COM1032 Mobile Computing
Lab 1
Introduction to Some OS Functionalities Commands in Linux & Raspberry Pi 3

Purpose:

The purpose of this lab session is to familiarise yourself with the Linux Operating System, and the Raspberry Pi 3 Single Board Computer.

Aim

By the end of the lab you will be able to:

- Use Linux Shell commands to query various processes by the Linux OS.
- Setup and connect your android device to your PC using the Android Debug Bridge (ADB) to query some of the OS processes of Android.

Lab Structure

Labs will be a mixture of step by step instructions in order to learn new skills and exercises so that you can define your own examples.

We will use **Concept Reminder**: in front of text when we are reminding you of concepts you have already learnt previously in labs or lectures. The OS functionality that we want to cover using Linux commands include: File system and Pipes (I/O), Processes creation and killing, Process scheduling Policies, mounting, HAL, and Security & Permissions.

UNIX/Windows Administration Commands:

Check the Unix Server Administration and the Windows Server Administration Documents in the other materials folder in Surrey Learn. You can practice in your own time if you want to know more about the various commands in windows and UNIX machines where you have administrator account. You can start a virtual machine using OpenNebula to be an administrator in your cloud-based host OS that you can access from anywhere. Follow this guide for more details:

https://bookstack.eps.surrey.ac.uk/books/open-nebula/page/creating-an-instance

In any Ubuntu machine (in the lab where you are a normal user, or your cloud VM, or your own), and using the Unix Administration document, experiment with some of the UNIX commands to find out the following:

OS interfaces the HW to the user applications:

- list the hardware peripherals attached to the machine (lscpu, lspci, lsusb, lshw)

OS manages processes and schedule the shared HW resources between them:

- the running processes (`ps`),
- `strace` to see the system calls (you will need root permission – do it in Raspberry Pi, in the virtual machine, or in your personal computers)

OS accounts for security and user permissions:

- find out the current user permissions on the current directory and quota limits (ls –la, quota).

The following exercise is challenging, but you can easily google the answer, and learn from your own research for now. The complete explanation to all the output options will be gradually explained in the following weeks. Spend no more than 10 minutes on this exercise.

Exercise 1: Can you find the scheduling policy and active processes' priority in Unix?

Hints:

- type "`ps -e -o s,pid,cls,pri`" and look at the output use "`man ps`" to decipher what the output means
- You are only interested in running processes. `grep` allows you to filter the results using pattern matching (`man grep`). Use the pipe "|" and grep to filter the output from part a). "`^X`" is a pattern that matches all lines starting with X
- `awk` (see "`man awk`")

Raspberry Pi 3 Setup

You are given Raspberry Pi 3 SoB and should start connecting it. The USB is pre-installed with NOOBS and Raspbian OS, and you can set up your own OS easily by following this guide:

https://www.raspberrypi.org/documentation/installation/installing-images/README.md

Generally the steps are as follows:

- For the labs of this Module, Raspbian OS is supported. However you can choose your linux flavour and follow the instructions for your choices.
  - Download the Raspbian OS from here to any SD of your choice: https://www.raspberrypi.org/downloads/raspbian/
    (Make sure to Download the full desktop Version)
  - You can follow these steps to prepare your SD card:
    - Install it on a SD card using win32diskimager (if you are running Windows) or use the new noobs installer.
  - Or these steps:
    - Extract the OS image file with 7-Zip, Download it: http://www.7-zip.org/
    - Insert your Micro SD card on a PC or Laptop using the Card Reader.
    - Now you have to Download the Image flashing software, here it is: https://etcher.io/
    - Open Etcher and select the Raspbian OS Image file, also select the memory card then click on flash.
- Whether you use the distributed SD or flashed your own, insert it on the Raspberry Pi SD Card slot. Connect a keyboard, mouse and monitor via HDMI cable (You can also connect it on TV). Choose the installation OS from the screen and follow the steps.
- You should have successfully installed Raspbian OS to the Raspberry Pi now. The default user is pi, and the password is raspberry.
- Reboot and explore the Raspbian OS GUI, you might need to check the following website to make best use of your board:

  https://www.raspberrypi.org/documentation/usage/

Once you connect your Raspberry Pi 3 to one of the lab machines and set it up, open a terminal and repeat the above exercises in the command line.

Raspberry Pi Network Settings

Connect your Raspberry Pi to network and enable VNC for remote connection. Either connect using Ethernet cable to your wired network. Or better connect to Wi-Fi as follows:

- In the Raspberry Pi's desktop environment, click the Terminal icon to open up your command line.
- Type in `sudo raspi-config` and press Enter.
- Go to Localisation Options, and change your Wi-fi Country
- Use the GUI networks icon on the top right-hand side and select the Wi-Fi SSID and connect as usual.
- You might need to do the following. From a terminal window type:

```
sudo ifconfig wlan0 up
```

- if the above command fails, due to RF-Kill run the following commands

```
sudo rfkill list all
```

```
sudo rfkill unblock wifi
sudo rfkill unblock all
```

- Now scan the available networks:

```
sudo iwlist wlan0 scan | grep ESSID
```

- Next, open wpa_supplicant.conf:

```
sudo nano /etc/wpa_supplicant/wpa_supplicant.conf
```

- You'll need to add or edit the following:

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev

update_config=1
country=GB

network={
         ssid="GUEST_WIFI"
         key_mgmt=NONE
}
```

- Then reboot your board.

```
sudo reboot
```

- After reboot you can update and upgrade your packages

```
sudo apt update
sudo apt list --upgradable
sudo apt full-upgrade
```

- Then reboot your board again.

```
sudo reboot
```

- Download VNC Viewer on Your Windows or Mac Computer, iPhone or Android, from RealVNC's VNC Viewer, click the Download button for your operating system, then download the free application and install it.
- Make sure both your board and your computer are on the same network.
- In your Raspberry Pi, click the VNC server icon on the top right side, and read the IP address to use in your viewer.
- Connect from your viewer to avoid using a keyboard, mouse and screen later on.

We will be mainly using Eclipse in the labs. You can download Eclipse using the following command:

```
sudo apt-get install eclipse
```

To get to know your Raspberry Pi more, you can experiment with your Morse code Project that you did on Arduino last semester in COM1031, by following the "Pi_Py_Morse_Code.pdf" tutorial in the Additional Resources section in Surrey Learn. This tutorial uses the GPIO extension, and code the coder and the decoder in python. Complete source code is available in:

https://github.com/BenKinchin/rpi_code

For additional projects, follow the Freenove Raspberry PI tutorial "Raspberry_Pi_Tutorial.pdf" available in the Additional Material section in SurreyLearn.

Optional Linux Kernel compilation:

In your VM in the cloud, download linux kernel source code that is known to work with Raspberry Pi 3 and cross compile it to your Raspberry Pi board:

https://github.com/raspberrypi/linux

You can follow the guide in this tutorial:

http://karuppuswamy.com/wordpress/2015/08/13/how-to-cross-compile-linux-kernel-for-raspberry-pi-on-ubuntu/