Solution to the Second COSC 6360 Quiz for Fall 2013

Jehan-François Pâris
jfparis@uh.edu

First question

- Consider a virtual memory system with 4 KB pages, 8 MB of RAM and a TLB with 256 entries.
  - What would be the ***TLB coverage*** of this architecture? (5 points)
  - How can ***superpages*** increase this coverage? (10 points)

Answer

- The TLB coverage is **256×4KB = 1MB**
- Superpages allow TLB entries to cover more main memory space
  - *If the same TLB included* 16 *superpages of* 64KB *each, the TLB coverage would be* 16×64KB + 240×4KB = 1,984KB

Second question

- A system of physical clocks consists of two clocks, namely, one that is slow and loses one minute every hour and another that is fast and advances by two minutes every hour. Assuming that the clocks are managed by Lamport's physical clock protocol, what will be the time marked by each clock at three o'clock given that:
  - Both clocks indicated the correct time at noon;
  - The sole message exchanged between them is a message sent at two o'clock by the processor on which the fast clock resides to the processor on which the slow clock resides;
  - Message transmission delays are negligible.

Answer

Time	Fast Clock	Slow Clock
noon	12:00 pm	12:00 pm

Answer

Time	Fast Clock	Slow Clock
noon	12:00 pm	12:00 pm
1:00 pm	1:02 pm	12:59 pm

Answer

Time	Fast Clock	Slow Clock
noon	12:00 pm	12:00 pm
1:00 pm	1:02 pm	12:59 pm
2:00 pm	2:04 pm	2:04 pm

Answer

Time	Fast Clock	Slow Clock
noon	12:00 pm	12:00 pm
1:00 pm	1:02 pm	12:59 pm
2:00 pm	2:04 pm	2:04 pm
3:00 pm	**3:06 pm**	**3:03 pm**

Third Question

- What problem do Corey ***kernel shares*** address? (10 points)
- How do these kernel shares solve that problem? (5 points)

Answer (I)

- Many kernel operations involve looking up identifiers in tables to
- Accessing these tables becomes costly whenever multiple cores contend for locks on the tables or on individual table entries.

Answer (II)

- Kernel shares lets applications dynamically create lookup tables and specify how these tables are shared.

Fourth question

- Explain why the ARC page replacement policy is said to be:
  - ***Scan resistant*** (10 points)
  - ***Self-tuning*** (10 points)

Answer

- The ARC cache replacement policy is ***scan-resistant*** because blocks that are only accessed once are expelled faster than blocks that are referenced more than once.
- It is self-tuning because it does not have a single user-settable tuning parameter.

Fifth question

- What are the major advantage and the major disadvantage of proof-carrying code (PCC)? (2×5 points)

Answer

- ***Main advantage:***
  - Provides complete protection against misbehaving extensions at ***zero*** run-time cost
- ***Main disadvantage:***
  - It is extremely difficult to generate correctness proofs for non-trivial extensions

Sixth question

- How do the **Nooks object tracking functions** try to prevent extensions from corrupting kernel data structures? (20 points)

Answer

- Object tracking code will prevent extensions from directly modifying kernel data structures.
- It will instead:
  - Copy kernel data structures into extension address space
  - Copy them back after changes have been applied
  - Perform checks whenever possible