

## Qualifying Examination: Operating Systems

1. Operating system is an interface between hardware and user programs; it is responsible for the management and coordination of activities and the sharing of the limited resource of the computer. In particular, OS presents an environment in which users can execute in a *convenient* and *efficient* manner. For convenient development and execution of user programs, OS provides hardware abstraction. For efficient execution of user programs, OS also supports various mechanisms to improve performance. (30 points)
  - 1) Describe the most important abstraction for the convenient use of memory, disk, and I/O devices, respectively; describe what kind of abstraction is used for different type of hardware, what are the principles behind the abstraction, what kind of benefits we can get from such abstraction (15 points; 5 points each for memory, disk, and I/O devices)
  - 2) For the efficient execution of programs, it is critical to identify some performance bottlenecks and resolve them. What would be performance bottlenecks in supporting (implementing) the abstractions that you described in the previous question? If any, what would be good approaches to resolve them? (15 points) (describe two performance bottleneck for memory, one for disk, and one for I/O devices)
2. Most OS allows a process to create its child processes. (20 points)
  - 1) Describe what operating systems (OS) do in creating a new process. In addition, describe what they do in creating a new thread, in comparison to process creation? (10 points)
  - 2) Generally, creating a process involves quite expensive tasks. How would you efficiently implement such tasks? Describe your ideas and explain why it is more efficient, and point out which OS techniques are critical to implement your ideas (10 points)
3. Suppose you invent a very new type of device. Then, you want to attach it to computing systems and have a better control over it. You can use creativity to imagine any new device. Or you can simply assume that the new device is a motor device (10 points).
  - 1) As a manufacturing developer of such a new type of device, what kind of issues would you consider to make it operate properly with computing systems? (5 points)
  - 2) As an operating system designer, what kind of issues would you consider to better support such a new type of device (5 points)?

