

Operating System

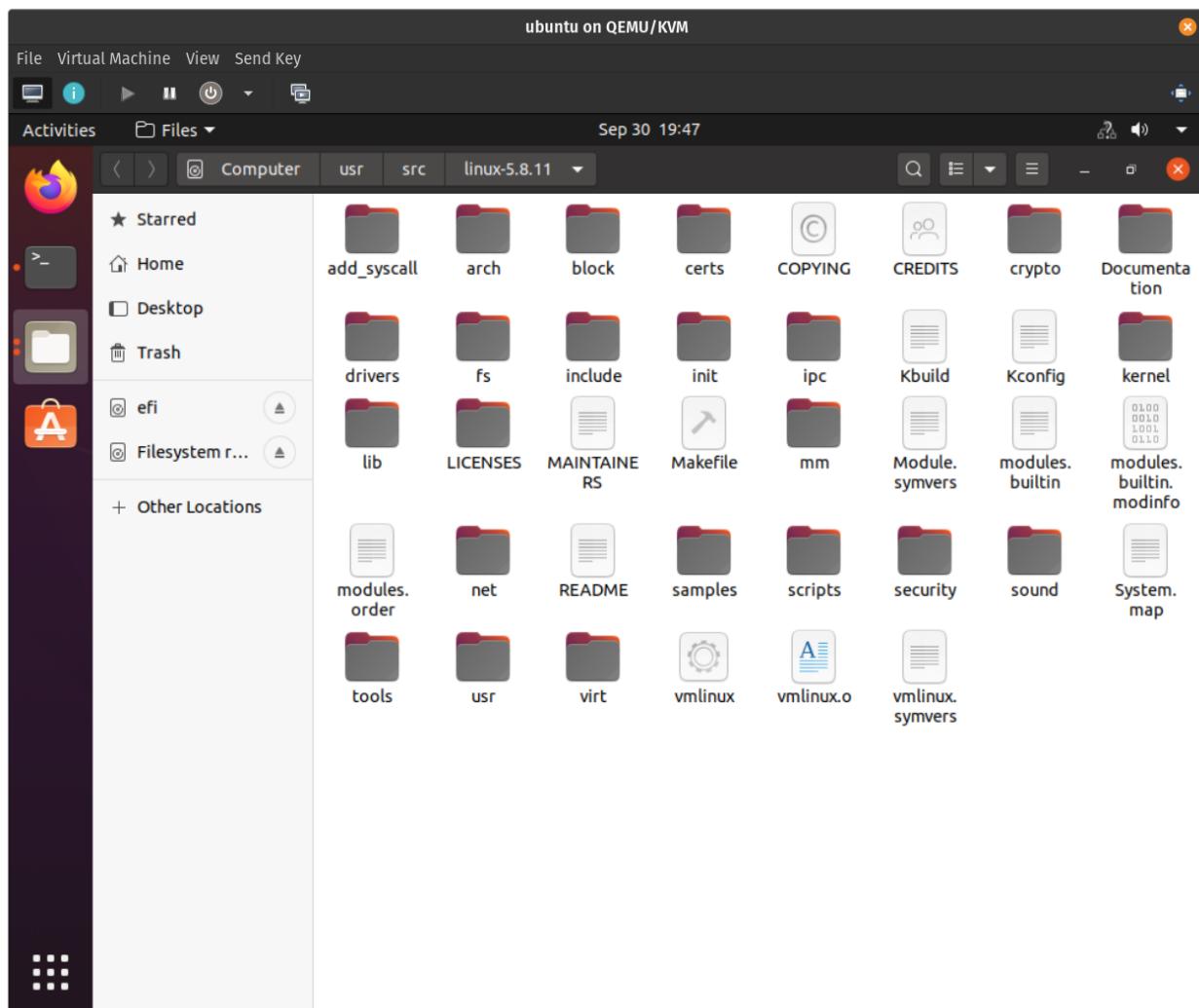
Online Evaluation 2

Submitted on - 30th September, 2020

By - Arjun Bajpai (2018A7PS0182G)

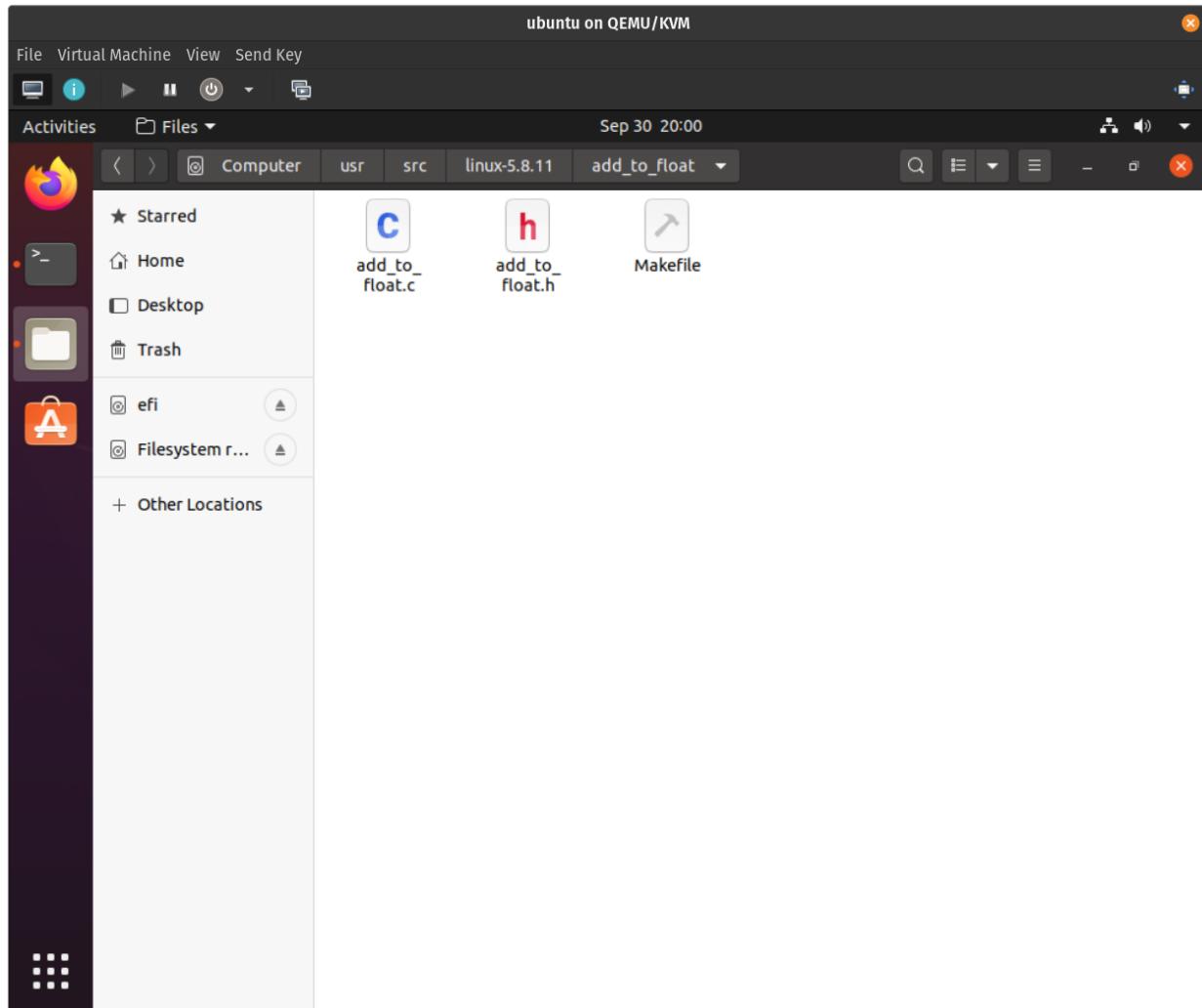
Attached are the screenshots of each step of the process of creating system to convert string to a floating point number.

1. Before adding any files to kernel



2. Added `/add_get_float/` to the kernel and added files:

- a. `add_to_float.c`
- b. `Add_to_float.h`
- c. `Makefile`



3. Modified the following files (modifications are highlighted):

- a. `./Makefile`
- b. `./include/linux/syscalls.h`

- c. `./include/asm-generic/syscalls.h`
- d. `./arch/x86/entry/syscalls/syscall_64.tbl`

ubuntu on QEMU/KVM

File Virtual Machine View Send Key

Activities Text Editor Sep 30 20:03

Makefile /usr/src/linux-5.8.11

```
1064  
1065 export MODORDER := $(extmod-prefix)modules.order  
1066 export MODULES_NSDEPS := $(extmod-prefix)modules.nsdeps  
1067  
1068 ifeq ($(KBUILD_EXTMOD),)  
1069 core-y += kernel/ certs/ mm/ fs/ ipc/ security/ crypto/ block/ add syscall/ add get float/  
1070  
1071 vmlinux-dirs := $(patsubst %,%,$(filter %, \  
1072 $(core-y) $(core-m) $(drivers-y) $(drivers-m) \  
1073 $(libs-y) $(libs-m)))  
1074  
1075 vmlinux-alldirs := $(sort $(vmlinux-dirs) Documentation \  
1076 $(patsubst %,%,$(filter %, $(core-) \  
1077 $(drivers-) $(libs-))))  
1078  
1079 subdir-modorder := $(addsuffix modules.order,$(filter %, \  
1080 $(core-y) $(core-m) $(libs-y) $(libs-m) \  
1081 $(drivers-y) $(drivers-m)))  
1082  
1083 build-dirs := $(vmlinux-dirs)  
1084 clean-dirs := $(vmlinux-alldirs)  
1085  
1086 # Externally visible symbols (used by link-vmlinux.sh)  
1087 KBUILD_VMLINUX_OBJS := $(head-y) $(patsubst %,%/built-in.a, $(core-y))  
1088 KBUILD_VMLINUX_OBJS += $(addsuffix built-in.a, $(filter %, $(libs-y)))  
1089 ifdef CONFIG_MODULES  
1090 KBUILD_VMLINUX_OBJS += $(patsubst %, %/lib.a, $(filter %, $(libs-y)))  
1091 KBUILD_VMLINUX_LDS := $(filter-out %/ $(libs-y))
```

Makefile Tab Width: 8 Ln 1069, Col 1 INS

"Makefile" selected (61.8 kB)

ubuntu on QEMU/KVM

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Activities Text Editor Sep 30 20:02

syscalls.h /usr/src/linux-5.8.11/include/linux

```
1220         unsigned long fd, unsigned long pgoff);
1221 asmlinkage long sys_old_mmap(struct mmap_arg_struct __user *arg);
1222
1223
1224 /*add_syscall: add_syscall/add_syscall.c*/
1225 asmlinkage long sys_add_syscall(int num1, int num2);
1226 asmlinkage long sys_add_to_float(char * s, int len);
1227 */
1228 */
1229 * Not a real system call, but a placeholder for syscalls which are
1230 * not implemented -- see kernel/sys_ni.c
1231 */
1232 asmlinkage long sys_ni_syscall(void);
1233
1234 #endif /* CONFIG_ARCH_HAS_SYSCALL_WRAPPER */
1235
1236
1237 /*
1238 * Kernel code should not call syscalls (i.e., sys_xyzzyz()) directly.
1239 * Instead, use one of the functions which work equivalently, such as
1240 * the ksys_xyzzyz() functions prototyped below.
1241 */
1242
1243 int ksys_umount(char __user *name, int flags);
1244 int ksys_dup(unsigned int fildes);
1245 int ksys_chroot(const char __user *filename);
1246 ssize_t ksys_write(unsigned int fd, const char __user *buf, size_t count);
1247 int ksys_chdir(const char __user *filename);
```

C/Object Header Tab Width: 8 Ln 1226, Col 1 INS

syslog.h sysrq.h sys_soc.h sysv_fs.h t10-pi.h task_io_accounting.h task_io_accounting_ops.h taskstats_kern.h

"syscalls.h" selected (57.4 kB)

ubuntu on QEMU/KVM

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Activities Text Editor Sep 30 20:01

syscalls.h /usr/src/linux-5.8.11/include/asm-generic

```
11 */
12
13 #ifndef sys_mmap2
14 asmlinkage long sys_mmap2(unsigned long addr, unsigned long len,
15                           unsigned long prot, unsigned long flags,
16                           unsigned long fd, unsigned long pgoff);
17 #endif
18
19 #ifndef sys_mmap
20 asmlinkage long sys_mmap(unsigned long addr, unsigned long len,
21                          unsigned long prot, unsigned long flags,
22                          unsigned long fd, off_t pgoff);
23 #endif
24
25 #ifndef sys_rt_sigreturn
26 asmlinkage long sys_rt_sigreturn(struct pt_regs *regs);
27 #endif
28
29 #ifndef sys_add_syscall
30 asmlinkage long sys_add_syscall(int num1, int num2);
31 #endif
32
33 #ifndef sys_add_to_float
34 asmlinkage long sys_add_to_float(char * s, int len);
35 #endif
36
37 #endif /* _ASM_GENERIC_SYSCALLS_H */
```

C/ObjC Header Tab Width: 8 Ln 33, Col 1 INS

uaccess.h unaligned.h user.h vdso vermagic.h vga.h vmlinux.lds.h vtime.h

word-at-a-time.h xor.h

"syscalls.h" selected (910 bytes)

ubuntu on QEMU/KVM

File Virtual Machine View Send Key

Activities Text Editor Sep 30 20:04

usr src linux-5.8.11 arch x86 entry syscalls

Makefile syscall_32 syscall_64 syscallhdr syscalltbl

sySCALL_64.tbl /usr/src/linux-5.8.11/arch/x86/entry/syscalls

Save

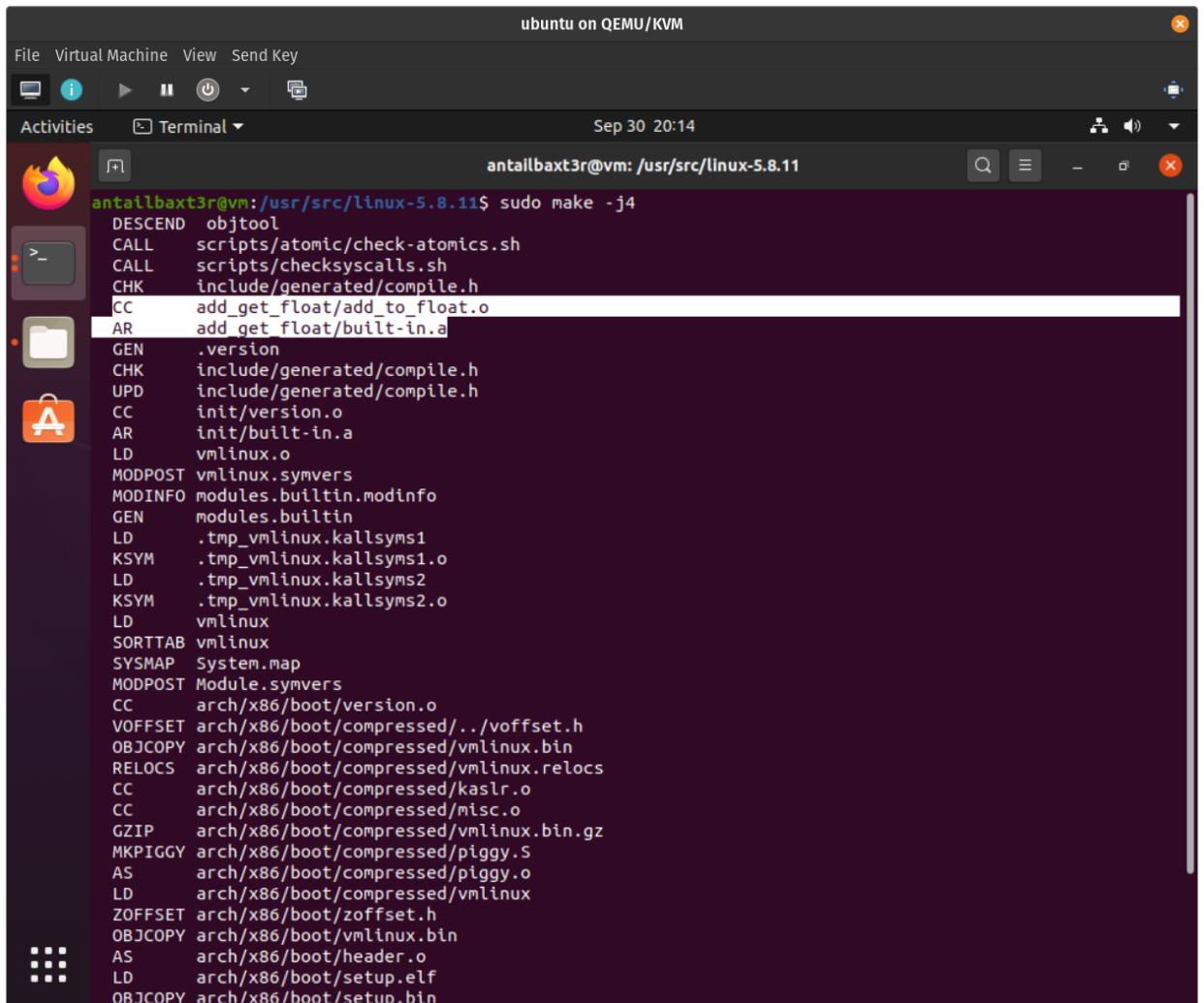
Open +

351 427	common	io_uring_register	sys_io_uring_register
352 428	common	open_tree	sys_open_tree
353 429	common	move_mount	sys_move_mount
354 430	common	fsopen	sys_fsopen
355 431	common	fsconfig	sys_fsconfig
356 432	common	fsmount	sys_fsmount
357 433	common	fspick	sys_fspick
358 434	common	pidfd_open	sys_pidfd_open
359 435	common	clone3	sys_clone3
360 437	common	openat2	sys_openat2
361 438	common	pidfd_getfd	sys_pidfd_getfd
362 439	common	faccessat2	sys_faccessat2
363 440	common	add syscall	sys add syscall
364 441	common	add to float	sys add to float
365 #			
366 #	x32-specific system call numbers start at 512 to avoid cache impact		
367 #	for native 64-bit operation. The __x32_compat_sys stubs are created		
368 #	on-the-fly for compat_sys_*() compatibility system calls if X86_X32		
369 #	is defined.		
370 #			
371 512	x32	rt_sigaction	compat_sys_rt_sigaction
372 513	x32	rt_sigreturn	compat_sys_x32_rt_sigreturn
373 514	x32	ioctl	compat_sys_ioctl
374 515	x32	readv	compat_sys_readv
375 516	x32	writev	compat_sys_writev
376 517	x32	recvfrom	compat_sys_recvfrom
377 518	x32	sendmsg	compat_sys_sendmsg

PlainText Tab Width: 8 Ln 364, Col 1

"syscall_64.tbl" selected (14.2 kB)

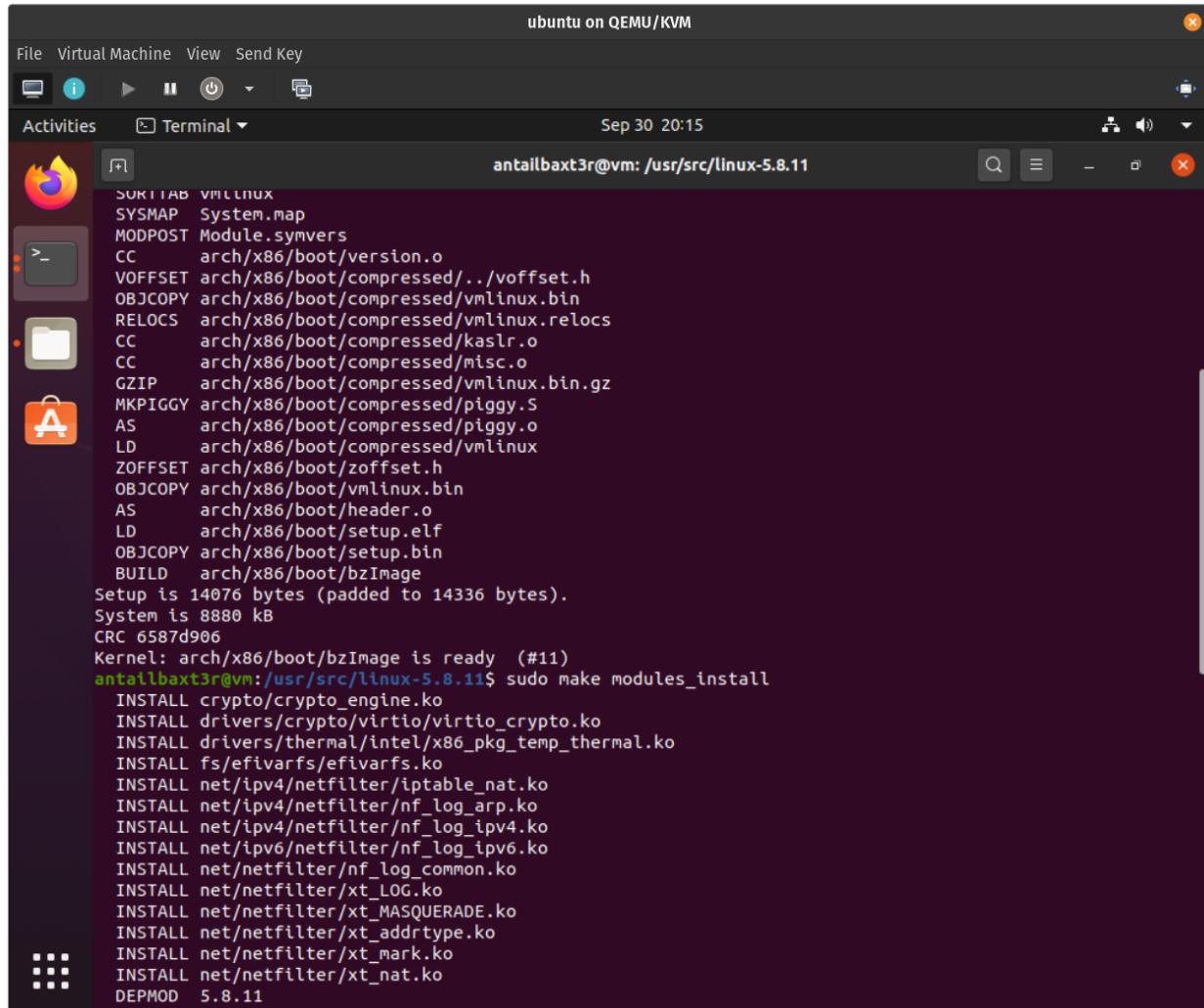
4. Recompiled kernel (sudo make)



The screenshot shows a terminal window titled "ubuntu on QEMU/KVM" running on an Ubuntu desktop environment. The terminal window has a dark theme and displays the command "antailbaxt3r@vm: /usr/src/linux-5.8.11\$ sudo make -j4". The output of the command is shown below:

```
antailbaxt3r@vm: /usr/src/linux-5.8.11$ sudo make -j4
DESCEND objtool
CALL scripts/atomic/check-atomics.sh
CALL scripts/checksyscalls.sh
CHK include/generated/compile.h
CC add_get_float/add_to_float.o
AR add_get_float/built-in.a
GEN .version
CHK include/generated/compile.h
UPD include/generated/compile.h
CC init/version.o
AR init/built-in.a
LD vmlinux.o
MODPOST vmlinux.symvers
MODINFO modules.builtin.modinfo
GEN modules.builtin
LD .tmp_vmlinux.kallsyms1
KSYM .tmp_vmlinux.kallsyms1.o
LD .tmp_vmlinux.kallsyms2
KSYM .tmp_vmlinux.kallsyms2.o
LD vmlinux
SORTTAB vmlinux
SYMSMAP System.map
MODPOST Module.symvers
CC arch/x86/boot/version.o
VOFFSET arch/x86/boot/compressed/../../../voffset.h
OBJCOPY arch/x86/boot/compressed/vmlinux.bin
RELOCS arch/x86/boot/compressed/vmlinux.relocs
CC arch/x86/boot/compressed/kaslr.o
CC arch/x86/boot/compressed/misc.o
GZIP arch/x86/boot/compressed/vmlinux.bin.gz
MKPIGGY arch/x86/boot/compressed/piggy.S
AS arch/x86/boot/compressed/piggy.o
LD arch/x86/boot/compressed/vmlinux
ZOFFSET arch/x86/boot/zoffset.h
OBJCOPY arch/x86/boot/vmlinux.bin
AS arch/x86/boot/header.o
LD arch/x86/boot/setup.elf
OBJCOPY arch/x86/boot/setup.bin
```

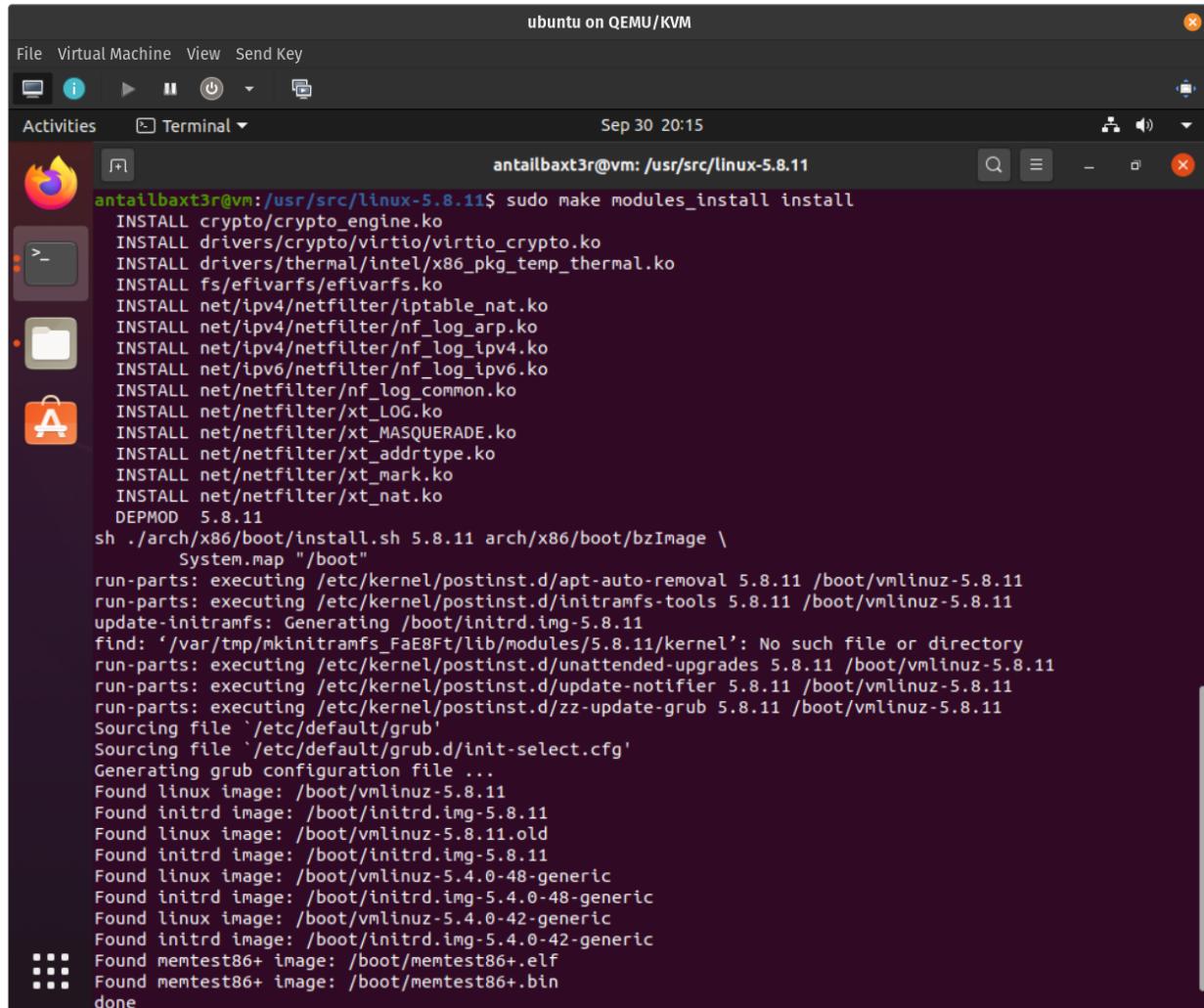
5. sudo make modules_install



The screenshot shows a terminal window titled "ubuntu on QEMU/KVM". The terminal window has a dark theme with a light-colored text area. The title bar includes the window name, a date and time stamp ("Sep 30 20:15"), and standard window control buttons. The terminal interface includes a header bar with "File", "Virtual Machine", "View", and "Send Key" options, along with a "Activities" button and a "Terminal" tab indicator. The main text area displays the command-line output of the "make modules_install" command:

```
SUKHILAB vmlinuz
SYSMAP System.map
MODPOST Module.symvers
CC arch/x86/boot/version.o
VOFFSET arch/x86/boot/compressed/.../voffset.h
OBJCOPY arch/x86/boot/compressed/vmlinux.bin
RELOCS arch/x86/boot/compressed/vmlinux.relocs
CC arch/x86/boot/compressed/kaslr.o
CC arch/x86/boot/compressed/misc.o
GZIP arch/x86/boot/compressed/vmlinux.bin.gz
MKPIGGY arch/x86/boot/compressed/piggy.S
AS arch/x86/boot/compressed/piggy.o
LD arch/x86/boot/compressed/vmlinux
ZOFFSET arch/x86/boot/zoffset.h
OBJCOPY arch/x86/boot/vmlinux.bin
AS arch/x86/boot/header.o
LD arch/x86/boot/setup.elf
OBJCOPY arch/x86/boot/setup.bin
BUILD arch/x86/boot/bzImage
Setup is 14076 bytes (padded to 14336 bytes).
System is 8880 kB
CRC 6587d906
Kernel: arch/x86/boot/bzImage is ready (#11)
antailbaxt3r@vm:~/usr/src/linux-5.8.11$ sudo make modules_install
INSTALL crypto/crypto_engine.ko
INSTALL drivers/crypto/virtio/virtio_crypto.ko
INSTALL drivers/thermal/intel/x86_pkg_temp_thermal.ko
INSTALL fs/efivars/efivarsfs.ko
INSTALL net/ipv4/netfilter/iptable_nat.ko
INSTALL net/ipv4/netfilter/nf_log_arp.ko
INSTALL net/ipv4/netfilter/nf_log_ipv4.ko
INSTALL net/ipv6/netfilter/nf_log_ipv6.ko
INSTALL net/netfilter/nf_log_common.ko
INSTALL net/netfilter/xt_LOG.ko
INSTALL net/netfilter/xt_MASQUERADE.ko
INSTALL net/netfilter/xt_addrtype.ko
INSTALL net/netfilter/xt_mark.ko
INSTALL net/netfilter/xt_nat.ko
DEPMOD 5.8.11
```

6. sudo make modules_install install

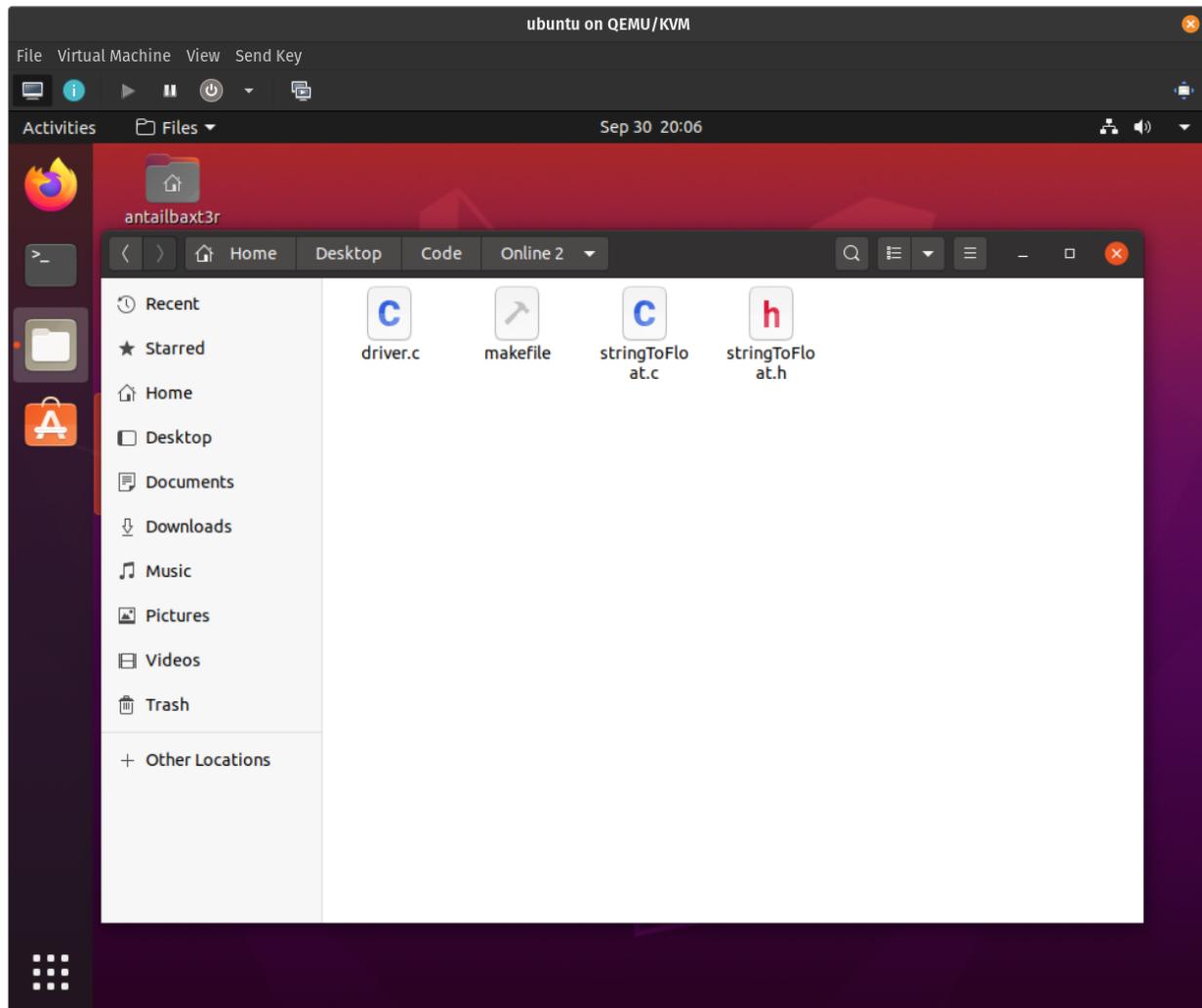


The screenshot shows a terminal window titled "ubuntu on QEMU/KVM" running on a desktop environment. The terminal window has a dark background and contains the following command and its output:

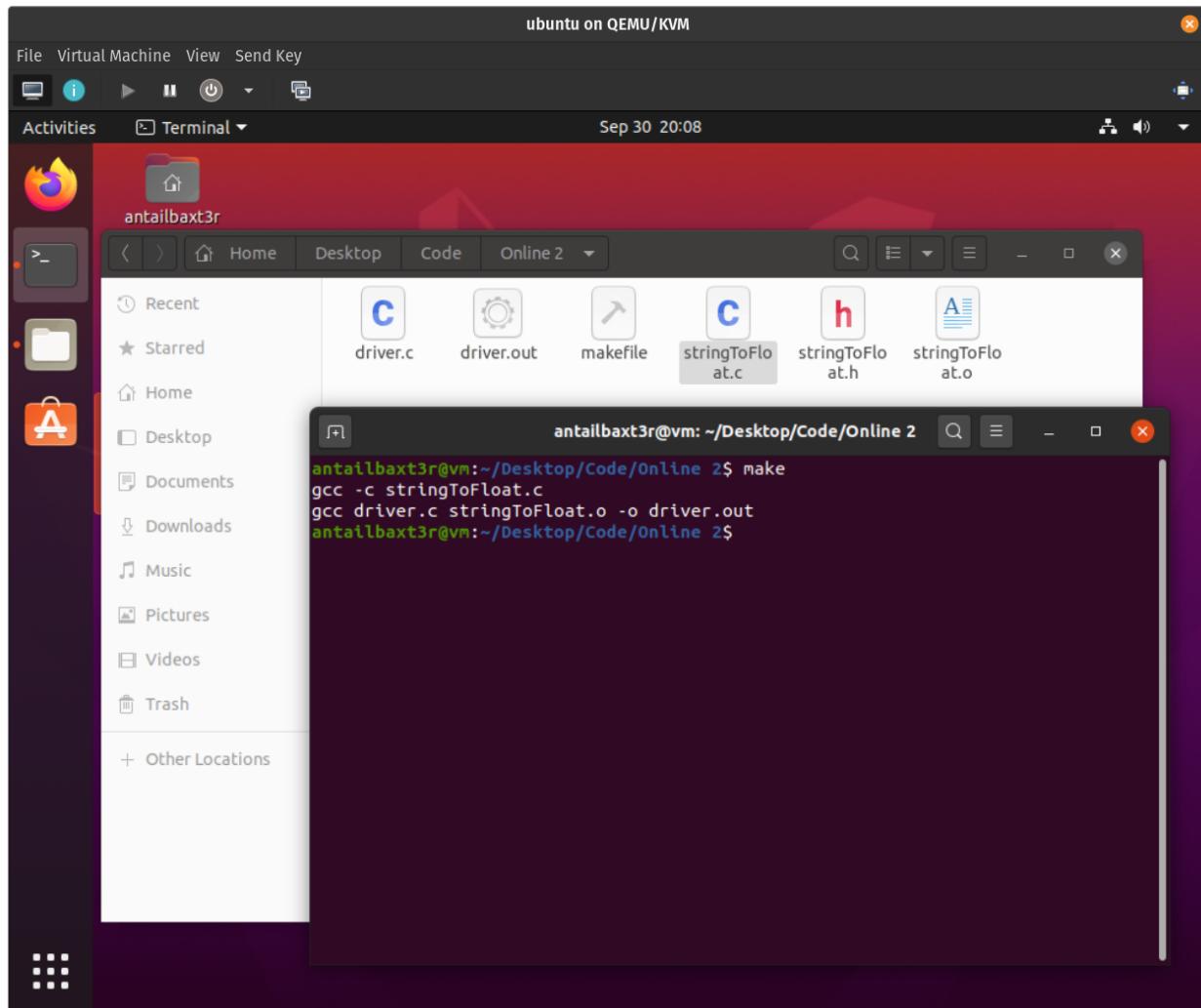
```
antailbaxt3r@vm:/usr/src/linux-5.8.11$ sudo make modules_install install
INSTALL crypto/crypto_engine.ko
INSTALL drivers/crypto/virtio/virtio_crypto.ko
INSTALL drivers/thermal/intel/x86_pkg_temp_thermal.ko
INSTALL fs/efivarfs/efivarfs.ko
INSTALL net/ipv4/netfilter/iptable_nat.ko
INSTALL net/ipv4/netfilter/nf_log_arp.ko
INSTALL net/ipv4/netfilter/nf_log_ipv4.ko
INSTALL net/ipv6/netfilter/nf_log_ipv6.ko
INSTALL net/netfilter/nf_log_common.ko
INSTALL net/netfilter/xt_LOG.ko
INSTALL net/netfilter/xt_MASQUERADE.ko
INSTALL net/netfilter/xt_addrtype.ko
INSTALL net/netfilter/xt_mark.ko
INSTALL net/netfilter/xt_nat.ko
DEPMOD 5.8.11
sh ./arch/x86/boot/install.sh 5.8.11 arch/x86/boot/bzImage \
System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 5.8.11 /boot/vmlinuz-5.8.11
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 5.8.11 /boot/vmlinuz-5.8.11
update-initramfs: Generating /boot/initrd.img-5.8.11
find: '/var/tmp/mkinitramfs_FaE8Ft/lib/modules/5.8.11/kernel': No such file or directory
run-parts: executing /etc/kernel/postinst.d/unattended-upgrades 5.8.11 /boot/vmlinuz-5.8.11
run-parts: executing /etc/kernel/postinst.d/update-notifier 5.8.11 /boot/vmlinuz-5.8.11
run-parts: executing /etc/kernel/postinst.d/zz-update-grub 5.8.11 /boot/vmlinuz-5.8.11
Sourcing file '/etc/default/grub'
Sourcing file '/etc/default/grub.d/init-select.cfg'
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-5.8.11
Found initrd image: /boot/initrd.img-5.8.11
Found linux image: /boot/vmlinuz-5.8.11.old
Found initrd image: /boot/initrd.img-5.8.11
Found linux image: /boot/vmlinuz-5.4.0-48-generic
Found initrd image: /boot/initrd.img-5.4.0-48-generic
Found linux image: /boot/vmlinuz-5.4.0-42-generic
Found initrd image: /boot/initrd.img-5.4.0-42-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
```

7. Added driver_code files

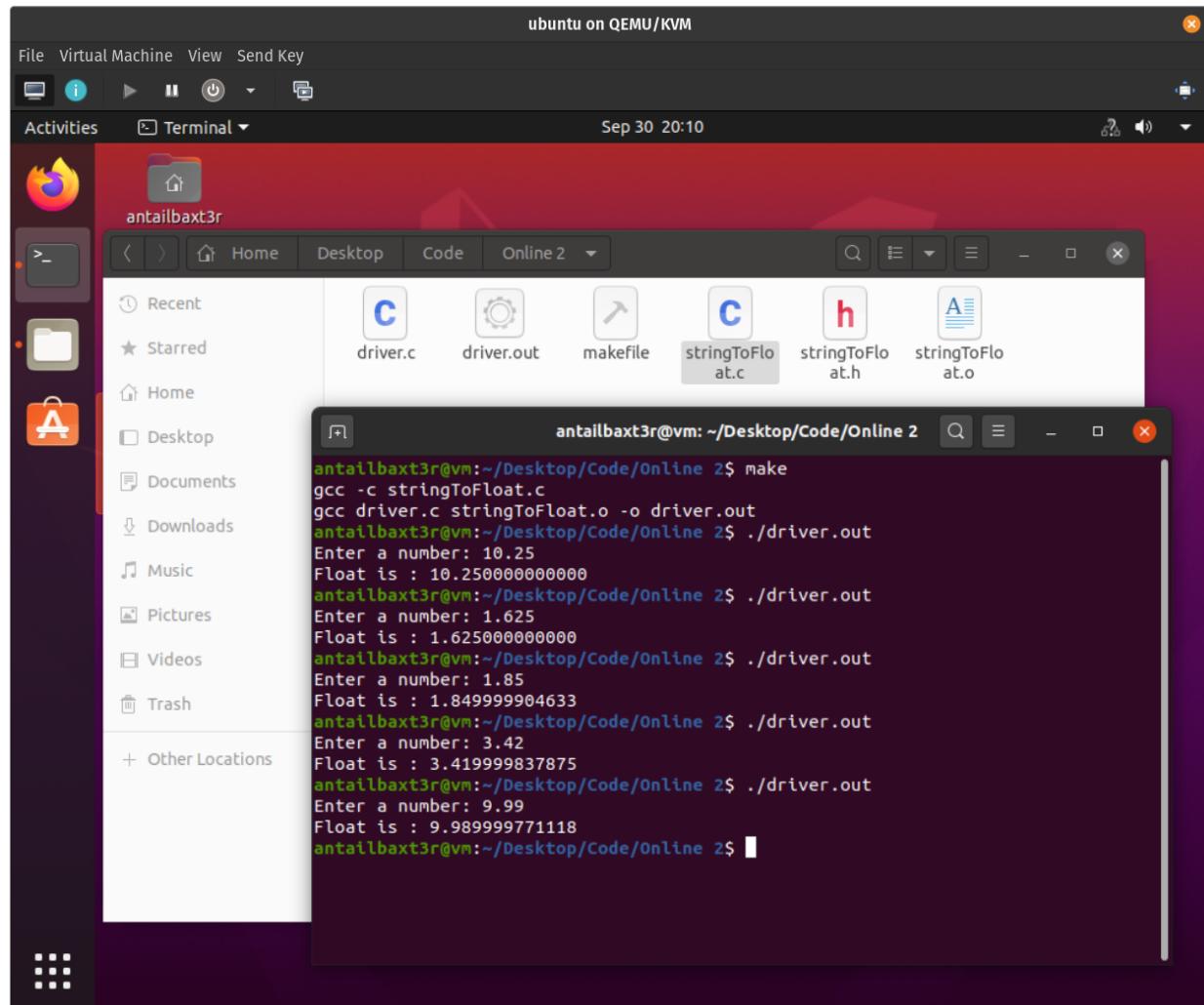
- a. driver.c
- b. stringToFloat.c
- c. stringToFloat.h
- d. makefile



8. Compiled



9. Ran some test cases



END

**Submitted on 30-09-2020
By Arjun Bajpai
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