

CS110 - Principles of Computer Systems

Midterm Exam

(Total time = 50 minutes, Total Points = 50)

Name: (please print) _____

In recognition of and in the spirit of the Stanford University Honor Code, I certify that I will neither give nor receive unpermitted aid on this exam.

Signature: _____

This examination is close book and close notes. You may not collaborate in any manner on this exam. You have 50 minutes to complete the exam. Please write your answers on the exam. Note there is one problem per page so the amount of space provided does not necessarily provide an indication of the expected length of the answer. In other words, do not feel compelled to fill every nanoacre of the exam with writing. Before starting, please check to make sure that you have all 8 pages.

Question	Points	Score
1	8	
2	7	
3	7	
4	7	
5	7	
6	7	
7	7	
Total	50	

1. (8 points) Modern processors contain memory mapping units (MMUs) that support paged virtual memory. In the MMU configuration used by most operating systems, virtual addresses generated by the processor are mapped to different physical memory addresses. If you compare the virtual address to the corresponding physical address you will notice that the least significant bits (i.e. low order bits) of the two addresses are the same while the most significant bits differ greatly. (E.g. virtual address `0xbaadf00d` could map to physical address `0xdeadb00d` but not `0xdeadbeef`). Explain why this is the case.

2. (7 points) Assume you are given a system that supports concurrent operations using 16 threads on a large one gigabyte shared data structure. The operations are divided into two types: small and large. Small operations only touch a few parts of the shared data structure and run in a short amount of time. Large operations touch most of the share data structure and take a long time to complete. Half of the threads (the *small op threads*) only perform small operations and the other half (*the large op threads*) performs only large operations. Assume there are two synchronization approaches: Method L uses coarse-grained locks to protect the shared data, while Method N protects the data using non-blocking synchronization. For each approach, describe what would happen to the large and small op threads.

3. (7 points) Assume you have started a new engineering job at a hot Silicon Valley startup and while looking through the source repository you see the following code fragment:

```
/* Pausing this thread for one second seems to make the
system more stable */
sleep(1);
```

Using concepts discussed in class, write an educated guess at what is going on here with the system.

4. (7 points) What is the purpose of intermediaries in client/services architectures? Give an example.

5. (7 points) Would it ever make sense to have a client/service architecture (complete with RPC communication) where all the clients and services are processes on the same machine? Justify your answer.

6. (7 points) In a naming scheme, would it ever make sense to have more *names* than possible values in the *universe of values*? Justify your answer.

7. (7 points) Explain why a complex software project may not be able to bring the number of bugs in the system to zero even if they had a large engineering team focused solely on a goal of getting rid of all the bugs.