

# CS4271 Assignment 1

January 15, 2011

## 1 Notes

- This assignment is due by 11:59 PM, Friday, 18th February, 2011. **No late submissions!**
- This is an individual assignment. Acts of plagiarism are subjected to disciplinary action by the university. Please refer to <http://www.comp.nus.edu.sg/students/plagiarism/> for details on plagiarism and its associated penalties.
- We shall be using Rhapsody tool for this assignment. The tool is installed in all machines of Embedded Systems Teaching Lab 1 and Embedded Systems Teaching Lab 2. The assignment must be done with the version installed in respective teaching labs.
- *Submission Instructions:* (Failure to follow these instructions may result in deduction of marks)
  1. Create a folder named your matriculation number YourMatricNumber, e.g. U123456M. Create the following files in this folder (name these files exactly as instructed.):
    - **assignment1:** Rhapsody project folders of your assignment. The animated sequence diagrams must be included in the projects.
    - **report.pdf:** Please include your particulars (name, matriculation number and NUS email address), assumptions you made in system modeling (if any), and a brief description of all the external events used in modeling.
  2. Zip (using WinZip) the entire YourMatricNumber folder (including the folder itself and all files in it) into a file YourMatricNumber.zip.
  3. Submit YourMatricNumber.zip to the IVLE Workbin Folder **Lab1**.

## 2 Problem Description

A railway system consists of interconnected stations. Shuttles running on the railway bid for orders to transport passengers between certain stations. Successful completion of an order results in a cash payment for the shuttle involved. New orders are made known to all shuttles, thus all shuttles can make an offer. The shuttle with the best, i.e. lowest offer will receive the assignment.

- *Railway network*
  1. The railway network consists of stations and tracks. Track can be traveled upon in one direction only (which is fixed). Two stations are connected bidirectionally, while there must only be one track between two stations in each direction. Furthermore, any number of shuttles can be present at a station at the same time.
  2. A track can only be occupied by one shuttle at a time. Shuttles willing to travel along the occupied track have to wait until the track is free.

- *Orders*

1. Orders are made known to all shuttles by the management system. An order defines start and destination stations. Additionally, an order has a certain size, namely the number of people wishing to travel.
2. After all shuttles are informed of the new order, each shuttle must reply with either an offer or refuse message. The offer should include the desired charge - the payment it will receive. The shuttle having made the lowest offer will receive the assignment. In the event of two equal offers, the assignment will go to the shuttle that first made the offer.

- *Shuttles*

1. Order processing is handled by the shuttles. Every shuttle can transport passengers up to its capacity. This means that a shuttle can transport more than one order at the same time, as long as the orders do not exceed the maximum capacity. The number of orders assigned - but not necessarily loaded - to a shuttle at any given time, is not limited.
2. To complete an order a shuttle has to travel to the start station, load the order and then proceed to the destination station to unload. Loading or unloading at other stations is not permitted.
3. A shuttle traveling on a track can neither change direction nor choose another destination.
4. When an order is received, a shuttle should make an offer only if (a) current loaded size plus the order size does not exceed the capacity, and (b) the start destination of the order is within two stations away from its current position (if it is on a track, its current position is its arriving station). Otherwise the shuttle should refuse to make an offer. (You may need to write C code for this requirement.)

## More details

- For simplicity, you can assume that there are six stations/tracks labeled from 1 to 6 connected as a ring.
- Initially each shuttle should be in a station.
- You may make every shuttle connecting to the management system before running.
- The charge in offers and the capacity can be fixed with respect to a shuttle.
- States in statechart should clearly reflect the status of the corresponding class/object. For example, the status of a shuttle is different when it stays in a station or runs on a track, it is loaded or unloaded, and it has order or no order.

## 3 Questions

1. (6 marks) Use “**Rhapsody in C**” to model the shuttle system according to the specification given above. Your model should contain the class diagram and statechart for all classes. Your class diagram should contain at least three classes - the management system, tracks, and shuttles, as well as corresponding multiplicities and associations. Please state clearly in the report any assumptions you make during modeling of the system. Your model should comply with the requirement strictly, otherwise marks may be deducted accordingly. For example, a shuttle should only unload (by entering “unloading” state) if it is at the destination station. *Note: “load”, “unload”, “make offer”, “refuse offer”, “assign order” should not be modeled as external triggers from environment.*
2. (4+4 = 8 marks) Suppose there are three shuttles -  $s_1$  (capacity: 5 people; charge: 2 dollars per person; initially at station 1),  $s_2$  (capacity: 8 people; charge: 4 dollars per person; initially at station 1) and  $s_3$  (capacity: 10 people; charge: 3 dollars per person; initially at station 2).
  - (a) Generate an animated sequence diagram named *q2Sequence* for the following scenario.

- An order of 5 people from station 2 to 4 is available to all shuttles.
  - $s_1$ ,  $s_2$  and  $s_3$  make offers.
  - $s_1$  is assigned with the order.
  - $s_1$  departs from the current station 1.
  - $s_1$  arrives the intermediate station 2.
  - An order of 2 people from station 2 to 3 is available to all shuttles.
  - $s_2$  and  $s_3$  make offers while  $s_1$  refuses to offer.
  - $s_3$  is assigned with the order.
  - $s_3$  loads 2 people.
  - $s_3$  departs from current station 2.
  - $s_1$  tries to depart from station 2 but failed.
  - $s_3$  arrives next station 3.
  - $s_3$  unloads 2 people.
  - $s_1$  departs from current station 2.
- (b) For the above system, produce a sequence of events that leads the system into a state that all shuttle are at stations without load, given the following condition:
- Two orders are available sequentially before any action of shuttles:
    - i. The first order: 4 people from station 1 to 3.
    - ii. The second order: 1 people from station 2 to 3.

Generate an animated sequence diagram named *q3Sequence* corresponding to this scenario.

END OF ASSIGNMENT 1