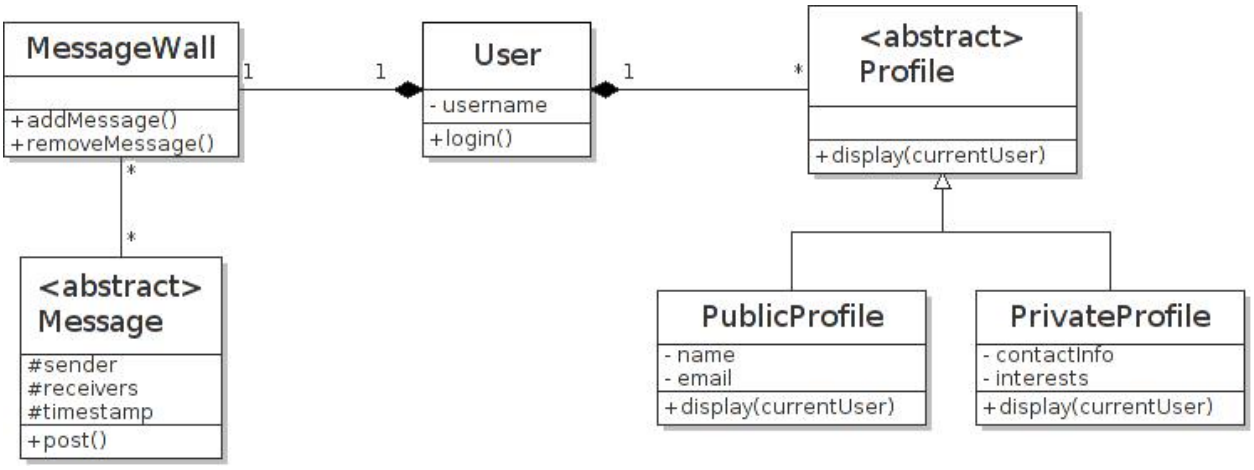
Object-oriented Analysis and Design

Sessional 1, Spring 2014

Date: February 27, 2014 **Marks: 60** **Time: 90 mins.**

Note: Please read the case and answer the questions



Consider the UML class diagram above illustrating a partial design of a social networking website such as Facebook. Each user has a public profile (visible to everybody) and a private profile (visible to user and her friends only). Moreover, each user has a message wall to which messages can be added.

Question 1 **20 points**

We need to support addition and removal of friends. A user's friend is another user. User can add a friend and remove a friend. When a user adds a friend, then both records are updated. For instance: a user Ali adds a friend Ahmed, then Ali has a friend Ahmed and Ahmed has a friend Ali. The same applies to removal functionality.

(a) Show the changes required in UML diagram to support the functionality

(b) Write C++ code to implement functionality

Question 2 **20 points**

Write a polymorphic program to display user profiles and show corresponding C++ implementations of Profile class and its subtypes. Please note that private profile is visible to friends only. Parameter currentUser refers to the user who is currently logged in and trying to view the profile of another user.

Question 3 **20 points**

Two types of messages can be posted on user's message wall: Text message having a simple description and Event info having event time, venue and details.

(a) Show changes to UML diagram required to support these message types

(b) Show C++ implementation of addMessage() method in MessageWall to support multiple message types

Object-oriented Analysis and Design

Sessional 1, Fall 2015

Date: September 16, 2015 **Marks: 60** **Time: 90 mins.**

Section _____ Roll No. _____ Name_____

Note for Invigilators: Students are allowed to use a single-sided, hand-written, A-4 size help sheet.
Note for Students: Solve the exam on this question paper. Do not submit answer sheets.

Question 1 (Max. Marks = 20 = 10 + 10)

a. Use a UML 2 analysis class diagram to depict the relationship between the following concepts: association, binary association (between two entities), ternary association (among three entities), n-ary association (among n entities), inheritance, single inheritance, multiple inheritance, aggregation, and composition. Treat each concept as a class. Show only the class name compartment.

b. Use a UML 2 analysis class diagram to depict the relationship between the following concepts: feature, attribute, and operation. Both attributes and operations / functions are basically features. Treat each concept as a class. Show the first two compartments (i.e. class name and attribute) for each class. You have to specify appropriate attributes for each class.

Question 2 (Max. Marks = 20)

Consider a final year project (FYP) management system. A FYP is undertaken by a team, advised by a faculty member, and evaluated by a committee. A team must undertake exactly one FYP. Every team works, presents, and procrastinates. A faculty member has a name and rank and can advise up to 5 FYPs. All faculty members teach, grade, and do research. Every FYP has a title, domain, and start date. All committees attend presentations and assign grades. A committee evaluates many FYPs and is composed of exactly three faculty members. A faculty member must be a part of at least four committees. FYPs are of only two types i.e. development and research. For every development FYP, technology must be specified while, for every research FYP, research paper title must be provided. Each team has a unique registration number. A team consists of at most three and at least two students with one being the team leader. A student cannot belong to more than one team. Every student has a name and roll number and is enrolled in a program. Every program has a name and duration and it enrolls at least 50 and at most 100 students.

Without making any assumptions, use the space provided below to model just the information provided above about a FYP management system using a UML 2 analysis class diagram.

Object-oriented Analysis and Design

Sessional 1, Fall 2015

Date: September 16, 2015 **Marks: 60** **Time: 90 mins.**

Section _____ Roll No. _____ Name_____

Question 3 (Max. Marks = 20)

Consider a simple spreadsheet application that has following abstractions:

- **Cell:** Cell represents a location in spreadsheet. It has a 1 – 1 association with Value. It contains a function *evaluate* that results the final computed value of Cell as an integer.
- **Value:** Value represents a value assigned to a cell. It is an interface and has an abstract (pure virtual) function *result* that returns an integer. Value may be of several types as Literal, Function etc.
- **Literal:** Literal is a Value containing a simple integer
- **Function:** Function is a Value that represents the result of carrying out some operation on a list of integer type parameters. Function itself is an abstract class having no implementation for the abstract *result* function it inherits from Value.
- **Sum:** Sum is a Function that represents a summation operation. It is a concrete class.

You are given the following main function as an illustration

```
Cell* cell = new Cell();

Literal* literal = new Literal(10);
cell->setValue(literal);
cout << cell->evaluate() << endl;      // prints 10

Function* function = new Sum();
function->addParameter(10);
function->addParameter(20);
cell->setValue(function);
cout << cell->evaluate() << endl;      // prints 30
```

Provide C++ code for the abstractions given above that can help us write the above main function and get the desired results.

National University of Computer and Emerging Sciences, Lahore Campus

	Course Name:	**Software Design & Analysis**	**Course Code:**	
	Degree Program:	**BS (CS)**	**Semester:**	**Fall 2020**
	Exam Duration:	**90 min**	**Total Marks:**	**40**
	Paper Date:	**19-Oct-2020**	**Weight**	
	Section:	**ALL**	**Page(s):**	**2**
	Exam Type:	**Mid-1**		

All the questions carry equal marks. Solve the objective question on this sheet.

Q1) Answer the following MCQ's:

1) Composition is

a. a special type of association
b. a special type of aggregation
c. a special type of inheritance
d. a special type of generalization
e. is very different from aggregation, inheritance, or generalization

2) Which of the following statement is incorrect?

a. Circle inherits Shape
b. Circle inherits Sphere
c. Lion inherits Mammal
d. Snake inherits Reptile
e. Bus inherits Vehicle

3) In the diamond problem

i. a child class may inherit multiple copies of a data member
ii. a class has a function named "diamond"
iii. child class uses aggregation
iv. parent class uses composition

6) What will be the multiplicity/cardinality between classes Author and Book:

a) One to one
b) One to many
c) Many to many
d) Many to one
e) Two to five

7) Which type of inheritance is not supported by java?
(a) single (b) multiple
(c) multi-level (d) hierarchical (e) public

8) A class in Java can inherit from

i) a single class

ii) multiple classes

iii) a single interface

iv) multiple inhterfaces

(a) i and ii only (b) all of above (c) ii and iii only

(d) ii and iv only (e) iv only

(a) i (b) ii (c) iii (d) iv (e) iii and iv only

4) Pick the odd one out:

a) Inheritance

b) Polymorphism

c) Association

d) Aggregation

e) Composition

5) Which of the following are part-whole relationships:

i. Simple association

ii. Aggregation

iii. Composition

iv. Inheritance

v. Polymorphism

(a) iv and v (b) iv (c) i (d) iii e) ii and iii

9) The vertical dimension of a UML sequence diagram shows

a) abstract b) line c) Time
d) messages e) space

10) A good abstraction hides _____ , and provides easy-to-use _____.

a) implementation details; interface
b) interface; implementation details
c) data members; functions
d) gold; tools
e) inherited data members; classes

Q2) Video-Rental Ltd. (VRL) is a small video rental store. The store lends videos to customers for a fee, and purchases videos from a local supplier. They need a computerized system that helps them run their daily business. Description of their daily business is as follows:

Only a registered customer can borrow videos from the store. New customers register by filling out a form with their personal details and credit card details. The credit card details are used to pay subscription fee, video borrowing fees, and overdue fines. On successful payment of subscription fee, the customer is issued a membership card by VRL. The membership card has a unique membership id which is later used when borrowing videos. Each new customer's form is also added to the customer file. A customer can request a video by providing video title, his/her membership id, and payment – payment is always with the credit card used to open the customer account. If the payment is successful the customer is handed over the video by VRL. The customer then returns the video to the store after watching it. If a loaned video is overdue by a day the customer's credit card is charged, and a reminder letter is sent to the customer. Each day after that a further transaction on card is made, and each week a reminder letter is sent. This continues until either the customer returns the video, or the charges are equal to the cost of replacing the video. The local video supplier sends a list of available titles to VRL, who decides whether to send the supplier an order and payment. If an order is sent then the supplier sends the requested videos to the store. For each new video a new stock form is completed and placed in the stock file.

Draw the use-case diagram for the above scenario.(Note: Use "include" and "extend" where required.)

Question 3 and 4

You are asked to develop a software system to solve the following problem:

There is a gap between skills required by the industry and skills being taught in the universities. A system needs to be developed that would help narrow this gap. The system should be able to collect required skills from industry and map them to university curriculum for pointing out gaps. You can assume that the required data about skills is available from industry and data about curriculum is available from academia that can be fed into the system. The challenge is to map the industry’s skills requirements to the academia’s curriculum. There is no one to one mapping available. However there are certain high level areas in which the skills can be categorized (e.g. Web Development, Mobile App Development, Automated Testing, Business Analysis, Software Design, Machine Learning etc.). One skill can be categorized into more than one skill-area. These skill-areas are then mapped to the curriculum taught by academia. Curriculum has courses that in turn have Objectives. One objective can fall into multiple courses.

In order for the skill to have a matching objective, it’s area must match a particular course within the curriculum and then the skill must match a particular objective within that course.

There is a service available that can tell if an area is related to a particular course. There is another service that can tell if a skill is related to a particular objective within a course.

Q3) Prepare a class diagram for the above scenario after identifying appropriate abstractions that will participate to provide required business logic. Identify at least 5 abstractions along with their relationships (e.g. association/aggregation/composition and generalization). Use association names and association end names where needed. Also show multiplicity.[Note: there is no need to write attributes and functions.]
Hint: read Q4

Q4) Prepare a sequence diagram for the following use case showing interactions between abstractions identified in the class diagram.

UseCase: Is skill covered by the curriculum?

0. Given a skill find out if it is being covered in the curriculum. Remember how the skills are categorized into skill-areas which are then mapped to courses and finally skills are matched to objectives within courses. Make use of two services mentioned in the description of the problem.

19

National University of Computer and Emerging Sciences, Lahore Campus

	Course Name:	Software Design and Analysis	Course Code:	CS3004
	Degree Program:	BS(Computer Science)	Semester:	Fall 2021
	Exam Duration:	60 Minutes	Total Marks:	30
	Paper Date:	20-Oct-2021	Weight	10%
	Section:	ALL	Page(s):	4
	Exam Type:	Midterm-I		

Student : Name: MNawad Ali Roll No. 19L-1048 Section: CS-E

Instruction/Notes: Attempt all questions. Programmable calculators are not allowed.

10

Q1. [10 marks]

1. _____ focuses on hiding the internal implementations of a process or method from the user. In this way, the user knows what he is doing but not how the work is being done.
   - i. Inheritance
   - ii. Abstraction
   - iii. Persistence
   - iv. Polymorphism
   - v. Multiple inheritance

2. Photocopy is inheriting both printer and scanner, is an example of
   - i. Multiple Inheritance
   - ii. Multi-level Inheritance
   - iii. Polymorphism
   - iv. Hybird inheritance
   - v. Composition

3. _____is the ability of any data to be processed in more than one form
   - i. Abstraction
   - ii. Static binding
   - iii. Multi-level inheritance
   - iv. Polymorphism
   - v. Association

4. In library management system, relationship between Book and BookCatalogue should be
   - i. Association
   - ii. Aggregation
   - iii. Composition
   - iv. Inheritance
   - vi. Polymorphism

5. A _____ is a behavior diagram and visualizes the observable interactions between actors and the system under development.

i. use case diagram
ii. Analysis Class Diagram
iii. System Diagram
iv. Architecture diagram
v. State diagram

6. It is compulsory to verify the identity before withdrawing amount from the bank."Withdraw Money" should _____ "verify identity" usecase.

i. Extends
ii. Inherit
iii. Provide abstraction to
iv. Include
v. Implements

7. A file is placed inside the folder. If one deletes the folder, then the file associated with that given folder is also deleted. In uml the given relationship is

i. Reflexive association
ii. Many-Many Association
iii. Self-Association
iv. Aggregation
v. Composition

8. A car needs a wheel, but it doesn't always require the same wheel. A car can function adequately with another wheel as well. In uml the given relationship is

i. Reflexive association
ii. Many-Many Association
iii. Self-Association
iv. Aggregation
v. Composition

9. The relationship between doctor and patient is

i. Reflexive association
ii. Many-Many Association
iii. Self-Association
iv. Aggregation
v. Composition

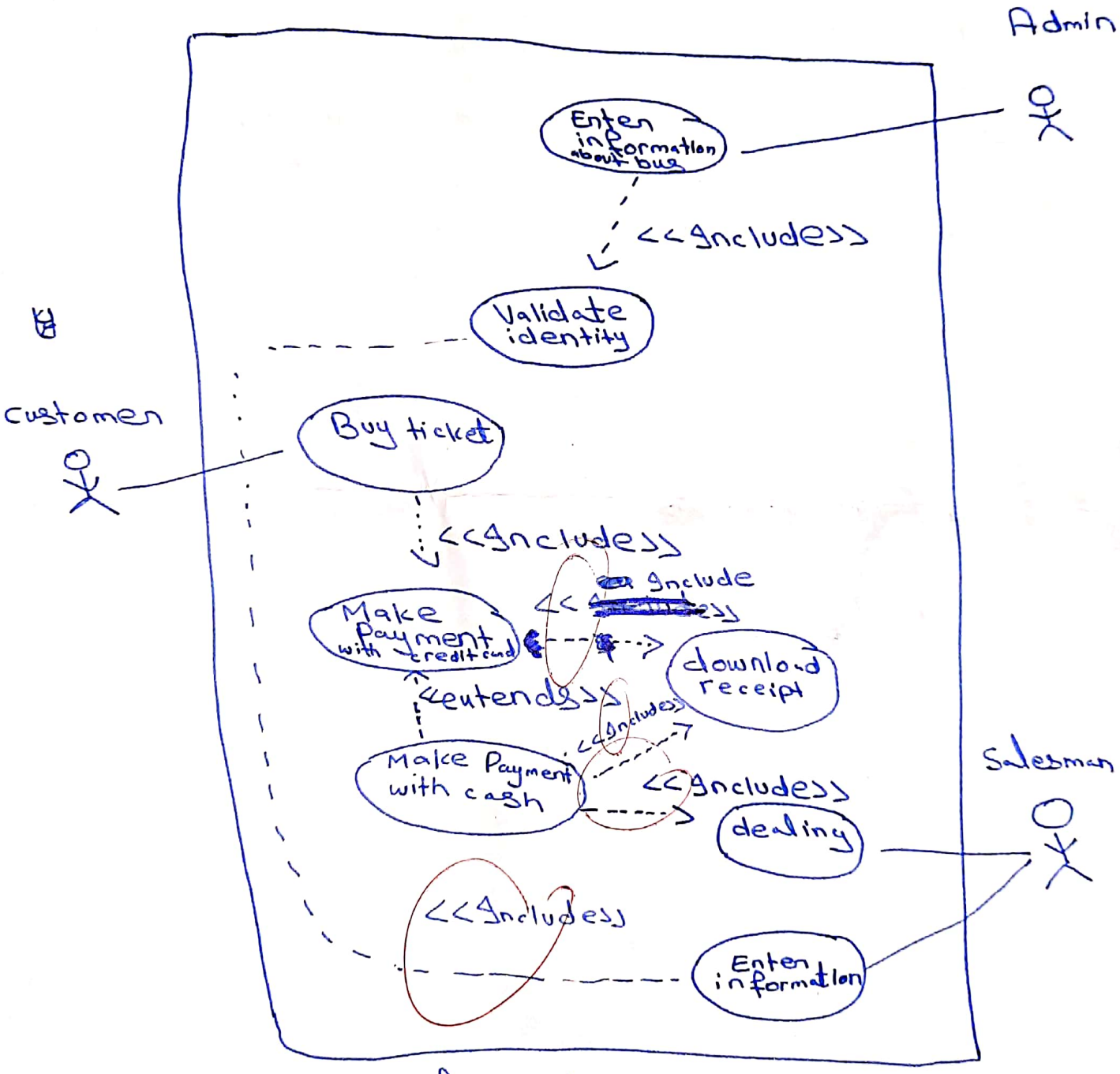
10. If there is an abstract method in a class then, _____

i) Class must be abstract class
ii) Class may or may not be abstract class
iii) Class is generic
iv) Class must be public
v) It should be interface

(10 marks]

Develop a use case diagram for an online ticket reservation system for an inter-city bus service. An admin enters information about buses, departure and arrival destinations and timings. A customer can buy tickets, make payments and download receipts. If a customer does not have any credit card, he can visit a company office to buy tickets by making cash payments. The company salesmen deal with the customers and enter information into the system.

6



- Admin enters information which requires him to confirm his identity

- Customer can make Payment by card and then he's given a receipt or he makes payment in an office
- Salesman deals and enters information

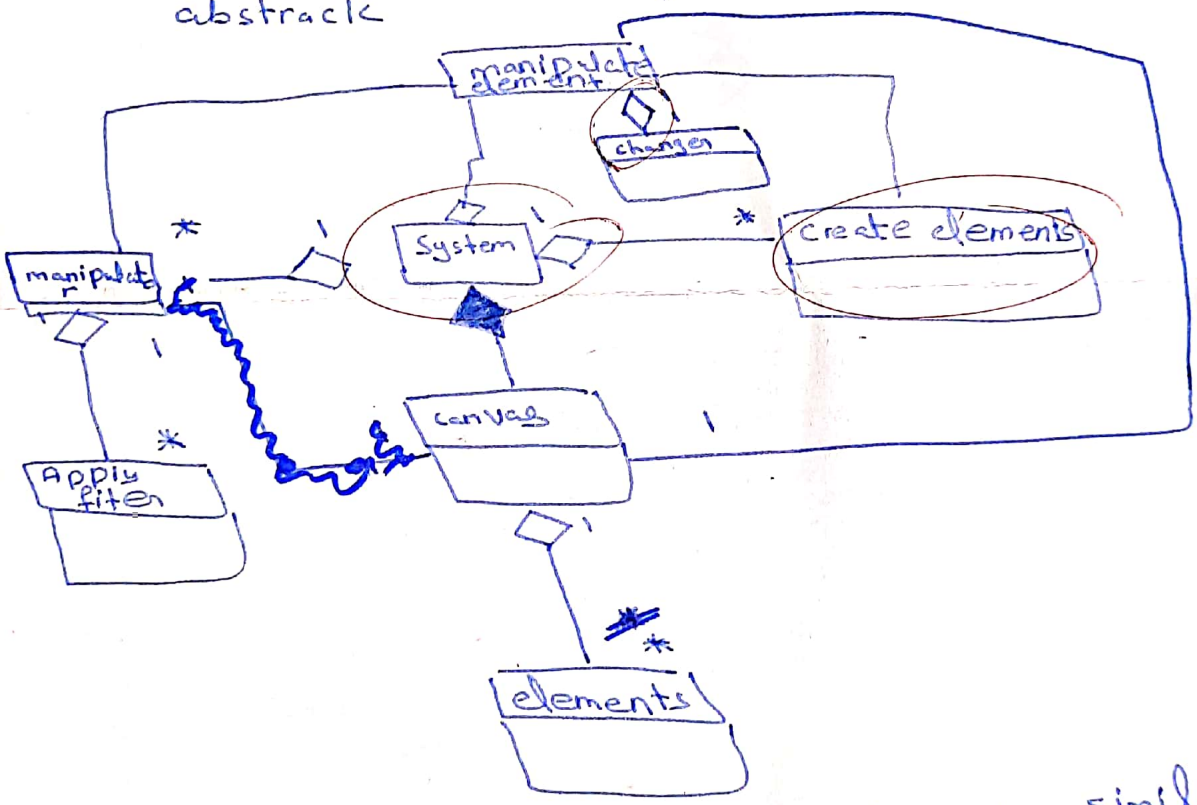
Q3. [10 marks] You are designing a graphics processing package that includes the following functionality.

The system can create and or manipulate different types of elements such as text, geometric shapes, images, etc. It allows the user to apply different filters (e.g. contrast, brightness, etc.) to the images. It also allows the user to change the shape, size, and color of the elements. More than one element can be grouped together to form a composite element. The manipulator controls various elements and manipulates them. It also applies filters to images. There is a canvas that contains all the elements inside it.

Prepare a UML class diagram to capture the design after identifying appropriate abstractions that are required to implement the system. Represent correct relationships between abstractions and also provide numerosity where applicable. Note: there is no need to write attributes and functions within classes.

Create element may have its own functionality of manipulation and manipulator may have its own so we make manipulate elements abstract

3



- System can create many elements, similarly manipulate many elements
- Manipulat elements is associated with canvas
- Manipulator and creator have their own definition of different functions

- Canvas has all elements new, previous so it must be composite

National University of Computer and Emerging Sciences, Lahore Campus

Course:	Software Design & Architecture	Course Code:	SE2002
Program:	BS (SE)	Semester:	Spring 2022
Duration:	60 Minutes (1 Hour)	Total Marks:	30 (21)
Paper Date:	21-Mar-22	Weight	15%
Section:	All	Page(s):	3
Exam:	Sessional I		

Instruction/Notes:

Attempt all questions on the question paper. Neither use nor submit any extra sheet.

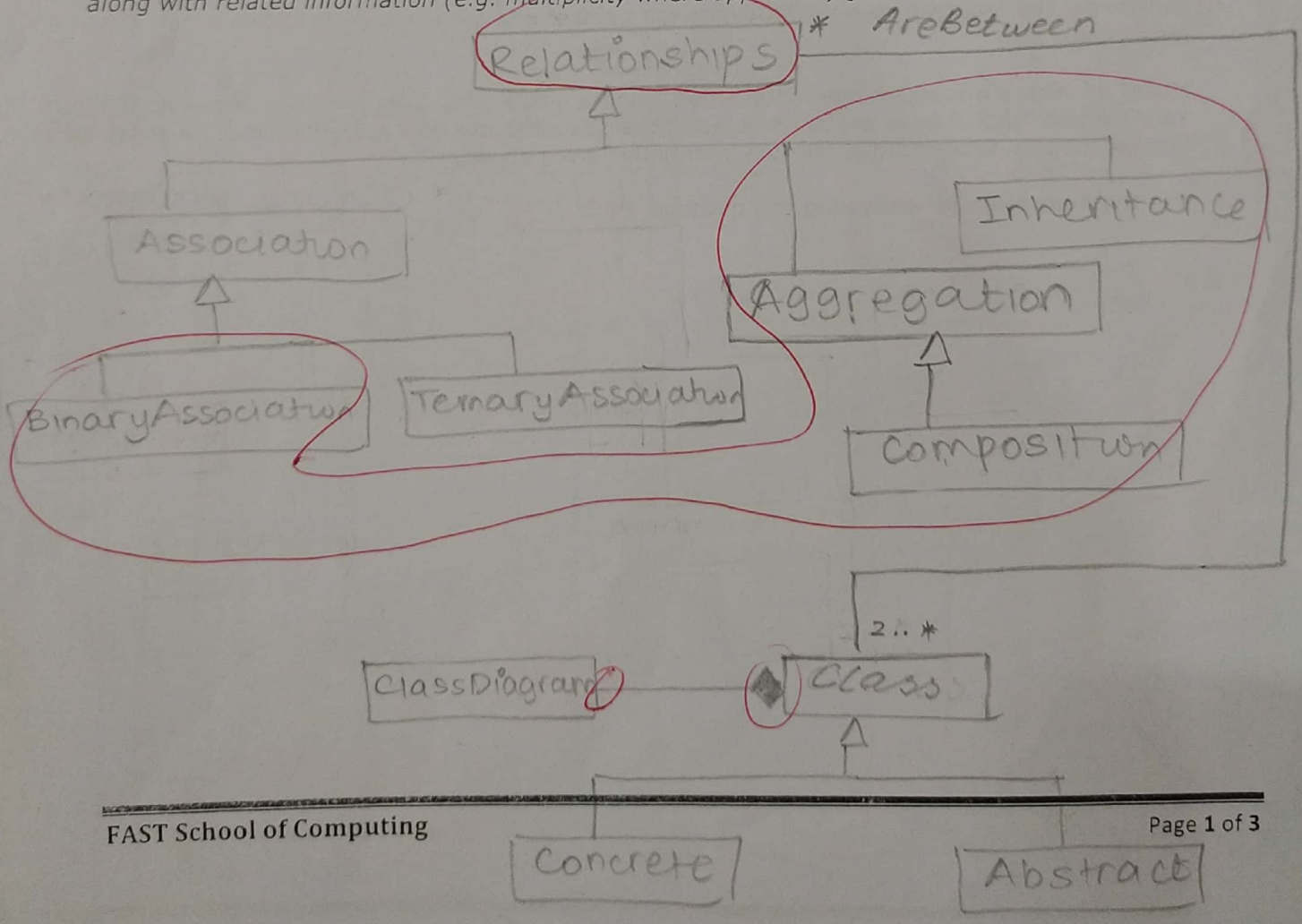
Name: _____ Roll Number: _____ Section _____

Question 1 (Max. Marks = 10)

(4) Depict the relationship between the following UML 2 concepts (listed in alphabetical order) using a UML 2 class diagram:

abstract class, aggregation, association, association class, binary association, class, class diagram, composition, concrete class, inheritance, ternary association

[Note: This class diagram can be considered a meta-level class diagram. Each concept listed above will appear as a separate class in this diagram. This diagram will not include any attributes or operations. It will include classes and (different types of) applicable associations between them along with related information (e.g. multiplicity where applicable).]



Name: _____ Roll Number: _____ Section ___

17 **Question 2** (Max. Marks = 20)

Soon after the convocation, students must obtain clearance in order to receive their diplomas. Clearance is granted to students by the registrar. After a student has requested a registrar for clearance, the registrar solicits the student's roll number. Once the roll number has been provided, the registrar uses it to retrieve the student's academic information (i.e. degree, CGPA, credits earned, and list of courses passed) from the academic record. Once the academic information has been retrieved, the registrar first obtains the minimum required CGPA for the degree from the university's prospectus. If the student's CGPA is less than the minimum required CGPA the registrar rejects the request for clearance. Otherwise, the registrar obtains the minimum credits required for the degree from the university's prospectus. If the credits earned by the student are less than the minimum credits required, the registrar rejects the clearance request. Otherwise, the registrar retrieves the core courses of the degree from the university's prospectus. If at least one core course has not been passed by the student, the registrar rejects the clearance request. Otherwise, the registrar uses the student's roll number to retrieve the student's library information (i.e. outstanding issued books and pending fine) from the library. If the student has any outstanding issued books or a pending fine, the registrar rejects the student's clearance request. Otherwise, as a final step, the registrar uses the student's roll number to retrieve a list of the student's societies from the societies record. For each society of the student, the registrar (using the student's roll number) retrieves equipment borrowed (and not returned) by the student. If there is any borrowed equipment from any society (that has not been returned), the registrar rejects the student's clearance request. Otherwise, the registrar uses the student's roll number and current date to create a new clearance for this student.

Model all of the aforementioned interaction using a single UML 2 design-level sequence diagram. Your diagram should have exactly 8 objects. Realistic attributes and operations may be assumed as long as they do not contradict with the information given above.

Use the **next page** for answering this question.

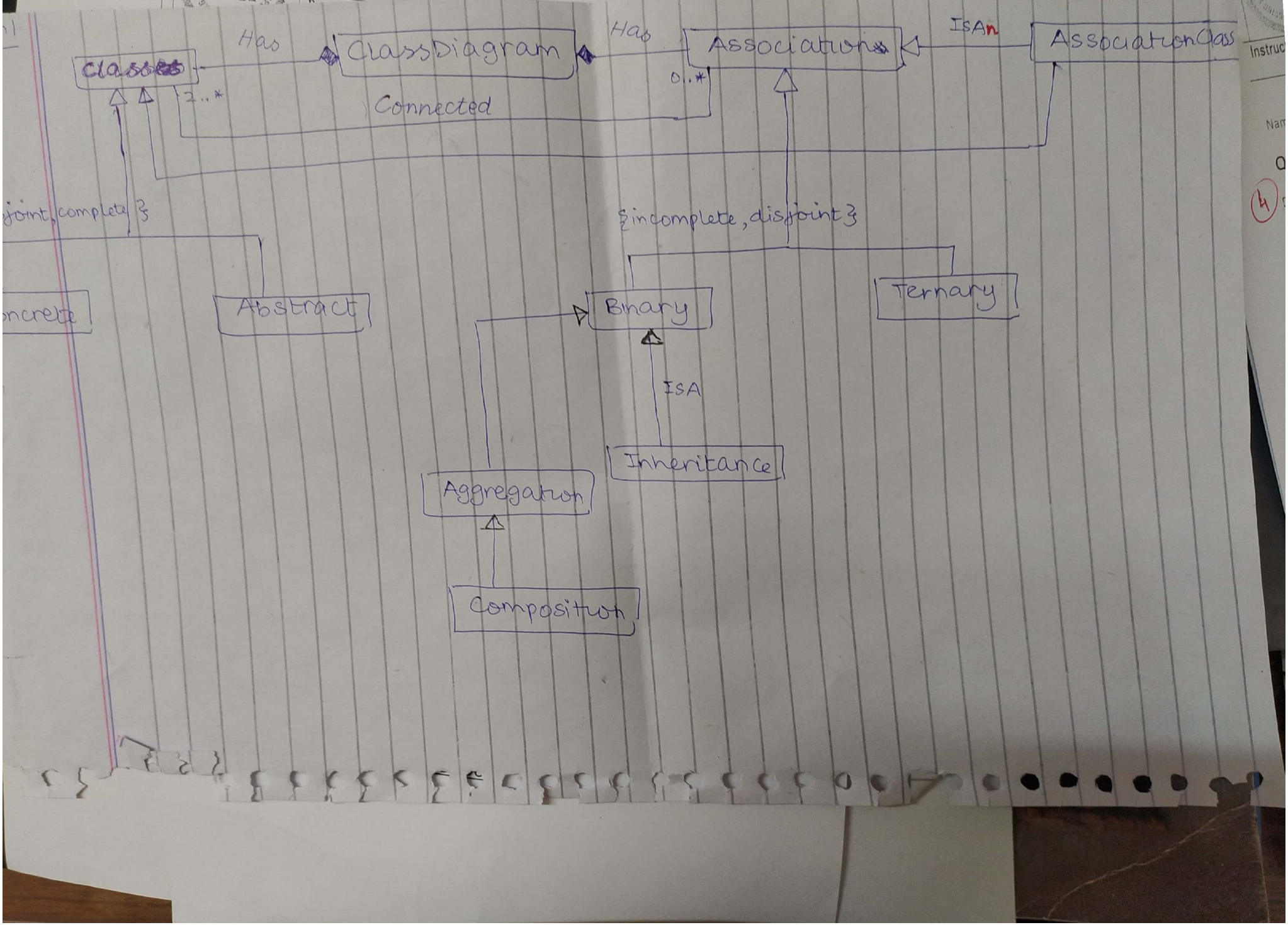
This diagram is on page 3 and 4

:Student

Name: _____ Roll Number: _____ Section _____

[Use this page for answering Question 2 only.]

continued



	Course Name:	Software Design & Analysis	Course Code:	CS3004
	Program:	BS (CS)	Semester:	Spring 2022
	Duration:	One hour	Total Marks:	30
	Paper Date:	22-Mar-2022	Weight:	
	Section:	(All)	Page(s):	3
	Exam Type:	First midterm		

Student : Name:_____ **Roll No.**_____

Q1 (10 marks)

1. Which of the following is incorrect

A. Analysis is done before the design
B. The requirements identified in the analysis phase are used to test the software
C. Design is not necessary for implementation
D. Good design helps in maintenance

2. Which of the following is incorrect

A. Maintainable software must be modular
B. Modular software is not easy to understand
C. Modules should be independent as much as possible in a good design
D. Good abstraction hides implementation details

3. Which of the following is incorrect

A. Composition is a type of association
B. Aggregation is a type of association
C. Composition is a type of aggregation
D. Association is a type of inheritance

4. Which of the following is incorrect

A. A class diagram shows the static relationship between classes
B. A class diagram shows the dynamic relationship between classes
C. A sequence diagram can show message passing between objects
D. A sequence diagram can show message passing between systems

5. Which of the following is incorrect

A. Polymorphism is achieved through inheritance
B. Encapsulation is achieved through inheritance
C. An abstract class cannot be instantiated
D. Inheritance allows us to reuse code

Q2 (10 marks)

Improve/Rewrite the following code by using the object-oriented features:

```
class Car {...}
class Bus {...}
class Truck {...}

int total(Car* c[], int m, Bus* b[], int n, Truck* t[], int o) {
      int sum = 0;
      for (i=0; i < m; ++i)
            sum = sum + c[i]->rent();
      for (i=0; i < n; ++i)
            sum = sum + b[i]->rent();
      for (i=0; i < o; ++i)
            sum = sum + t[i]->rent();
      return sum;
}
```

Q3 (10 marks)
Consider the following description of a Police Information System:

This system helps the Java Valley police officers keep track of the work they are assigned to do. Officers may be assigned to investigate particular cases, to patrol particular areas, or to attend particular events such as court cases. Some work assignments are regular ongoing assignments, while others are for a particular period of time. The system information is updated by the logistics administrator, but individual officers have an interface to display their assigned work.

Now give a class diagram for this system. Show classes, inheritance and associations. However, you do not need to show data members or member functions.

Course:	**Object-oriented Analysis & Design**	**Course Code:**	**CS-309**
Program:	**BS (Computer Science)**	**Semester:**	**Fall 2018**
Duration:	**60 Minutes**	**Total Marks:**	**30**
Paper Date:	**02-Oct-18**	**Weight**	**15 %**
Section:	**All**	**Page(s):**	**2**
Exam:	**Midterm-I**	**Reg. No.**	

Instruction/Notes: Solve the exam on this paper. Do not submit answer sheets. You may use rough sheets but those shouldn't be attached.

Question 1 **10 points**

Answer the following questions:

1. Which of the following statement is incorrect about object oriented paradigm ?
   (a) Identifying appropriate abstractions is one of the major activity we perform during object oriented analysis

   (b) In object oriented analysis we analyze requirements from the perspective of the classes and objects found in the vocabulary of the problem domain

   (c) Any design prepared in UML is guaranteed to be the best object oriented design

   (d) Object oriented programs are organized as cooperative collections of objects

   (e) A standard notation (UML) is used to depict object oriented design

2. Which of the following statement is incorrect about relationships between classes/objects ?
   (a) Inheritance relationship can also be called “is a” relationship

   (b) Aggregation is a stronger form of association

   (c) Generalization can be considered a “part of” relationship

   (d) Composition binds the lifetime of constituent objects with the container

   (e) Inheritance hierarchy enable the objects to have polymorphic behavior

Course:	**Object-oriented Analysis & Design**	**Course Code:**	**CS-309**
Program:	**BS (Computer Science)**	**Semester:**	**Fall 2018**
Duration:	**60 Minutes**	**Total Marks:**	**30**
Paper Date:	**02-Oct-18**	**Weight**	**15 %**
Section:	**All**	**Page(s):**	**2**
Exam:	**Midterm-I**	**Reg. No.**	

3. Which of the following statement is incorrect ?

   (a) Abstraction focuses on the observable behavior of an object

   (b) Encapsulation focuses on the implementation of an object

   (c) Encapsulation supports the concept of information hiding

   (d) Abstraction can be achieved without encapsulation

   (e) Abstractions lets you focus on the essential aspects of an application while ignoring details

4. Which of the following relationship does not exists between classes?
   (a) Association

   (b) Aggregation

   (c) Composition

   (d) Inheritance

   (e) Polymorphism

5. Which of the following statement is incorrect?

   (a) Circle inherits Shape

Course:	**Object-oriented Analysis & Design**	**Course Code:**	**CS-309**
Program:	**BS (Computer Science)**	**Semester:**	**Fall 2018**
Duration:	**60 Minutes**	**Total Marks:**	**30**
Paper Date:	**02-Oct-18**	**Weight**	**15 %**
Section:	**All**	**Page(s):**	**2**
Exam:	**Midterm-I**	**Reg. No.**	

(b) Circle inherits Sphere

(c) Lion inherits Mammal

(d) Snake inherits Reptile

(e) Bus inherits Vehicle

Question 2 **10 points**

Consider a reservation system for an inter-city transportation company that operates buses on different routes. Each route is determined by a source and destination. On each route different buses run at different timings. There are two categories of buses that differ in services and consequently fare. Economy buses provide standard transportation facility and their fare is computed as a product of the route distance and base rate (fare per km). Luxury buses on the other hand have a higher base rate, considering reduced seating capacity. In addition, luxury buses provide different options for refreshments as well as extra luggage, the cost of which can be added to the fare.

Develop a UML class diagram to model this problem.

Course:	**Object-oriented Analysis & Design**	**Course Code:**	**CS-309**
Program:	**BS (Computer Science)**	**Semester:**	**Fall 2018**
Duration:	**60 Minutes**	**Total Marks:**	**30**
Paper Date:	**02-Oct-18**	**Weight**	**15 %**
Section:	**All**	**Page(s):**	**2**
Exam:	**Midterm-I**	**Reg. No.**	

Question 3 **10 points**

Write a **polymorphic** program to compute pays of employees working for an organization. An employee can either be a **SalariedEmployee** earning a fixed monthly salary or a **CommissionEmployee** who earns commission on the number of jobs completed using a fixed commission rate.

You may write code either in C++ or Java, but should clearly mention the language used. Also, make use of concepts like abstract class and/or interface where applicable.

Course:	**Object-oriented Analysis & Design**	**Course Code:**	**CS-309**
Program:	**BS (Computer Science)**	**Semester:**	**Fall 2018**
Duration:	**60 Minutes**	**Total Marks:**	**30**
Paper Date:	**02-Oct-18**	**Weight**	**15 %**
Section:	**All**	**Page(s):**	**2**
Exam:	**Midterm-I**	**Reg. No.**	

// continue writing code here

National University of Computer and Emerging Sciences, Lahore Campus

Course:	**Object-oriented Analysis & Design**	**Course Code:**	**CS-309**
Program:	**BS (Computer Science)**	**Semester:**	**Fall 2018**
Duration:	**60 Minutes**	**Total Marks:**	**30**
Paper Date:	**02-Oct-18**	**Weight**	**15 %**
Section:	**All**	**Page(s):**	**4**
Exam:	**Midterm-I**	**Reg. No.**	

Instruction/Notes: Solve the exam on this paper. Do not submit answer sheets. You may use rough sheets but those shouldn't be attached.

Question 1 **10 points**

Answer the following questions:

1. Which of the following statement is incorrect about object oriented paradigm?

   (a) Identifying appropriate abstractions is one of the major activity we perform during object oriented analysis
   (b) In object oriented analysis we analyze requirements from the perspective of the classes and objects found in the vocabulary of the problem domain
   (c) Any design prepared in UML is guaranteed to be the best object oriented design √
   (d) Object oriented programs are organized as cooperative collections of objects
   (e) A standard notation (UML) is used to depict object oriented design

2. Which of the following statement is incorrect about relationships between classes/objects?

   (a) Inheritance relationship can also be called "is a" relationship
   (b) Aggregation is a stronger form of association
   (c) Generalization can be considered a "part of" relationship √
   (d) Composition binds the lifetime of constituent objects with the container
   (e) Inheritance hierarchy enable the objects to have polymorphic behavior

3. Which of the following statement is incorrect?

   (a) Abstraction focuses on the observable behavior of an object
   (b) Encapsulation focuses on the implementation of an object
   (c) Encapsulation supports the concept of information hiding
   (d) Abstraction can be achieved without encapsulation √
   (e) Abstractions lets you focus on the essential aspects of an application while ignoring details

4. Which of the following relationship does not exists between classes?

   (a) Association
   (b) Aggregation
   (c) Composition
   (d) Inheritance
   (e) Polymorphism √

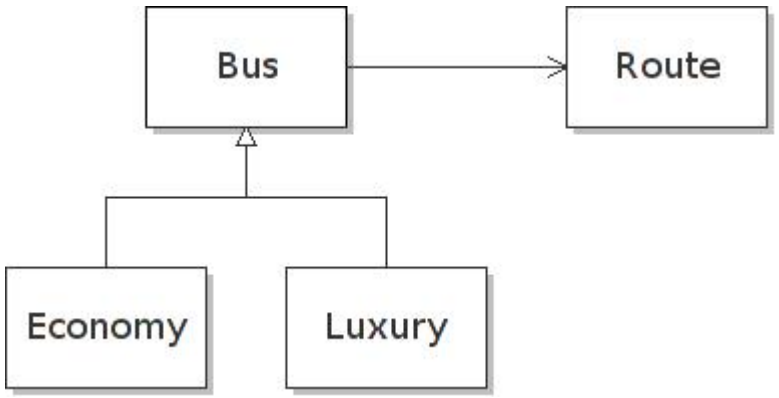
5. Which of the following statement is incorrect?

(a) Circle inherits Shape
(b) Circle inherits Sphere √
(c) Lion inherits Mammal
(d) Snake inherits Reptile
(e) Bus inherits Vehicle

Question 2 **10 points**

Consider a reservation system for an inter-city transportation company that operates buses on different routes. Each route is determined by a source and destination. On each route different buses run at different timings. There are two categories of buses that differ in services and consequently fare. Economy buses provide standard transportation facility and their fare is computed as a product of the route distance and base rate (fare per km). Luxury buses on the other hand have a higher base rate, considering reduced seating capacity. In addition, luxury buses provide different options for refreshments as well as extra luggage, the cost of which can be added to the fare.

Develop a UML class diagram to model this problem.



Course:	Object-oriented Analysis & Design	Course Code:	CS-309
Program:	BS (Computer Science)	Semester:	Fall 2018
Duration:	60 Minutes	Total Marks:	30
Paper Date:	02-Oct-18	Weight	15 %
Section:	All	Page(s):	4
Exam:	Midterm-I	Reg. No.	

Question 3 **10 points**

Write a **polymorphic** program to compute pays of employees working for an organization. An employee can either be a **SalariedEmployee** earning a fixed monthly salary or a **CommissionEmployee** who earns commission on the number of jobs completed using a fixed commission rate.

You may write code either in C++ or Java, but should clearly mention the language used. Also, make use of concepts like abstract class and/or interface where applicable.

```
class Employee {
      public:
            float computePay() = 0;
};

class SalariedEmployee : public Employee {
      private:
            float salary;
      public:
            float computePay() {
                  return salary;
            }
};

class CommissionEmployee : public Employee {
      private:
            float commissionRate;
            int jobsCompleted;
      public:
            float computePay() {
                  return commissionRate x jobsCompleted;
            }
};

void computePays(Employee* [] employees, int size){
      for(int i=0; I < size; i++){
            cout << employees[i]->computePay();
      }
}
```

Course:	Object-oriented Analysis & Design	Course Code:	CS-309
Program:	BS (Computer Science)	Semester:	Fall 2018
Duration:	60 Minutes	Total Marks:	30
Paper Date:	02-Oct-18	Weight	15 %
Section:	All	Page(s):	4
Exam:	Midterm-I	Reg. No.	

// continue writing code here