

hw1 Report

313551099 李以恩

I. Compiling the Linux Kernel

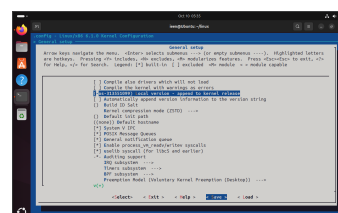
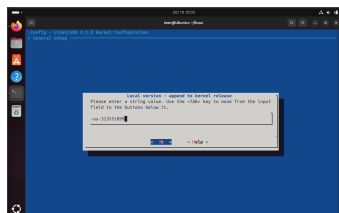
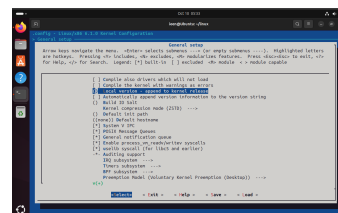
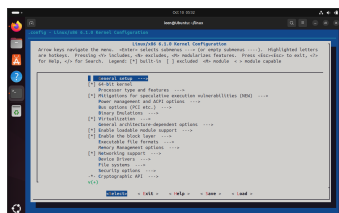
1. Install Required Packages

```
sudo apt install build-essential libncurses-dev bison flex libssl-dev libelf-dev
```

2. Configure Kernel

```
cp -v /boot/config-$(uname -r) .config  
make menuconfig
```

- Append my student-ID to the kernel release.



3. Build the Kernel

- It takes up to 3 hours to finish compiling.

```
sudo make  
sudo make modules_install  
sudo make install
```

4. Reboot and Verify Kernel Version

- When the system boots up, I access the GRUB menu to choose the kernel I just compiled.
- GRUB Menu → Advanced options for Ubuntu → Ubuntu with Linux 6.10-os-313551099

My result

```

teen@Ubuntu:~/linux$ make kernelrelease
6.1.0-os-313551099
teen@Ubuntu:~/linux$ uname -a
Linux Ubuntu 6.1.0-os-313551099 #1 SMP PREEMPT_DYNAMIC Thu Oct 10 09:02:02 UTC 2024 x86_64 x86_64 x86_64 GNU/Linux
teen@Ubuntu:~/linux$ cat /etc/os-release
PRETTY_NAME="Ubuntu 24.04.1 LTS"
NAME="Ubuntu"
VERSION_ID="24.04"
VERSION="24.04.1 LTS (Noble Numbat)"
VERSION_CODENAME=noble
ID=ubuntu
ID_LIKE=debian
HOME_URL="https://www.ubuntu.com/"
SUPPORT_URL="https://help.ubuntu.com/"
BUG_REPORT_URL="https://bugs.launchpad.net/ubuntu/"
PRIVACY_POLICY_URL="https://www.ubuntu.com/legal/terms-and-policies/privacy-policy"
UBUNTU_CODENAME=noble
LOGO=ubuntu-logo

```

II. Implementing a new System Calls

1. Modify system call number definition

- Open the system call table file

```
vim arch/x86/entry/syscalls/syscall_64.tbl
```

- Add the system call number definition to the file

```
451    common    revstr    sys_revstr
```

2. Modify system call declaration

- Open the system call declaration file

```
vim include/linux/syscalls.h
```

- Add the declaration of my system call

```
asmlinkage long sys_revstr(char __user *str, int length);
```

3. Implement a new system call

- Create my own system call file: revstr/revstr.c

```
vim revstr/revstr.c
```

- Write my system call file:

```

#include <linux/syscalls.h>
#include <linux/linkage.h>
#include <linux/kernel.h>
#include <linux/uaccess.h>

SYSCALL_DEFINE2(revstr, char __user *, str, int, length)
{
    int i;
    char original_str[256];
    char reversed_str[256];

    // Copy from user
    if(copy_from_user(original_str, str, length))
    {
        return -EFAULT;
    }
    original_str[length] = '\0';

```

```

// Reverse
for(i=0; i<length; i++)
{
    reversed_str[i] = original_str[length - i - 1];
}
reversed_str[length] = '\0';

// Print
printf("The original string: %s\n", original_str);
printf("The reversed string: %s\n", reversed_str);

// Copy to user
if (copy_to_user(str, reversed_str, length))
{
    return -EFAULT;
}
return 0;
}

```

4. Add the system call to the kernel build system

- Create the makefile of my system call

```
vim revstr/Makefile
```

- Add the following code, to let the revstr.c be compiled as revstr.o

```
obj-y := revstr.o
```

5. Modify the Makefile

- Open the Makefile from the linux folder

```
vim Makefile
```

- Append the following code after "core-y"

```
core-y += kernel/ certs/ mm/ fs/ ipc/ security/ crypto/ revstr/
```

6. Recompile

```

sudo make
sudo make modules_install
sudo make install
sudo update-grub
sudo reboot

```

7. Test

- Use the test code provided from the TAs. Create **revstr_test.c** in user-space.
- Compile and run it.

```

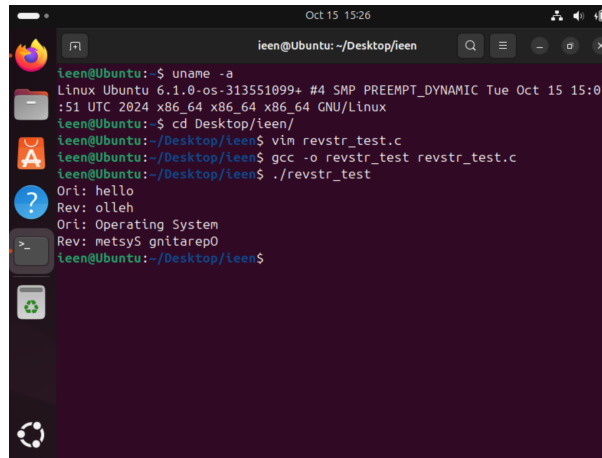
vim revstr_test.c
gcc -o revstr_test revstr_test.c

```

```
./revstr_test  
dmesg
```

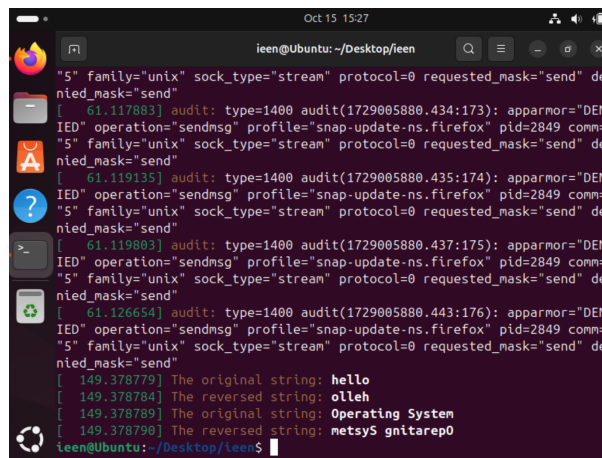
My result

- The output of the above user-space program:



```
ieen@Ubuntu: ~/Desktop/ieen  
ieen@Ubuntu:~$ uname -a  
Linux Ubuntu 6.1.0-os-313551099+ #4 SMP PREEMPT_DYNAMIC Tue Oct 15 15:07:51 UTC 2024 x86_64 x86_64 x86_64 GNU/Linux  
ieen@Ubuntu:~$ cd Desktop/ieen/  
ieen@Ubuntu:~/Desktop/ieen$ vi revstr_test.c  
ieen@Ubuntu:~/Desktop/ieen$ gcc -o revstr_test revstr_test.c  
ieen@Ubuntu:~/Desktop/ieen$ ./revstr_test  
Ori: hello  
Rev: olleh  
Ori: Operating System  
Rev: metsyS gnitarep0  
ieen@Ubuntu:~/Desktop/ieen$
```

- the kernel ring buffer for the output messages:



```
ieen@Ubuntu: ~/Desktop/ieen  
[ 61.117883] audit: type=1400 audit(1729005880.434:173): apparmor="DENIED" operation="sendmsg" profile="snap-update-ns.firefox" pid=2849 comm="S" family="unix" sock_type="stream" protocol=0 requested_mask="send" denied_mask="send"  
[ 61.119135] audit: type=1400 audit(1729005880.435:174): apparmor="DENIED" operation="sendmsg" profile="snap-update-ns.firefox" pid=2849 comm="S" family="unix" sock_type="stream" protocol=0 requested_mask="send" denied_mask="send"  
[ 61.119803] audit: type=1400 audit(1729005880.437:175): apparmor="DENIED" operation="sendmsg" profile="snap-update-ns.firefox" pid=2849 comm="S" family="unix" sock_type="stream" protocol=0 requested_mask="send" denied_mask="send"  
[ 61.126654] audit: type=1400 audit(1729005880.443:176): apparmor="DENIED" operation="sendmsg" profile="snap-update-ns.firefox" pid=2849 comm="S" family="unix" sock_type="stream" protocol=0 requested_mask="send" denied_mask="send"  
[ 149.378779] The original string: hello  
[ 149.378784] The reversed string: olleh  
[ 149.378789] The original string: Operating System  
[ 149.378790] The reversed string: metsyS gnitarep0  
ieen@Ubuntu:~/Desktop/ieen$
```

III. Patch

IV. Package list

- Package list

```
dpkg --get-selections > packages_list_313551099.txt
```

- config

```
find ~/linux -name ".config"
```