COSC 1114 Operating Systems Principles
Year: 2017 Second Semester
Assignment 1

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Total Marks: 25
Lab Time: Wednesday 15:30-16:30
Lab assistant: Paul

1. Running Environment

RAM: 16GB
CPU: Intel Core i7-4710HQ CPU
DISK:512GB SSD
SYSTEM: Ubuntu 16.04.3

2. Process diary

Stage	Step	Task Description	Comments	Time
1		Install virtual machine and operating system Ubuntu in your computer	Problem of this stage: Unable to install Linux on virtual machine so install on real machine instead	23.8.2017

1	1	Download
		`ubuntu-16.04.3-desktop-amd64.iso (64 bit)`
		`ubuntu-16.04.3-desktop-i356.iso (32 bit)`
		from `ubuntu.com`
			Use `.torrent` download will be faster	23.8.2017

1	2	Download Virtual box 5.1 (Windows Edition) from `virtualbox.org`		23.8.2017
1	3	Install VirtualBox on windows system		23.8.2017
1	4.0	Open VirtualBox manager and install ubuntu		23.8.2017
1	4.a	Create virtual machine and enter virtual machine running environment • Name: Assignment_1 • Type: Linux • Version: Ubuntu 32 bit • 2G memory • 30 GB disk space	For unknown reason there's no Ubuntu 64-bit option, reason will explore on next stage	23.8.2017

1	4.b	Select corresponding Ubuntu system image and install	Problem: Once the image is selected and click “OK”, the Windows system goes down! Probably reason: For my virtual option is on in my BIOS system and there’s no 64-bit option, probably there’s a software occupies the virtual machine process. However, there’s no other VM software on my system and I closed Hyper-V system service the problem still not be solved. I change to real running environment	23.8.2017
1	4.c	Go to step 5	Not able to continue virtual machine go to step 5	23.8.2017
1	4.d	Go to step 5	Not able to continue virtual machine go to step 5	23.8.2017
1	5.1	Download UltraISO From https://www.ezbsystems.com/ultraiso/		23.8.2017
1	5.2	Install and Open UltraISO		23.8.2017
1	5.3	Write system image (Ubuntu 64 bit) on an empty U-disk with UltraISO		23.8.2017
1	5.4	Shrink a disk about 50 GB to prepare installation of ubuntu		23.8.2017
1	5.5	Restart system and boot from U-disk with system image		23.8.2017
1	5.6	Install Ubuntu system and restart		23.8.2017

1	5.7	Update ubuntu to prepare next stage, Open terminal
		`sudo apt-get upgrade`
		`sudo apt-get update`
				23.8.2017

2		Download and Compile Linux kernel source codes	Problem: Need some other services package like:	23.8.2017
2	0	Download kernel **4.12.7** from `www.kernel.org` And use terminal goes to corresponding downloaded folder		23.8.2017
2	a.1	Extract kernel package `tar xvf linux-4.12.7.tar.xz`		23.8.2017
2	a.2	Go to extracted folder `cd linux-4.12.7`		23.8.2017
2	b.3.1	Make kernel compile config `make config`	Problem: Too many to config to enter use `menuconfig` to set all config directly, so abort go to 2.3.2	23.8.2017

2	b.3.2	Install menuconfig package
		`sudo apt-get install libncurses5`
		`sudo apt-get install libncurses5-dev`
				23.8.2017

2	b.3.3	Make config `make menuconfig` Then first “Save” and “Exit”		23.8.2017
2	b.4.1	Compile kernels `make`	Problem: Encounter `“fatal error: openssl/openssl.h: No such file or directory”`	23.8.2017
2	b.4.2	Install openssl: `sudo apt-get install libssl-dev`		23.8.2017
2	b.4.3	Continue compile kernels `sudo make`	Promotion: • Use several threads can make compile much quicker use j parameter. • Use time parameter to record compile time `sudo time make -j10`	23.8.2017

2	b.5	Compile modules `sudo make modules`		23.8.2017
2	b.6	Install modules `sudo make modules_install`		23.8.2017
2	b.7	Install kernel `sudo make install`		23.8.2017
2	b.8	Reboot system `reboot`		23.8.2017
2	b.9	Check whether kernel installed `uname -r`	Output `4.12.7-21-generic`	23.8.2017
3		Add a system call helloworld() to linux kernel and recompile linux kernel		24.8.2017
3	1.0	Add a system call to relevant files (Details from 1.1)		24.8.2017
3	1.1	Add usistd in `/arch/x86/include/generated/uapi/asm/unistd_64.h`		24.8.2017
3	1.2	Add the unistd in system call table in `/arch/x86/entry/syscalls/syscall_64.tbl`		24.8.2017
3	1.3	Add system call function declare in `/include/linux/syscalls.h`	System call only can return Pfunction! Other returns will make compile error or invalid kernel!	24.8.2017
3	1.4	Add system call function implementation in `/kernel/sys.c`	System call only can return long function! Other returns will make compile error or invalid kernel! `printk()` will print to system log	24.8.2017
3	2.0	Recompile kernel and reinstall		24.8.2017
3	2.1	Clean all compiled files and config `sudo make mrproper`		24.8.2017

3	2.2	Make new config `sudo make menuconfig`		24.8.2017
3	2.3	Compile system `sudo time make -j10`		24.8.2017
3	2.4	Install new kernel `sudo make install`		24.8.2017
3	2.5	Reboot `reboot`		24.8.2017
3	3.0	Write a user program to invoke the new system call which print the message		24.8.2017
3	3.1	Write a test file (`test.cpp`)	Need system call uid will we are calling system function.	24.8.2017
3	3.2	Compile and run	Sometime `demesg` need `sudo` permission, for unknown reason.	24.8.2017

3. Files modified

a) In stage 3 step 1.1 (`/arch/x86/include/generated/uapi/asm/unistd_64.h`)

Add

```
#define __NR_helloworld 335
```

before the last `#endif`

b) In stage 3 step 1.2 (`/arch/x86/entry/syscalls/syscall_64.tbl`)

Add

```
335   64    helloworld            sys_helloworld
```

At the end of 64 system call list

c) In stage 3 step 1.3 (`/include/linux/syscalls.h`)

Add

```
asmlinkage long sys_helloworld(const char __user *content);
```

At the end of library

d) In stage 3 step 1.4 (/kernel/sys.c)

Add

```
asmlinkage long sys_helloworld(const char __user *content){
            printk("This is  %s\'s message",content);
          return 0;
}
```

At the end of the file

e) In stage 3 step 3.1 (test.cpp)

```
#include <sys/syscall.h>
#include <iostream>
#include <unistd.h>
#include <string>
#include <cstring>
int main(){
    std::cout<<"Please enter your first name\n";
    std::string firstName = "";
    std::cin>>firstName;
    char * toKernel = new char[firstName.length() + 1];
    std::strcpy(toKernel,firstName.c_str());
    long ret = syscall(335, toKernel);
    if(ret==0){
        std::cout<<("Kernel returns 0. Success!\n");
    }
    return 0;
}
```