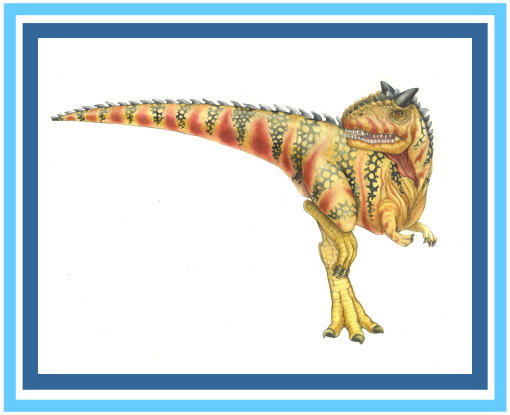
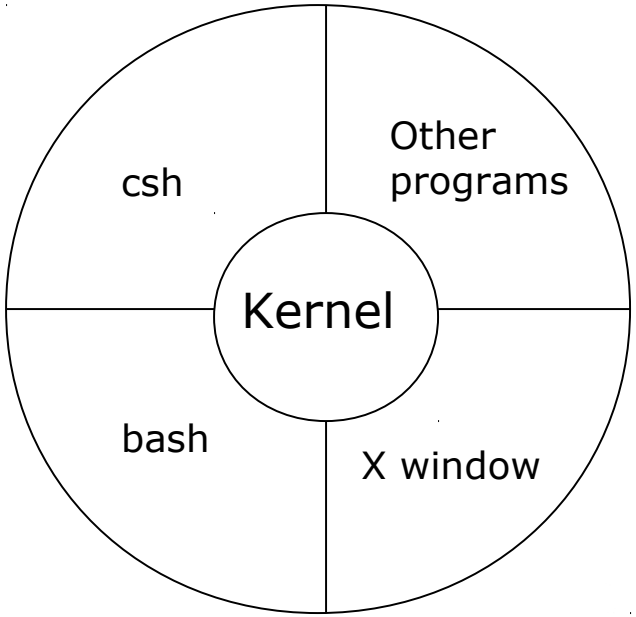
# Chapter 2: Scripting



# What is Shell?

- Shell is the interface between end user and the Linux system, similar to the commands in Windows
- Bash is **NOT ALWAYS** installed as in /bin/sh
- Check the version

```
% /bin/sh --version
% /bin/bash --version
```



# Pipe and Redirection

- Redirection (< or >)
  - `% ls -l > lsoutput.txt` (save output to lsoutput.txt)
  - `% ps >> lsoutput.txt` (append to lsoutput.txt)
  - `% more < killout.txt` (use killout.txt as parameter to more)
  - `% kill -l 1234 > killouterr.txt 2 >&1` (redirect to the same file)
  - `% kill -l 1234 >/dev/null 2 >&1` (ignore std output)
- Pipe (|)
  - Process are executed *concurrently*
  - `% ps | sort | more`
  - `% ps -xo comm | sort | uniq | grep -v sh | more`
  - `% cat mydata.txt | sort | uniq | > dummy.txt` (generates an empty file !)

# Some Command-Lines

```
echo        print out a string
            echo "$HOME is where I want to be"

cat         Output specified files in sequence
            cat file1 file2 file3

whereis     Show where a file can be found

printenv    Display all environment variables

grep        Get Regular Expression and Print

head        first few lines of output
            head -5 filename

tail        last few lines of output
            tail -8 filename
```

# More Commands

```
$ pwd
$ ls
$    ls file; ls directory ; ls -a ; ls -l ; ls -R
$ cd
$   cd ..
$   cd /home/tim/projects
$   cd ~/projects
$   cd ~tim/projects
$   cd $HOME/projects
$ mkdir make-a-directory
$ rmdir a-directory
$ mv
$   mv oldfilename newfilename
$   mv file1 file2 file3 newtargetdirectory
$ cp
$   cp -r dir1 dir1copy
$ rm
$ pushd
$ pop
$ find
$   find . -ls
$   find . -type d -print
$   find . -type f -exec "echo" "{}" ";"
```

# Shell as a Language

- We can write a script containing many shell commands
- Interactive Program:
  - grep files with POSIX string and print it

```
% for file in *
> do
> if grep -l POSIX $file
> then
> more $file
> fi
> done
Posix
There is a file with POSIX in it
```

  - '*' is wildcard

```
% more `grep -l POSIX *`
% more $(grep -l POSIX *)
```

# Writing a Script

- Use text editor to generate the “first” file

```
#!/bin/sh
# first
# this file looks for the files containing POSIX
# and print it
for file in *
do
   if grep -q POSIX $file
   then
      echo $file
   fi
done
exit 0
```

```
% /bin/sh first
% chmod +x first
%./first (make sure . is include in PATH parameter)
```

# Variables

- Variables needed to be declared, note it is case-sensitive (e.g. foo, FOO, Foo)
- Add '$' for storing values

```
% salutation=Hello
% echo $salutation
Hello
% salutation=7+5
% echo $salutation
7+5
% salutation="yes dear"
% echo $salutation
yes dear
% read salutation
Hola!
% echo $salutation
Hola!
```

# Quoting

- Edit a “vartest.sh” file

```
#!/bin/sh

myvar=“Hi there”

echo $myvar
echo “$myvar”
echo `$myvar`
echo \$myvar

echo Enter some text
read myvar

echo ‘$myvar’ now equals $myvar
exit 0
```

**Output**

```
Hi there
Hi there
$myvar
$myvar
Enter some text
Hello world
$myvar now equals Hello world
```

# Environment Variables

- $HOME — home directory
- $PATH — path
- $SHELL — which shell
- $PS1 — The first layer prompt (normally %)
- $PS2 — The second layer prompt (normally >)
- $0 — name of the script file
- $n — argument n
- $$ — process id of the script (current PID)
- $! — last PID
- $? — exit code
- $# — number of input parameters
- $* — all arguments as one list
- $@ — all arguments as separated lists
- $IFS — separation character (white space)
- Use ‘env’ to check the value

# Condition

- test or ‘ [ ‘

```
if test -f fred.c
then
...
fi

if [ -f
fred.c ]
then
...
fi

if [ -f fred.c ];then
...
fi
```

# Example 1

```
$ vi coba1.sh
#! /bin/bash
for VAR in Satu Dua Tiga Empat
do
     echo $VAR
done
exit 0

$ chmod +x coba1.sh
$./coba1.sh
Satu
Dua
Tiga
Empat
```

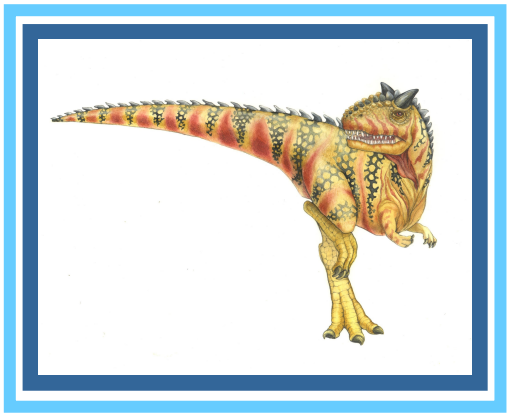
# Example 2

```
$ vi coba2.sh
$ chmod 755 coba2.sh
$ ./coba2.sh 1 2 3

#!/bin/bash
echo "Ini PID[$$] dengan $# ARGUMEN YAITU:"
echo "(satu list)  $*"
for VAR in "$*" ; do echo $VAR ; done

echo "(satu per satu)  $@"
for VAR in "$@"
do
   echo $VAR
done
exit 0
```

# coba.sh

```
$ ./coba2.sh 1 2 3

Ini PID[4857] dengan 3 ARGUMEN YAITU:
(satu list)  1 2 3
1 2 3
(satu per satu)  1 2 3
1
2
3
```

# End of Scripting



# More Scripting

A modification of Don Towsley's file which has been downloaded from the net a long-long time ago. Sorry...

Rev 2014-02-24-03

# Commands for programmers

| | |
|---|---|
| – man | Man pages |
| – time | How long your program took to run |
| – date | print out current date/time |
| – test | Compare values, existence of files, etc |
| – tee | Replicate output to one or more files |
| – diff | Report differences between two files |
| – sdiff | Report differences side-by-side |
| – wc | Show number of lines, words in a file |
| – sort | Sort a file line by line |
| – gzip | Compress a file |
| – gunzip | Uncompress it |

# Administrative Tools

- `wc`
  - count the number of characters, words and lines
- `cat`
  - display the contents of a file or join files
- `more` and `less`
  - Display the contents of a file a page at a time
- `head`
  - display the first few lines of a file
- `tail`
  - Display the last few lines of a file

- `sort`
  - sort the content of a file into order
- `uniq`
  - Remove duplicate lines from a file
- `cut`
  - remove columns of characters from a file
- `paste`
  - join columns of files together
- `tr`
  - translate specific characters
- `split`
  - split files evenly

# Job control

- Start a background process:
  - program1 &
  - program1
    *Hit* CTRL-Z
    bg
- Where did it go?
  - jobs
  - ps
- Terminate the job: kill it
  - kill %*jobid*
  - kill *pid*
- Bring it back into the foreground
  - fg %1
- Start a job in the future
  - at

# Kill: send signals

- When to use
  - Terminate a process, sending TERM
  - Send any signals.
  - Syntax

    kill [-signal] pid

    Note: pid = -1 may mean all process except system processes and the current shell. See man pid for more options.
  - Kill pid
    - Can be caught, blocked and ignored
  - kill –9 pid
    - Guarantee the process die?

# Pipelines

- Pipes take the output of the first program and feed that output into the input of the next program.
- Also sometimes known as “filters”.
- Examples:

```
last | less

last | grep ^root | less

last | grep ^root | cut -d -f 2 | less

grep “error” something.out | tail -1
```

# Redirection: < >

- >&*filename* redirects the standard output and error to the file called *filename*:
```
last | grep ^root  >& root-logins.txt
less root-logins.txt
```
- >*filename* redirects just standard output
- Don't Clobber me! By default, > will overwrite existing files, but you can turn this off using shell settings and/or environment variables.
- Appendicitis! You can append to existing files this way:
  - *sh: >>filename >&1*
  - *csh: >>&filename*
- Use < to redirect a file to a command's *standard input*
```
# cat calculation.txt
(3+2)*8
# bc < calculation.txt
40
```
- Useful when a program does not already query the command line for files to read

# Pipelining into awk

- Manipulate the output of another command
- Picking out the columns

  Example:

  - List the users that run dooms.

```
$ps –ef | grep "[d]oom" | awk '{print $1}'
```

  - Create a file to store the users that run dooms, include the data, cpu time

```
$ (date ; ps –ef | grep "[d]oom" | awk
  '{print $1 " [ " $7 "]" }' | sort | uniq)
  >> doomed.users
```

# Conditional Execution

- program1 && program2
  - Program 2 will execute if and only if program1 exited with a 0 status
  - Example:
    - project1 && echo “Project1 Finished correctly!”
- program1 || program2
  - Program 2 will execute if and only if program1 exited with a *non*-0 status
  - Example:
    - project1 || echo “Project1 FAILED to complete!”
- Exit a script with an error:
    - exit 1

# FIND

- Find locates files having certain characteristics on where you tell it to look.
- Basic syntax

  #find starting-dir(s) criteria-and-action
- Matching criteria
- Action
  - What to do with the files matches all the criteria

| | |
|---|---|
| -atime n | File was last accessed n days ago |
| -mtime n | File was last modified exactly n days ago |
| -newer file | File was modified more recently |
| -size n | File is exactly n 512-byte blocks long |
| -type c | Specifies file typeL f, d |
| -name nam | The filename is nam |
| -perm p | The file's access mode is p |
| -user usr | The file's owner is usr |
| -group grp | The file's group owner is grp |
| -nouser | The file's owner is not listed |
| -nogroup | The file's group owner is not listed |

- Use +, - to indicate more than, less than
  - -mtime +7  last modified more than 7 days ago
  - -atime –2  last accessed less than 2 days ago
  - -size +100  larger than 50k
- Use wildcards with –name option
  - -name “*.dat”
- Join more condition together
  - Or relation -o

    \( -atime +7 –o –mtime +30 \)
  - Not relation !

    ! –name gold.dat –name *.dat

- Check for a specific access mode with –perm
  - Exact permission
    - -perm 75
  - At least permission with “‘-” sign
    - -perm –002  world writable
    - -perm –4000  SUID access is set
    - -perm –2000  SGID access is set

| option | Meaning |
| --- | --- |
| -print | Display pathname of matching file |
| -ls | Display long directory listing for matching files |
| -exec cmd | Execute command on file |
| -ok cmd | Prompt before executing command on file |
| -xdev | Restrict the search to the file system of the starting directory |
| -prune | Don't descend into directories encountered |

- Default is –print
  - Example: $ find . –name *.c -print
- -exec and –ok must end with \;
- {} may be used in commands as a placeholder for the pathname of each found file.
  - -exec rm –f {} \;

# FIND (examples):

- The usage of find for administration
  - Monitoring disk usage
  - Locating file that pose potential security problems
  - Performing recursive operations
- Example:

```
$find /chem -size +2048 -mtime +30 -exec ls -l {} \;
$find /chem -size +2048 \( -mtime +30 -o -atime +120 \) -ls
$find / \( -perm -2000 -o -perm -4000\) -print | diff - files.secure
$find /chem -name '*.c' -exec mv {} /chem1/src \;
```

# Shell programming

- When you create a shell script using a editor
  - does it have execute permission typically?
  - Example

```
$ ./test
./test: Permission denied.
$ ls -l test
-rw------- 1 user user 22Jan08 test
$ chmod +x test
$ ./test
this is a test
```

# Bourne Shell Programming

- Control structures
  - if … then
  - for … in
  - while
  - until
  - case
  - break and continue

# if … then

- Structure

  if ***test-command***

  then

  ***commands***

  fi

Example:

```
if test  "$word1"  =  "$word2"
     then
          echo "Match"
 fi
```

# test

- Command test is a built-in command
- Syntax

```
test expression
[ expression ]
```

  - The test command evaluate an expression
  - Returns a condition code indicating that the expression is either true (0) or false (not 0)
- Argument
  - Expression contains one or more criteria
    - Logical AND operator to separate two criteria: -a
    - Logical OR operator to separate two criteria: -o
    - Negate any criterion: !
    - Group criteria with parentheses
  - Separate each element with a SPACE

# Test Criteria

- Test Operator for integers: int1 relop int2

| Relop | Description |
|---|---|
| -gt | Greater than |
| -ge | Greater than or equal to |
| -eq | Equal to |
| -ne | Not euqal to |
| -le | Less than or equal to |
| -lt | Less than |

# Exercise

- Create a shell script to check there is at least one parameter
  - Something like this:

```
...
if test $# -eq 0
   then
        echo "Supply at least one argument"
        exit  1
 fi
...
```

# Test Criteria

- The test built-in options for files

| Option | Test Performed on file |
|---|---|
| -d filename | Exists and is a directory file |
| -f filename | Exists and is a regular file |
| -r filename | Exists and it readable |
| -s filename | Exists and has a length greater than 0 |
| -u filename | Exists and has setuid bit set |
| -w filename | Exists and it writable |
| -x filename | Exists and it is executable |
| … … | … … |

# Exercise

- Check weather or not the parameter is a non-zero readable file name
  - Continue with the previous script and add something like

```
if [ -r  “$filename” –a –s “$filename” ]
then
        … …
fi
```

# Test Criteria

- String testing

| Criteria | meaning |
|---|---|
| String | True if string is not the null string |
| -n string | True if string has a length greater than zero |
| -z string | True if string has a length of zero |
| String1 = string2 | True if string1 is equal to string2 |
| String1 != string2 | True if string1 is not equal to string2 |

# Exercise

- Check users confirmation
  - Frist, read user input

```
echo  -n "Please confirm: [Yes | No] "
read user_input
```

  - Then, compare it with standard answer 'yes'

```
if  [  "$user_input"  =  Yes  ]
then
        echo "Thanks for your confirmation!"
fi
```

  - What will happen if no "" around $user_input and user just typed return?

# if…then…else

- Structure

```
if test-command
   then
      commands
   else
      commands
fi
```

  - You can use semicolon (;) ends a command the same way a NEWLINE does.

```
if [ …  ]; then
   … …
fi

if [ 5 = 5 ]; then echo "equal"; fi
```

# if…then…elif

- Structure

```
if test-command
   then
      commands
   elif test-command
      then
            commands
    .
    .
    .
      else
            commands
fi
```

# Debugging Shell Scripts

- Display each command before it runs the command
  - Set the –x option for the current shell
    - $set –x
  - Use the –x to invoke the script
    - $sh –x command arguments
    - **`sh -x coba 1 2 3 4`**
  - Add the set command at the top of the script
    - set –x
- Then each command that the script executes is preceded by a plus sign (+)
  - Distinguish the output of trace from any output that the script produces
- Turn off the debug with set +x

# for… in

- Structure

  for ***loop-index*** in ***argument_list***

  do

  ***commands***

  done

Example:

```
for  file in *
 do
      if [ -d "$file" ]; then
          echo $file
      fi
  done
```

# for

- Structure

```
for loop-index
do
    commands
done
```

  - Automatically takes on the value of each of command line arguments, one at a time. Which implies

```
for arg in "$@"
```

# while

- Structure

```
while test_command
do
    commands
done
```

Example:

```
while [ "$number" -lt 10 ]
do
    … …
    number=`expr $number + 1`
done
```

# until

- Structure

  until ***test_command***
  do
  ***commands***
  done

Example:

```
secretname=jenny
 name=noname
 until  [ "$name" = "$secretname" ]
 do
         echo " Your guess: \c"
         read name
 done
```

# break and continue

- Interrupt for, while or until loop
- The break statement
  - transfer control to the statement AFTER the done statement
  - terminate execution of the loop
- The continue statement
  - Transfer control to the statement TO the done statement
  - Skip the test statements for the current iteration
  - Continues execution of the loop

# Example:

```
for index in 1 2 3 4 5 6 7 8 9 10
do
        if [ $index –le 3 ]; then
            echo continue
            continue
        fi
        echo $index
        if  [ $index –ge 8 ]; then
            echo “break”
            break
        fi
 done
```

# case

- Structure

```
case  test_string in
pattern-1 )
        commands_1
        ;;
pattern-2 )
        commands_2
        ;;
… …
esac
```

- default case: catch all pattern

```
* )
```

# case

- Special characters used in patterns

| Pattern | Matches |
|---|---|
| * | Matches any string of characters. |
| ? | Matches any single character. |
| [...] | Defines a character class. A hyphen specifies a range of characters |
| \| | Separates alternative choices that satisfy a particular branch of the case structure |

# Example

```
#!/bin/sh
 echo "\n Command MENU\n"
 echo " a. Current data and time"
 echo " b. Users currently logged in"
 echo " c. Name of the working directory\n"
 echo "Enter a,b, or c:  \c"
 read answer
 echo
 case "$answer" in
    a)
         date
         ;;
    b)
         who
         ;;
    c)
         pwd
         ;;
     *)
         echo "There is no selection: $answer"
          ;;
esac
```

# echo and read

- The backslash quoted characters in echo
  - \c suppress the new line
  - \n new line
  - \r return
  - \t tab
- Read
  - read variable1 [variable2 …]
    - Read one line of standard input
    - Assign each word to the corresponding variable, with the leftover words assigned to last variables
    - If only one variable is specified, the entire line will be assigned to that variable.

# Built-in: exec

- Execute a command:
  - Syntax: exec command argument
  - Run a command without creating a new process
    - Quick start
    - Run a command in the environment of the original process
    - Exec does not return control to the original program
    - Exec can be the used only with the last command that you want to run in a script
    - Example, run the following command in your current shell, what will happen?

```
$exec who
```

# Built-in: exec

- Redirect standard output, input or error of a shell script from within the script
  - exec < infile
  - exec > outfile 2> errfile

- Example:

```
sh-2.05b$ more redirect.sh
exec > /dev/tty
echo "this is a test of redirection"

sh-2.05b$ ./redirect.sh 1 > /dev/null 2 >& 1
this is a test of redirection
```

# Catch a signal: builtin trap

- Built-in trap
  - Syntax: trap ‘commands’ signal-numbers
  - Shell executes the commands when it catches one of the signals
  - Then resumes executing the script where it left off.
    - Just capture the signal, not doing anything with it

      trap ‘ ‘ signal_number
  - Often used to clean up temp files
  - Signals
    - SIGHUP 1 disconnect line
    - SIGINT 2 control-c
    - SIGKILL 9 kill with -9
    - SIGTERM 15 default kill
    - SIGSTP 24 control-z
    - …

# Example

```
$ more inter
#!/bin/sh
trap 'echo PROGRAM INTERRUPTED' 2
while true
do
        echo "programming running."
        sleep 1
done
```

# A partial list of built-in

- bg, fg, jobs — job control
- break, continue — change the loop
- cd, pwd — working directory
- echo, read — display/read
- eval — scan + evaluate the command
- exec — execute a program
- exit — exit from current shell
- export, unset — export/ remove a val or fun
- test — compare arguments

# A partial list of built-in

- kill sends a signal to a process or job
- set sets flag or argument
- shift promotes each command line argument
- times total times for the current shell
- trap traps a signal
- type show if command, build-in, or function
- umask file creation mask
- wait waits for a process to terminate.
- ulimit the value of one/more resource limits

# functions

- A shell function is similar to a shell script
  - It stores a series of commands for execution at a later time.
  - The shell stores functions in the memory
  - Shell executes a shell function in the same shell that called it.
- Where to define
  - In .profile
  - In your script
  - Or in command line
- Remove a function
  - Use unset built-in

# functions

- Syntax

```
function_name()
   {
      commands
   }
```

- Example:

```
sh-2.05b$ whoson()
> {
> date
> echo "users currently logged on"
> who
> }
sh-2.05b$ whoson
Tue Feb  1 23:28:44 EST 2005
users currently logged on
ruihong  :0          Jan 31 08:46
ruihong  pts/1       Jan 31 08:54 (:0.0)
ruihong  pts/2       Jan 31 09:02 (:0.0)
```

# Example

```
sh-2.05b$ more .profile
setenv()
{
   if [ $# -eq 2 ]
   then
     eval $1=$2
     export $1
   else
     echo "usage: setenv NAME VALUE" 1>&2
   fi
}
sh-2.05b$. .profile
sh-2.05b$ setenv T_LIBRARY /usr/local/t
sh-2.05b$ echo $T_LIBRARY
/usr/local/t
```

# sed, awk, regex

cut and pasted from the net

rev. 2014-02-24-03

# sed description

- pattern a text → add to output
- address s /regex/replacement/
- address d → delete line
- delete lines 1-10: `sed -e '1,10d‘`
- delete comments: `sed -e '/^#/d‘`
- print only matching:

```
sed -n -e '/regexp/p'
```

- convert Unix to DOS:

```
sed -e 's/$/\r/' myunix.txt > mydos.txt
```

# awk

- Special-purpose language for line-oriented pattern processing
- pattern {action}
- action =
  - if (conditional) *statement* else *statement*
  - while (conditional) statement
  - break
  - continue
  - variable=expression
  - print expression-list

# Examples (1)

```
$ awk '{ print $0 }' /etc/passwd
$ awk '{ print "" }' /etc/passwd
$ awk '{ print "hiya" }' /etc/passwd
$ awl -f file.awk /etc/passwd

file.awk:
BEGIN  { FS=":" }
END    { print “xxxxxxxxxxxxxxxxxxxx” }
/user/ { print }
/[0-9]+.[0-9]*/ { print }
{ print $1 }
```

# Examples (2)

- Print first two fields in opposite order

```
awk '{ print $2, $1 }' file
```

- Print lines longer than 72 characters:

```
awk 'length > 72' file
```

- Print length of string in 2nd column

```
awk '{print length($2)}' file
```

- Add up first column, print sum and average

```
{ s += $1 }
END {
    print "sum is",s," average is", s/NR
}
```

# Examples (3)

- Print fields in reverse order

```
awk '{ for (i=NF; i > 0; --i) print $i }' file
```

- Print the last line

```
{line = $0}
END {print line}
```

- Print the total number of lines of word "Pat"

```
/Pat/ {nlines = nlines + 1}
END {print nlines}
```

# Examples (4)

- Print all lines between start/stop pairs

  **awk '/start/, /stop/' file**
- Print all lines whose first field is different from previous one

  **awk '$1 != prev { print; prev = $1 }' file**
- Print column 3 if column 1 > column 2

  **awk '$1 > $2 {print $3}' file**
- Print line if column 3 > column 2

  **awk '$3 > $2' file**

# Examples (5)

- `awk '$3 > $1 {print i + "1"; i++}' file`
- `awk '{print NR, $1}' file`
- `awk '{$2 = ""; print}' file`
- `yes | head -28 | awk '{ print "hi" }'`
- `yes | head -90 | \`
  `awk '{printf("hi00%2.0f n", NR+9)}'`
- `yes | head -4 | awk '{print rand()}'`
- `yes|head -40|awk '{print int(100*rand())%5}'`
- `{ for (i = 1; i <= NF; i=i+1)`
  `if ($i < 0) $i = -$i print}`

# What Is a Regular Expression?

- A regular expression (regex) describes a set of possible input strings.
- Regular expressions descend from a fundamental concept in Computer Science called finite automata theory
- Regular expressions are endemic to Unix
  - vi, ed, sed, and emacs
  - awk, tcl, perl and Python
  - grep, egrep, fgrep
  - compilers
- The simplest regular expressions are a string of literal characters to match.
- The string matches the regular expression if it contains the substring

# Regular Expressions

**Fundamentals**

Match the specified character unless it is a ...

| | |
|---|---|
| . | Match any character (except EOL) |
| [character class] | Match the characters in character class. |
| [start-end] | start to end |
| [^character class] | Match anything except the character class. |
| $ | Match the end of the line |
| ^ | Match the beginning of the line |
| * | Match the preceding expression zero or more times |
| ? | Match the preceding zero or one time |
| \| | Match the left hand side OR the right side |
| (regexp) | Group the regular expression |
| \ | Treat next character literally (not specially) |

# Regular Expressions

*regular expression* → **c k s**

**UNIX Tools rocks.**

*match*

---

**UNIX Tools sucks.**

*match*

---

**UNIX Tools is okay.**

*no match*

# Regular Expressions (con't)

*regular expression* → **a p p l e**

**Scrapple from the apple.**

*match 1* *match 2*

# Character Classes

*regular expression* →

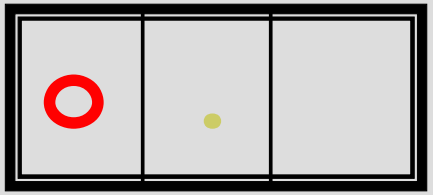
| | | | |
|---|---|---|---|
| b | [eor] | a | t |

**beat a brat on a boat**

*match 1* *match 2* *match 3*

# Character Classes (con't)

*regular expression* →



**For me to poop on.**

*match 1* *match 2*

# Negated Character Classes

*regular expression* →

| | | | |
|---|---|---|---|
| b | [^eo] | a | t |

**beat a brat on a boat**

*match*

# Anchors

*regular expression* → `^` `b` `[eor]` `a` `t`

**beat a brat on a boat**

*match*

---

*regular expression* → `b` `[eor]` `a` `t` `$`

**beat a brat on a boat**

*match*

---

`^word$` `^$`

# Repetitions

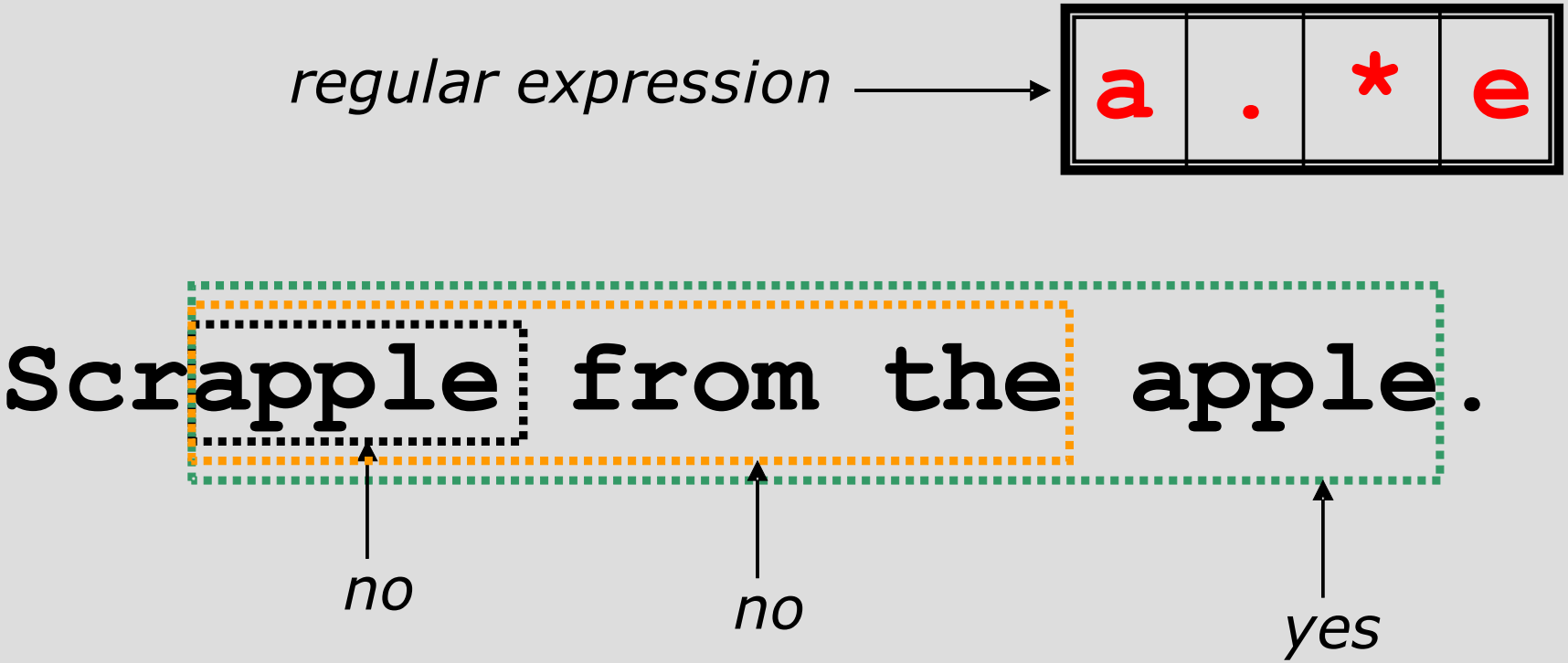
*regular expression* → **y a * y**

**I got mail, yaaaaaaaaaay!**

*match*

.*

# Match Length



# Examples (1)

- Examples:

Match a line beginning with a space-padded line number and colon.

**^[ \t]*[0-9][0-9]*:**

Match a name (various spellings)

**(Tim Shelling)|(TJS)|(T\. Shelling)|(Timothy J\. Shelling)**

Match if the line ends in a vowel or a number:

**[0-9aeiou]$**

Match if the line begins with anything but a vowel or a number:

**^[^0-9aeiou]**

# Example (2)

- IP v4 Address (255.255.255.255)
- `\b\d{1,3}\.\d{1,3}\.\d{1,3}\.\d{1,3}\b`
  - `999.999.999.999`
- `\b(25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)\.`
  `(25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)\.`
  `(25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)\.`
  `(25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)\b`
- ALAMAT@EMA.IL
  `\b[A-Z0-9._%+-]+@[A-Z0-9.-]+\.[A-Z]{2,4}\b`
- YYYY-MM-DD (1900-01-01 sd. 2099-12-31)
  `(19|20)\d\d[- /.](0[1-9]|1[012])[- /.](0[1-9]|[12][0-9]|3[01])`