

Instructions: There are **three** questions which count 100 points in total. Each question may have several sub-questions. Please read the questions thoroughly before answering.

1. (35 pts) When the multi-core processors are used in a system and the physical memory are shared among all the cores, the operating system has to assure that the data are consistent all the time. One general approach is to organize all the memory in memory pages and lock the memory page when used. Please answer the following questions.
  - A. Please define false sharing for shared memory. (5 pts)
  - B. When is the false sharing likely to occur? Please provide at least two examples. (10 pts)
  - C. Please discuss the advantages and disadvantages of using large block size and small block size in the design of block-based DSM system. (10 pts)
  - D. Please describe the difference between pipelined Random-access memory (PRAM) consistency and processor consistency. (10 pts)
  
2. (35 points) The following questions are related to distributed file systems.
  - A. (10 points) Please describe the major difference between centralized and distributed file systems, in terms of system architecture, scalability, reliability, and robustness.
  - B. (10 points) Please describe the difference between replicated files and cached files on networked file systems.
  - C. (15 points) Please describe the difference between stateful and stateless servers.
  
3. Process Management (30 points)
  - A. (10 points) What is the difference between “multi-threading” and “multi-process”? Please discuss the robustness and performance in these two modes.
  - B. (10 points) Consider several operating systems deployed over a virtual machine software such as VirtualBox and VMWare. Please briefly describe the procedure for a task that runs over an operating system to receive a Ctrl-C signal from keyboard.
  - C. (10 points) Consider round-robin scheduling and scheduling criteria being “average waiting time”. Will the response time of each process becomes shorter with a smaller time quantum? You must explain why.