

長庚大學 101 學年度第二學期 電機所博士班資工領域資格考試
科目：作業系統

1. You are asked to explain why a computer needs an operating system. For each of the service provided by an OS listed below, indicate one drawback if there is no OS to provide such a service.
 - (a) Virtual memory (**3 pts**)
 - (b) File system (**3 pts**)
 - (c) Process scheduling (**3 pts**)
 - (d) System protection by separating kernel and user mode (**3 pts**)
 - (e) Time-sharing and multi-tasking support (**3 pts**)
2. Explain the difference between a process and a thread. Please also describe the advantage of multi-threading compared to multi-process programming. (**10 pts**)
3. For each of the process scheduling algorithm listed below, give an example to explain how the algorithm works. You should draw a time-line to show how a set of processes work.
 - (a) First Come First Serve (**5 pts**)
 - (b) Shorted Job First (**5 pts**)
 - (c) Priority Scheduling (**5 pts**)
 - (d) Round-Robin Scheduling (**5 pts**)
4. You are using a new computer and wondering whether the system has virtual memory support or not. Unfortunately, you don't have any document regarding the operating system but you can use standard C/C++ programming tools in this computer. The only hardware spec you know is that the computer has 1 GByte of RAM. Write a program with only standard C/C++ constructs such that you can tell whether the computer has virtual memory or not from the outcome. (**10 pts**)
5. Consider the situation of using a USB flash disk on an MS-Windows system. You should press the "safely remove" button before you remove the USB flash disk from the computer, or you may destroy the data stored in the flash disk. From the perspective of how an OS implements the file system, explain why removing without unmounting may crash the disk content. (**10 pts**)
6. Explain the concepts about memory fragmentation by answering the following questions:

- (i) Give an example (with a sequence of memory allocation/de-allocation requests) to explain why there are fragmentations. **(5 pts)**
- (ii) Give an example to explain what is external fragmentation. **(5 pts)**
- (iii) Give an example to explain what is internal fragmentation. **(5 pts)**
- (iv) Explain why a demand paging system does not have external fragmentation. **(5 pts)**

7. You are asked to explain how the famous cloud service “Dropbox” is implemented using mechanisms provided by an operating system. The Dropbox service program monitors a dedicated directory on your computer and synchronizes file contents with cloud storage. After you modify a file in the Dropbox directory, the modified file content is automatically uploaded to the cloud. Answer the following questions to explain how the Dropbox works:

- (a) How the Dropbox monitors the directory content without consuming high CPU workload through repeatedly examine files in the directory? (Hint: some OS mechanism enables the Dropbox to realize the monitoring functionality.) **(7 pts)**
- (b) The Dropbox also provides bandwidth control for network data transfer. The user may enforce limited network bandwidth on Dropbox such that file synchronization at the background does not interfere foreground jobs running on the computer. Explain how to realize the bandwidth control through utilizing hardware and OS mechanisms. **(8 pts)**