CS5270 Assignment 2

February 23, 2007

NOTES:

1. This assignment is due on 22nd March 6:30pm. You can hand it in at the beginning of the lecture, or pass it to me beforehand - slipping under the door is fine.
2. There will be a late submission penalty of 10%/day.
3. Submissions should be typed (not hand-written).

1 Problem1 (10 marks)

In class a reasonably efficient algorithm for computing the parallel composition of a set of transition systems was shown, with lots of hand-waving. Formalize this algorithm, writing it in pseudo-code, with a clear description of how the algorithm is applied. You can assume high-level pseudo-code that can (for example) iterate over items in a set and so on.

We can also more compactly express the parallel composition in a mathematical way, as described on page 51 of the notes. However, implementing this approach may be inefficient. Clearly state why it is inefficient, and why the (hand-waving) algorithm is better. Try to quantify the improvement in efficiency.

2 Problem2 (10 marks)

Consider a situation similar to the one in slide 25 of the fourth set of overheads, except changed as follows: At t_1 task J1 is scheduled, and at time t_2 it does it's wait(a). At t_3, J2 is scheduled - it is supposed to wait one time unit and then do a wait(b). Draw and label a diagram which shows the events if you were scheduling using PCP. For each `wait()` or `signal()` describe how the PCP resource access protocol is applied.

3 Problem3 (10 marks)

Consider Table 3.5, page 41 of the notes. There are four semaphores protecting various critical sections, and the semaphores are shared with three processes. The numbers in the table indicate the duration of the corresponding critical section. If the number is 0, it means that this semaphore is not used by the corresponding process (for example τ_2 is not using semaphore B).

Assuming PIP, draw a timing diagram which shows a worst-case timing for τ_1 - i.e. that it will be blocked for the longest possible time.

4 Problem4 (10 marks)

Repeat problem 3, but assuming PCP.

5 Problem5 (60 marks)

Use Uppaal to construct a timed model of a road-traffic-light system. In this system, one set of lights is North-South, the other East-West, and we have a traffic light controller which cycles the lights for cars according to the following sequence:

Sequence	North-South	East-West	Time
1	Green	Red	20
2	Amber	Red	4
3	Red	Red	1
4	Red	Green	20
5	Red	Amber	4
6	Red	Red	1

In addition, the controller has pedestrian push buttons (for either North-South or East-West), and pedestrian WALK lights (for either North-South or East-West) which will either be WALK or STOP. The pedestrian walk lights will always show STOP unless a pedestrian arrives and presses the correct pedestrian push button *before* the corresponding lights for cars have turned green. Once the pedestrian push button is pressed, other pedestrians do not have to re-press it to cross during the same phase of the lights. The pedestrian walk lights will only show WALK at the same time as the corresponding lights for cars are green.

Model the controller accurately in Uppaal, and two (or more) pedestrians. Ensure that pedestrians are always safely across the walkway before traffic could run them over (you will have to constrain the behaviour of the pedestrians). For extra credit, construct Uppaal queries that verify that your system is correct.

In addition to a brief writeup, including the (graphical) transition system and brief descriptions, you must submit the Uppaal code electronically in the `Assignment2` folder in the IVLE.