

Takehome Final Exam, COSC 361 Operating Systems

Fall 2022, Dr. Beck

Due 13 Dec 2022

1. [20 points] Consider two processors that are identical except that one has an MMU that uses a single-level page table and the other has an MMU with a two-level page table. The Translation Lookaside Buffer (TLB) works identically in both cases. The same program is run with the same input on each.
 - a. On which processor would the program be expected to run faster, and why?
 - b. What is the principal advantage of using a two-level page table?
 - c. Explain why a switch between user processes results in a temporarily lowered hit rate in the TLB.
 - d. What is Temporal Locality and how does it impact the effectiveness of the TLB?
2. [15 points] Compare lottery scheduling and stride scheduling in detail, giving a summary of the implementation of each. Address the different notion of fairness implemented by each and the differences between their implementation with regard to complexity and the amount of state that must be maintained.
3. [15 points] Explain how the Program Control Register and Memory Management are used in the following operating system functions:
 - a. Protecting resources such as a storage device or a network interface
 - b. Transition from user to kernel execution mode
 - c. Isolating user processes from one another
4. [15 points] Explain
 - a. What the optimal page replacement algorithm (OPT) is and why it is not used in practice.
 - b. What temporal and spatial locality are and why how they improve the performance obtained using Least Recently Used (LRU) page replacement algorithm
 - c. What the dirty bit is and how it can be used to improve the performance of LRU approximation in page replacement.
5. [20 points] In a *reader-writer lock* a group of readers can share the lock, but a writer cannot share the lock with another writer or with a reader. A *group lock* is a variant of read-writer locks in which a group of writers can share the lock with each other, but not with a reader. Modify the reader-writer lock code in Figure 31.13 of Operating Systems in Three Easy Pieces to implement a group lock.
6. [15 point] File systems
 - a. Explain the role of inode blocks in the implementation of a file.
 - b. How does the structure of an inode tree enable small files to be implemented with low overhead but also allow files to grow very large?
 - c. Explain how a file system can use read-ahead to speed up the sequential reading of files.