Shell Scripting

What is Shell

- A shell is special user program which provide an interface to user to use operating system services.
- Shell accept human readable commands from user and convert them into something which kernel can understand.
- It is a command language interpreter that execute commands read from input devices such as keyboards or from files.

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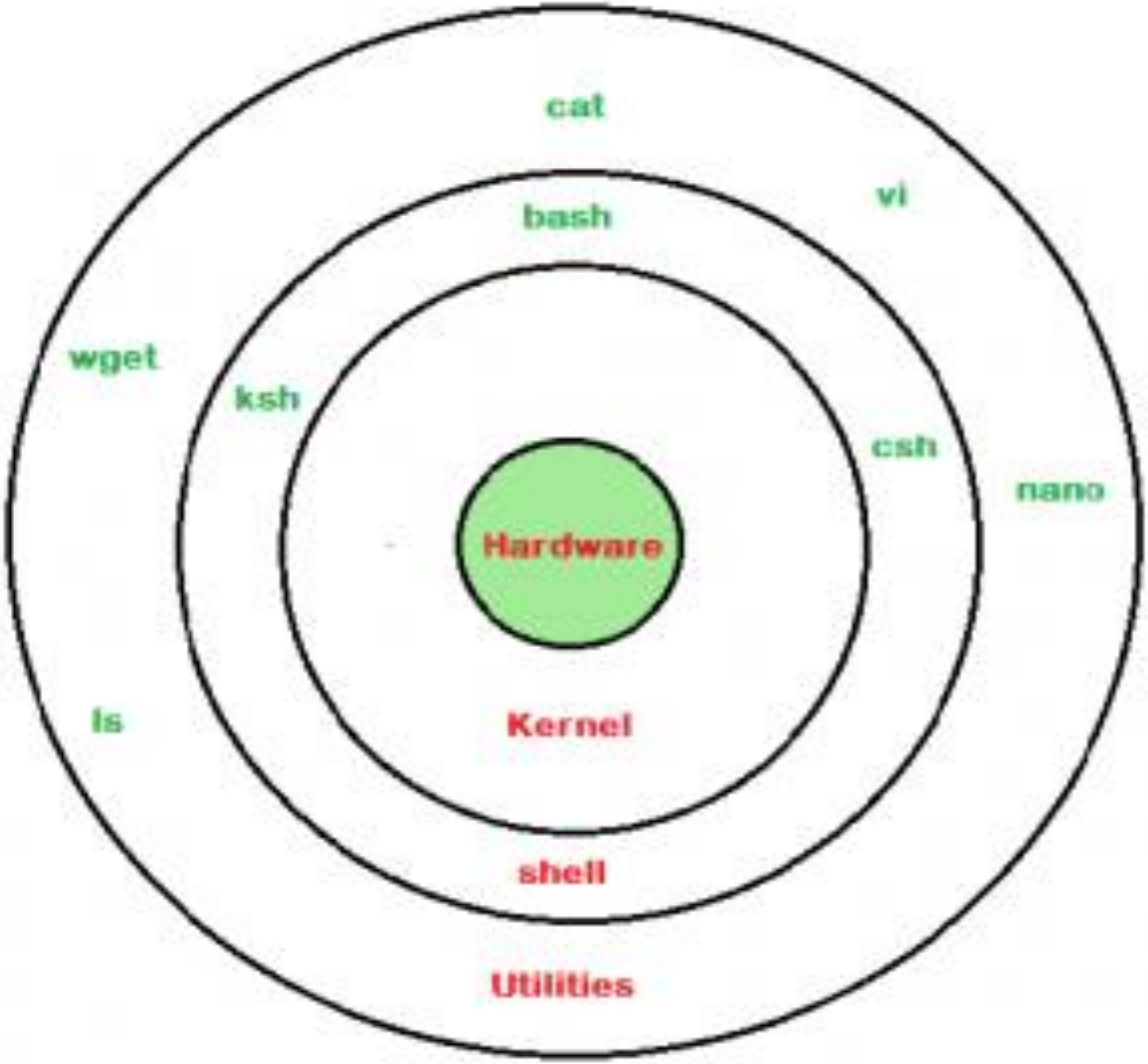

cat
vi
bash
wget
ksh
csh
nano
Hardware
ls
Kernel
shell
Utilities

TYPES OF SHELLS

There are four shells

- Bourne shell(sh),
- Korn shell(ksh),
- C shell(csh) and
- Bourne Again Shell (bash).

Basic Shell Programming

- A script is a file that contains shell commands
  - data structure: variables
  - control structure: sequence, decision, loop
- Shebang line for bash shell script:

```
#! /bin/bash
#! /bin/sh
```

- to run:
  - make executable: `% chmod +x script`
  - invoke via: `% ./script`

Bash shell programming

- Input
  - prompting user
  - command line arguments
- Decision:
  - if-then-else
  - case
- Repetition
  - do-while, repeat-until
  - for
  - select
- Functions
- Traps

VARIABLE

- A variable is a character string to which we assign a value.
- The value assigned could be a number, text, filename, device, or any other type of dat
- Valid variables
- _abc
- Ab_c
- Ab_1
- Invalid Variables
- 1_ab
- -ab
- Ab-cd
- Ab_c!

Special shell variables

Parameter	Meaning
$0	Name of the current shell script
$1-$9	Positional parameters 1 through 9
$#	The number of positional parameters
$*	All positional parameters, “$*” is one string
$@	All positional parameters, “$@” is a set of strings
$?	Return status of most recently executed command
$$	Process id of current process

EXAMPLES: COMMAND LINE ARGUMENTS

```
% set tim bill ann fred
      $1  $2   $3  $4
% echo $*
tim bill ann fred
% echo $#
4
% echo $1
tim
% echo $3 $4
ann fred
```

The ‘set’ command can be used to assign values to positional parameters

ARRAY VARIABLE

- This can hold multiple values at the same time.
- Arrays provide a method of grouping a set of variables.
- syntax of array initialization
- Array=(va1 va2 va3)
- echo “first value=${Array[0]}”

OPERATORS

- Arithmetic Operators
- Relational Operators
- Boolean Operators
- String Operators
- File Test Operators

Arithmetic Operators

- shell didn't originally have any mechanism to perform simple arithmetic operations but it uses external programs, either **awk** or **expr**.
- C=`expr 1 + 1`
- There must be spaces between operators and expressions. For example, 2+2 is not correct; it should be written as 2 + 2.
- The complete expression should be enclosed between ` `, called the backtick.

Arithmetic Operators

Operator	Description	Example
+ (Addition)	Adds values on either side of the operator	`expr $a + $b`
- (Subtraction)	Subtracts right hand operand from left hand operand	`expr $a - $b`
* (Multiplication)	Multiplies values on either side of the operator	`expr $a \* $b`
/ (Division)	Divides left hand operand by right hand operand	`expr $b / $a`
% (Modulus)	Divides left hand operand by right hand operand and returns remainder	`expr $b % $a`
= (Assignment)	Assigns right operand in left operand	a = $b
== (Equality)	Compares two numbers, if both are same then returns true.	[$a == $b]
!= (Not Equality)	Compares two numbers, if both are different then returns true.	[$a != $b]

- all the conditional expressions should be inside square braces with spaces around them,
- for example
- **[$a == $b]** is correct
- **[$a==$b]** is incorrect.

Relational Operators

Operator	Description	Example
-eq	Checks if the value of two operands are equal or not; if yes, then the condition becomes true.	[$a -eq $b]
-ne	Checks if the value of two operands are equal or not; if values are not equal, then the condition becomes true.	[$a -ne $b]
-gt	Checks if the value of left operand is greater than the value of right operand; if yes, then the condition becomes true.	[$a -gt $b]
-lt	Checks if the value of left operand is less than the value of right operand; if yes, then the condition becomes true.	[$a -lt $b]
-ge	Checks if the value of left operand is greater than or equal to the value of right operand; if yes, then the condition becomes true.	[$a -ge $b]
-le	Checks if the value of left operand is less than or equal to the value of right operand; if yes, then the condition becomes true.	[$a -le $b]

Boolean Operators

x=5 y=10

Operator	Description	Example
!	This is logical negation. This inverts a true condition into false and vice versa.	[! false] is true.
-o	This is logical **OR**. If one of the operands is true, then the condition becomes true.	[$x -lt 10 -o $y -gt 100] is true.
-a	This is logical **AND**. If both the operands are true, then the condition becomes true otherwise false.	[$x -lt 20 -a $y -gt 100] is false.

String Operators

x=“ab” y=“fg”

Operator	Description	Example
=	Checks if the value of two operands are equal or not; if yes, then the condition becomes true.	[$x = $y] is not true.
!=	Checks if the value of two operands are equal or not; if values are not equal then the condition becomes true.	[$x != $y] is true.
-z	Checks if the given string operand size is zero; if it is zero length, then it returns true.	[-z $x] is not true.
-n	Checks if the given string operand size is non-zero; if it is nonzero length, then it returns true.	[-n $x] is not false.
str	Checks if **str** is not the empty string; if it is empty, then it returns false.	[$x] is not false.

User input

- shell allows to prompt for user input

Syntax:

```
read varname [more vars]
```

- or

```
read -p "prompt" varname [more vars]
```

- words entered by user are assigned to **`varname`** and "**`more vars`**"
- last variable gets rest of input line

User input example

```
#! /bin/bash
read -p "enter your name: " first last

echo "First name: $first"
echo "Last name: $last"
```

BASH CONTROL STRUCTURES

- if-then-else
- case
- loops
  - for
  - while
  - until
  - select

IF STATEMENT

```
if command
then
  statements
fi
```

- statements are executed only if **`command`** succeeds, i.e. has return status “0”

TEST COMMAND

Syntax:

```
  test expression
  [ expression ]
```

- evaluates ‘expression’ and returns true or false

Example:

```
read –p “Enter your password= “ pass
if test “$pass“ == “admin”
     then
     echo “Password Verfied"
  fi
```

The simple if statement

```
if [ condition ]; then
  statements
fi
```

- executes the statements only if **`condition`** is true

The if-then-else statement

```
if [ condition ]; then
   statements-1
else
  statements-2
fi
```

- executes statements-1 if condition is true
- executes statements-2 if condition is false

THE IF…STATEMENT

```
if [ condition ]; then
       statements
elif [ condition ]; then
        statement
else
        statements
fi
```

- The word **elif** stands for "else if"
- It is part of the if statement and cannot be used by itself

Relational Operators

Meaning	Numeric	String
Greater than	-gt	
Greater than or equal	-ge	
Less than	-lt	
Less than or equal	-le	
Equal	-eg	= or ==
Not equal	-ne	!=
str1 is less than str2		str1 < str2
str1 is greater str2		str1 > str2
String length is greater than zero		-n str
String length is zero		-z str

COMPOUND LOGICAL EXPRESSIONS

`!`	not
`&&`	and
`||`	or

and, or
must be enclosed within

[[ ]]

Example: Using the ! Operator

```
#!/bin/bash

read -p "Enter years of work: " Years
if [ ! "$Years" -lt 20 ]; then
   echo "You can retire now."
else
   echo "You need 20+ years to retire"
fi
```

EXAMPLE: USING THE && OPERATOR

```
#!/bin/bash

Bonus=500
read -p "Enter Status: " Status
read -p "Enter Shift: " Shift
if [[ "$Status" = "H" && "$Shift" = 3 ]]
then
   echo "shift $Shift gets \$$Bonus bonus"
else
   echo "only hourly workers in"
   echo "shift 3 get a bonus"
fi
```

Example: Using the | | Operator

```
#!/bin/bash

read -p "Enter calls handled:" CHandle
read -p "Enter calls closed: " CClose
if [[ "$CHandle" -gt 150 || "$CClose" -gt 50 ]]
   then
   echo "You are entitled to a bonus"
else
   echo "You get a bonus if the calls"
   echo "handled exceeds 150 or"
   echo "calls closed exceeds 50"
fi
```

File Testing

	Meaning
-d file	True if ‘file’ is a directory
-f file	True if ‘file’ is an ord. file
-r file	True if ‘file’ is readable
-w file	True if ‘file’ is writable
-x file	True if ‘file’ is executable
-s file	True if length of ‘file’ is nonzero

EXAMPLE: FILE TESTING

```
#!/bin/bash
echo "Enter a filename: "
read file
if [ ! -r $file ]
 then
   echo "File is not read-able"

fi
```

Example: File Testing

```
#! /bin/bash

echo "Enter a filename: "
read file
if [[ ! -f $file || ! -r $file || ! -w $file ]]
then
  echo "File $file is not accessible"

fi
```

Example: if… Statement

```
# The following THREE if-conditions produce the same result

* DOUBLE SQUARE BRACKETS
read -p "Do you want to continue?" reply
if [[ $reply = "y" ]]; then
   echo "You entered " $reply
fi

* SINGLE SQUARE BRACKETS
read -p "Do you want to continue?" reply
if [ $reply = "y" ]; then
   echo "You entered " $reply
fi

* "TEST" COMMAND
read -p "Do you want to continue?" reply
if test $reply = "y"; then
   echo "You entered " $reply
fi
```

The case Statement

- use the case statement for a decision that is based on multiple choices

Syntax:

```
case word in
    pattern1) command-list1
    ;;
    pattern2) command-list2
    ;;
    patternN) command-listN
    ;;
esac
```

CASE PATTERN

- checked against word for match
- may also contain:

  `*`

  `?`

  `[ … ]`

  `[:class:]`
- multiple patterns can be listed via:

  `|`

Example 1: The case Statement

```
#!/bin/bash
echo "Enter Y to see all files including hidden
  files"
echo "Enter N to see all non-hidden files"
echo "Enter q to quit"

read -p "Enter your choice: " reply

case $reply in
  Y|YES) echo "Displaying all (really…) files"
         ls -a ;;
  N|NO)  echo "Display all non-hidden files..."
         ls ;;
  Q)     exit 0 ;;

  *) echo "Invalid choice!"; exit 1 ;;
esac
```

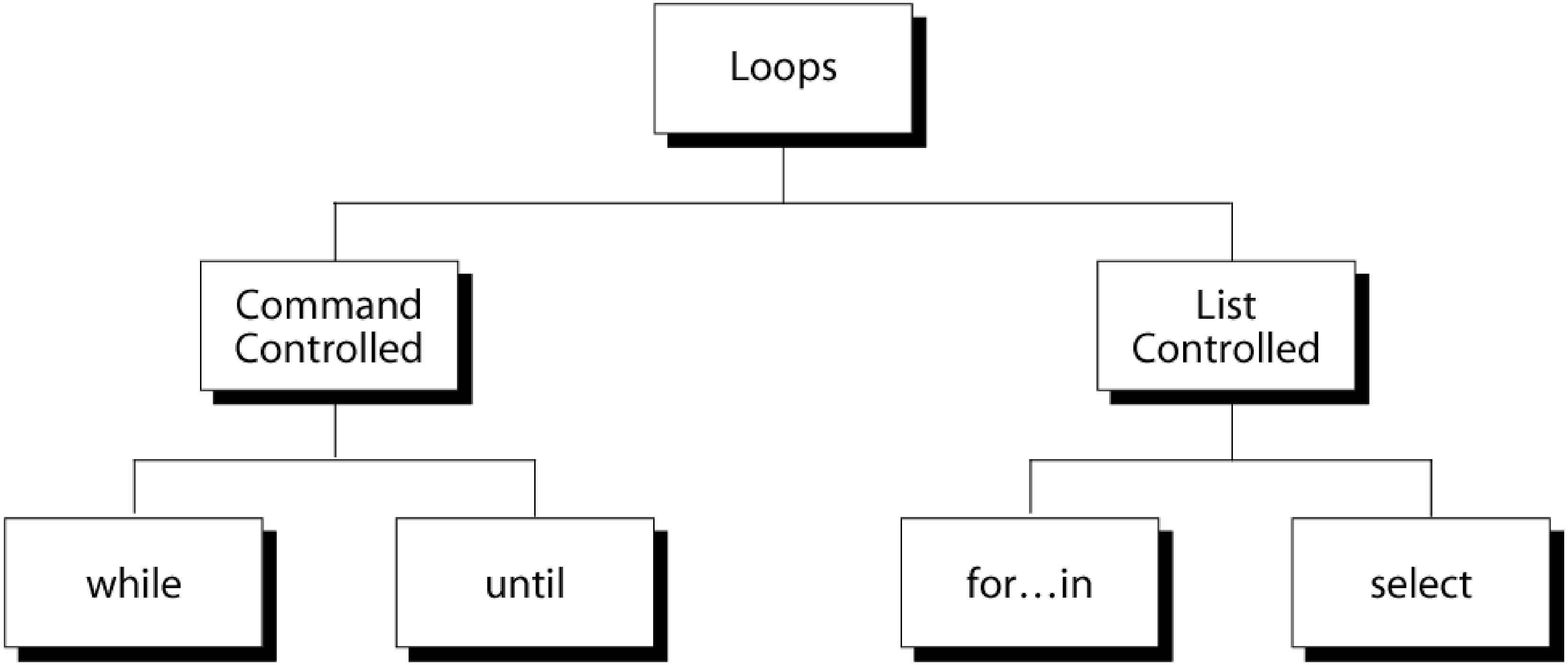
Bash programming: so far

- Data structure
  - Variables
  - Numeric variables
  - Arrays
- User input
- Control structures
  - if-then-else
  - case

BASH PROGRAMMING: STILL TO COME

- Control structures
  - Repetition
    - do-while, repeat-until
    - for
    - select
- Functions
- Trapping signals

Repetition Constructs



The while Loop

- Purpose:

  To execute commands in "command-list" as long as "expression" evaluates to true

Syntax:

```
while [ expression ]
do
    command-list
done
```

Example: Using the while Loop

```
#!/bin/bash
COUNTER=0
while [ $COUNTER -lt 10 ]
do
   echo The counter is $COUNTER
   let COUNTER=$COUNTER+1
done
```

Example: Using the while Loop

```
#!/bin/bash

Cont="Y"
while [ $Cont = "Y" ]; do
  ps -A
  read -p "want to continue? (Y/N)" reply
  Cont=`echo $reply | tr [:lower:] [:upper:]`
done
echo "done"
```

Example: Using the while Loop

```
#!/bin/bash

x=1
while [ $x -le 5 ]; do
 echo “Welcome $x times”
 x=$(( $x + 1 ))
done
```

The until Loop

- Purpose:

  To execute commands in “command-list” as long as “expression” evaluates to false

Syntax:

```
until [ expression ]
do
    command-list
done
```

Example: Using the until Loop

```
#!/bin/bash

COUNTER=20
until [ $COUNTER -lt 10 ]
do
   echo $COUNTER
   let COUNTER-=1
done
```

Example: Using the until Loop

```
#!/bin/bash

Stop="N"
until [ $Stop = "Y" ]; do
  ps -A
  read -p "want to stop? (Y/N)" reply
  Stop=`echo $reply | tr [:lower:] [:upper:]`
done
echo "done"
```

The for Loop

- Purpose:

  To execute commands as many times as the number of words in the "argument-list"

Syntax:

```
for variable in argument-list
do
    commands
done
```

Example 1: The for Loop

```
#!/bin/bash

for i in 7 9 2 3 4 5
do
   echo $i
done
```

Example 2: Using the for Loop

```
#!/bin/bash
# compute the average weekly
  temperature

for num in 1 2 3 4 5 6 7
do
   read -p "Enter temp for day $num: "
  Temp
   let TempTotal=$TempTotal+$Temp
done

let AvgTemp=$TempTotal/7
echo "Average temperature: " $AvgTemp
```

USING COMMA IN THE BASH C-STYLE FOR LOOP

```
#!/bin/bash

for  ((i=1, j=10;  i <= 5 ; i++, j=j+5))

do

echo “Number $i: $j”

done
```

SELECT COMMAND

- Constructs simple menu from word list
- Allows user to enter a number instead of a word
- User enters sequence number corresponding to the word

Syntax:

```
select WORD in LIST
do
    RESPECTIVE-COMMANDS
done
```

- Loops until end of input, i.e. ^d (or ^c)

Select example

```
#! /bin/bash
select var in alpha beta gamma
do
     echo $var
done
```

- Prints:

```
1) alpha
2) beta
3) gamma
#? 2
beta
#? 4
#? 1
alpha
```

Select detail

- PS3 is select sub-prompt
- $REPLY is user input (the number)

```
#! /bin/bash
PS3="select entry or ^D: "
select var in alpha beta
do
     echo "$REPLY = $var"
done
```

```
Output:
select ...
1) alpha
2) beta
? 2
2 = beta
? 1
1 = alpha
```

Select example

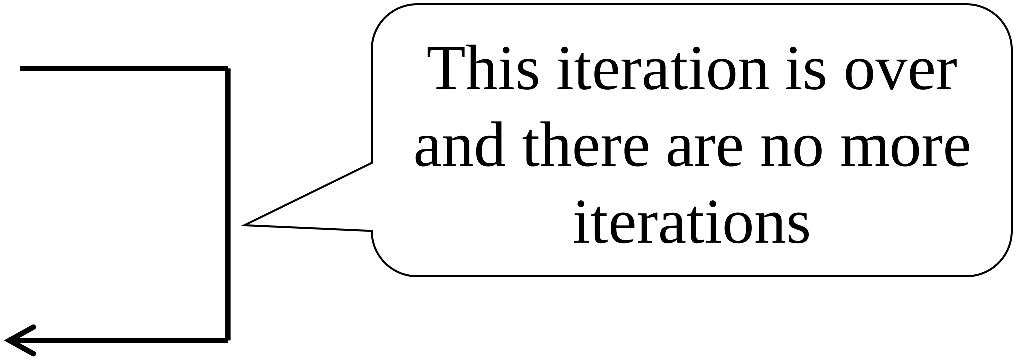
```
#!/bin/bash
echo "script to make files private"
echo "Select file to protect:"

select FILENAME in *
do
  echo "You picked $FILENAME ($REPLY)"
  chmod go-rwx "$FILENAME"
  echo "it is now private"
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

The break command

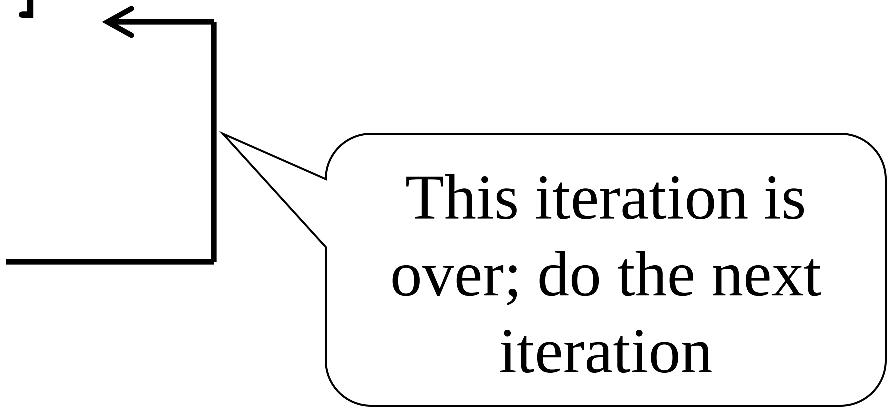
```
while [ condition ]
do
    cmd-1
    break
    cmd-n
done
echo "done"
```



This iteration is over and there are no more iterations

THE CONTINUE COMMAND

```
while [ condition ]
do
    cmd-1
    continue
    cmd-n
done
echo "done"
```



This iteration is over; do the next iteration

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
```

Bash shell programming

- Sequence
- Decision:
  - if-then-else
  - case
- Repetition
  - do-while, repeat-until
  - for
  - select

DONE !

- Functions
- Traps

still to come

Shell Functions

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

Shell Functions

- must be defined before they can be referenced
- usually placed at the beginning of the script

Syntax:

```
function-name () {
    statements
}
```

EXAMPLE: FUNCTION

```
#!/bin/bash

test () {
  # This is a simple function
  echo "This is a test function."
  echo "Now exiting test function."
}

# declaration must precede call:

test
```

EXAMPLE: FUNCTION

```
#!/bin/bash
fun () { # A somewhat more complex function.
  JUST_A_SECOND=1
  let i=0
  REPEATS=10
  echo "And now the fun really begins."
  while [ $i -lt $REPEATS ]
  do
      echo "-------FUNCTIONS are fun-------->"
      sleep $JUST_A_SECOND
      let i+=1
  done
}
fun
```

ARRAY VARIABLE

- This can hold multiple values at the same time.
- Arrays provide a method of grouping a set of variables.
- syntax of array initialization
- Array=(va1 va2 va3)
- echo “first value=${Array[0]}”

Syntax	Result
arr=()	Create an empty array
arr=(1 2 3)	Initialize array
${arr[2]}	Retrieve third element
${arr[@]}	Retrieve all elements
${!arr[@]}	Retrieve array indices
${#arr[@]}	Calculate array size
arr[0]=3	Overwrite 1st element
arr+=(4)	Append value(s)
str=$(ls)	Save ls output as a string
arr=($(ls))	Save ls output as an array of files
${arr[@]:s:n}	Retrieve n elements starting at index s

```
#!/bin/bash
 #Declare a string array

Array=("PHP"  "Java"  "C#"  "C++"  "VB.Net"  "Python"  "Perl")

# Print array values in  lines
echo "Print every element in new line"

for val1 in ${Array[*]}; do
     echo $val1
done

echo ""

# Print array values in one line
echo "Print all elements in a single line"
for val2 in "${Array[*]}"; do
    echo $val2
done
echo ""
```

```
#!/bin/bash
i=0
p=0
n=0
z=0
while [ $i -le 9 ]
do
read -p "Enter a Number: " a[$i]

if [ ${a[$i]} -gt 0 ]
then
    p=$(($p+1))
else
    if [ ${a[$i]} -eq 0 ]
    then
      z=$(($z+1))
    else
        n=$(($n+1))
    fi
fi
i=$(($i+1))
done
echo "+ve number= $p"
echo "-ve no= $n"
echo "zero= $z"
```

```
# !/bin/bash

clear
read -p "string= " str
echo
len=`echo $str | wc -c`
echo "len=$len"
len=$((len-1))
echo "len=$len"
i=1
j=`expr  $len / 2`
echo "j=$j"
while test $i -le $j
do
k=`echo $str | cut -c $i`
l=`echo $str | cut -c $len`
if test $k != $l
then
echo "String is not palindrome"
exit
fi
i=`expr $i + 1`
len=`expr $len - 1`
done
echo "String is palindrome"
```