Bourne Shell Scripting

Introduction

- Bourne (`sh`) / BASH (`bash`) are more than command interpreters
  - they are also a programming language
    - variables, control structures (conditional expressions, loops)
- shell script
  - simple text file containing a sequence of commands and statements interpreted by the `sh`
  - anything you type on a command line can be part of the script

- Con’s:
  - – syntax (ie. spacing) is very picky
  - – error messages are not very helpful
- Pro’s:
  - – quick and simple to write

Shell Script Example

```
#!/bin/bash
# read in users name
echo "Enter your name:"
read name

# read in a number
echo "Hello $name. Guess a number between 0-9:"
read guess
if [ $guess -eq 8 ]
    then
        echo "$name, your right!"
    else
        echo "$name, your wrong!"
fi
```

Executing a Shell Script

- Make the script runnable by setting execution bit:

```
% chmod u+x myscript.sh
```

- Now you can run the script by any of the following

```
% ./myscript.sh
% /bin/sh myscript.sh
```

Shell Variables

- Variable
  - memory location that can be referenced by a name rather than an address
- shell variable
  - sequence of characters, numbers, and underscores ("_")
  - must begin with a char or "_"
  - stored as a string of chars – even when assigned a number

Two types of shell variables:

1. Environment Variables
   - customize your shell environment
   - most are read-write (ex. PATH)
   - others are read-only (i.e. command line arguments, PID)

Common Read-Only Shell Variables

Env Variable	Variable Description
`$0`	Name of Program
`$1 - $9`	Values of command line args 1-9
`$*`	Values of all command line args
`$@`	Values of all command line args; each quoted i.e. "`-Plexmark_lp`"
`$#`	Number of command line args
`$$`	PID of current process
`$?`	Exit status of most recent command
`$!`	PID of most recent background cmd

2. User-Defined Variables
   - temporary locations to store values during computation of the script
   - don't need to be declared in advance
   - initialized to the null string

- `env` command displays *many* shell variables
- `set` commands displays *all* shell vars

Reading/Writing Shell Variables

- Assigning a value to a shell variable follows the simple syntax of

  `% var=value`

  – notice the lack of white space

  – to include spaces enclose the string in quotes

  `% var="Hello world"`

- Inside of quotes everything except metacharacters are treated as a string

- More examples:

```
% myvar=hello world
bash: world: command not found
% echo $myvar
hello
% echo \$myvar
$myvar
% star=*
% echo $star
[names of all files in pwd]
% echo "$*"
*
```

Exporting Variables

- User-defined variables are not inherited by commands or subshells. Consider the following,

```
% myvar=hello; echo $myvar
hello
% cat > myscript.sh
echo $myvar
^D
% mychod u+x myscript.sh; ./myscript.sh

% export myvar; ./myscript.sh
hello
```

- myvar was not known by myscript until it was exported (not in scope)
- changes to myvar inside of myscript's scope doesn't change the value in the shell's scope

```
% myvar=hello
% cat > myscript.sh
echo $myvar
myvar=world
^D
% ./myscript
hello
```

Command Substitution

- Enclosing a command in backquotes causes the command to be substituted for it's results. For example:

```
% echo "The current dir is `pwd`"
The current dir is /home/jay
```

Resetting Variables

- A variable retains a value until script finished or the variable is reset to null

```
% echo $myvar
hello
% unset myvar; echo $myvar
```

- Explicit assignment to null

% myvar=

Read-Only Variables

- If a variable remains constant then it can be made a symbolic constant using the `readonly` command
- Syntax:

  readonly [variable-list]

- For example,

  % pi=3.14
  % readonly pi
  % pi=6
  bash: pi: readonly variable

Argument Handling

- Command line arguments (args) passed to a script can be referenced via `$1`-`$9`
- `$#` identifies the args count
- `$*` and `$@` store all args
- To access more than nine args we use the shift command to move the args to the left (`$5` becomes `$4` etc.).
- Syntax: Shift args left by `n`

```
shift [n]
```

- `Set` command can be used to fix args position

```
% set `date`
Sat Oct 13 14:04:53 EDT 2007
% echo “$@”
Sat Oct 13 14:04:53 EDT 2007
% echo “$2 $3, $6”
Oct 13, 2007
```

Formatting `echo` Output

Character	Meaning
`\b`	Backspace
`\c`	Print line without moving cursor to next line
`\f`	Form feed
`\n`	Newline
`\r`	Carriage return
`\t`	Horizontal tab
`\v`	Vertical tab
`\\`	Backslash
`\ON`	Character with ASCII octal number N

Getting User Input

- The `read` command can be used to receive input from the user. `read` consumes an entire line at once.
- Syntax:

```
read variable-list
```

- Number of elements in variable-list dictates how the input will be spliced.

read Example

```
echo "Enter some text:"
read text1
echo text1
echo "Enter more text:"
read text2 text3
echo $text2
echo $text3
```


Control Flow Statements

- Conditional expressions which alter sequential program execution
  - two-way branch
    - `if` statement
  - multi-way branch
    - `if` and `case` statements
  - repetition/loop
    - `for`, `while` and `until` statements

`if` Statements

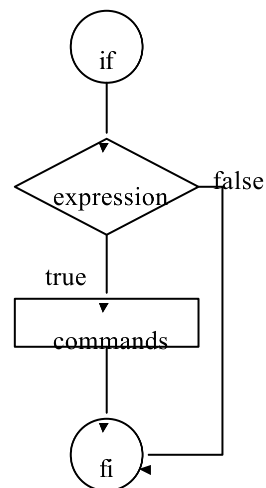
- `if-then-elif-else-fi` statement
  - Test if a condition is true or false
- Syntax:

```
if expression
     then
          [elif expression
               then
                    true-commands
          [else
                false-commands
fi
```

Simple `if` Statement

- Two-way branching:

```
if expression
      then
            commands
fi
```



test Command

- Used in conjunction with an if statement
- Evaluates to true or false
- For example,

```
if test -f "$myfile"
    then
         echo "File exists"
     else
         echo "File does not exists"
fi
```

File Testing

Expression	Return Value
-d file	True if file is a directory
-f file	True is file is an ordinary file
-r file	True is file is readable
-w file	True is file is writable
-x file	True is file is executable
-s file	True is file length is nonzero

Integer Testing

Expression	Return Value
`i1 -eq i2`	True if `i1` equals `i2`
`i1 -ge i2`	True if `i1` is greater than or equal to `i2`
`i1 -gt i2`	True if `i1` is greater than `i2`
`i1 -le i2`	True if `i1` is less then or equal to `i2`
`i1 -lt i2`	True if `i1` is less than `i2`
`i1 -ne i2`	True if `i1` does not equal `i2`

String Testing

Expression	Return Value
`s`	True if `s` is non-null
`s1 = s2`	True if `s1` equals `s2`
`s1 != s2`	True if `s1` does not equal `s2`
`-n s`	True if length of `s` is greater than 0
`-z s`	True if length of `s` is 0

Logical Operators

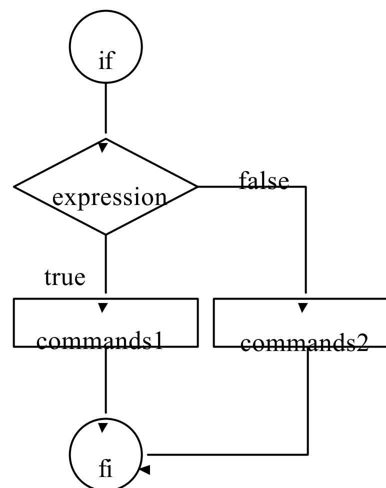
- All of the test expressions can be used with the following operators

`!`	Logical NOT
`-o`	Logical OR
`-a`	Logical AND
`(expression)`	Grouping multiple expressions together

`if-else` Statement

- Two-way branching:

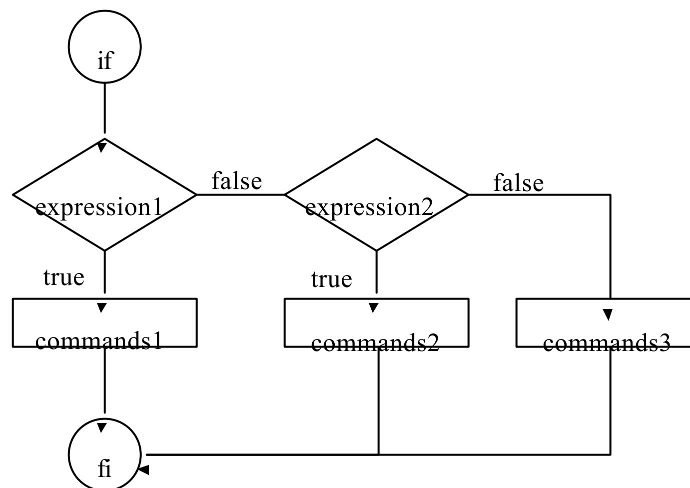
```
if expression
     then
          commands1
     else
          commands2
fi
```



`if-elif-else` Statement

- Multi-way branching:

```
if expression1
     then
          commands1
     elif expression2
          commands2
     else
          commands3
fi
```



`for` Statement

- Counted loop that repeats the same sequence of commands (loop body) usually a known number of iterations.
- Syntax:

```
for variable [in list]
do
   commands
done
```

`for` Loop Example

- Print all the files in the current dir that end with `.ps`

```
for file in *.ps
do
  lpr -Plexmark_lp $file
done
```

`while` Statement

- Repeat the loop body while a condition remains true.
- Syntax:

```
while condition
do
  commands
done
```

- `condition` is evaluated at the start of every iteration prior to entering the loop body (and therefore executing `commands`)

`while` Loop Example

- Keep guessing until user gets correct number:

```
guess=0
while [ $guess != 8 ]
do
  echo "Guess a number between 0-9:"
  read guess
done
echo "$name, your right!"
```

`until` Statement

- Opposite of while loop
- Repeat until some condition is true
- Syntax:

```
until condition
do
  commands
done
```

`until` Loop Example

- Keep guessing until user gets correct number:

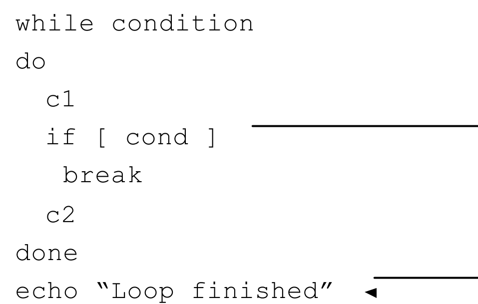
```
guess=0
until [ $guess = 8 ]
do
  echo "Guess a number between 0-9:"
  read guess
done
echo "$name, your right!"
```

`break` and `continue` Commands

- Interrupt execution of a loop iteration
- break
  - jump to command following done
  - “break” out of current iteration
- continue
  - jump to command following done
  - “continue” at next iteration

`break` Example

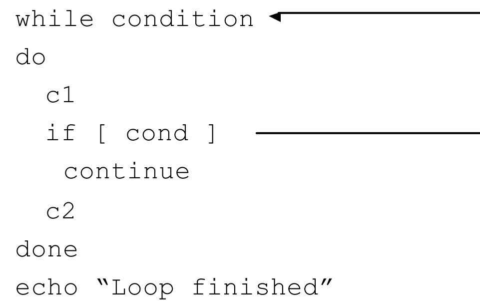
- Jump out of loop if some cond is true



```
while condition
do
  c1
  if [ cond ]
   break
  c2
done
echo “Loop finished”
```

continue Example

- Jump to the start of the next iteration if some cond is true



```
while condition
do
  c1
  if [ cond ]
   continue
  c2
done
echo "Loop finished"
```

`case` Statement

- Multi-way branch similar to if-elif
  - More concise and readable
- Syntax:

```
case str in
  pattern1)  commands1
             ;;
  pattern2)  commands2
             ;;
esac
```

`case` Statement Example

- User menu:

```
echo "Enter a command"
read input
case "$input" in
  a|A)        echo "A"
              ;;
  b|B)        echo "B"
              ;;
  x|X)        echo "Good-bye"
              ;;
esac
```

Functions

- Program statements that accomplish a specific task can be grouped into a function
  - improves structure, robustness, readability, reuse
  - smaller, easier to program
- Syntax:

```
MyFunction ()
{
   commands
}
```

Example of a Simple Function

```
% gohome ()
>{
>    echo `pwd`;
>    cd;
>    echo `pwd`
>}
% gohome
/tmp
/home/Jason
```

Processing Numeric Data

- Shell scripting is better suited for string processing
  - variables stored as strings
  - arithmetic
    - convert variable into a number perform computation and then translate it back to string for storage
- Enabled by the *evaluate expression* (`expr`) command

expr Command

Operator	Explaination
|	Return 1st expr if it is not null (or 0), else return 2nd expr
\&	Return 1st expr if neither is null (or 0), else return 0
=	Equal to
\>	Greater than
\>=	Greater than or equal to
\<	Less than
\<=	Less than or equal to
!=	Not equal to
+, -, *, /, %	addition, subtraction, multiplication, division, modulo

Script Debugging

- Running a script with the –x (echo) and –v (verbose) options aids debugging
- This will report (echo) all of the scripts commands before they are executed