CS4/591 Midterm

Full Name: _____

- This is a closed book, closed note, closed device, closed neighbour exam.

- If you have questions about the exam please quietly approach me at the front so I can assist.

- The exam will end promptly at 11:50am. Please make sure I have your exam before 11:50am.

- There is only one correct answer for each of the multiple-choice questions. Is multiple answers are selected the answer will be marked wrong.

- The short answer questions only require a couple of sentences to answer, at most.

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1 A Brief History of Supercomputing

1. Why was FORTRAN the first successful high level language?

   ○ DARPA required its use and it was bundled with ASCI Red.
   ○ Its machine code was as fast as a human programmer's machine code.
   ○ It supported OpenMP, which made it faster than any other programming language.
   ○ FORTRAN supported circuit switching.

2. What are Beowulf clusters and why are they important to HPC?

2 iDRAC and Linux Installation

3. iDRAC is useful because:

   ○ It runs in firmware.
   ○ Allows remote configuration of a server.
   ○ All HPC servers have iDRAC.
   ○ All of the above.

4. What distribution and version of Linux are we using in class?

3 Vector Operations

5. Vector operations allow CPUs to?

   ○ Compute vector distances efficiently.

   ○ Switch threads of execution with less overhead.

   ○ Apply a single instruction to multiple values at once.

   ○ None of the above.

6. Do vector operations always speed up code execution? Why or why not?

4 Devices

7. In userspace device events are handled by:

   ○ Udevd

   ○ InitDevd

   ○ Httpd

   ○ Sshd

8. What does it mean to say "everything is a file in Linux" in the context of devices?

5 Filesystems

9. You find an EFI partition on a drive. What does that imply

   ○ It is a GPT drive.

   ○ It could have an MBR boot block.

   ○ It is a UEFI compatible partition scheme.

   ○ All of the above.

10. Give a reason why spinning disks might be more suitable in an HPC environment than SSDs.

6 Networking

11. ARP does which of the following:

    ○ Secures routers against hackers.

    ○ Provides benefits for those over 60 years old.

○ Makes packet switching possible.

○ Maps ethernet mac addresses to IP addresses.

12. Which subnet mask allows more host addresses: 255.255.255.0 or 255.255.0.0 and why?

13. Give a difference between infiniband and ethernet and why it matters.

7 The Machine Room

14. Which of the following is true about the CARC Machine Room?

○ It uses a hot aisle/cold aisle configuration.

○ It is solar powered.

○ It is liquid cooled.

○ It isolates the supercomputers from the outside world.

15. What is the fastest type of network in the CARC machine room?

8 Booting and the Kernel

16. Which of the following is true:

○ The bootloader is an ELF program.

○ The first thing the Kernel does is load the init program (systemd or initd).

○ The Kernel is read from the MBR boot block.

○ User space programs interact with the Kernel through syscalls.

17. Name three things for which the kernel is responsible.

9 System Daemons

18. Which of the following is false:

○ Processes are created with fork()-exec().

○ The init process is the ancestor of of all processes.

○ In System V, initd is the init process.

○ Systemd is part of the Kernel.

19. What utility would you use monitor the output logs of systemd units?

10   Compiler Optimisation

20. In Homework 3 you compared the speed of programs compiled with Intel and GCC compilers. What did you observe?

21. In Homework 3 you compared different optimisation levels. What did you observe?

11   Shared Memory Parallelism

22. Shared memory parallelism technologies such as OpenMP allows for:

    ○ Multiple threads of execution in the same program.

    ○ Hyperthreading

    ○ Less context switching by the Kernel.

    ○ Distribution of computation over the network to multiple nodes.

23. What doe this mean: "export OMP_NUM_THREADS=4"? How much faster would an OpenMP program run given that command (be careful)?

12   Process and Resource Monitoring

24. What is the system load?

    ○ Percentage of CPU in use.

    ○ Number of processes running.

    ○ Number of processes in the ready state.

    ○ Number of processes in the blocked state.

25. Give two commands you could run to monitor the CPU usage of a process.

13   SLURM

26. SLURM is

    ○ a way to implement SMP.

    ○ a job scheduler.

    ○ a delicious soda.

    ○ the best way to ensure code is properly parallelised.

27. Explain the difference between "ntasks" and "cpus-per-task" in SLURM.