Please take few moments to write down your name. Then pass the paper to the person to your right (and left) to write his/her name before you start answering

Name: _____ ID: _____

Major: _____

Person to your right: _____ Signature: _____

Person to your left: _____ Signature: _____

(Q1) For the following class diagram that represents an employee in an organization.

Employee
emp#: Number manager: Employee manager#: Number assign: Project
…….

a) Propose two improvements to the diagram. You need not draw another diagram (2 Points)

(a) Remove the manager# attribute, it is redundant. (1 mark) "Mandatory"
(b) Make "assign" an association, so that an employee can have several assignments. (1 mark)

Specify in OCL the following constraint:

- **Right Constraint (1 mark)**
- **Right Syntax (1 mark)**

1. "The manager# of an employee is the same with the emp# of his/her manager" (2 Points)

Employee
manager# = manager.emp#

or

Context Employee inv:

manager# = manager.emp#

2. No employee can earn more than 20,000 LE (2 Points)

Employee
salary <= 20,000

or

Context Employee inv:
salary <= 20,000

3. An employee can only be assigned to projects run by her company (2 Points)

Context Employee::assignProject(p) pre:
companyName = p.companyName

4. No employee can earn more than his president (2 Points)

Employee
salary < manager.salary

or

Context Employee inv:
salary < manager.salary

(Q2) Specify which of the following inheritance relationship is specification inheritance and which is implementation inheritance (5 Points – 1 point each)

a. A rectangle class inherits from a polygon class — **Specification (1 mark)**

b. A set class inherits from a binary tree class — **Implementation (1 mark)**

c. A set class inherits from a bag class (a bag class is defined as an unordered collection) — **Specification (1 mark)**

d. A player class inherits from a user class — **Specification (1 mark)**

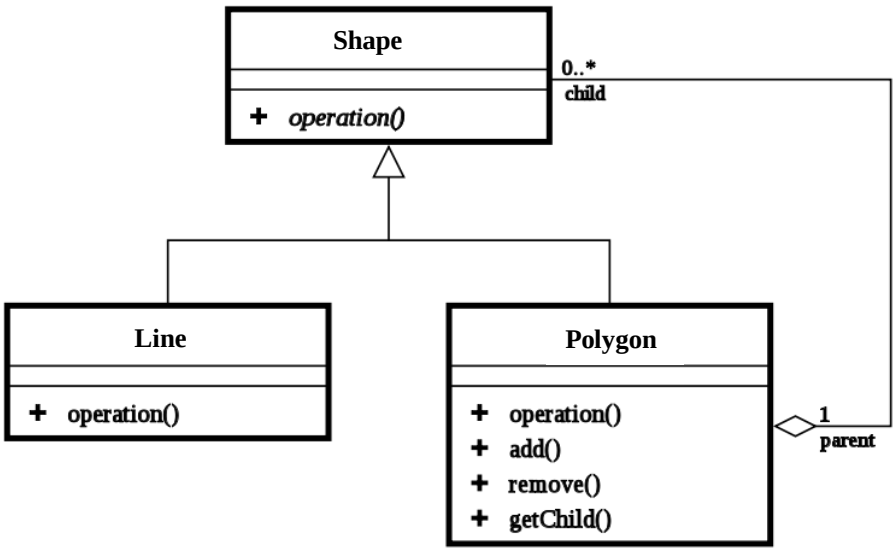
e. A window class inherits from a polygon class — **Implementation (1 mark)**

(Q3) Design a simple GraphicsEditor that can draw two types of shapes: lines and polygons; an example of a polygon is a rectangle which is made of four line objects. The GraphicsEditor can manipulate the shapes by adding, deleting and/or editing them,

i. Which design pattern would you use to design the GraphicsEditor? **(2 Points)**

Composite Design Pattern (2 marks)

i. Draw a UML class diagram for your design. **(5 Points)**



Instead of operation, you should write at least one related operation to shapes such as -> draw() , edit(), …etc.

- **Relation between classes and choose the Classes correctly (3 marks)**
- **Multiplicity and Methods (2 marks)**

The Best Of Luck,,,
\Amr Kamel