University of Colorado
Colorado Springs

CS 2080: Programming with UNIX

Summer 2024 - Professor: Dr. Armin Moin

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Assignment 1 - Solutions

Total points: 150

1. Who are your semester project teammates? 5 points

   The answer is specific to each student.

2. Describe your project's topic in one paragraph. Explain whose problem will be solved and what that problem is or for whom you will essentially create value. 15 points

   The answer is specific to each student.

3. What is an Operating System (OS)? Name three examples of an OS. 20 points

   A software system that manages a computer's hardware resources (e.g., CPU, memory, I/O devices, and storage) and allocates those resources to programs. [15 points]

   For instance:
   GNU/Linux
   Windows
   [2.5 points for each)

4. What are the eight core principles in principle-based ethics? Name and describe each item in one sentence. 40 points

   i) Integrity: Act with honesty in all situations. [5 points]
   ii) Trust: Build trust in all stakeholder relationships. [5 points]
   iii) Accountability: Accept responsibility for all decisions. [5 points]
   iv) Transparency: Maintain open and truthful communications. [5 points]
   v) Fairness: Engage in fair competition and create equitable and just relationships. [5 points]
   vi) Respect: Honor the rights, freedoms, views, and property of others. [5 points]
   vii) Rule of law: Comply with the spirit and intent of laws and regulations. [5 points]
   viii) Viability: Create long-term value for all relevant stakeholders. [5 points]

5. Explain the dual-mode operation mechanism. What is the advantage of this mechanism? Do UNIX and Linux support this? 20 points

   The dual-mode operation mechanism separates the execution of the Operating System (OS) code from the user-defined code through hardware support (i.e., a mode bit). [5 points]

   If the mode bit is zero, the processor is in the kernel (superuser) mode running OS code. However, if the mode bit is one, the processor is in the user mode. [5 points]

   This way, a malicious program cannot harm other programs or the OS since it is only running in the user mode. [5 points]

   Both UNIX and Linux support dual-mode operation. [5 points: 2.5 points for each UNIX and Linux]

6. What is the difference between containerization and virtualization? 20 points

   Virtualization: Running multiple OS instances on one machine through hardware support. [10 points]

   Containerization: Running a single OS instance on one machine with multiple user spaces to isolate processes by software support. This enables multi-tenancy. [10 points]

7. What is multiprogramming? Do UNIX and Linux support this? 15 points

   Multiprogramming: The ability of an OS to run multiple programs (processes). This increases the CPU utilization. [10 points]

   Yes, they both support multiprogramming. [5 points: 2.5 points for each UNIX and Linux]

8. What is multitasking? Do UNIX and Linux support this? 15 points

   The OS keeps several processes in memory simultaneously. The CPU switches between them when it needs to wait; thus, it is never idle. Multi-tasking is a logical extension of multiprogramming, in which the CPU switches among tasks frequently, and the response time is so fast that it can satisfy the user. [10 points]

   Yes, they both support multiprogramming. [5 points: 2.5 points for each UNIX and Linux]

9. What are the four principles of the UNIX philosophy? 20 points

i) Write programs that do one thing and do it well. [5 points]
ii) Write programs to work together. Expect the output of one program to become the input of another. [5 points]
iii) Design and build software (including operating systems) to be tried early, ideally within weeks. [5 points]
iv) Write programs to handle text streams since that is a universal interface. [5 points]

10. What are the four essential freedoms of Free Libre Open-Source Software (FLOSS)? 20 points

i) The freedom to run the program as you wish for any purpose (freedom 0). [5 points]
ii) The freedom to study how the program works and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this. [5 points]
iii) The freedom to redistribute copies so you can help others (freedom 2). [5 points]
iv) The freedom to distribute copies of your modified versions to others (freedom 3). By doing this, you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this. [5 points]

11. Name one UNIX-based Operating system. 5 points

For instance:
GNU/Linux

12. Name one GNU/Linux distribution. 5 points

For instance:
Ubuntu

13. Name four graphical desktop environments for GNU/Linux. Which one is geared toward more resource-constrained (low-power) platforms? 20 points

For instance:
i) Gnome [2.5 points]
ii) KDE [2.5 points]
iii) Xfce [2.5 points]
iv) LXDE [2.5 points]

LXDE is focused on resource-constrained (low-power) platforms. [10 points]

14. What is a command on the Ubuntu GNU/Linux that can show which Shell is being used? 5 points

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echo $SHELL
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15. What is a command on the Ubuntu GNU/Linux that can show which graphical desktop environment is being used? 5 points

    echo $XDG_CURRENT_DESKTOP

16. What are two categories of open-source software licenses? Name, briefly explain, and give one example for each of them. 20 points

    i) Permissive open-source licenses [2.5 points]: The software licensed under these licenses can be used in proprietary, closed-source projects as well. This means the software system using a part or the entire open-source software with a permissive license may have a different license. [5 points] One example of a permissive open-source license is the Apache software license. [2.5 points]

    ii) Non-permissive open-source licenses [2.5 points]: The software licensed under these licenses may not be used in proprietary, closed-source projects. In fact, the software system using a part or the entire open-source software with a non-permissive license must have the same license. [5 points] One example of a non-permissive open-source license is the GPL license. [2.5 points]