Flinders University

COMP2812 Systems Software

Artefact Creation – Systems Software Scavenger Hunt

Objectives and Learning Outcomes

- Students will apply core systems software concepts to practical scenarios, through diagnosing and resolving realistic system-level issues in a Linux environment
- Students will explain key system-level behaviours related to processes, storage, performance and services, and communicate their findings and understanding through structured documentation and reflection
- Contributes to the following Learning Outcomes: *LO1, LO2, LO3, LO4 and LO5*

Expectations and submission guidelines

- This task must be completed **individually**
- Submission must be in the form of a **single PDF** containing:
  - the knowledge base entries and theoretical reflections for all attempted tasks
  - a single evidence table including all unique codes found
  - a statement acknowledging how AI was used in your assignment (if applicable)
  - an appendix containing AI prompts, responses and original work (if applicable)
- You may complete the tasks in any order you wish
- Please submit all tasks attempted (even if you do not manage to do all five)
- Any **updates or edits** to any portion of the assignment **after the due date** will incur the **same penalty** as if the whole assignment was submitted at the time of the last edit
- **Late penalty:** 5% per 24-hour period for every day late

Writing knowledge base entries

Knowledge base articles aim to help users solve problems quickly and share your technical expertise in an accessible format. They should be concise, use plain language, avoid jargon, be organised clearly using sub-headings, and include visual elements where they add value.

Each KB entry you produce for this assignment should include at least the following:

- **Title:** be specific (e.g., "How to Reset Your Password")
- **Introduction:** briefly state the purpose and relevance of the article
- **Steps / content:**
  - use numbered or bulleted lists for clarity
  - include at least 2 screenshots, cropped and annotated as appropriate
- **Conclusion:** summarise key points or provide next steps

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Use of artificial intelligence (AI)

For this assessment you may use AI tools to **brainstorm initial ideas** during the planning stage of your work, to **assist you to troubleshoot the given issues**, and to **edit your work** for the purpose of improving its clarity and quality.

If you do use AI, you must:

(1) attach an **appendix** that includes:

1. a copy of your **original work** with no AI content or editing
2. the AI **prompts** you used
3. the AI **responses** you received

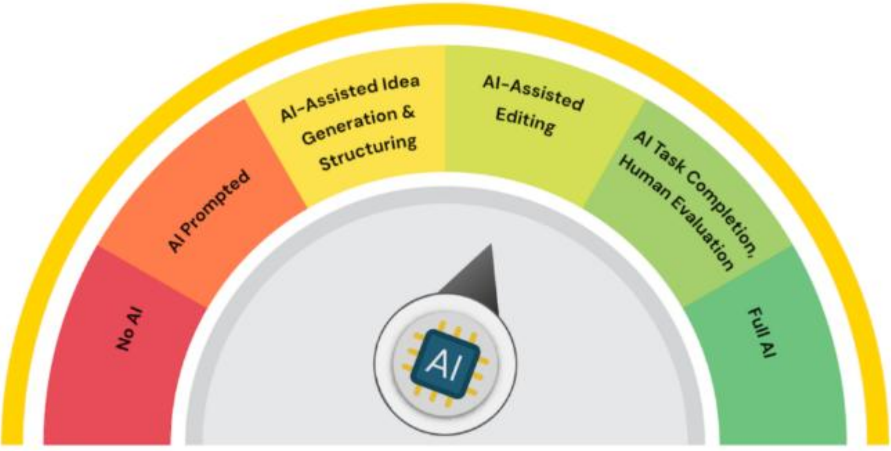
You may upload this as a separate PDF file or include it at the end of your report

(2) include at the start of your report a **declaration** acknowledging **which AI technologies have been used and how**, for example:

- I acknowledge the use of ChatGPT in paraphrasing original content (OpenAI, 2025). The prompts and output from ChatGPT are included in Appendix 1

(3) keep any **drafts** demonstrating authorship, as these may be requested by assessors

Please note that Turnitin and other tools will be used to assist with checking for plagiarism and other academic integrity issues. Failure to acknowledge AI assistance or properly reference AI generated content will result in a **score of 0** for the assignment and a **report of academic misconduct**.


No AI
AI Prompted
AI-Assisted Idea Generation & Structuring
AI-Assisted Editing
AI Task Completion, Human Evaluation
Full AI
AI

Adapted from the AI Assessment Scale Perkins, M., Furze, L., Roe, J., & MacVaugh, J. (2023). Navigating the generative AI era: Introducing the AI assessment scale for ethical GenAI assessment. arXiv preprint arXiv:2312.07086.
https://leonfurze.com/2023/12/18/the-ai-assessment-scale-version-2/

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Background

You’ve just started your industry placement as a junior Systems Software Engineer at a mid-sized tech company, *ByteSafe Solutions*. The team supports a mix of internal infrastructure and customer environments, and your job this week is to triage and resolve several tickets that have been escalated to your queue. These aren’t the usual kind of “turn it off and on again” issues - they’ve already stumped the helpdesk and need someone with your understanding of the system internals to dig a little deeper.

Each task below represents a real issue reported by a customer or colleague. Some problems are simple misconfigurations, others are due to overlooked performance issues or flawed scripts left running unchecked. Your job is to figure out what’s going on before things get worse.

For **each ticket**, you’ll need to:

- **Investigate and resolve** the issue using your virtual machine.

- **Write a mini knowledge base article** explaining **what** the problem was, **how** you diagnosed it, and the **steps you took** to resolve it. Each KB article must include at least 2 relevant **screenshots**. Assume the next person who gets this issue has no idea where to start - make it clear and concise.

- **Connect to the theory**: Write a short reflection that explains the core theoretical concepts behind the issue. Think in terms of what you’ve learned: permissions, processes, services, threads, synchronisation, etc. Where possible, describe these in your own words, using examples from the given task or from class.

Evidence table

To verify the work is your own, each task contains a **personalised component** based on your FAN (Flinders Authentication Name). This might be part of a filename, service, or log entry that only appears for you.

You’ll need to include an **evidence table** (as shown here) on the first page of your assignment that includes all your unique codes for full marks:

Task	Where to find the code	Code
1	In the problematic service’s description	
2	In a comment in a relevant file	
3	In the running script’s output	
4	In the name of the problematic process/file	
5	In the output of the running Python program	

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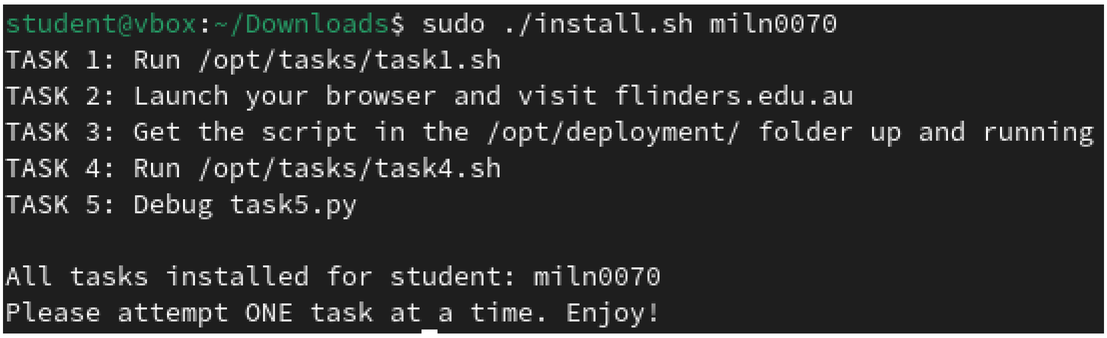
Run the installation script

1. Create a **clone of your original, working VM** (or create a new VM if preferred)
2. Launch the clone, then from **inside the VM** open the browser (e.g. Firefox) and download the installation script from the following URL:

   https://tinyurl.com/syssoft-assign1

3. Using your terminal, navigate to the **Downloads** folder
4. Run `chmod +x install.sh` to make the installation script executable
5. Run `sudo ./install.sh YOUR_FAN` to install the files you'll need for the assignment tasks below. Notes:
   - Make sure to replace `YOUR_FAN` with your own FAN, e.g. stud0123
   - You will likely be prompted to enter your admin password

When run successfully, the installation script's output should look like this:



```
student@vbox:~/Downloads$ sudo ./install.sh miln0070
TASK 1: Run /opt/tasks/task1.sh
TASK 2: Launch your browser and visit flinders.edu.au
TASK 3: Get the script in the /opt/deployment/ folder up and running
TASK 4: Run /opt/tasks/task4.sh
TASK 5: Debug task5.py

All tasks installed for student: miln0070
Please attempt ONE task at a time. Enjoy!
```

You may like to **take a snapshot of your VM** now to revert to if anything goes wrong

Collect baseline stats

1. Before you begin the tasks below, collect baseline stats for key metrics such as:
   - memory usage
   - CPU performance
   - disk storage
   - disk activity
2. You're ready! It's strongly recommended to attempt only one task at a time, both to avoid overworking your VM and host computer, and to avoid confusion.

Task 1: A simple performance issue (TOTAL MARKS: 20)

Customer ticket:

```
Hey IT, my laptop has been ridiculously slow all morning. Programs
are taking forever to open – even the file manager took like 30
seconds to load. I thought it was just a fluke, but after rebooting,
it’s still the same. Fans are going non-stop and the whole system
feels like it’s crawling.

I haven’t installed anything weird lately. Could something be
running in the background that’s chewing up all the resources?
```

Investigative steps

Launch the Task 1 simulation on your VM by running the following command:

```
/opt/tasks/task1.sh
```

1. Monitor the system’s performance and compare with your baseline stats.
2. Observe the output closely. What resource is getting consumed at an abnormal rate?
3. Identify the **process** that is causing the problem, then the **systemd service** responsible for launching it. Finally, fix the issue. **Reboot the VM** to make sure it stays fixed. Hints:
   - Use one of the following to work out what service is calling the problematic script:
     - `systemctl status PID` (replace `PID` with your process’s PID)
     - `grep -rl "SCRIPT_NAME" /etc/systemd/system/` (replace `SCRIPT_NAME` but keep the quotation marks)
   - Use `systemctl status YOUR_SERVICE_NAME` to inspect the service - **look closely to find the unique task code to add to your evidence table!**

Knowledge base entry [12 marks]

Write up a concise KB-style entry explaining the issue and how you diagnosed it. Include:

1. The steps, tools and commands you used to identify the problem
2. Your diagnosis of the cause, backed by evidence (e.g. output screenshots, observation notes)
3. Steps you used to resolve the issue, and how you confirmed it was resolved

Theoretical reflection (200-250 words) [8 marks]

Answer the following, linking back to core systems software concepts where appropriate:

1. What does the CPU do, and what limits its performance? Use the terms: utilisation, scheduler, context switching.
2. Explain what it means for a program to be CPU-bound, and how this affected what you saw in this task. Use the terms: CPU-bound, resource contention, response time.

Task 2: Network issues (TOTAL MARKS: 20)

Customer ticket:

> Hey team,
> I’m trying to connect to **flinders.edu.au** from my work laptop but I’m getting ‘unable to connect’ errors. It was working last week, so maybe someone changed something? I can’t even ping it.
>
> Can you check if something’s been blocked or changed on the firewall or host setup?

Investigative steps

1. Open the browser on your VM and visit http://flinders.edu.au and https://flinders.edu.au
2. What do you observe? Is it just this website that’s blocked, or other websites too?
3. Inspect the network configuration and firewall. Consider the following:
   - Is the domain resolving correctly?
   - Could traffic to the site be getting blocked by a local firewall rule?
   - **You’ll find your unique task code in a comment in one of the files you need to fix**

Knowledge base entry [12 marks]

Write up a concise KB-style entry explaining the issue and how you diagnosed it. Include:

1. The steps, tools and commands you used to identify the problem
2. Your diagnosis of the cause, backed by evidence (e.g. output screenshots, observation notes)
3. Steps you used to resolve the issue, and how you confirmed it was resolved

Theoretical reflection (200-250 words) [8 marks]

Answer the following, linking back to core systems software concepts where appropriate:

1. How does the system find the address of a website? What role does `/etc/hosts` play, and what happens if there is an incorrect entry? Use the terms: DNS, hostname resolution, loopback address
2. What do firewalls do to network traffic? How could a firewall block access to a website, even when the name resolves correctly? Use the terms: iptables, packet filtering, transport layer

Task 3: Deployment script won't run (TOTAL MARKS: 20)

Customer ticket:

> Hi guys,
> I'm trying to run the deployment script from the shared drive like the instructions say, but I keep getting 'Permission denied' or 'Command not found'. Please help me, it's holding up our rollout.

Investigative steps

1. You've been asked to verify and run a shared deployment script, which is provided in the `/opt/deployment/` folder of your VM
2. Start by navigating to the deployment folder and listing its contents. Resolve any configuration or permissions issues you encounter
3. Next, try running the script. What happens? Why? Resolve the issues and run the script
4. **You'll see your unique task code in the script's output**

Knowledge base entry [12 marks]

Write up a concise KB-style entry explaining the issues and how you diagnosed them. Include:

1. The steps, tools and commands you used to identify the problems
2. Your diagnoses, backed by evidence (e.g. output screenshots, observation notes)
3. Steps you used to resolve the issues, and how you confirmed they were resolved

Theoretical reflection (250-350 words) [8 marks]

Answer the following, linking back to core systems software concepts where appropriate:

1. How do file permissions and ownership help to protect files in Linux? What happens when you try to view or run files in directories with restricted access?
2. What is the difference between *read* and *execute* permissions for files and for directories? Why might a file marked as executable still not work?
3. What is file metadata and why is it important for secure and reliable file access?
4. Why is *execute* permission separate from *read* permission? How does this make the system more flexible and secure?

Task 4: Another performance issue (TOTAL MARKS: 20)

Customer ticket:

```
Hey folks,
I'm having a strange problem on one of the shared dev machines.
Every time I try to save a file or upload something, I get some kind
of error. I also noticed some apps crash when trying to write logs.
I thought it might be a permissions issue at first, but I'm logged
in as normal. Could you take a look?
```

Investigative steps

Launch the Task 4 simulation on your VM by running the following command:

```
/opt/tasks/task4.sh
```

1. Monitor the system's performance and compare with your baseline stats.
2. Observe the output closely. What resource is getting consumed at an abnormal rate?
3. Identify the **process** that is causing the problem, then the **systemd service** responsible for launching it. Finally, fix the issue. **Reboot the VM** to make sure it stays fixed. Hints:
    - You can use this to work out what service is calling the problematic script:
        - `systemctl status PID` (replace `PID` with your process's PID)
    - You may find this useful. What does it do?
        - `sudo du -h --max-depth=1 /path | sort -hr | head`
    - **Your unique task code will be part of the name of one of your files of interest**

Knowledge base entry [12 marks]

Write up a concise KB-style entry explaining the issue and how you diagnosed it. Include:

1. The steps, tools and commands you used to identify the problem
2. Your diagnosis of the cause, backed by evidence (e.g. output screenshots, observation notes)
3. Steps you used to resolve the issue, and how you confirmed it was resolved

Theoretical reflection (200-250 words) [8 marks]

Answer the following, linking back to core systems software concepts where appropriate:

1. How does Linux track disk usage? Why might deleting a file not immediately free up space?
2. What problems can happen when a system runs low on disk space?
3. How does the file system organise storage using blocks? What happens when the disk gets full? Use the terms: block size, fragmentation, allocation methods.

Task 5: Diagnosing concurrency issues (TOTAL MARKS: 20)

Customer ticket

> Hi support,
> We've got a script that's supposed to move data between two services using threads. It used to run fine, but now it sometimes just hangs halfway through. I suspect something's off with the threading logic. Could someone debug it?

Investigative steps

Please download `task5.py` from Canvas. This task does not need to be run on your VM.

The staff member has provided their Python script for you to take a look at (see **`task5.py`**)

1. Paste the code into an IDE of your choice, e.g. https://www.online-python.com/ or PyCharm
2. **Update line 7 by replacing YOUR_FAN with your own** (keep the quotation marks)
   - E.g. `FAN = "YOUR_FAN"` becomes something like `FAN = "stud0123"`
3. Now run the code. **You'll see your unique task code in the script's output [PY-?????]**
4. Observe the output closely - you may need to run it several times to observe patterns
5. After each run, consider the following:
   - Did the script finish cleanly, or hang partway through? Is the behaviour consistent?
   - If it hung, what do you think caused the threads to stop progressing?

Knowledge base entry [12 marks]

Write up a concise KB-style entry explaining the issue and how you diagnosed it. Include:

1. The approach you used to identify the problem
2. Your diagnosis of the cause, backed by evidence (e.g. output screenshots, observation notes)
3. Strategies you recommend for preventing this issue in future (you don't need to actually fix it!)
4. A clear, detailed description of your proposed fix. Explain using plain language, then support this with pseudocode or Python code *if you wish*. If you changed the given code, include the complete working program.

Theoretical reflection (200-250 words) [8 marks]

Answer the following, linking back to core systems software concepts where appropriate:

1. What is a deadlock and what is a race condition? Use examples to help explain and include terms like critical section and mutual exclusion
2. In this task, were any of the four Coffman conditions for deadlock present? Explain.
3. Why are deadlocks a problem in real systems that need to run for a long time or serve many users? What might happen if they aren't detected or resolved?

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Task rubric (5 tasks x 20 marks per task = 100 marks total)

Criteria	**4** **Excellent**	**3** **Good**	**2** **Developing**	**1** **Needs improvement**	**0** **Insufficient**
KB – Diagnosis process	Clear, logical steps with appropriate tools used effectively	Mostly clear steps and appropriate tools used	Some relevant tools used, but process is vague	Attempted, but steps are unclear, or tools are poorly chosen	No meaningful steps or tools shown
KB – Evidence and observation **Note:** 1 mark will be deducted if unique task code is missing	Strong evidence (e.g. output, logs; 2+ relevant screenshots) clearly supports diagnosis	Good evidence used (e.g. 2+ relevant screenshots), mostly relevant	Limited or loosely connected evidence	Evidence included but lacks clarity or relevance	No evidence provided
KB – Fix and verification	Fix is well-explained, effective, and verified (e.g. after reboot)	Fix mostly effective and verified	Fix is attempted but weakly explained or unverified	Fix unclear or incomplete	No attempt to fix or confirm issue
Reflection – Conceptual understanding	Clear, accurate explanation with correct technical terms used confidently	Solid understanding with mostly correct terminology	Basic understanding, some minor errors	Limited understanding or vague terminology	No meaningful reflection or major misunderstanding
Reflection – Clarity and accuracy	Clear and well-written, technically accurate, and within word limit	Mostly clear with few technical errors, within word limit	Some technical or structural issues	Unclear or technically weak	Incoherent or unrelated to task