Faculty of Arts and Science
University of Toronto

Midterm Test

Department: Computer Science
Instructor: John Mylopoulos
Date and Time: 9:10pm, February 27, 1997

Conditions: Open book
Duration: 50 minutes

This test counts for 20% of the final grade

Name: _____

(Please underline last name)

Student Number: _____

Question Marks

1. _____/30

2. _____/20

3. _____/30

Total _____/80

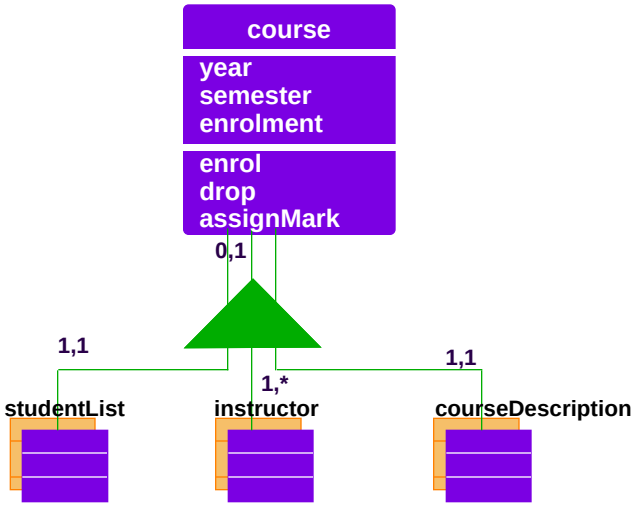
1. [Short Questions; 30 marks, 5 marks for each question]

(a) [Entity-Relationship Model, functional dependencies] Does it make sense for a non-key attribute of an entity in an entity-relationship diagram ***not*** to functionally depend on the key of the entity? Explain your answer.

No, it does not. An entity key determines uniquely an entity and an entity determines uniquely its attributes, hence there is a functional dependency from a key to every non-key attribute.

(b) [Object-Oriented Analysis] Use Coad's Object-Oriented model to describe a course as an aggregate of simpler concepts, with associated attributes and services.

This is only one of several possible solutions



1. [Short Questions; continued]

(c) [Decision Tables] Draw a decision table for deciding what mode of transportation you will use (i.e., fly, take a taxi, take the TTC, walk) to go to a place. Define carefully the conditions and outcomes you are using.

In town?	Y	Y	Y	Y	Y	N	N	N
Short distance?	Y	Y	Y	N	N	Y	N	N
Good weather?	Y	N	N	*	*	*	*	*
Can afford?	*	Y	N	Y	N	*	Y	N
Walk!	X							
Take TTC!			X		X			
Take taxi!		X		X				
Take train!						X		X
Fly!							X	

(d) [Entity-Relationship Model, keys] Assume that someone has defined `COURSE` as an entity with attributes `name, dept, year, semester` (with values `Fall, Summer, Winter`), `instructor`. Each of the following keys makes different assumptions about the university setting being modelled. Describe these assumptions.

(I) name

Each course is only given once (ever!)

(ii) instructor, year

Each instructor is only teaching one course per year

(iii) name, dept, semester

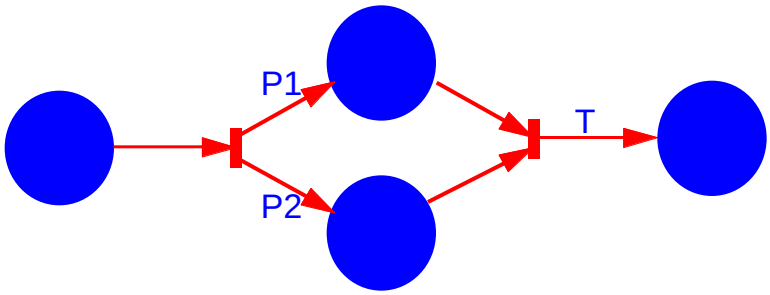
Each course is only given once per semester by each department (can't have multiple sections, unless if each is given by a different department)

(iv) name, instructor

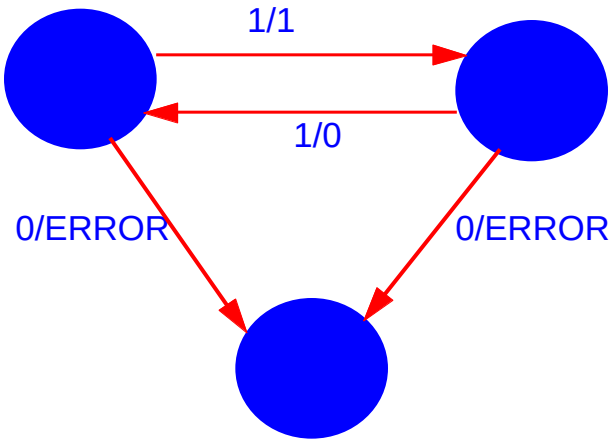
Each instructor only teaches a course once

1. [Short Questions; continued]

(e) [Petri Nets] Draw a Petri net which models a process P which launches two other processes P1 and P2 simultaneously. When both P1 and P2 terminate, then P carries out some final task T (e.g., outputs a report) and terminates. You may label Petri net transitions with P1, P2, T to indicate what happens during each transition shown on your Petri net.



(f) [Finite Sate Machines] Draw a finite state machine which accepts a sequence of 1's and outputs a 1 for the first input 1, a 0 for the second, a 1 for the third etc. (i.e., the output stream is 101010...). If a 0 is input, the machine outputs ERROR and stops (i.e, goes into a state with no outgoing transitions).



2. [Data Flow Diagrams; 20 marks]

Draw context and level 0 data flow diagrams for the process you are following in working out the details and preparing assignment 3. Keep in mind that the process you are describing involves several persons (your teammates as well as yourself), as well as various information sources, external entities (prof, tutors,...)

Your answer will be marked on the basis of how precise and legible it is, also on how well formed are your diagrams. You may want to include some explanatory statements with each diagram.

Context level diagram
Mention prof, tutors as external entities (assignment, questions/answers, report)
Mention library material as data store(s)

Level 0 diagram
Processes
Get assignment from prof
Assign tasks to team members
[Meet and discuss]
[Ask questions, get answers]
Collect and integrate material
Generate report

3. [Entity-Relationship Diagrams, Normal Forms; 30 marks]

Consider a supplier data store which stores information about suppliers for a car manufacturer. The data store is supposed to contain the following types of information:

Suppliers:

- Every supplier has a unique supplier# (assigned by the car manufacturer for identification purposes);
- Every supplier supplies 1 or more parts;
- Every supplier has a unique name, city and postal code attribute;

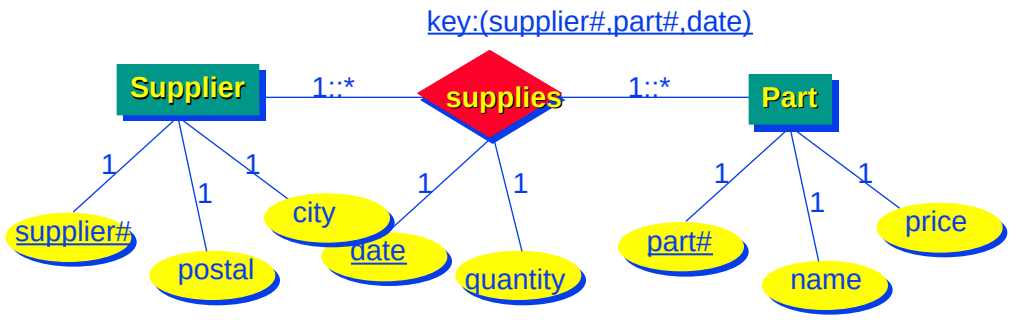
Parts:

- Every part has a unique name, part# and price;
- Every part is supplied by one or more suppliers;
- Part# identifies uniquely a part.

Supplies:

- Every supply involves a supplier supplying a part;
- Every supply has a unique quantity and a date;
- Every supply is identified uniquely by its supplier, part and date.

(a) [10 marks] Draw an entity-relationship diagram for this data store, showing clearly entities, relationships, attributes, cardinalities and keys.



3. [Entity-Relationship Diagrams; continued]

(b) [20 marks] Suppose someone has included in her answer to question **3(a)** two entities (`Supplier`, `Part`) and a single relationship (`Supplies`):

```
Supplier(supplier#,name)
Part(part#,name)
Supplies(supplier#,part#,date,quantity,partName,
supplierCity,supplierPostal)
```

Keys are underlined. All attributes are assumed to be single-valued. These definitions are in 1NF. Assume the following functional dependencies among attributes:

`supplier#,part#,date` → `quantity`
(`quantity` functionally depends on `supplier#, part#, date`)
`part#` → `partName`
`supplier#` → `supplierCity,supplierPostal`
(each of `supplierCity,supplierPostal` functionally depend on `supplier#`)
`supplierPostal` → `supplierCity`

Your task is to place the above entities and relationship in 3NF. You may want to proceed by first placing the three definitions in 2NF, then 3NF.

2NF

Supplier(supplier#,name,supplierCity,supplierPostal)
Part(part#,name)
Supplies(supplier#,part#,date,quantity)

3NF

Supplier(supplier#,name,city,postal)
Part(part#,name)
Supplies(supplier#,part#,date,quantity)
Postal(postalCode, city)