

University of Colombo School of Computing

Bachelor of Science in Computer Science

First Year Examination — Semester I

ENH1301 — Application Laboratory

Sample Paper A — Marking Scheme

Two (2) Hours

Answer All Questions

Number of Pages = 8

Number of Questions = 4 _____

To be completed by the candidate

Index Number

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Important Instructions to candidates

- The students are required to answer all questions within two hours.
- The medium of instructions and questions is English.
- You shall write your answers in **English**.
- This paper has **4** questions on **8** pages.
- Answer **all 4** questions.
- **Write your answers on and only on the space provided** on this question paper.
- Write your index number on each and every page of the question paper.
- Do not tear off any part of this answer book. Under no circumstances may this book (or any part of this book), used or unused, be removed from the Examination Hall by a candidate.
- Questions appear on both sides of the paper. If a page is not printed, please inform the supervisor immediately.
- Any electronic device capable of storing and retrieving text, including electronic dictionaries and mobile phones, are **not allowed**.
- Calculators are **not allowed**.

To be completed by
the examiners

1	
2	
3	
4	
Total	

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1.

(a). Consider the following directory hierarchy and sequence of commands executed in an Ubuntu GNU/Linux terminal.

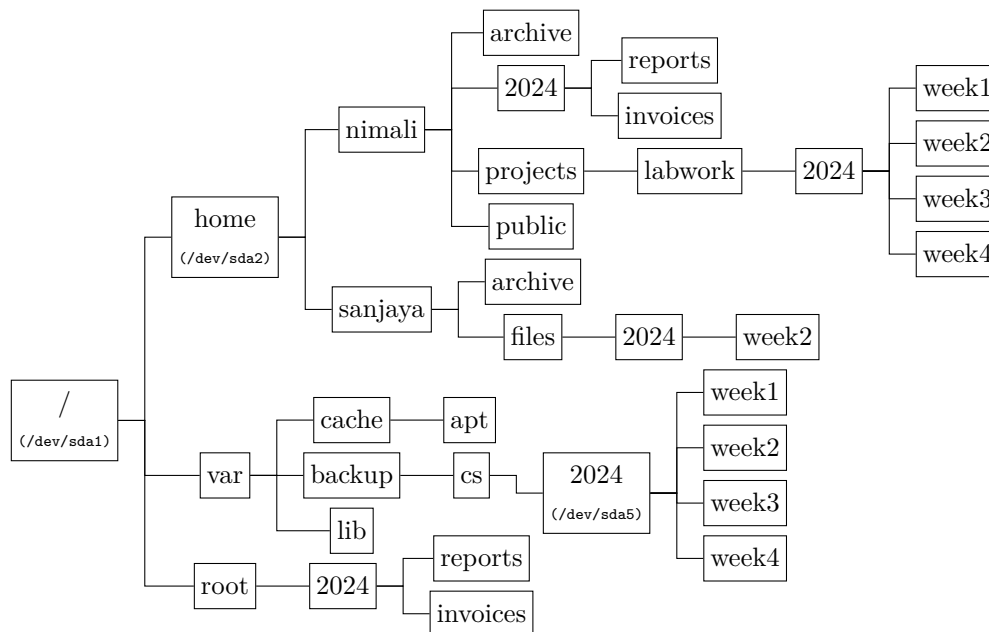


Figure 1: *Extract of an Ubuntu GNU/Linux directory structure*

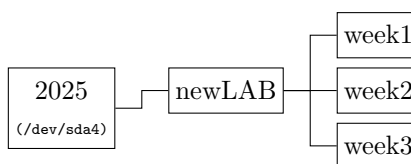


Figure 2: *Extract of an Ubuntu GNU/Linux directory structure of /dev/sda4 partition*

Assume you logged in as `nimali` and executed the following commands, and `/var/backup/cs/` is accessible for `nimali` to write.

\$ cd projects/labwork/2024	①
\$ rm week1	②
\$ ls -a	③
\$ pushd /var/backup/cs/2024	④
\$ sudo cd /root/2024/reports	⑤
\$ ls -a ../	⑥
\$ popd	⑦
\$ popd	⑧
\$ cd ..	⑨
\$ mkdir 2025	⑩
\$ sudo mount /dev/sda4 /home/nimali/projects/labwork/2025	⑪
\$ _____	⑫

Example question and answer:

Q: What is the outcome of the command ①?

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Ans: User `nimali` change directory to `projects/labwork/2024`

Use the Figure 1 and sequence of commands given to answer the following sub questions.

Output: Write the output you will see in the STDOUT

Outcome: Write the result you get by executing a particular command

- i. What is the outcome of command ②? [2 marks]

The command fails. `rm` without `-r` will not remove a directory — `week1` is a directory, so the shell reports
`rm: cannot remove 'week1': Is a directory`
 and `week1` is left in place.

- states the command fails / nothing is deleted [1]
- reason: `week1` is a directory and `-r` was not given [1]

- ii. What is the output of the command ③? [2 marks]

```
.  .. week1 week2 week3 week4
```

- lists the four week directories [1]
- includes the hidden entries `.` and `..` [1]

- iii. What is the output of the command ⑥? [2 marks]

```
.  .. 2024
```

- recognises that ⑤ failed, so the working directory is still `/var/backup/cs/2024`; `../` is therefore `/var/backup/cs`, which contains only `2024` [2]

- iv. What is the output of the command ⑧? [2 marks]

```
bash: popd: directory stack empty
```

- only one `pushd` was issued, so ⑦ already emptied the stack; the second `popd` is an error [2]

- v. Explain the purpose of the command ⑪? [2 marks]

Attaches the filesystem on the partition `/dev/sda4` to the directory `/home/nimali/projects/labwork/2025`, which becomes its *mount point*. After this, the contents of that partition shown in Figure 2 — `newLAB` and the week directories beneath it — are reachable through that path. `sudo` is required because mounting needs administrative privileges.

- mounts / attaches the `/dev/sda4` filesystem [1]
- makes its contents accessible under the given mount point [1]

- vi. `nimali` used the command ⑫ with an absolute path to navigate to the `newLAB` directory. Write the command? [2 marks]

```
cd /home/nimali/projects/labwork/2025/newLAB
```

- uses `cd` [1]
- absolute path, i.e. begins with `/` [1]

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(b). Consider the Figure 3 to answer the sub questions.

```
Get:1 http://lk.archive.ubuntu.com/ubuntu jammy InRelease [270 kB]
Get:2 http://lk.archive.ubuntu.com/ubuntu jammy-updates InRelease [119 kB]
Hit:3 http://lk.archive.ubuntu.com/ubuntu jammy-backports InRelease
Get:4 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Fetched 499 kB in 2s (250 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
```

Figure 3: Screen capture

i. Write the command **nimali** has to issue to get the output of Figure 3? **[2 marks]**

`sudo apt update`

- apt update [1]
- sudo — updating the package lists needs root [1]

ii. What is the difference between “Get” and “Hit” in Figure 3? **[4 marks]**

Hit — the index for that repository has not changed since the last check, so the cached copy is still valid and nothing is downloaded.

Get — the index has changed, so apt downloads the new package list; the size of the download is shown in brackets.

- Hit: unchanged since last update, nothing downloaded [2]
- Get: changed, new package index is fetched [2]

(c). What is the command that can be used to get the network Internet Protocol (IP) address in a GNU/Linux system? **[2 marks]**

`ip a` (also accept `ip addr show`, `ip address`, `hostname -I` or the older `ifconfig`)

(d). What is the command that can be used to list the disk partitions of the system together with their mount points? **[2 marks]**

`lsblk` (also accept `df -h` or `findmnt`)

(e). If **nimali** plugged in a USB hard disk into her Ubuntu GNU/Linux system, what will be the directory that the device will get automatically mounted? **[3 marks]**

`/media/nimali/` followed by the volume label of the device — that is, `/media/<username>/<label>`.

- `/media/` [2]
- under a sub-directory named after the user [1]

Question 1 total: 25 marks

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2.

(a). Given below is a US QWERTY keyboard and answer the sub questions using the knowledge of touch typing.

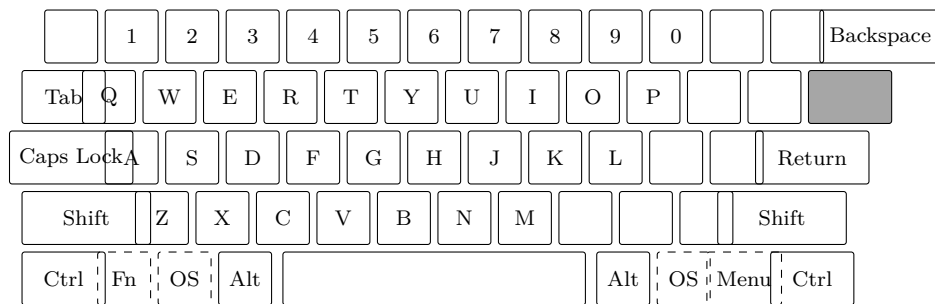


Figure 4: QWERTY Keyboard

- i. Write letters of **three (03)** keys typed by using the **ring finger** of your **right hand**. [3 marks]

O, L, and the full stop . (the digit 9 is also on this finger)

- one mark for each correct key [3]

- ii. Write letters of **four (04)** keys typed by using the **index finger** of your **right hand**. [4 marks]

Any four of: J, H, U, Y, N, M (the digits 6 and 7 also belong to this finger)

- one mark for each correct key [4]

(b). The command `ls` in a directory produced the following output.

```
Lab10.txt  LabA.txt  LabB.txt  MSCLabs.txt
notes.md   temp1.csv  temp2.csv  temp_final.csv
```

- i. Write a single command that lists **only** `temp1.csv` and `temp2.csv` from this directory. [3 marks]

`ls temp?.csv` or `ls temp[0-9].csv`

- a wildcard matching exactly one character in that position [2]

- excludes `temp_final.csv` [1]

- ii. What is the output of the command `ls [[:upper:]]*` in this directory? [2 marks]

`Lab10.txt LabA.txt LabB.txt MSCLabs.txt`

- only the four names beginning with an uppercase letter [2]

(c). Everything in Linux is a file. The result of `ls -l /home/nimali/documents/` is given below.

```
-rw-rw-r-- 1 nimali staff 18320 Jul 14 2025 budget.ods
drwxr-x--- 2 nimali staff 4096 Aug 02 2025 archive
-rwsr-xr-x 1 nimali staff 55240 Jun 09 2025 collect
lrwxrwxrwx 1 nimali staff 12 Aug 02 2025 latest -> budget.ods
-r--r--r-- 1 nimali staff 254912 May 30 2025 policy.txt
```

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- i. `nimali` executed `chmod 640 budget.ods`. Write the new permissions of the file `budget.ods` in the same format as the `ls -l` output? [2 marks]

`-rw-r---`

- owner `rw-`, group `r-` [1]
- others `--`, and the leading `-` for a regular file [1]

- ii. Explain the meaning of the `s` that appears in the permissions of the file `collect`? [3 marks]

It is the *setuid* bit. When the file is executed it runs with the privileges of its **owner** (`nimali`) rather than those of the user who ran it. It replaces the `x` in the user triplet.

- `setuid` — runs with the owner's privileges [2]
- occupies the position of the owner's execute bit [1]

- iii. If the file `budget.ods` is removed, what will happen to `latest`? [3 marks]

`latest` is a symbolic link to `budget.ods`. The link itself is not deleted, but its target no longer exists, so it becomes a *dangling* (broken) link. Any attempt to read it fails with `No such file or directory`, although `ls -l` still shows the entry.

- the link survives but its target is gone / becomes broken [2]
- accessing it now produces an error [1]

- (d). `nimali` wants to log in to a remote server using SSH without typing a password each time.

- i. Write the command she should use to generate the key pair. [2 marks]

`ssh-keygen -t rsa -b 4096` (also accept `ssh-keygen -t ed25519` or plain `ssh-keygen`)

- ii. After copying the public key to the server, the login still asks for a password. Give **two (02)** file permission settings on the server that must be correct for key-based login to work. [3 marks]

`~/.ssh` must be 700 (`drwx---`), and `~/.ssh/authorized_keys` must be 600 (`-rw----`). SSH refuses to use keys that other users on the system could read or replace.

- `~/.ssh` is 700 [1.5]
- `authorized_keys` is 600 [1.5]

Question 2 total: 25 marks

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3.

(a). Write the key or key combinations or commands to achieve the given tasks in a **vim** editor command mode.

i. Move the cursor to the beginning of a line. [2 marks]

`0` (accept `^` for the first non-blank character)

ii. Cut the current line. [2 marks]

`dd`

iii. Move the cursor 25 lines down. [2 marks]

`25j`

iv. Divide the vim editor view horizontally and open a new file named **report**. [2 marks]

`:sp report` (or `:split report`)

v. Read the output of the `ls -l` bash shell command into the file you are working on, without exiting the opened file. [4 marks]

`:r !ls -l` (also written `:read !ls -l`)

- `:r` / `:read` to insert into the current buffer [2]

- `!` to run the command in a shell [2]

vi. Navigate forward to the next spelling mistake in the vim spellchecker. [2 marks]

`]s`

vii. Navigate to the top of the document. [2 marks]

`gg`

viii. Change the word under the cursor. [2 marks]

`ciw` (accept `cw`)

(b). Write the **three (03)** areas defined in **Git**. [3 marks]

1. The working directory — the files you edit.
2. The staging area (also called the index) — the changes selected for the next commit.
3. The repository — the committed history, stored in the `.git` directory.

- one mark for each area [3]

(c). Describe the function of the staging area in **Git**. [2 marks]

It holds the set of changes that will go into the next commit. `git add` moves a change into it, and `git commit` turns everything in it into a snapshot. Because it sits between the working directory and the repository, you can edit several files but commit only some of them as one logical change.

- holds what will be included in the next commit [1]

- lets you commit a chosen subset of your edits [1]

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(d). What is the use of the `git diff` command?

[2 marks]

It shows, line by line, what has changed but has not yet been staged. `git diff --staged` shows what has been staged but not yet committed. It is used to review a change before locking it in.

- shows the line-level differences between working directory and index (or index and last commit)

[2]

Question 3 total: 25 marks

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4.

(a). L^AT_EX is a powerful tool for technical writers. Write the output of the L^AT_EX script combined with the other files given.

<pre> \documentclass[a4paper]{article} \usepackage{listings} \usepackage{natbib} \begin{document} A block of \$2^{10}\$ bytes is called a \textit{kibibyte}. \citep{perrin2023shell} \begin{table}[h!] \begin{tabular}{ l c r } \hline {\bf Name} & Marks & Grade \\ \hline \hline Nimali & 82 & A \\ Sanjaya & 67 & B \\ \hline \end{tabular} \caption{Results} \label{tab:res} \end{table} \begin{enumerate} \item First \item Second \end{enumerate} \lstinputlisting[language=bash]{ sample.sh} \bibliography{ex} \bibliographystyle{apalike} \end{document} </pre>	<pre> #!/bin/bash for i in 1 2 3 do echo "Week \$i" done </pre>	<pre> @article{ perrin2023shell, author = {Perrin, Nadia and Fernando, Ruwan}, title = {Shell Scripting for Scientists}, journal = {Journal of Systems Practice}, year = {2023}, volume = {11}, number = {3}, } </pre>
ex.tex	sample.sh	ex.bib

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The document has no `\maketitle`, so there is no title, author or date — the text begins at the top of the page.

1. Body text. One paragraph:

“A block of 2^{10} bytes is called a *kibibyte*. (Perrin and Fernando, 2023)” — with *kibibyte* in italics, the exponent typeset as a superscript, and the `apalike` style giving an author–year citation in round brackets.

2. A table, placed at that point because of `[h!]`, with three columns — left, centre and right aligned — and vertical rules on both sides and between every column. A single horizontal rule at the top, a **double** rule under the heading row, and a single rule at the bottom. The heading row reads **Name** (bold), Marks, Grade; then the rows *Nimali 82 A* and *Sanjaya 67 B*.

Below the table, the caption **Table 1: Results**. The `\label` produces no visible output.

3. A numbered list:

1. First
2. Second

4. The contents of `sample.sh` typeset verbatim in a monospaced font, all five lines exactly as written, including the `#!/bin/bash` line and the indentation of the `echo`. It is *not* executed — “Week 1 Week 2 Week 3” does **not** appear.

5. A References section at the end, containing the single cited entry:

Perrin, N. and Fernando, R. (2023). Shell scripting for scientists. *Journal of Systems Practice*, 11(3).

(`apalike` lower-cases the title; accept either capitalisation, and accept an answer that simply says a References list containing this one work.)

- no title block, because `\maketitle` is absent [2]
- 2^{10} as a superscript and *kibibyte* in italics [2]
- an author–year citation in round brackets, because `apalike` is an author–year style and `\citep` is the parenthetical form. Award the mark for “(Perrin and Fernando, 2023)” or any equivalent author–year rendering; do not require exact punctuation [2]
- table: three alignments, vertical and horizontal rules, double rule under the heading, bold **Name** [4]
- caption *below* the table, numbered *Table 1* [2]
- the numbered list [2]
- `sample.sh` reproduced verbatim, not executed [2]
- References section with the one cited work [2]

(b). Write the commands with parameters, in the correct sequence, to successfully compile the above L^AT_EX document and get the `ex.pdf` file. [4 marks]

```
pdflatex ex.tex
bibtex ex
pdflatex ex.tex
pdflatex ex.tex
```

- first `pdflatex` run, which writes the `.aux` file [1]
- `bibtex ex` — note: no `.tex` extension [1]
- two further `pdflatex` runs, to resolve the citation and the table reference [2]

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(c). A LibreOffice Calc sheet holds a student's five subject marks in cells B2:F2, and the pass mark for the whole class in cell J1. Write the formula for cell G2 that displays **Pass** when the total of the five marks is at least the value in J1, and **Fail** otherwise. The formula must still be correct after it is copied down to G3:G20. **[3 marks]**

`=IF(SUM(B2:F2)>=$J$1,"Pass","Fail")`

- SUM(B2:F2) for the total [1]
- IF with the two text results in the right order [1]
- \$J\$1 — an absolute reference, so it does not shift when copied down [1]

Question 4 total: 7 marks

Total marks accounted for in this paper: 82