

COMP 521/L—Advanced Operating Systems and Lab

Assignment #2— Linux Kernel Module for Task Information

Objective:

To create a Linux kernel module that uses the /proc file system to display a task's information based on its process identifier value (pid).

Specification:

- The program will be coded/tested within a Linux Virtual Machine (VirtualBox, Vmware, etc.) to prevent any potential permanent impact/changes to the testing computer's actual Operating System.
- The program will consist of a module that displays a task's information based on its process identifier value (**pid**)
- In order to test the module, you need to do the following:
 - Create a kernel source code file, named: **pidinfo.c** which contain the following:
 - Appropriate **#include** statements of header files:
 - `linux/module.h`
 - `linux/kernel.h`
 - `linux/proc_fs.h`
 - `linux/seq_file.h,`
 - `linux/uaccess.h,`
 - `linux/sched/signal.h,`
 - `linux/version.h`
 - The function **proc_show** for reading **/proc/pidinfo**
This will be called whenever: `cat /proc/pidinfo` is executed.
 - The function **pidinfo_write** for writing to **/proc/pidinfo**
This will be called whenever: `echo "{pid}" > /proc/pidinfo` is executed.
 - A file operations structure called **proc_ops** which contains the functions that will be called whenever a process reads **pidinfo** (namely: **proc_show**) or **writes to pidinfo** (namely: **proc_write**)
 - The **proc_init** function which calls **proc_create** to register the module and create the **/proc** file.
 - The **proc_exit** function which calls **remove_proc_entry** to remove the module from the **/proc** file system.
 - Compile the kernel source code using the provided make file **Makefile** and debug any errors, if necessary, using the command: **make**
 - Load the kernel module using the command: **sudo insmod pidinfo.ko**
 - To check whether the module has loaded, use the command: **lsmod | head**
 - Check which **pid** is valid by the command: **ps -gx**
 - Write to the module with the command: `echo "{pid}" > /proc/pidinfo`
 - To store multiple **pid**'s, use a static interger array: `int stred_pids[MAX_PIDS]` and keep track of the number of pid stored: `int num_pids`
 - Read the module with the command: `cat /proc/pidinfo`
 - Remove the kernel module using the command: **sudo rmmmod pidinfo**
{Note: the **.ko** suffix is unnecessary}

Compiling using Makefile:

```
osc@ubuntu:~/comp521/asmt2$ make clean; ls
make -C /lib/modules/4.15.0-213-generic/build M=/home/osc/comp521/asmt2 clean
make[1]: Entering directory '/usr/src/linux-headers-4.15.0-213-generic'
make[1]: Leaving directory '/usr/src/linux-headers-4.15.0-213-generic'
Makefile pidinfo.c
osc@ubuntu:~/comp521/asmt2$ make
make -C /lib/modules/4.15.0-213-generic/build M=/home/osc/comp521/asmt2 modules
make[1]: Entering directory '/usr/src/linux-headers-4.15.0-213-generic'
  CC [M] /home/osc/comp521/asmt2/pidinfo.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC      /home/osc/comp521/asmt2/pidinfo.mod.o
  LD [M] /home/osc/comp521/asmt2/pidinfo.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.15.0-213-generic'
osc@ubuntu:~/comp521/asmt2$
```

Inserting and Executing the module:

```
osc@ubuntu:~/comp521/asmt2$ sudo insmod pidinfo.ko
osc@ubuntu:~/comp521/asmt2$ lsmod | head
Module                Size  Used by
pidinfo               16384  0
binfmt_misc           20480  1
joydev                24576  0
vboxvideo             36864  1
input_leds            16384  0
snd_intel8x0          40960  0
ttm                   106496  1 vboxvideo
drm_kms_helper        172032  1 vboxvideo
drm                   401408  4 drm_kms_helper,vboxvideo,ttm
osc@ubuntu:~/comp521/asmt2$ emacs &
[1] 4351
osc@ubuntu:~/comp521/asmt2$ ps -gx
  PID TTY          STAT TIME  COMMAND
  1323 ?            Ss   0:00 /lib/systemd/systemd --user
  1324 ?            S    0:00 (sd-pam)
  1346 tty1        S    0:00 -bash
  4351 tty1        Tl   0:00 emacs
  4353 tty1        R+   0:00 ps -gx

[1]+  Stopped                  emacs
osc@ubuntu:~/comp521/asmt2$ cat /proc/pidinfo
No PIDs written yet.
osc@ubuntu:~/comp521/asmt2$ echo "1346" > /proc/pidinfo
osc@ubuntu:~/comp521/asmt2$ echo "4351" > /proc/pidinfo
osc@ubuntu:~/comp521/asmt2$ cat /proc/pidinfo
command = [bash]      pid = [1346]    state = [1]
command = [emacs]     pid = [4351]    state = [260]
```

Removing the module from the Kernel, and deleting the output (non-source) files:

```
osc@ubuntu:~/comp521/asmt2$ sudo rmmod pidinfo
osc@ubuntu:~/comp521/asmt2$ lsmod | head
Module                Size  Used by
binfmt_misc           20480  1
joydev                24576  0
vboxvideo             36864  1
input_leds            16384  0
snd_intel8x0          40960  0
ttm                   106496  1 vboxvideo
drm_kms_helper        172032  1 vboxvideo
drm                   401408  4 drm_kms_helper,vboxvideo,ttm
fb_sys_fops           16384  1 drm_kms_helper
osc@ubuntu:~/comp521/asmt2$ make clean; ls
make -C /lib/modules/4.15.0-213-generic/build M=/home/osc/comp521/asmt2 clean
make[1]: Entering directory '/usr/src/linux-headers-4.15.0-213-generic'
  CLEAN      /home/osc/comp521/asmt2/.tmp_versions
  CLEAN      /home/osc/comp521/asmt2/Module.symvers
make[1]: Leaving directory '/usr/src/linux-headers-4.15.0-213-generic'
Makefile pidinfo.c
```