

## Operating Systems

### Problem Set 1

1. State with justifications which of the following CPU instructions should be privileged.
  - a. Put the CPU in privileged mode
  - b. Load the upper bound register and lower bound register w.r.t. memory
  - c. Load a value in a CPU register
  - d. Disable the interrupt system
  - e. Read the status of an I/O device
2. An OS provides a system call for requesting allocation of memory. An experienced programmer offers the following advice: *"If your program contains many requests for memory, you can speed up its execution by combining all these requests into a single system call"*. Explain why this is so.
3. A multiprogramming operating system uses a degree of multiprogramming  $m$ , which is large. It is proposed to double the throughput of the system by augmenting / replacement of its hardware components. Comment on the following four proposals in this context:
  - a. Replace the CPU by a CPU with twice the speed.
  - b. Expand the main memory to twice its present size.
  - c. Add new I/O devices capable of operation in DMA mode.
  - d. Replace the CPU by a CPU with twice the speed and expand the main memory to twice its present size.
4. How many processes will be created by the following program segment:

```
fork();
fork();
fork();
fork();
```
5. The classical batch-processing system completely ignores the cost of increased waiting time for users. Consider a single batch characterized by the following parameters:

M	average mounting time (i.e. time to start a batch of jobs)
T	average service time per job
N	number of jobs
S	unit price of service time
W	unit price of waiting time per user

  - a) Show that the optimal batch size that minimizes the cost of service time and waiting time per user (within a single batch) is
  - b) In an installation in which  $M = 5$  minutes,  $T = 1$  minute, and  $S = \$200/\text{hour}$ . The operator chooses  $N = 50$ . Assuming that this is an optimal choice, find the unit cost of user waiting time  $W$ .
6. What is the difference between a system call and an exception?