Linux For Embedded Systems

For Arabs

Course 102:

Understanding Linux

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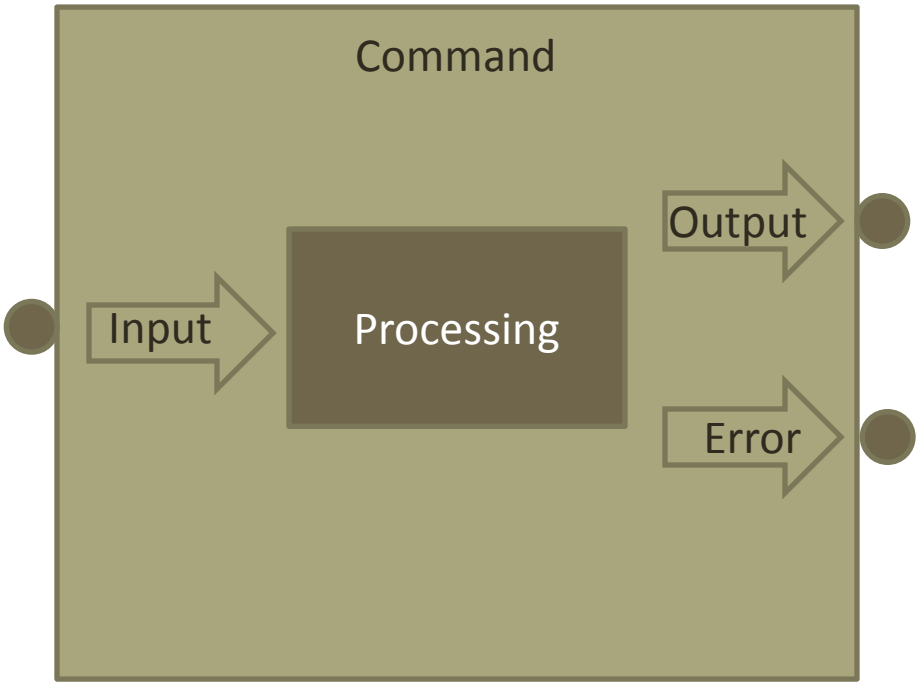
Lecture 8: Composite Commands

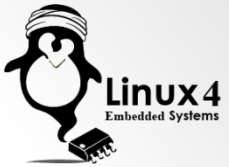
Linux Command Philosophy

- Linux commands follows the following philosophy,
  - Create small, portable, specialized programs that perform one task well
  - Make this program capable of receiving input from, and redirect output to, other programs
- This way, Linux commands are like LEGO blocks
- This philosophy has resulted in creation of a lot of small but very powerful when joined together

Command Model

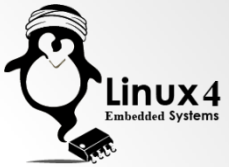


I/O Streams



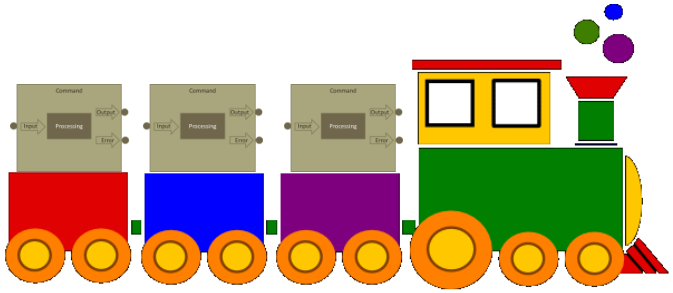
Function	Stream Name	Stream Descriptor	Default Device
Input	stdin	0	Keyboard
Output	stdout	1	Screen
Error	stderr	2	Screen

Composite Commands



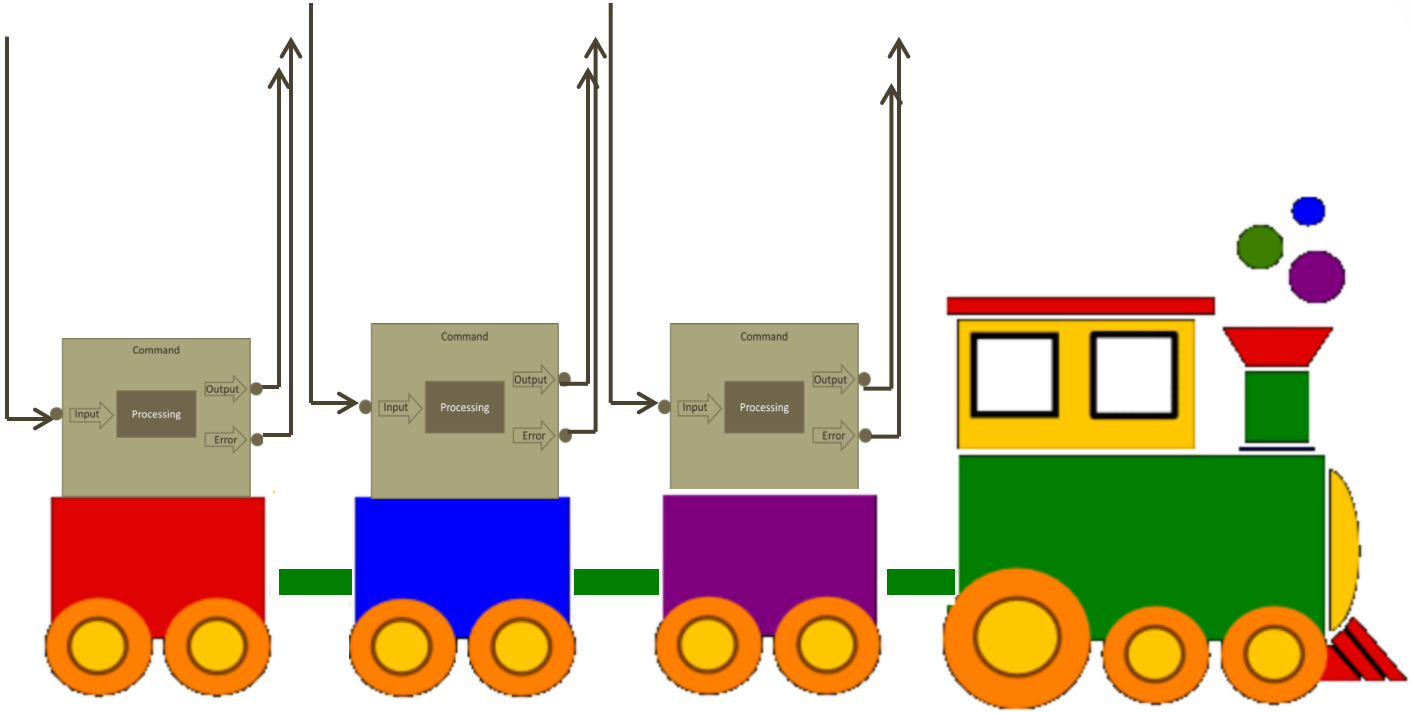
We can build Composite Commands through the following:

- Sequential Commands
- Conditional Commands
- Command Loops
- Input/Output Redirection
- Pipes
- Command Argument Expansion
- Command Argument Quoting



1. SEQUENTIAL COMMANDS

Independent Input & Output



Sequential Commands

We can have multiple commands in the same line as follows

$ <first Command> ; <second Command> ; <third Command>

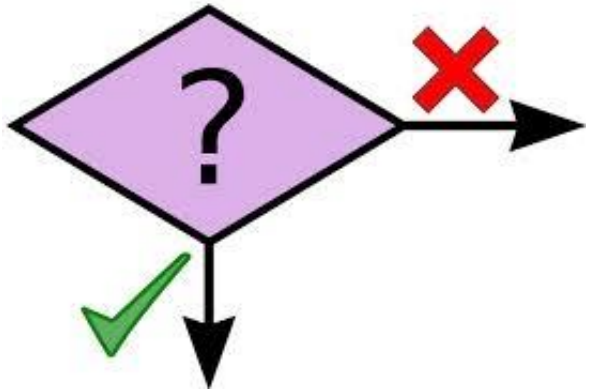
$ echo "One" ; sleep 10; echo "Two"

Using sequential commands is useful when the first command takes long time to execute and we don't want to wait until it is complete

$ make ; sudo make install

Note:

The Sequential Commands just run after each other, they have independent Input & Output



2. CONDITIONAL COMMANDS

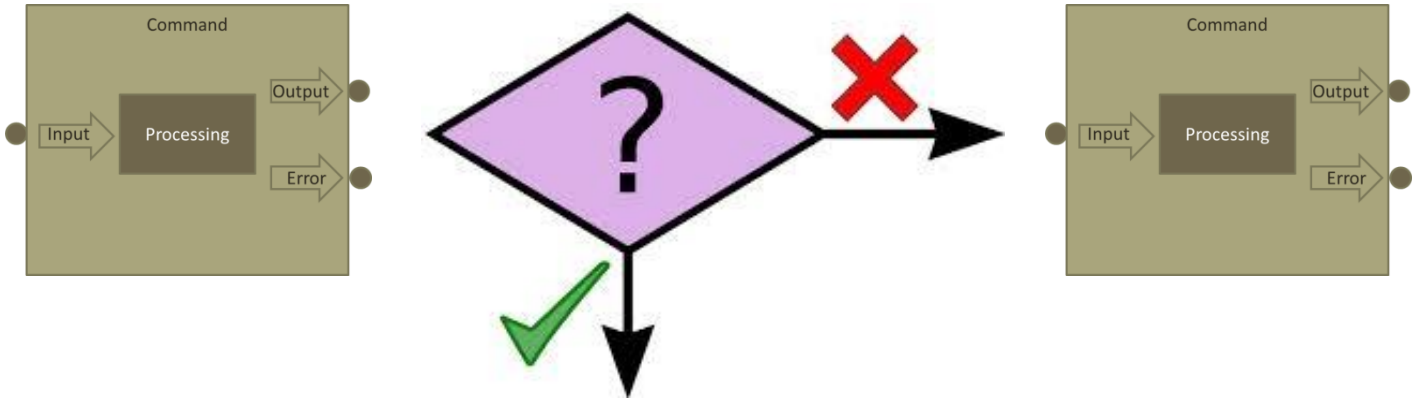
Conditional Commands

ORing ("||")

Second command will only execute if the First Returns Failure

$ cat <filename> || echo "File Not Found"

Used for Error Handling



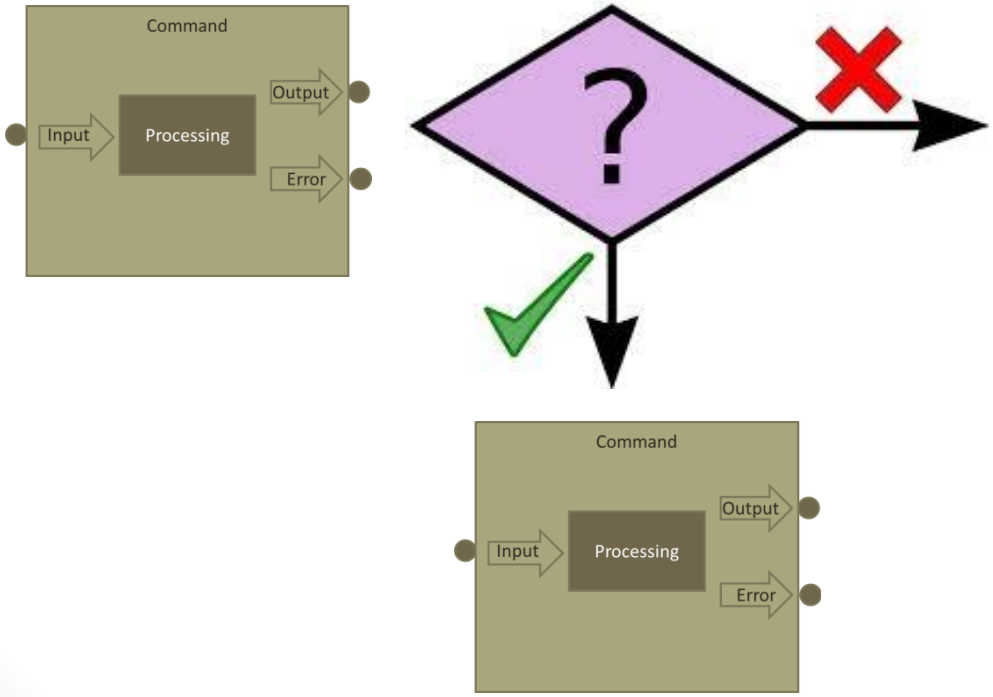
Conditional Commands

ANDing ("**&&**")

Second command will only execute if the First Returns Successfully

$ mkdir dir1 && cd dir1

Continue as long as you are successful



3. COMMAND LOOPS

Command Loops

We can build a loop when we want the command to execute multiple times (maybe on different files or so)

Example:

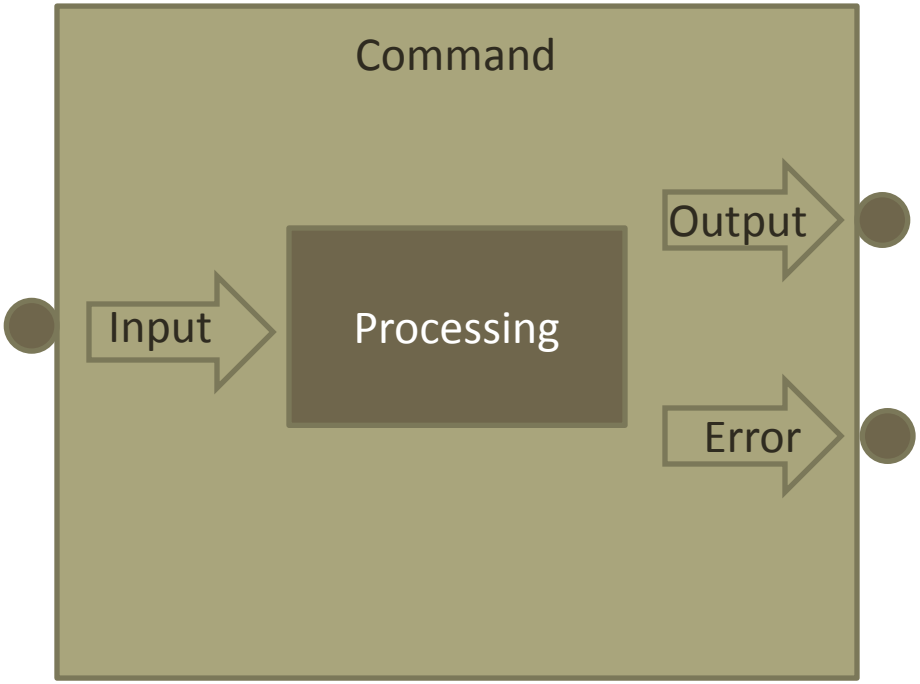
```
$ for file in *.txt
> do
> mv -v $file $file.old
> done
```

Loops are normally used in scripts, but sometimes it is useful to use on the command line

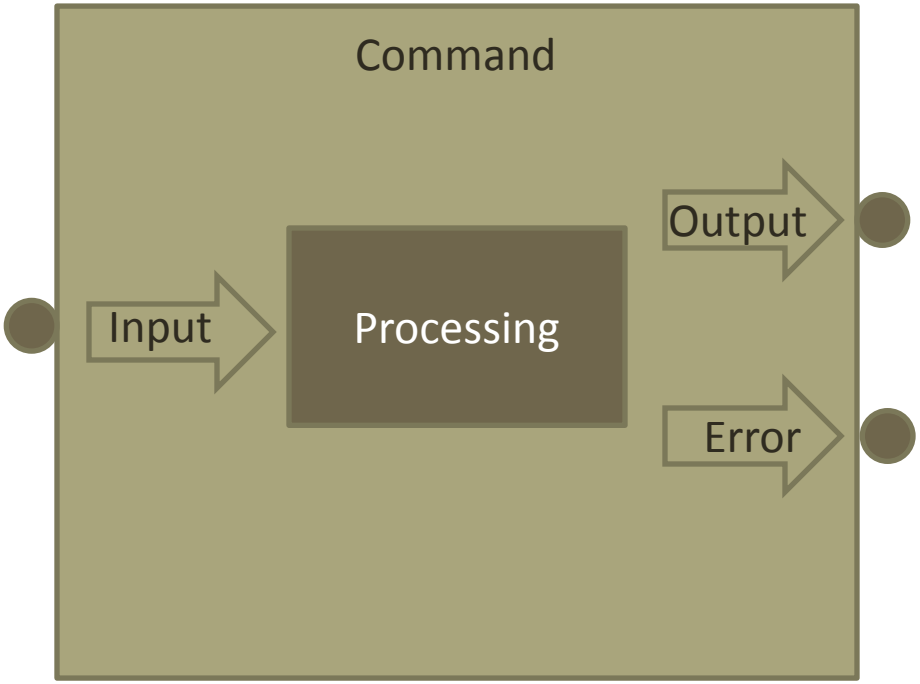
We will discuss them in more detail in Our Bash Scripting Course

4. INPUT/OUTPUT REDIRECTION

I/O Redirection

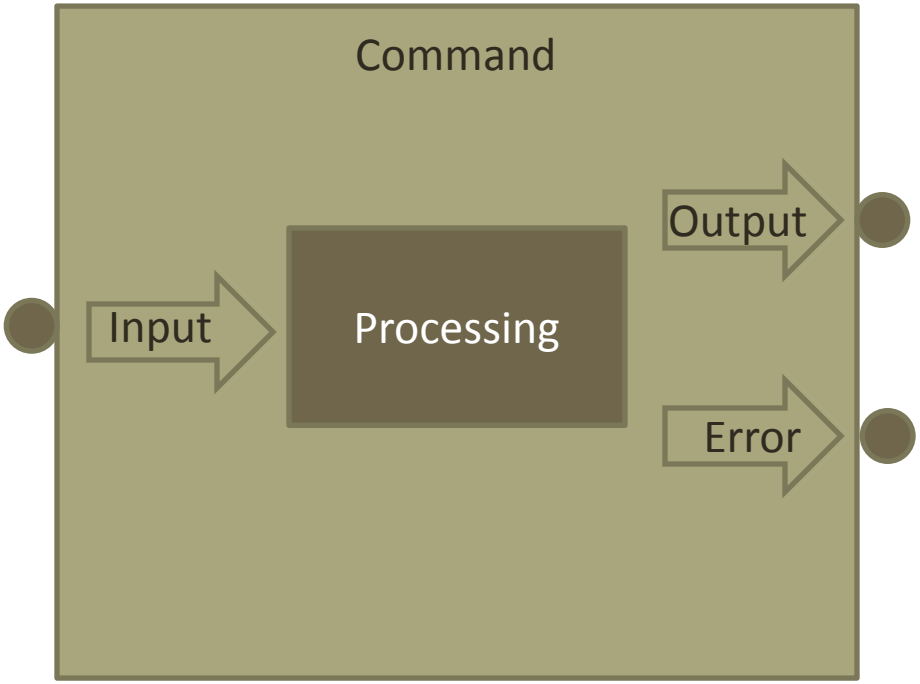


I/O Redirection



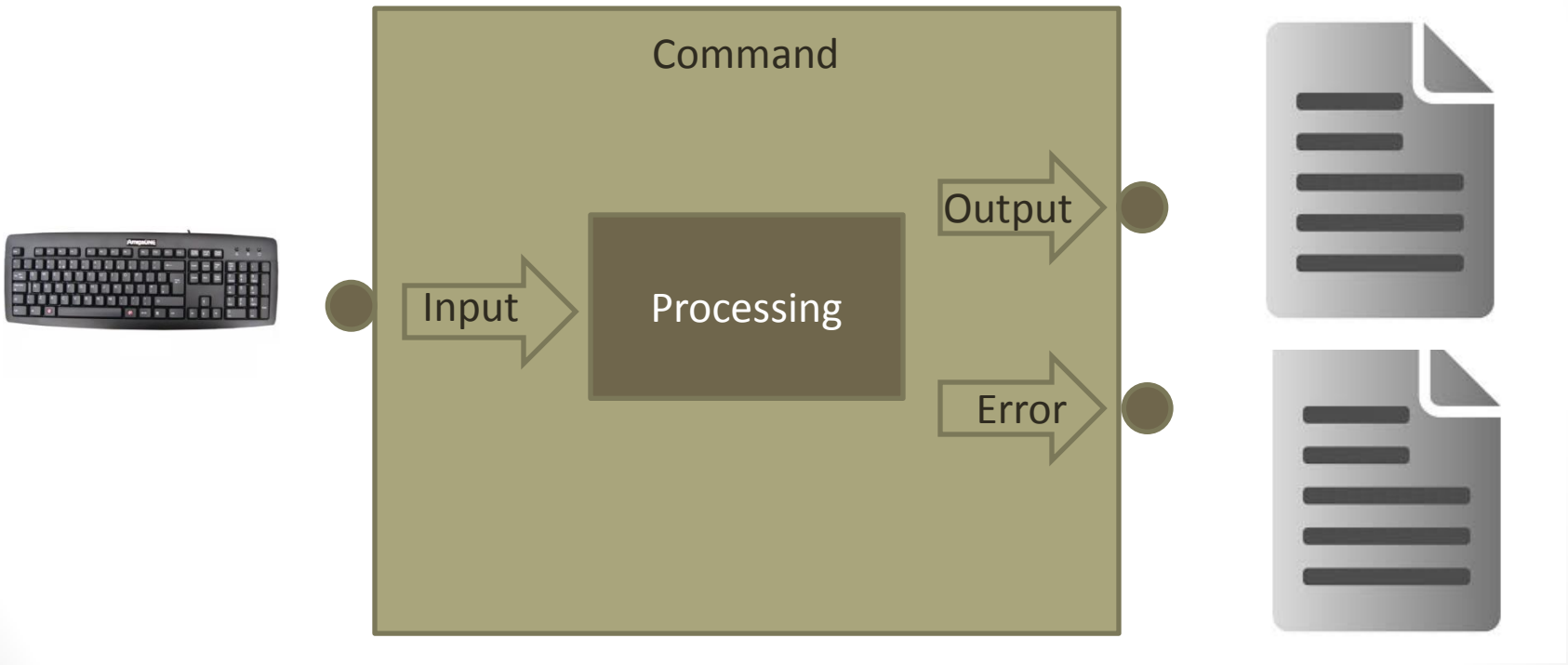
Redirect Output to File

I/O Redirection



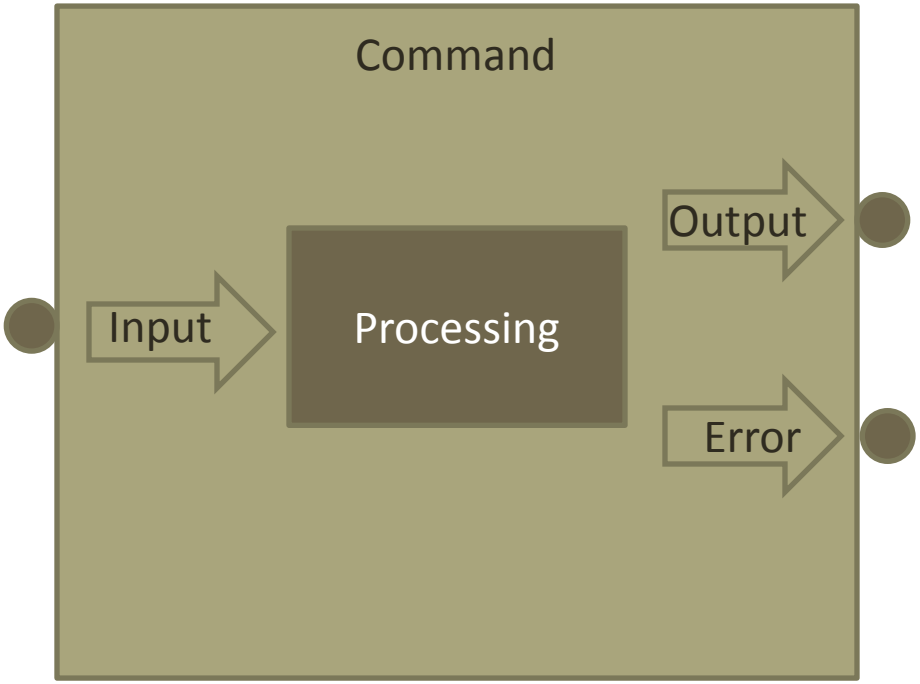
Redirect Error to File

I/O Redirection



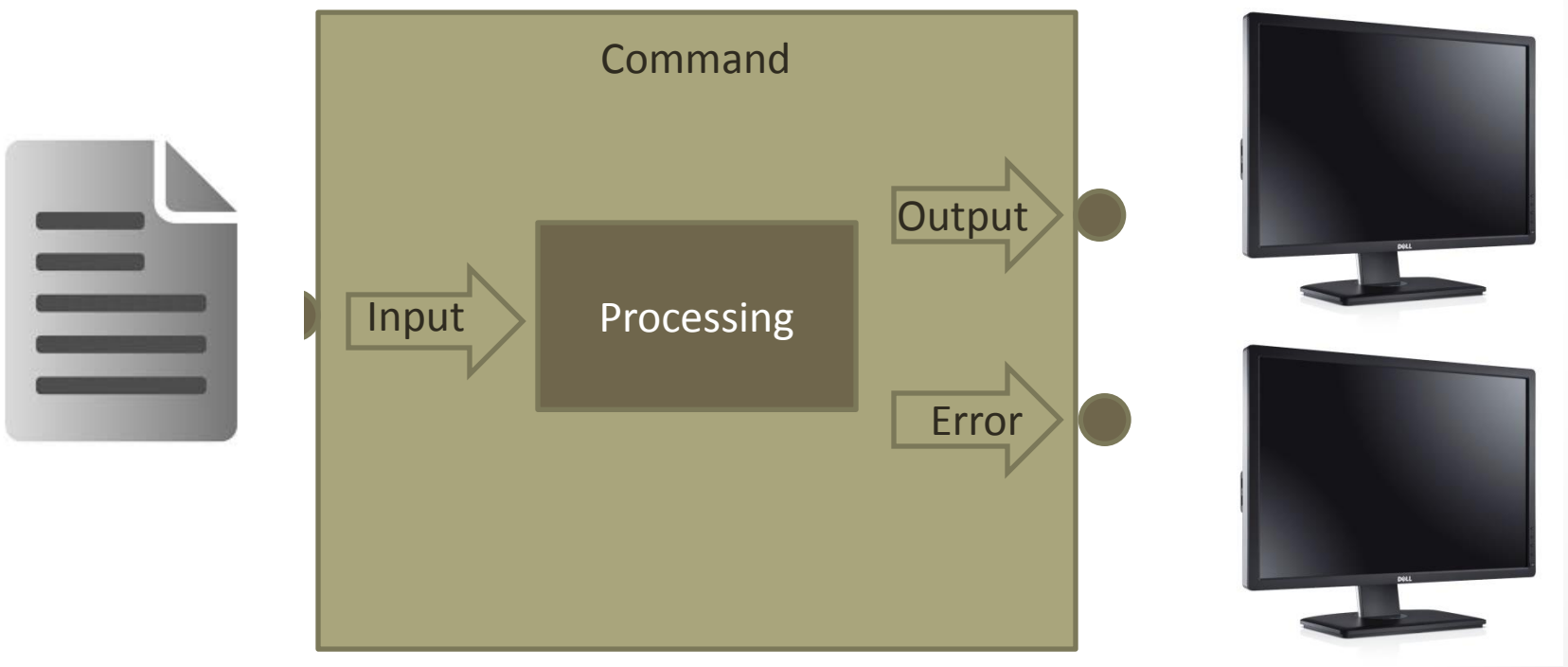
Redirect both Output and Error to Files

I/O Redirection



Redirect both Output and Error to same File

I/O Redirection



Redirect Input from File

Standard Output Redirection

$ <Command> > file (Redirect Output to file; Overwrite)

$ <Command> >> file (Redirect Output to file; Append)

$ echo "Hello world" (output goes to screen)

$ echo "Hello world" > greeting.txt (output goes to the file, overwrite)

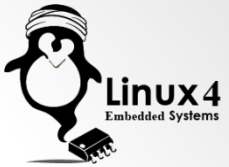
$ ls -al /usr/bin >> file-listing.txt (output goes to the file, append)

$ cat file1 file2 > combined-file.txt

Note:

1. Error Messages Still go to the screen
2. "***>***"stands for (and can be replaced by) "***1>***" which means Redirect Output Stream

Standard Error Redirection



$ <Command> 2> file (Redirect Error to file; Overwrite)

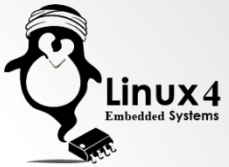
$ <Command> 2>> file (Redirect Error to file; Append)

$ make (Both Output and Error messages go to screen)

$ make 2> log (Output goes to screen;
Error messages go to file, Overwrite)

$ make 2>> log (Output goes to screen;
Error messages go to file; Append)

Both Output & Error Redirection



- Output and Error go to Different Files,

  $ <command> >file1 2>file2 (output to file1, error to file2)

  $ <command> >>file1 2>>file2 (output to file1, error to file2)

- Both Output and Error go to the same file,

  $ <command> >file 2>&1 (both to file)

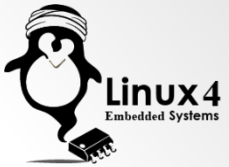
  $ <command> >>file 2>>&1 (both to file)

- Short version of the same command

  $ <command> &>file (both to file)

  $ <command> &>>file (both to file)

Standard Input Redirection



$ command < file (input to the command is read from the file)

Examples:

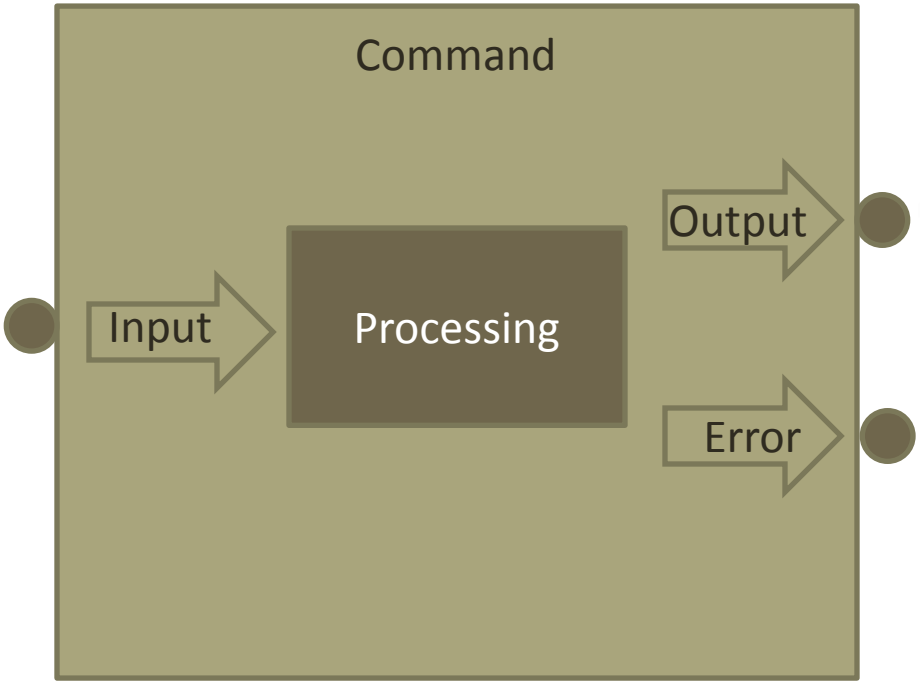
$ wc -l < log-file.log

$ sort < log-file > sorted-log-file

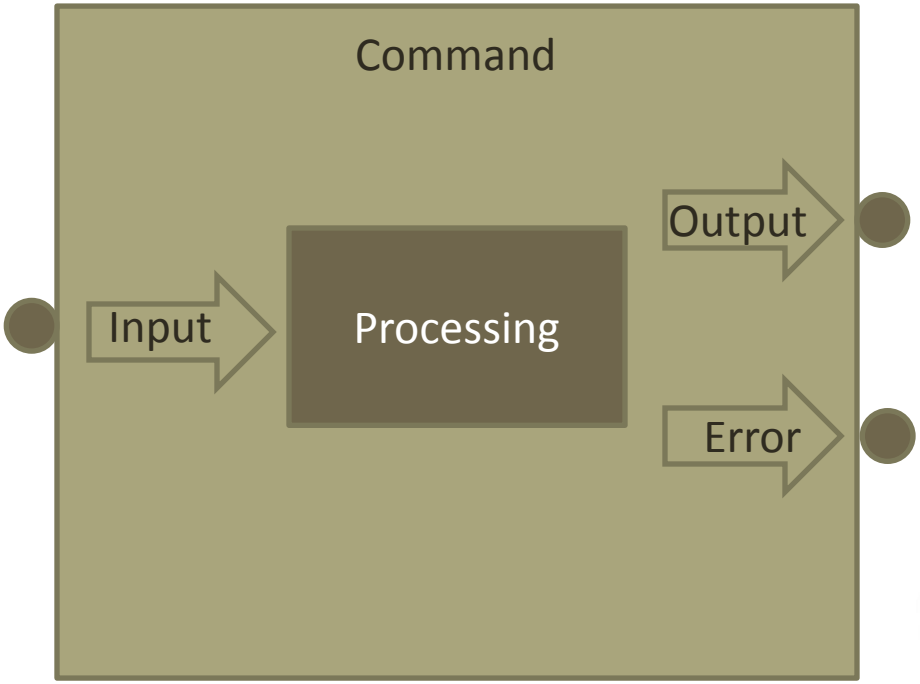
$ mail ceo@company.com < resume

$ spell < report.txt > error.log

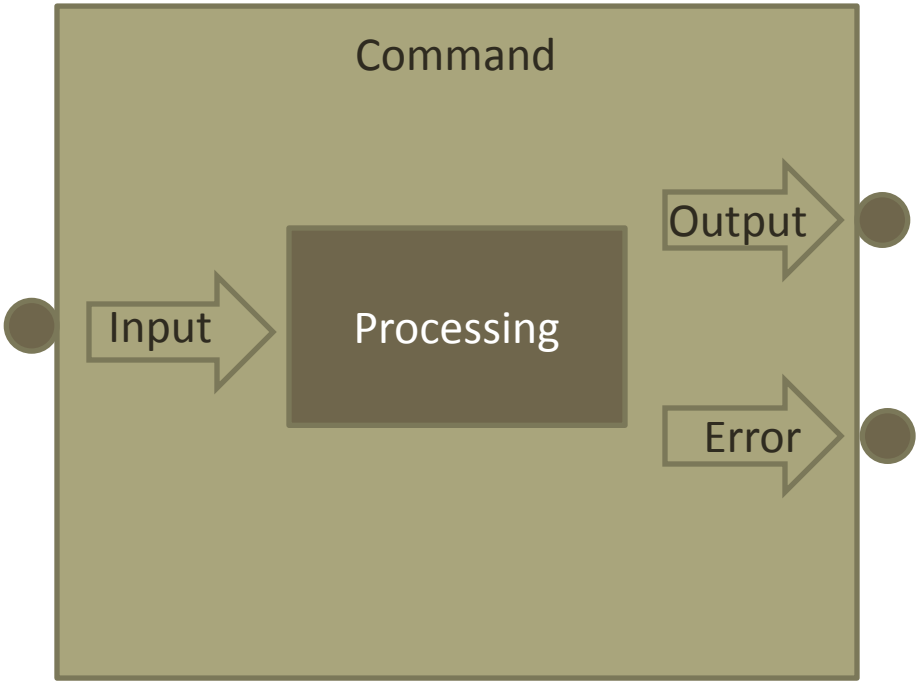
I/O Redirection With Devices



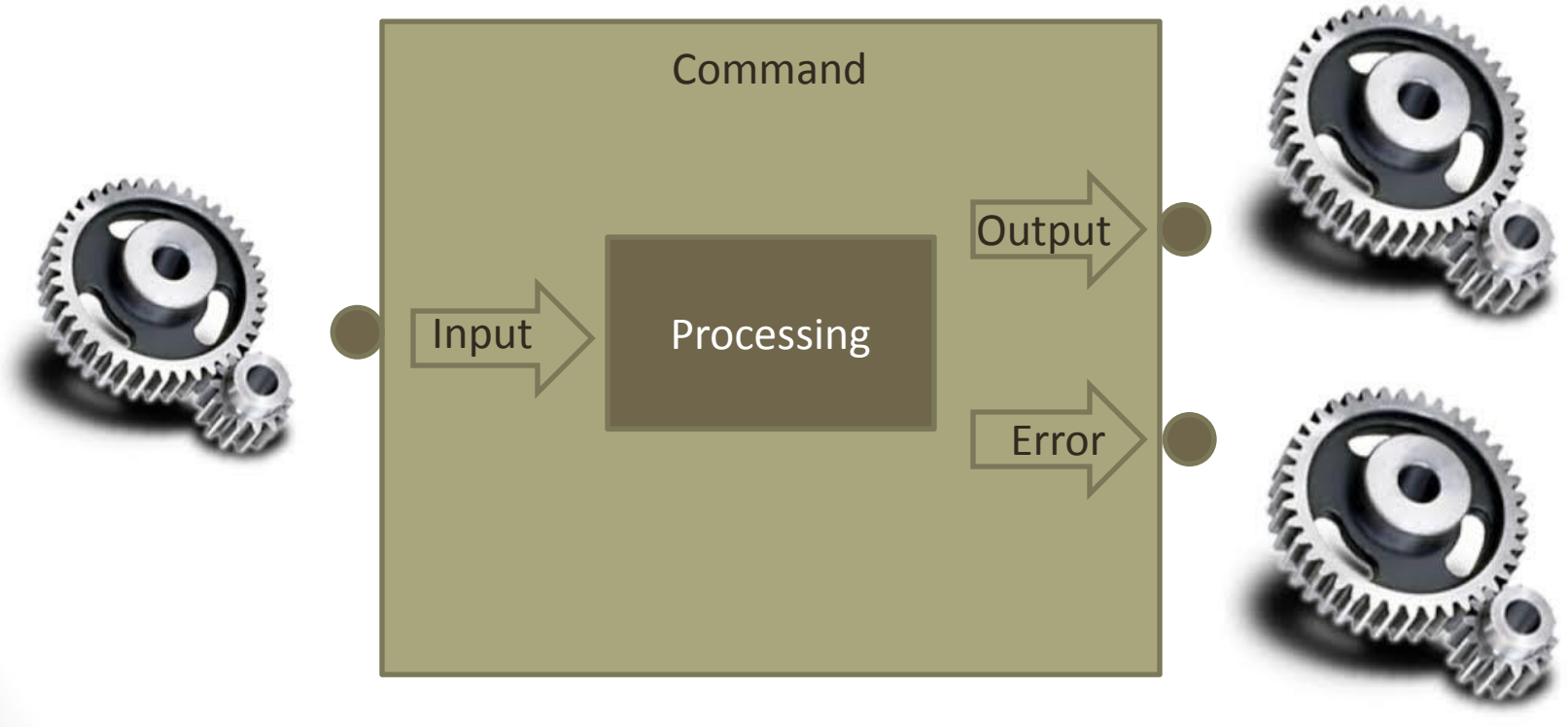
I/O Redirection With Devices



I/O Redirection With Devices



I/O Redirection With Devices

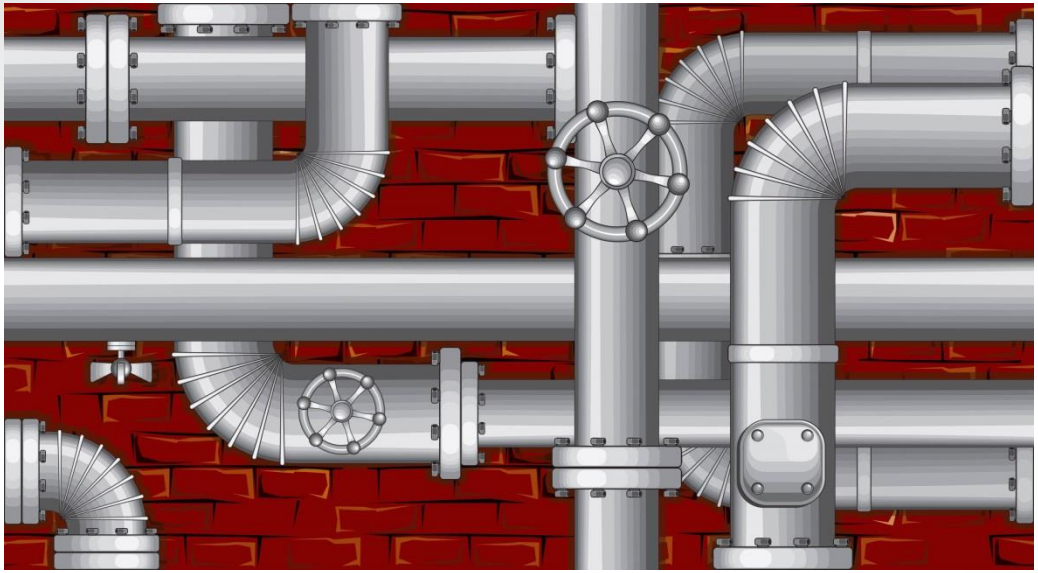


Common Devices for Redirection

1. ***/dev/stdout*** : Standard output device
2. ***/dev/stderr***: Standard error device
3. ***/dev/stdin***: Standard input device

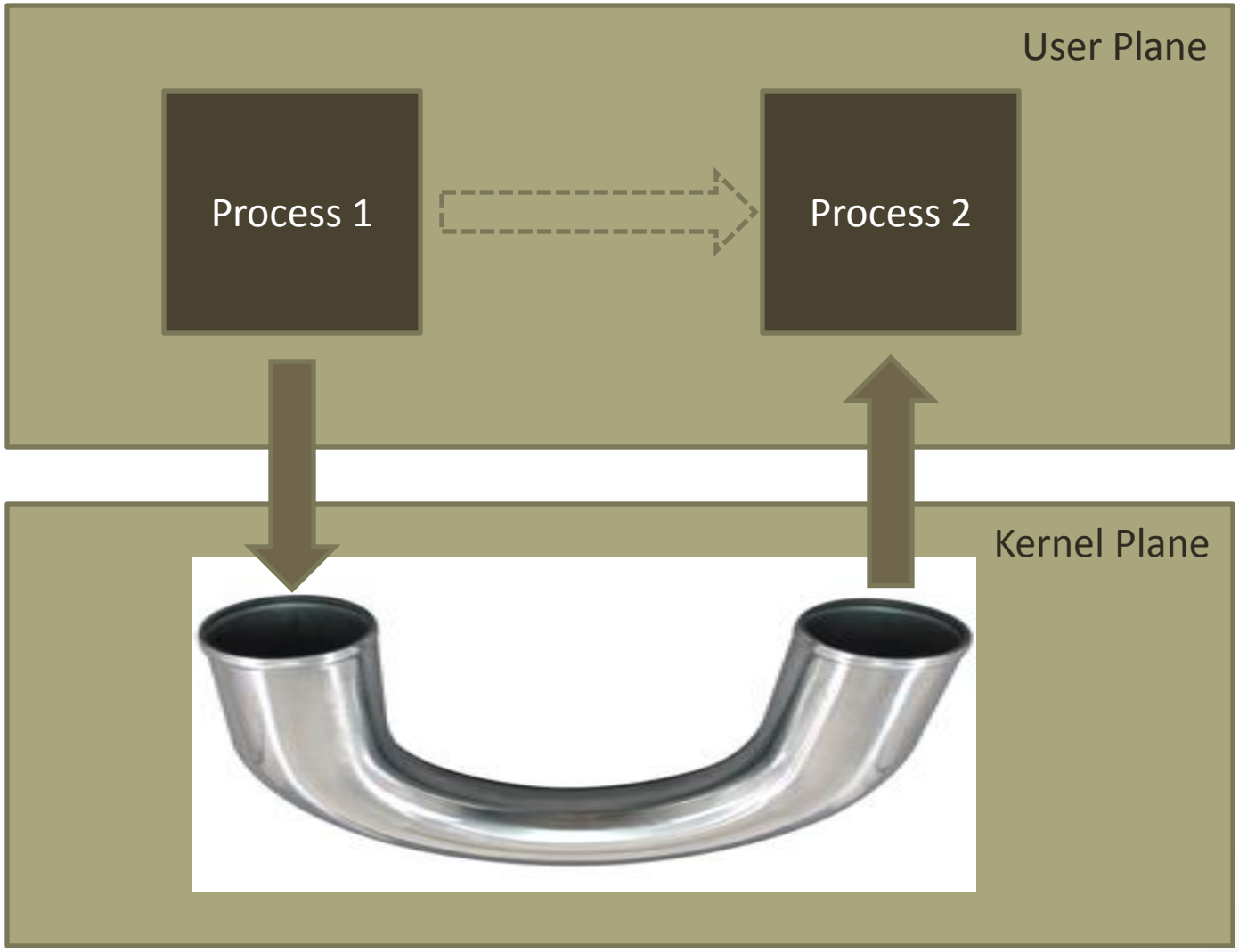
Default

4. ***/dev/null*** :
   This device is useful for being a data sink. This is useful when we want to discard the command output (such as compiler long output)
5. ***/dev/zero***
   This device is useful as an input device to generate and infinite stream of zeros
6. ***/dev/random***
   This device is useful as an input device to generate random bytes. It may block
7. ***/dev/urandom***
   This device is useful as an input device to generate quasi-random bytes. It is non blocking
8. ***/dev/full***
   This device is used as an output device to simulate a full file. It is used for testing purposes



5. USING PIPES

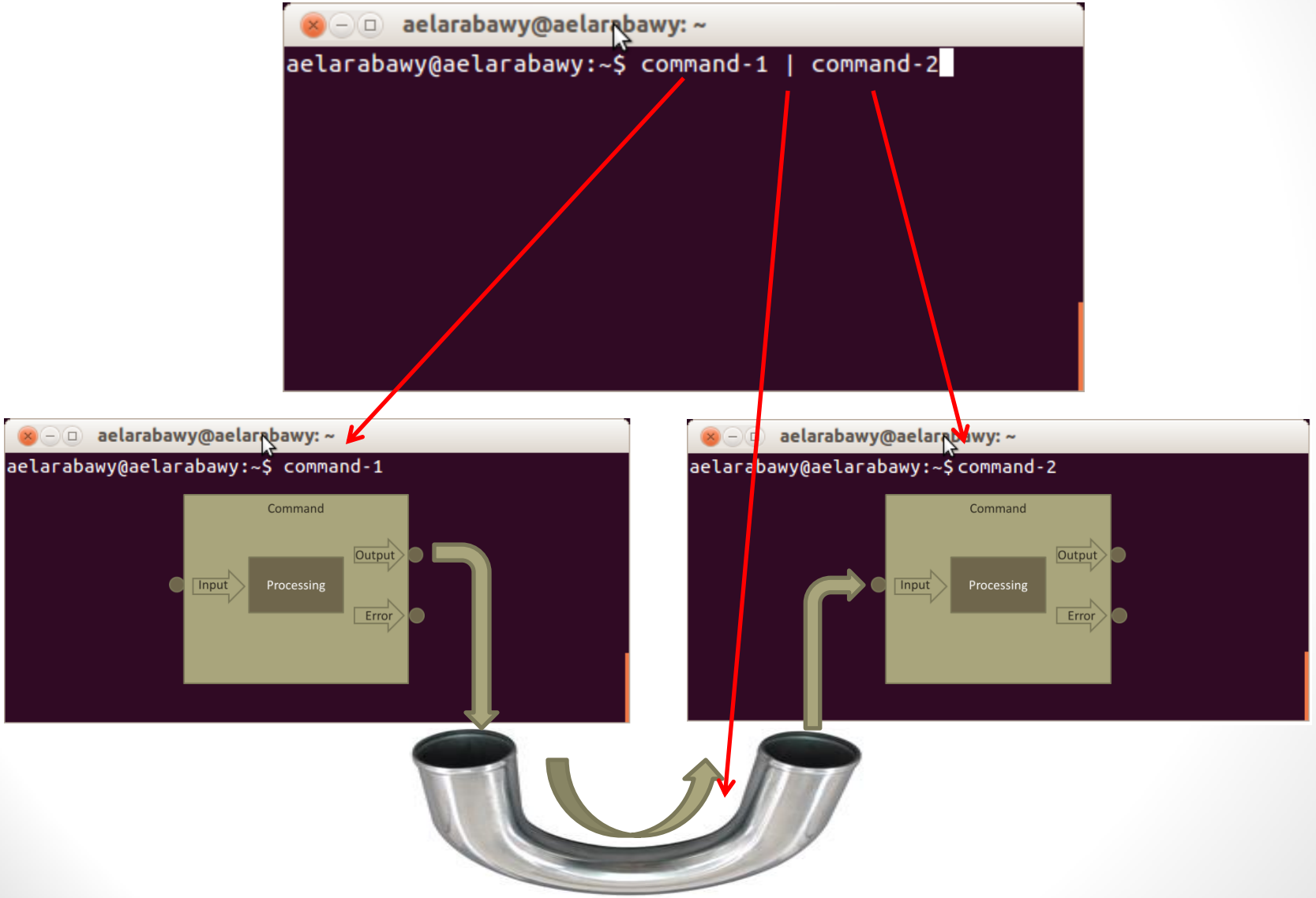
What is a Pipe ?



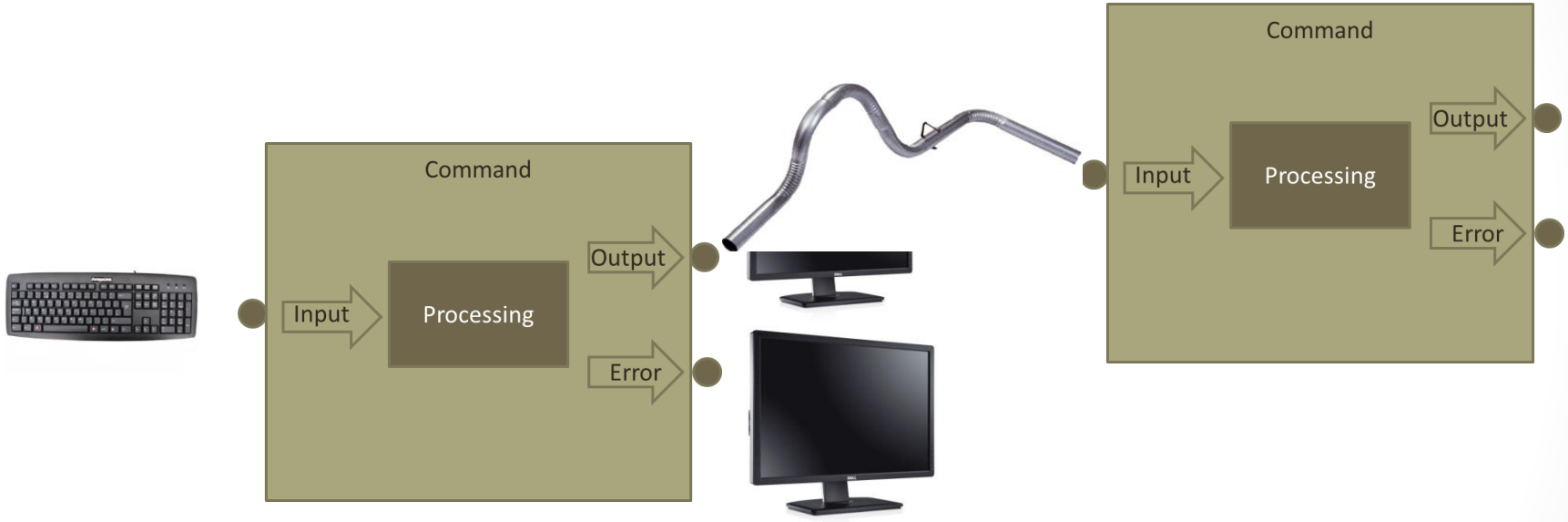
What is a Pipe ?

- A Pipe is a mechanism in Linux Kernel that is used to enable one process to send information to the other process
- This is called IPC (Inter Process Communication)
- A Pipe is a unidirectional mechanism, so if you need data to flow in both directions, you will need two pipes (One for each direction)

Using Pipes


aelarabawy@aelarabawy: ~
aelarabawy@aelarabawy:~$ command-1 | command-2
aelarabawy@aelarabawy: ~
aelarabawy@aelarabawy:~$ command-1
Command
Input
Processing
Output
Error
aelarabawy@aelarabawy: ~
aelarabawy@aelarabawy:~$ command-2
Command
Input
Processing
Output
Error

Using Pipes


Command
Input
Processing
Output
Error
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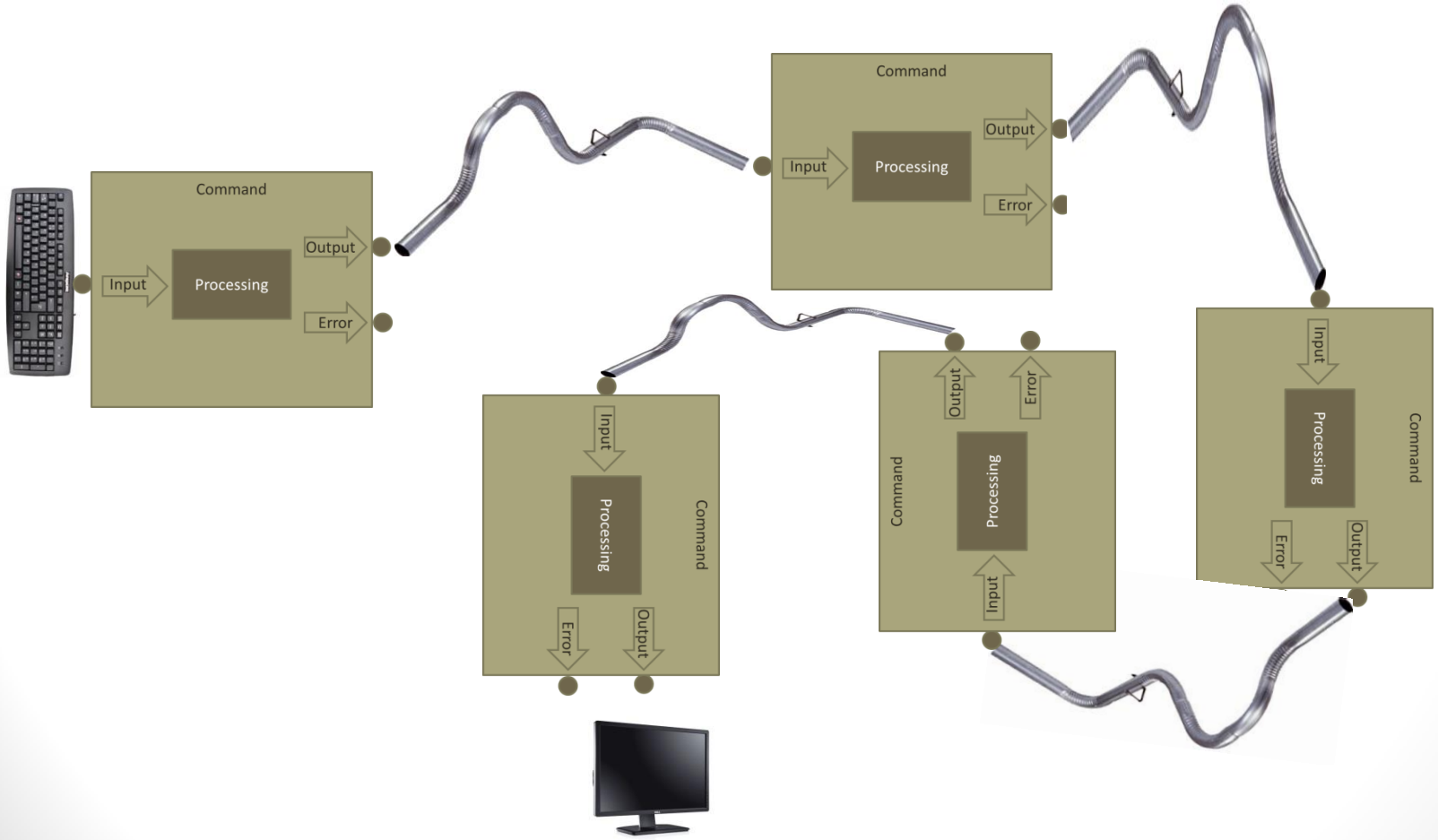
Using Pipes


Command
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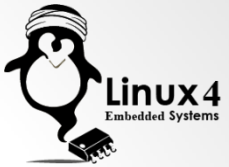
Using Pipes



- Pipes in Linux are a method for Communication between different processes (Inter-Process Communication)
- On the Command line Interface, we can run two commands and connect them with a pipe, so output of one command feeds in the input of another one
- Note that every command runs in a sub-shell of the shell issuing it (child shell)

Using Pipes

$ <command1 > | <command2> | <command3>

- Examples:

  $ cat log-file.log | grep "Error"

  $ man gzip | grep -i "compress"

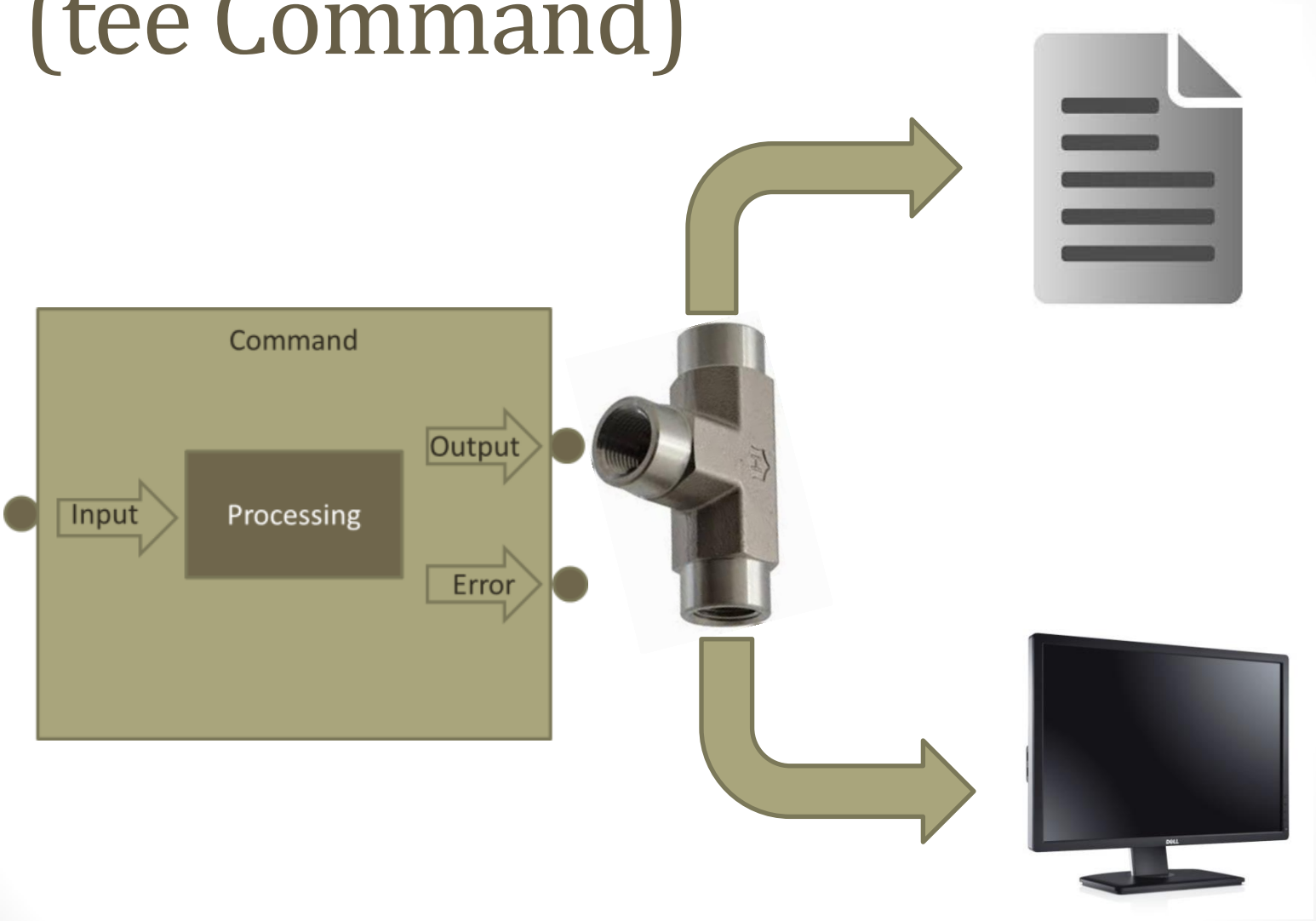
  $ cat log-file-1.log log-file-2.log | grep -i "error"

  $ cat name-list.txt | sort

  $ cat * | grep -i "error" | grep -v "severe" | sort > file.log

  $ cat resume | mail bill-gates@microsoft.com

More with Pipes (tee Command)



tee Command

<Command > | tee <list of Sinks>

The tee command sends the output to a set of files as well as the standard stdout (default is screen)

- Examples:

  $ make |tee make.out.txt (output to the screen and the file)

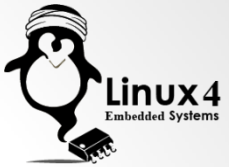
  $make |tee -a make.out.txt (same, but uses append mode)

  $ date | tee file1 file2 file3 file4 (date is sent to the 4 files & screen)

  $ make |tee make.out.txt >> file2 (output goes to make/out.txt and appends file2)

  $ make | tee make.out | grep "error"

More With Pipes (yes Command)



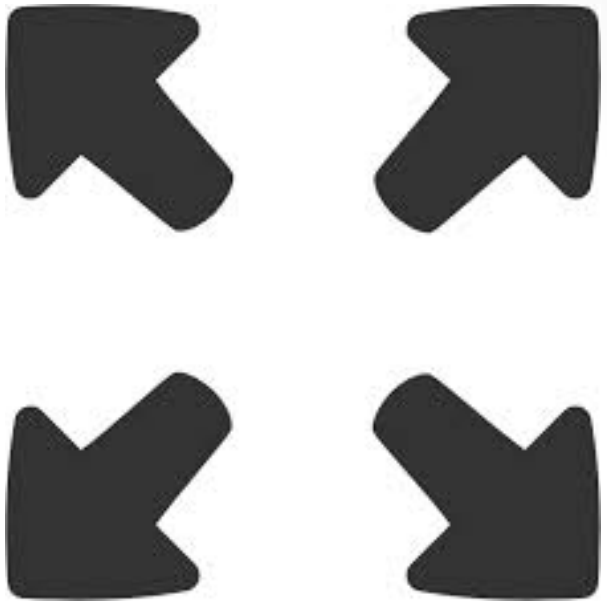
$ yes <string> |<command>

- The command “yes” passes a string to the command prompt
- The default string is “***y***”

Examples:

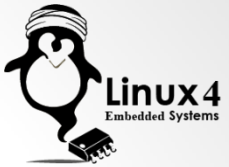
$ yes |rm -r ~/project-folder/

$ yes “ “ |make config (pass empty string to accept defaults)



6. COMMAND ARGUMENT EXPANSION

Commands Arguments Expansion Wild Card Expansion (*, ?, …)



- Discussed In a previous Lecture
- Applies for File and Directory names

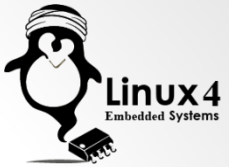
Examples:

$ cp * ../project/

$ cat * > log-files

$ echo *

Commands Arguments Expansion
Tilde Expansion (~)

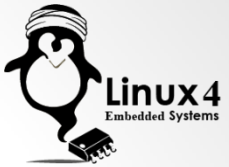


- The Tilde is expanded to the path of the user home folder ***/home/<username>***

Examples:

$ echo ~ ➔ /home/aelarabawy

Commands Arguments Expansion Parameter Expansion ($ and ${ })



The Parameter Expansion is used to evaluate shell or environment variables

Examples:

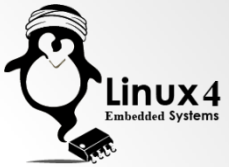
$ echo $PATH

$ echo ${PATH}

$ MY_NAME=TOM

$ echo "My Name Is $MY_NAME"

Commands Arguments Expansion Arithmetic Expansion ($(( )))



The Arithmetic Expansion is used to put arithmetic expressions to be evaluated

Examples:

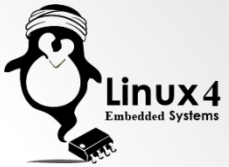
$ echo $((5 + 6)) ➔ 11

$ echo $((((5**2)) * 3)) ➔ 75

$ echo $((5 % 2)) ➔ 1

$echo $((5/2)) ➔ 2

Commands Arguments Expansion Brace Expansion ({ })



The Brace Expansion results in a set of values as described inside the braces

Examples:

$ echo abc-{A,B,C}def ➔ abc-Adef abc-Bdef abc-Cdef

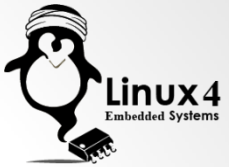
$ echo a{A{1,2} , B{3,4} }b ➔ aA1b aA2b aB3b aB4b

Similarly, you can use the expansions

{1..5}

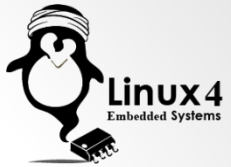
{A..Z}

{Z..A}



7. Command Argument Quoting

Commands Arguments Quoting Double Quotes (“ ”)



Double quotes,

- Protect strings (spaces, wild cards, tilde, ….)

  $ echo “*” ➔ *

- Protect from command substitution

  $ echo “ls” ➔ ls

- Protect from Arithmetic Expansion

  $ echo “ $((5 + 6)) “ ➔ $((5 +6))

- Does not stop variable retrieval

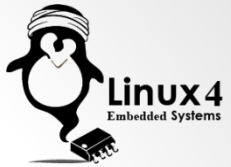
  $ echo “My Name Is $MY_NAME” ➔ My Name Is Tom

Examples:

$ echo “cp *.*” ➔ cp *.*

$ echo “$HOME” ➔ /home/aelarabawy

Commands Arguments Quoting Single Quotes (‘ ‘)



Single Quotes,

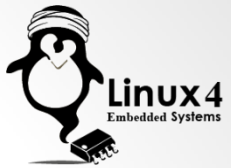
- Similar to double quotes except that it also protects variable retrieval

Examples:

$ echo ‘$PATH’ ➔ $PATH

$ echo ‘My Name Is $MY_NAME’ ➔ My Name Is $MY_NAME

Commands Arguments Quoting Back Quotes (` `)



Back Quotes are used to do commands inside commands/strings

Examples:

$ cd /lib/modules/`uname -r`

this is equivalent to

$ cd /lib/modules/3.11.0-15-generic

Can also be replaced by ***$(<command>)*** so,

`command` is the same as ***$(cmmand)***

Example:

$ cd /lib/modules/$(uname -r)

Other Examples:

$ pushd `pwd`

$ touch `date +%m-%d-%Y`

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