CS153: Final Review 2

Chengyu Song

Slides modified from Harsha Madhyvasta, Nael Abu-Ghazaleh, and Zhiyun Qian
Administrivia

• Final exam
  • Thursday, June 15, 3:00 p.m. - 6:00 p.m.
  • In this classroom (Sproul Hall 1102)
  • Read questions carefully!
  • Closed book. No additional sheets of notes
  • DO NOT CHEAT
Peterson's algorithm

```c
int turn = 1;
bool try1 = false, try2 = false;

while (true) {
    try1 = true;
    turn = 2;
    while (try2 && turn != 1);
    critical section
    try1 = false;
    outside of critical section
}
```

```c
while (true) {
    try2 = true;
    turn = 1;
    while (try1 && turn != 2);
    critical section
    try2 = false;
    outside of critical section
}
```
Readers/Writers (no starvation)

```c
// number of readers
int readcount = 0;
// mutual exclusion to readcount
Semaphore mutex = 1;
// exclusive writer or reader
Semaphore w_or_r = 1;
// turnstile for everyone
Semaphore turnstile = 1;

writer {
    wait(turnstile); // get in queue
    wait(w_or_r); // lock out readers
    Write;
    signal(w_or_r); // up for grabs
    signal(turnstile); // next
}

reader {
    wait(turnstile); // get in queue
    signal(turnstile); // next
    wait(mutex); // lock readcount
    readcount += 1; // one more reader
    if (readcount == 1)
        wait(w_or_r); // synch w/ writers
    signal(mutex); // unlock readcount
    Read;
    wait(mutex); // lock readcount
    readcount -= 1; // one less reader
    if (readcount == 0)
        signal(w_or_r); // up for grabs
    signal(mutex); // unlock readcount
}
```
True of False?

• For machines with 32-bit addresses (i.e. a 4GB address space), since 4GB physical memories are common and cheap, virtual memory is really no longer needed.

• Answer: False
True or False?

• A TLB miss could occur even though the requested page was in memory.

• Answer: True
True or False?

- A smaller page size leads to smaller page tables
- Answer: False
True or False?

• A smaller page size leads to more TLB misses
• Answer: True
True or False?

- A program allocating 100MB of memory cost only 100MB of memory
- Answer: False
True or False?

• The optimal page replacement algorithm is the best choice in practice
• Answer: False
True or False?

- Belady’s page replacement algorithm = LRU
- Answer: False
Virtual memory can be thought of as a cache for the disk drive.

(a) (6 points) Explain the above statement.
(b) (6 points) Often, there is also a separate disk cache set aside in memory. Is this redundant?
(c) (6 points) List two other caches in a computer system.
(d) (12 points) Replacement is usually an issue in cache design. Do all caches need a replacement policy?
For two of the caches discussed above, suggest a suitable replacement policy. Justify your answer.
Short Answer

Consider a computer where the page tables are kept in memory. The cost of accessing memory is 500nsec. A TLB is used to optimize translation; the cost of accessing the TLB is 50nsec. What should the TLB hit rate be to make the average translation time 75nsec?

\[ X \times 50 + (1-X) \times 500 = 75 \]
\[ \Rightarrow 450X = 425 \]
\[ \Rightarrow X = 94.4\% \]
Short Answer

- (18 points) In class we described three file descriptor structures:
  (a) Indexed files.
  (b) Linked files.
  (c) Contiguous (extent-based) allocation.

Each of the structures has its advantages and disadvantages depending on the goals for the file system and the expected file access pattern. For each of the following situations, rank the three structures in order of preference. Be sure to include the justification for your rankings.

(a) You have a file system where the most important criteria is the performance of sequential access to very large files.

(b) You have a file system where the most important criteria is the performance of random access to very large files

(c) You have a file system where the most important criteria is the utilization of the disk capacity (i.e. getting the most file bytes on the disk).
The End

• Congratulations on (almost) surviving CS 153!
  • It’s a challenging course, but I hope you found it worthwhile
• Good luck for the final!