Family Name: FALCAO (That the university has for you in its records)

First Name(s): _____

Student Number: _____ Section: _____ **(A, B OR C)**

Université d'Ottawa
Faculté de génie

School of Information Technology and Engineering

uOttawa
L'Université canadienne
Canada's university

University of Ottawa
Faculty of Engineering

École d'ingénierie et de technologie de l'information

SEG 2105
Introduction to Software Engineering

MIDTERM – SOLUTIONS

Time Allowed for Examination: 90 Minutes

Professors: Miguel Alejandro Garzón and Ayman El-Sawah

Instructions:

1. **Exam is closed book.**
2. If you don't understand a question, **state an assumption**;
3. Beware, poor hand writing can affect grades;
4. Do not remove the staple holding the examination pages together.
5. You can remove the last page of this examination.
6. Write your answers in the space provided. Use the back of the pages if necessary. You may not hand in additional pages;

Good luck!

Part 1 (/40)	Part 2 (/40)	Total (/80)
40	40	80

PART 1 – Multiple Choice Questions (40 marks)

Questions 1-20 are multiple choice and are worth 2 marks each (total of 40 marks).
Circle the single best answer.

1. Which of the following statements is **wrong**?

D

a) If you have a variable of type X then you can always create an object of class X and put it in the variable.
b) A variable can have as its type an abstract class.
c) A variable can have as its type a class or an interface
d) If class A is the superclass of concrete class B, then I can put an object of class B in a variable of type A.
e) An abstract class can have concrete methods.

2. Which of the following superclass - subclass pairs would be a poor generalization, for any of the reasons we discussed in class?

E

a) Person - Employee
b) Country - ProvinceOrState
c) Student - GraduateStudent
d) a and b
e) b and c
f) a and c

3. In a framework, a slot:

A

a) Requires you to implement something when creating an application based on the framework
b) Can be 'fat' or 'thin'
c) Is code you reuse
d) Is code you create for others to reuse
e) Is a method or procedure that is called but does nothing, allowing you to override it to do something when creating an application based on the framework

B

4. Which of the following is a 'quality' requirement:

a) The system must display rectangles and circles in either red or green
b) The system must update the display within 0.1s of any change being made
c) The system must run on Windows XP or later
d) The system must be written in C++

5. Which of the following is not a special kind of association that may appear in a class diagram?

D

a) Aggregation
b) Composition
c) Unidirectional
d) Generalization
e) Reflexive

6. Imagine you are going to be opening a toy store. You want to create a catalog of the different types of toys, including a hierarchy of many different toy categories. How would you implement this hierarchy?

C

a) As an IsA hierarchy of classes (i.e. an inheritance hierarchy) where each category is a class.
b) As an aggregation hierarchy of classes.
c) As a hierarchy of instances, where there is a single Category class.
d) As a Vector of instances.
e) As a Vector of classes.

7. Imagine I have a server based on OCSF that is communicating with two clients. During this time, the server will have how many threads running?

C

a) At least one
b) At least two
c) At least three
d) At least four
e) At least five

8. An educational technology such as *Brightspace* where students can see the contents available for a course, submit assignments and see their grades is considered a _____ client application.

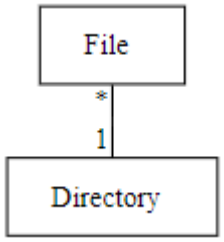
A

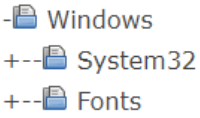
a) Thin
b) Fat
c) Horizontal
d) Peer-to-Peer
e) Multi-threaded

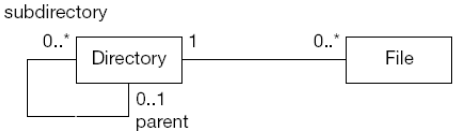
9. What should be added to the diagram below to represent the fact that **parent** directories could have subdirectories? For instance, *Windows* is the parent directory of *System32* and *Fonts*, which may contain other files or (sub) directories.

C

a) An association class.
b) A symmetric reflexive association (in class Directory)
c) An asymmetric reflexive association (in class Directory)
d) An attribute 'subdirectory' in class Directory.
e) Multiple subclasses for class Directory





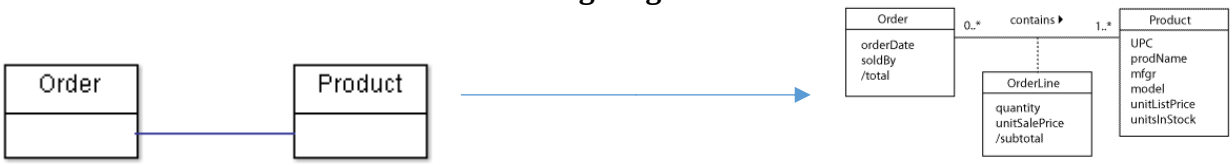


10. Which of the following statements is **false** in the context of object (instance) diagrams?

A

a) Generalizations describe a relationship between instances at run-time
b) An object diagram can only contain links generated by associations
c) The number of links among instances are consistent with the multiplicity of the class diagram
d) A class diagram can generate an infinite number of object diagrams
e) An object diagram shows a configuration of objects and links that exist at run-time

Questions 11 and 12 are based on the following diagram.



11. In the above diagram, what should the **multiplicities** between the classes Order and Product be?

D

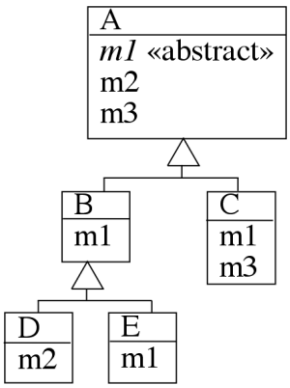
a) 0..1 to 0..1
b) 0..* to 1
c) 0..* to 0..1
d) 0..* to 1..*
e) 1..* to 0..*

12. If I wanted to add the ability to know how many units of that product are being ordered and what price we are actually selling the product, each time an order is placed for a product, what would be the best way to do it?

D

a) Add attributes quantity and unitPrice to the Product Class.
b) Add attributes quantity and unitPrice to the Order Class.
c) Create a class OrderLine with attributes quantity and unitPrice and associate it with class Product in a many-to-one association.
d) Create an association class OrderLine with attributes quantity and unitPrice
e) Create a class OrderLine with attributes quantity and unitPrice and associate it with class Order in a many-to-many association.

Refer to the following diagram for questions 13 and 14



13. In the above diagram, which method would run if you had a variable of type A containing an object of class E (i.e. A a = new E()), and the operation m1 was called on this variable?

D

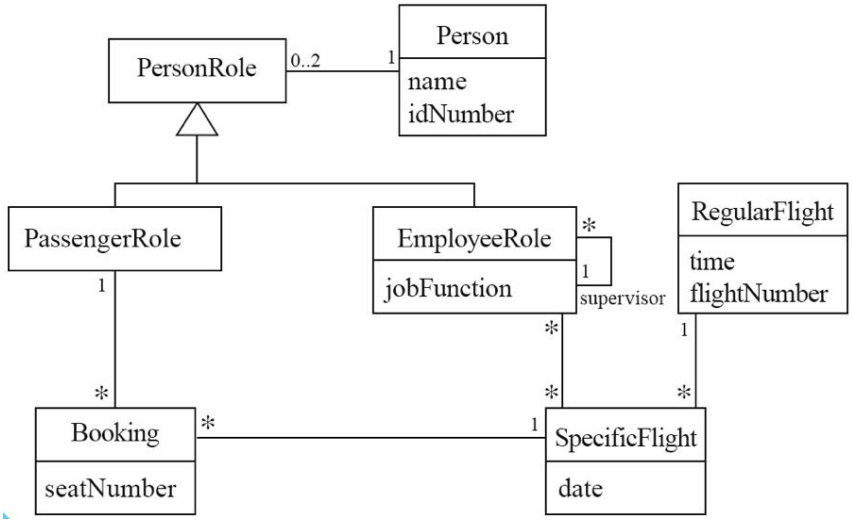
a) The m1 in class A
b) The m1 in class B
c) The m1 in class C
d) The m1 in class E
e) There would be an error as the m1 in class A is abstract

14. In the above diagram, if you had a variable of type B, which operations on this variable would always require *dynamic binding*?

D

a) m1
b) m2
c) m3
d) m1 and m2
e) m1 and m3
f) m2 and m3

Questions 15-16 relate to this diagram



E

15. Which if the following is **false**?

a) PassengerRole inherits the association to Person
b) Booking inherits the association to Person
c) We can always determine the unique name of any EmployeeRole
d) People who are employees cannot be given passenger seats on the plane
e) More than one of the above

16. One of the 1 multiplicities in this diagram is incorrect. Which is it?

D

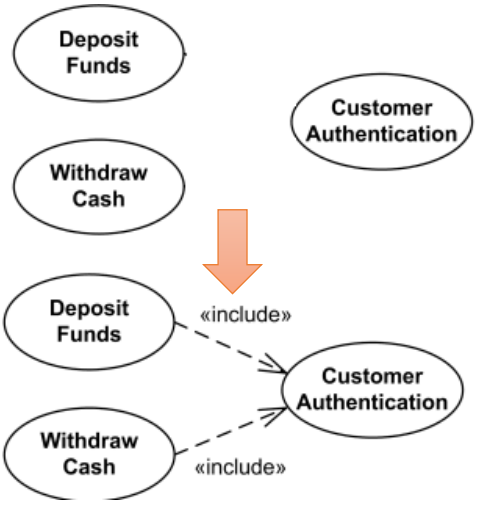
a) The 1 next to SpecificFlight (from Booking)
b) The 1 next to PassengerRole (from Booking)
c) The 1 next to RegularFlight (from SpecificFlight)
d) The 1 next to EmployeeRole (from EmployeeRole)
e) The 1 next to Person (from PersonRole)

Note. The lower bound of a reflexive association should always be zero.

17. What should be the relationship between the *Deposit Funds* and *Withdraw Cash* use cases with the *Customer Authentication* use case?

A

a) **Include** relationship between use cases with the arrow pointing to the *Customer Authentication* use case
b) A **generalization** relationship where the abstract use case (super use case) is the *Customer Authentication* use case
c) **Include** relationship with arrows pointing to the *Deposit Funds and Withdraw* use cases
d) **Extend** relationship with arrows pointing to the *Deposit Funds and Withdraw* use cases
e) None of the above



18. Which of the following is a Non-Functional Process requirement?

E

a) The system shall prevent detected denial-of-service attacks for up to 1000 simultaneous attackers.
b) The system shall ensure that users will be able to perform tasks X, Y, and Z after one month of non-usage, with a minimum success rate of 80%.
c) The system shall comply with Part III of the Freedom of Information and Protection of Privacy Act.
d) The system shall meet or exceed 99.999 % uptime
e) None of the above

19. Which of the following should be an ordinary association (and not an aggregation or composition)?

B

a) A telephone and its handsets
b) A school and its teachers
c) A book and its chapters
d) A vehicle and its vehicle parts
e) A building and its rooms

20. Which of the following associations can generate the code in the figures below?

C

a) A **0..1 -- *** B
b) A **0..1 -- 1..*** B
c) A **1 -- *** B
d) A **1 -- 1** B
e) None of the above

```
public class A
{
  private List<B> bs;
  public A(){}
  //More Code omitted
}
```

```
public class B
{
  private A a;

  public B(A aA)
  {
    boolean didAddA = setA(aA);
    if (!didAddA)
    {
     throw new Exception("ERROR");
    }
  }
  //More Code omitted
}
```

PART 2 (40 marks)

1. **Create a UML class diagram for the system described below**. Show all attributes, and associations. Make sure you include correct multiplicity. If generalizations are necessary, show them too. **(32 points). Use the paper provided for rough work. Draw your final answer on page 8.**
2. Determine the **methods** needed to implement **3 different operations** and specify in which classes they belong. Use the following Table to answer. That is, you do **not** need to add them in the UML class diagram. **(3 points)**

   For this question, check that methods described make sense.
   1 for each correct operation
   -0.5 for major mistakes in the method description or classes not listed.

3. Write 2 (**two**) functional requirements and 3 (**three**) non-functional requirement for the system below. Make any necessary assumptions. **(5 points)**

Functional Requirements:

- **The system must record the guards at a specific post.**

Requirement must always start with the subject + verb + predicate
1 point if the requirement is not FUNCTIONAL
- 0.5 if it is not realistic (or statement does not make any sense or not appropriate for the context)

Non-Functional Requirements

Examples:
The system must be implemented using an Agile methodology
The system must be implemented before December 2018.

Requirement must always start with the subject + verb + predicate
A non functional requirement:

- **Must be realistic, and have measurable criteria**
- **-1 if the requirement is not NON-functional**
- **- 0.5 if it is not realistic (or not measurable)**

System description: Software for a company called Supersecure

Supersecure runs the physical security of businesses using security guards. Each business client signs a contract with Supersecure to secure certain rooms in certain buildings. Each contract has a start date and an end date.

There will be different security plans for working hours and non-working hours. The client might require no guards or fewer guards during non-working hours. The schedule for which hours are working hours is determined by the client.

In a security plan, one or more guards is assigned to patrol each zone. A zone is a group of rooms. There are also certain spots called 'posts' where there must be at least one guard; i.e. posts cannot be left unguarded. A post is always in a particular room, which is identified by a room number. Some zones have to have more than one guard, and certain zones require high levels of security clearance for the guards that work there. The number of guards needs to be captured by the system.

Supersecure hires guards and assigns them to shifts to meet the contractual requirements of clients. A guard can be assigned to different shifts. A guard can work on a part-time or full-time basis. A shift can be assigned to several guards. Supersecure needs to record the posting of a single guard to a single shift.

Each guard has to log incidents that happen during their shift. A log entry includes the room, the time, a description, and the guards involved.
-2 for each incorrect class (if class is missing then do not subtract points for the associations).

-2 for each incorrect association (-1 for each association end)

-0.5 for each missing attribute (-0.5 if student specifies the attribute as a class)

-2 if association class is missing. We need an association class for this: "A guard can be assigned to different shifts. A shift can be assigned to several guards. Supersecure needs to record the posting of a single guard to a single shift"

-2 for any incorrect generalization

BONUS (+3 POINTS)

Specify the following **constraint** with OCL: A shift has a start and end time and cannot exceed 14 hours.

OCL Constraint:

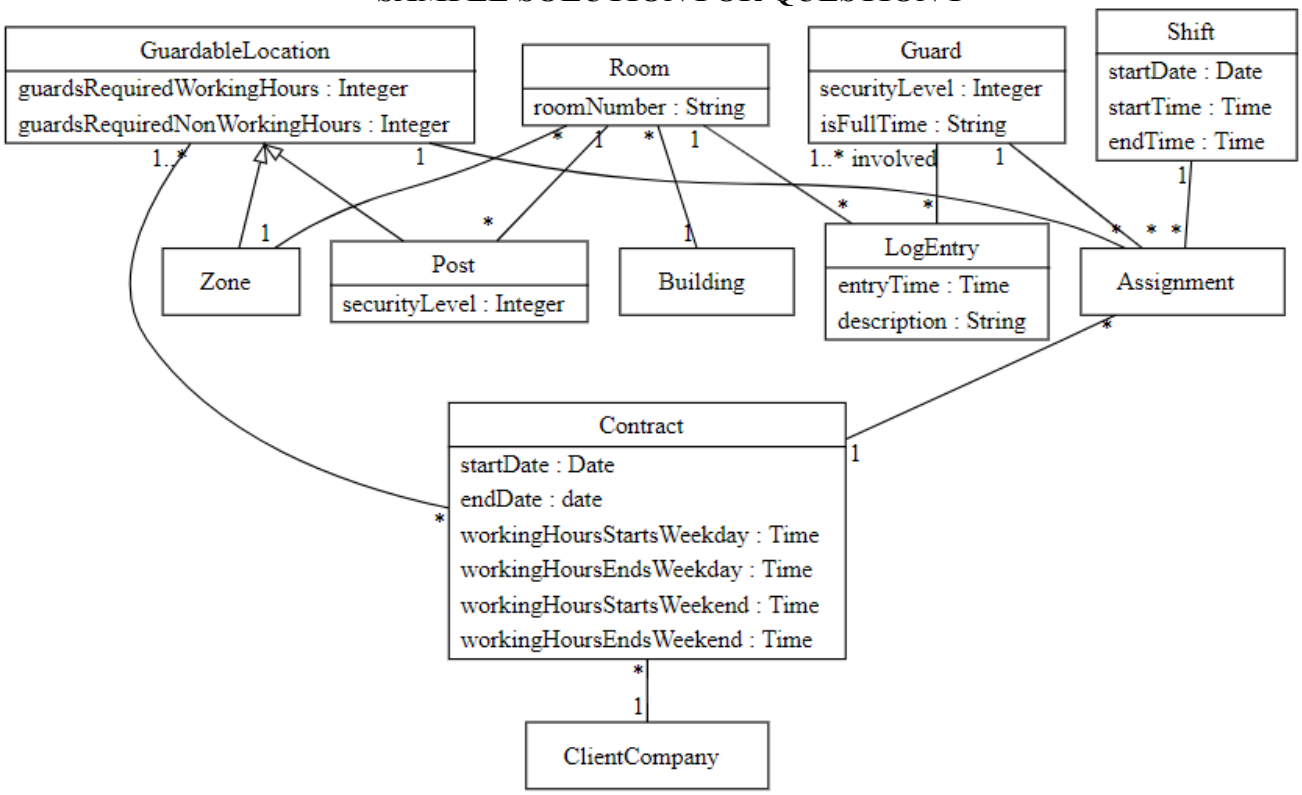
Context Shift inv:

(Self.endtime.hour – self.startime.hour) <= 14;

Assuming you have declared endtime as Time type.

Do not very too rigid about the syntax.
1 point for the context
2 points for the condition

SAMPLE SOLUTION FOR QUESTION 1



Classes required (mandatory) : Contract, Room, Post, Zone, Building, Guard, Shift (check for other possible names) and an association class between Shift and Contract or between Contract and Guard.

The generalization between GuardableLocation and the subclasses is NOT mandatory (but recommended). Do not subtract point if absent.

- **-2 if students create a generalization for Working And Non Working Hours**
- **-2 if students create a generalization for PartTime and FullTime guards.**

All attributes shown in the UML class diagram above are mandatory. Check for other possible names.

Check that all association's multiplicities make sense in the context of the SecureSystem.