Computer Architecture and Technology Convergence Assignment

[DOCUMENT SUBTITLE]

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Contents

1: Binary Arithmetic

Using Putty, log in to the Amazon Ubuntu VM (at the following IP address: 54.197.176.72) as

1.1. Binary Addition

Add 11011 to 1011.

Table 1: Binary Number Addition

	Sign							
Num 1 (27)	0	0	0	1	1	0	1	1
Num 2 (11)	0	0	0	0	1	0	1	1
Carry			1	1		1	1	
Result (38)	0	0	1	0	0	1	1	0

1.2. 8-bit two's complement integers

Rewrite the following base-10numbers as 8-bit two's complement integers: -31, &-59.

-31 (8-bit two's complement integers)

Decimal	**Conversion**	**Invert all bits**	**Add 1**
-31	31/2 = 1 15/2= 1 7/2 = 1 3/2= 1 1/2= 1 0001 1111	1110 0000	11100001

Table 2: -31 (2 compliments - add 1 to inverted binary number)

Inverted bits	1	1	1	0	0	0	0	0
Add 1								1
Carry								
-31	1	1	1	0	0	0	0	1

-59 (8-bit two's complement integers)

Decimal	**Conversion**	**Invert all bits**	**Add 1**
-59	59/2 = 1 29/2=1 14/2=0 7/2=1 3/2=1 ½=1 00111011	11000100	11000101

Table 3: -59 (2 compliments - add 1 to inverted binary number

Inverted bits	1	1	0	0	0	1	0	0

Add 1								1
Carry								
-59	1	1	0	0	0	1	0	1

1.3. 8-bit Two's Complement Integer Interpretation

What does the bit pattern 11101001 represent if you interpret it as an 8-bit two's complement integer?

1110 1001 is the binary representation of a negative integer, on 8 bits.

1. Subtract 1 from bit pattern. 11101001 -1 = 11101000.
2. Invert 11101000 to 00010111
3. Convert 0001011 to decimal see, Table 4 Convert 00010111 Binary to Decimal

Table 4 Convert 00010111 Binary to Decimal

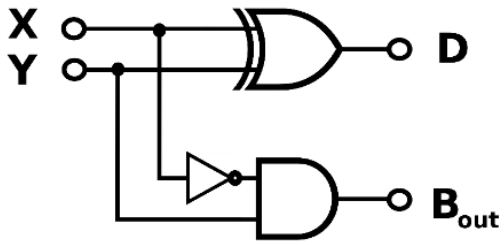
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	0	0	1	0	1	1	1
			16		4	2	1

16 + 4 + 2+ 1 = 23

4. **-23** (1110 1001 negative representation)

1.4. Circuit Truth Table

Draw up the truth table for the circuit below (inputs are X and Y and outputs are B and D). From observing the result, what function do you think this circuit performs?



The above is a Logic Diagram for a Half Subtractor. Output D is the difference and output B is the carry.

Table 5 Truth Table for Half Subtractor

Inputs			*Outputs*	
X	**X '**	**Y**	**D (X ⊕ Y)**	**B (X'· Y)**
0	1	0	0	0
0	1	1	1	1
1	0	0	1	0
1	0	1	0	0

1.5. Circuit Diagram

Draw the circuit diagram for the Boolean logic equation: (AB + C)D

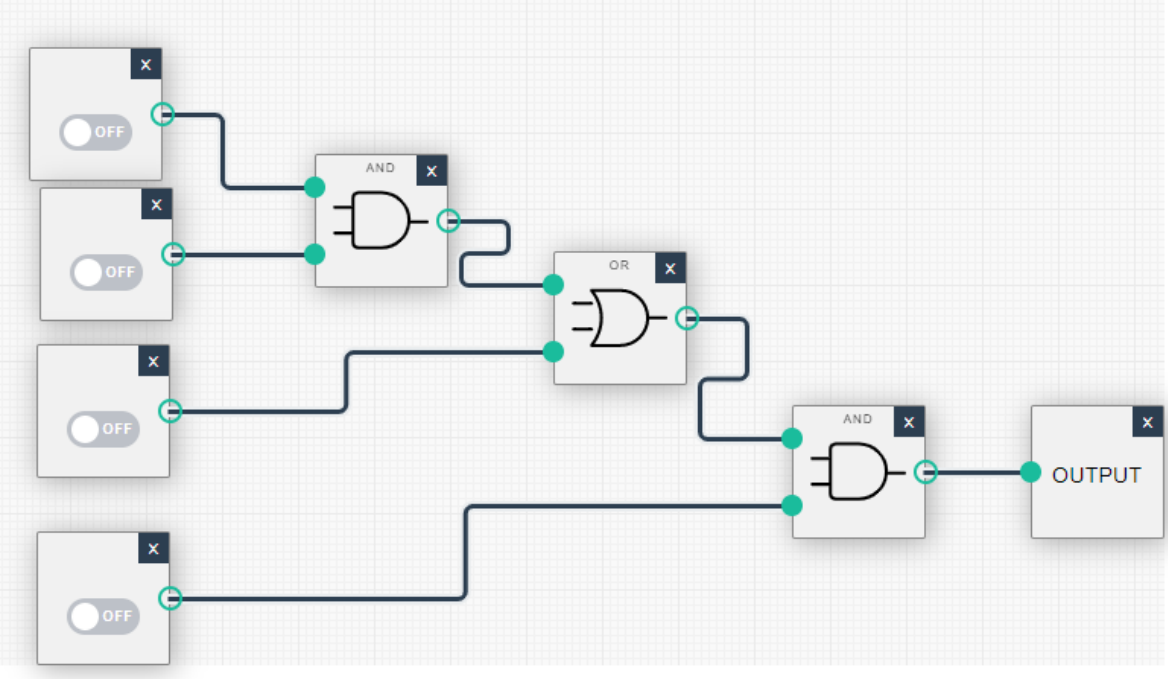


Figure 1 Circuit Diagram (AB + C)D

2. Linux Assignment

2.1. Linux Command Interpretation

Table 6 Command Interpretation

commands	
`echo hello world` ↵	Displays the words 'hello world' to the screen
`passwd` ↵	Enables the user to change their password - The user will be prompted to enter their old password first and if this step is passed then the new password must meet certain criteria.
`date` ↵	Displays date to screen.
`hostname` ↵	Displays the Domain Name System (DNS) name of the host system. Example: ip-172-31-87-57
`arch` ↵	Displays the machine architecture name. Example: x86_64
`uname -a` ↵	Display all the system information: Kernel, node name, kernel release, kernel version, machine, processor (if known), hardware platform (if known), O.S.
`dmesg | more` ↵	displays kernel ring buffer logs by page
`uptime` ↵	Displays how long the system has been up and running, number of users logged in, and load average
`whoami` ↵	Displays your username
`who` ↵	Displays other users who are logged in at that time
`last` ↵	Displays a list of users logged on previously
`finger` ↵	Displays details of all users logged in – username, idle time, login time, IP address (office)
`w` ↵	Displays details of what other users including self are working on at that time

`top`↵	Displays the summary information of the system and the list of processes or threads which are currently managed by the Linux Kernel
`echo $shell` ↵	Displays the Linux shell currently using i.e. Bash
`echo {con,pre}{sent,fer}{s,ed}`↵	Bash supports *brace expansion* and can be used to generate arbitrary strings. Output consents consented confers confered presents presented prefers prefered
`man ls`↵	Displays info/manual info on the command `ls`, which gives a directory listing
`man who`↵	Display manual info on the command `who`, which shows who is logged on
`clear`↵	Clears the terminal screen
`cal 2000`↵	Displays a calendar for the year 2000
`cal 9 1752`↵	Displays Sept for the year 1792. 11 days were skipped to make up for lack of leap year adjustments (Plan 9- Bell labs)
`yes please`↵	Repeats a string until user manually stops it.
`time sleep 5`↵	Pauses the execution on the next shell command for a given time
`history`↵	Lists previous commands entered into the Shell

```
 42  exit
 43  echo hello world
 44  echo man
 45  man echo
 46  man passwd
 47  man date
 48  date
 49  date --help
 50  date --date=%A
 51  date --date=STRING
 52  hostname
 53  man hostname
 54  man arch
 55  arch
 56  arch --help
 57  --help arch
 58  man arch
 59  passwd
 60  uname -a
 61  man uname -a
 62  uname --version
 63  man uname -a
 64  man dmesg | more
 65  dmesg | more
 66  --#help dmesg
 67  --help dmesg
 68  dmesg --help
 69  kernel ring bufferq
 70  man uptime
 71  uptime
 72  whoamI
 73  whoami
 74  who
 75  man who
 76  man last
 77  last
 78  man finger
 79  finger
 80  man w
 81  w
 82  man top
 83  top
 84  man echo $SHELL
 85  echo $SHELL
```

Figure 3: commands history (1)

```
 85  echo $SHELL
 86  echo {con,pre}{sent,fer}{s,ed}
 87  man echo {con,pre}{sent,fer}{s,ed}
 88  man echo {con, pre}{sent, fer}{s, ed}
 89  echo {con, pre}{sent, fer}{s, ed} --help
 90  man
 91  man brace expansion
 92  echo {con, pre}{sent, fer}{s, ed}
 93  echo {con,pre}{sent,fer}{s,ed}
 94  man ls
 95  man who
 96  who
 97  finger
 98  w
 99  man clear
100  man cal 2000
101  cal 2000
102  cal 9 1952
103  man epoch
104  cal 9 1752
105  man yes please
106  yes please
107  man time sleep 5
108  time sleep 5
109  man history
110  history
mairemurphy@ip-172-31-87-57:~$
```

Figure 3: Commands History (2)

2.2. Shell Script, VIM & Output Redirection

Below are the commands redirected to mairemurphy.txt. The contents of the text are below:

Date:

Mon Apr 19 18:55:45 UTC 2021

Hostname:

ip-172-31-87-57

Hardware Architecture:

x86_64

System Information:

Linux ip-172-31-87-57 5.4.0-1038-aws #40-Ubuntu SMP Fri Feb 5 23:50:40 UTC 2021 x86_64 x86_64 x86_64 GNU/Linux

System Uptime, Users & Load Average:

18:55:45 up 35 days, 21:32, 3 users, load average: 0.00, 0.00, 0.00

Username:::

mairemurphy

Users currently logged in:

mairemurphy pts/0 2021-04-19 17:51 (86.42.86.226)

damienflaherty pts/1 2021-04-19 17:22 (188.93.3.48)

alexandrucraciun pts/3 2021-04-19 15:05 (87.198.30.163)

What current users are doing:

Login Name Tty Idle Login Time Office Office Phone

alexandrucraciun pts/3 2:19 Apr 19 15:05 (87.198.30.163)

damienflaherty pts/1 1:33 Apr 19 17:22 (188.93.3.48)

mairemurphy pts/0 Apr 19 17:51 (86.42.86.226)

What users working on :

18:55:45 up 35 days, 21:32, 3 users, load average: 0.00, 0.00, 0.00

USER TTY FROM LOGIN@ IDLE JCPU PCPU WHAT

mairemur pts/0 86.42.86.226 17:51 0.00s 0.07s 0.00s w

damienfl pts/1 188.93.3.48 17:22 1:33m 0.03s 0.03s -bash

alexandr pts/3 87.198.30.163 15:05 2:19m 0.33s 0.00s lynx

System Summary:

top - 18:55:45 up 35 days, 21:32, 3 users, load average: 0.00, 0.00, 0.00

Tasks: 118 total, 1 running, 116 sleeping, 0 stopped, 1 zombie

%Cpu(s): 0.0 us, 0.0 sy, 0.0 ni,100.0 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st

MiB Mem : 978.6 total, 110.5 free, 239.2 used, 628.9 buff/cache

MiB Swap: 0.0 total, 0.0 free, 0.0 used. 562.1 avail Mem

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
1	root	20	0	170944	11364	6704	S	0.0	1.1	3:52.86	systemd
2	root	20	0	0	0	0	S	0.0	0.0	0:00.10	kthreadd
3	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_gp
4	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_par_gp
6	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/0:0H-kblockd
9	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	mm_percpu_wq
10	root	20	0	0	0	0	S	0.0	0.0	1:37.69	ksoftirqd/0
11	root	20	0	0	0	0	I	0.0	0.0	1:38.87	rcu_sched
12	root	rt	0	0	0	0	S	0.0	0.0	0:15.90	migration/0
13	root	20	0	0	0	0	S	0.0	0.0	0:00.00	cpuhp/0
14	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kdevtmpfs
15	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	netns
16	root	20	0	0	0	0	S	0.0	0.0	0:00.00	rcu_tasks_kthre
17	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kauditd
18	root	20	0	0	0	0	S	0.0	0.0	0:00.00	xenbus
19	root	20	0	0	0	0	S	0.0	0.0	0:00.01	xenwatch
20	root	20	0	0	0	0	S	0.0	0.0	0:00.91	khungtaskd
21	root	20	0	0	0	0	S	0.0	0.0	0:00.00	oom_reaper
22	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	writeback
23	root	20	0	0	0	0	S	0.0	0.0	0:00.15	kcompactd0
24	root	25	5	0	0	0	S	0.0	0.0	0:00.00	ksmd
25	root	39	19	0	0	0	S	0.0	0.0	0:06.89	khugepaged
71	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kintegrityd
72	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kblockd
73	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	blkcg_punt_bio
74	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	tpm_dev_wq

```
 75 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 ata_sff
 76 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 md
 77 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 edac-poller
 78 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 devfreq_wq
 79 root     rt  0      0     0     0 S  0.0   0.0   0:00.00 watchdogd
 82 root     20  0      0     0     0 S  0.0   0.0   0:11.06 kswapd0
 83 root     20  0      0     0     0 S  0.0   0.0   0:00.00 ecryptfs-kthrea
 85 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 kthrotld
 86 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 nvme-wq
 87 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 nvme-reset-wq
 88 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 nvme-delete-wq
 89 root     20  0      0     0     0 S  0.0   0.0   0:00.00 scsi_eh_0
 90 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 scsi_tmf_0
 91 root     20  0      0     0     0 S  0.0   0.0   0:00.00 scsi_eh_1
 92 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 scsi_tmf_1
 94 root      0 -20      0     0     0 I  0.0   0.0   0:42.52 kworker/0:1H-kblockd
 95 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 ipv6_addrconf
104 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 kstrp
107 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 kworker/u31:0
120 root     20  0      0     0     0 S  0.0   0.0   0:16.25 jbd2/xvda1-8
121 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 ext4-rsv-conver
159 root     19  -1  168948  63288  61472 S  0.0   6.3  23:03.45 systemd-journal
192 root     20  0   18964   4372   2920 S  0.0   0.4   0:30.83 systemd-udevd
204 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 cryptd
267 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 kaluad
268 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 kmpath_rdacd
269 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 kmpathd
270 root      0 -20      0     0     0 I  0.0   0.0   0:00.00 kmpath_handlerd
271 root     rt  0  280200  17992   8200 S  0.0   1.8   3:37.32 multipathd
279 root      0 -20      0     0     0 S  0.0   0.0   0:00.04 loop0
282 root      0 -20      0     0     0 S  0.0   0.0   0:00.01 loop1
284 root      0 -20      0     0     0 S  0.0   0.0   0:00.00 loop2
303 systemd+  20   0   90424   4944   4072 S   0.0   0.5   0:03.73 systemd-timesyn
377 systemd+  20   0   26924   5392   4424 S   0.0   0.5   0:05.21 systemd-network
380 systemd+  20   0   24092   9656   5496 S   0.0   1.0   0:05.32 systemd-resolve
443 root     20   0  241640   6384   4664 S   0.0   0.6   6:43.79 accounts-daemon
444 root     20   0    2540    856    788 S   0.0   0.1   0:00.00 acpid
```

```
  451 root      20   0    8536   2988   2712 S   0.0   0.3   0:04.25 cron
  452 message+  20   0    7852   4712   3580 S   0.0   0.5   0:14.53 dbus-daemon
  463 root      20   0   29264  12112   4480 S   0.0   1.2   0:00.07 networkd-dispat
  465 syslog    20   0  224500   4884   3284 S   0.0   0.5   3:50.53 rsyslogd
  471 root      20   0   17460   7156   5488 S   0.0   0.7   0:10.70 systemd-logind
  475 daemon    20   0    3792   2224   2052 S   0.0   0.2   0:00.04 atd
  588 root      20   0    7352   2132   2008 S   0.0   0.2   0:00.00 agetty
  626 root      20   0    5828   1788   1676 S   0.0   0.2   0:00.02 agetty
  627 root      20   0  242048   5756   4212 S   0.0   0.6   0:02.47 polkitd
  645 root      20   0  108088  13148   5496 S   0.0   1.3   0:00.06 unattended-upgr
 1074 root      20   0  645572  10024      0 S   0.0   1.0   1:24.04 amazon-ssm-agen
 1100 root      20   0  734388  16752      0 S   0.0   1.7   1:07.87 ssm-agent-worke
50766 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 xfsalloc
50767 root       0 -20       0      0      0 I   0.0   0.0   0:00.00 xfs_mru_cache
52504 root      20   0   12176   5256   4324 S   0.0   0.5   5:33.89 sshd
91239 root       0 -20       0      0      0 S   0.0   0.0   0:00.00 loop5
328916 root      0 -20       0      0      0 S   0.0   0.0   0:00.16 loop6
594181 root      0 -20       0      0      0 S   0.0   0.0   0:00.00 loop3
836451 angelrua  20   0   18452   8404   6876 S   0.0   0.8   0:01.01 systemd
836457 angelrua  20   0  172156   4780      0 S   0.0   0.5   0:00.00 (sd-pam)
838257 angelrua  20   0   11216   4164   3468 S   0.0   0.4  20:22.15 top
838599 angelrua  20   0   11216   4052   3356 S   0.0   0.4  20:27.99 top
965913 root      0 -20       0      0      0 S   0.0   0.0   0:00.15 loop7
965950 root      20   0  642360  19968   5364 S   0.0   2.0   0:54.40 snapd
1208720 paulobo+  20   0   18468   8260   6816 S   0.0   0.8   0:00.66 systemd
1208724 paulobo+  20   0  172156   4792      0 S   0.0   0.5   0:00.00 (sd-pam)
1209392 paulobo+  20   0   11240   4084   3388 S   0.0   0.4  13:58.37 top
1246933 jamesly+  20   0   18452   8316   6864 S   0.0   0.8   0:00.63 systemd
1246935 jamesly+  20   0  172156   4792      0 S   0.0   0.5   0:00.00 (sd-pam)
1247188 jamesly+  20   0   11236   4016   3324 S   0.0   0.4  13:11.96 top
1879192 root      20   0   13924   9096   7636 S   0.0   0.9   0:00.02 sshd
1879207 alexand+  20   0   18460   9224   7768 S   0.0   0.9   0:00.05 systemd
1879209 alexand+  20   0  172156   4800      0 S   0.0   0.5   0:00.00 (sd-pam)
1879283 alexand+  20   0   14056   6100   4620 S   0.0   0.6   0:00.58 sshd
1879284 alexand+  20   0   10164   5248   3464 S   0.0   0.5   0:00.10 bash
1880944 root      20   0       0      0      0 I   0.0   0.0   0:01.55 kworker/0:1-events
1881208 alexand+  20   0   23072  15028   7348 S   0.0   1.5   0:00.23 lynx
```

```
1881252 alexand+  20   0      0      0      0 Z   0.0   0.0   0:00.00 lynx
1882136 root      20   0   13928   9048   7588 S   0.0   0.9   0:00.01 sshd
1882150 damienf+  20   0   18456   9124   7676 S   0.0   0.9   0:00.03 systemd
1882153 damienf+  20   0  172156   4800      0 S   0.0   0.5   0:00.00 (sd-pam)
1882249 damienf+  20   0   14060   5852   4372 S   0.0   0.6   0:00.00 sshd
1882250 damienf+  20   0   10032   5100   3400 S   0.0   0.5   0:00.03 bash
1882820 root      20   0      0      0      0 I   0.0   0.0   0:00.08 kworker/u30:1-events_power_efficient
1882834 root      20   0   13920   9004   7548 S   0.0   0.9   0:00.01 sshd
1882846 mairemu+  20   0   18456   9224   7768 S   0.0   0.9   0:00.04 systemd
1882848 mairemu+  20   0  172156   4800      0 S   0.0   0.5   0:00.00 (sd-pam)
1882922 mairemu+  20   0   14052   6048   4572 S   0.0   0.6   0:00.68 sshd
1882923 mairemu+  20   0   10032   5040   3324 S   0.0   0.5   0:00.07 bash
1884022 root      20   0      0      0      0 I   0.0   0.0   0:00.00 kworker/0:0
1884045 root      20   0      0      0      0 I   0.0   0.0   0:00.01 kworker/u30:0-events_unbound
1884174 root      20   0   13204   8056   6960 S   0.0   0.8   0:00.00 sshd
1884175 sshd      20   0   12176   4532   3620 S   0.0   0.5   0:00.00 sshd
1884176 mairemu+  20   0    8752   3748   3296 S   0.0   0.4   0:00.00 bash
1884186 mairemu+  20   0   10872   3756   3300 R   0.0   0.4   0:00.00 top
```

History:

```
  1  echo "Date: " > MaireMurphy.txt
  2  date >> MaireMurphy.txt
  3  echo "Hostname: " >> MaireMurphy.txt
  4  hostname >> MaireMurphy.txt
  5  echo "Hardware Architecture:" >> MaireMurphy.txt
  6  arch >> MaireMurphy.txt
  7  echo "System Information: " >> MaireMurphy.txt
  8  uname -a >> MaireMurphy.txt
  9  echo "System Uptime, Users & Load Average: " >> MaireMurphy.txt
 10  uptime >> MaireMurphy.txt
 11  echo "Username::: " >> MaireMurphy.txt
 12  whoami >> MaireMurphy.txt
 13  echo "Users currently logged in: " >> MaireMurphy.txt
 14  who  >> MaireMurphy.txt
 15  echo "What current users are doing: " >> MaireMurphy.txt
 16  finger >> MaireMurphy.txt
```

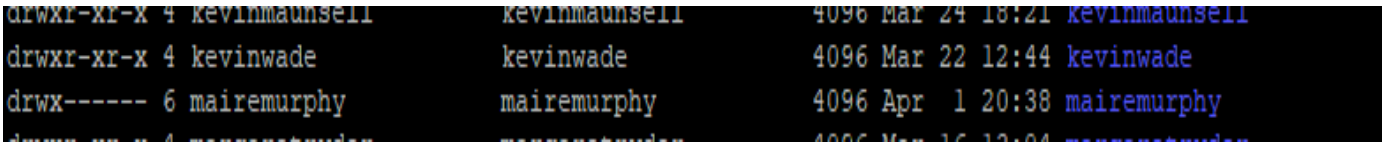
```
17 echo "What users working on :" >> MaireMurphy.txt
18 w >> MaireMurphy.txt
19 echo "System Summary: " >> MaireMurphy.txt
20 top -b -n 1 >> MaireMurphy.txt
21 echo " " >> MaireMurphy.txt
22 echo "History: " >> MaireMurphy.txt
23 history >> MaireMurphy.txt
```

2.3

2.3.1. Folder Permissions

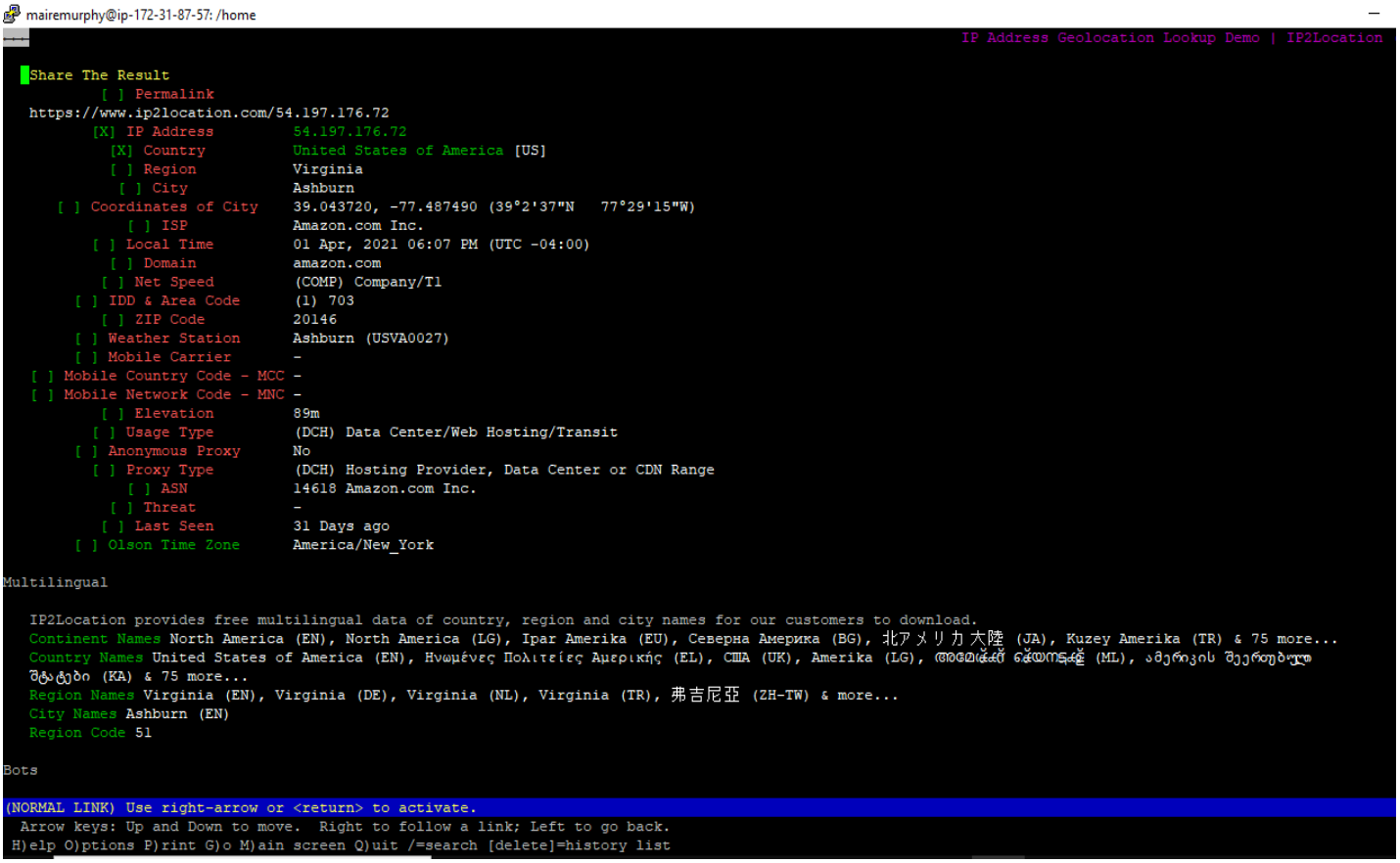
Give owner full permission and block out Groups and Others.

```
$chmod 700 mairemurphy
```

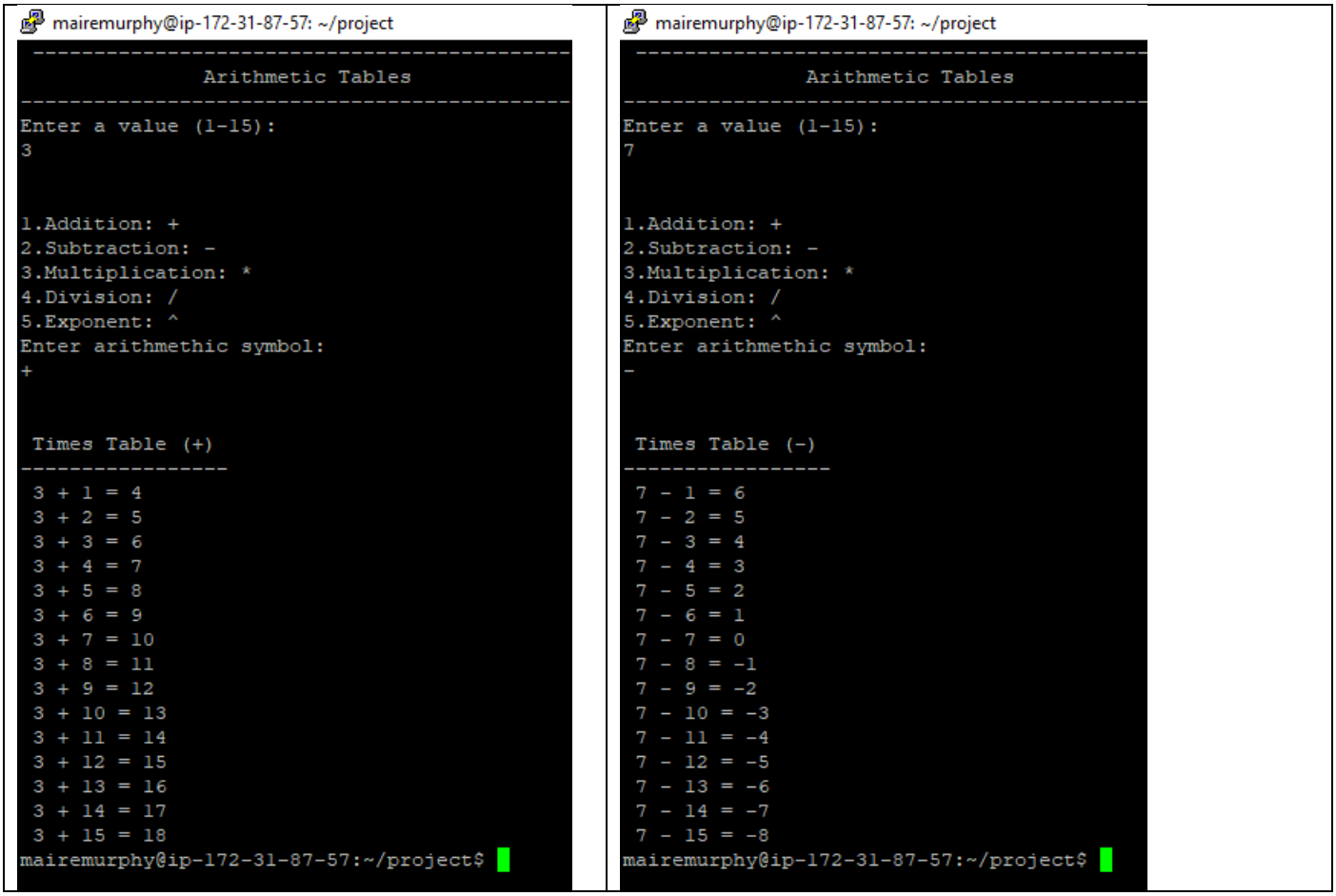


2.3.2. Lynx, VM Location

Virtual Machine IP address and location using text-based editor Lynx.



2.4. Arithmetic Tables Using Bash Script



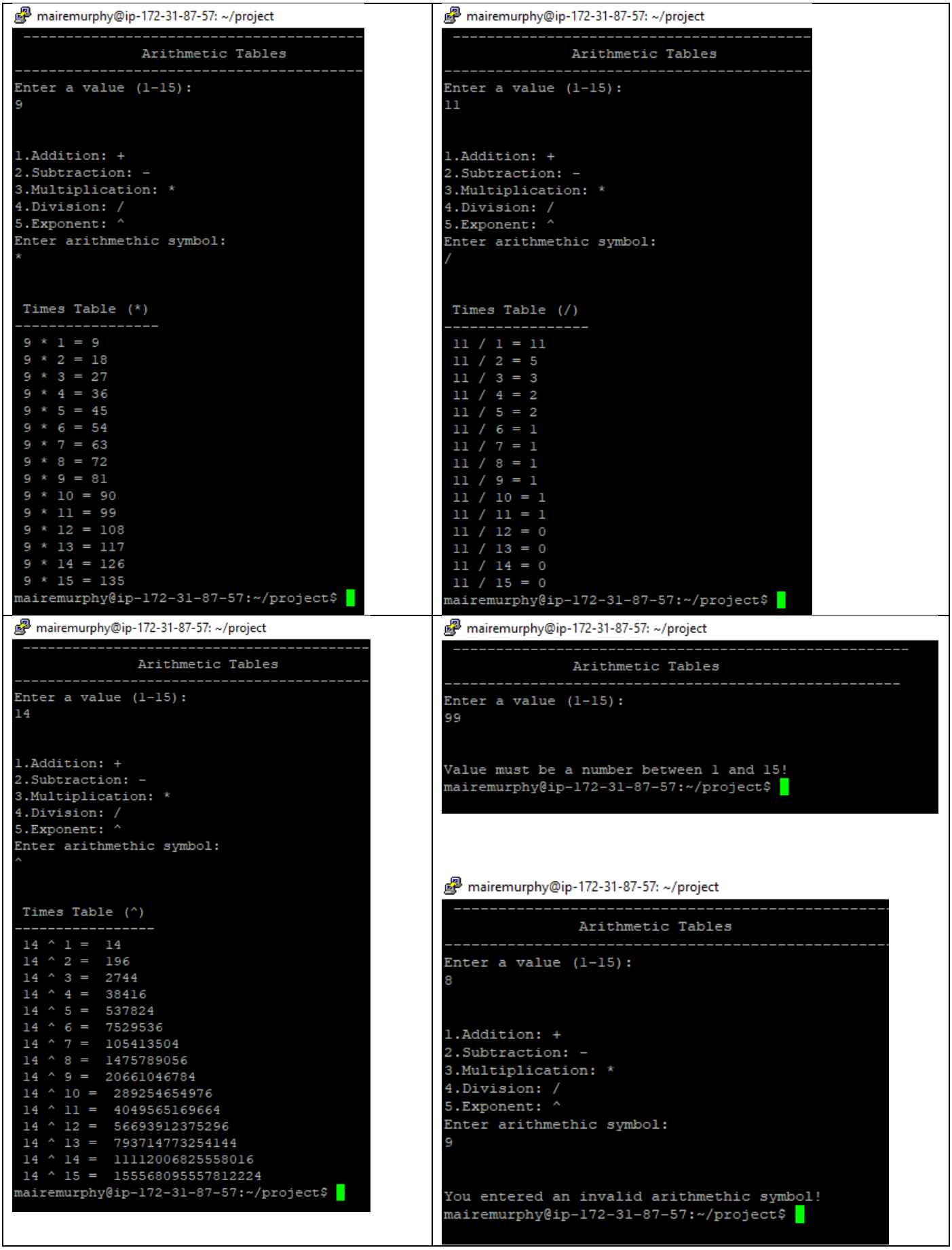


Figure 4: 2. 4 Output from Bash Script

mairemurphy@ip-172-31-87-57: ~/project

```
#!/bin/bash
clear
validChoice=false
validValue=false
echo " ------------------------------------------------------"
echo "               Arithmetic Tables                      "
echo ------------------------------------------------------
echo "Enter a value (1-15): "
read value
echo " "
echo " "
if (( $value >= 1 )) && (( $value <= 15 )); then  #validation operand must be between 1 and 15 inclusive
        validValue=true
        echo 1.Addition: +
        echo 2.Subtraction: -
        echo "3.Multiplication: *"
        echo 4.Division: /
        echo 5.Exponent: ^
        echo "Enter arithmethic symbol: "
        read choice
        echo " "
        echo " "
        #check for a valid arithmetic choice
        if [[ "$choice" == "*" ]] || [[ "$choice" == "+" ]] || [[ "$choice" == "^" ]] || [[ "$choice" == "-" ]] || [[ "$choice" == "/" ]]; then
                validChoice=true
        elif [[ $validChoice == false ]]; then
                echo "You entered an invalid arithmethic symbol!"
        fi

        if [[ $validChoice == true ]] && [[ $validValue == true ]]; then
                        echo "$x Times Table ($choice)"
                        echo "-----------------"
                        i="1"
                        while [ $i -le 15 ] #loop 15 times
                        do
                                if [[ "$choice" == "*" ]]; then
                                        echo " $value * $i = `expr $value \* $i`" #multiplication calculation
                                elif [[ "$choice" == "+" ]]; then
                                        echo " $value + $i = `expr $value \+ $i`" #additional calculation
                                elif [[ "$choice" == "-" ]]; then
                                        echo " $value - $i = `expr $value \- $i`" #subtraction calculation
                                elif [[ "$choice" == "/" ]]; then
                                        echo " $value / $i = `expr $value \/ $i`" #division calculation
                                elif [[ "$choice" == "^" ]]; then               #exponent calculation
                                        answer=$(echo $(( value ** i )))
                                        echo " $value ^ $i = " $answer
                                fi
                                ((i=i+1))
                        done
        fi
elif [[ $validValue == false ]]; then
        echo "Value must be a number between 1 and 15!"
fi
-- INSERT --
```

Figure 5: Bash Program to Create Arithmetic Table