

C1. Operating Systems (25 points) Answer all parts.

- a) (6 points) Name at least four scheduling approaches. Describe their applicability, as well as positive and negative aspects.
- b) (9 points) Give an overview of current process scheduling in modern operating systems like Windows and Linux. Note similarities and differences.
- c) (6 points) Give an overview of real-time scheduling.
- d) (4 points) What is “processor affinity” and how can it affect scheduling?

C2. Operating Systems (25 points) Answer all parts.

- a) (8 points) Describe filesystem size allocation considerations and tradeoffs. Example considerations include, but are not limited to, storage units and metadata management approaches. Give examples.
- b) (4 points) What is the buffer cache and how is it used?
- c) (9 points) Describe the structure of NTFS or a Unix filesystem in as much detail as you can.
- d) (4 points) What is the difference between a “file handle” and a “file descriptor”?

C3. Operating Systems (25 points) Answer all parts.

- a) (4 points) Concurrent processes come into conflict with each other when they are competing for the use of the same resources. To address the issue, mutual exclusion is enforced. However, the enforcement of mutual exclusion may create two additional problems. Explain what they are.
- b) (8 points) "Test-and-set" and "swap" are two special machine instructions to enforce mutual exclusion. Please describe the pros and cons of using these instructions to enforce mutual exclusion.
- c) (7 points) Describe a "binary" semaphore implementation in pseudocode, assuming an atomic "swap" machine instruction.
- d) (6 points) Using the binary semaphore implemented above, describe a pseudocode implementation of a counting semaphore.

C4. Operating Systems (25 points) Answer all parts.

- a) (10 points) What is thrashing? What is the cause of thrashing? What is working set? What is the principle behind working set? Explain how working set could be used to address thrashing?
- b) (9 points) Discuss the pros and cons of pure paging and pure segmentation memory management systems. Discuss the benefits of combining paging and segmentation into one scheme.
- c) (6 points) Discuss the various hardware features useful for implementing virtual memory systems.