

CIST-4350 Content Summary At Course End; 20101208

Meta

Scope and Organization

Collection assembled from multiple sources, representing: (1) Consensus opinions; and (2) Instructor's selections.

There is no general consensus on taxonomy across multiple sources. Nor is there one source significantly more credible than others. The organization of content into categories for this document is inspired by multiple sources but ultimately reflects the instructor's preferences.

Categories

1. User Interface & Shell (UIS)
2. Storage Management (STM)
3. Information Content Management (ICM)
4. System Management & Administration (SMA)
5. Miscellaneous (MSC)
6. Services (SVC)
7. Software Development (SWD)
8. Internals (INT)
9. References (REF)

1. User Interface & Shell (UIS)

This category focused on user interfaces. Topics include shell scripts and remote shells.

1A. UIS Knowledge Areas

1.A.1. UIS Knowledge Areas Already Discussed

1. Aliases
2. Arguments, options: short-syle, long-style, name=value
3. Autocomplete (commands, filename)
4. Bash shell
5. Bash startup scripts
6. Brace expansion
7. CLI vs GUI tools
8. Command line editing
9. Command line processing (high-level)
10. Command line processing (more detail)
11. Command search patch... special security concerns
12. Command sequences (in current shell)
13. Command substitution
14. Environment variables
15. Escaping, quoting...
16. Exit codes
17. Filename globbing, wildcards
18. Foreground and background jobs
19. Getting help
20. I/O redirection
21. Metacharacters
22. Positional parameter shifting

23. Scripting: arguments, variables, environment variables, commands, functions, exit code, flow control
24. Shell job control
25. Shell scripting
26. Shell variables
27. Shell variables: scope
28. Subshell
29. Virtual consoles, terminal window

1.A.2. Pending UIS Knowledge Areas

1.A.3. UIS Knowledge Areas Left for Independent Study

Everything else, including:

1. Arithmetic expressions
2. Desktop: X11, GNOME, Nautilus
3. Easter eggs:
gnome: free the fish; gegls from outer space;
terminal: apt-get moo; aptitude -v moo, -vv moo, ...
4. String operators
5. Tokens
6. VMware Tools

1B. UIS Tools & Commands

1.B.1. UIS Tools & Cmds Already Discussed

1. (cmd1; cmd2; cmd3) : execute sequence of commands from single spawned
2. . : "dot" command, equivalent to source command
3. ^Z : suspends job
4. alias : substitute one command for another
5. bash : Bourne Again shell
6. bg : restart suspended job in background
7. break : break out of loop
8. case, esac : for flow control
9. clear : clear screen or window
10. continue : start next iteration of loop
11. date : display current date
12. echo : print arguments
13. env
14. exit : exit shell script or close console
15. export
16. fg : restart suspended job in foreground
17. for, done loops : iterates
18. getops : get options and arguments
19. help : get help for shell builtin command
20. history
21. if, elif, else, fi : for flow control
22. info : display GNU-style documentation for external command
23. jobs : lists jobs
24. let : evaluate an arithmetic expression
25. man : display online manual for external command
26. printenv : print environment
27. printf : prints arguments under control of format specifier
28. read : reads input from standard input

29. reset : reset the terminal
30. return : causes a function to exit with specified return value
31. shift : renumbers the positional arguments
32. sleep : specified delay
33. source file : in command line, executes script in file without spawning
34. until, done
35. whatis : print 1-line man summary
36. while, done loops : repeat while true

1.B.2. Pending UIS Tools & Cmds

1.B.3. UIS Tools & Cmds Left for Independent Study

Everything else, including:

1. { cmd1; cmd2; cmd3; } : execute sequence of commands in current shell
2. eval
3. expr : deprecated, use \$((expr)) instead
4. fortune

1C. UIS Environment Variables & Special Files

1.C.1. UIS Env Vrbles & Spcl Files Already Discussed

1. .
2. ..
3. ~
4. \$EUID
5. \$HOME
6. \$PATH
7. \$PS1 : shell prompt, first line
8. \$PS2 : shell prompt, second line
9. \$PWD
10. \$UID
11. \$USER
12. .bash_login
13. .bash_profile
14. .bashrc

1.C.2. Pending UIS Env Vrbles & Spcl Files

1.C.3. UIS Env Vrbles & Spcl Files Left for Independent Study

Everything else, including:

1. \$IFS :
2. \$LOGNAME
3. \$LOGNAME.
4. \$OLDPWD : previous working directory
5. \$SHELL
6. .profile

1D. UIS Special Characters

1.D.1. UIS Special Characters Already Discussed

1. ' ' (single quote) : Strong or full quote; prevents interpretation of all special characters within enclosed string; use in pairs
2. - (hyphen or dash) used as argument to cd : refers to previous directory; cd - : change working directory to previous directory
3. - : (minus) used in arithmetic expression : minus or subtraction operator
4. ! (bang) : negation operator (bash keyword); inverts the exit status of the command to which it is applied
5. ![set] : match any character not in set
6. " " (double quote) : partial quote; prevents interpretation of most (but not all) special characters within enclosed string; use in pairs
7. # (pound or sharp) : comment
8. #! (sha-bang) : indicates file contains commands that can be executed by specified command interpreter; two-byte magic number indicating file type is executable script
#!/bin/bash : shell script written for bash shell
9. \$# : number of positional parameters 1..n (not counting \$0)
10. \$\$: process ID (PID) of the script
11. \$(cmd): command substitution
12. \$* : all the positional parameters separated by first variable in IFS
13. \$? : exit status variable; exit status of last command executed by shell
14. @\$: all the positional parameters as separate double-quoted strings
15. \${#variable} : length of variable
16. \${} : parameter substitution
17. \$0 : name of script
18. \$n : value of the nth argument; if n>9, must use \${n}; \$1 : value of the first argument; \${10} : value of tenth argument
19. \$var1 : value or content of the shell variable
20. \$var1 : value or content of the shell variable
21. & : ampersand : used after cmd to run in background;
cmd & : run cmd in background
22. && : double ampersand : logical AND
23. &2 : refers to stderr; 2>&1 : redirect stderr to same file as stdout; cmd >&2 : redirects cmd's stdout to stderr
24. ((integer-expr)) : expand and evaluate integer expression
25. * : asterisk or star used in filename globbing : matches any string
26. * : asterisk or star used in filename globbing : matches any string
27. -, -- : hyphen or dash used as option prefix : option prefix
28. . : dot used as directory name : represents current working directory
29. . : dot used as first character of a filename : hides the file from ls, but not from ls -a

30. . dot used as a command : equivalent to source command (bash builtin); Causes file to be included in current script

31. .. : double dot used as directory name: represents parent directory (of working directory)

32. .. : double dot used as directory name: represents parent directory (of working directory)

33. / : forward slash used in arithmetic expressions : division operator

34. / f: orward slash used in directory/file pathnames : component separator

35. : colon : field separator in files like /etc/passwd and shell variable PATH

36. ; semicolon" : separates two commands on same line

37. ;; : double semicolon" : terminates case option

38. ? : hook used in filename globbing : matches any single character

39. ? : hook used in parameter substitution expression : tests whether a variable has been set

40. ? : hook used in test operator : indicates test for condition

41. [expr] : [is part of test (bash built-in); tests expr

42. [set] : match any character in set

43. \ : backslash : escape or quoting mechanism for single characters; also used to represent special characters in prompt strings, print format strings, and so forth

44. {char...char} : extended brace expansion

45. {char..char} : extended brace expansion

46. {cmd; cmd} : block or code or inline group; an anonymous function

47. {s1,s2} : brace expansion

48. | : pipe : connects two commands into a pipeline;
cmd1 | cmd2 : redirects cmd1's stdout to cmd2's stdin

49. || : used as operator : logical OR

50. ~ : tilde used as directory name : equivalent to \$HOME, user's home directory

51. ~ : tilde used as directory name; ~ : equivalent to \$HOME, user's home directory

52. ~+ : equivalent to \$PWD, current working directory

53. < : redirection of input; cmd < file : redirect file to cmd's stdin

54. < : less-than used as comparision operators : compares arguments

55. = : equal used as comparision operator : sring comparison operator

56. = : equal used for assignment : assignment operator

57. > : greater-than used as comparision operators : compares arguments

58. > : redirects stdout, overwrite mode
cmd > file : cmd's stdout redirected to file, overwriting
cmd &> file : redirects cmd's stdout and stderr to file; overwrites file

59. >| : forced redirection; cmd >| file : forcibly overwrites file even if noclobber option set

60. >> : redirects stdout, overwrite mode; cmd >> file : cmd's stdout redirected to file, overwriting; cmd &>> file : redirects cmd's stdout and stderr to file; overwrites file

61. 2>&1 : redirect stderr to same location as stdout

1.D.2. Pending UIS Special Characters

1.D.3. UIS Special Characters Left for Independent Study

Everything else, including:

1. - (hyphen or dash) used as a filename argument : in some utilities, means to use stdin (or stdout) instead of file
2. % (modulo) used in arithmetic expression: modulus operator (remainder of division)
3. * (asterisk or star) used in arithmetic expression : multiplication operator
4. ** (double asterisk) used in arithmetic expression : exponentiation operator
5. , (comma operator) : used with series of arithmetic operations
6. : (colon) : null command (bash builtin); like a NOP; always True
7. ? (hook) used in double-parenthesis construct : serves as a C-style trinary operator
8. [n] : used in array context : refers to element of the array
9. ` : backquote or backtick : archaic form of command substitution; use in pairs
10. {} \; : used with find constructs to hold pathname
11. {} : double curly brackets used as placeholder : placeholder for output text
12. ~- : equivalent to \$OLDPWD, previous working directory
13. + : plus, other uses : may be used as option flag for command or filter (e.g., to enable or disable certain options)
14. + : plus used in arithmetic expression : addition operator
15. << : redirection of input for here document
cmd <<Identifier text Identifier : redirects text/commands to cmd's stdin
16. <<< : redirection of input for string here
cmd <<< \$vrbl : expands vrbl and redirects to cmd's stdin
17. <> : open file
[i]<>file : opens file for read/write with file descriptor i

2. Storage Management (STM)

STM focuses on containers; ICM focuses on the content within the containers.

2A. STM Knowledge Areas

2.A.1. STM Knowledge Areas Already Discussed

1. Disk interfaces: IDE; SCSI; USB
2. LVM
3. Mounts
4. Partitions: Primary; Extended (logical)
5. RAID
6. Storage devices
7. Unix directory structure

8. Virtual memory/Swap
9. Access classes: user, group, other
10. Access control permissions
11. Access types: read, write, execute
12. Archives
13. Backup media
14. Compression
15. Directory table
16. Disk mounts
17. Extended Attributes: Immutable
18. File structures: Directory tables; Inodes
19. Hard links
20. Ownership: user and group
21. Soft links
22. Standard Permissions: (Read, Write, Execute); (Setuid, Setgid, Sticky)
23. Filesystems: ext2/3; FAT; NTFS

2.A.2. Pending STM Knowledge Areas

2.A.3. STM Knowledge Areas Left for Independent Study

Everything else, including ext4 filesystem.

2B. STM Tools & Commands

2.B.1. STM Tools & Cmds Already Discussed

1. cd : change directory
2. cfdisk : manage partition tables
3. chattr : change file's extended attributes
4. chgrp : change file's group owner
5. chmod : change file's permissions
6. chown : change file's user owner
7. compress; uncompress
8. cp : copy
9. dd: copy and convert
10. df : display disk usage statistics
11. du : display directory usage statistics
12. fdisk : manage partition tables
13. file : determines file type
14. find : finds a file
15. gzip; gunzip: compress; uncompress
16. ln : create link
17. locate : locate a file
18. ls : list files
19. lsattr : list extended file attributes
20. lsof : list open files
21. mkdir : make a directory
22. mount : attaches a filesystem
23. mv : move or rename a file
24. pwd : print current working directory
25. rm : remove a file or directory tree
26. rmdir : remove empty directory
27. sfdisk : manage partition tables
28. slocate, locate : searches for files using its own index

29. stat : get information about a file or filesystem
30. tar
31. touch : create a file or update file's timestamp
32. umask : display/set default file permissions (mask)
33. whereis : locates source/binary & manuals for specified files

2.B.2. Pending STM Tools & Cmds

2.B.3. STM Tools & Cmds Left for Independent Study

Everything else, including:

1. split : splits one large file into multiple smaller files
2. parted : manage partition tables

2C. STM Environment Variables & Special Files

2.C.1. STM Env Vrbles & Spcl Files Already Discussed

1. . : current directory
2. .. : parent directory
3. / : root directory
4. /bin and /usr/bin : user commands
5. /boot : boot files
6. /dev : device files
7. /dev/null: null device
8. /etc : files used by subsystems...
9. /etc/fstab
10. /home : home directories for user accounts
11. /proc : psuedo-filesystem
12. /sbin and /usr/sbin : system administration commands
13. /var : administrative files
14. ~ : same as /home

2.C.2. Pending STM Env Vrbles & Spcl Files

2.C.3. STM Env Vrbles & Spcl Files Left for Independent Study

Everything else.

3. Information Content Management (ICM)

ICM focuses on the content within containers. (STM focuses on the containers themselves.)

3A. ICM Knowledge Areas

3.A.1. ICM Knowledge Areas Already Discussed:

Regular expressions.

3.A.2. Pending ICM Knowledge Areas

3.A.3. ICM Knowledge Areas Left for Independent Study

Everything else.

3B. ICM Tools & Commands

3.B.1. ICM Tools & Cmds Already Discussed

1. awk : text programming language
2. cat : display and concatenates files
3. cut : extracts columns of text
4. grep : search for lines matching an expression [basic]
5. grep : search for lines matching an expression [not so basic]
6. hd, hexdump : ascii, decimal, hex, and octal view of file
7. head : output first part of file(s)
8. less: display text file page at a time, a replacement for more
9. look : return words that match the prefix pattern
10. more : display text file
11. nl : copies files to stdout, prepending them with line numbers
12. paste : treat multiple files as columns and combine them on stdout
13. sed : stream editor used in pipelines and/or scripts to transform or filter text
14. sort : prints lines of text according to specified sort order
15. tail : output last part of files
16. tr : translates one set of characters into another set of characters
17. uniq : report or omit duplicate adjacent lines
18. wc : count characters, words, lines in file (-l)

3.B.2. Pending ICM Tools & Cmds

3.B.3. ICM Tools & Cmds Left for Independent Study

Everything else, including:

1. cmp : byte by byte comparison of two files
2. comm : line by line comparison of two sorted files
3. diff : compares two text files, line by line, reporting differences between them
4. ed : line-oriented text editor
5. emacs : powerful text editor
6. gedit : GUI text editor for GNOME desktop
7. join : join lines of two files on a common field
8. pr : convert text files for printing
9. tac : concatenate and print files in reverse
10. vi/vim : text editor

3C. ICM Environment Variables & Special Files

None

4. System Management & Administration (SMA)

SMA focuses on non-storage system resources; and privileged tools & commands.

4A. SMA Knowledge Areas

4.A.1. SMA Knowledge Areas Already Discussed

1. Access control lists (ACLs)
2. Architectural Considerations: Purpose, Functional Roles; Operating Environment; Processor Considerations; Host Memory (Including Special Concerns); I/O; Networking
3. ARP
4. Backups: media; (full, incremental, differential)
5. Boot process expanded
6. Boot Process: BIOS; MBR; Boot Loader
7. Command search path
8. Core Security Principles: (Simplicity; Complete Mediation; Least Privilege; Proportionality; Psychological Acceptability)
9. Core Security Threats, Types Of Malware; Types Of Attacks
10. Core System Security Definitions: Confidentiality; Integrity; Availability; Identification & Authentication; Access & Access Control; Authorization; Roles; Accountability; Audits/Logs
11. Discretionary access control (DAC)
12. DNS
13. Ethernet addresses
14. Firewall
15. Groups
16. Hostnames
17. Init process
18. Installing Linux: Livecd; Native; Multiboot; Virtual
19. IP
20. IP addresses: (host, netmask); (static, dynamic, dhcp)
21. Jobs
22. Least privilege
23. Logging: log files, log rotation
24. Mandatory vacations
25. Passwords: how to choose; cracking
26. Permission bits
27. Process life cycle: forking; exec; exit
28. Process priorities
29. Process signals: types; how handled
30. Process states: runnable, sleeping; stopped; zombie
31. Process types: (interactive, foreground; background); (attached or detached); batch; daemons
32. Processes
33. Protocol layers
34. Role-based access control (RBAC)
35. Rotation of duties
36. Routing, gateway
37. Separation of privilege
38. Services
39. System Administration Scope: SAGE Definitions & Job Descriptions; LPI Certification Requirements; UCP Certification Requirements
40. System Management Options: KVMs; Local GUI Or Console Shell; X Windows; GUI Terminal; Virtual Console; Remote GUI Or Console Shell

41. System State
42. TCP
43. Unix Way: History; Multiple Versions & Distributions; Culture And Philosophy
44. User accounts: real users, pseudo users
45. User termination best practices
46. Users
47. Virtual Machines
48. Users: User And Group Ids; Access Controls; Superuser

4.A.2. Pending SMA Knowledge Areas

4.A.3. SMA Knowledge Areas Left for Independent Study

Everything else, including:

1. Grub control
2. HTTP
3. ICMP
4. Licensing
5. Mandatory access control (MAC)
6. PAM
7. Quotas
8. SE Linux
9. SNMP
10. UDP
11. VNC

4B. SMA Tools & Commands

4.B.1. SMA Tools & Cmds Already Discussed

1. adduser : add user
2. arch: display system architecture
3. arp
4. chage : changes password age attributes
5. chattr
6. chfn
7. chpasswd : updates passwords in batch mode
8. crontab : schedule recurring jobs for future execution
9. date : display current date
10. dhclient
11. dmesg
12. free : display free memory statistics
13. gksudo : use like sudo for GUI applications
14. groupadd : create new group account
15. groupdel
16. groups : show user group membership
17. gzip; gunzip: compress; uncompress
18. host : query remote hostnames
19. hostname : print local hostname
20. id
21. ifconfig
22. ifdown
23. ifup
24. ip
25. iptables
26. kill : send a signal to a process
27. last: show information about last logins

28. login : allow user to login
29. lsattr
30. lshw : list hardware
31. lsmod : list kernel loaded modules
32. lsof : list open file associated with a process
33. lspci : list PCI devices
34. mkpasswd : creates a password hash
35. mount : attaches a filesystem
36. netstat
37. passwd : changes user and group passwords
38. ping
39. ps : report running processes in table structure
40. pstree : report running processes in tree structure
41. pwck : checks entries in /etc/passwd and /etc/shadow
42. shutdown : shutdown/restart
43. strace : trace system calls made by a process
44. su : substitute user
45. sudo : execute a command as another user
46. tar
47. telinit : tell init what to do
48. time : report resources used to execute a command
49. top : report status of running processes
50. trace : trace shared library calls made by a process
51. umask
52. umount : detaches filesystem
53. uname : print system information
54. uptime : report how long system has been running, # of users, load averages
55. useradd : create new user; or update default new user information
56. userdel : delete user account and related files
57. vipw
58. visudo
59. vmstat : reports information about processes, memory, paging, block IO, traps, and cpu activity
60. who : show system information, including current logins
61. whoami : print effective userid

4.B.2. Pending SMA Tools & Cmds

4.B.3. SMA Tools & Cmds Left for Independent Study

Everything else, including:

1. acls
2. aptitude
3. at : schedule a job for future execution
4. dnsdomainname
5. grpconv
6. mkfs : make file system
7. modprobe
8. ntpdate
9. openssl passwd : creates a password hash
10. pkgs
11. pwconv
12. resolv
13. route
14. rpcinfo
15. usermod
16. uuencode; uudecode

4C. SMA Environment Variables & Special Files

4.C.1. SMA Env Vrbles & Spcl Files Already Discussed

1. \$EGID
2. \$EUID
3. \$GID
4. \$UID
5. .bashrc, .bash_profile, .bash_logout
6. /bin/false
7. /boot/grub/menu.lst
8. /dev/null
9. /dev/zero
10. /etc/default/useradd
11. /etc/group
12. /etc/hostname
13. /etc/iftab
14. /etc/init.d/networking
15. /etc/init.d/rc
16. /etc/inittab
17. /etc/login.defs
18. /etc/network/interfaces
19. /etc/passwd
20. /etc/shadow
21. /etc/skel
22. /etc/sudoers
23. /home/<username>
24. /proc /sys/net/ipv4/conf/eth1/accept_redirects
25. /proc/partitions
26. /proc/sys/net/ipv4/icmp_echo_ignore_broadcasts
27. /proc/sys/net/ipv4/ip_default_ttl
28. /var/log
29. eth0: first ethernet interface
30. lo : local loopback, local host

4.C.2. Pending SMA Env Vrbles & Spcl Files

4.C.3. SMA Env Vrbles & Spcl Files Left for Independent Study

Everything else, including:

1. /etc/gshadow
2. /etc/resolv.conf
3. /proc /devices
4. /proc /interrupts
5. /proc /iomem
6. /proc /ioports
7. /proc /meminfo
8. /proc /sys/net/ipv4/ip_forward
9. /proc /version
10. /proc /version_signature
11. /var/run/network/ifstate

5. Miscellaneous (MSC)

Reserved.

6. Services (SVC)

Mostly left for independent study.

SVC Topics Already Discussed

1. SSH.
2. HTTP

SVC Topics Left for Independent Study:
Everything else.

7. Software Development (SWD)

Left for independent study. Shell scripting included in SMA.

8. Internals (INT)

Left for independent study.

9. References (REF)

Provided separately.