Step 1 : Login to the cloud ssh using ssh command

```
● ● ●  🏠 williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

   Get cloud support with Ubuntu Advantage Cloud Guest:
     http://www.ubuntu.com/business/services/cloud

0 packages can be updated.
0 updates are security updates.



The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

Changing password for root.
[(current) UNIX password:                                              ]
[Enter new UNIX password:                                              ]
[Retype new UNIX password:                                             ]
root@williamscott:~# █
```

Step 2 : Download the kernel source using wget command from kernel website.

```
● ● ●  🏠 williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
root@williamscott:~# wget https://www.kernel.org/pub/linux/kernel/v4.x/linux-4.1
7.4.tar.xz█
```

Downloading

```
●  ●  ●  ⌂ williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
[root@williamscott:~# wget https://www.kernel.org/pub/linux/kernel/v4.x/linux-4.1]
7.4.tar.xz
--2018-07-12 07:56:48--  https://www.kernel.org/pub/linux/kernel/v4.x/linux-4.17
.4.tar.xz
Resolving www.kernel.org (www.kernel.org)... 2604:1380:40a0:500::1, 147.75.42.13
9
Connecting to www.kernel.org (www.kernel.org)|2604:1380:40a0:500::1|:443... conn
ected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: https://mirrors.edge.kernel.org/pub/linux/kernel/v4.x/linux-4.17.4.tar
.xz [following]
--2018-07-12 07:57:01--  https://mirrors.edge.kernel.org/pub/linux/kernel/v4.x/l
inux-4.17.4.tar.xz
Resolving mirrors.edge.kernel.org (mirrors.edge.kernel.org)... 2604:1380:2001:39
00::1, 147.75.101.1
Connecting to mirrors.edge.kernel.org (mirrors.edge.kernel.org)|2604:1380:2001:3
900::1|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 102176828 (97M) [application/x-xz]
Saving to: 'linux-4.17.4.tar.xz'

linux-4.17.4.tar.xz  64%[===========>          ]  62.77M  10.9MB/s    eta 5s
```

Download Complete

```
●  ●  ●  ⌂ williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
.4.tar.xz
Resolving www.kernel.org (www.kernel.org)... 2604:1380:40a0:500::1, 147.75.42.13
9
Connecting to www.kernel.org (www.kernel.org)|2604:1380:40a0:500::1|:443... conn
ected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: https://mirrors.edge.kernel.org/pub/linux/kernel/v4.x/linux-4.17.4.tar
.xz [following]
--2018-07-12 07:57:01--  https://mirrors.edge.kernel.org/pub/linux/kernel/v4.x/l
inux-4.17.4.tar.xz
Resolving mirrors.edge.kernel.org (mirrors.edge.kernel.org)... 2604:1380:2001:39
00::1, 147.75.101.1
Connecting to mirrors.edge.kernel.org (mirrors.edge.kernel.org)|2604:1380:2001:3
900::1|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 102176828 (97M) [application/x-xz]
Saving to: 'linux-4.17.4.tar.xz'

linux-4.17.4.tar.xz 100%[====================>]  97.44M  11.1MB/s    in 11s

2018-07-12 07:57:13 (9.21 MB/s) - 'linux-4.17.4.tar.xz' saved [102176828/1021768
28]

root@williamscott:~#
```
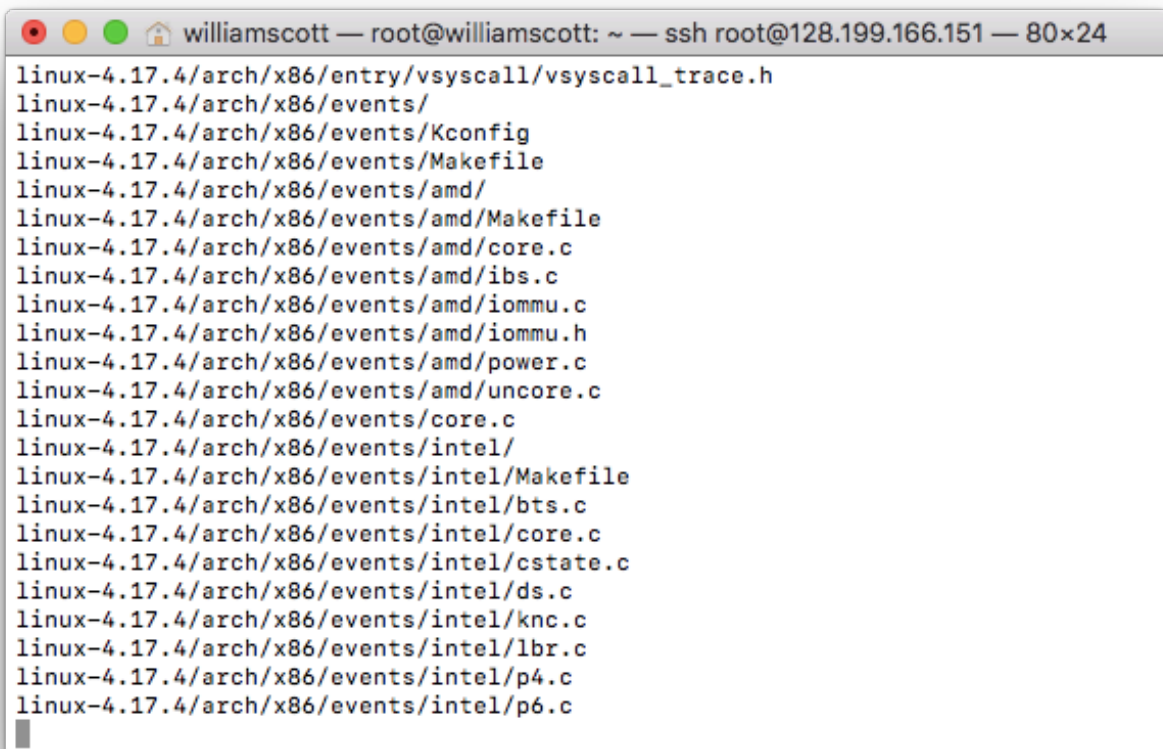
Step 3 : Extract the kernel source code using tar —xvf command

```
● ● ●  ⌂ williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
root@williamscott:~# sudo tar -xvf linux-4.17.4.tar.xz -C/usr/src/▌
```

Extracting

```
● ● ●  ⌂ williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
linux-4.17.4/arch/x86/entry/vsyscall/vsyscall_trace.h
linux-4.17.4/arch/x86/events/
linux-4.17.4/arch/x86/events/Kconfig
linux-4.17.4/arch/x86/events/Makefile
linux-4.17.4/arch/x86/events/amd/
linux-4.17.4/arch/x86/events/amd/Makefile
linux-4.17.4/arch/x86/events/amd/core.c
linux-4.17.4/arch/x86/events/amd/ibs.c
linux-4.17.4/arch/x86/events/amd/iommu.c
linux-4.17.4/arch/x86/events/amd/iommu.h
linux-4.17.4/arch/x86/events/amd/power.c
linux-4.17.4/arch/x86/events/amd/uncore.c
linux-4.17.4/arch/x86/events/core.c
linux-4.17.4/arch/x86/events/intel/
linux-4.17.4/arch/x86/events/intel/Makefile
linux-4.17.4/arch/x86/events/intel/bts.c
linux-4.17.4/arch/x86/events/intel/core.c
linux-4.17.4/arch/x86/events/intel/cstate.c
linux-4.17.4/arch/x86/events/intel/ds.c
linux-4.17.4/arch/x86/events/intel/knc.c
linux-4.17.4/arch/x86/events/intel/lbr.c
linux-4.17.4/arch/x86/events/intel/p4.c
linux-4.17.4/arch/x86/events/intel/p6.c
▌
```
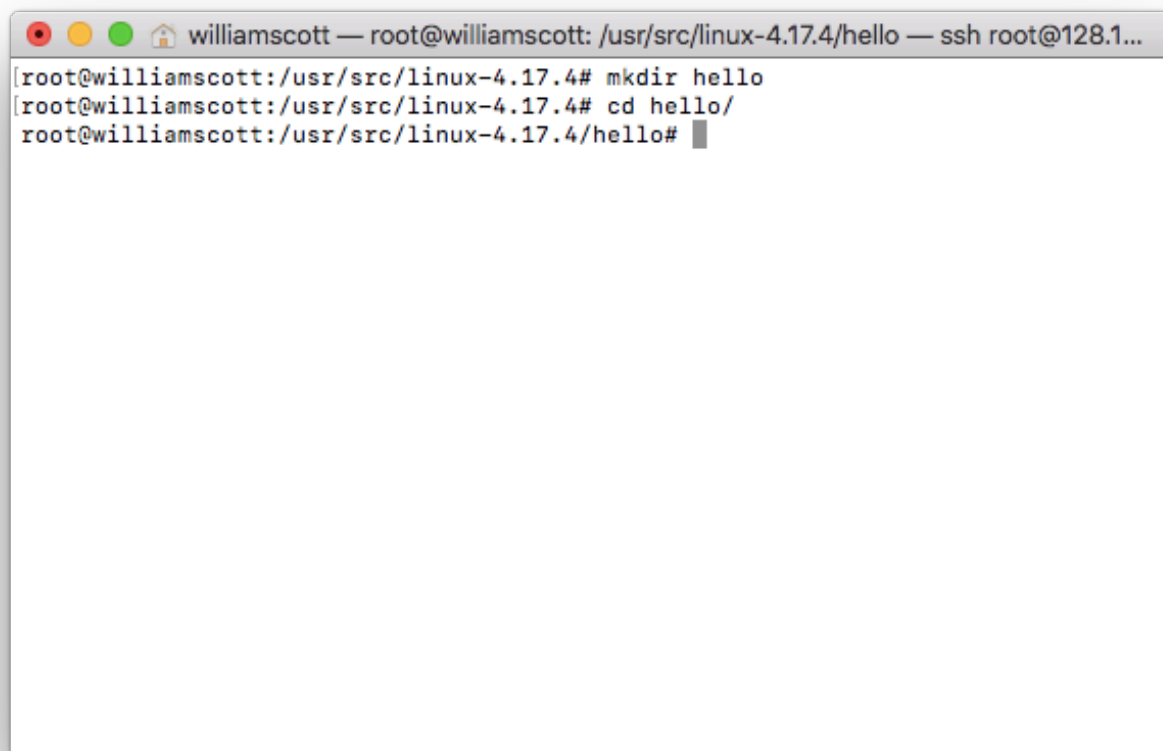
Extract Complete

```
● ● ●  ⌂ williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
linux-4.17.4/virt/kvm/arm/vgic/vgic-kvm-device.c
linux-4.17.4/virt/kvm/arm/vgic/vgic-mmio-v2.c
linux-4.17.4/virt/kvm/arm/vgic/vgic-mmio-v3.c
linux-4.17.4/virt/kvm/arm/vgic/vgic-mmio.c
linux-4.17.4/virt/kvm/arm/vgic/vgic-mmio.h
linux-4.17.4/virt/kvm/arm/vgic/vgic-v2.c
linux-4.17.4/virt/kvm/arm/vgic/vgic-v3.c
linux-4.17.4/virt/kvm/arm/vgic/vgic-v4.c
linux-4.17.4/virt/kvm/arm/vgic/vgic.c
linux-4.17.4/virt/kvm/arm/vgic/vgic.h
linux-4.17.4/virt/kvm/async_pf.c
linux-4.17.4/virt/kvm/async_pf.h
linux-4.17.4/virt/kvm/coalesced_mmio.c
linux-4.17.4/virt/kvm/coalesced_mmio.h
linux-4.17.4/virt/kvm/eventfd.c
linux-4.17.4/virt/kvm/irqchip.c
linux-4.17.4/virt/kvm/kvm_main.c
linux-4.17.4/virt/kvm/vfio.c
linux-4.17.4/virt/kvm/vfio.h
linux-4.17.4/virt/lib/
linux-4.17.4/virt/lib/Kconfig
linux-4.17.4/virt/lib/Makefile
linux-4.17.4/virt/lib/irqbypass.c
root@williamscott:~#
```

Step 4 : Change the current directory to the kernel source file.

```
● ● ●  ⌂ williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
root@williamscott:~# cd /usr/src/linux-4.17.4/
```

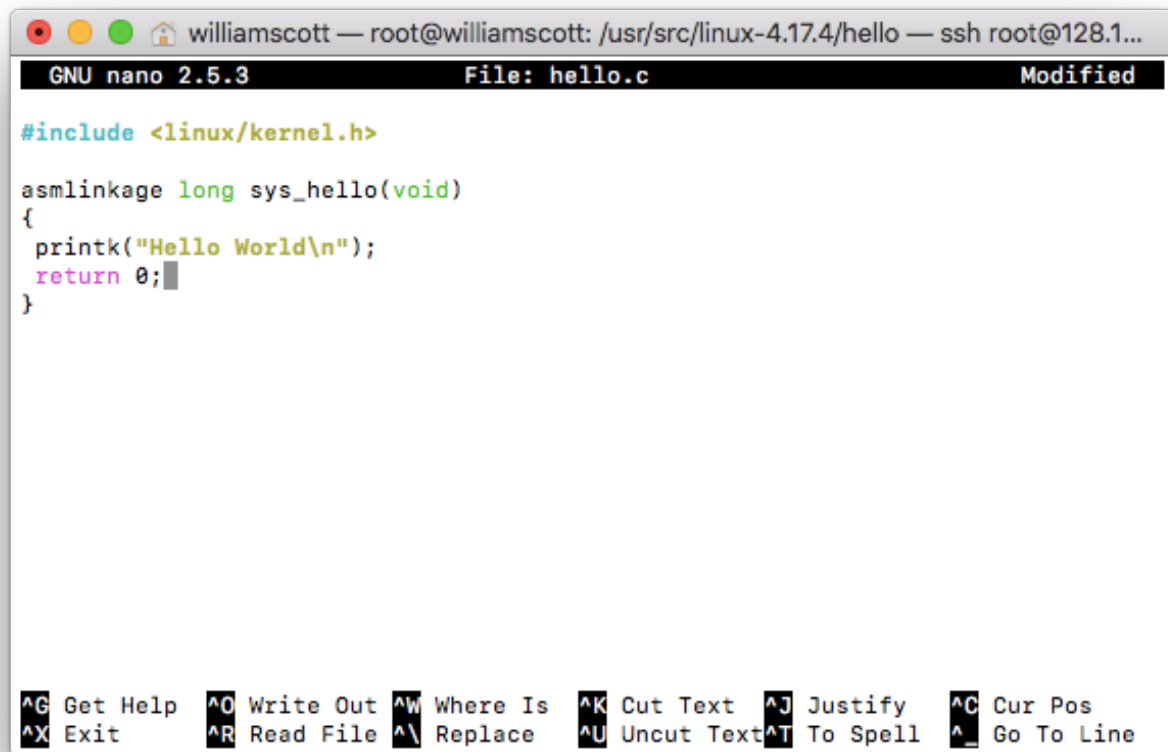**Step 5 :** Create a folder hello to create a new system call.


```
[root@williamscott:/usr/src/linux-4.17.4# mkdir hello
[root@williamscott:/usr/src/linux-4.17.4# cd hello/
 root@williamscott:/usr/src/linux-4.17.4/hello# █
```

Step 6 : create a new system call sys_helo


```
root@williamscott:/usr/src/linux-4.17.4/hello# nano hello.c
```

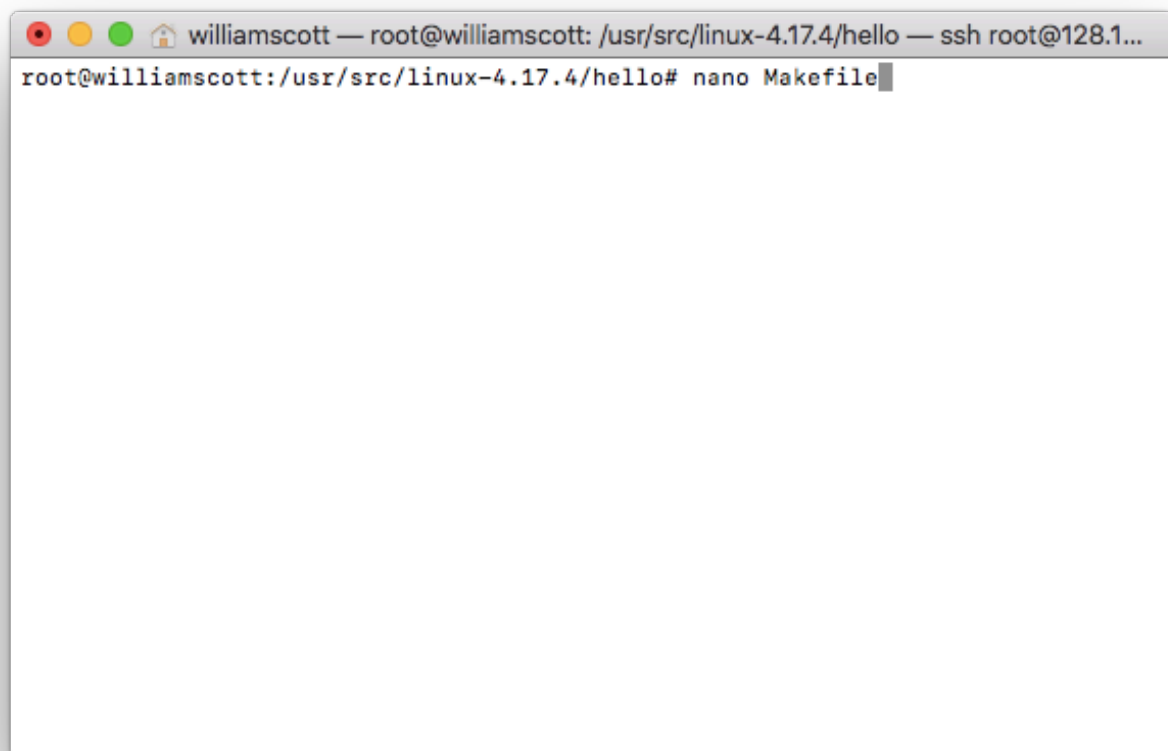**Step 7 :** Define the new sys_call, to print hello world when invoked

```
● ● ●  ⌂ williamscott — root@williamscott: /usr/src/linux-4.17.4/hello — ssh root@128.1...
  GNU nano 2.5.3                File: hello.c                        Modified

#include <linux/kernel.h>

asmlinkage long sys_hello(void)
{
 printk("Hello World\n");
 return 0;
}













^G Get Help  ^O Write Out ^W Where Is  ^K Cut Text  ^J Justify  ^C Cur Pos
^X Exit      ^R Read File ^\ Replace   ^U Uncut Text^T To Spell  ^_ Go To Line
```

Step 8 : Create a make file in the hello directory

```
● ● ●  ⌂ williamscott — root@williamscott: /usr/src/linux-4.17.4/hello — ssh root@128.1...
root@williamscott:/usr/src/linux-4.17.4/hello# nano Makefile
```

Step 9 : add the following line to make sure that the hello.c file is included in the kernel source code

```
GNU nano 2.5.3                    File: Makefile                         Modified

obj-y := hello.o




                                  [ New File ]
^G Get Help    ^O Write Out ^W Where Is   ^K Cut Text  ^J Justify   ^C Cur Pos
^X Exit        ^R Read File ^\ Replace    ^U Uncut Text^T To Spell  ^_ Go To Line
```
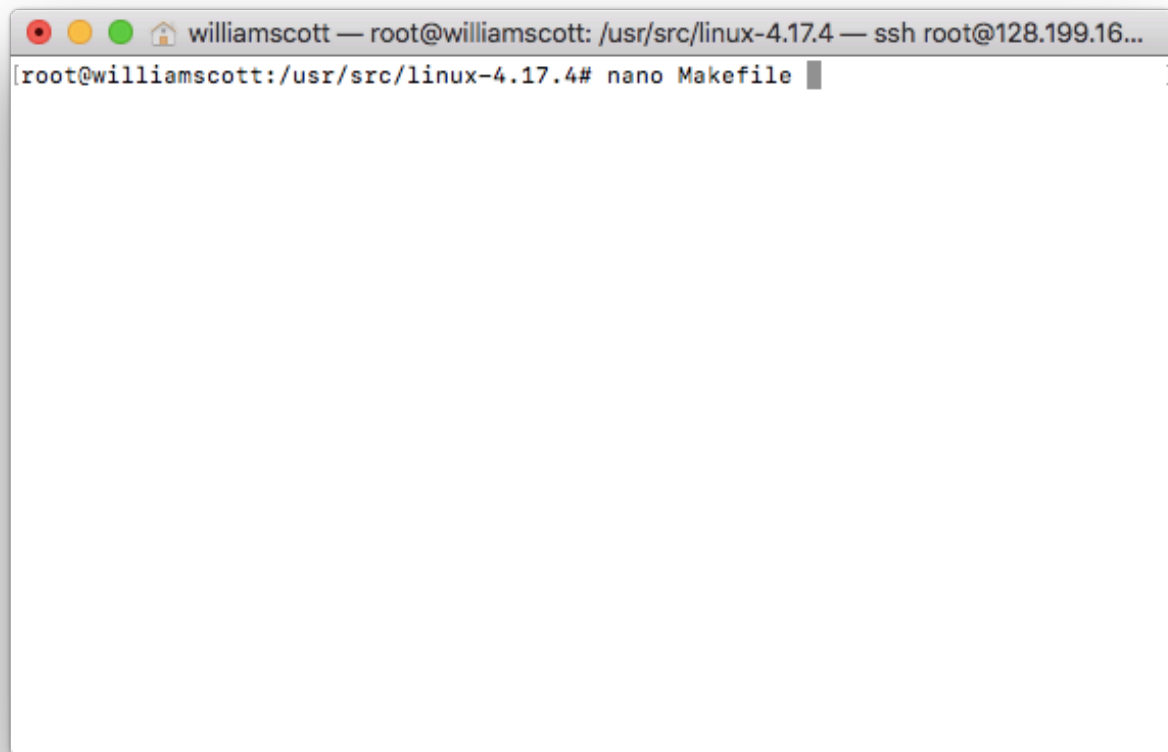
Step 10 : view the contents of Makefile
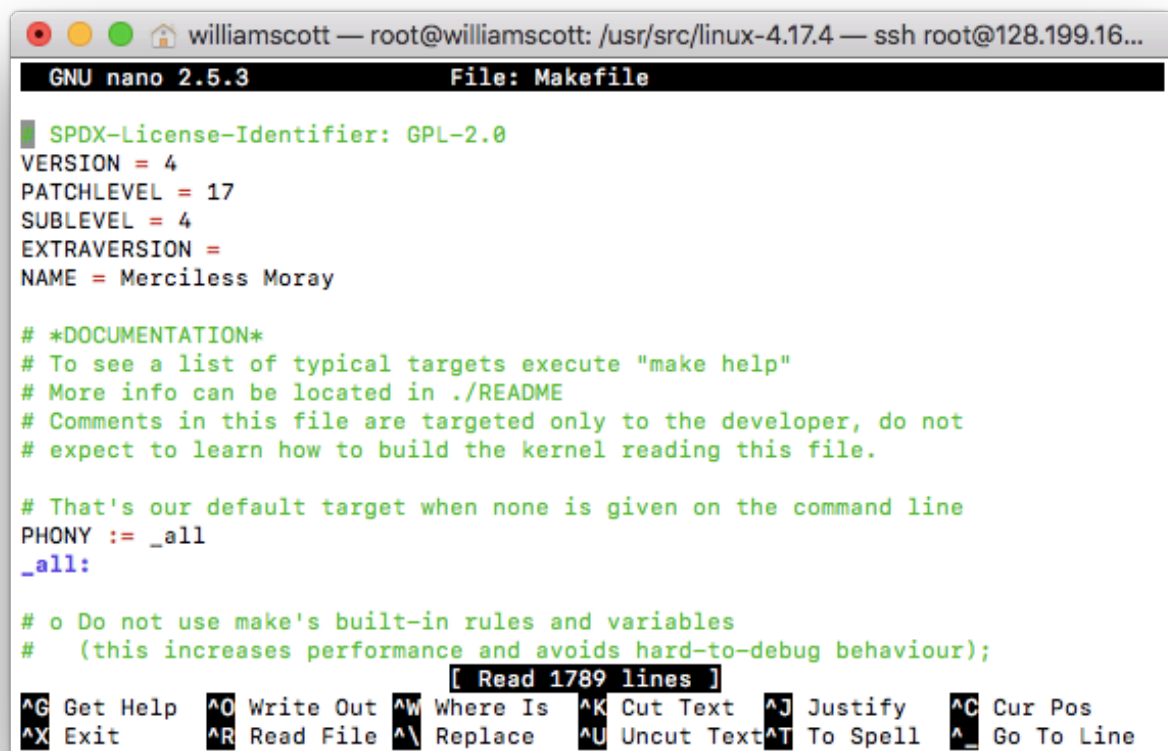
```
[root@williamscott:/usr/src/linux-4.17.4/hello# nano Makefile             ]
[root@williamscott:/usr/src/linux-4.17.4/hello# cat Makefile              ]
obj-y := hello.o
root@williamscott:/usr/src/linux-4.17.4/hello#
```

Step 11 : Edit the Makefile in the linux source code


```
[root@williamscott:/usr/src/linux-4.17.4# nano Makefile
```

Make file open


```
GNU nano 2.5.3                    File: Makefile

  SPDX-License-Identifier: GPL-2.0
VERSION = 4
PATCHLEVEL = 17
SUBLEVEL = 4
EXTRAVERSION =
NAME = Merciless Moray

# *DOCUMENTATION*
# To see a list of typical targets execute "make help"
# More info can be located in ./README
# Comments in this file are targeted only to the developer, do not
# expect to learn how to build the kernel reading this file.

# That's our default target when none is given on the command line
PHONY := _all
_all:

# o Do not use make's built-in rules and variables
#    (this increases performance and avoids hard-to-debug behaviour);
                        [ Read 1789 lines ]
^G Get Help  ^O Write Out ^W Where Is  ^K Cut Text  ^J Justify   ^C Cur Pos
^X Exit      ^R Read File ^\ Replace   ^U Uncut Text^T To Spell  ^_ Go To Line
```
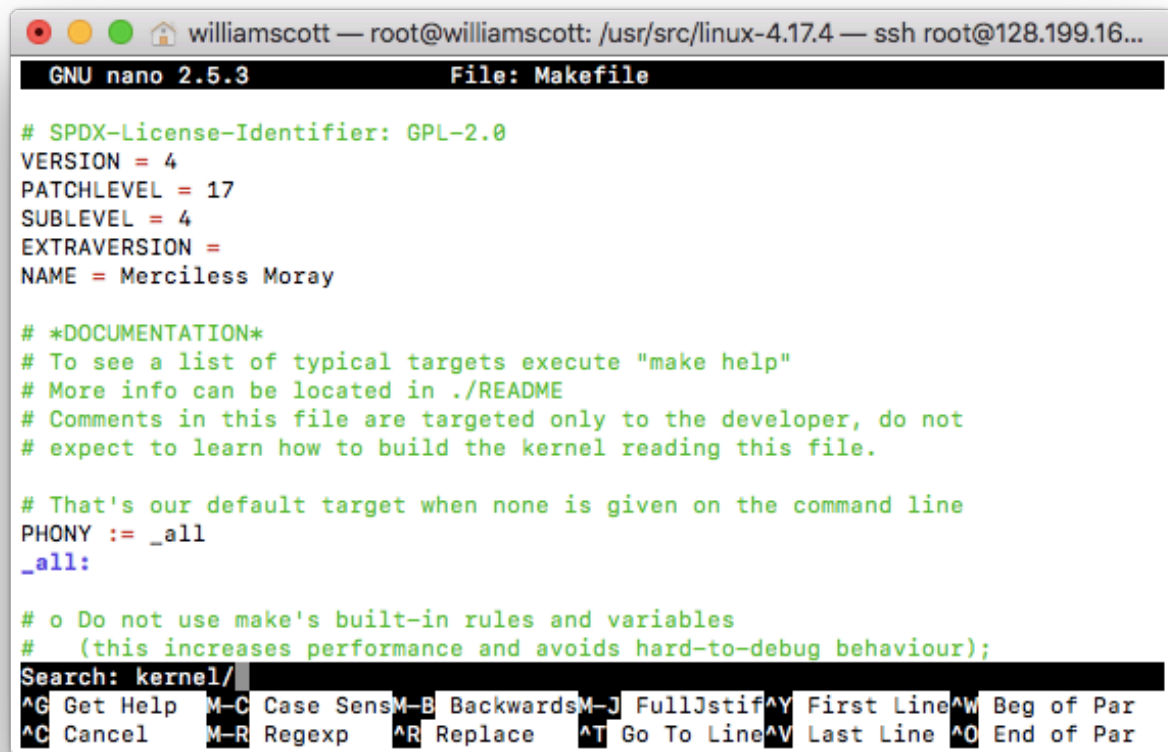
Step 12 : Search for the line we need using "kernel/"

Step 13 : add our hello/ to the end of the line indicating the compiler that the source file is in that particular directory

Step 14 : change the directory to arch/x86/entry/syscalls

williamscott — root@williamscott: /usr/src/linux-4.17.4/arch/x86/entry/syscalls...

```
[root@williamscott:/usr/src/linux-4.17.4# cd arch/x86/entry/syscalls/
root@williamscott:/usr/src/linux-4.17.4/arch/x86/entry/syscalls# 
```

Step 15 : Edit syscall_64.tbl to include our system call

williamscott — root@williamscott: /usr/src/linux-4.17.4/arch/x86/entry/syscalls...

```
[root@williamscott:/usr/src/linux-4.17.4# cd arch/x86/entry/syscalls/
[root@williamscott:/usr/src/linux-4.17.4/arch/x86/entry/syscalls# nano syscall_64]
.tbl 
```

syscall_64 file open

```
●  ●  ●  ⌂  williamscott — root@williamscott: /usr/src/linux-4.17.4/arch/x86/entry/syscalls...
  GNU nano 2.5.3              File: syscall_64.tbl

#
# 64-bit system call numbers and entry vectors
#
# The format is:
# <number> <abi> <name> <entry point>
#
# The __x64_sys_*() stubs are created on-the-fly for sys_*() system calls
#
# The abi is "common", "64" or "x32" for this file.
#
0         common  read                    __x64_sys_read
1         common  write                   __x64_sys_write
2         common  open                    __x64_sys_open
3         common  close                   __x64_sys_close
4         common  stat                    __x64_sys_newstat
5         common  fstat                   __x64_sys_newfstat
6         common  lstat                   __x64_sys_newlstat
7         common  poll                    __x64_sys_poll
8         common  lseek                   __x64_sys_lseek
                             [ Read 386 lines ]
^G Get Help   ^O Write Out  ^W Where Is   ^K Cut Text   ^J Justify    ^C Cur Pos
^X Exit       ^R Read File  ^\ Replace    ^U Uncut Text ^T To Spell   ^_ Go To Line
```
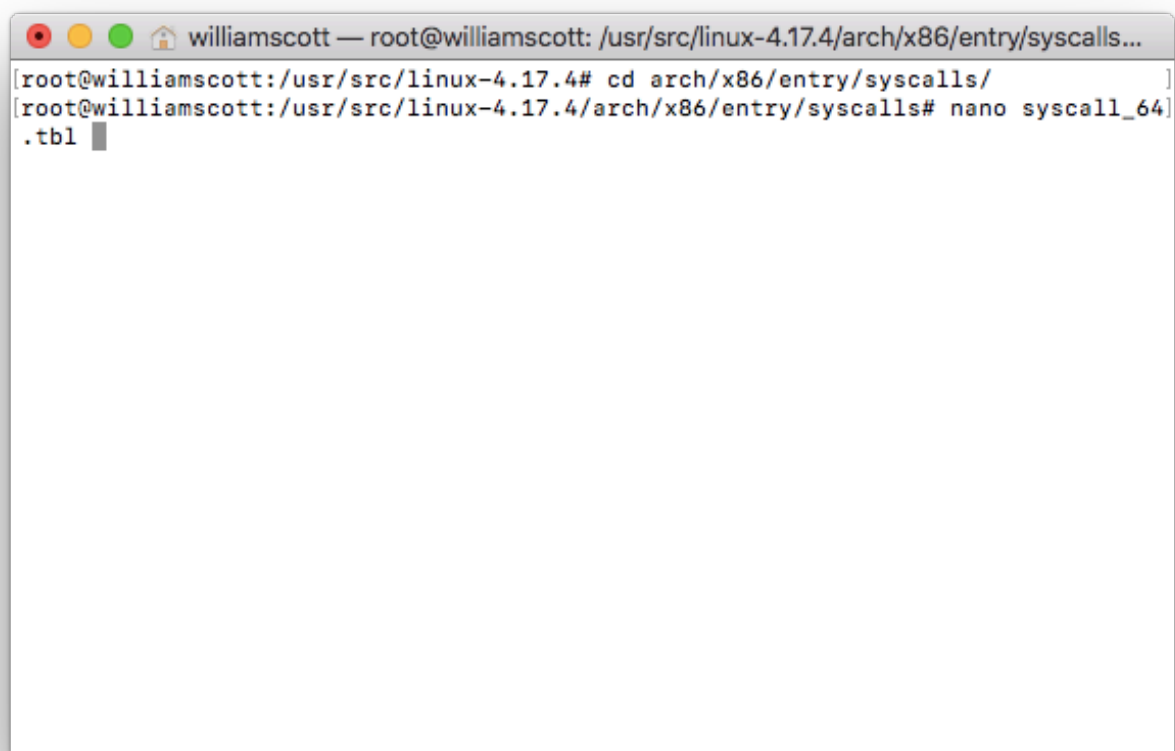
Step 16 : add our new system call in line 333

```
●  ●  ●  ⌂  williamscott — root@williamscott: /usr/src/linux-4.17.4/arch/x86/entry/syscalls...
  GNU nano 2.5.3              File: syscall_64.tbl

320       common  kexec_file_load         __x64_sys_kexec_file_load
321       common  bpf                     __x64_sys_bpf
322       64      execveat                __x64_sys_execveat/ptregs
323       common  userfaultfd             __x64_sys_userfaultfd
324       common  membarrier              __x64_sys_membarrier
325       common  mlock2                  __x64_sys_mlock2
326       common  copy_file_range         __x64_sys_copy_file_range
327       64      preadv2                 __x64_sys_preadv2
328       64      pwritev2                __x64_sys_pwritev2
329       common  pkey_mprotect           __x64_sys_pkey_mprotect
330       common  pkey_alloc              __x64_sys_pkey_alloc
331       common  pkey_free               __x64_sys_pkey_free
332       common  statx                   __x64_sys_statx
333       64      hello                   sys_hello

#
# x32-specific system call numbers start at 512 to avoid cache impact
# for native 64-bit operation. The __x32_compat_sys stubs are created
# on-the-fly for compat_sys_*() compatibility system calls if X86_X32

^G Get Help   ^O Write Out  ^W Where Is   ^K Cut Text   ^J Justify    ^C Cur Pos
^X Exit       ^R Read File  ^\ Replace    ^U Uncut Text ^T To Spell   ^_ Go To Line
```
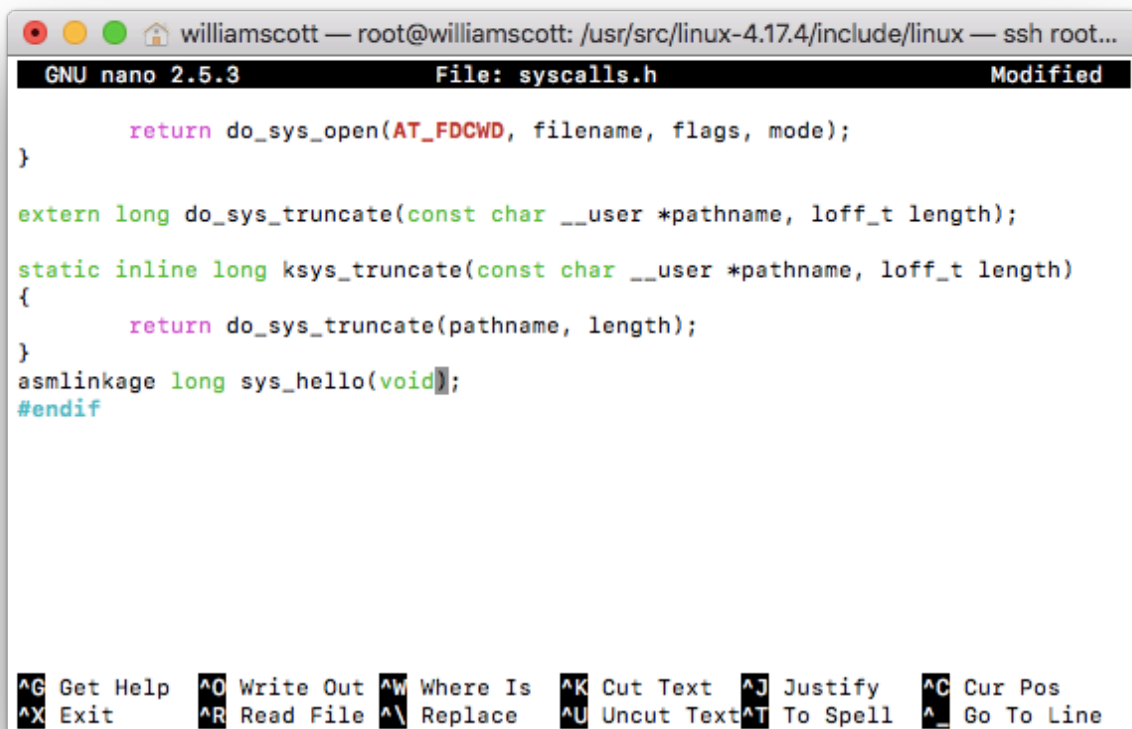
Step 17 : save and close the previous file and changed the directory to include/linux

```
● ● ●  ⌂ williamscott — root@williamscott: /usr/src/linux-4.17.4/include/linux — ssh root...
[root@williamscott:/usr/src/linux-4.17.4# cd include/linux/
root@williamscott:/usr/src/linux-4.17.4/include/linux# █
```

Step 18 : add a new asmlinkage long sys_hello(void); line at the end of our syscalls.h file
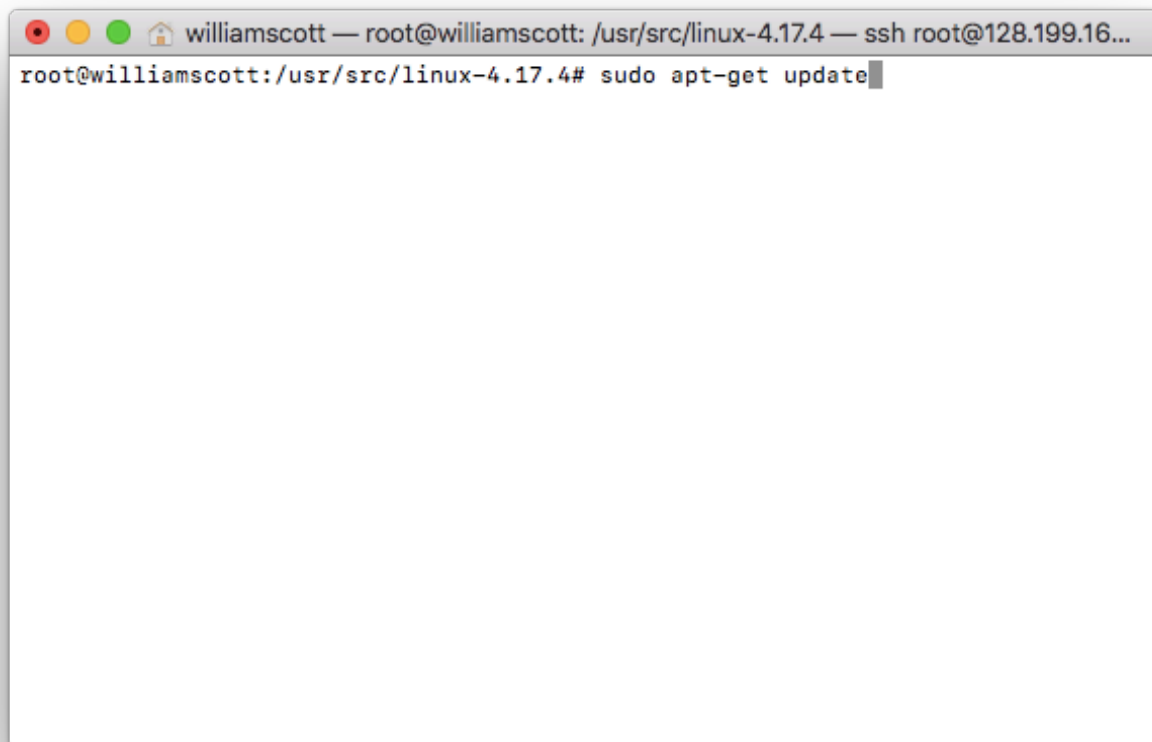
```
● ● ●  ⌂ williamscott — root@williamscott: /usr/src/linux-4.17.4/include/linux — ssh root...
  GNU nano 2.5.3              File: syscalls.h                      Modified

        return do_sys_open(AT_FDCWD, filename, flags, mode);
}

extern long do_sys_truncate(const char __user *pathname, loff_t length);

static inline long ksys_truncate(const char __user *pathname, loff_t length)
{
        return do_sys_truncate(pathname, length);
}
asmlinkage long sys_hello(void);
#endif




^G Get Help  ^O Write Out  ^W Where Is   ^K Cut Text   ^J Justify    ^C Cur Pos
^X Exit      ^R Read File  ^\ Replace    ^U Uncut Text ^T To Spell   ^_ Go To Line
```
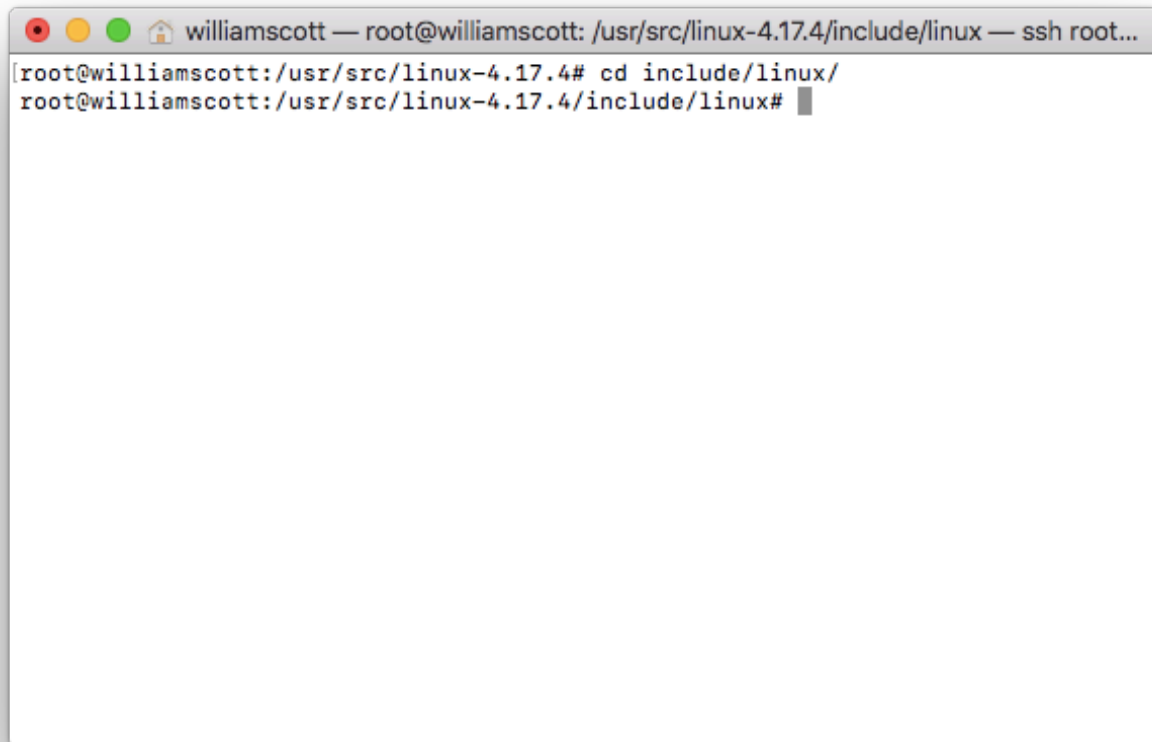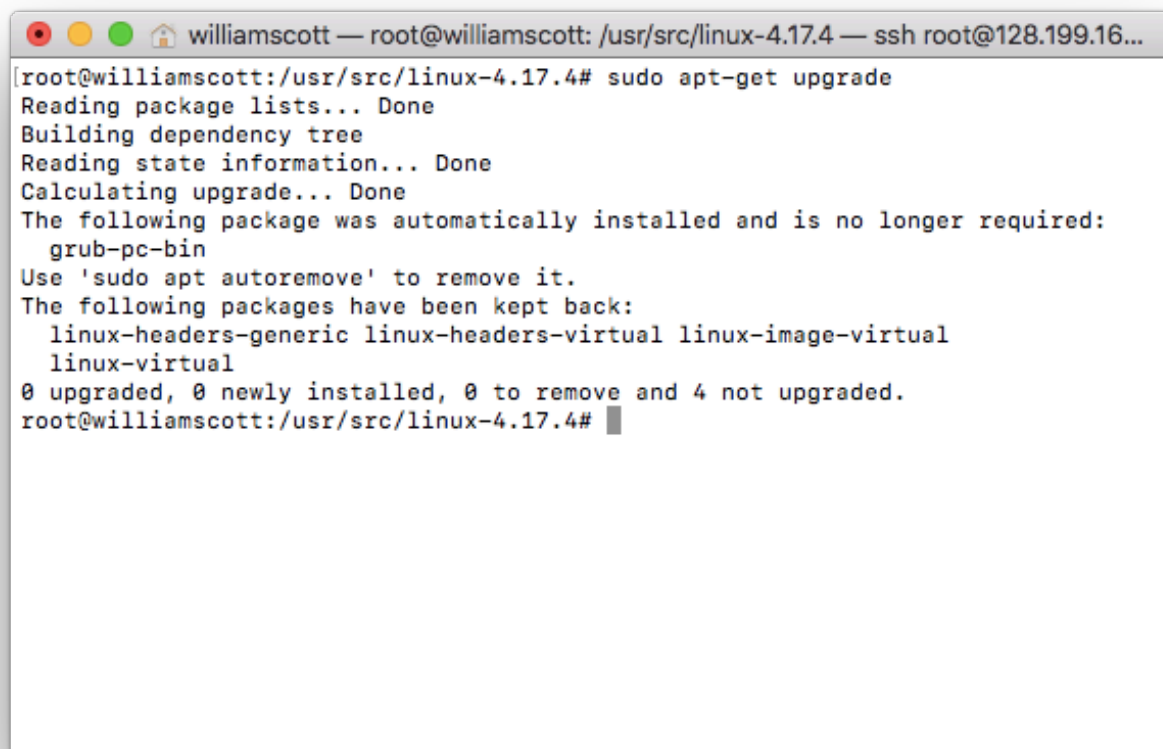
Step 19 : install gcc, libncurses5-dev, bison, flex, libssl-dev, bc, make and then update and upgrade

```
● ● ●  🏠 williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
root@williamscott:/usr/src/linux-4.17.4# sudo apt-get update
```

installed updated and upgraded

```
● ● ●  🏠 williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
[root@williamscott:/usr/src/linux-4.17.4# sudo apt-get upgrade                      ]
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
The following package was automatically installed and is no longer required:
   grub-pc-bin
Use 'sudo apt autoremove' to remove it.
The following packages have been kept back:
   linux-headers-generic linux-headers-virtual linux-image-virtual
   linux-virtual
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
root@williamscott:/usr/src/linux-4.17.4# ▊
```

Step 20 : make menuconfig

```
● ● ●   ⌂ williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
root@williamscott:/usr/src/linux-4.17.4# make menuconfig
```

```
● ● ●   ⌂ williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
ES_NETDEV
/boot/config-4.4.0-127-generic:1161:warning: symbol value 'm' invalid for NF_TAB
LES_IPV4
/boot/config-4.4.0-127-generic:1165:warning: symbol value 'm' invalid for NF_TAB
LES_ARP
/boot/config-4.4.0-127-generic:1206:warning: symbol value 'm' invalid for NF_TAB
LES_IPV6
/boot/config-4.4.0-127-generic:1243:warning: symbol value 'm' invalid for NF_TAB
LES_BRIDGE
/boot/config-4.4.0-127-generic:1633:warning: symbol value 'm' invalid for RXKAD
/boot/config-4.4.0-127-generic:3599:warning: symbol value 'm' invalid for SERIAL
_8250_FINTEK
/boot/config-4.4.0-127-generic:3653:warning: symbol value 'm' invalid for HW_RAN
DOM_TPM
/boot/config-4.4.0-127-generic:4561:warning: symbol value 'm' invalid for LIRC
/boot/config-4.4.0-127-generic:7486:warning: symbol value 'm' invalid for NVMEM
/boot/config-4.4.0-127-generic:7574:warning: symbol value 'm' invalid for EXT4_E
NCRYPTION
configuration written to .config

*** End of the configuration.
*** Execute 'make' to start the build or try 'make help'.

root@williamscott:/usr/src/linux-4.17.4# █
```

Step 21: Make the main source directory (—j6 indicates the number of cores)

```
● ● ●   🏠 williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
root@williamscott:/usr/src/linux-4.17.4# make -j6
```

```
● ● ●   🏠 williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
  SYSTBL   arch/x86/include/generated/asm/syscalls_32.h
  WRAP     arch/x86/include/generated/uapi/asm/bpf_perf_event.h
  HOSTCC   scripts/basic/bin2c
  WRAP     arch/x86/include/generated/uapi/asm/poll.h
  SYSHDR   arch/x86/include/generated/asm/unistd_32_ia32.h
  DESCEND  objtool
  SYSHDR   arch/x86/include/generated/asm/unistd_64_x32.h
  UPD      include/config/kernel.release
  SYSTBL   arch/x86/include/generated/asm/syscalls_64.h
  HYPERCALLS arch/x86/include/generated/asm/xen-hypercalls.h
  SYSHDR   arch/x86/include/generated/uapi/asm/unistd_32.h
  HOSTCC   /usr/src/linux-4.17.4/tools/objtool/fixdep.o
  SYSHDR   arch/x86/include/generated/uapi/asm/unistd_64.h
  HOSTLD   /usr/src/linux-4.17.4/tools/objtool/fixdep-in.o
  LINK     /usr/src/linux-4.17.4/tools/objtool/fixdep
  SYSHDR   arch/x86/include/generated/uapi/asm/unistd_x32.h
  CC       /usr/src/linux-4.17.4/tools/objtool/exec-cmd.o
  CC       /usr/src/linux-4.17.4/tools/objtool/help.o
  CC       /usr/src/linux-4.17.4/tools/objtool/pager.o
  CC       /usr/src/linux-4.17.4/tools/objtool/parse-options.o
  CC       /usr/src/linux-4.17.4/tools/objtool/run-command.o
  CC       /usr/src/linux-4.17.4/tools/objtool/sigchain.o
  CC       /usr/src/linux-4.17.4/tools/objtool/subcmd-config.o
```

Make command complete

```
● ● ●   🏠 williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
  LD [M]  sound/soc/intel/skylake/snd-soc-skl-ipc.ko
  LD [M]  sound/soc/snd-soc-acpi.ko
  LD [M]  sound/soc/intel/haswell/snd-soc-sst-haswell-pcm.ko
  LD [M]  sound/soc/xtensa/snd-soc-xtfpga-i2s.ko
  LD [M]  sound/soc/snd-soc-core.ko
  LD [M]  sound/soundcore.ko
  LD [M]  sound/synth/emux/snd-emux-synth.ko
  LD [M]  sound/usb/bcd2000/snd-bcd2000.ko
  LD [M]  sound/synth/snd-util-mem.ko
  LD [M]  sound/usb/6fire/snd-usb-6fire.ko
  LD [M]  sound/usb/caiaq/snd-usb-caiaq.ko
  LD [M]  sound/usb/hiface/snd-usb-hiface.ko
  LD [M]  sound/usb/line6/snd-usb-pod.ko
  LD [M]  sound/usb/line6/snd-usb-podhd.ko
  LD [M]  sound/usb/line6/snd-usb-line6.ko
  LD [M]  sound/usb/line6/snd-usb-toneport.ko
  LD [M]  sound/usb/line6/snd-usb-variax.ko
  LD [M]  sound/usb/misc/snd-ua101.ko
  LD [M]  sound/usb/snd-usbmidi-lib.ko
  LD [M]  sound/usb/snd-usb-audio.ko
  LD [M]  sound/usb/usx2y/snd-usb-usx2y.ko
  LD [M]  virt/lib/irqbypass.ko
  LD [M]  sound/usb/usx2y/snd-usb-us122l.ko
root@williamscott:/usr/src/linux-4.17.4# █
```

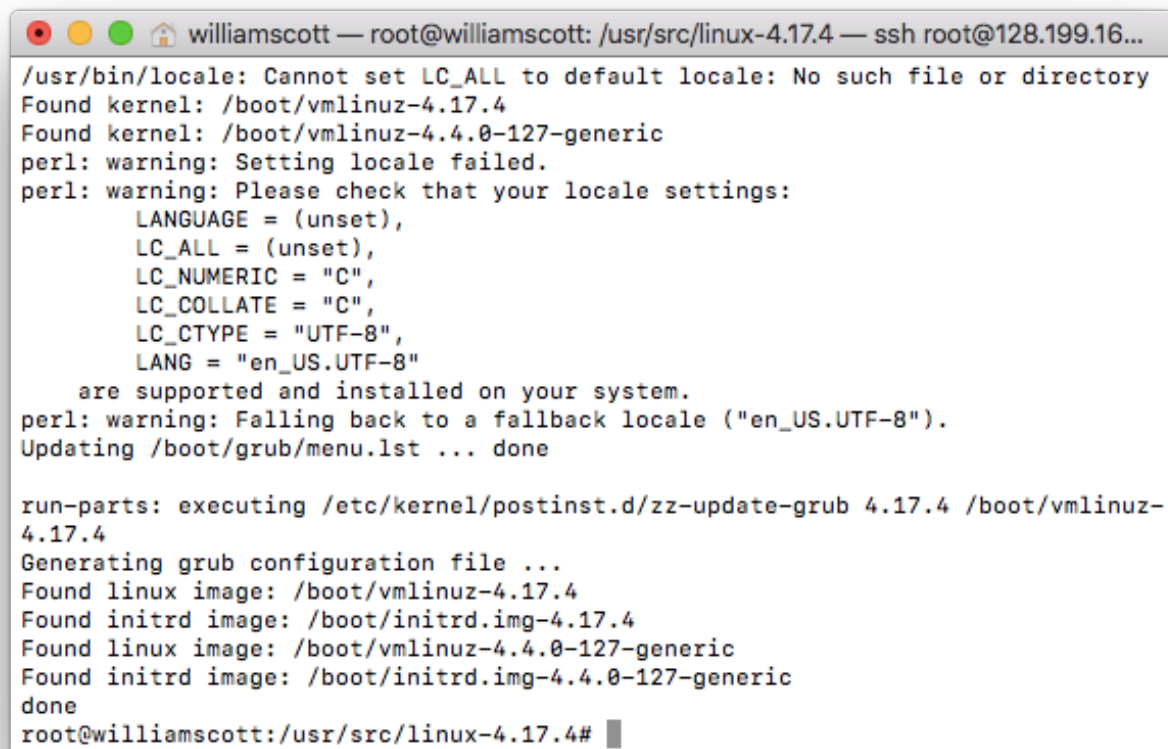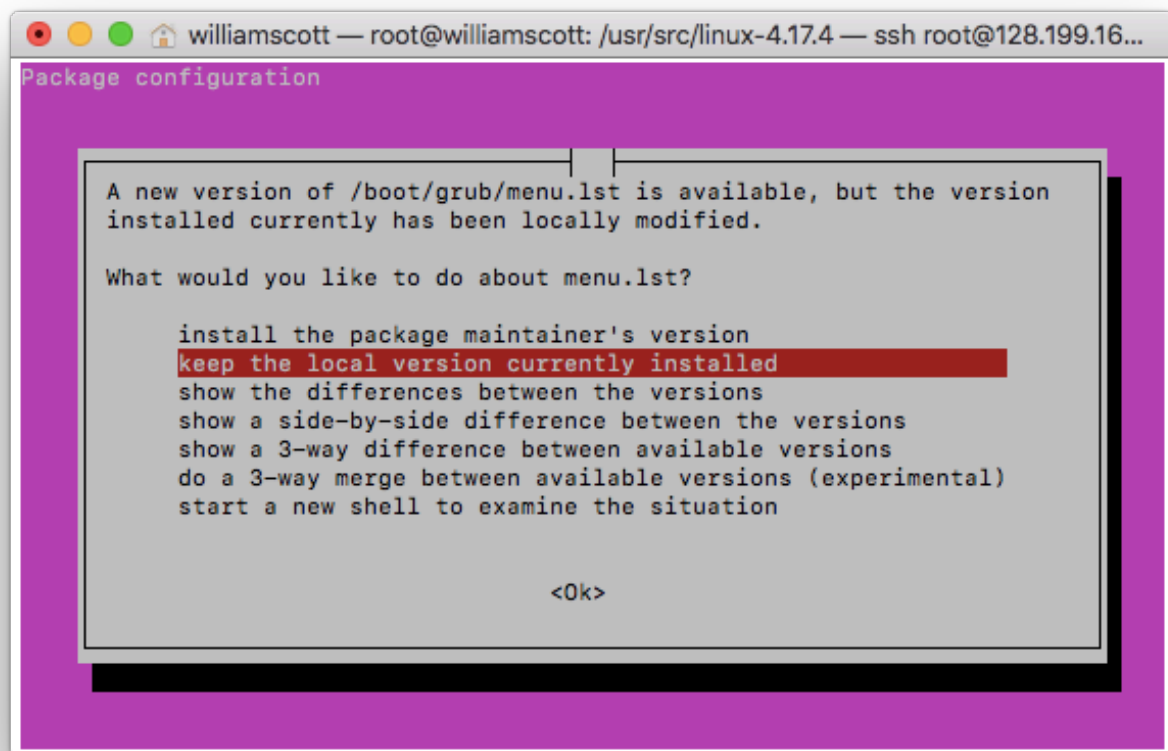**Step 22 :** Now make modules_install to install the new kernel

```
● ● ●   🏠 williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
root@williamscott:/usr/src/linux-4.17.4# make modules_install install█
```

Installing

```
● ● ●   🏠 williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
    INSTALL drivers/block/paride/epat.ko
    INSTALL drivers/block/paride/epia.ko
    INSTALL drivers/block/paride/fit2.ko
    INSTALL drivers/block/paride/fit3.ko
    INSTALL drivers/block/paride/friq.ko
    INSTALL drivers/block/paride/frpw.ko
    INSTALL drivers/block/paride/kbic.ko
    INSTALL drivers/block/paride/ktti.ko
    INSTALL drivers/block/paride/on20.ko
    INSTALL drivers/block/paride/on26.ko
    INSTALL drivers/block/paride/paride.ko
    INSTALL drivers/block/paride/pcd.ko
    INSTALL drivers/block/paride/pd.ko
    INSTALL drivers/block/paride/pf.ko
    INSTALL drivers/block/paride/pg.ko
    INSTALL drivers/block/paride/pt.ko
    INSTALL drivers/block/pktcdvd.ko
    INSTALL drivers/block/rbd.ko
    INSTALL drivers/block/rsxx/rsxx.ko
    INSTALL drivers/block/skd.ko
    INSTALL drivers/block/sx8.ko
    INSTALL drivers/block/umem.ko
    INSTALL drivers/block/xen-blkback/xen-blkback.ko
▊
```

```
● ● ●   🏠 williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
    INSTALL sound/usb/6fire/snd-usb-6fire.ko
    INSTALL sound/usb/bcd2000/snd-bcd2000.ko
    INSTALL sound/usb/caiaq/snd-usb-caiaq.ko
    INSTALL sound/usb/hiface/snd-usb-hiface.ko
    INSTALL sound/usb/line6/snd-usb-line6.ko
    INSTALL sound/usb/line6/snd-usb-pod.ko
    INSTALL sound/usb/line6/snd-usb-podhd.ko
    INSTALL sound/usb/line6/snd-usb-toneport.ko
    INSTALL sound/usb/line6/snd-usb-variax.ko
    INSTALL sound/usb/misc/snd-ua101.ko
    INSTALL sound/usb/snd-usb-audio.ko
    INSTALL sound/usb/snd-usbmidi-lib.ko
    INSTALL sound/usb/usx2y/snd-usb-us122l.ko
    INSTALL sound/usb/usx2y/snd-usb-usx2y.ko
    INSTALL virt/lib/irqbypass.ko
    DEPMOD  4.17.4
sh ./arch/x86/boot/install.sh 4.17.4 arch/x86/boot/bzImage \
        System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 4.17.4 /boot/vmlinu
z-4.17.4
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 4.17.4 /boot/vmlinuz
-4.17.4
update-initramfs: Generating /boot/initrd.img-4.17.4
▊
```
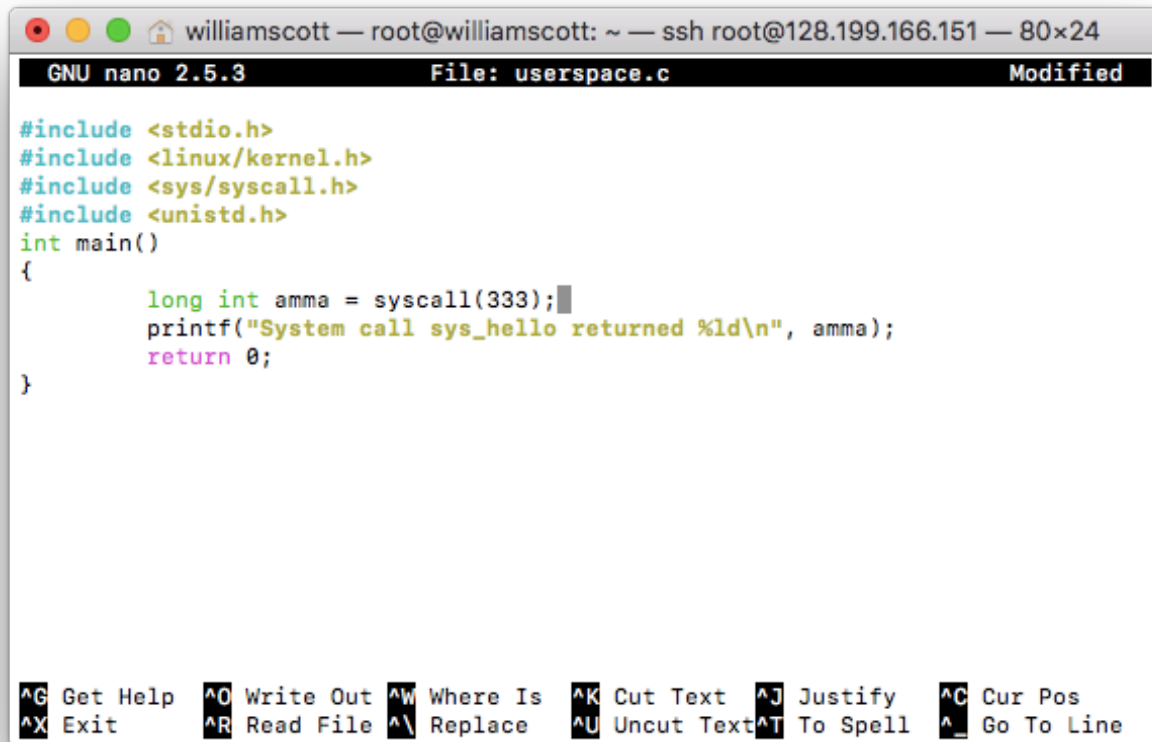
Package configuration

```
    A new version of /boot/grub/menu.lst is available, but the version
    installed currently has been locally modified.

    What would you like to do about menu.lst?

            install the package maintainer's version
            keep the local version currently installed
            show the differences between the versions
            show a side-by-side difference between the versions
            show a 3-way difference between available versions
            do a 3-way merge between available versions (experimental)
            start a new shell to examine the situation


                             <Ok>
```

```
/usr/bin/locale: Cannot set LC_ALL to default locale: No such file or directory
Found kernel: /boot/vmlinuz-4.17.4
Found kernel: /boot/vmlinuz-4.4.0-127-generic
perl: warning: Setting locale failed.
perl: warning: Please check that your locale settings:
        LANGUAGE = (unset),
        LC_ALL = (unset),
        LC_NUMERIC = "C",
        LC_COLLATE = "C",
        LC_CTYPE = "UTF-8",
        LANG = "en_US.UTF-8"
    are supported and installed on your system.
perl: warning: Falling back to a fallback locale ("en_US.UTF-8").
Updating /boot/grub/menu.lst ... done

run-parts: executing /etc/kernel/postinst.d/zz-update-grub 4.17.4 /boot/vmlinuz-
4.17.4
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-4.17.4
Found initrd image: /boot/initrd.img-4.17.4
Found linux image: /boot/vmlinuz-4.4.0-127-generic
Found initrd image: /boot/initrd.img-4.4.0-127-generic
done
root@williamscott:/usr/src/linux-4.17.4#
```

```
●  ●  ● ⌂ williamscott — root@williamscott: /usr/src/linux-4.17.4 — ssh root@128.199.16...
/usr/bin/locale: Cannot set LC_ALL to default locale: No such file or directory
Found kernel: /boot/vmlinuz-4.17.4
Found kernel: /boot/vmlinuz-4.4.0-127-generic
perl: warning: Setting locale failed.
perl: warning: Please check that your locale settings:
        LANGUAGE = (unset),
        LC_ALL = (unset),
        LC_NUMERIC = "C",
        LC_COLLATE = "C",
        LC_CTYPE = "UTF-8",
        LANG = "en_US.UTF-8"
    are supported and installed on your system.
perl: warning: Falling back to a fallback locale ("en_US.UTF-8").
Updating /boot/grub/menu.lst ... done

run-parts: executing /etc/kernel/postinst.d/zz-update-grub 4.17.4 /boot/vmlinuz-
4.17.4
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-4.17.4
Found initrd image: /boot/initrd.img-4.17.4
Found linux image: /boot/vmlinuz-4.4.0-127-generic
Found initrd image: /boot/initrd.img-4.4.0-127-generic
done
root@williamscott:/usr/src/linux-4.17.4# █
```

Step 23 : Restart and check the new kernel version

```
●  ●  ● ⌂ williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
[root@williamscott:~# uname -r                                                  ]
4.17.4
root@williamscott:~# █
```

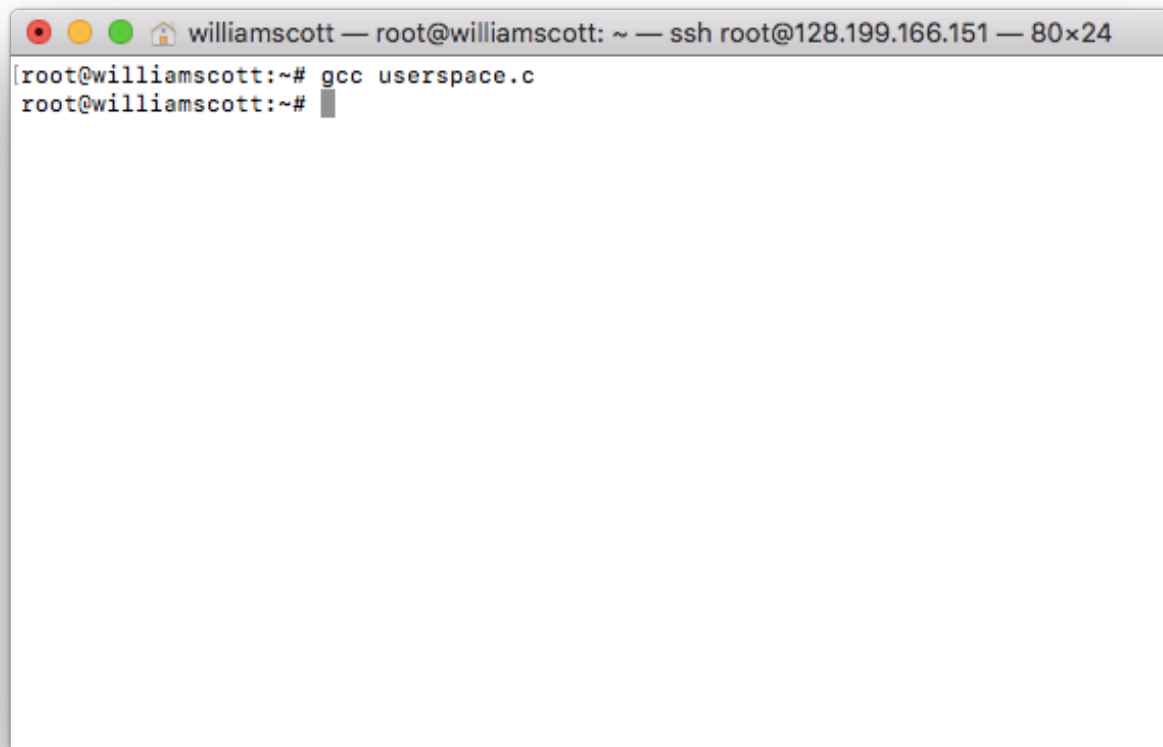**Step 24 :** Write a c program calling the system call, this should print Hello World

```
● ● ●  williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
  GNU nano 2.5.3                File: userspace.c                      Modified

#include <stdio.h>
#include <linux/kernel.h>
#include <sys/syscall.h>
#include <unistd.h>
int main()
{
        long int amma = syscall(333);
        printf("System call sys_hello returned %ld\n", amma);
        return 0;
}




^G Get Help   ^O Write Out ^W Where Is  ^K Cut Text  ^J Justify   ^C Cur Pos
^X Exit       ^R Read File ^\ Replace   ^U Uncut Text^T To Spell  ^_ Go To Line
```

Step 25 : Compile the C program

```
● ● ●  williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
[root@williamscott:~# gcc userspace.c                                          ]
root@williamscott:~# █
```

Step 26 : Execute

Returned success 0

Step 27 : Check kernel message

```
● ● ●   🏠 williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
root@williamscott:~# dmesg█
```

<u>**Done:**</u> **Our system call printed in kernel message.**

```
● ● ●   🏠 williamscott — root@williamscott: ~ — ssh root@128.199.166.151 — 80×24
tion="profile_load" profile="unconfined" name="/usr/sbin/tcpdump" pid=804 comm="
apparmor_parser"
[   19.431547] audit: type=1400 audit(1531387328.004:7): apparmor="STATUS" opera
tion="profile_load" profile="unconfined" name="lxc-container-default" pid=798 co
mm="apparmor_parser"
[   19.431552] audit: type=1400 audit(1531387328.004:8): apparmor="STATUS" opera
tion="profile_load" profile="unconfined" name="lxc-container-default-cgns" pid=7
98 comm="apparmor_parser"
[   19.431554] audit: type=1400 audit(1531387328.004:9): apparmor="STATUS" opera
tion="profile_load" profile="unconfined" name="lxc-container-default-with-mounti
ng" pid=798 comm="apparmor_parser"
[   19.431556] audit: type=1400 audit(1531387328.004:10): apparmor="STATUS" oper
ation="profile_load" profile="unconfined" name="lxc-container-default-with-nesti
ng" pid=798 comm="apparmor_parser"
[   19.432593] audit: type=1400 audit(1531387328.008:11): apparmor="STATUS" oper
ation="profile_load" profile="unconfined" name="/sbin/dhclient" pid=799 comm="ap
parmor_parser"
[   23.463134] new mount options do not match the existing superblock, will be i
gnored
[  268.029419] random: crng init done
[  268.029425] random: 7 urandom warning(s) missed due to ratelimiting
[  542.957621] Hello World
[  555.941285] Hello World
root@williamscott:~# █
```