

COMPUTER SCIENCE TRIPOS Part IB – 2012 – Paper 5

7 Concurrent and Distributed Systems (SMH)

- (a) What is the relationship between *critical sections* and *mutual exclusion*? [2 marks]
- (b) Describe how mutual exclusion can be achieved using:
- (i) Spinlocks [2 marks]
 - (ii) Semaphores [2 marks]
 - (iii) Event Counts and Sequencers [2 marks]
- (c) Describe the operation of a *monitor*. Be sure to explain how it supports mutual exclusion and *condition synchronization*. [6 marks]
- (d) Why are monitors used in preference to *conditional critical regions*? [2 marks]
- (e) In an effort to promote diversity, the Master of Holy Rock College, Cambridge, decides that the JCR must always hold at least one state school educated (SSE) student for every three public school educated (PSE) students. Reasoning that students are not very dissimilar from threads, he suggests the following entry and exit routines be followed:

```
JCR = new Semaphore(0);

/* for SSE threads */          /* for PSE threads */
enterRoom() {                  enterRoom() {
    signal(JCR, 3);             wait(JCR);
}                                }

leaveRoom() {                  leaveRoom() {
    wait(JCR);                  signal(JCR, 1);
    wait(JCR);                  }
    wait(JCR);
}                                }
```

We can assume that undergraduates are smart enough not to try and enter the JCR when it is full. Yet despite this, the Master's solution does not work quite as hoped! Describe what can go wrong, and suggest a fix. [4 marks]