

# Introduction to Shell Programming

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## What is Shell Programming?

- putting UNIX<sup>TM</sup> commands in a file
- almost always special-purpose code
- often one-time code
- seldom used where speed is important
- often used to manipulate files

## About cygwin

a good but not perfect emulation of unix  
included in standard RPI laptop image  
to download (long) go to [www.cygwin.com](http://www.cygwin.com)

if you want real unix get Linux (site licensed)  
it is possible to dual-boot Linux with Windows  
ask at the Help Desk  
watch for an ACM installfest

starting cygwin

start → All Programs → Cygwin → XTerm  
opens unix window with command prompt  
\$

RCSHome is a link to your RCS home directory

to print a file from cygwin

open the file with **notepad** *filename*  
use the **notepad** print function

to cut and paste you need a 3-button mouse  
cygwin names executables **a.exe**

## Review of Basic UNIX™

familiar commands often useful in shell scripts

<code>cat</code>	concatenate files
<code>cp</code>	copy a file
<code>date</code>	print the date and time
<code>grep</code>	scan for a string
<code>head</code>	show first lines of a file
<code>tail</code>	show last lines of a file
<code>mv</code>	move or rename a file
<code>rm -f</code>	remove files (silently)
<code>wc</code>	count lines, words, characters
	<code>wc</code> output format varies between systems

path names of files and directories

<code>schedule</code>	relative
<code>/home/37/jones/schedule</code>	absolute

wild cards in filenames

- \* matches zero or more characters
- ? matches exactly 1 character

redirection

- > redirects std-out to a file
- >> appends std-out to a file
- < redirects std-in from a file

## Pipelines of Commands

send std-out of one command to std-in of another

`look e`

shows spelling words that begin with e

`look e | more`

displays the words one page at a time

often use `echo` to feed a pipeline

`echo "count me" | wc`

prints 1 2 9

`echo * | wc -w`

counts files in current directory

## About Shell Scripts

type shell program text in a file using an editor:

```
#!/bin/sh
```

```
# this is a comment
```

```
body of program
```

```
to continue a line append \
```

```
this is the rest of the continued line
```

```
exit 0
```

```
chmod +x scriptfile
```

make the file executable  
not needed in cygwin

```
scriptfile
```

execute the program

```
sh -v scriptfile
```

print input lines as read

```
sh -x scriptfile
```

print commands as executed

shell programs often use temporary files in `/tmp`  
and send unwanted outputs to `/dev/null`

## Some New Commands Useful in Shell Programs

<code>basename</code>	extract file name from path name
<code>cmp -s</code>	compare files (silently)
<code>cut</code>	extract selected parts of a line
<code>expr</code>	evaluate an expression
<code>mail</code>	send email (not in <code>cygwin</code> )
<code>sed -e</code>	stream editor
<code>sleep</code>	suspend execution for given time
<code>tr</code>	translate characters
<code>true, false</code>	provide truth values
<code>whoami</code>	print current username
<code>head -1</code>	read a line from the keyboard

## Some Example Scripts

In the following examples, the text of the shell script is shown on top, and the result of executing it interactively is shown below. The text of each example script is in a file available for downloading, so that you can try the scripts without having to type them in. The name of each file is given in a comment in each script.

These examples show the scripts being executed in the directory `/home/mike/Classes/shell`. When you run a script in your own directory, some of the names appearing in the output will be different.

```
#!/bin/sh
# hi
echo "Hello, world!"
exit 0
```

```
unix[1] hi
Hello, world!
unix[2]
```

```
#!/bin/sh
# himike
name=Mike
echo "Hello, $name!"
exit 0
```

```
unix[3] himike
Hello, Mike!
unix[4]
```

```
#!/bin/sh
#  rem
rm junk
echo "The return code from rm was $?"
exit 0
```

```
unix[5] touch junk
unix[6] rem
The return code from rm was 0
unix[7] rem
rm: junk: No such file or directory
The return code from rm was 2
```

```
#!/bin/sh
#  quiet
rm junk 2> /dev/null
echo "The return code from rm was $?"
exit 0
```

```
unix[8] touch junk
unix[9] quiet
The return code from rm was 0
unix[10] quiet
The return code from rm was 2
```

```
#!/bin/sh
#  pars
echo "There are $# parameters."
echo "The parameters are $@"
echo "The script name is $0"
echo "The first parameter is $1"
echo "The second parameter is $2"
exit 0
```

```
unix[11] pars apple orange
There are 2 parameters.
The parameters are apple orange
The script name is ./pars
The first parameter is apple
The second parameter is orange
unix[12]
```

```
#!/bin/sh
#  shifter
echo $1
shift
echo $1
shift
echo $1
shift
echo $1
exit 0
```

unix[13] shifter one two three four five

one

two

three

four

unix[14] shifter one two three

one

two

three

unix[15] shifter one two

one

two

shift: shift count must be <= \$#

unix[16]

```
#!/bin/sh
#  sorter
rm -f /tmp/sorted
sort $1 > /tmp/sorted
cp /tmp/sorted $1
rm -f /tmp/sorted
exit 0
```

unix[17] more names

Jeff

Alan

Nancy

Yossl

Scott

Harriet

Chris

unix[18] sorter names

unix[19] more names

Alan

Chris

Harriet

Jeff

Nancy

Scott

Yossl

unix[20]

```
#!/bin/sh
#  hiyou
name='whoami'
echo "Hello, $name!"
exit 0
```

```
unix[21] hiyou
Hello, kupfem!
unix[22]
```

```
#!/bin/sh
# hiyou2
echo "Hello, 'whoami'!"
exit 0
```

```
unix[23] hiyou2
Hello, kupfem!
unix[24]
```

```
#!/bin/sh
# countem
echo "File \"$1\" contains \
exactly 'wc $1 | cut -c6-7' lines."
exit 0
```

```
unix[25] countem text
File "text" contains exactly 21 lines.
unix[26]
```

## cut

reads std-in, extracts selected fields, writes std-out

<code>cut -c1,4,7</code>	characters 1, 4, and 7
<code>cut -c1-3,8</code>	characters 1 thru 3, and 8
<code>cut -c-5,10</code>	characters 1 thru 5, and 10
<code>cut -c3-</code>	characters 3 thru last
<code>cut -f1,4,7</code>	tab-separated fields 1, 4, and 7
<code>cut -d" " -f1</code>	blank-separated field 1

```
echo a.b.c | cut -d"." -f2 yields b
```

```
#!/bin/sh
#  compile
if [ "$SRCDIR" = "" ]
then
    echo "using default source directory"
    SRCDIR=$HOME/src
else
    echo "using source directory $SRCDIR"
fi
g77 $SRCDIR/$1
exit $?
```

```
unix[27] export SRCDIR='pwd'
unix[28] compile hello.f
using source directory /home/mike/Classes/shell
unix[29] echo $?
0
unix[30] a.out
hello
unix[31] export SRCDIR=""
unix[32] compile hello.f
using default source directory
g77: /home/mike/src/hello.f:
    No such file or directory
unix[33] echo $?
1
unix[34]
```

```
#!/bin/sh
#  finder
grep $1 text > /dev/null
if [ $? -eq 0 ]
then
    echo "found"
fi
exit 0
```

```
unix[35] finder ancient
found
unix[36] finder modern
unix[37]
```

```
#!/bin/sh
#  compares
echo "true yields 0, false yields 1"
x="005"
[ "$x" = "005" ]
echo "Are strings 005 and 005 equal? $?"
[ "$x" = "5" ]
echo "Are strings 005 and 5 equal? $?"
[ $x -eq 005 ]
echo "Are integers 005 and 005 equal? $?"
[ $x -eq 5 ]
echo "Are integers 005 and 5 equal? $?"
exit 0
```

unix[38] compares

true yields 0, false yields 1

Are strings 005 and 005 equal? 0

Are strings 005 and 5 equal? 1

Are integers 005 and 005 equal? 0

Are integers 005 and 5 equal? 0

unix[39]

```
#!/bin/sh
# empty
if [ -s $1 ]
then
    echo "The file $1 has contents."
    exit 0
else
    echo "The file $1 is absent or empty."
    exit 1
fi
```

```
unix[40] empty text
The file text has contents.
unix[41] empty xxxx
The file xxxx is absent or empty.
unix[42] echo $?
1
unix[43]
```

```
#!/bin/sh
#  adder
sum=0
for x in $@
do
    sum='expr $sum + $x'
done
echo "The sum is $sum."
exit 0
```

```
unix[44] adder 1 2 3 4 5
The sum is 15.
unix[45]
```

```
#!/bin/sh
#  fixfor
for fyle in *.for
do
    new='echo $fyle | sed -e"s/\.for$/\.f/"'
    mv $fyle $new
done
exit 0
```

```
unix[46] ls *.for
a.for b.for pgm.for xyz.w.for
unix[47] fixfor
unix[48] ls *.f
a.f   b.f   pgm.f   xyz.w.f
```

```
#!/bin/sh
#  suffix
for fyle in *.$1
do
    new='echo $fyle | sed -e"s/\.$1$/\.$2/" '
    mv $fyle $new
done
exit 0
```

```
unix[49] ls *.f
a.f    b.f    pgm.f    xyz.w.f
unix[50] suffix f for
unix[51] ls *.for
a.for  b.for  pgm.for  xyz.w.for
unix[52]
```

# sed

reads std-in, edits line(s), writes std-out

`sed -e"s/old/new/"`      replace first old by new

`sed -e"s/old/new/g"`      replace each old by new

old can be a regular expression

`^`      matches the beginning of the line

`$`      matches the end of the line

`.`      matches any single character

`.*`      matches zero or more characters

`[tT]`      matches `t` or `T`

escape these and other special characters with `\`

```
unix[53] echo banana | sed -e"s/a$/\ .x/"
```

```
banan.x
```

```
unix[54] more fruit
```

```
xapple
```

```
xpear
```

```
xplum
```

```
xcherry
```

```
unix[55] sed -e"s/^x/ /" < fruit
```

```
apple
```

```
pear
```

```
plum
```

```
cherry
```

# A Final Example

```
#!/bin/sh
# list names of all files containing given words

if [ $# -eq 0 ]
then
    echo "findtext word1 word2 word3 ..."
    echo "lists names of files containing all given words"
    exit 1
fi

for fyle in *
do
    bad=0
    for word in $*
    do
        grep $word $fyle > /dev/null 2> /dev/null
        if [ $? -ne 0 ]
        then
            bad=1
            break
        fi
    done
    if [ $bad -eq 0 ]
    then
        echo $fyle
    fi
done
exit 0
```

## Gotchas

Never use `test` as the name of a variable or a shell script file.

When using `=` as an assignment operator, do not put blanks around it.

When using `=` as a comparison operator, you *must* put blanks around it.

When using `if [ ]` put spaces around the brackets (except after `]` when it is the last character on the line).

## Exercises

some hints are given in the files  
`exer1`, `exer2`, `exer2.aix`, and `exer3`.

1. Write a script that counts files. (a) First make it count the files in the current directory. (b) Now modify your script to accept a parameter that is the name of a directory, and count the files in that directory. Try this version on the current directory (`.`) and on the `/afs/rpi.edu/campus/doc` directory. (c) Further modify your script so that if it is invoked without a parameter it prints out an explanation of how to use it.
2. If the `ls` command is given the name of a single extant file it merely prints that filename back out. (a) Write a script `myls` that behaves like `ls` except that when a single filename parameter is supplied it produces the output that `ls -l` would give for the file. (b) Revise your script so that when a single filename parameter is given the output produced is the filename followed by the date and time of its most recent change and then the size of the file in bytes.
3. A script `isyes` is required that sets its exit code to 0 if its parameter is some variation of y or yes, and to 1 otherwise. (a) Assume the only acceptable parameter values meaning “yes” are y, yes, Y, and YES, and solve the problem using only shell programming features we have discussed. (b) Simplify and generalize your script by using `tr a-z A-Z`, which reads from std-in, translates to upper case, and writes to std-out.
4. Write a script that adds up the sizes reported by `ls` for the files in the current directory. The script should print out only the total number of bytes used.

## References

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