CS5225 Parallel and Concurrent Programming

Homework 1

Due – July 11 before 11:55 PM

Answers can be submitted to LMS as a pdf or can hand them over during the class before the deadline.

1. Use Amdahl's Law to solve the following questions

   a. Suppose a computer program has a method *M* that cannot be parallelized. *M* accounts for 40% of the program's execution time. How much speed up can we gain if the program runs on a quad-core CPU? [2 marks]

   b. Is it worthwhile to invest an 8-core CPU to run this program? Justify. [3 marks]

2. Test and Set Lock (TSL) instruction can be used to provide mutual exclusion using busy waiting. Following is one such implementation.

```
enter_region:
       TSL REGISTER,LOCK       | copy lock to register and set lock to 1
       CMP REGISTER,#0         | was lock zero?
       JNE enter_region        | if it was non zero, lock was set, so loop
       RET                     | return to caller; critical region entered
leave_region:
       MOVE LOCK,#0            | store a 0 in lock
       RET                     | return to caller
```

   a. Briefly explain how the above code works and how can it be used to provide mutual exclusion? [3 marks]

   b. In some systems we may have an instruction to swap the contents of a register and a memory word in a single indivisible action instead of a TSL instruction. Use it to write alternative routines for *enter_region* and *leave_region* such as the one found above.

   [6 marks]

3. At a crossroads with STOP signs on all four approaches, the rule is that each driver yields the right of way to the driver on his right. This rule is not adequate when four vehicles arrive simultaneously. Fortunately, humans are sometimes capable of acting more intelligently than computers and the problem is usually resolved when one driver signals the driver to his left to go ahead. Can you draw an analogy between this behaviour and any of the ways of recovering from deadlock? Why is a problem with such a simple solution in the human world so difficult to apply to a computer system? [6 marks]