CS5270 Assignment 1

January 24, 2007

1 Problem1 (10 marks)

Consider a motor vehicle. The top speed of the vehicle is 125 km/hr, and the wheels have a diameter of 0.8 metre. What is the maximum rotation speed of the wheel in RPM? If a sensor attached to a computer gives a signal once per revolution, and these signals were sensed by a computer to calculate the speed of the car, then for a speed accuracy of 0.1%, what temporal accuracy is needed?

2 Problem2 (10 marks)

Still with our car example... Assume that we have three computers associated with braking, one located near the foot pedals, another located near the front wheels and the third located near the back wheels. Assume that these computers can communicate via a communication network of some sort. For each computer, list the sensors and actuators that would most likely be needed. For each sensor or actuator, write a short description, and identify those sensors or actuators that are critical. For example, the computer near the foot pedals is likely to need (at least) a brake pedal sensor, and a speedometer actuator.

3 Problem3 (10 marks)

In Chapter 1 of the notes, simple transition systems were introduced using an example with a `gate`, `train` and `controller` TS. These were shown to be limited in their modeling power, and the *timed* transition system was introduced, with a `gate` that signals that it needs to be repaired if it fails to *close* the gate after 4 time units. Extend this timed transition system so that the `gate` signals that it needs to be repaired if it fails to *open* the gate after 4 time units. Add a new TS `repairman` to respond to this new signal. Comment on your new system: List any new signals. What new features does the `repairman` TS allow? What other changes to the systems are appropriate?

4 Problem4 (10+15 marks)

In the same vein as the gate/train/controller example on page 16, develop a simple transition system diagram for a foot-pedal, rear-brake and front-brake system for a car. Show the new diagrams, and for each briefly describe its properties. Develop a *timed* transition system version. Show the new diagrams, and for each briefly describe its properties.

5 Problem5 (15 marks)

Find an example (that has not been mentioned in Hugh's notes or lecture slides for lectures 1 to 4) of a computer system that has failed due to a software timing failure (i.e. the system did not meet some timing constraint). Briefly describe the failure, how it happened, and any details you can discover. Provide your references (URL/book/article OK). NOTE: A good unique example will get the full 20 marks, but if you choose some common example that other students have also picked, then you will get one mark removed for each other student who chose the same example. Life is tough.

6 Problem6 (10 marks)

Consider the periodic task set given below. Comment on the schedulability, and justify your comment.

	τ_1	τ_2	τ_3
C_i	3	2	3
T_i	6	5	12

7 Problem7 (10+10 marks)

Give an RMS schedule (if possible) for the periodic task set given below. Give an EDF schedule (if possible) for the periodic task set given below.

	τ_1	τ_2	τ_3	τ_4	τ_5
C_i	1	1	1	1	1
T_i	24	12	8	4	2