



# Week 9 Lecture 2: Shell Scripting

# Review and Preview

---

- More Testing
- Design

---

- Shell Scripting

**K&R: Chapters 1-5  
Sections 4.5, 4.11  
Sections 5.1-5.5  
Sections 6.1-6.3**



# Review: What is the Shell?

---

- The shell provides a **command line user interface** for UNIX systems.
- The shell is both an **interactive** command language and a **scripting** language.
- There are different versions of the UNIX shell including the C, Korn, and Bourne shells.
- But the most popular modern shell is the **Bourne-Again shell** or **bash** which provides a superset of Bourne shell functionality.
- It is the default interactive shell for most Linux and macOS systems.

# What is Scripting?

---

- Scripting allows for the automatic execution of shell commands that would otherwise be executed interactively one-by-one.
- The simplest script is a text file that contains a list of commands to execute (one command on each line) like the following:

```
date  
pwd  
ls -l | wc -l
```

# Simple Scripts

---

- Let's call our script **dirInfo.sh**
- Let's also adjust its permission so that it is designated an executable file.
- Now let's run it!

```
$ chmod 755 dirInfo.sh
$ ls -l dirInfo.sh
-rwxr-xr-x 1 debs debs 35 Nov  6 17:39 dirInfo.sh
$ ./dirInfo.sh
Wed 06 Nov 2019 05:36:07 PM EST
/home/debs/Programs
```

# Giving the Shell Script More Information

---

- You can find out what your default shell is by using the following command:

```
$ echo $SHELL  
/bin/bash
```

- To define your script's interpreter as **bash**, you add the following to your bash script as the first line:

```
#!/bin/bash  
date  
pwd  
ls -l | wc -l
```

# Adding some Text to the Script

---

- If you want to print out something in addition to the results of your commands you can use the **echo** command:

```
#!/bin/bash
date
pwd
echo "There are "
ls -l | wc -l
echo "files in the directory"
```

```
$ ./dirInfo.sh
Wed 06 Nov 2019 06:52:06 PM EST
/home/debs/Programs
There are
82
files in the directory
```

# Variables in Scripts

---

- Variables are necessary for programming and for scripting. You can store information in variables in shell scripts - this information can be numbers, text, or commands.

```
#!/bin/bash
A=1
B="text string"
C=$(date)
echo "A is $A"
echo "B is $B"
echo "C is $C"
```

```
$ ./variables.sh
A is 1
B is text string
C is Wed 6 Nov 2019 18:57:43 EST
```

# Working with Variables

---

```
#!/bin/bash
A=$(date)
B=$(pwd)
C=$(ls -l | wc -l)
echo "On $A there were $C files in $B"
```

\$ ./dirInfo.sh

On Wed 06 Nov 2019 07:01:43 PM EST there were 82 files in /home/debs/Programs

**But...**

# But did that last script give the right answer?

---

```
#!/bin/bash
A=$(date)
B=$(pwd)
C=$(ls -l | wc -l)
echo "On $A there were $C files in $B"
```

But there is an extra line produced by ls -l

```
$ ls -l
```

```
total 1364
```

```
-rw-r--r-- 1 debs debs 5613 Oct 30 20:46 1880Names.txt
```

But how can we do some math?  
We need to subtract one from variable C.

# Arithmetc Operations in the Shell

---

- Format: \$( ( expression ) )
- e.g. echo \$( ( 5 + 20 ) )
- Operators include +, -, \*, /, %, ++, --, \*\*

```
$ echo $( ( 2 ** 3 ) )
```

# Correcting our Shell Script

---

```
#!/bin/bash
A=$(date)
B=$(pwd)
C=$(ls -l | wc -l)
C=$((C-1))
echo "On $A there were $C files in $B"
```

\$ ./dirInfo.sh

On Wed 06 Nov 2019 07:36:42 PM EST there were 81 files in /  
home/debs/Programs

# Command Line Parameters

---

- Like C programs, bash shell scripts can read in its command line parameters.

```
parm1=$1
parm2=$2
parm3=$3
echo "command line parameters are $parm1, $parm2, and $parm3"
```

```
$ ./parms.sh one two three
command line parameters are one, two, and three
```

# UNIX Command: find

---

- `find` - search for files in a directory hierarchy
- `-type f`: regular files
- `-type d`: directories

```
$ find /home/debs/Programs -type f
```

```
$ find /home/debs/Programs -type d
```

# UNIX Command: find

---

```
$ find Week1 -type d
```

Week1

Week1/A2

Week1/A2/CourseLink

Week1/A2/CourseLink/Mac

Week1/A2/CourseLink/TAR

Week1/Lecture2

Week1/Lecture1

```
$ find Week1 -type d | wc -l
```

# Functions in Shell Scripts

---

- Like C programs we can organize our code into functions so that we do not have to repeat ourselves when we use popular computations.

```
#!/bin/bash
function totalFiles {
    find $1 -type f | wc -l
}
home=/home/debs/Programs
echo -n "Files in this directory: "
totalFiles $home
```

```
$ ./funcs.sh
Files in this directory: 690
```

# Improving the Original Script

---

```
#!/bin/bash
function totalFiles {
    find $1 -type f | wc -l
}

now=$(date)
home=$(pwd)
num=$(totalFiles $home)
echo "On $now there were $num files in $home"
```

```
$ ./dirInfo.sh
On Wed 06 Nov 2019 08:36:11 PM EST there were 690 files in
/home/debs/Programs
```

# Conditional Branching

---

```
#!/bin/bash

numA=$1
numB=$2

if [ $numA -lt $numB ]; then
    echo "$numA is less than $numB"
elif [ $numA -eq $numB ]; then
    echo "$numA is equal to $numB"
else
    echo "$numA is greater than $numB"
fi
```

# Conditional Branching

---

```
$ ./compare.sh 100 200  
100 is less than 200
```

```
$ ./compare.sh 100 100  
100 is equal to 100
```

```
$ ./compare.sh 200 100  
200 is greater than 100
```

# Comparisons

---

Bash Shell Numeric and String Comparisons

Description	Numeric Comparison	String Comparison
less than	-lt	<
greater than	-gt	>
equal	-eq	=
not equal	-ne	!=
less or equal	-le	N/A
greater or equal	-ge	N/A

# Loops: **for**

---

- Just like C there are **for** loops but...there is a difference.
- There are many different versions of **for**:
  - `for i in 1 2 3 4 5`
  - `for i in {1..5}`
  - `for i in {0..10..2}` *Only in bash 4.0 and later*
  - `for (( i=1; i<=5; i++ ))` *Similar to C*

```
#!/bin/bash
for i in 1 2 3 4 5
do
    echo "Number $i"
done

for i in {1..5}
do
    echo "Number $i"
done
echo "Bash version ${BASH_VERSION}..."
for i in {0..10..2}
do
    echo "Number $i"
done

for (( i=1; i<=5; i++ ))
do
    echo "Number $i"
done
```

```
$ ./forLoops.sh
```

Number 1

Number 2

Number 3

Number 4

Number 5

-----

Number 1

Number 2

Number 3

Number 4

Number 5

-----

**for i in 1 2 3 4 5**

Bash version 5.0.3(1)-release...

Number 0

Number 2

Number 4

Number 6

Number 8

Number 10

-----

Number 1

Number 2

Number 3

Number 4

Number 5

**for i in {0..10..2}**

**for (( i=1; i<=5; i++ ))**

# Files and `for` Loops

---

- Here is a shell script that reads in the files given on the command line and prints them out in a `for` loop.

```
#!/bin/bash
FILES="$@"
for f in $FILES
do
    echo $f
done
```

```
$ forLoops.sh *.sh
checkL2Bonus.sh
checkLab2.sh
compare.sh
dirInfo.sh
forLoops.sh
funcs.sh
```

# Loops: while

---

- The `while` loop in bash shell scripting has the following format:

```
while [ condition ]
```

```
do
```

```
    commands
```

```
done
```

# Loops: while

---

```
#!/bin/bash
i=0
while [ $i -le 4 ]
do
    echo "Number $i"
    i=$(( $i + 1 ))
done
```

```
$ ./whileLoops.sh
Number 0
Number 1
Number 2
Number 3
Number 4
```

# Case Study - Shell Script and UNIX Commands

---

Finding a Needle in a Haystack or Finding Types  
of Assaults that are in the ICD10

\$ ls -l ICD10\_1.0.owl

-rw-r--r--@ 1 debstacey staff

10828264

17 Mar 2008 ICD10\_1.0.owl

```
<owl:Class rdf:ID="T13_1">
  <owl:disjointWith>
    <owl:Class rdf:ID="T13_6"/>
  </owl:disjointWith>
  <owl:disjointWith>
    <owl:Class rdf:ID="T13_8"/>
  </owl:disjointWith>
  <owl:disjointWith>
    <owl:Class rdf:ID="T13_0"/>
  </owl:disjointWith>
  <owl:disjointWith>
    <owl:Class rdf:ID="T13_2"/>
  </owl:disjointWith>
  <has_Description rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >Open wound of lower limb, level unspecified</has_Description>
  <owl:disjointWith>
    <owl:Class rdf:ID="T13_4"/>
  </owl:disjointWith>
  <owl:disjointWith>
    <owl:Class rdf:ID="T13_3"/>
  </owl:disjointWith>
  <owl:disjointWith>
    <owl:Class rdf:ID="T13_9"/>
  </owl:disjointWith>
  <rdfs:subClassOf>
    <owl:Class rdf:ID="T13"/>
  </rdfs:subClassOf>
  <owl:disjointWith>
    <owl:Class rdf:ID="T13_5"/>
  </owl:disjointWith>
</owl:Class>
```

*ID Number*

*</has\_Description> identifies the line we want*

*Description of disease/condition*

\$ grep "/has\_Description>" ICD10\_1.0.owl

```
>Hypertension secondary to endocrine disorders</has_Description>
>Glucocorticoids and synthetic analogues</has_Description>
>Antivaricose drugs, including sclerosing agents</has_Description>
>Other immediate postpartum haemorrhage</has_Description>
>Congenital malformations of posterior segment of eye</has_Description>
>Thyroid hormones and substitutes</has_Description>
>Sleep terrors [night terrors]</has_Description>
>Other and unspecified antidepressants</has_Description>
>Other problems related to medical facilities and other health care</has_Description>
>Superficial frostbite</has_Description>
>Other pulmonary aspergillosis</has_Description>
>Hydrocephalus in infectious and parasitic diseases classified elsewhere</has_Description>
>Macrophthalmos</has_Description>
>Crushing injury of thorax and traumatic amputation of part of thorax</has_Description>
>Delayed and secondary postpartum haemorrhage</has_Description>
>Other and unspecified agents primarily affecting the cardiovascular system</has_Description>
>Recurrent and persistent haematuria</has_Description>
>Trade and service area</has_Description>
>Passenger injured in nontraffic accident</has_Description>
>Microphthalmos</has_Description>
>Invasive pulmonary aspergillosis</has_Description>
>Person on outside of vehicle injured in nontraffic accident</has_Description>
>Other congenital malformations of ear</has_Description>
>Accidental puncture and laceration during a procedure, not elsewhere classified</has_Description>
>Postpartum coagulation defects</has_Description>
>Rapidly progressive nephritic syndrome</has_Description>
>Street and highway</has_Description>
>Home</has_Description>
>Other anophthalmos</has_Description>
>Contact with venomous snakes and lizards</has_Description>
>Unspecified car occupant injured in nontraffic accident</has_Description>
```

#lines in ICS10\_1.0.owl = 302015      #lines after grep = 14501

```
$ grep "/has_Description>" ICD10_1.0.owl | sort | uniq
```

```
>With peripheral circulatory complications</has_Description>
>With renal complications</has_Description>
>With the statement of no, or minimal, impairment of behaviour</has_Description>
>With unspecified complications</has_Description>
>Withdrawal state with delirium</has_Description>
>Withdrawal state</has_Description>
>Withdrawal symptoms from therapeutic use of drugs in newborn</has_Description>
>Without complications</has_Description>
>Without mention of impairment of behaviour</has_Description>
>Withrenal complications</has_Description>
>Work-related condition</has_Description>
>Wound myiasis</has_Description>
>Wrist or foot drop (acquired)</has_Description>
>Wrong fluid used in infusion</has_Description>
>X-linked ichthyosis</has_Description>
>X-ray contrast media</has_Description>
>Xanthelasma of eyelid</has_Description>
>Xeroderma pigmentosum</has_Description>
>Xerosis cutis</has_Description>
>Yaws, unspecified</has_Description>
>Yaws</has_Description>
>Yellow fever, unspecified</has_Description>
>Yellow fever</has_Description>
>Yellow nail syndrome</has_Description>
>Zinc and its compounds</has_Description>
>Zoonotic bacterial disease, unspecified</has_Description>
>Zoster [herpes zoster]</has_Description>
>Zoster encephalitis</has_Description>
>Zoster meningitis</has_Description>
>Zoster ocular disease</has_Description>
>Zoster with other complications</has_Description>
```

**#lines after grep = 14501; after uniq = 11108**

```
$ grep "/has_Description>" ICD10_1.0.owl | sort | uniq |  
sed 's/<\ /has_Description>/'
```

```
>With peripheral circulatory complications  
>With renal complications  
>With the statement of no, or minimal, impairment of behaviour  
>With unspecified complications  
>Withdrawal state with delirium  
>Withdrawal state  
>Withdrawal symptoms from therapeutic use of drugs in newborn  
>Without complications  
  
>Without mention of impairment of behaviour  
>With renal complications  
>Work-related condition  
>Wound myiasis  
>Wrist or foot drop (acquired)  
>Wrong fluid used in infusion  
>X-linked ichthyosis  
>X-ray contrast media  
>Xanthelasma of eyelid  
>Xeroderma pigmentosum  
>Xerosis cutis  
>Yaws, unspecified  
>Yaws  
>Yellow fever, unspecified  
>Yellow fever  
.. .. .
```

Removes the has\_Description> at the end of the line

```
$ grep "/has_Description>" ICD10_1.0.owl | sort | uniq |  
sed 's/<\ /has_Description>/' | sed 's/^ >/' //
```

With peripheral circulatory complications  
With renal complications  
With the statement of no, or minimal, impairment of behaviour  
With unspecified complications  
Withdrawal state with delirium  
Withdrawal state  
Withdrawal symptoms from therapeutic use of drugs in newborn  
Without complications  
Without mention of impairment of behaviour  
Withrenal complications  
Work-related condition  
Wound myiasis  
Wrist or foot drop (acquired)  
Wrong fluid used in infusion  
X-linked ichthyosis  
X-ray contrast media  
Xanthelasma of eyelid  
Xeroderma pigmentosum  
Xerosis cutis  
Yaws, unspecified  
Yaws  
Yellow fever, unspecified  
Yellow fever  
.. .

Removes the > at the beginning of the line

```
$ grep "/has_Description>" ICD10_1.0.owl | sort | uniq |  
sed 's/<\Vhas_Description>//' | sed 's/^>// | grep "Assault" -
```

```
--  
Assault by blunt object  
Assault by bodily force  
Assault by corrosive substance  
Assault by crashing of motor vehicle  
Assault by drowning and submersion  
Assault by drugs, medicaments and biological substances  
Assault by explosive material  
Assault by gases and vapours  
Assault by handgun discharge  
Assault by hanging, strangulation and suffocation  
Assault by other and unspecified firearm discharge  
Assault by other specified chemicals and noxious substances  
Assault by other specified means  
Assault by pesticides  
Assault by pushing from high place  
Assault by pushing or placing victim before moving object  
Assault by rifle, shotgun and larger firearm discharge  
Assault by sharp object  
Assault by smoke, fire and flames  
Assault by steam, hot vapours and hot objects  
Assault by unspecified chemical or noxious substance  
Assault by unspecified means  
Assault
```

302015  
14501  
11108  
23

Using 4 UNIX  
commands:

- 1) grep
- 2) sort
- 3) uniq
- 4) sed

Finds all lines with the word “Assault”

```
#!/bin/bash
grep "/has_Description>" ICD10_1.0.owl | sort | uniq > intermed1
sed 's/<\!>/<Vhas_Description>/' intermed1 > intermed2
sed 's/^>/' intermed2 > intermed3
grep "$1" intermed3
```

\$ ./caseStudy.sh **Assault**

\$ ./caseStudy.sh "Intentional self-harm"

## \$ ./caseStudy.sh Assault

Assault by blunt object  
Assault by bodily force  
Assault by corrosive substance  
Assault by crashing of motor vehicle  
Assault by drowning and submersion  
Assault by drugs, medicaments and biological substances  
Assault by explosive material  
Assault by gases and vapours  
Assault by handgun discharge  
Assault by hanging, strangulation and suffocation  
Assault by other and unspecified firearm discharge  
Assault by other specified chemicals and noxious substances  
Assault by other specified means  
Assault by pesticides  
Assault by pushing from high place  
Assault by pushing or placing victim before moving object  
Assault by rifle, shotgun and larger firearm discharge  
Assault by sharp object  
Assault by smoke, fire and flames  
Assault by steam, hot vapours and hot objects  
Assault by unspecified chemical or noxious substance  
Assault by unspecified means  
Assault

## \$ ./caseStudy.sh "Intentional self-harm"

Intentional self-harm by blunt object

Intentional self-harm by crashing of motor vehicle

Intentional self-harm by drowning and submersion

Intentional self-harm by explosive material

Intentional self-harm by handgun discharge

Intentional self-harm by hanging, strangulation and suffocation

Intentional self-harm by jumping from a high place

Intentional self-harm by jumping or lying before moving object

Intentional self-harm by other and unspecified firearm discharge

Intentional self-harm by other specified means

Intentional self-harm by rifle, shotgun and larger firearm discharge

Intentional self-harm by sharp object

Intentional self-harm by smoke, fire and flames

Intentional self-harm by steam, hot vapours and hot objects

Intentional self-harm by unspecified means

Intentional self-harm