

**Faculty of Arts and Science
University of Toronto**

Midterm Test

Department: Computer Science
Instructor: John Mylopoulos
Date and Time: 6:10pm Monday, March 3, 2003

Conditions: Closed book
Duration: 50 minutes

This test counts for 20% of your final grade

Name: _____

(Please underline last name)

Student Number: _____

Question Marks

1. _____/20

2. _____/30

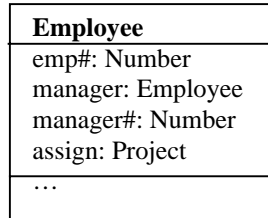
3. _____/20

4. _____/30

Total _____/100

1. [Short Questions; 20 marks total]

(a) [Class diagrams – 4 marks] Here is a class diagram that represents employees in an organization. Propose two improvements to the diagram. You need *not* draw another diagram.



- (a) **Remove the manager# attribute, it is redundant**
- (b) **Make “assign” an association, so that an employee can have several assignments.**

(b) [Class diagrams – 2 marks] For the class Employee given above, specify in OCL the following constraint: “The manager# of an employee is the same with the emp# of his/her manager”

Employee
manager# = manager.emp#

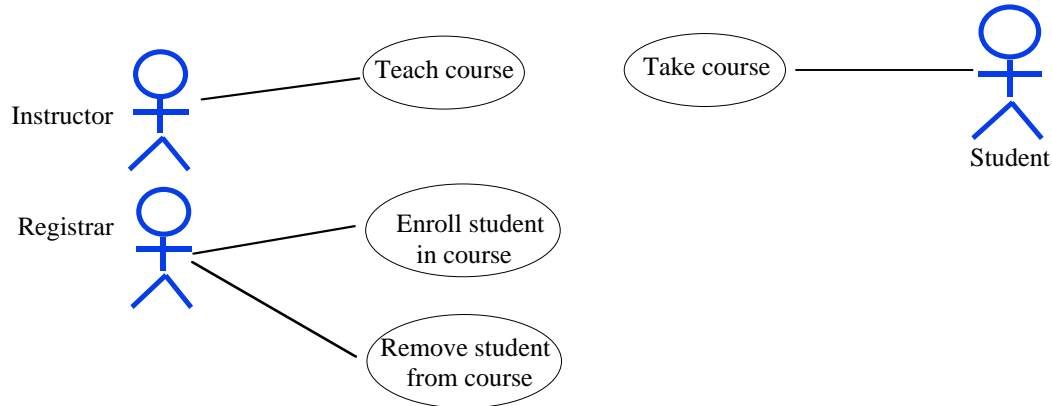
(c) [Non-functional requirements – 4 marks] Describe a possible metric for measuring each of the following non-functional requirements:

Reliability **Percentage of up-time per year**

Usability **Number of training days required for users**

1. [Short Questions; continued]

(d) [Use Case Diagrams – 5 marks] Draw a use case diagram for courses. In particular, assume that courses are taught by instructors, while registrars can enroll or remove students from a course. Students take a course, provided they are enrolled in it.



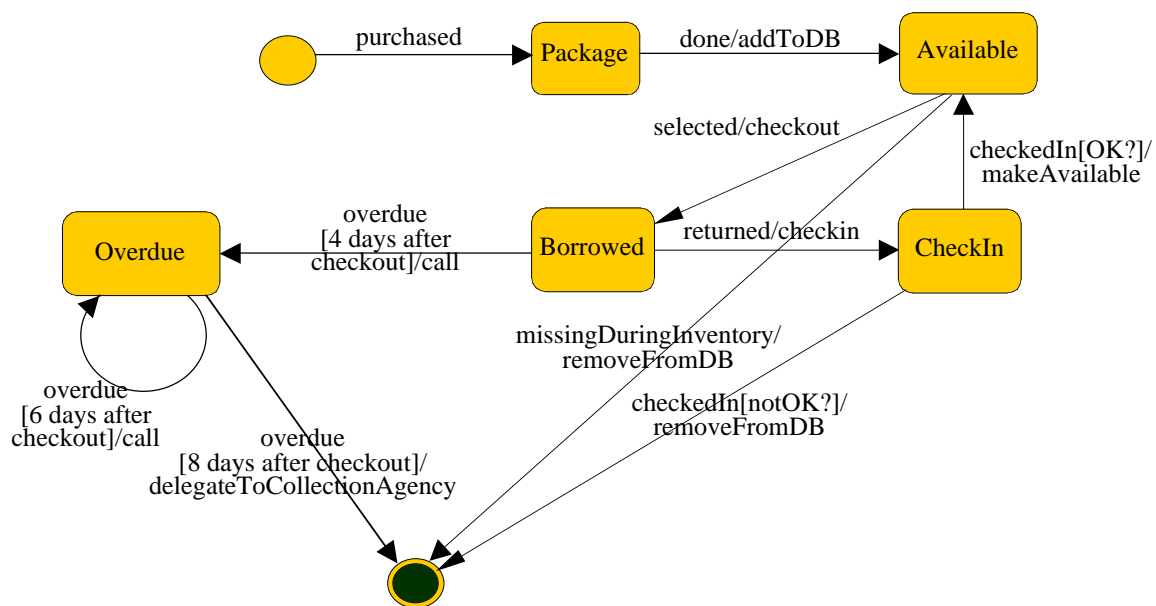
(e) [Requirements specifications – 5 marks] What does it mean to have a requirements specification document that is “traced” and “traceable”? How do you ensure each one of these qualities?

Traced -- there is information in the document on the source of each requirement (i.e., where did it come from.)

Traceable -- each requirement is numbered; document sections are numbered down to the paragraph level so that one can refer to them during the design phase.

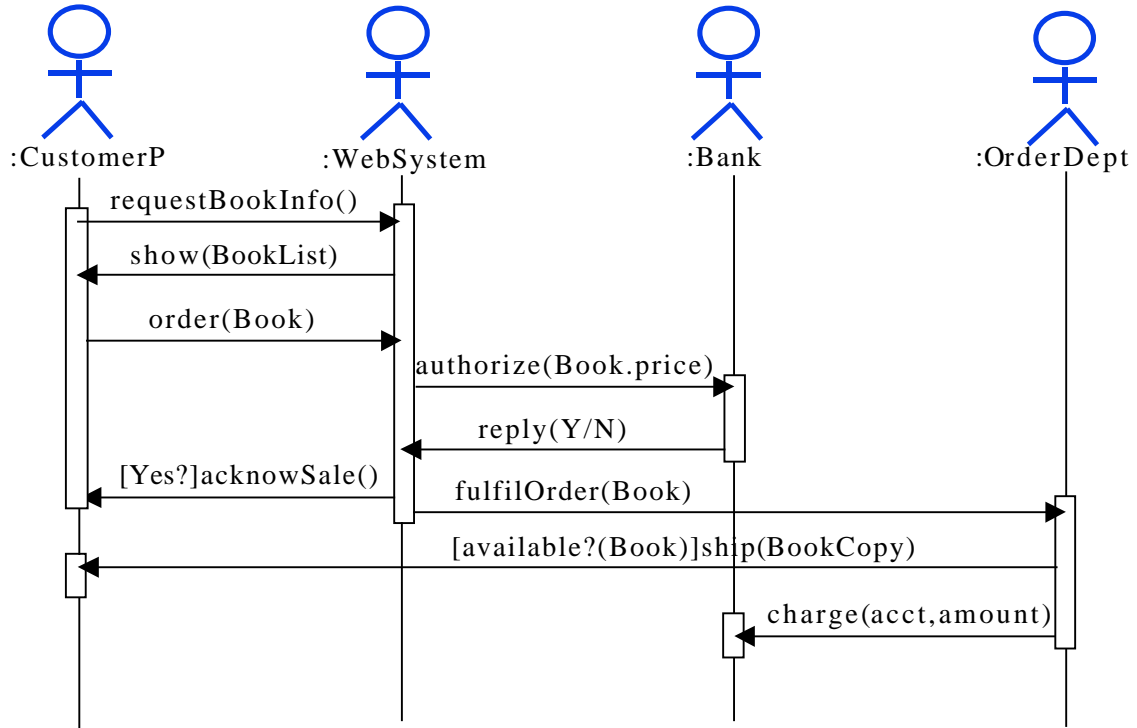
2. [State Diagrams; 30 marks] Give a state diagram that describes the lifetime of a video tape in a video store. You can assume that a video tape is purchased, packaged properly (plastic case with identification information on the outside), put in the video store database, and is then put up for rental. Customers who choose to rent it, check it out and return it in 3 days. If a customer fails to return it, the store calls him/her the next day. The call is repeated a second time after 2 more days, and if the tape is not returned within 2 more days, the store delegates the matter to a collection agency and removes the video tape from its collection. If the tape is damaged on return, it is removed from the collection database also. Finally, if the tape is missing during the annual store inventory, it is removed from the collection database as well.

Make sure to define events, conditions, actions for transitions in your diagram, where appropriate.



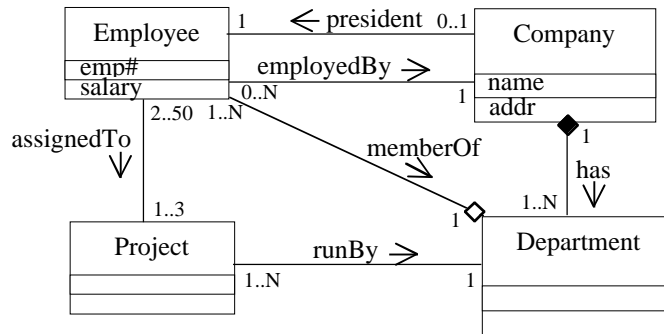
3. [Sequence Diagrams; 20 marks] To buy a book electronically from chapters.com, a customer needs to select the book from a list provided by Chapters' eCommerce system, provide credit card information to the system, then the system gets authorization from the bank for the payment, and -- if positive -- confirms the sale. The order is then sent to the orders department and when the book becomes available, it is shipped to the customer. Also, the order department charges the customer's credit card by informing the bank of the amount.

Draw a sequence diagram that models this process. Make sure to model all relevant actors and the interactions between them. Do show explicitly the time intervals when different actors actively participate in the process you are modeling.



4. [Class Diagrams, 30 marks] Consider the world of companies: Companies employ employees (who can only work for one company), and consist of one or more departments. Each company has a single president, who is an employee. Departments have employees as members and run projects (one or more.) Employees can work in 1 to 3 projects, while a project can have 2 to 50 assigned employees. You may assume that companies have a name and address, while employees have a emp# and a salary.

(a) [Drawing class diagrams – 20 marks] Draw a class diagram for the description above. Make sure to show attributes, multiplicities and aggregation associations, where appropriate. No need to show any operations.



(b) [Object Constraint Language (OCL) -- 10 marks] Express the following class constraints in OCL:

No employee can earn more than \$200K

salary ≤ \$200K (or, self.salary ≤ \$200K)

An employee can only be assigned to projects run by her company

self.assignedTo.runBy.has = self.employedBy

No employee can earn more than her president

self.salary ≤ self.employedBy.president.salary

(Scratch paper)

(Scratch paper)