

University of Toronto**Faculty of Arts and Science
Department of Computer Science****CSC340S - Information Systems Analysis and Design**

Spring 2004

John Mylopoulos

April-May Examination***Calculators are the only Aids Allowed******Duration: 2 hours*****Make sure that your examination booklet has 12 pages
(including this one). Write your answers in the space provided.****This examination counts for 35% of your final mark.****Name:**

*(Please underline your last name)***Student Number:****Question Marks**

1. _____/15

2. _____/15

3. _____/20

4. _____/15

5. _____/10

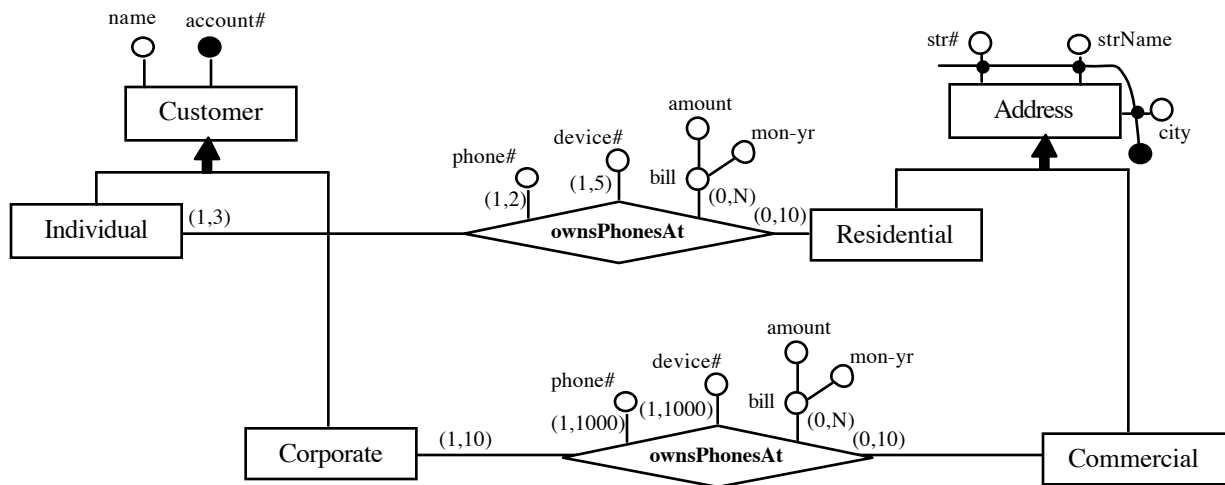
6. _____/25

Total _____/100

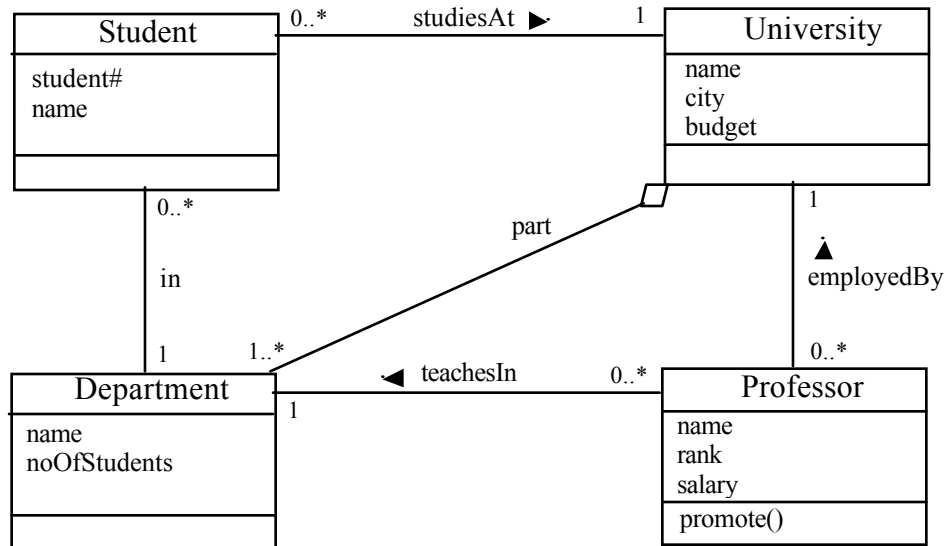
1. [Entity-Relationship Diagrams; 15 marks] A telephone company decides to computerize its customer information system that keeps track of customers, their addresses, telephone numbers and rented telephone devices, also their monthly bills. Draw an entity-relationship diagram for the customer database, assuming the following:

There are individual and corporate customers. Each individual customer has at least one and up to three residential addresses, but a residential address can have up to ten customers. For each customer, a residential address has one to two associated telephone numbers and zero to five rented telephone devices (some customers own the telephone devices they use at home). A bill is sent each month of the year for each customer address and includes charges for all telephone numbers and all rented devices at that address. Corporate customers have one to ten commercial addresses, one to one thousand telephone numbers, and one to one thousand rented devices. Commercial addresses can have any number of (corporate) customers. All customers have a name and a unique account number. Telephone devices are identified by their serial number. Addresses are identified by their street number, street name, and city.

Make sure that your solution is an Entity-Relationship diagram, **NOT** a UML class diagram!



2. [Constraint Language; 15 marks] Consider the following class diagram



Express the following constraints in CL:

[Part a; 4 marks] “No two universities have the same name and are in the same city”

University:

forall x[University(x) and x.name = self.name and x.city = self.city implies x = self]

[Part b; 4 marks] “The sum of all professor salaries is less than the budget of the university they are employed by”

University: *sum(self.employedBy.salary) < self.budget*

[Part c; 4 marks] “A professor with rank equal to fullProf can’t be promoted; moreover, when a professor is promoted her rank changes and her salary increases”

University::promote()

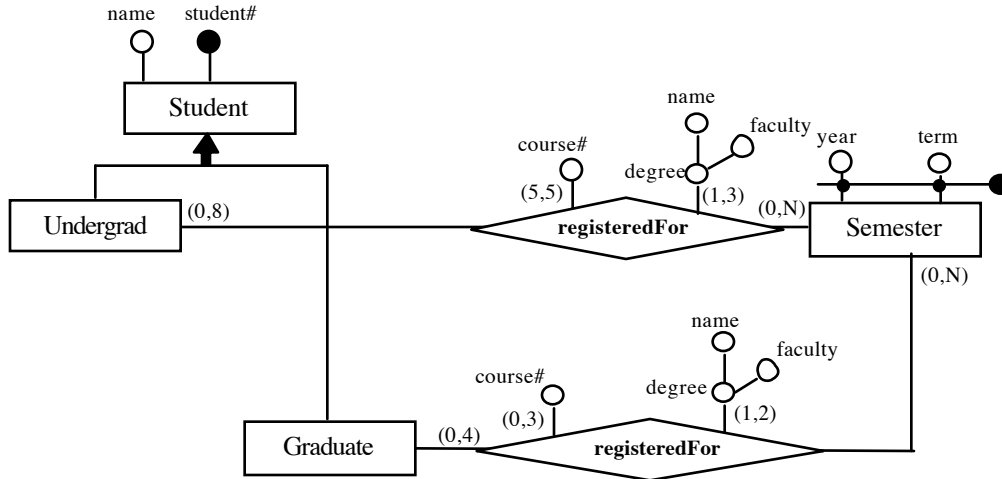
pre: self.rank ≠ fullProf

post: self.rank ≠ self.rank@pre and self.salary > self.salary@pre

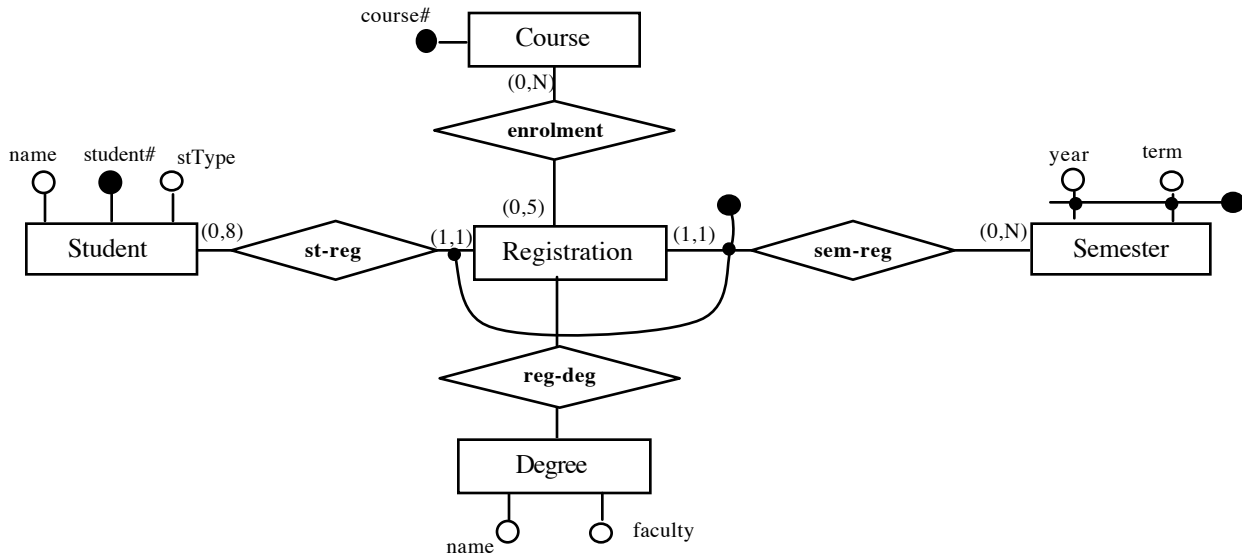
[Part d; 3 marks] “The value of the noOfStudents attribute of Department is equal to the number of students in that department”

Department: *size(self.in) = self.noOfStudents*

3. [Database Design; 20 marks] Consider the Entity-Relationship (ER) schema shown below which describes the contents of a student database. Unless otherwise stated, attributes are assumed to be single-valued. In addition, you may assume that database operations (register, graduate) treat undergraduate and graduate students the same way.



[Part a; 10 marks] Draw an ER schema that captures the same information as the schema above, but does not have any generalization relationships, nor any multi-valued, or composite attributes.



[Part b; 10 marks] Give a relational schema that captures the same information as your ER schema of part (a). Show clearly keys for each relation in your schema.

Sample solution

Student(student#,name,stType)

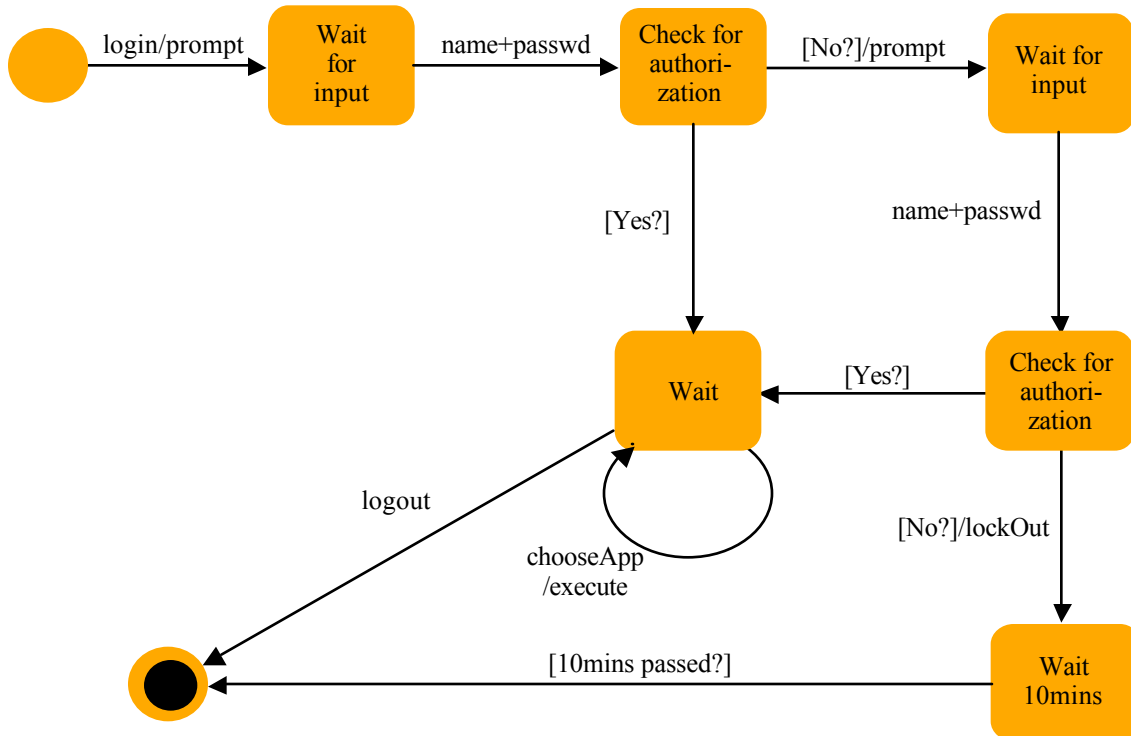
Semester(year,term) -- could be omitted

Registration(student#,year,term, name,faculty)

Enrolment(student#, year,term,course#)

Degree(student#, year,term,degName,degFaculty)

4. [User Interfaces; 15 marks] Draw a state diagram that specifies the dialogue structure of a login session. The session begins when the user clicks on a login button. Then the system prompts the user for her name and password, checks that the user has authorization and logs the user in. If there is a problem with the name or password, the user is given one more chance to input a valid name and password, otherwise the login program goes into a 10-minute time-out, then returns to idle mode. While the user is logged in, she is allowed to execute different applications by clicking on appropriate buttons. When the user clicks the “log out” button, the session terminates.



It is OK to loop back to the start state instead of an end state.

5. [Feasibility Study; 10 marks] Consider a project that involves building a web-based e-Commerce system for a video store. The expenses for the project are estimated to be \$20,000 for development costs, \$5,000 for hardware and software (all in year 0), and annual costs of \$5,000 for maintenance (for year 1 and thereafter). The new income to be generated by the system is estimated to be \$5,000 for year 1, with an increase of 50% in income for subsequent years.

Estimate the net income/loss of this project at the end of year 2. You may assume that the present value for one year is 0.9.

	Year 0	Year 1	Year 2
Development costs	(\$20,000)		
Hardware/Software	(\$5,000)		
Maintainance		(\$4,500)	(\$4,050)
Income		\$4,500	\$6,075
Totals	(\$25,000)	(\$25,000)	(\$22,975)

6. [Short Questions; 25 marks total]

[Part a: Feasibility Study; 4 marks] What is risk analysis? Give two examples of risk factors.

During a feasibility study, risk analysis compares alternatives under consideration from the point of view of risk.

Examples of risk factors: Poorly understood requirements at scheduling time, no technology standards.

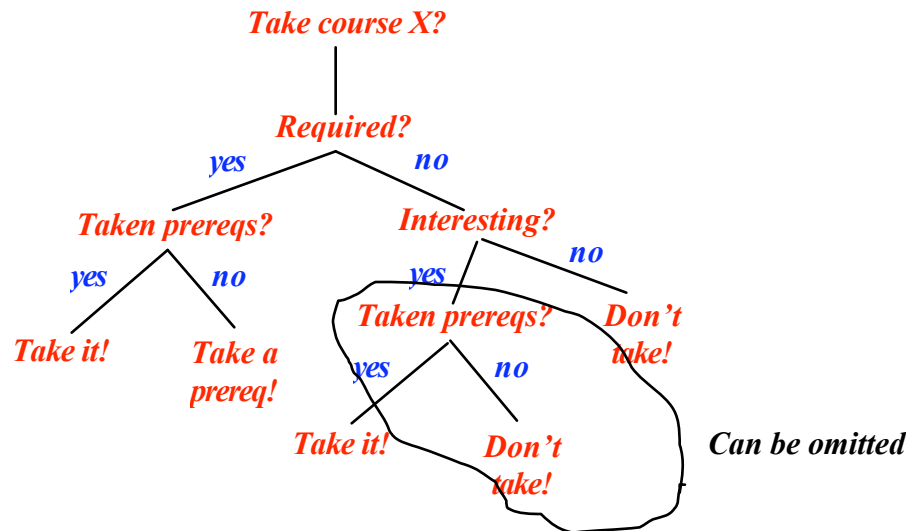
[Part b: Software Architectures; 5 marks] Describe the process by which a server delivers services to clients in a client-server architecture.

Server establishes connection with each client, accepts messages from each client and responds to each.

[Part c: Computing Platform; 4 marks] Why are personnel considerations more important than hardware, software or network considerations in selecting a computing platform?

Personnel costs are often higher than hardware, software and network costs combined.

[Part d: Decision Trees; 6 marks] Consider the decision whether to take a course. First, you check to see if it is required for the degree program you are registered under. If yes, then you check to see if you have all the prerequisites, and if so you add the course to your schedule; if not, then you add one of the missing prerequisites to your schedule. If the course is not required, you check to see if it is interesting. If it's not, you decide not to take it, otherwise you take it. Draw a decision tree for this decision.



[Part e: State Diagrams; 6 marks] Give a state diagram that prints “YES” when it receives events E_1 , E_2 , and E_3 and outputs “NO” for all other combinations of input events. You may assume that the state diagram has a special variable EVENT that takes as value the current event that triggered a transition, and is reset to NIL once a transition has been completed.

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[Scratch paper]



[Scratch paper]

