# CS3104 Operating Systems
## Tutorial 2 - Week 5

Monday, 13 October 2025

This tutorial is given in the form of a mock exam question. You are expected to attempt the questions before arriving at the tutorial. It is strongly recommended that you attempt the questions under exam conditions, such as closed book, hand-written, and timed. Answer the below 20 mark question in 1 hour.

Note that tutorial sessions are not recorded and the answers discussed during the sessions are not released outside the session. Material covered in the tutorials and tutorial questions are examinable.

1. **OS Basics and Memory**

   (a) Highlight three scenarios when a CPU switches from executing user-mode code to executing kernel-mode code?

   [3 marks]

   (b) What function does the timer interrupt play in an OS with pre-emptive multi-tasking?

   [1 marks]

   (c) A USB keyboard is attached to a PC via a USB controller and PCI bus. The USB controller uses DMA. Explain the interaction between the CPU, RAM and hardware controllers on how the operating system would register and process a key press.

   [3 marks]

   (d) Process 1 writes the value 123 to address 0x1000, Process 2 immediately reads from address 0x1000. Explain three potential reasons why Process 2 does not see 123? What hardware feature(s) facilitate this?

   [3 marks]

   (e) i. What is a privileged instruction?

   ii. Give two examples of x86 privileged instructions.

   iii. Explain how an OS detects and responds to a user process attempting to execute a privileged instruction.

   [3 marks]

(f) i. What is demand paging?

ii. Provide two design considerations of a memory management scheme that implements demand paging.

[3 marks]

(g) In a sequence of 2,000,000 memory accesses there were 400 page faults. The page fault handler takes an average of 2 milliseconds. A memory access takes an average of 1 microsecond. What is the effective memory access time for this sequence?

[4 marks]

[Total marks 20]