**Linux Shell Part 2**

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| **Shell Script**  A text file containing shell commands and/or shell language statements is a shell script.  A comment in a shell script is indicated by beginning the line with a "#".  In a shell script, a **shebang** interpreter directive tells Linux which command interpreter to use. Example shebangs:  #!/bin/bash  #!/bin/tcsh  #!/usr/bin/perl  The shebang must be on the first line of the file. If you get tired of typing it in vim, see "**How can I more easily type shebang values?"** in my website's set up section.  Notes about UTSA:   * Login shell is **tcsh** * When you launch a shell script which doesn't contain a shebang, the launched shell isn't tcsh nor bash; instead, it is **dash**. | $ cat >whoson  #!/bin/bash  # Shows the date and who is on  date  echo "who is on?"  who  CTRL-D  $ |
| **Shell Variables**  Shell variables are similar to variables in other languages since they represent other values. The variable names must begin with a letter or underscore, but can contain letters, numbers, and underscores.  The value of a variable is referenced by preceding it with a $. (Note that we will see how numeric calculations might not use $ references.)  The parameters to a shell script are referenced by a "$" followed by a positional number. The name of the command is $0. $1 is the first parameter, $2 is the second parameter, and so on. The number of parameters is $#.  Variable names are case sensitive. | Valid variable names:  line, name1, name2, first\_name  Invalid variable names:  first-name, last.name, 1char  # Variable references  $ cat >echoName  echo "Number of parameters is $#"  echo "Full name is $1 $2"  name=$1  echo "First name is $1"  CTRL-D  $ chmod u+x echoName  $ ./echoName bob wire  Number of parameters is 2  Full Name is bob wire  First name is bob |
| **Setting Variable Values**  Shell scripts provide assignment statements which can give shell variables values during the execution of the shell.  bash/dash:  *targetVariable*=*value* (no spaces around "=")  tcsh:  set *targetVariable* = *value* (spaces optional)  We will learn about the scope of variables below. | # assign some variables using a bash script  $ cat > assignVar  #!/bin/bash  first=ray  last=king  echo $first $last  CTRL-D  $ chmod u+x assignVar  $ ./assignVar  ray king  # assign variables using a tcsh script  $ cat >assignVarT  #!/bin/tcsh  set first = lee  set last=king  echo $first $last  CTRL-D  $ chmod u+x assignVarT  $ ./assignVarT  lee king  # what are the values after the shell script executed?  $ echo $first $last  first: Undefined variable. |
| **Assigning From Math Expressions in BASH**  Four forms:  **let** *targetVariable*=*expression*  **let** *targetVariable*=$((*expression*))  *targetVariable*=$((*expression*))  ((*targetVariable*=*expression*))  Note that the double parentheses allow spacing around operators within the double parentheses. | # create a shell script for simple math taking two parameters  $ vi simpMath  #!/bin/bash  let sum=$1+$2  let product=$(($1 \* $2))  diff=$(($1 - $2))  ((quotient = $1 / $2))  echo "sum is $sum, product is $product"  echo "diff is $diff, quotient is $quotient"  $ chmod u+x simpMath  $ ./simpMath 3 2  sum is 5, product is 6  diff is 1, quotient is 1 |
| **Exercise** | # what is the result of the following script  $ cat > massign  #!/bin/bash  one=two  two=one  let $two=2 # assign 2 to one  echo "one is $one"  echo "two is $two"  CTRL-D  $ chmod u+x massign  $ ./massign  one is 2  two is one |
| **Some Important Variables**  There are several important environment variables (global variables) for your login session:  PATH list of directories to search to find commands. This is initially established by a Systems Administrator having root privileges.  HOME this is where your home directory exists. The shell uses this for the value of ~.  PWD this is the current directory.  Use echo $variable to show the value of a particular variable. | # show the contents of PATH  $ echo $PATH  /usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin  :/sbin:/bin:/usr/local/faculty/bin:.:/home/clark/bin |
| **Showing Env Variables**  You can see all of your current environment variables by using the **printenv** command. | # show all the environment variables  $ printenv | more  USER=clark  LOGNAME=clark  HOME=/home/clark  PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin  :/bin:/usr/local/faculty/bin:.:/home/clark/bin  MAIL=/var/mail/clark  SHELL=/bin/tcsh  --More-- |
| **Setting PATH**  You can set your path to include your bin**. Make certain your ~/bin exists.** If not, mkdir it.  tcsh:   * To have it set each time you login, change your **~/.cshrc** * To search ~/bin after the other directories use:   set path=($path ~/bin)  bash:   * To have it set each time you **login**, change your   **~/.bash\_profile**   * Since our login uses tcsh, that file isn't executed. * To change PATH to search ~/bin after the other directories, use   PATH=$PATH:$HOME/bin | # It is very common to specify your own "bin" directory be added  # to PATH in your .bash\_profile (for bash) or .cshrc (for csh)  # see which you have. The "a" switch shows all files including  # hidden files.  # ls -al ~/.\*rc  -rwx--x--x 1 clark faculty 441 Jul 14 2015 /home/clark/.cshrc  -rw-r--r-- 1 clark faculty 43 May 31 2016 /home/clark/.dmrc  -rw------- 1 clark faculty 97 Oct 17 2016 /home/clark/.vimrc  # create your ~/bin  $ mkdir ~/bin  # If you want to add your own bin directory (~/bin) to  # .cshrc, make certain it exists, and add this to the  # .cshrc using **vi ~/.cshrc** (be careful)  set path=($path ~/bin)  $  # If you want to add your own bin directory (~/bin) to  # .bash\_profile, make certain it exists, and add this to the  # .bash\_profile (be careful) using vi  # Since our login uses tcsh, this will not have an affect.  PATH=$PATH:$HOME/bin  $ |
| **Scope of Shell Variables**  By default, shell variables are only known to the script and do not propagate to any script invoked from that script. | # Create the following scripts  $ cat >extest1  echo "$0 0: $cheese"  cheese=american  echo "$0 1: $cheese"  ./subtest1  echo "$0 2: $cheese"  CTRL-D  $ cat >subtest1  echo "$0 0: $cheese"  cheese=swiss  echo "$0 1: $cheese"  CTRL-D  $ chmod u+x \*test1  # execute extest1  $ ./extest1  ./extest1 0:  ./extest1 1: american  ./subtest1 0:  ./subtest1 1: swiss  ./extest1 2: american  # notice that cheese did not propagate to subtest1 and the  # change to cheese in subtest1 is not known in extest1. |
| **Exporting variables**  You can propagate shell variables to invoked shell scripts by exporting the variables. Exporting a variable makes it an **environment variable**, which is a global variable for shells. | # copy extest1 to extest2 and add an export  $ cp extest1 extest2  $ vi extest2  echo "$0 0: $cheese"  cheese=american  export cheese  echo "$0 1: $cheese"  ./subtest1  echo "$0 2: $cheese"  $  # What do you expect to happen?  # The value "american" should be known to subtest1.  # Will "swiss" be propagated back to extest2?  $ ./extest2  ./extest2 0:  ./extest2 1: american  ./subtest1 0: american  ./subtest1 1: swiss  ./extest2 2: american  # What happens if we run extest1 again?  $ ./extest1  ./extest1 0:  ./extest1 1: american  ./subtest1 0:  ./subtest1 1: swiss  ./extest1 2: american |
| **How do I get an invoked shell script to set variables in the current shell?**  Depending on the shell, you can either use "**.**" or **source** when invoking a shell script. This causes the invoked shell script to execute as part of the current process instead of a new process. Changes to variables in the invoked shell will affect the current shell. | # create another version of extest2  $ cp extest2 extest3  $ vi extest3  echo "$0 0: $cheese"  cheese=american  export cheese  echo "$0 1: $cheese"  . ./subtest1  echo "$0 2: $cheese"  # Invoke extest3  $ ./extest3  ./extest3 0:  ./extest3 1: american  ./extest3 0: american  ./extest3 1: swiss  ./extest3 2: swiss  What changed? |
| **Exit Status**  In addition to commands writing output to stdout, commands have an **exit status**:  0 success  non-zero command failed  This can be tested to see whether something that was invoked actually worked.  Your shell commands can return a failure by executing:  exit *n*  To show a failure, the value of *n* will typically be 1 for most scripts.  You can get the last exit status by accessing the special value $?. | # attempt to show an unknown file  $ cat xxx  cat: xxx: No such file or directory  $ echo $?  1 |
| **Job Sequences**  Within shell scripts, we can specify job sequences, which are an easy way to link two commands based on the execution status.  *cmd1 args* && *cmd2 args #* logical and  *cmd2* only executes if *cmd1* returns 0.  *cmd1 args* || *cmd2 args #* logical or  *cmd2* only executes if *cmd1* returns non-zero.  The approach of using && and || is like short circuiting in many languages.  If it is necessary for *cmd2* to be multiple commands, surround them in parentheses. | $ mkdir ~/cs3423/Jobs  # Create a backup directory, if it fails show an error.  # The name for the backup directory will be "Backup" followed by  # the current date.  # Note that the \ is used to continue the command. The question mark  # is a shell prompt for the continuation.  $ mkdir "Backup`date +%Y%m%d`" || \  ? echo "creation of Backup directory failed"  # Execute it again  $ mkdir "Backup`date +%Y%m%d`" || \  ? echo "creation of Backup directory failed"  mkdir: cannot create directory Backup20170713: File exists  creation of Backup directory failed  # Create a Backup directory. If it is successful,  # cp the contents of a folder to it. cp -r will  # recursively create/copy any subdirectories,  $ mkdir "Backup`date +%Y%m%d`" && cp -r ~/cs2123/\* "Backup`date +%Y%m%d`"  mkdir: cannot create directory Backup20170713: File exists  # Remove the backup directory (whatever its name is)  $ rmdir Backup20170713  # make the backup copy only of creating the directory is ok  $ mkdir "Backup`date +%Y%m%d`" && cp -r ~/cs2123/\* "Backup`date +%Y%m%d`"  # Create the backup directory and copy the files. If either of those  # failed, show an error message.  $ ( mkdir "Backup`date +%Y%m%d`" && \  ? cp -r ~/cs2123/\* "Backup`date +%Y%m%d`" ) || echo "backup failed";  mkdir: cannot create directory Backup20170713: File exists  backup failed  # Remove the backup directory (whatever its name is) and try that again  ... |
| **Reading input from stdin (works in bash and dash)**  The **read** built-in command reads from stdin. Syntax:  read *variable* reads the input into the specified variable until linefeed  read *var1 var2 …*  reads the first word into *var1*, the second word into *var2*, and so on. **read** looks for a linefeed. If there are less words in the input than read variables, it doesn't populate the other variables. If there are more words than variables, the remaining words are placed in the last variable.  read -p "*prompt message" variableList* This shows the *prompt message* and read the words into the variables represented by *variableList*. Those variables and input work the same as without the **-p** and prompt. | # Use vi to create the following file called simpRead  $ vi simpRead  read -p "Enter some words:" line  echo "line = $line"  read -p "Enter your first and last name:" first last  echo "first = $first, last = $last"  read -p "Enter first name only, but read asked for 2:" first2 last2  echo "first2 = $first2, last2 = $last2"  read -p "Enter more than 2 words:" one other  echo "one = $one, other = $other"  $  # change the permissions and then execute it  $ ./simpRead  Enter some words:one two three  line = one two three  Enter your first and last name:bob wire  first = bob, last = wire  Enter first name only, but read asked for 2:bob  first2 = bob, last2 =  Enter more than 2 words:bob and barb wire  one = bob, other = and barb wire |
| **Reading Text from stdin until EOF (in bash)**  **read** returns a **success** exit status if it reads a line of input.  while read line; do  *do something with it*  done  Note that you can tell the while loop to use a different file for stdin by specifying < and a *fileName* after the **done**.  while read line; do  *do something with it*  done < *fileName* | # copy the file mySentences from  # /usr/local/courses/clark/cs3423/ShellExamples to your directory  #create this script and change its permissions  $ vi rloop  #!/bin/bash  count=0  while read line; do  echo $line  let count+=1  done  echo "$count lines"  $ chmod +x rloop  # Invoke rloop using mySentences for stdin  $ ./rloop <mySentences  Scooby Doo shook with fear when he saw the ghost. Shaggy ran and hid  in the Mystery van. Freddie tried to act brave to impress Daphne, but  she was lovinly watching Scooby Doo. Velma was studying the foot  prints in the mud.  Velma said, "this is the same mud that we saw on the stairs at UTSA!"  6 lines |
| **Flow Control Statements in bash**  The **while, if, case,** and **for** statements are used for flow control. The various shell dialects have different syntax for flow control.  while *condCommand*; do  *doSomething*  done  if *condCommand;* then  *doSomething*  fi  if *condCommand;* then  *doSomething*  else  *doSomethingWhenNotTrue*  fi  if *condCommand;* then  *doSomething*  elif *condCommand2;* then  *doSomething2*  …  else  *doSomethingN*  fi | # use vi to create this simple script which sums integers from  # 1 to n  $ vi simpWhile  #! /bin/bash  # check for too few arguments, be careful of the spacing  if [ $# -lt 1 ]; then  echo "usage: simpWhile number"  echo " where number is a number"  exit 1  fi  sum=0  index=$1  # the spacing is important  while [ $index -gt 0 ]; do  ((sum=sum+index))  ((index=index-1))  done  echo $sum  $  $ chmod +x simpWhile  $ ./simpWhile 4  10  $ |
| **Conditional Commands**  **while** and **if** statements use conditions which can be commands. There is a special command, **test,** which can be used to test conditions:  if test $var -gt 100; then  The test command returns an exit status of 0 to represent that the condition is true if the variable is greater than 100.  Some people prefer using single brackets around the condition:  if [ $var -gt 100 ]; then  Both **test** and the surrounding single brackets cause bash to invoke the **test** command.  bash-only scripts can use double brackets which is handled by bash instead of invoking the test command. Problems associated with using ">" or "<" for test are avoided when using the double brackets.  if [[ $var -gt 100 ]]; then | Test Conditional Operators   |  |  | | --- | --- | |  |  | | *op1* -gt *op2*  *op1* -lt *op2*  *op1* -eq *op2*  *op1* -ne *op2*  *op1* -le *op2*  *op1* -ge *op2* | Numeric comparisons of the two operands. With numeric comparisons, 12 > 2. | | *op1 >* *op2*  *op1 <* *op2*  *op1 =* *op2*  *op1 !=* *op2*  *op1 <=* *op2*  *op1 >=* *op2* | String comparisons of the two operands. With string comparisons, 12 < 2 since the character "1" < "2".  See the warning below. | | -d *filename* | exists and is a directory | | -e *filename* | exists | | -f *filename* | exists and is a file not a directory | | -r *filename* | exists and is readable | | -s *filename* | exists and has a size > 0 bytes | | -w *filename* | exists and is writable | | -x *filename* | exists and is executable | |
| **Warning Warning Warning**  The following example does not do what is expected:  if [ $varA > $varB ]; then  With test and the single bracket expressions, the ">" is interpreted as **redirection** of output to the file named as the value of $varB. | The problem on the left can be avoided with one of these approaches:   * if [ $varA \> $varB ]; then * if [[ $varA > $varB ]]; then |
| **case statement**  The **case** statement is very powerful. It has multiple patterns for matching values. Syntax:  case "*variableRef*" in  *pattern1*)  *doSomething1*  ;;  *pattern2*)  *doSomething2*  ;;  …  \*)  *doSomethingDefault*  ;;  esac  Each pattern can include  *simpleValue* This is just a string to match (e.g., Jan, Feb)  \* This matches anything. By itself, this is used for the default case.  *alt1*|*alt2* This specifies alternatives (e.g., dog|cat)  [*list*] This specifies a list of possible values (e.g. [Jj]an, [Ff]eb). You can also use hyphen for a range of values (e.g., [A-Z]).  ? This matches any single character. | #create this exCase file (just type some of the months)  $ vi exCase  #!/bin/bash  read -p "Enter Month (MMM) DayOfMonth and Year:" month day year  # convert the alpha month to a numeric  case "$month" in  [Jj]an) mon=1;;  [Ff]eb) mon=2;;  [Mm]ar) mon=3;;  [Aa]pr) mon=4;;  [Mm]ay) mon=5;;  [Jj]un) mon=6;;  [Jj]ul) mon=7;;  [Aa]ug) mon=8;;  [Ss]ep) mon=9;;  [Oo]ct) mon=10;;  [Nn]ov) mon=11;;  [Dd]ec) mon=12;;  \*) echo "Bad month value = '$month'"  exit 1;;  esac  echo "date=$mon/$day/$year"  $ chmod +x simpCase  $ ./simpCase |
| **for statement**  The **for** statement iterates over a list. Syntax options:  for *var*  in "$@"; do  *doSomething*  done  for *var*  in *valueList*; do  *doSomething*  done  for *var*  in $(*command args*); do  *doSomething*  done | #use vi to create each of these  $ vi simpFor  echo "1. show the list of files"  for file in "$@"; do  echo "$file"  done  echo "2. show the list of fruit"  for fruit in orange apple grape; do  echo "$fruit"  done  echo "3. show the list of files from a command"  for file in $(ls -a \*); do  echo "$file"  done  $ chmod +x simpFor  $ ./simpFor simp\* | more |
| **break and continue**  The **break** and **continue** statements can be used within **for, while,** and **until** statements.  **break** exits the loop. **continue** continues with the next iteration skipping the remaining statements within the current iteration. | #!/bin/bash  # loop until one of the arguments is not a valid file  for file in "$@"; do  if [ ! -r "$file" ]; then  **break**  fi  cat $file  done |
| **word and pattern matching**  There are many utility commands which use word and pattern matching:  aspell list < *input* returns a list of words (one per line) which were not in the aspell dictionary.  grep *pattern fileList* returns test lines containing *pattern* for each file in *fileList*.  sed *program fileList* modifies files in the *fileList* based on a *program* which is based on sed features. The -i option causes the files to be changed. Without -i, the result only goes to stdout.  awk *program fileList* returns output based on a *program* matching patterns in column-oriented files in the *fileList*  Note that grep is one of the most important tools to help analyze program source code in a large application of many files. | # This spellCheck script can check to see whether a list  # of words is in a file of valid words.  $ vi spellCheck  #!/bin/bash  # syntax: spellCheck validWordFile < listOfWords  #  if [ $# -lt 1 ]; then  echo "Usage: spellCheck validWordFile < listOfWords"  exit 1  fi  # see if the validWordFile exists  #  if [ ! -r "$1" ]; then  echo "spellCheck: $1 is not readable"  exit 1  fi  #  # read each line which contains one word and  # check to see if it exists in the validWordFile  #  while read line; do  if ! grep "$line" "$1" > /dev/null; then  echo $line  fi  done  $  # create a dictionary for our spellCheck  $ cat > myDictionary  Scooby  Doo  UTSA  Shaggy  Freddie  CTRL-D  $ |
|  | # use aspell on mySentences  $ aspell list <mySentences  Scooby  Doo  lovinly  Scooby  Doo  UTSA  $ aspell list <mySentences >badspell  $ ./spellCheck myDictionary <badspell  lovinly  $ aspell list <mySentences | ./spellCheck myDictionary |

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