COSC 6360 SECOND MIDTERM MARCH 30, 2005

This exam is **closed book**. You can have **two pages** of notes. UH expels cheaters.

1. A system of physical clocks consists of two clocks, one that is slow and loses one minute every hour and another that is fast and advances by one minute every hour. Assuming that the clocks are managed by Lamport's physical clock protocol , what will be the time marked by each clock at two PM given that

a) both clocks indicated the correct time at noon;

b) the processor on which the fast clock resides sent at one PM one message to the other processor;

c) the message transmission delay was negligible;

d) no other messages were exchanged in the system. (2×5 points)

The fast clock will indicate __2_ hours __2_ minutes plus or minus a few seconds.

The slow clock will indicate __2_ hours __0_ minutes plus or minus a few seconds.

2. Explain why the ARC cache replacement policy is at the same time (a) ***scan-resistant*** and (b) ***self-tuning***. (2×5 points)

ARC is scan-resistant because a scan of all the files in the system will not alter the size of the portion of the cache dedicated to files that have been referenced more than once.

It is self-tuning because it adjusts itself to changes in the workload.

3. Which of the following statements are ***true*** or ***false*** (2 points) and ***why***? (3 points)

a) The main problem with the LRU cache replacement policy is that it is ***not self-tuning.***

FALSE, LRU has no tunable parameter.

b) LibOSes cannot be trusted by the exokernel.

TRUE, they are parts of each individual user process..

c) Totem always delivers messages in the order specified by their ***sequence numbers***.

FALSE, Totem always delivers messages in the order specified by their timestamps. Each time a message is forwarded from a ring to another ring, it gets a new sequence number.

d) Spring shuttles never cross machine boundaries.

FALSE, they do.

4. Explain how the exokernel approach can satisfy the needs of (a) applications that want to manage their own resources and (b) applications that prefer to let the system manage these resources. (2×5 points)

The exokernel allows processes that want to manage their own resources to manage themselves. Processes that prefer to let the system manage their own resources can use a libOS.

5. Explain how Spin can "***combine extensibility, safety and performance in a single system***." (3×5 points)

Spin is extensible because users can add extensions to the kernel.

Spin is safe because the kernel and the extensions are all written in a strongly typed programming language. As a result, incorrect extensions cannot corrupt the kernel.

Spin is fast because the kernel and its extensions share the same address space.

6. What will be the final value of the variable f after this CSP program is executed? (5 points)

```
i, f : integer; f := 1; i := 5;
*[ i > 0 → f := f*i; i := i – 1]
```

Answer: f = 5!

7. What would be the main advantage of adding an alternative command to C? (5 points) Why was it never done? (5 points)

Adding an alternative command to C would allow C programs to execute more than one blocking receive() command in parallel. This property is essential in CSP because it uses direct naming and requires each receive() to specify a unique sender. BSD sockets use indirect naming, which means that a process doing an accept() can receive connection request from many senders. In addition, UNIX offers the option of specifying non-blocking read() and receive().

8. How does Spring manage server threads? (10 points)

Spring applications can explicitly create pools of server threads. To allow target domains to create new threads whenever needed, Spring includes a system call that blocks until no available threads can be found in the domain.

9. How could a malicious extension bypass the protection offered by Nooks ***lightweight protection domains***? (10 points)

Nooks extensions execute in the kernel address space with the same privileges as the remainder of the kernel but using a more restrictive page map. A rogue extension could restore the original page map, thus achieving unrestricted access to the whole kernel address space