



SHANGHAI JIAO TONG UNIVERSITY

IEEE CLASS

COMPUTER SYSTEMS ENGINEERING

The report of Project 1

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1 The environment of the experiment

I finish this experiment on a Linux virtual machine through VMware. And the version of my Linux is 14.04.5. In order to make it more convenient to edit files, I installed Sublime on my virtual machine.

2 Problem 1

2.1 Analysis

In this problem, we are asked to 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.

In fact, this problem is not difficult to cope with. Before we begin to do the assignment, the textbook has provided us with some examples to exercise. The textbook has told us how to design a kernel module that creates a kernel module that creates a `/proc` file named `/proc/jiffies`. If a user enters the command “`cat /proc/hello`”, “Hello World” message will be returned.

This problem is similiar to this example. We just need to change the content it will return. In this problem, we need to return the value of `jiffies` which maintains the number of timer interrupts that have occurred since the system was booted. And the `jiffies` variable is declared in the file “`linux/jiffies.h`”. So the file should include this necessary header files.

The main part in the problem which differs from the example in the textbook is the content returned. To realize this goal, we only need to change one line of the codes of the example into the following code.

```
1      rv = sprintf(buffer, "The current value of jiffies is %d\n",  
                  jiffies);
```

Listing 1: Script

Because `jiffies` is an `int`. So we need to add “`%d`” when we want to output it. Then the value of `jiffies` is written to the variable `buffer` where `buffer` exists in kernel memory. Since `/proc/jiffies` can be accessed from user space, we must copy the contents of `buffer` to user space using the kernel function `copy_to_user()`.

Now, the problem has been solved.

2.2 Result

The result will be demonstrated as follows.

```
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ sudo insmod jiffies.ko
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/jiffies
The current value of jiffies is 6165552
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/jiffies
The current value of jiffies is 6165825
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/jiffies
The current value of jiffies is 6166034
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/jiffies
The current value of jiffies is 6166261
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/jiffies
The current value of jiffies is 6166487
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/jiffies
The current value of jiffies is 6166738
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/jiffies
The current value of jiffies is 6166966
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ sudo rmmod jiffies.ko
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$
```

Figure 1: Result of the Problem 1

3 Problem 2

3.1 Analysis

In problem 2, we are asked to design a kernel module that creates a /proc file named /proc/seceonds 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”, the kernel module will report the number of seconds that have elapsed since the kernel module was first loaded.

How to use the variable jiffies has been introduced in Problem 1. And the method of application of the varieable HZ is almost the same. It’s corresponding header file is asm/param.h.

Then we begin to design the timer. It’s asked that the module need to return the number of seconds that have elapsed since the kernerl module was first loaded. So we need to find a method to calculate the time. It’s easy to come up with the following the formula.

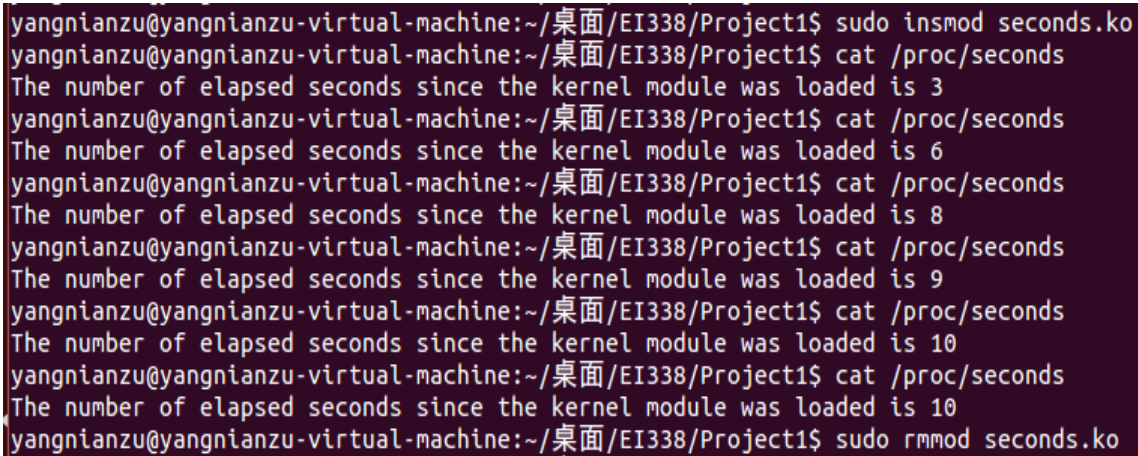
$$time = \frac{jiffies_{current} - jiffies_{initial}}{HZ}$$

$jiffies_{current}$ represents the value when we enter the command and $jiffies_{initial}$ represents the value when the kernel module was first loaded. Here comes the question that when we should record the value. For convenience, I defined two global variables named start and end to record the initial and the current value of jiffies in the beginning. When we first load the kernel module, we assign the current value of jiffies to start. Therefore, I realize this step in function proc_init. And I assign the current value of jiffies to end in function proc_read. In this way, we can have the jiffies's increment everytime we enter the command. Because the value of HZ is easy to get, so we can work out the number of seconds that have elapsed since the kernel module was first loaded.

Then we can use the same method mentioned in Problem 1 to display the result in terminal.

3.2 Result

The result will be demonstrated as follows.



```
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ sudo insmod seconds.ko
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/seconds
The number of elapsed seconds since the kernel module was loaded is 3
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/seconds
The number of elapsed seconds since the kernel module was loaded is 6
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/seconds
The number of elapsed seconds since the kernel module was loaded is 8
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/seconds
The number of elapsed seconds since the kernel module was loaded is 9
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/seconds
The number of elapsed seconds since the kernel module was loaded is 10
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ cat /proc/seconds
The number of elapsed seconds since the kernel module was loaded is 10
yangnianzu@yangnianzu-virtual-machine:~/桌面/EI338/Project1$ sudo rmmod seconds.ko
```

Figure 2: Result of the Problem 2

4 Acknowledgement

Thanks for the guidance of teacher Wu Chentao. Without enough knowledge we learned in class, we can't finish this project easily. Also thanks for assistants' effort.