Warning: These notes are not complete, it is a Skelton that will be modified/add-to in the class. If you want to us them for studying, either attend the class or get the completed notes from someone who did

CSE2301

Unix/Linux
Introduction

These slides are based on slides by Prof. Wolfgang Stuerzlinger at York University

Introduction

- In this part, we introduce
  - OS (Linux)
  - File system
  - Shell commands
  - Pattern matching
  - Shell programming

Unix

- What does an OS do?
  - File management
  - Scheduling
  - Memory management
  - I/O management
- Examples

Unix

- OS includes
- Kernel: Performs key OS functions
- System programs: various tools
- Shell: Interface to the user

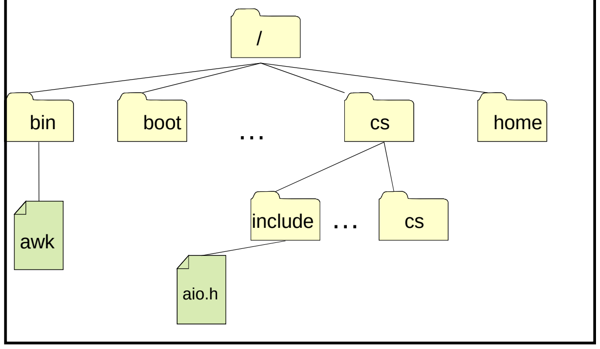
Processes

- Each program running is called a process
- Each process has its own identification PID
- If the program is running twice, even by the same user, these are 2 different processes.

File System

- In Unix, the files are organized into a tree structure with a root named by the character '/'.
- Everything in the file system is a file or subdirectory

Our File System



File System

- File names could be relative (with respect to the current directory) or using full path name (relative to /) for example aio.h or /cs/include/aio.h
- Your home directory is ~username, so in my case ~aboelaze/test.c is equivalent to /cs/home/aboelaze/test.c

Devices

- /dev contains devices, just like any other file (fopen, fread, fwrite, ..) but it communicate with a device.
- /dev/tty
- /dev/null
- /dev/zero

Unix Commands

- ls cp mv rm mkdir cd pwd cat less more head tail ….
- bg, fg, CTRL-C, CTRL-Z
- kill ps od diff ln echo …
- Redirection and pipes Examples

```
• tigger 215 % ls –las
• total 44
• 4 drwx------  2 aboelaze faculty 4096 Nov 29 13:44 ./
• 4 drwx------  9 aboelaze faculty 4096 Nov 29 14:47 ../
• 4 -rw-------  1 aboelaze faculty  184 Nov 18 13:30 data
• 4 -rw-------  1 aboelaze faculty   23 Nov 28 19:52 file1
• 4 -rw-------  1 aboelaze faculty   24 Nov 28 19:52 file2
• 4 -rw-------  1 aboelaze faculty  481 Nov 29 12:27 mergefiles.awk
• 4 -rw-------  1 aboelaze faculty  178 Nov 28 19:32 p1
• 4 -rw-------  1 aboelaze faculty 1245 Nov 18 13:29 prchecks.awk
• 4 -rw-------  1 aboelaze faculty   83 Nov 14 17:46 t
• 4 -rwx------  1 aboelaze faculty   35 Nov 21 13:08 test.sh*
• 4 -rw-------  1 aboelaze faculty   50 Nov  1 18:31 unmatched
• chmod 744 file   What does it mean?
• chmod [ugo][+-][rwx]      chmod ug+rw p1
```

Basic UNIX Commands

- ls, cp, mv, rm, mkdir, cd, pwd
- cat, more, less, head, tail
- diff, who, date, ps, kill, od, du, cal
- chmod, chgrp, pipeline
- Redirection
  - command >file
  - commnad >>file
  - command <file >file1

Sequence of Commands

- command1; command2
- (command1; command2) what is the difference
- command1 && command2
- command1 || command2

Quotations mark

- ddouble quote some characters
- Single quote -- ,No evaluation
- back quote – execute command
- x= this is true
- x="this is true"
- echo $x
- echo "$x"
- echo '$x'

Shell Pattern Matching--Wild Cards

- The character * matches any string of characters
- ? Matches a single character
- [0-9] matches any digit
- [a-z] matches any small case letter
- [abc] x[ab]y matches xay and xby
- \c matches c only
- a|b matches a or b **in case expression only**

Shell Variables

- set x = 3 -- csh
- x=3 -- sh (no spaces around the “=“)
- echo x
- echo $x what is the difference
- B=5 C=3 D=2 -- That is O.K.
- Valid variables begin with a letter, contains letters, numbers and _ a5_6

PATH path

- The shell searches in PATH looking for the command you typed
- echo $PATH .:/usr/local/bin:/usr/ucb: /usr/bin /usr/etc:/etc:/bin:/usr/bin/X11
- set path = ($path /a/b/c) --csh
- PATH=$PATH:/a/b/c --sh
- Aliases and startup files

Shell scripting

```
#!/cs/local/bin/sh
echo “Hello World”
```

```
tigger 397 % script1
Hello World
tigger 398 %
```

```
echo -n “Hello
World”
```

```
tigger 393 % script1
Hello Worldtigger 394 %
```

```
#!/cs/local/bin/sh
echo "Now I will guess your OS"
echo -n "Your OS is : "
uname
```

```
tigger 399 % script1
Now I will guess your OS
Your OS is : Linux
tigger 400 %
```

Shell Scripting

```
#!/cs/local/bin/sh
echo -n "Please enter your first name : "
read FNAME
echo -n "Last name pelase : "
read LNAME
MESSAGE=" Your name is : $LNAME , $FNAME"
echo "$MESSAGE"
```

```
tigger 439 % script3
Please enter your first name : Mokhtar
Last name pelase : Aboelaze
 Your name is : Aboelaze , Mokhtar
```

Shell Scripting

```
#!/cs/local/bin/sh
read FNAME
echo "1-> $FNAME123"
echo "2-> ${FNAME}123"
```

```
tigger 454 % script4
abcd
1->
2-> abcd123
tigger 455 %
```

Shell Scripting

```
# Set the initial value.
myvar=abc
echo "Test 1 ======"
echo $myvar        # abc
echo ${myvar}      # same as above, abc
echo {$myvar}      # {abc}

echo "Test 2 ======"
echo myvar         # Just the text myvar
echo "myvar"       # Just the text myvar
echo "$myvar"      # abc
echo '$myvar'
echo "\$myvar"     # $myvar

echo "Test 3 ======"
echo $myvardef     # Empty line
echo ${myvar}def   # abcdef
```

```
$ sh var_refs
Test 1 ======
abc
abc
{abc}

Test 2 ======
myvar
myvar
Abc
$myvar
$myvar

Test 3 ======

abcdef
```

Shell Scripting

```
echo "Test 4 ======"
echo $myvar$myvar      # abcabc
echo ${myvar}${myvar}  # abcabc
echo "Test 5 ======"
# Reset variable value, with spaces
myvar=" a   b    c"
echo "$myvar"          # a   b    c
echo $myvar            # a b c
```

```
Test 4 ======
abcabc
abcabc
Test 5 ======


 a   b    c
a b c
```

Special variables

- Special variables starts with $
- $?   The exit status of the last command
- $$ The process id of the shell
- $*   String containing list of all arguments
- $#   Number of argument
- $0   Command line

Special Substitution

- Various special substitutions:
- **${**_name_**-**_word_**}** - value of _name_ if it exists,
- otherwise “_word_”
- **${**_name_**+**_word_**}** - “_word_” if _name_ exists, blank otherwise
- **${**_name_**=**_word_**}** - if _name_ does not exist, sets
- variable _name_ to _word_, substitutes value of _name_
- ***${****name****?****word****}*** - if _name_ does not exist then prints an error (“_word_”) then exits shell - otherwise substitutes value of _name_

Special substitution

- aboelaze@indigo echo ${v-goodbye}
- goodbye
- aboelaze@indigo v=Hello
- aboelaze@indigo echo ${v-goodbye}
- Hello
- aboelaze@indigo

Read

- So if stdin has '*hello there world*'
- **read a b c**
- (a = 'hello', b = 'there', c = 'world')
- **read a b**
- (a = 'hello', b = 'there world')
- **read a b c d**
- (a = 'hello', b = 'there', c = 'world', d is empty)

Read

- **read** with just one argument assigns entire line
- **read x**
- This reads a line from stdin and puts it in 'x'.
- **read** is a built-in command with an exit status of 0 on success, or non-zero on failure or EOF
- When reading input, **read** by defaults separates words by space and tab characters
- Can change separator by setting the environment
- variable **IFS**:
- • **IFS=:**

read

```
aboelaze@indigo read x
Hello and goodbye
aboelaze@indigo echo $x
Hello and goodbye
aboelaze@indigo read x y
hello and goodbye
aboelaze@indigo echo $x
hello
aboelaze@indigo echo $y
and goodbye
aboelaze@indigo
```

Arithmetic operations

- Does this work?
- x=5
- y=$x+1 ## echo $y → 5+1
- y=$x + 1 ## + command not found
- $ z=5
- $ z=`expr $z+1` ---- Need spaces around + sign.
- $ echo $z 5+1 $ z=`expr $z + 1`
- $ echo $z 6

Arithmetic Operations

- **expr** command supports only integer arithmetic.
- **sum=`expr $a + $b`** SPACES !@#$
- **diff=`expr $a - $b`**
- **prod=`expr $a \* $b`**
- **quot=`expr $a / $b`**
- **remind=`expr $a % $b`**