Syed Ahmed Farrukh

ProblemSet2

Exercise 1

```
syedahmedfarrukh@Hydrasd

kernel/syscall.c
      126 [SYS_link]    sys_link,
      127 [SYS_mkdir]   sys_mkdir,
      128 [SYS_close]   sys_close,
      129 };
      130
      131 void
      132 syscall(void)
B+>   133 {
      134   int num;
      135   struct proc *p = myproc();
      136
      137   num = p->trapframe->a7;
      138   if(num > 0 && num < NELEM(syscalls) && syscalls[num]) {
      139     // Use num to lookup the system call function for num, call it,
      140     // and store its return value in p->trapframe->a0
      141     p->trapframe->a0 = syscalls[num]();
      142   } else {
remote Thread 1.2 (src) In: syscall                                  L133   PC: 0x80001cde
(gdb) backtrace
#0  syscall () at kernel/syscall.c:133
#1  0x0000000080001a9c in usertrap () at kernel/trap.c:68
#2  0x0000003ffffff09c in ?? ()
(gdb)
```

```
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kernel/syscall.c
      126 [SYS_link]    sys_link,
      127 [SYS_mkdir]   sys_mkdir,
      128 [SYS_close]   sys_close,
      129 };
      130
      131 void
      132 syscall(void)
B+    133 {
      134   int num;
      135   struct proc *p = myproc();
      136
  >   137   num = p->trapframe->a7;
      138   if(num > 0 && num < NELEM(syscalls) && syscalls[num]) {
      139     // Use num to lookup the system call function for num, call it,
      140     // and store its return value in p->trapframe->a0
      141     p->trapframe->a0 = syscalls[num]();
      142   } else {
remote Thread 1.2 (src) In: syscall                                  L137   PC: 0x80001cf0
(gdb) n
(gdb) p /x *p
$1 = {lock = {locked = 0x0, name = 0x80007118, cpu = 0x0}, state = 0x4, chan = 0x0,
  killed = 0x0, xstate = 0x0, pid = 0x1, parent = 0x0, kstack = 0x3fffffd000, sz = 0x5000,
  pagetable = 0x87f52000, trapframe = 0x87f56000, context = {ra = 0x800012fc,
    sp = 0x3fffffdc50, s0 = 0x3fffffdc80, s1 = 0x80007cb0, s2 = 0x80007880, s3 = 0x0,
    s4 = 0x80012dc0, s5 = 0x3, s6 = 0x80018950, s7 = 0x0, s8 = 0x80018a78, s9 = 0x182,
    s10 = 0xb0, s11 = 0x2}, ofile = {0x0 <repeats 16 times>}, cwd = 0x80015dc0, name = {
    0x69, 0x6e, 0x69, 0x74, 0x0 <repeats 12 times>}}
(gdb)
```

```
syedahmedfarrukh@Hydrasd
kernel/syscall.c
      126 [SYS_link]    sys_link,
      127 [SYS_mkdir]   sys_mkdir,
      128 [SYS_close]   sys_close,
      129 };
      130
      131 void
      132 syscall(void)
B+    133 {
      134   int num;
      135   struct proc *p = myproc();
      136
  >   137   num = p->trapframe->a7;
      138   if(num > 0 && num < NELEM(syscalls) && syscalls[num]) {
      139     // Use num to lookup the system call function for num, call it,
      140     // and store its return value in p->trapframe->a0
      141     p->trapframe->a0 = syscalls[num]();
      142   } else {
remote Thread 1.2 (src) In: syscall                                          L
  pagetable = 0x87f52000, trapframe = 0x87f56000, context = {ra = 0x800012fc,
    sp = 0x3fffffdc50, s0 = 0x3fffffdc80, s1 = 0x80007cb0, s2 = 0x80007880, s3 = 0x0,
    s4 = 0x80012dc0, s5 = 0x3, s6 = 0x80018950, s7 = 0x0, s8 = 0x80018a78, s9 = 0x182,
    s10 = 0xb0, s11 = 0x2}, ofile = {0x0 <repeats 16 times>}, cwd = 0x80015dc0, name =
    0x69, 0x6e, 0x69, 0x74, 0x0 <repeats 12 times>}}
(gdb) p /x p->trapframe->a7
$2 = 0xf
(gdb) p /x $sstatus
$3 = 0x200000022
(gdb)
```

```
syedahmedfarrukh@Hydrasd
no-builtin-strchr -fno-builtin-exit -fno-builtin-malloc -fno-builtin
mcpy -Wno-main -fno-builtin-printf -fno-builtin-fprintf -fno-builtin
pie -no-pie  -c -o kernel/syscall.o kernel/syscall.c
riscv64-unknown-elf-ld -z max-page-size=4096 -T kernel/kernel.ld -o
loc.o kernel/string.o kernel/main.o kernel/vm.o kernel/proc.o kernel
p.o kernel/syscall.o kernel/sysproc.o kernel/bio.o kernel/fs.o kerne
o kernel/pipe.o kernel/exec.o kernel/sysfile.o kernel/kernelvec.o ke
/start.o kernel/console.o kernel/printf.o kernel/uart.o kernel/spinl
riscv64-unknown-elf-ld: warning: kernel/kernel has a LOAD segment wi
riscv64-unknown-elf-objdump -S kernel/kernel > kernel/kernel.asm
riscv64-unknown-elf-objdump -t kernel/kernel | sed '1,/SYMBOL TABLE/
m
mkfs/mkfs fs.img README user/findtest.sh user/sixfive.txt user/_cat
er/_init user/_kill user/_ln user/_ls user/_mkdir user/_rm user/_sh
ind user/_wc user/_zombie user/_logstress user/_forphan user/_dorpha
nmeta 47 (boot, super, log blocks 31, inode blocks 13, bitmap blocks
balloc: first 956 blocks have been allocated
balloc: write bitmap block at sector 46
qemu-system-riscv64 -machine virt -bios none -kernel kernel/kernel -
-mmio.force-legacy=false -drive file=fs.img,if=none,format=raw,id=x0
=virtio-mmio-bus.0

xv6 kernel is booting

hart 1 starting
hart 2 starting
scause=0xd sepc=0x80001cee stval=0x0
panic: kerneltrap
```

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```
   0x80001cde <syscall>    addi    sp,sp,-32
   0x80001ce0 <syscall+2>  sd      ra,24(sp)
   0x80001ce2 <syscall+4>  sd      s0,16(sp)
   0x80001ce4 <syscall+6>  sd      s1,8(sp)
   0x80001ce6 <syscall+8>  addi    s0,sp,32
   0x80001ce8 <syscall+10> jal     0x80000d7a <myproc>
   0x80001cec <syscall+14> mv      s1,a0
B+>0x80001cee <syscall+16> lw      a3,0(zero) # 0x0
   0x80001cf2 <syscall+20> addiw   a4,a3,-1
   0x80001cf6 <syscall+24> li      a5,20
   0x80001cf8 <syscall+26> bltu    a5,a4,0x80001d16 <syscall+56>
   0x80001cfc <syscall+30> slli    a4,a3,0x3
   0x80001d00 <syscall+34> auipc   a5,0x6
   0x80001d04 <syscall+38> addi    a5,a5,-1448
   0x80001d08 <syscall+42> add     a5,a5,a4
   0x80001d0a <syscall+44> ld      a5,0(a5)
   0x80001d0c <syscall+46> beqz    a5,0x80001d16 <syscall+56>
   0x80001d0e <syscall+48> ld      s1,88(a0)
   0x80001d10 <syscall+50> jalr    a5
remote Thread 1.3 (asm) In: syscall
(gdb) c'
Not stopped at any breakpoint; argument ignored.
Continuing.
[Switching to Thread 1.3]

Thread 3 hit Breakpoint 1, syscall () at kernel/syscall.c:137
(gdb) p p->name
$1 = "init", '\000' <repeats 11 times>
(gdb) p p->pid
$2 = 1
(gdb)
```

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```
loc.o kernel/string.o kernel/main.o kernel/vm.o kernel/proc.o kernel/swtch.o kernel/tra
p.o kernel/syscall.o kernel/sysproc.o kernel/bio.o kernel/fs.o kernel/log.o kernel/slee
o kernel/pipe.o kernel/exec.o kernel/sysfile.o kernel/kernelvec.o kernel/plic.o kernel/
/start.o kernel/console.o kernel/printf.o kernel/uart.o kernel/spinlock.o
riscv64-unknown-elf-ld: warning: kernel/kernel has a LOAD segment with RWX permissions
riscv64-unknown-elf-objdump -S kernel/kernel > kernel/kernel.asm
riscv64-unknown-elf-objdump -t kernel/kernel | sed '1,/SYMBOL TABLE/d; s/ .* / /; /^$/d
m
mkfs/mkfs fs.img README user/findtest.sh user/sixfive.txt user/_cat user/_echo user/_fo
er/_init user/_kill user/_ln user/_ls user/_mkdir user/_rm user/_sh user/_stressfs user
ind user/_wc user/_zombie user/_logstress user/_forphan user/_dorphan  user/_memdump
nmeta 47 (boot, super, log blocks 31, inode blocks 13, bitmap blocks 1) blocks 1953 tot
balloc: first 956 blocks have been allocated
balloc: write bitmap block at sector 46
qemu-system-riscv64 -machine virt -bios none -kernel kernel/kernel -m 128M -smp 3 -nogr
-mmio.force-legacy=false -drive file=fs.img,if=none,format=raw,id=x0 -device virtio-blk
=virtio-mmio-bus.0

xv6 kernel is booting

hart 1 starting
hart 2 starting
scause=0xd sepc=0x80001cee stval=0x0
panic: kerneltra
QEMU: Terminated
syedahmedfarrukh@Hydrasden:~/xv6lab_syedahmedfarrukh_28543$ nano kernel/kernel.asm
syedahmedfarrukh@Hydrasden:~/xv6lab_syedahmedfarrukh_28543$ grep 80001cee kernel/kernel
    8000[illegible]: 00002683                lw      a3,0(zero) # 0 <_entry-0x80000000>
syedahmedfarrukh@Hydrasden:~/xv6lab_syedahmedfarrukh_28543$
```

Exercise 2

```
syedahmedfarrukh@Hydrasd
riscv64-unknown-elf-ld -z max-page-size=4096 -T user/user.ld -o user/_sandbox user/sandbox.o user/ulib.o user/usys.o use
r/printf.o user/umalloc.o
riscv64-unknown-elf-objdump -S user/_sandbox > user/sandbox.asm
riscv64-unknown-elf-objdump -t user/_sandbox | sed '1,/SYMBOL TABLE/d; s/ .* / /; /^$/d' > user/sandbox.sym
riscv64-unknown-elf-gcc -Wall -Werror -O -fno-omit-frame-pointer -ggdb -gdwarf-2 -DSOL_UTIL -DLAB_UTIL -MD -mcmodel=meda
ny -ffreestanding -fno-common -nostdlib -fno-builtin-strncpy -fno-builtin-strncmp -fno-builtin-strlen -fno-builtin-memse
t -fno-builtin-memmove -fno-builtin-memcmp -fno-builtin-log -fno-builtin-bzero -fno-builtin-strchr -fno-builtin-exit -fn
o-builtin-malloc -fno-builtin-putc -fno-builtin-free -fno-builtin-memcpy -Wno-main -fno-builtin-printf -fno-builtin-fpri
ntf -fno-builtin-vprintf -I. -fno-stack-protector -fno-pie -no-pie   -c -o user/memdump.o user/memdump.c
riscv64-unknown-elf-ld -z max-page-size=4096 -T user/user.ld -o user/_memdump user/memdump.o user/ulib.o user/usys.o use
r/printf.o user/umalloc.o
riscv64-unknown-elf-objdump -S user/_memdump > user/memdump.asm
riscv64-unknown-elf-objdump -t user/_memdump | sed '1,/SYMBOL TABLE/d; s/ .* / /; /^$/d' > user/memdump.sym
mkfs/mkfs fs.img README user/findtest.sh user/sixfive.txt user/_cat user/_echo user/_forktest user/_grep user/_init user
/_kill user/_ln user/_ls user/_mkdir user/_rm user/_sh user/_stressfs user/_usertests user/_grind user/_wc user/_zombie
user/_logstress user/_forphan user/_dorphan user/_sandbox  user/_memdump
nmeta 47 (boot, super, log blocks 31, inode blocks 13, bitmap blocks 1) blocks 1953 total 2000
balloc: first 993 blocks have been allocated
balloc: write bitmap block at sector 46
qemu-system-riscv64 -machine virt -bios none -kernel kernel/kernel -m 128M -smp 3 -nographic -global virtio-mmio.force-l
egacy=false -drive file=fs.img,if=none,format=raw,id=x0 -device virtio-blk-device,drive=x0,bus=virtio-mmio-bus.0

xv6 kernel is booting

hart 2 starting
hart 1 starting
init: starting sh
$ sandbox 32768 - cat README
cat: cannot open README
$
```

```
syedahmedfarrukh@Hydrasd

qemu-system-riscv64 -machine virt -bios none -kernel kernel/kernel -m 128M -smp 3 -nographic -global virtio-mmio.force-legacy=false -drive file=fs.img,if=none,format=raw

xv6 kernel is booting

hart 1 starting
hart 2 starting
init: starting sh
$ ls
.              1 1 1024
..             1 1 1024
README         2 2 2425
findtest.sh    2 3 91
sixfive.txt    2 4 19
cat            2 5 36584
echo           2 6 35440
forktest       2 7 17160
grep           2 8 40824
init           2 9 35896
kill           2 10 35360
ln             2 11 35176
ls             2 12 38720
mkdir          2 13 35424
rm             2 14 35408
sh             2 15 58424
stressfs       2 16 36296
usertests      2 17 186328
grind          2 18 51824
wc             2 19 37576
zombie         2 20 34760
logstress      2 21 37360
forphan        2 22 36184
dorphan        2 23 35632
sandbox        2 24 35496
memdump        2 25 36800
console        3 26 0
$ cat README
xv6 is a re-implementation of Dennis Ritchie's and Ken Thompson's Unix
Version 6 (v6).  xv6 loosely follows the structure and style of v6,
but is implemented for a modern RISC-V multiprocessor using ANSI C.

ACKNOWLEDGMENTS

xv6 is inspired by John Lions's Commentary on UNIX 6th Edition (Peer
to Peer Communications; ISBN: 1-57398-013-7; 1st edition (June 14,
2000)).  See also https://pdos.csail.mit.edu/6.1810/, which provides
pointers to on-line resources for v6.

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Nathaniel Filardo, flespark, Peter Froehlich, Yakir Goaron, Shivam
Handa, Matt Harvey, Bryan Henry, jaichenhengjie, Jim Huang, Matúš
```

```
syedahmedfarrukh@Hydrasd
riscv64-unknown-elf-gcc -Wall -Werror -O -fno-omit-frame-pointer -ggdb -gdwarf-2 -DSOL_UTIL -DLAB_UTIL -MD -mcmodel=meda
ny -ffreestanding -fno-common -nostdlib -fno-builtin-strncpy -fno-builtin-strncmp -fno-builtin-strlen -fno-builtin-memse
t -fno-builtin-memmove -fno-builtin-memcmp -fno-builtin-log -fno-builtin-bzero -fno-builtin-strchr -fno-builtin-exit -fn
o-builtin-malloc -fno-builtin-putc -fno-builtin-free -fno-builtin-memcpy -Wno-main -fno-builtin-printf -fno-builtin-fpri
ntf -fno-builtin-vprintf -I. -fno-stack-protector -fno-pie -no-pie   -c -o user/memdump.o user/memdump.c
riscv64-unknown-elf-ld -z max-page-size=4096 -T user/user.ld -o user/_memdump user/memdump.o user/ulib.o user/usys.o use
r/printf.o user/umalloc.o
riscv64-unknown-elf-objdump -S user/_memdump > user/memdump.asm
riscv64-unknown-elf-objdump -t user/_memdump | sed '1,/SYMBOL TABLE/d; s/ .* / /; /^$/d' > user/memdump.sym
mkfs/mkfs fs.img README user/findtest.sh user/sixfive.txt user/_cat user/_echo user/_forktest user/_grep user/_init user
/_kill user/_ln user/_ls user/_mkdir user/_rm user/_sh user/_stressfs user/_usertests user/_grind user/_wc user/_zombie
user/_logstress user/_forphan user/_dorphan user/_sandbox  user/_memdump
nmeta 47 (boot, super, log blocks 31, inode blocks 13, bitmap blocks 1) blocks 1953 total 2000
balloc: first 993 blocks have been allocated
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egacy=false -drive file=fs.img,if=none,format=raw,id=x0 -device virtio-blk-device,drive=x0,bus=virtio-mmio-bus.0

xv6 kernel is booting

hart 1 starting
hart 2 starting
init: starting sh
$ sandbox 32768 - cat README
cat: cannot open README
$ QEMU: Terminated
syedahmedfarrukh@Hydrasden:~/xv6lab_syedahmedfarrukh_28543$ ./grade-lab-syscall sandbox_mask
```
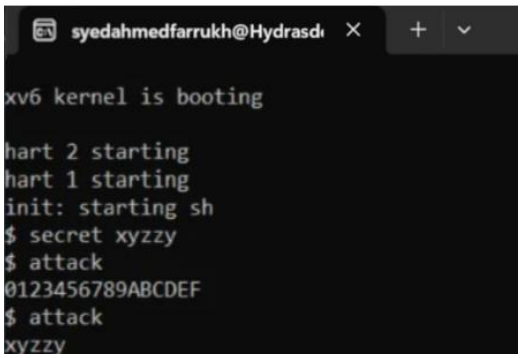

Exercise 3

```
syedahmedfarrukh@Hydrasd

riscv64-unknown-elf-objdump -t user/_sandbox | sed '1,/SYMBOL TABLE/d; s/ .* / /; /^
riscv64-unknown-elf-gcc -Wall -Werror -O -fno-omit-frame-pointer -ggdb -gdwarf-2 -DS
ny -ffreestanding -fno-common -nostdlib -fno-builtin-strncpy -fno-builtin-strncmp -f
t -fno-builtin-memmove -fno-builtin-memcmp -fno-builtin-log -fno-builtin-bzero -fno-
o-builtin-malloc -fno-builtin-putc -fno-builtin-free -fno-builtin-memcpy -Wno-main -
ntf -fno-builtin-vprintf -I. -fno-stack-protector -fno-pie -no-pie   -c -o user/memd
riscv64-unknown-elf-ld -z max-page-size=4096 -T user/user.ld -o user/_memdump user/m
r/printf.o user/umalloc.o
riscv64-unknown-elf-objdump -S user/_memdump > user/memdump.asm
riscv64-unknown-elf-objdump -t user/_memdump | sed '1,/SYMBOL TABLE/d; s/ .* / /; /^
mkfs/mkfs fs.img README user/findtest.sh user/sixfive.txt user/_cat user/_echo user/
/_kill user/_ln user/_ls user/_mkdir user/_rm user/_sh user/_stressfs user/_usertest
user/_logstress user/_forphan user/_dorphan user/_sandbox  user/_memdump
nmeta 47 (boot, super, log blocks 31, inode blocks 13, bitmap blocks 1) blocks 1953
balloc: first 993 blocks have been allocated
balloc: write bitmap block at sector 46
qemu-system-riscv64 -machine virt -bios none -kernel kernel/kernel -m 128M -smp 3 -n
egacy=false -drive file=fs.img,if=none,format=raw,id=x0 -device virtio-blk-device,dr

xv6 kernel is booting

hart 2 starting
hart 1 starting
init: starting sh
$ sandbox 32768 README grep xv6 README
xv6 is a re-implementation of Dennis Ritchie's and Ken Thompson's Unix
Version 6 (v6).  xv6 loosely follows the structure and style of v6,
xv6 is inspired by John Lions's Commentary on UNIX 6th Edition (Peer
(kaashoek,rtm@mit.edu).  The main purpose of xv6 is as a teaching
```

MAKE GRADE

```
syedahmedfarrukh@Hydrasd
== Test answers-syscall.txt ==
answers-syscall.txt: OK
== Test sandbox_mask ==
$ make qemu-gdb
sandbox_mask: OK (7.3s)
== Test sandbox_fork ==
$ make qemu-gdb
sandbox_fork: OK (1.0s)
== Test sandbox_path ==
$ make qemu-gdb
sandbox_path: OK (2.0s)
== Test sandbox_most ==
$ make qemu-gdb
sandbox_most: OK (0.7s)
== Test sandbox_minus ==
$ make qemu-gdb
sandbox_minus: OK (0.8s)
== Test attack ==
$ make qemu-gdb
attack: OK (0.7s)
== Test time ==
time: OK
Score: 45/45
syedahmedfarrukh@Hydrasden:~/xv6lab_syedahmedfarrukh
```

Exercise 4


syedahmedfarrukh@Hydrasd
xv6 kernel is booting
hart 2 starting
hart 1 starting
init: starting sh
$ secret xyzzy
$ attack
0123456789ABCDEF
$ attack
xyzzy