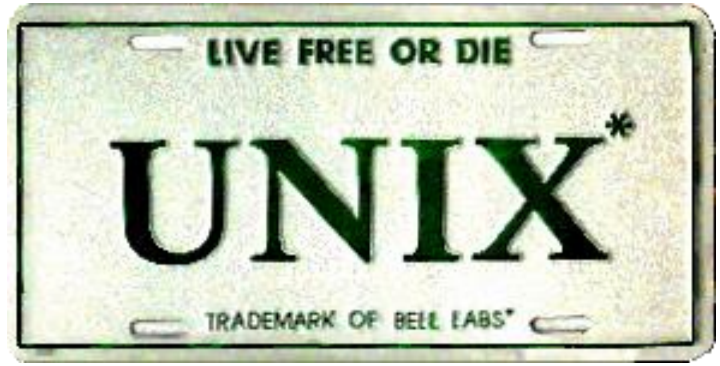

Bash Shell

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The shell of Linux

- Linux has a variety of different shells:
  - Bourne shell (sh), C shell (csh), Korn shell (ksh), TC shell (tcsh), Bourne Again shell (bash).

- Certainly the most popular shell is "bash". Bash is an sh-compatible shell that incorporates useful features from the Korn shell (ksh) and C shell (csh).

- It is intended to conform to the IEEE POSIX P1003.2/ISO 9945.2 Shell and Tools standard.

- It offers functional improvements over sh for both programming and interactive use.

Programming or Scripting ?

- bash is not only an excellent command line shell, but a scripting language in itself. Shell scripting allows us to use the shell's abilities and to automate a lot of tasks that would otherwise require a lot of commands.

- Difference between programming and scripting languages:

  – Programming languages are generally a lot more powerful and a lot faster than scriptin g languages. Programming languages generally start from source code and are compil ed into an executable. This executable is not easily ported into different operating syste ms.
  – A scripting language also starts from source code, but is not compiled into an executabl e. Rather, an interpreter reads the instructions in the source file and executes each inst ruction. Interpreted programs are generally slower than compiled programs. The main a dvantage is that you can easily port the source file to any operating system. bash is a s cripting language. Other examples of scripting languages are Perl, Lisp, and Tcl.

The first bash program

- There are two major text editors in Linux:
  - vi, emacs (or xemacs).

- So fire up a text editor; for example:

```
$ vi &
```

and type the following inside it:

```
#!/bin/bash
echo "Hello World"
```

- The first line tells Linux to use the bash interpreter to run this script. We call it hello.sh. Then, make the script executable:

```
$ chmod 700 hello.sh
$ ./hello.sh
Hello World
```

The second bash program

- We write a program that copies all files into a directory, and then deletes the directory along with its contents. This can be done with the following commands:

```
$ mkdir trash
$ cp * trash
$ rm -rf trash
$ mkdir trash
```

- Instead of having to type all that interactively on the shell, write a shell program instead:

```
$ cat trash.sh
#!/bin/bash
# this script deletes some files
cp * trash
rm -rf trash
mkdir trash
echo “Deleted all files!”
```

Variables

- We can use variables as in any programming languages. Their values are always stored as strings, but there are mathematical operators in the shell language that will convert variables to numbers for calculations.

- We have no need to declare a variable, just assigning a value to its reference will create it.

- Example

```
#!/bin/bash
STR="Hello World!"
echo $STR
```

- Line 2 creates a variable called STR and assigns the string "Hello World!" to it. Then the value of this variable is retrieved by putting the '$' in at the beginning.

Warning !

- The shell programming language does not type-cast its variables. This means that a variable can hold number data or character data.

```
count=0
count=Sunday
```

- Switching the TYPE of a variable can lead to confusion for the writer of the script or someone trying to modify it, so it is recommended to use a variable for only a single TYPE of data in a script.

- \ is the bash escape character and it preserves the literal value of the next character that follows.

```
$ ls \*
ls: *: No such file or directory
```

Single and Double Quote

- When assigning character data containing spaces or special characters, the data must be enclosed in either single or double quotes.

- Using double quotes to show a string of characters will allow any variables in the quotes to be resolved

$ var=“test string”
$ newvar=“Value of var is $var”
$ echo $newvar
Value of var is test string

- Using single quotes to show a string of characters will not allow variable resolution

$ var=’test string’
$ newvar=’Value of var is $var’
$ echo $newvar
Value of var is $var

The export command

- The export command puts a variable into the environment so it will be accessible to child processes. For instance:

```
$ x=hello
$ bash          # Run a child shell.
$ echo $x       # Nothing in x.
$ exit          # Return to parent.
$ export x
$ bash
$ echo $x
hello           # It's there.
```

- If the child modifies x, it will not modify the parent’s original value. Verify this by changing x in the following way:

```
$ x=ciao
$ exit
$ echo $x
hello
```

Environmental Variables

- There are two types of variables:

- Local variables
- Environmental variables

- Environmental variables are set by the system and can usually be found by using the env command. Environmental variables hold special values. For instance:

```
$ echo $SHELL
/bin/bash
$ echo $PATH
/usr/X11R6/bin:/usr/local/bin:/bin:/usr/bin
```

- Environmental variables are defined in /etc/profile, /etc/profile.d/ and ~/.bash_profile. These files are the initialization files and they are read when bash shell is invoked.

- When a login shell exits, bash reads ~/.bash_logout

- The startup is more complex; for example, if bash is used interactively, then /etc/bashrc or ~/.bashrc are read. See the man page for more details.

Environmental Variables

- HOME: The default argument (home directory) for cd.
- PATH: The search path for commands. It is a colon-separated list of directories that are searched when you type a command.

- Usually, we type in the commands in the following way:

$ ./command

- By setting PATH=$PATH:. our working directory is included in the search path for commands, and we simply type:

$ command

- If we type in

$ mkdir ~/bin

- and we include the following lines in the ~/.bash_profile:

```
PATH=$PATH:$HOME/bin
export PATH
```

- we obtain that the directory /home/userid/bin is included in the search path for commands.

Environemnt Variables

- LOGNAME: contains the user name
- HOSTNAME: contains the computer name.

- PS1: sequence of characters shown before the prompt

\t	hour
\d	date
\w	current directory
\W	last part of the current directory
\u	user name
\$	prompt character

Example:

```
[userid@homelinux userid]$ PS1='hi \u *'
hi userid* _
```

Exercise ==> Design your own new prompt. Show me when you are happy with it.

- RANDOM: random number generator
- SECONDS: seconds from the beginning of the execution

Read command

- The read command allows you to prompt for input and store it in a variable.

- Example:

```
#!/bin/bash
echo -n “Enter name of file to delete: ”
read file
echo “Type 'y' to remove it, 'n' to change your mind ... ”
rm -i $file
echo "That was YOUR decision!”
```

- Line 2 prompts for a string that is read in line 3. Line 4 uses the interactive remove (rm -i) to ask the user for confirmation.

Command Substitution

- The backquote “`” is different from the single quote “´”. It is used for command substitution: `command`

```
$ LIST=`ls`
$ echo $LIST
hello.sh read.sh

$ PS1=“`pwd`>”
/home/userid/work> _
```

- We can perform the command substitution by means of $(command)

```
$ LIST=$(ls)
$ echo $LIST
hello.sh read.sh

$ rm $( find / -name “*.tmp” )

$ cat > backup.sh
#!/bin/bash
BCKUP=/home/userid/backup-$(date +%d-%m-%y).tar.gz
tar -czf $BCKUP $HOME
```

Arithmetic Evaluation

- The let statement can be used to do mathematical functions:

```
$ let X=10+2*7
$ echo $X
24
$ let Y=X+2*4
$ echo $Y
32
```

- An arithmetic expression can be evaluated by $[expression] or $((expression))

```
$ echo "$((123+20))"
143
$ VALORE=$[123+20]
$ echo "$[123*$VALORE]"
17589
```

Arithmetic Evaluation

- Available operators: +, -, /, *, %
- Example

```
$ cat arithmetic.sh
#!/bin/bash
echo -n “Enter the first number: ”; read x
echo -n “Enter the second number: ”; read y
add=$(($x + $y))
sub=$(($x - $y))
mul=$(($x * $y))
div=$(($x / $y))
mod=$(($x % $y))
# print out the answers:
echo “Sum: $add”
echo “Difference: $sub”
echo “Product: $mul”
echo “Quotient: $div”
echo “Remainder: $mod”
```

Conditional Statements

- Conditionals let us decide whether to perform an action or not, this decision is taken by evaluating an expression. The most basic form is:

```
if [ expression ];
then
        statements
elif [ expression ];
then
        statements
else
        statements
fi
```

- the elif (else if) and else sections are optional
- Put spaces after [and before], and around the operators and operands.

Expressions

- An expression can be: String comparison, Numeric comparison, File operators and Logical operators and it is represented by [expression]:

- String Comparisons:

=	compare if two strings are equal
!=	compare if two strings are not equal
-n	evaluate if string length is greater than zero
-z	evaluate if string length is equal to zero

- Examples:

[s1 = s2]	(true if s1 same as s2, else false)
[s1 != s2]	(true if s1 not same as s2, else false)
[s1]	(true if s1 is not empty, else false)
[-n s1]	(true if s1 has a length greater then 0, else false)
[-z s2]	(true if s2 has a length of 0, otherwise false)

Expressions

- Number Comparisons:

-eq	compare if two numbers are equal
-ge	compare if one number is greater than or equal to a number
-le	compare if one number is less than or equal to a number
-ne	compare if two numbers are not equal
-gt	compare if one number is greater than another number
-lt	compare if one number is less than another number

- Examples:

[n1 -eq n2]	(true if n1 same as n2, else false)
[n1 -ge n2]	(true if n1greater then or equal to n2, else false)
[n1 -le n2]	(true if n1 less then or equal to n2, else false)
[n1 -ne n2]	(true if n1 is not same as n2, else false)
[n1 -gt n2]	(true if n1 greater then n2, else false)
[n1 -lt n2]	(true if n1 less then n2, else false)

Examples

```
$ cat user.sh
 #!/bin/bash
  echo -n "Enter your login name: "
  read name
  if [ "$name" = "$USER" ];
  then
          echo "Hello, $name. How are you today ?"
  else
          echo "You are not $USER, so who are you ?"
  fi

$ cat number.sh
#!/bin/bash
  echo -n "Enter a number 1 < x < 10: "
  read num
  if [ "$num" -lt 10 ];     then
          if [ "$num" -gt 1 ]; then
                  echo "$num*$num=$(($num*$num))"
          else
                  echo "Wrong insertion !"
          fi
  else
          echo "Wrong insertion !"
  fi
```

Expressions

- Files operators:

-d	check if path given is a directory
-f	check if path given is a file
-e	check if file name exists
-r	check if read permission is set for file or directory
-s	check if a file has a length greater than 0
-w	check if write permission is set for a file or directory
-x	check if execute permission is set for a file or directory

- Examples:

[-d fname]	(true if fname is a directory, otherwise false)
[-f fname]	(true if fname is a file, otherwise false)
[-e fname]	(true if fname exists, otherwise false)
[-s fname]	(true if fname length is greater then 0, else false)
[-r fname]	(true if fname has the read permission, else false)
[-w fname]	(true if fname has the write permission, else false)
[-x fname]	(true if fname has the execute permission, else false)

Example

```
#!/bin/bash
 if [ -f /etc/fstab ];
 then
         cp /etc/fstab .
         echo "Done."
 else
         echo "This file does not exist."
         exit 1
 fi
```

<u>Exercise.</u>

- Write a shell script which:
  - accepts a file name
  - checks if file exists
  - if file exists, copy the file to the same name + .bak + the current date (if the backup file already exists ask if you want to replace it).
- When done you should have the original file and one with a .bak at the end.

Expressions

- Logical operators:

!	negate (NOT) a logical expression
-a	logically AND two logical expressions
-o	logically OR two logical expressions

Example:

```
#!/bin/bash
  echo -n “Enter a number 1 < x < 10:”
  read num
  if [ “$num” -gt 1 –a “$num” -lt 10 ];
  then
          echo “$num*$num=$(($num*$num))”
  else
          echo “Wrong insertion !”
  fi
```

Expressions

- Logical operators:

&& logically AND two logical expressions
|| logically OR two logical expressions

Example:

```
#!/bin/bash
  echo -n "Enter a number 1 < x < 10: "
  read num
  if [ “$number” -gt 1 ] && [ “$number” -lt 10 ];
  then
          echo “$num*$num=$(($num*$num))”
  else
          echo “Wrong insertion !”
  fi
```

Example

```
$ cat iftrue.sh
  #!/bin/bash
  echo "Enter a path: "; read x
  if cd $x; then
          echo "I am in $x and it contains"; ls
  else
          echo "The directory $x does not exist";
          exit 1
  fi

$ iftrue.sh
Enter a path: /home
userid anotherid …
$ iftrue.sh
Enter a path: blah
The directory blah does not exist
```

Shell Parameters

- Positional parameters are assigned from the shell's argument when it is invoked. Positional parameter "N" may be referenced as "${N}", or as "$N" when "N" consists of a single digit.

- Special parameters

$#	is the number of parameters passed
$0	returns the name of the shell script running as well as its location in the file system
$*	gives a single word containing all the parameters passed to the script
$@	gives an array of words containing all the parameters passed to the script

```
$ cat sparameters.sh
#!/bin/bash
echo "$#; $0; $1; $2; $*; $@"
$ sparameters.sh arg1 arg2
2; ./sparameters.sh; arg1; arg2; arg1 arg2; arg1 arg2
```

Trash

$ cat trash.sh

```
#!/bin/bash
if [ $# -eq 1 ];
then
        if [ ! –d “$HOME/trash” ];
        then
                mkdir “$HOME/trash”
        fi
        mv $1 “$HOME/trash”
else
        echo “Use: $0 filename”
        exit 1
fi
```

Case Statement

- Used to execute statements based on specific values. Often used in place of an if statement if there are a large number of conditions.

- Value used can be an expression
- each set of statements must be ended by a pair of semicolons;
- a *) is used to accept any value not matched with list of values

```
case $var in
 val1)
        statements;;
 val2)
        statements;;
 *)
        statements;;
 esac
```

Example (case.sh)

```
$ cat case.sh
#!/bin/bash
 echo -n “Enter a number 1 < x < 10: ”
 read x
 case $x in
         1) echo “Value of x is 1.”;;
         2) echo “Value of x is 2.”;;
         3) echo “Value of x is 3.”;;
         4) echo “Value of x is 4.”;;
         5) echo “Value of x is 5.”;;
         6) echo “Value of x is 6.”;;
         7) echo “Value of x is 7.”;;
         8) echo “Value of x is 8.”;;
         9) echo “Value of x is 9.”;;
         0 | 10) echo “wrong number.”;;
         *) echo “Unrecognized value.”;;
 esac
```

Iteration Statements

- The for structure is used when you are looping through a range of variables.

```
for var in list
  do
    statements
  done
```

- statements are executed with var set to each value in the list.

- Example

```
#!/bin/bash
  let sum=0
  for num in 1 2 3 4 5
    do
      let “sum = $sum + $num”
    done
  echo $sum
```

Iteration Statements

```
#!/bin/bash
for x in paper pencil pen
do
  echo "The value of variable x is: $x"
  sleep 1
done
```

- if the list part is left off, var is set to each parameter passed to the script ($1, $2, $3,…)

```
$ cat for1.sh
#!/bin/bash
for x
do
  echo "The value of variable x is: $x"
  sleep 1
done
$ for1.sh arg1 arg2
The value of variable x is: arg1
The value of variable x is: arg2
```

Example (old.sh)

```
$ cat old.sh
#!/bin/bash
# Move the command line arg files to old directory.
if [ $# -eq 0 ] #check for command line arguments
then
  echo “Usage: $0 file …”
  exit 1
fi
if [ ! –d “$HOME/old” ]
then
  mkdir “$HOME/old”
fi
echo The following files will be saved in the old directory:
echo $*
for file in $* #loop through all command line arguments
do
  mv $file “$HOME/old/”
  chmod 400 “$HOME/old/$file”
done
ls -l “$HOME/old”
```

Example (args.sh)

```
$ cat args.sh
#!/bin/bash
# Invoke this script with several arguments: “one two three“
if [ ! -n “$1” ]; then
  echo “Usage: $0 arg1 arg2 ..." ; exit 1
fi
echo ; index=1 ;
echo “Listing args with \”\$*\”:”
for arg in “$*” ;
do
  echo “Arg $index = $arg”
  let “index+=1” # increase variable index by one
done
echo “Entire arg list seen as single word.”
echo ; index=1 ;
echo “Listing args with \”\$@\”:”
for arg in “$@” ; do
  echo “Arg $index = $arg”
  let “index+=1”
done
echo “Arg list seen as separate words.” ; exit 0
```

Using Arrays with Loops

- In the bash shell, we may use arrays. The simplest way to create one is using one of the two subscripts:

```
pet[0]=dog
pet[1]=cat
pet[2]=fish
pet=(dog cat fish)
```

- We may have up to 1024 elements. To extract a value, type ${arrayname[i]}

```
$ echo ${pet[0]}
  dog
```

- To extract all the elements, use an asterisk as:

```
echo ${arrayname[*]}
```

- We can combine arrays with loops using a for loop:

```
for x in ${arrayname[*]}
  do
        ...
  done
```

A C-like for loop

- An alternative form of the for structure is

```
for (( EXPR1 ; EXPR2 ; EXPR3 ))
  do
          statements
  done
```

- First, the arithmetic expression EXPR1 is evaluated. EXPR2 is then evaluated repeatedly until it evaluates to 0. Each time EXPR2 is evaluates to a non-zero value, statements are executed and EXPR3 is evaluated.

```
$ cat for2.sh
  #!/bin/bash
  echo –n “Enter a number: ”; read x
  let sum=0
  for (( i=1 ; $i<$x ; i=$i+1 )) ; do
    let “sum = $sum + $i”
  done
  echo “the sum of the first $x numbers is: $sum”
```

Debugging

- Bash provides two options which will give useful information for debugging

-x : displays each line of the script with variable substitution and before execution
-v : displays each line of the script as typed before execution

- Usage:

#!/bin/bash –v or #!/bin/bash –x or #!/bin/bash –xv

```
$ cat for3.sh
  #!/bin/bash –x
  echo –n “Enter a number: ”; read x
  let sum=0
  for (( i=1 ; $i<$x ; i=$i+1 )) ; do
    let “sum = $sum + $i”
  done
  echo “the sum of the first $x numbers is: $sum”
```

Debugging

```
$ for3.sh
+ echo –n ‘Enter a number: ’
Enter a number: + read x
3
+ let sum=0
+ (( i=0 ))
+ (( 0<=3 ))
+ let ‘sum = 0 + 0’
+ (( i=0+1 ))
+ (( 1<=3 ))
+ let ‘sum = 0 + 1’
+ (( i=1+1 ))
+ (( 2<=3 ))
+ let ‘sum = 1 + 2’
+ (( i=2+1 ))
+ (( 3<=3 ))
+ let ‘sum = 3 + 3’
+ (( i=3+1 ))
+ (( 4<=3 ))
+ echo ‘the sum of the first 3 numbers is: 6’
the sum of the first 3 numbers is: 6
```

While Statements

- The while structure is a looping structure. Used to execute a set of commands while a specified condition is true. The loop terminates as soon as the condition becomes false. If condition never becomes false, loop will never exit.

```
while expression
 do
        statements
 done
```

```
$ cat while.sh
 #!/bin/bash
 echo –n "Enter a number: "; read x
 let sum=0; let i=1
 while [ $i –le $x ]; do
   let "sum = $sum + $i"
        i=$i+1
 done
 echo "the sum of the first $x numbers is: $sum"
```

Menu

```
$ cat menu.sh
#!/bin/bash
  clear ; loop=y
  while [ “$loop” = y ] ;
  do
    echo “Menu”;  echo “====”
              echo “D: print the date”
    echo “W: print the users who are currently log on.”
    echo “P: print the working directory”
    echo “Q: quit.”
    echo
    read –s choice                    # silent mode: no echo to terminal
    case $choice in
            D | d) date ;;
            W | w) who ;;
            P | p) pwd ;;
            Q | q) loop=n ;;
            *) echo “Illegal choice.” ;;
    esac
    echo
  done
```

Find a Pattern and Edit

```
$ cat grepedit.sh
#!/bin/bash
# Edit argument files $2 ..., that contain pattern $1
if [ $# -le 1 ]
then
  echo “Usage: $0 pattern file …” ; exit 1
else
  pattern=$1                  # Save original $1
  shift                       # shift the positional parameter to the left by 1
  while [ $# -gt 0 ]          # New $1 is first filename
  do
    grep “$pattern” $1 > /dev/null
    if [ $? -eq 0 ] ; then    # If grep found pattern
      vi $1                   # then vi the file
    fi
    shift
  done
fi
$ grepedit.sh while ~
```

Continue Statements

- The continue command causes a jump to the next iteration of the loop, skipping all the remaining commands in that particular loop cycle.

```
$ cat continue.sh
#!/bin/bash
  LIMIT=19
  echo
  echo "Printing Numbers 1 through 20 (but not 3 and 11)"
  a=0
  while [ $a -le "$LIMIT" ]; do
    a=$(($a+1))
    if [ "$a" -eq 3 ] || [ "$a" -eq 11 ]
    then
              continue
    fi
    echo -n "$a "
  done
```

Break Statements

- The break command terminates the loop (breaks out of it).

```
$ cat break.sh
#!/bin/bash
 LIMIT=19
 echo
 echo “Printing Numbers 1 through 20, but something happens after 2 … ”
 a=0
 while [ $a -le “$LIMIT” ]
 do
   a=$(($a+1))
   if [ “$a” -gt 2 ]
   then
     break
   fi
   echo -n “$a ”
 done
 echo; echo; echo
 exit 0
```

Until Statements

- The until structure is very similar to the while structure. The until structure loops until the condition is true. So basically it is “until this condition is true, do this”.

```
until [expression]
 do
        statements
 done
```

```
$ cat countdown.sh
 #!/bin/bash
 echo “Enter a number: ”; read x
 echo ; echo Count Down
 until [ “$x” -le 0 ]; do
   echo $x
   x=$(($x –1))
   sleep 1
 done
echo ; echo GO !
```

Manipulating Strings

- Bash supports a number of string manipulation operations.

${#string} gives the string length
${string:position} extracts sub-string from $string at $position
${string:position:length} extracts $length characters of sub-string from $string at $position

- Example

```
$ st=0123456789
$ echo ${#st}
 10
$ echo ${st:6}
 6789
$ echo ${st:6:2}
 67
```

Parameter Substitution

- Manipulating and/or expanding variables

${parameter-default}, if parameter not set, use default.

```
$ echo ${username-`whoami`}
  alice
$ username=bob
$ echo ${username-`whoami`}
  bob
```

${parameter=default}, if parameter not set, set it to default.

```
$ unset username
$ echo ${username=`whoami`}
$ echo $username
  alice
```

${parameter+value}, if parameter set, use value, else use null string.

```
$ echo ${username+bob}
  bob
```

Parameter Substitution

${parameter?msg}, if parameter set, use it, else print msg

```
$ value=${total?'total is not set'}
  total: total is not set
$ total=10
$ value=${total?'total is not set'}
$ echo $value
  10
```

Example

```
#!/bin/bash
OUTFILE=symlinks.list                    # save file
directory=${1-`pwd`}
for file in "$( find $directory -type l )"
                                         # -type l == symbolic links
do
  echo "$file"
done | sort >> "$HOME/$OUTFILE"
exit 0
```

Functions

- Functions make scripts easier to maintain. Basically it breaks up the program into smaller pieces. A function performs an action defined by you, and it can return a value if you wish.

```
#!/bin/bash
 hello()
 {
 echo “You are in function hello()”
 }

 echo “Calling function hello()…”
 hello
 echo “You are now out of function hello()”
```

- In the above, we called the hello() function by name by using the line: hello . When this line is executed, bash searches the script for the line hello(). It finds it right at the top, and executes its contents.

Functions

```
$ cat function.sh
#!/bin/bash
function check() {
if [ -e "/home/$1" ]
then
  return 0
else
  return 1
fi
}
echo “Enter the name of the file: ” ; read x
if check $x
then
  echo “$x exists !”
else
  echo “$x does not exists !”
fi.
```

Example: Picking a random card from a deck

```
#!/bin/bash
# Count how many elements.

Suites="Clubs Diamonds Hearts Spades"
Denominations="2 3 4 5 6 7 8 9 10 Jack Queen King Ace"

# Read into array variable.
suite=($Suites)
denomination=($Denominations)

# Count how many elements.
num_suites=${#suite[*]}
num_denominations=${#denomination[*]}
echo -n "${denomination[$((RANDOM%num_denominations))]} of "
echo ${suite[$((RANDOM%num_suites))]}
exit 0
```

Example: Changes all filenames to lowercase

```
#!/bin/bash
for filename in *
                        # Traverse all files in directory.
do
                        # Get the file name without the path.
 fname=`basename $filename`
                        # Change name to lowercase.
 n=`echo $fname | tr A-Z a-z`
 if [ “$fname” != “$n” ]
                        # Rename only files not already lowercase.
 then
  mv $fname $n
 fi
done
exit 0
```

Example: Compare two files with a script

```
#!/bin/bash
ARGS=2                                  # Two args to script expected.
if [ $# -ne “$ARGS” ]; then
  echo “Usage: `basename $0` file1 file2” ; exit 1
fi
if [[ ! -r "$1" || ! -r "$2" ]] ;  then
  echo “Both files must exist and be readable.” ; exit 2
fi
                              # /dev/null buries the output of the “cmp” command.
cmp $1 $2 &> /dev/null
                              # Also works with 'diff', i.e., diff $1 $2 &> /dev/null
if [ $? -eq 0 ]               # Test exit status of “cmp” command.
then
  echo “File \“$1\” is identical to file \“$2\”.”
else
  echo “File \“$1\“ differs from file \“$2\”.”
fi
exit 0
```

Example: Suite drawing statistics

```
$ cat cardstats.sh
#!/bin/sh # -xv
N=100000
hits=(0 0 0 0)# initialize hit counters
if [ $# -gt 0 ]; then           # check whether there is an argument
        N=$1
else                            # ask for the number if no argument
        echo "Enter the number of trials: "
        TMOUT=5                 # 5 seconds to give the input
        read N
fi
i=$N
echo "Generating $N random numbers... please wait."
SECONDS=0                       # here is where we really start
while [ $i -gt 0 ]; do  # run until the counter gets to zero
        case $((RANDOM%4)) in                   # randmize from 0 to 3
                0) let "hits[0]+=1";;           # count the hits
                1) let "hits[1]=${hits[1]}+1";;
                2) let hits[2]=$((${hits[2]}+1));;
                3) let hits[3]=$((${hits[3]}+1));;
        esac
        let "i-=1"# count down
done
echo "Probabilities of drawing a specific color:"
                                # use bc - bash does not support fractions
echo "Clubs: " `echo ${hits[0]}*100/$N | bc -l`
echo "Diamonds: " `echo ${hits[1]}*100/$N | bc -l`
echo "Hearts: " `echo ${hits[2]}*100/$N | bc -l`
echo "Spades: " `echo ${hits[3]}*100/$N | bc -l`
echo "========================================="
echo "Execution time: $SECONDS"
```

Challenge/Project: collect

- Write a utility to collect “well-known” files into convenient directory holders.

collect <directory>*

- The utility should collect all executables, libraries, sources and includes from each directory given on the command line or entered by the user (if no arguments were passed) into separate directories. By default, the allocation is as follows:
  - executables go to ~/bin
  - libraries (lib*.*) go to ~/lib
  - sources (*.c, *.cc, *.cpp, *.cxx) go to ~/src
  - includes (*.h, *.hxx) go to ~/inc

- The utility should ask whether another directory should be used in place of these default directories.
- Each move should be recorded in a log file that may be used to reverse the moves (extra points for writing a reverse utility!). The user should have an option to use a log file other than the default (~/organize.log).
- At the end, the utility should print statistics on file allocation: how many directories were processed, how many files in each category were moved and how long the reorganization was (the processing time in seconds).
- The utility should wait only limited time for user input; if no input, then use defaults.