

Report of OS Project 1

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Assignment

Project 1 will involve designing two kernel modules:

- Design a kernel module that creates a /proc file named /proc/jiffies that reports the current value of jiffies when the /proc/jiffies file is read, such as with the command:

```
cat /proc/jiffies
```

- Design a kernel module that creates a proc file named /proc/seconds that reports the number of elapsed seconds since the kernel module was loaded. This will involve using the value of jiffies as well as the HZ rate. When a user enters the command:

```
cat /proc/seconds
```

your kernel module will report the number of seconds that have elapsed since the kernel module was first loaded. Be sure to remove /proc/seconds when the module is removed.

Environment

- Virtual platform: VMware Workstation Pro 15.0
 - Operating system: Ubuntu 18.04
 - Kernel: Linux 5.3.1
-

Solution

- Assignment 1

```
ssize_t proc_read(struct file *file, char __user *usr_buf,
size_t count, loff_t *pos)
{
    long int rv = 0;
    char buffer[BUFFER_SIZE];
    static int completed = 0;

    if (completed) {
        completed = 0;
        return 0;
    }
}
```

```

    }

    completed = 1;

    rv = sprintf(buffer, "%lu%s", jiffies, "\n");
    // copies the contents of buffer to userspace usr_buf
    copy_to_user(usr_buf, buffer, rv);

    return rv;
}

```

- "jiffies" can be called directly in <linux/jiffies.h> .
- This "proc_read" function copies "jiffies" to user buffer so that it can be showed in dmesg.
- The source code is showed in "jiffies.c".
- "Makefile" is also of great importance. It's like a script in Linux shell. It's source code are showed below:

```

obj-m += jiffies.o
all:
make -C /lib/modules/$(shell uname -r)/build M=$(PWD) modules
clean:
make -C /lib/modules/$(shell uname -r)/build M=$(PWD) clean

```

• Assignment 2

```

int proc_init(void)
{
    // creates the /proc/hello entry
    // the following function call is a wrapper for
    // proc_create_data() passing NULL as the last argument
    proc_create(PROC_NAME, 0, NULL, &proc_ops);
    count1 = jiffies;
    printk(KERN_INFO "/proc/%s created\n", PROC_NAME);
    return 0;
}

```

- Use count1 to store the starting jiffies.

```

ssize_t proc_read(struct file *file, char __user *usr_buf,
size_t count, loff_t *pos)
{
    int rv = 0;
    char buffer[BUFFER_SIZE];
    static int completed = 0;

    if (completed) {

```

```
        completed = 0;
        return 0;
    }

    completed = 1;

    second = (jiffies - count1)/HZ ;
    rv = sprintf(buffer,"%d%s", second, "\n");
    // copies the contents of buffer to userspace usr_buf
    copy_to_user(usr_buf, buffer, rv);

    return rv;
}
```

- Use "jiffies-count1" / HZ to calculate the second.
- "Makefile" needs to change into:

```
obj-m += seconds.o
all:
make -C /lib/modules/$(shell uname -r)/build M=$(PWD) modules
clean:
make -C /lib/modules/$(shell uname -r)/build M=$(PWD) clean
```

- The source code is showed in "seconds.c".
- "HZ" can be called directly in <linux/gcd.h> .

Experiment Result

- Assignment 1

```

os@ubuntu: ~/GUO/Homework/1
File Edit View Search Terminal Help
[ 33.723050] audit: type=1400 audit(1571146443.166:29): apparmor="STATUS" operation="profile_load" profile="unconfined" name="snap-update-ns.gnome-characters" pid=746 comm="apparmor_parser"
[ 34.250673] usbcore: registered new interface driver btusb
[ 56.790837] NET: Registered protocol family 40
[ 57.658037] Bluetooth: BNEP (Ethernet Emulation) ver 1.3
[ 57.658038] Bluetooth: BNEP filters: protocol multicast
[ 57.658043] Bluetooth: BNEP socket layer initialized
[ 83.790134] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: None
[ 83.791109] IPv6: ADDRCONF(NETDEV_CHANGE): ens33: link becomes ready
[ 190.941484] Bluetooth: RFCOMM TTY layer initialized
[ 190.941488] Bluetooth: RFCOMM socket layer initialized
[ 190.941493] Bluetooth: RFCOMM ver 1.11
[ 193.059414] rfkill: input handler disabled
[ 196.803505] ISO 9660 Extensions: Microsoft Joliet Level 3
[ 197.014329] ISO 9660 Extensions: RRIP_1991A
[ 3421.652992] jiffies: loading out-of-tree module taints kernel.
[ 3421.653225] jiffies: module verification failed: signature and/or required key missing - tainting kernel
[ 3421.656059] /proc/jiffies created
os@ubuntu:~/GUO/Homework/1$ cat /proc/jiffies
4295766869
os@ubuntu:~/GUO/Homework/1$

```

"Jiffies" is showed successfully.

- Assignment 2

```

os@ubuntu: ~/GUO/Homework/1
File Edit View Search Terminal Help
[ 57.658038] Bluetooth: BNEP filters: protocol multicast
[ 57.658043] Bluetooth: BNEP socket layer initialized
[ 83.790134] e1000: ens33 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: None
[ 83.791109] IPv6: ADDRCONF(NETDEV_CHANGE): ens33: link becomes ready
[ 190.941484] Bluetooth: RFCOMM TTY layer initialized
[ 190.941488] Bluetooth: RFCOMM socket layer initialized
[ 190.941493] Bluetooth: RFCOMM ver 1.11
[ 193.059414] rfkill: input handler disabled
[ 196.803505] ISO 9660 Extensions: Microsoft Joliet Level 3
[ 197.014329] ISO 9660 Extensions: RRIP_1991A
[ 3421.652992] jiffies: loading out-of-tree module taints kernel.
[ 3421.653225] jiffies: module verification failed: signature and/or required key missing - tainting kernel
[ 3421.656059] /proc/jiffies created
[ 3597.385491] /proc/jiffies removed
[ 3691.874181] /proc/seconds created
os@ubuntu:~/GUO/Homework/1$ cat /proc/seconds
20
os@ubuntu:~/GUO/Homework/1$ cat /proc/seconds
24
os@ubuntu:~/GUO/Homework/1$ cat /proc/seconds
25
os@ubuntu:~/GUO/Homework/1$

```

The used second is showed successfully. 20, 24, 25 is the second.

Logs

This is my first time to develop a Linux kernel. I learned how to use "insmod", "rmmod", "dmesg" and so many other commands. I also installed many packages and environment files before doing this project to ensure this kernel work. Finally, thanks teacher or TA for reading my report and code.

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