

2008 Paper 11 Question 9

Operating System Foundations

- (a) Why is I/O buffering used by operating systems? [2 marks]
- (b) Explain why both mutual exclusion and condition synchronisation are needed for controlling access by concurrent processes to a shared buffer. [3 marks]
- (c) Why is forbidding interrupts not a general solution to implementing concurrency control? [1 mark]
- (d) Explain how a “read and clear” instruction can be used as a basis for building concurrency control. [2 marks]
- (e) Define semaphores, including how they differ from a simple free/busy flag. [2 marks]
- (f) The following pseudocode fragments represent access by a single producer and a single consumer to a shared, N-slot, cyclic buffer.

`items` is a semaphore initialised to 0

`spaces` is a semaphore initialised to the buffer size, N

```
producer repeats:
  produce data
  WAIT (spaces)
  insert data in buffer
  SIGNAL (items)
```

```
consumer repeats:
  WAIT (items)
  remove data from buffer
  SIGNAL (spaces)
  consume data
```

- (i) Explain in detail how the semaphores are being used to enforce concurrency control. [6 marks]
- (ii) Extend the code fragments for multiple producers and multiple consumers, explaining how your solution implements concurrency control. [4 marks]