

# Final Exam Replacement Individual Project: Machine Problem on Linux Character Device Driver

In this project, you are supposed to build a Linux character device driver on your own machine (in case you are presenting the project online, note you must have accomplished Lab5-2-2 as a prerequisite for this case) or on a desktop (including the attached ARM embedded computer) in PQ603 (in case you are presenting the project face-to-face in PQ603, note you must have accomplished Lab5-2-1 as a prerequisite for this case) and demonstrate its use.

## Task 1 (basic task):

You are supposed to build a Linux character device driver that can take in user inputted string and echo it on the display. Specifically, when the user application writes ASCII printable bytes to a device file linked to this driver, whatever the user application writes will be echoed **by the driver** to the display.

## Task 2 (additional task, do this only after you have completed Task 1):

Same as **Task 1**, except that now the driver only echoes user input that satisfies the regular expression:

$$(a|b)^*c^*$$

You must fulfill this task via the following steps:

- Step 1: convert the regular express to an equivalent NFA;
- Step 2: convert the NFA of Step 1 to a DFA;
- Step 3: write a program to realize the DFA of Step 2;
- Step 4: use the program of Step 3 in the driver to check if the user input satisfies the regular expression.

## Evaluation Methods 1 (for online presentation mode only, prerequisite: having got 100 points in Lab5-2-2):

**Item 1.** During the final exam weeks of the semester, you will be arranged an MS Teams online meeting to do this project with the examiner (referred to as the “meeting” in the following). At the start of the meeting, you need to authenticate yourself by showing your face and your student ID (or government issued ID, in case you do not yet have student ID). The meeting will be recorded, and the recording may be used within COMP and PolyU for administrative/educational purposes.

**Item 2.** The setup of the environment shall follow that of Lab5-2-2. In addition, you must have installed your own Linux system, and downloaded and **built** (compiled and linked) your own Linux kernel source tree (same way as required by Lab9) **before the meeting**. The kernel source tree must have been built for at least once. This is because the first time building of kernel source tree takes hours to finish; if you do not do this before your meeting, you can certainly not finish building your programs during the

meeting. In case you installed the Linux upon VirtualBox, the Guest Additional Disk of the VirtualBox must have been installed; otherwise, the Linux will be intolerably slow, and cannot finish building your programs during the meeting. **During the meeting, you must first demonstrate you have fulfilled all the requirements of this item. If not, you must fulfill all the requirements of this item before you can proceed to any other task(s); and all the time cost henceforth incurred will be counted as part of your accumulated time cost (see Item 3).**

**Item 3.** During the meeting, you are given 25 **accumulated** minutes (plus 5 additional accumulated minutes for compiling/linking programs) to finish the project's tasks **from scratch**. The clock starts at the start of the meeting. The examiner can pause the clock at any time and ask questions for as long as necessary.

**Item 4.** You can only reference the following materials during the meeting:

Material 1: All the lecture materials (including the source codes, particularly, **you can reuse them**) put online in Learn@PolyU for the COMP3438 Fall 2021 semester.

Material 2: All the man pages in Linux displayed in the shell using the man command.

Material 3: The Linux kernel source code and related documents on the <https://elixir.bootlin.com/> website.

Material 4: For Task 2, to derive the needed math, you can use scratch paper. But you need to show in the monitoring video that the paper is empty of any content at the beginning of its usage, and show that you have never swapped the paper throughout the meeting. Failure to do so may be considered as cheating, and may hence get 0 mark for the entire project.

All the referenced materials (except Material 4, which should be shown in the monitoring video) must be displayed on the MS Teams shared desktop, so that the examiner may monitor what you are looking at. Use of any other reference materials, including printed paper materials, may be counted as cheating, and you may hence get 0 mark for the entire project. Throughout the meeting, the examiner may request to look at your physical surrounding via your camera, to make sure you are not looking at other reference materials. Such request must be accepted, otherwise you will be regarded as cheating, and get 0 mark for the entire project.

Note programming suggestions from the source code editor/IDE (e.g. Visual Studio's prompt on what functions to use) are considered as **illegal** reference materials, and risk being considered as cheating and get 0 mark for the entire project. So use a dumb source code editor (e.g. Linux vi or Windows Notepad) instead.

**Item 5.** To be fair to all students, at the start of the meeting, you may be logged into your Linux account, but **no** GUI application window of the Linux can be opened. Particularly, shell window, editor, web browser etc. can be opened only after the meeting starts. Same way, Web browser of any other OS(s) (e.g. a web browser of MS Windows) can be opened only after the meeting starts. Violations of this item will be regarded as cheating, and hence get 0 mark for the entire project.

**Item 6.** Rubrics are also available online in Learn@PolyU. Pay attention that speed of completing all the tasks also matters (contributes to 10% of the total marks). Please read the rubrics for details.

**Evaluation Methods 2 (for face-to-face-in-PQ603 presentation mode only, prerequisite: having got 100 points in Lab5-2-1):**

**Item 1.** During the final exam weeks of the semester, you will be arranged a face-to-face meeting in PQ603 to do this project with the examiner (referred to as the “meeting” in the following). At the start of the meeting, you need to authenticate yourself by showing your face and your student ID (or government issued ID, in case you do not yet have student ID). The meeting will be recorded, and the recording may be used within COMP and PolyU for administrative/educational purposes.

**Item 2.** The setup of the environment shall follow that of Lab5-2-1. Particularly, you must open the preinstalled Ubuntu Linux virtual machine upon VirtualBox on a PQ603 desktop before the meeting starts (see the department’s “apps” drive \Subject\vm\_image\EmbeddedSystem\StartTheVM). You also need to turn on the desktop’s attached ARM embedded computer, open the desktop Windows PuTTY to connect to the embedded ARM computer, and set up NFS remote directory mounting between the desktop Ubuntu Linux and the ARM embedded computer. This is because the Ubuntu Linux can only compile for the ARM embedded computer, hence the kernel/driver/application can only be run on the ARM embedded computer. In addition, throughout the meeting, the desktop screen should be shared via MS Teams to the examiner, so as to be recorded. The recording may be used within COMP and PolyU for administrative/educational purposes. **During the meeting, you must first demonstrate you have fulfilled all the requirements of this item. If not, you must fulfill all the requirements of this item before you can proceed to any other task(s); and all the time cost henceforth incurred will be counted as part of your accumulated time cost (see Item 3).**

**Item 3.** During the meeting, you are given 25 **accumulated** minutes (plus 5 additional accumulated minutes for compiling/linking programs) to finish the project’s tasks **from scratch**. The clock starts at the start of the meeting. The examiner can pause the clock at any time and ask questions for as long as necessary.

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Material 4: For Task 2, to derive the needed math, you can use scratch paper. But you need to show that the paper is empty of any content at the beginning of its usage, and show that you have never swapped the paper throughout the

meeting. Failure to do so may be considered as cheating, and may hence get 0 mark for the entire project.

Use of any other reference materials, including printed paper materials, may be counted as cheating, and you may hence get 0 mark for the entire project.

Note programming suggestions from the source code editor/IDE (e.g. Visual Studio's prompt on what functions to use) are considered as **illegal** reference materials, and risk being considered as cheating and get 0 mark for the entire project. So use a dumb source code editor (e.g. Linux vi or Windows Notepad) instead.

**Item 5.** To be fair to all students, at the start of the meeting, you may be logged into your Linux (including the Ubuntu Linux on the desktop, and the PuTTY terminal connected to the ARM embedded computer), but **no** GUI application window of the Linux can be opened. Particularly, shell window, editor, web browser etc. can be opened only after the meeting starts. Same way, Web browser of any other OS(s) (e.g. a web browser of MS Windows) can be opened only after the meeting starts. Violations of this item will be regarded as cheating, and hence get 0 mark for the entire project.

**Item 6.** Rubrics are also available online in Learn@PolyU. Pay attention that speed of completing all the tasks also matters (contributes to 10% of the total marks). Please read the rubrics for details.