

## COMP30640 Operating Systems: Quiz 3

### Exercise 1

What are the four components of a process?

### Sample Solution 1

A process includes all information needed to run its program. Process address space (main memory section), is divided into:

- Text region (executable code or program)
- Data region (global variables)
- Heap (containing memory dynamically allocated during run time)
- Stack region (return address and local variables for active procedure calls)

### Exercise 2

Processes can be in several states, namely: ready, waiting, and running. For each of these states, discuss how a process might get into that state, and what the process is waiting for (if anything).

### Sample Solution 2

- New: The process has just been born and will be admitted to the ready queue as soon as it is fully set up.
- Ready: The process is waiting to run, i.e., to get access to CPU (which is decided by the Scheduler).
- Running: Instructions are being executed (the process has access to the CPU).
- Waiting: Process waiting for some event to occur. After the event happens the process will be ready and will join the ready queue. For instance the process can be waiting for an I/O query to be processed, or for a timer to end, etc.
- Terminated: The process has finished execution and will be removed from memory.

### Exercise 3

Three states of a process life cycle are running, ready, and waiting. Are there any circumstances in which a transitions might occur between ready and waiting? Justify your answer.

### Sample Solution 3

A process is ready when it's waiting for the CPU, either after its creation, after an interrupt (the CPU has stopped it) or after being sent voluntarily to the waiting state (e.g., when requesting an I/O). Because the process is not in the CPU, nothing can happen to it (it is not running, hence its state cannot change) and it cannot be sent to a waiting state (which would require an event to happen to the process).

### Exercise 4

Three states of a process life cycle are running, ready, and waiting. Could a single-processor system have no processes ready and no process running simultaneously?

### Sample Solution 4

The exercise's objective was to make you question the idea of an OS with no process at all ready or running. In short this can happen only if the computer is off...

### Exercise 5

Explain the concept of a context switch.

### Sample Solution 5

Whenever the CPU starts executing a new process, the old process's state must be preserved. The context of a process is represented by its process control block. Switching the CPU to another process requires performing a state save of the current process and a state restore of a different process. This task is known as a context switch. When a context switch occurs, the kernel saves the context of the old process in its PCB and loads the saved context of the new process scheduled to run.

### Exercise 6

What is a Process Control Block (PCB)?

### Sample Solution 6

Process Control Block is a structure in the operating system representing a process (1 per process). It contains: process ID, process state, process privileges, registers/program counters, memory information, I/O information (list of open files, list of open inter process communication channels), pointers to other data structures, accounting