Unix Systems Administration and Programming

COSC1133

Assignment 1

Installing and Configuring Linux on a Raspberry Pi

Assessment Marks: 100

Assessment Weight: 40%

Assessment Type: individual

Due Dates:

- Unix Survival Quiz (5 marks): end week 2, 9pm Sun Aug 2nd
- Installation Report and Docker Image (95 marks): end mid-semester break, 9pm Sun Sep 6th

Overview

This assignment amounts to 40% of your marks for this course.

There are three submissions:

1. Sun Aug 2nd for the Unix survival guide
2. Sun 6th Sep for your how-to report
3. Sun 6th Sep for your repo committed to Docker hub. Your repo on Docker hub MUST use the "latest" tag to be marked.

Please note that the Unix Survival quiz is due end of week 2. This is due earlier so you can consider changing your studies if you find the course not to your liking or too difficult.

The assignment is to be done on a Raspberry Pi 4, or an older Pi 3B+. Please see canvas advice on hardware required to complete assignments in this course.

Introduction

It is a common systems administration task to be able to install and configure an operating system.

While the process of installation of an operating system can be somewhat simplified by the fact that the media you boot off is also the storage media for the system (on a server or a laptop / desktop, these are different media), the considerations are not that different.

It is also common for system administrators to have to document the systems they create. For example, how to create or use a particular kind of system. As such, the main deliverable for this assignment is a pdf document that explains how to achieve these tasks, including adequate screenshots, images, diagrams, writing or other media. You will also need to submit a Docker container that contains a portable environment that can be deployed to many systems. Don't worry too much about the Docker container at this stage as this will be explained in the course material closer to the due date.

Your pdf should contain clear instructions and diagrams / images that explain unambiguously how to achieve each task. Note that all images must be clear and well labelled so they would be unambiguous to someone learning about Linux.

Your documentation should be sufficiently detailed so that someone reasonably familiar with using computers but has not used Linux or the raspberry pi before can follow your instructions.

Course Learning Outcomes
This assignment covers the following course learning outcomes:

CLO 1: Demonstrate knowledge of the role and responsibilities of a Unix system administrator

CLO 2: Install and configure the Linux operating system

CLO 3: Manage the resources and security of a computer running Linux at a basic level

CLO 4: Make effective use of Unix utilities, and scripting languages

CLO 5: Configure and manage simple TCP/IP network services on a Linux system

Referencing and Academic Integrity

All work submitted by you must be your own work and you are required to submit with each assignment a reference list of ALL the references you have used with the assignment, including courseware. We will check your report against other reports and online sources using the Turnitin tool and any cases we are concerned about will be referred to the appropriate authority within the school of Science for further action.

You are required to agree with the RMIT assessment declaration (available here) prior to submitting your work. Any violations of this declaration will be pursued thoroughly.

The Tasks

Performing tasks such as writing to the SD card or installing software must be done using terminal applications, editing configuration files, etc, whenever that is possible. You must use dd to write images to a SD card and you must use vim or vi for editing of any configuration files. In the Unix world, nano and emacs and other editors are not guaranteed to be installed but vi is largely universal. This is in-line with standard Unix certifications. Eg: you cannot get your Redhat certifications using any other editor than vi / vim. If you do not have a Linux desktop system at home, we have provided a live disk you can boot off. The best way to do this is via the discussion board set aside for tutor assistance. Although please be aware that your tutor is not there to do your assignment for you and nor are your fellow students. There are intended issues and complexities involved in solving each task in the assignment. It is up to you to find fixes and solve problems. There is very little that is straight forward in systems administration.

Please note that if you have stumbling blocks along the way, do not claim that the assignment is "not doable". All tasks in this assignment are doable because we have done them. The point here is to use the resources available to you to help you to solve the problems you come across.

Unix Survival Guide Quiz (5 Marks)

By the end of week 2 you must complete the Unix survival guide quiz. This quiz is set to be completed earlier as this will set the base minimum you need to know coming into this course. If you struggle with the quiz, then you will struggle with this course.

The link to the form that you need to fill in to complete this assessment is given in Canvas.

Setup the Environment on your Own Computer (15 Marks)

You are to setup the environment on your desktop / laptop machine that will make it easier to work with your raspberry pi. In order to do this, you will need administrative access to the machine or otherwise you won't be able to complete the tasks.

For MacOS

For MacOS, you will need to install homebrew (available from https://brew.sh/). Then you will need to install via homebrew the packages for pv, nmap and tigervnc. You will also need to install xquartz (available at https://www.xquartz.org/).

For Windows

If on Windows 10, you will need to install a WSL (Windows Subsystem for Linux) distribution. We don't mind which you use but Ubuntu and Debian seem to be better tested than Fedora and so that's what we recommend.

If you are running a version of Windows prior to Windows 10, you will need to install cygwin rather than WSL but the tasks you need to do will remain the same as below.

In either case, you will also need to download and install Xming or VcXsrv for graphical connection with the Pi to work. Within WSL you will need to install tigervnc and nmap.

For Linux

You will need to explain how to install the same software as above, being tigervnc and nmap. If you've got a linux system up and running you've already shown some of the required learning for this part of the assignment.

Install RaspberryPiOS on a Raspberry Pi 3B+ or 4 (10 Marks)

Retrieve the disk image for RaspberryPiOS (any of the desktop images will do - not lite) and install it to your raspberry pi. This will be your computer for working on all exercises in this course until the end of the study period. You should download whichever version of Raspberry Pi OS from https://www.raspberrypi.org/downloads/raspberry-pi-os/ you would prefer but please note that you must not use the NOOBS version or any other operating system other than the ones listed on the linked page. We would recommend the "Raspberry Pi OS (32-bit) with desktop and recommended software".

As part of this, complete the following tasks:

- Write the disk image to your Raspberry Pi (we want you to use dd - if you are on windows you will need to use one of the provided isos to boot into first - details and support will be provided in the week 3 lab)
- Once you have this installed on the Pi and restarted, you will want to verify the address of your Pi on the network. Use nmap to do this using the instructions provided in the lab material.
- Connect to the pi and uninstall realvnc from the pi and install tigervnc.
- Start the vnc-server on the pi and enable it to run on each boot, ensuring a reasonable graphical environment when connecting.
- Connect to the pi using the installed vnc viewer on your computer.

You'll now be able to use either the terminal or vnc to login to your pi and do your work for the rest of the semester.

Set Up a RAID Configuration (10 Marks)

Please note that for the following exercise you will need two USB keys. This activity will wipe the two keys so ensure that any data you have on them is backed up.

Using two USB keys of the same size, connect these to your raspberry pi. You will set these up as a RAID mirror using mdadm (RAID 1). Normally we only would make something a mirror if we really care about what is on there so you should also follow the tutorial on setting up a basic shell script to send pushbullet notifications for when one of the disks in the mirror fails.

Install Docker (5 Marks)

You must follow the official instructions provided on Docker's website to install Docker community edition to your Raspbian install (with small modifications). Your user must be able to use Docker without typing "sudo". If you do not show in your installation guide that you can run Docker without being root, half the marks for this requirement will be deducted.

Please note that the rest of the tasks listed here are not required to be documented in your pdf.

Install the following packages in Docker (15 Marks)

Pull the official image for centos 8 as your base container. We have chosen Centos 8 here as the commands are a little different to those in Raspbian. This is to give you some variety of experience of different Linux distributions.

Please ensure you commit your container fairly often in case there are problems with your container at any point. You should use yum in most cases to install a package unless it is not available in this way.

- wget (1 marks)
- man page support (1 marks)
- Install the latest clang for c and c++ programming. (1.5 marks)
- Install clang-format and clang-tidy (1.5 marks)
- vim (1 marks)
- nginx(1 mark)
- git (1 marks)
- nmap (1 marks)
- berryconda python install (version 3) (2 marks)
- rr (reverse and replay – custom debugger for c and c++) (1 marks)
- sshd (1 marks)
- zsh (you must compile this from source code - installation using a package manager will get no marks for this requirement) (2 marks)

Berryconda must **not** be installed in root's (or any other) home directory or any other home directory. It must be globally accessible by all users and must be installed in a sensible **standard** location. If you don't know what that is, do some research and find out (it's covered in the course material). You may of course ask questions to the course staff about this.

Make the following Configuration changes in Docker (20 Marks)

Please note that this section is considered more difficult to get and may require you to do additional research to figure out how to get them to work.

- Expose nginx so that if you connect with a browser using a port that is specified at image creation, you will connect to port 80 in the Docker. (1.5 marks)
- Create a user called fred who has access to root commands via sudo. Their home directory should be /home/fred. Please note that we don't care about the password you use, as your Docker container should drop me in as the default user (root) when I run your shell. The user 'user' should have the Berryconda executables in its search path by default and their default shell should be set to zsh. The user "user" must be able to use sudo to gain root access. (2 marks)
- Install ohmyzsh for the above user. You should enable auto suggestions based on history of commands and you should set a custom prompt from the list of available prompts (2 marks)
- Enable ssh into the Docker container such that port 1234 will redirect to port 22 within the container. (1.5 marks)
- Enable x11 over ssh into the container so that the user 'user' can login and run graphical programs like emacs and have their output display in the operating system of the client, presuming that the right software is running on the client. (2 marks)

- Disable ssh into the Docker container for the root user. (2 marks)
- Add zsh to the list of shells on the system so it can be switched to by a user using the "chsh" command without any warnings. (2 marks)
- Write a basic shell script to start ngninx and sshd. (2 marks)
- git should be configured with your correct name (as per your enrolment) and student email address so if any commits were made from the account 'user' they would be labelled with this information. (2 marks)
- running each of the programs that you installed must invoke that version of the program and no other. Any symbolic links you create should be managed by update-alternatives.The path to each of these executables must be globally accessible and should be available simply by invoking the command name. (3 marks)
- **Do not configure your container so that it loads the user 'fred' by default. As explained in the lectures, it must load a root shell for the markers to be able to gain access. If we cannot become root and therefore cannot test some things, those things will get no marks for those things.**

Commit your Docker image to Docker Hub (5 Marks)

You are to create a Docker image and commit to Docker hub. You will need to create an account to do this and then commit the container to Docker Hub, ensuring it is shared with the rmitusap account.

If you can't get this to work, you may save the image and upload as a zip file to onedrive or google drive. You'll need to then provide a shareable link in your submitted report so we can find your image.

Please note that regardless of how you submit, if we cannot access your Docker image, we cannot give you any marks for the Docker components of this assignment, including installation and configuration of packages within Docker. You may choose any name for your account, but you MUST use the tag of 'latest' for us to find your work. You must also submit the url to your image in the pdf you submit and have it clearly labelled. We don't want any confusion based on information that has not been clearly specified.

Please note that there are two submissions for this assignment: a pdf document explaining all required tasks which should contain screenshots and clear instructions on how to install the required software, and a Docker image submitted to One Drive, Google Drive, or Docker Hub. If submitted to One Drive or Google Drive there are no marks for the submission but there are marks for the tasks inside the Docker container. If we cannot retrieve your Docker container, or it does not work correctly, there will be no marks provided for the tasks inside the Docker container.

Please note that all tasks must be completed in a Unix environment including the writing of the sd cards (must be done with dd). This means that MacOS terminal and WSL termina are acceptable for this purpose as is a Linux terminal. Using GUI software to write the SD cards will result in no marks for that task.

Correct Referencing (5 Marks)

Referencing will be worth 5 marks and must be done in the IEEE style and be complete. You may use the following referencing guide to help with the formatting:
http://mams.rmit.edu.au/v2sr1nxkzriu1.rtf

Correct Spelling and Grammar (5 Marks)
You must take care to ensure you use correct spelling and that your submitted PDF is easy to read.

Professional Presentation (5 Marks)
Your PDF must be presented in such a way that it would be acceptable in a workplace. Eg: coverpage, table of contents and well formatted headings and text. Text from screenshots should be easy to read.

Late Submission Policy
You will lose 10% of possible assignment marks for each day you submit late. If you submit more than 5 days late, your asssignment will not be marked.

Rubric

See each requirement above where the marks are indicated.