Unix-like Operating Systems

Flow control.

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Content

Exit status

- Every process returns exit status during termination.
- Exit status = integer 0, 1, 2, ...
  - Sucess: 0.
  - Error: 1, 2, ...
- Built-in shell variable ? contains the exit status of the last foreground command.
- Shell script can be terminated with exit status `n` by command

  `exit [n]`
- Shell function can be terminated with exit status n by command

  `return [n]`

Exit status – examples

- See manual page of the command grep.
  - A line with the pattern was found by grep..

```
~> grep 'root' /etc/passwd
root:x:0:0:root:/root:/bin/bash
~> echo $?
0
```

  - A line with the pattern was not found by grep.

```
~> grep 'XXX' /etc/passwd
~> echo $?
1
```

  - Input file was not found by grep.

```
~> grep 'root' /XXX
grep: /XXX: No such file or directory
~> echo $?
130
```

  - Command XXXgrep was not found by shell.

```
~> XXXgrep 'root' /etc/passwd
If '[-f' is not a typo you can use command-not-found ...
~> echo $?
127
```

Command `test`

- Command `test` exits with the exit status determined by expression.
- Arguments are analysed by `test`, therefore
  - they must be separated by `space` or `TAB`,
  - use symbol \ before meta-character.
- To get more info about the command use `help test` (built-in command) or `man test` (for binary program).
- Compound expressions

`( A )`	Brackets define priority of the expression `A`.
`A -a B`	Logical conjunction: the expression is true if both `A` and `B` are true.
`A -o B`	Logical disjunction: the expression is true if either `A`, `B`, or both, are true.
`! A`	Logical negation: the expression is true if `A` is false and false if `A` is true.

Command test and its synonyms

- `test expression`
  - The test utility evaluates the condition and indicates the result of the evaluation by its exit status.
  - The command test is built-in command in ksh and bash (faster).
- `[ expression ]`
  - Synonym of the command `test`.
- `[[ expression ]]`
  - Only in ksh and bash, built-in command.
  - `-a` is replaced by `&&`.
  - `-o` is replaced by `||`.
- `(( arithmetic_expression ))`
  - Only in ksh and bash.
  - The arithmetic expression is evaluated.
  - Command returns true if expression is not equals to zero.

File attributes

- Command `test` enable to check some attributes of files/directories.
- For more info use `help test`.

Option	Example	Meaning
`-f`	`[ -f file ]`	True if file exists and is a regular file.
`-d`	`[ -d file ]`	True if file is a directory.
`-e`	`[ -e file ]`	True if file exists.
`-s`	`[ -s file ]`	True if file exists and is not empty.
`-L`	`[ -L file ]`	True if file is a symbolic link.
`-r`	`[ -r file ]`	True if file is readable by you.
`-w`	`[ -w file ]`	True if the file is writable by you.
`-x`	`[ -x file ]`	True if the file is executable by you.

File attributes – examples

- Test if /etc/passwd is a regular file.

```
~> test -f /etc/passwd ; echo $?
0
```

```
~> [ -f /etc/passwd ] ; echo $?
0
```

- Test if /etc/passwd is a regular file and do something in dependence on the test result.

```
~> name="/etc/passwd"
~> if [ -f "$name" ] ; then echo "$name is file" ; fi
/etc/passwd is file
```

```
~> name="/etc/XXX"
~> if [ -f "$name" ] ; then echo "$name is file" ; fi
```

```
~> if [ -f "$name" ] ; then echo "$name is file" ;  \
   else echo "$name is not file"; fi
/etc/XXX is not file
```

File attributes – examples

- If the you can modify the content of directory, then create new file in the directory.

```
~> name="my␣file.txt"
~> if [ -d "$HOME" -a -w "$HOME" ] ; then\
   echo "Hello" > "$HOME/$name" ; fi
```

- Badly written command.

```
~> cd
~> if [ -f $name -a -r $name ] ; then wc -l < $name ; fi
bash: [: too many arguments
```

- Badly written command.

```
~> if [-f "$name" -a -r "$name" ] ; then wc -l < "$name" ; fi
If '[-f' is not a typo you can use command-not-found ...
```

- Badly written command.

```
~> if [ -f "$name" -a -r "$name"] ; then wc -l < "$name" ; fi
bash: [: missing `]'
```

String comparison

- Shell can compare strings.
- If shell variable is used as argument, then put quotes around the variable to avoid error.
- For more info use `help test`.

Expression	Meaning
`[ str1 = str2 ]`	True if the strings are equal.
`[ str1 != str2 ]`	True if the strings are not equal.
`[ str1 \< str2 ]`	True if `str1` sorts before `str2` lexicographically.
`[ str1 \> str2 ]`	True if `str1` sorts after `str2` lexicographically.
`[ -z str ]`	True if string is empty..
`[ -n str ]`	True if string is not empty..

String comparison – examples

- Check lexicographical order of two strings.

```
~> test "John" \< "Peter" ; echo $?
0
```

```
~> [ "John" \< "Peter" ] ; echo $?
0
```

```
~> A="Alex"  B="John"  C="Good morning"
~> test "$A" \< "$B" ; echo $?
0
```

- Comparison of two strings

```
~> test "$A" = "$B" ; echo $?
1
```

- Badly written command.

```
test $B = $C ; echo $?
bash: test: too many arguments
2
```

Integer comparison

- Shell can compare integer numbers.
- For more info use `help test`.

Expression	Meaning
`[ num1 -eq num2 ]`	True if the numbers are equal.
`[ num1 -ne num2 ]`	True if the numbers are not equal.
`[ num1 -lt num2 ]`	True if the `num1` is less than `num2`.
`[ num1 -le num2 ]`	True if the `num1` is less than or equal to `num2`.
`[ num1 -gt num2 ]`	True if the `num1` is greater than `num2`.
`[ num1 -ge num2 ]`	True if the `num1` is greater than or eaual to `num2`.

Integer comparison – examples

- Comparison of two numbers.

```
~> test 2 -lt 7 ; echo $?
0
```

```
~> [ 2 -lt 7 ] ; echo $?
0
```

- Compare two numbers and do something in dependence on the test result.

```
~> A="10" B="7"
~> if  test \! "$A" -eq "$B" \\
   then echo "$A is not equal to $B." ; fi
10 is not equal to 7.
```

```
~> [ "$A" -eq "$B" ] || echo "$A is not equal to $B."
10 is not equal to 7.
```

Command if/then/else

- Single-line syntax

```
if LIST1 ; then LIST2 ; [ else LIST3 ; ] fi
```

- Multiple line syntax

```
if LIST1
   then
       LIST2
   [ else
       LIST3 ]
fi
```

- The LIST1 of commands is executed.
- If its exit status is 0, the LIST2 of commands is executed.
- Otherwise, the LIST3 of commands is executed, if present.
- Line with `fi` must end by newline character!!!
- For more info use `help if` or `man bash`.

Command if/then/else – example

- The shell script that tries to find the file type.

```
#! /bin/bash

name="$1"

if [ -f "$name" ]
  then
    echo "$name is file"
  else
    if [ -d "$name" ]
      then
        echo "$name is directory"
      else
        if [ -b "$name" -o -c "$name" ]
          then
            echo "$name is special file"
          else
            echo "$name is not file/directory/special file"
        fi
    fi
fi
```

Command if/then/else – example

- The shell script that tries to find the file type.
- Better syntax in this case: `else if` is replaced by `elif`.

```
#! /bin/bash

name="$1"

# --- regular file ---
if [ -f "$name" ] ; then
  echo "$name is file"

# --- directory ---
elif [ -d "$name" ] ; then
  echo "$name is directory"

# --- special file ---
elif [ -b "$name" -o -c "$name" ] ; then
  echo "$name is special file"

# --- the others ---
else
  echo "$name is not file/directory/special file"
fi
```

Command if/then/else – example

- The shell script checks the number of arguments and then prints a greater i number.

```
#! /bin/bash

# --- check number of arguments  ---
if [ $# -ne 2 ] ; then

  echo "Usage: $0 interger1 integer2" >&2
  exit 1
fi

# --- print greater integer ---
if [ "$1" -gt "$2" ] ; then

  echo "$1"

else

  echo "$2"
fi
```

Command case

- Single-line syntax

```
case WORD in [ PATTERN1 [ | PATTERN2 ] ...  )  LIST ;; ] ...  esac
```

- Multiple line syntax

```
case WORD in
    [ PATTERN1 [ | PATTERN2 ] ...  )  LIST ;; ]
      ...
esac
```

- A case command first expands `WORD`.
- Then it tries to match WORD against each PATTERN in turn, using the same matching rules as for pathname expansion.
- If the operator ;; is used, no subsequent matches are attempted after the first pattern match.
- Line with `esac` must end by newline character!!!
- For more info use `help case` or `man bash`.

Command case – example

- The shell script will check the argument and try to start or stop some system service.

```
#! /bin/bash

case "$1" in
   "start" )
      [ -x /usr/bin/lib/lpsched ] && /usr/bin/lib/lpsched
      ;;
   "stop" )
      [ -x /usr/bin/lib/lpshut ] && /usr/bin/lib/lpshut
      ;;
   *)
      echo "Usage: $0 [ start | stop ]" >&2
      exit 1
      ;;
esac
```

Command case – example

- The shell script will set the environment to en_US.utf8.
- The shell script will try to determine the type of the day.

```
#! /bin/bash

# --- set environment ---
export LANG="en_US.utf8"
export LC_ALL="en_US.utf8"

# --- determine type of day ---
case "$(date '+%a')" in
   "Mon" | "Tue" | "Wed" | "Thu" | "Fri" )
      echo "Today is working day."
      ;;
   "Sat" | "Sun" )
      echo "Today is weekend."
      ;;
   *)
      echo "Something is wrong." >&2
      exit 1
      ;;
esac
```

While loop

- Single-line syntax

```
while LIST1 ; do LIST2; done
```

- Multiple line syntax

```
while LIST1
 do
    LIST2
 done
```

- The while command continuously executes the list of commands `LIST2` as long as the last command in the list `LIST1` returns an exit status of zero.
- Line with `do` must end by newline character!!!
- For more info use `help while` or `man bash`.

While loop – example

- The shell script will check the argument and prints numbers $1, \ldots, MAX$.

```
#! /bin/bash

# --- check arguments ---
if (( $# != 1 )) ; then
  echo "Usage: $0 integer" >&2
  exit 1
fi

# --- print numbers ---
I="1"           # from
MAX="$1"        # to

while (( I <= MAX ))
  do
    echo "Value of I is $I"
    (( I++ ))
  done
```

Loop until

- Single-line syntax

```
until LIST1 ; do LIST2; done
```

- Multiple line syntax

```
until LIST1
 do
    LIST2
 done
```

- The until command is identical to the while command, except that the test is negated.
- List `LIST2` is executed as long as the last command in `LIST1` returns a non-zero exit status.
- Line with `do` must end by newline character!!!
- For more info use `help until` or `man bash`.

Loop until – example

- The shell script will check the argument and prints numbers $1, \ldots, MAX$.

```
#! /bin/bash

# --- check arguments ---
if (( $# != 1 )) ; then
  echo "Usage: $0 integer" >&2
  exit 1
fi

# --- print numbers ---
I="1"           # from
MAX="$1"        # to

until (( I >  MAX ))
  do
    echo "Value of I is $I"
    (( I++ ))
  done
```

For loop

- Single-line syntax

```
for NAME [ in WORDS ...  ]  do LIST; done
```

- Multiple line syntax

```
for NAME [ in WORDS ...  ]
 do
    LIST
 done
```

- The list of WORDS following in is expanded, generating a list of items.
- The variable NAME is set to each element of this list of items in turn, and LIST is executed each time.
- If the in WORDS ... is omitted, the for command executes LIST once for each positional parameter that is set.
- Line with do must end by newline character!!!

For loop – example

- The shell script will repeat steps $1, 2, \ldots, 5$.

```
#! /bin/bash

for I in 1 2 3 4 5
  do
    echo "Step $I"
  done
```

- Same behaviour, but different syntax.

```
#! /bin/bash

for (( I=1;  I<=5; I++ ))
  do
    echo "Step $I"
  done
```

For loop – example

- The shell script will check argument and print all script arguments.

```
#! /bin/bash

# --- check arguments ---
if (( $# -eq 0 )) ; then
  echo "Usage: $0 arg1 [ arg2 ... ]" >&2
  exit 1
fi

# --- print script arguments ---
I="1"

for ARG
  do
    echo "arg$I = \"$ARG\""
    (( I++ ))
  done
```

For loop – example

- The shell script will check argument and print all regular files from the given directory.

```
#! /bin/bash

# --- check arguments ---
if [ \! \( $# -eq 1 -a -d "$1" -a -r "$1" \) ] ; then
  echo "Usage: $0 directory" >&2
  exit 1
fi

# --- print all items of given directory ---
I="1"

for NAME in "$1/"* "$1/".*
  do
    if [ -f "$NAME" ] ; then
      echo "  file$I = \"$NAME\""
      (( I++ ))
    fi
  done
```