Q1
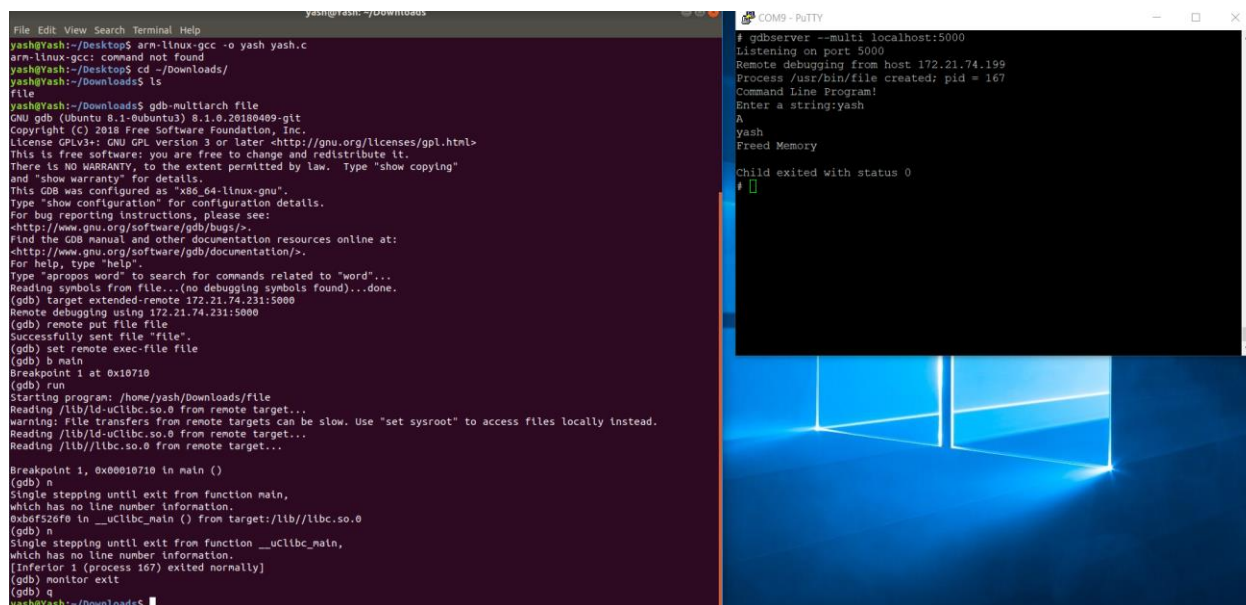
```
# cat /var/log/messages | grep syslog | grep eth0
Jan  1 00:00:03 buildroot daemon.info syslog[99]: eth0: waiting for carrier
Jan  1 00:00:03 buildroot daemon.info syslog[99]: eth0: carrier acquired
Jan  1 00:00:03 buildroot daemon.info syslog[99]: eth0: IAID 32:2e:be:7b
Jan  1 00:00:03 buildroot daemon.info syslog[99]: eth0: adding address fe80::df5a:2bf1:52ae:6f73
Jan  1 00:00:03 buildroot daemon.info syslog[99]: eth0: carrier lost
Jan  1 00:00:03 buildroot daemon.info syslog[99]: eth0: deleting address fe80::df5a:2bf1:52ae:6f73
Jan  1 00:00:06 buildroot daemon.info syslog[99]: eth0: carrier acquired
Jan  1 00:00:06 buildroot daemon.info syslog[99]: eth0: IAID 32:2e:be:7b
Jan  1 00:00:06 buildroot daemon.info syslog[99]: eth0: adding address fe80::df5a:2bf1:52ae:6f73
Jan  1 00:00:06 buildroot daemon.info syslog[99]: eth0: rebinding lease of 172.21.74.221
Jan  1 00:00:06 buildroot daemon.warn syslog[99]: eth0: NAK: requested address not available from 128.138.129.173
Jan  1 00:00:06 buildroot daemon.warn syslog[99]: eth0: message: requested address not available
Jan  1 00:00:06 buildroot daemon.info syslog[99]: eth0: soliciting a DHCP lease
Jan  1 00:00:06 buildroot daemon.info syslog[99]: eth0: soliciting an IPv6 router
Jan  1 00:00:07 buildroot daemon.info syslog[99]: eth0: offered 172.21.74.231 from 128.138.240.17
Jan  1 00:00:07 buildroot daemon.info syslog[99]: eth0: probing address 172.21.74.231/24
Jan  1 00:00:12 buildroot daemon.info syslog[99]: eth0: leased 172.21.74.231 for 604800 seconds
Jan  1 00:00:12 buildroot daemon.info syslog[99]: eth0: adding route to 172.21.74.0/24
Jan  1 00:00:12 buildroot daemon.info syslog[99]: eth0: adding default route via 172.21.74.1
Jan  1 00:00:19 buildroot daemon.warn syslog[99]: eth0: no IPv6 Routers available
# ifconfig
eth0      Link encap:Ethernet  HWaddr 40:BD:32:2E:BE:7B
          inet addr:172.21.74.231  Bcast:172.21.74.255  Mask:255.255.255.0
          inet6 addr: fe80::df5a:2bf1:52ae:6f73/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:4598 errors:0 dropped:0 overruns:0 frame:0
          TX packets:17 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:331823 (324.0 KiB)  TX bytes:2221 (2.1 KiB)
          Interrupt:46

#
```

Q1

```
                          yash@Yash: ~/Desktop
File  Edit  View  Search  Terminal  Help
cp: cannot create regular file 'root@172.21.74.231:/usr/bin': No such
file or directory
yash@Yash:~/Desktop$ scp yash.c root@172.21.74.231:/usr/bin
The authenticity of host '172.21.74.231 (172.21.74.231)' can't be esta
blished.
ECDSA key fingerprint is SHA256:NmwwX4sf3R8qRZNlN+DzqwjpjZXL4RI8pROqnP
1/DYI.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '172.21.74.231' (ECDSA) to the list of know
n hosts.
root@172.21.74.231's password:
Permission denied, please try again.
root@172.21.74.231's password:
Permission denied, please try again.
root@172.21.74.231's password:
root@172.21.74.231: Permission denied (publickey,password).
lost connection
yash@Yash:~/Desktop$ scp yash.c root@172.21.74.231:/usr/bin
root@172.21.74.231's password:
yash.c                              100%   11     3.9KB/s
00:00
yash@Yash:~/Desktop$
```
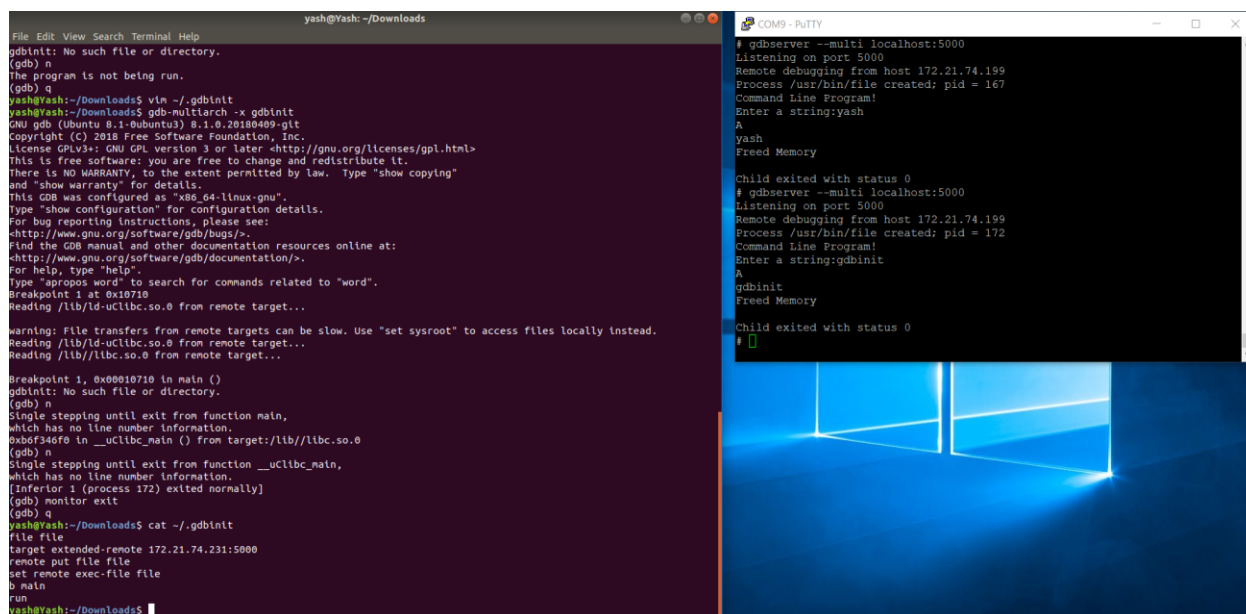
```
# cd /usr/bin
# ls | grep yash.c
# ls | grep yash.c
yash.c
#
```

Q2


```
yash@Yash:~/Downloads
File Edit View Search Terminal Help
yash@Yash:~/Desktop$ arm-linux-gcc -o yash yash.c
arm-linux-gcc: command not found
yash@Yash:~/Desktop$ cd ~/Downloads/
yash@Yash:~/Downloads$ ls
file
yash@Yash:~/Downloads$ gdb-multiarch file
GNU gdb (Ubuntu 8.1-0ubuntu3) 8.1.0.20180409-git
Copyright (C) 2018 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.  Type "show copying"
and "show warranty" for details.
This GDB was configured as "x86_64-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.
For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from file...(no debugging symbols found)...done.
(gdb) target extended-remote 172.21.74.231:5000
Remote debugging using 172.21.74.231:5000
(gdb) remote put file file
Successfully sent file "file".
(gdb) set remote exec-file file
(gdb) b main
Breakpoint 1 at 0x10710
(gdb) run
Starting program: /home/yash/Downloads/file
Reading /lib/ld-uClibc.so.0 from remote target...
warning: File transfers from remote targets can be slow. Use "set sysroot" to access files locally instead.
Reading /lib/ld-uClibc.so.0 from remote target...
Reading /lib/libc.so.0 from remote target...

Breakpoint 1, 0x00010710 in main ()
(gdb) n
Single stepping until exit from function main,
which has no line number information.
0xb6f526f0 in __uClibc_main () from target:/lib//libc.so.0
(gdb) n
Single stepping until exit from function __uClibc_main,
which has no line number information.
[Inferior 1 (process 167) exited normally]
(gdb) monitor exit
(gdb) q
yash@Yash:~/Downloads$
```

```
COM9 - PuTTY
# gdbserver --multi localhost:5000
Listening on port 5000
Remote debugging from host 172.21.74.199
Process /usr/bin/file created; pid = 167
Command Line Program!
Enter a string:yash
A
yash
Freed Memory

Child exited with status 0
#
```

Q2


```
yash@Yash:~/Downloads
File Edit View Search Terminal Help
gdbinit: No such file or directory.
(gdb) n
The program is not being run.
(gdb) q
yash@Yash:~/Downloads$ vim ~/.gdbinit
yash@Yash:~/Downloads$ gdb-multiarch -x gdbinit
GNU gdb (Ubuntu 8.1-0ubuntu3) 8.1.0.20180409-git
Copyright (C) 2018 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.  Type "show copying"
and "show warranty" for details.
This GDB was configured as "x86_64-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.
For help, type "help".
Type "apropos word" to search for commands related to "word".
Breakpoint 1 at 0x10710
Reading /lib/ld-uClibc.so.0 from remote target...

warning: File transfers from remote targets can be slow. Use "set sysroot" to access files locally instead.
Reading /lib/ld-uClibc.so.0 from remote target...
Reading /lib/libc.so.0 from remote target...

Breakpoint 1, 0x00010710 in main ()
gdbinit: No such file or directory.
(gdb) n
Single stepping until exit from function main,
which has no line number information.
0xb6f346f0 in __uClibc_main () from target:/lib//libc.so.0
(gdb) n
Single stepping until exit from function __uClibc_main,
which has no line number information.
[Inferior 1 (process 172) exited normally]
(gdb) monitor exit
(gdb) q
yash@Yash:~/Downloads$ cat ~/.gdbinit
file file
target extended-remote 172.21.74.231:5000
remote put file file
set remote exec-file file
b main
run
yash@Yash:~/Downloads$
```

```
COM9 - PuTTY
# gdbserver --multi localhost:5000
Listening on port 5000
Remote debugging from host 172.21.74.199
Process /usr/bin/file created; pid = 167
Command Line Program!
Enter a string:yash
A
yash
Freed Memory

Child exited with status 0
# gdbserver --multi localhost:5000
Listening on port 5000
Remote debugging from host 172.21.74.199
Process /usr/bin/file created; pid = 172
Command Line Program!
Enter a string:gdbinit
A
gdbinit
Freed Memory

Child exited with status 0
#
```

Q3

```
# insmod TimerModule.ko name="Yash" diff=1000
# [  142.328910] Yash : Count: 1
[  143.368414] Yash : Count: 2
[  144.408419] Yash : Count: 3
[  145.448418] Yash : Count: 4
[  146.488421] Yash : Count: 5
[  147.528424] Yash : Count: 6
[  148.568429] Yash : Count: 7
[  149.608433] Yash : Count: 8
[  150.648436] Yash : Count: 9
[  151.688438] Yash : Count: 10
[  152.728439] Yash : Count: 11
[  153.768446] Yash : Count: 12
[  154.808448] Yash : Count: 13
[  155.848446] Yash : Count: 14
[  156.888452] Yash : Count: 15
[  157.928452] Yash : Count: 16
[  158.968455] Yash : Count: 17
[  160.008464] Yash : Count: 18
[  161.048466] Yash : Count: 19
[  162.088464] Yash : Count: 20
[  163.128466] Yash : Count: 21
[  164.168481] Yash : Count: 22
[  165.208474] Yash : Count: 23
[  166.248475] Yash : Count: 24
[  167.288480] Yash : Count: 25
[  168.328480] Yash : Count: 26
```

Q3

```
# [  203.688567] Yash : Count: 60
r[  204.728574] Yash : Count: 61
mmod T[  205.768569] Yash : Count: 62
# rmmod TimerModule.ko
# modinfo TimerModule.ko
filename:        /usr/bin/TimerModule.ko
description:     MY TIMER MODULE
author:          Yash Gupte
license:         GPL
srcversion:      0551018CB2AAFF3D265EC0B
depends:
name:            TimerModule
vermagic:        4.14.40 SMP mod_unload modversions ARMv6 p2v8
parm:            name:charp
parm:            count:int
parm:            diff:int
# [  270.189240] random: crng init done
```

Q4

```
# insmod Q4.ko
[   35.658141] Q4: loading out-of-tree module taints kernel.
[   35.664753] List of nodes with count for Set-1
[   35.669637] Ant--1
[   35.671746] Bee--1
[   35.673846] Bull--3
[   35.676043] Cat--3
[   35.678217] Cheetah--2
[   35.680684] Croc--2
[   35.682874] Dog--2
[   35.684975] Dragon--2
[   35.687652] Fish--2
[   35.689849] Hippo--2
[   35.692135] Leopard--2
[   35.694601] Lion--3
[   35.696794] Lizard--2
[   35.699234] Mice--1
[   35.701427] Panther--2
[   35.703893] Pig--3
[   35.705990] Puma--2
[   35.708225] Rat--3
[   35.710329] Sheep--3
[   35.712610] Snake--2
[   35.714995] Tiger--3
[   35.717174] Turtle--2
[   35.719587] Zebra--2
[   35.721871] Number of nodes in Set-1:23
[   35.721881] Size occupied by Set1: 736
[   35.729859] Size freed by Set1: 736
[   35.733556] List of nodes for Set-2 without any filter
[   35.738970] Ant--1
[   35.741074] Bee--1
[   35.743173] Bull--3
[   35.745364] Cat--3
[   35.747504] Cheetah--2
[   35.749966] Croc--2
[   35.752154] Dog--2
[   35.754250] Dragon--2
[   35.756621] Fish--2
[   35.758854] Hippo--2
[   35.761133] Leopard--2
[   35.763600] Lion--3
[   35.765794] Lizard--2
[   35.768203] Mice--1
[   35.770397] Panther--2
[   35.772863] Pig--3
[   35.774964] Puma--2
[   35.777151] Rat--3
[   35.779291] Sheep--3
[   35.781572] Snake--2
```

```
[   35.781572] Snake--2
[   35.783850] Tiger--3
[   35.786132] Turtle--2
[   35.788546] Zebra--2
[   35.790823] Applying filter for count
[   35.794649] All nodes with count :2
[   35.798323] Animal name: Bull
[   35.801420] Animal name: Cat
[   35.804427] Animal name: Cheetah
[   35.807839] Animal name: Croc
[   35.810934] Animal name: Dog
[   35.813940] Animal name: Dragon
[   35.817264] Animal name: Fish
[   35.820362] Animal name: Hippo
[   35.823550] Animal name: Leopard
[   35.826924] Animal name: Lion
[   35.830062] Animal name: Lizard
[   35.833338] Animal name: Panther
[   35.836701] Animal name: Pig
[   35.839747] Animal name: Puma
[   35.842844] Animal name: Rat
[   35.845857] Animal name: Sheep
[   35.849083] Animal name: Snake
[   35.852270] Animal name: Tiger
[   35.855459] Animal name: Turtle
[   35.858773] Animal name: Zebra
[   35.861964]_____
[   35.861973] Applying filter for name
[   35.872289] Nodes with string : Dog
[   35.875933] Animal name: Dog
[   35.875933] ==>Animal Count:2
[   35.875942]_____
[   35.882072] Applying filter for count and name
[   35.893283] Nodes with string : Cat and Count:2
[   35.898055] Animal name: Cat
[   35.898055] ==>Animal Count:3
[   35.898065]_____
[   35.904149] Traversing the list using list_for_each_entry()
[   35.916544] Animal name: Ant - count: 1
[   35.920593] Animal name: Bee - count: 1
[   35.924599] Animal name: Bull - count: 3
[   35.928738] Animal name: Cat - count: 3
[   35.932741] Animal name: Cheetah - count: 2
[   35.937104] Animal name: Croc - count: 2
[   35.941234] Animal name: Dog - count: 2
[   35.945241] Animal name: Dragon - count: 2
[   35.949559] Animal name: Fish - count: 2
[   35.953651] Animal name: Hippo - count: 2
[   35.957871] Animal name: Leopard - count: 2
[   35.962246] Animal name: Lion - count: 3
```

```
[   35.830062] Animal name: Lizard
[   35.833338] Animal name: Panther
[   35.836701] Animal name: Pig
[   35.839747] Animal name: Puma
[   35.842844] Animal name: Rat
[   35.845857] Animal name: Sheep
[   35.849083] Animal name: Snake
[   35.852270] Animal name: Tiger
[   35.855459] Animal name: Turtle
[   35.858773] Animal name: Zebra
[   35.861964]
[   35.861973] Applying filter for name
[   35.872289] Nodes with string : Dog
[   35.875933] Animal name: Dog
[   35.875933] ==>Animal Count:2
[   35.875942]
[   35.882072] Applying filter for count and name
[   35.893283] Nodes with string : Cat and Count:2
[   35.898055] Animal name: Cat
[   35.898055] ==>Animal Count:3
[   35.898065]
[   35.904149] Traversing the list using list_for_each_entry()
[   35.916544] Animal name: Ant - count: 1
[   35.920593] Animal name: Bee - count: 1
[   35.924599] Animal name: Bull - count: 3
[   35.928738] Animal name: Cat - count: 3
[   35.932741] Animal name: Cheetah - count: 2
[   35.937104] Animal name: Croc - count: 2
[   35.941234] Animal name: Dog - count: 2
[   35.945241] Animal name: Dragon - count: 2
[   35.949559] Animal name: Fish - count: 2
[   35.953651] Animal name: Hippo - count: 2
[   35.957871] Animal name: Leopard - count: 2
[   35.962246] Animal name: Lion - count: 3
[   35.966344] Animal name: Lizard - count: 2
[   35.970668] Animal name: Mice - count: 1
[   35.974765] Animal name: Panther - count: 2
[   35.979174] Animal name: Pig - count: 3
[   35.983183] Animal name: Puma - count: 2
[   35.987315] Animal name: Rat - count: 3
[   35.991324] Animal name: Sheep - count: 3
[   35.995508] Animal name: Snake - count: 2
[   35.999740] Animal name: Tiger - count: 3
[   36.003930] Animal name: Turtle - count: 2
[   36.008246] Animal name: Zebra - count: 2
[   36.012430] Time elapsed: 347784208ns
[   36.016256] Size occupied by Set2: 736
[   36.020220] Size freed by Set2: 736
# [   95.364711] random: crng init done
```