Bash Script

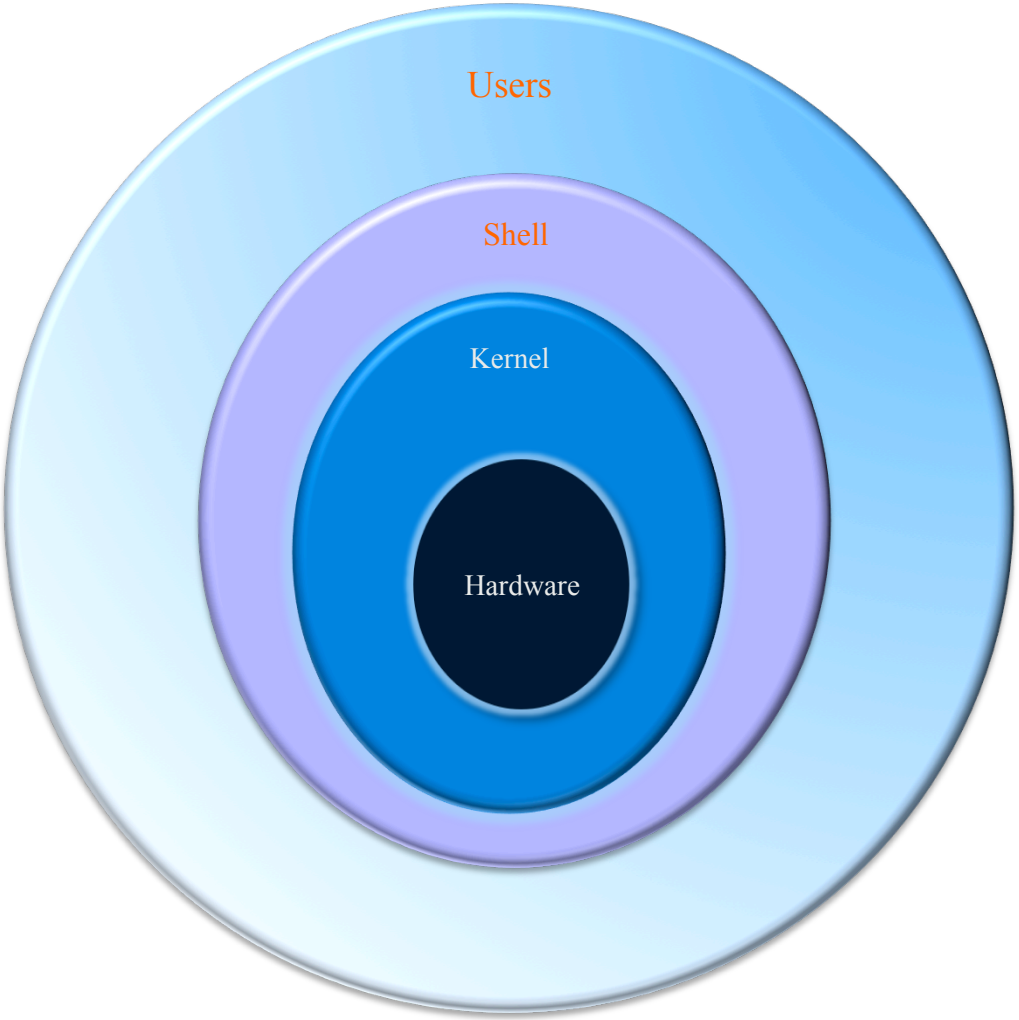
CIRC Summer School 2015

Baowei Liu

Command Lines VS. Bash Script

- Unix/Linux commands in a text file
- A series of commands executed in batch mode

Review of Linux



Linux and Shells

From: torvalds@klaava.Helsinki.FI (Linus Benedict Torvalds)
Newsgroups: comp.os.minix
Subject: What would you like to see most in minix?
Summary: small poll for my new operating system
Message-ID: <1991Aug25.205708.9541@klaava.Helsinki.FI>
Date: 25 Aug 91 20:57:08 GMT
Organization: University of Helsinki

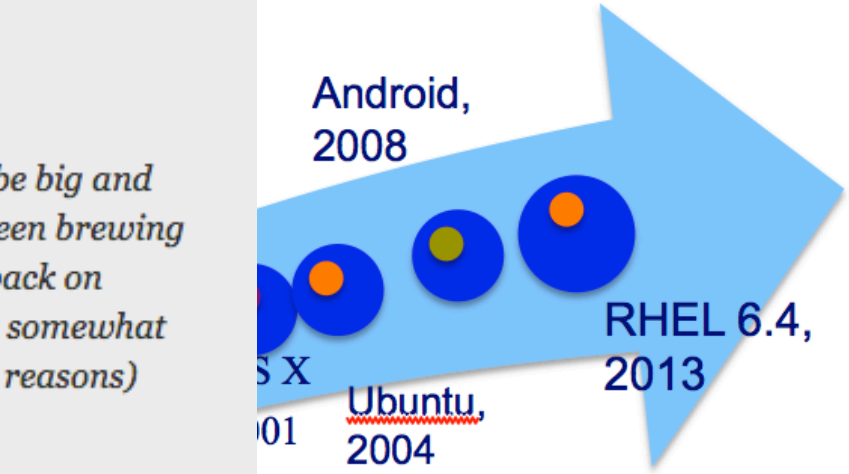
Hello everybody out there using minix -

I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready. I'd like any feedback on things people like/dislike in minix, as my OS resembles it somewhat (same physical layout of the file-system (due to practical reasons) among other things).

I've currently ported bash(1.08) and gcc(1.40), and things seem to work. This implies that I'll get something practical within a few months, and I'd like to know what features most people would want. A are welcome, but I won't promise I'll implement them 😀

Linus (torvalds@kruuna.helsinki.fi)

PS. Yes – it's free of any minix code, and it has a multi-thr It is NOT protable (uses 386 task switching etc), and it pr will support anything other than AT-harddisks, as that's all I have :-(.



https://en.wikipedia.org/wiki/

```
cd /media/botwindata/repositories/astrobear_dev
changeSet=`hg heads | head -n 1`
currentRevision=`echo ${changeSet} | awk '{print $2}'`
oldRevision=`cat /home/bliu/mornitor_Revision/revision.old`

TITLE="New Revision < "${currentRevision}" > Available in Dev Repo"

if [ "$currentRevision" != "$oldRevision" ]; then
cat <<EOF |/usr/lib/sendmail -t -oi
To: $ADDRS
Reply-to: $SENDER
From: $SENDER
Subject: $TITLE

======================== AstroBEAR Reminder ============================

A new revision `echo ${currentRevision}` has been checked in to the our dev repo:
/media/botwindata/repositories/astrobear_dev.

========================================================================

EOF

fi
```

Examples Using Bash Script – Pipeline things

- File manipulation
- Wrappers

Shell Script VS. Other Script Language

- Easy to program: the commands and syntax are exactly the same as those directly entered at the command line. Quick start.
- Slow run speed comparing with other programming languages
- Not easy for some tasks like floating point calculations or math functions
- Not friendly to use: error messages/white space.

Linux Commands

- ls: list directory contents
- cd: change directory
- man: manual
- echo

Linux Command echo

- Display a line of text
- Example: echo hello world
- “…” or ‘…’

To Write a Bash Script

- An editor: vi emacs, nano,….
- Specify interpreter as bash: #!/bin/bash
- Some Linux commands
- Comments: # (single line)
- Set executable permission

File permissions and First Script

```
-rw-r-----@ 1 liu  staff  446317 Jan 20 14:08 TcshAndShScreenCapture.png
drwxr-xr-x@ 9 liu  staff     306 Jan 23 12:31 Tests
```

- Three scopes and permissions
- Bash script has to have execute permission to allow the operating system to run it.
- Check permissions: ls –l
- Add execute permission: chmod +x
- First script

Bash Variables

- Create a variable: name=value
- No data type
- No need to declare but can be declared with "declare command"
- No space allowed before and after =
- Use $ to refer to the value: $name

Environment Variables

- env
- $SHELL
- $PATH
- $LD_LIBRARY_PATH
- $RANDOM
- $USER

Variable Value

- Assign value: a=2
- Pass value: b=$a
- Display value: echo $a
- Multiple Variables
- Strong quoting & weak quoting

Assign Variable Value

- Parameter expansion ${}
- Command Substitution: $(), or `
- Arithmetic expansion: $((…))

Arithmetic Expression

- Arithmetic operators: + - * /
- Integer only
- Arithmetic Expansion ((…))
- Floating point calculation: other tools like bc, or awk

Basic calculator: bc

- An arbitrary precision calculator language
- Simple usage: echo $a+$b | bc
- Can use math library: echo “s(0.4)” | bc –l

Conditional Expression and if

- If condition
  then
    ….
  else
    ….
  fi

Conditional Expression

- Integers (Numeric Comparison): (( ))
- operators ==, !=,>,<,>=,<=
- You can use standard C-language operators inside (( ))
- white spaces are not necessary

Conditional Expression: Strings

- Compare strings: [[“$a” = “$b”]]
- operators = or ==, !=, >, < (careful!)
- White spaces around [[ ]] and operators are necessary!!

```
if [[ $a=$b ]]; then
 echo "$a=$b"
else
 echo "$a!=$b"
 fi
```

- -n (not null), -z(null)

Compound Operators

- &&, ||

```
if [[ … ]] && [[ … ]]
then
    ….
 fi
```

A c

- Old

Feature	new test [[	old test [
string comparison	>	\> (*)
	<	\< (*)
	= (or ==)	=
	!=	!=
integer comparison	-gt	-gt
	-lt	-lt
	-ge	-ge
	-le	-le
	-eq	-eq
	-ne	-ne
conditional evaluation	&&	-a (**)
	||	-o (**)

Compare Floating Point Numbers

- Use Basic Calculator: bc

  compare_results=`echo "$a>$b" | bc`

  double quotation are important!!
- Operators: ==, !=, >, >=, <, <=
- Convert to integer (Return 1 for True and 0 for False)
- Always check the command before using it!

Shell Expansions Review

- Parameter Expansion: $variable, ${variable}
- Arithmetic Expansion: $((expression))
- Command Substitution: $() or ``

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Exit Status of Commands

A successful command returns 0 (shell true) while an unsuccessful command returns non-zero (shell false)

- Use echo $? To check the exit status
- true and false commands
- [[…]]; echo $?

Conditional Expression

```
if command
then
…
fi
```

Conditional Executions & Arguments

- Command 1 && Command 2
- Command 1 || Command 2

Brace Expansion

- Brace expansion is used to generate an list.
- {string1, string2, …,stringN}

  space not allowed between braces!!!
- Range{<start>..<end>}: {1..20}
- Very first expansion to do !!

  {$a..$b}

Brace Expansion

- Preamble and Postscript

  a{1,3,4}b

  space is important!!!

- Combining and nesting

  {a,b,c}{1..3}

  {{a,b,c},{1..3}}

- Escaping backslash

Loop Constructs: for loop

- Basic Syntax

```
for arg in [list]
do
    …..
done
```

- [list]:
  1. Brace Expansion (string or integer): {1..5}
  2. Command Substitution: `ls`
  3. Arithmetic Expansion?

for loop –Arithmetic Expansion

- Basic Syntax

```
for (( expr1; expr2; expr3 ))
do
  …
done
```

- Examples:
- White space are not important for Arithmetic Expansion

Loop Constructs –while loop

- Conditional Expression

```
while [[ conditional expression ]]
 do
    ….
done
```

- Arithmetic Expansion

```
while (( arithmetic expression ))
 do
  …
done
```

Loop Constructs –until loop

- Conditional Expression

  until [[conditional expression]]

  do

  ….

  done

- Arithmetic Expansion

  until ((arithmetic expression))

  do

  …

  done

Functions

- Syntax

```
Function functname{
   commands….
  }
Function functname(){
   commands….
  }
```

- Pass Arguments
- Returning Values

Other Flow Control Constructs: case

```
case expression in
  pattern1)
        statement;;
  pattern2)
        statement;;
   ….
esac
```

;; and *

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Filename Expansion / Globbing

- Expanding filenames containing special characters
- Wild cards * ?, not include . ..
- Square brackets [set]: “-”
- Special characters: ! (other than)
- Quote special pattern character if they are to be matched literally
- Escaping backslash: protect a subsequent special character

File Manipulation

- Examine the status of a file

  -a file: True if file exists

  -s file: True if file exists and has a size greater than zero

  -f file: True if file exists and is a regular file

- Compare files

  file1 –nt file2: newer than

  file1 –ot file2: older than

Merge files

- join: merge files by a common column
- cat: merge files by rows

Arrays

- Array is a numbered list
- One-dimensional only
- Create an array with = and (), or declare –a
- Array element: ArrayName[index]
- Access elements: ${ArrayName[n]} @, *
- Array size:${#ArrayName([@])},${#ArrayName([*])}
- Initialize an array with brace expansion
- Delete array or element: unset ArrayName[n]
- Add element without key: ArrayName+=(...)

Strings and Manipulation

- Create a string
- Display a string
- Length of a string
- Substring: a Bash string just holds one element
- Compare strings:
- Concatenate of string
- Substring extraction: position starting with 0
- Substring replacement

Compare Strings

- =: [[“$a” = “$b”]], white space are important!!
- !=
- -z True if the string is null /zero-length
- -n True if the string is Not null

Substring Extraction

- ${string:position:length}
- ${string:position}

Substring Removal

- ${string#substring}
- ${string##substring}
- ${string%substring}
- ${string%%substring}

Substring Replacement

- ${string/substring/replacement}
- ${string//substring/replacement}
- ${string/#substring/replacement}
- ${string/%substring/replacement}

grep and Regular Expression

- grep: search for matches to a pattern in a file and print the matched line to stdout

  grep PATTERN file

- Regular Expression: a sequence of characters that define a search pattern, mainly for string match -- globbing pattern used for text

Regular Expression

- . : Equivalent to ? in filename expansion
- .*: any string. Equivalent to * in filename expansion
- * : zero or more times, a* will match a,aa,… but not ab
- ^: starting with, ^ab
- $: ending with, ab$

Regular Expression

- []: “[-]” “[^]”
- “\< >\” exact word

sed and Regular Expressions

- sed ‘s/abc/xyz’ File: All occurrences
- sed ‘5,10s/abc/xyz’ File: specified lines
- sed ‘0~2 s/abc/xyz/’ File: only in the even lines
- More complicated examples

sed and Regular Expressions

- Word Characters: Alphanumeric characters plus “_” [A-Za-z0-9_]
- Replace all occurrences in a line

awk

- A text-processing programming language in Linux
- awk ‘{print $1}’
- Floating number calculations

head and tail

- –n
- –c
- -f

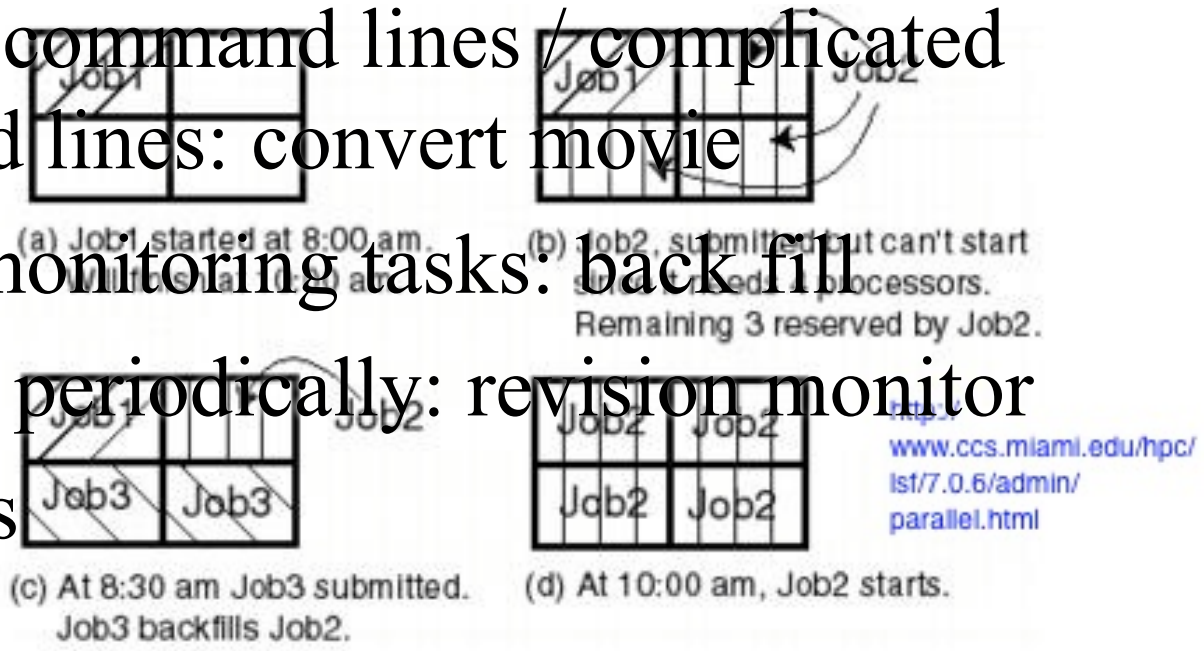
wc

- wc: print the number of bytes, words and lines in a file.
- -c
- -l
- -w

Some Examples

Scenarios & Examples Using Bash Script

- Multiple command lines / complicated command lines: convert movie
- System monitoring tasks: back fill
- Run jobs periodically: revision monitor
- Wrappers



Job Scheduler Slurm

- Slurm

  1. Free and open-source job scheduler
  2. Arbitrate resources by managing a queue of pending jobs
  3. Examples for submitting jobs to our local systems can be found on info.circ.rochester.edu

http://en.wikipedia.org/wiki/Slurm_Workload_Manager

Job Scheduler Cron

- Time-based job scheduler
- Schedule the command to run with crontab –e
- Each line of a crontab file represents a job

Cron and Crontab

- Specify the time:

  * * * * * script/command

  min hr dom m dow(0-6)

- Specify every five hour

  * */5 * * * script/command

  0 0 1 1,6 * script/command

- Non standard macros

  @yearly @reboot …

Stdin, stdout and stderr

- Stdin: standard in, data stream that is going into a process
- Stdout: data stream coming from a running process
- Stderr: data stream of error messages being generated by a process

Redirect and Pipes

- Redirect between files including the three file descriptors, stdin, stdout and stder: > >>
- Pipes takes the output of one command as the input of another command |