl's regex engine to *remember* what text fragment matched the inner pattern for later reporting or reuse.

- For example, in the code:

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my $str = "I'm a melodious little soooongbird, hear me sing";
print "found <$1>\n" if $str =~ /(so+ng|bla+ck)bird/;
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After the match succeeds, the capture buffer variable `$1` contains `soooong` - the part of `$str` matching the bracketed regex.

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- Another example: /first(.*)second/ matches exactly the same strings as /first.*second/, but remembers the particular sequence of characters found between first and second as $1.
- If the string contains several occurrences of first and second, greediness maximises /.*/ so the regex matches the *leftmost* first and the *rightmost* second:

```
.....first...first...second...first...second........
     ^^^^^!!!!!!!!!!!!!!!!!!!!!!!!!!!!!^^^^^^
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- Here, the character immediately following 'm' (for match) or 's' (for search and replace) is used as the regex quote character.

- We can also reuse a capture buffer (under the syntax \1) to enforce the *same* literal text is found twice in a pattern match:

```
/first(.*)second\1/
```

- This will only match strings like:

```
...........firstXYZsecondXYZ...............
```

  but not strings like:

```
..................firstABCsecondXYZ..........
```

- Test **eg3** out with a variety of inputs and regexes and check you understand how they work.
- If your pattern contains lots of '/' characters - while you can write each as '\/' - it's easier to change the regex quote character:

```
$str =~ m%^/([^/]+)/%;
$str =~ s!/[^/]*$!!;
```

- Here, the character immediately following 'm' (for match) or 's' (for search and replace) is used as the regex quote character.
- That's a basic overview of Perl regexes; there are loads more features (a few more bizarre ones seem to get added every year or so). See `perldoc perlre` for more details.

```
$str =~ tr/firstcharlist/secondcharlist/[cds]
```

- `tr` is the character transliterator. It works very like the Unix filter `tr` - turning each occurrence of a character from the first character list into the corresponding character from the second character list.

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- eg: `tr/aB/Ab/` uppercases every '`a`' and lowercases every '`B`'.

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- `tr` is rather like a series of regexes that only use character classes - the above example is equivalent to `s/a/A/g` followed by `s/B/b/g`. But `tr` is much more efficient.

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- Like `s///`, `tr//` also returns a scalar value - a count of how many characters were modified/deleted.
- Let's give some examples:

`$str =~ tr/A-Z/a-z/`	lowercase every character in `$str`.
`$str =~ tr/xyz/ZYX/`	turn every occurence of `x` into `Z`, `y` into `Y` and `z` into `X`.
`$str =~ tr/A-Z//d`	delete all upper case letters.
`$str =~ tr/A-Z//cd`	delete all characters *except* upper case letters.
`$str =~ tr/aeiou/V/`	replace any lower case vowel with a '`V`'.
`$str =~ tr/aeiou/V/s`	replace each *sequence* of vowels with a single '`V`'.
`$count = ($str =~ tr/a-z/a-z/)`	Set `$count` to the number of lower case letters found in `$str` (without changing `$str`).

- Implement a simplified Perl version of the Unix grep command - take two or more command line arguments (die with a nice usage message if not enough!):
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- Add line number counting (reset it for each file) and print out the current line number on matching lines (as well as the filename and line itself).
- Now add in a sanity check to ensure that the search string does not contain any regex meta-characters. Die with a nice helpful message if it does (or escape them first!).

- Prepare an input file containing a list of words, in no particular order, one per line. Write a program to open such a file - take the filename on the command line - read each line, delete leading and trailing whitespace from each line, delete leading or trailing punctuation too, and then print each line (word) out.

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- Now make this word-splitter program count word frequencies - do `$freq{$word}++` for each word `$word` you find. After processing all lines, print out a sorted list of frequencies of all the words found - using magic syntax:

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- For each file, first use your frequency building code to build the frequency table for that file.

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- You'd also need two programs - one to index (or reindex) a list of files, and another to perform a search for a word...