King Saud University
College of Computer & Information Sciences
Computer Science Department

| **Final Exam Preparation:** Fall 2014-2015	
Course Title: Software Engineering	**Course Code:** CSC 342541
	Dr. Salah Hammami

Exercise:

Consider the following problem description:

Consider an online reservation system for a bus Mekkah-Company. The bus Mekkah-Company realizes trips to Mekkah and Medina city. Each bus is identified by its plate number. The trips are based on a predefined schedule and stop at predefined bus stations. Each bus can have only one trip per day. Each bus includes a driver and one hostess. For long trips, the bus will have breaks at service and rest areas. There are two types of trips, normal trips and express trips. Express trips do not stop at intermediate stations and get faster at the destination.

Seats can be reserved by customers on the web site of the bus Mekkah-Company. The customer has the option to directly pay for the seat through the website. In that case, the seat cannot be cancelled (neither by the customer nor by the bus Mekkah -Company). If the customer has not paid for the seat, the bus Mekkah-Company administrator can cancel the seat if the customer does not show up one hour before the trip. When the reservation is cancelled, the seat will become free and can be sold to another customer. Both the customer and the Mekkah-Company staff must authenticate themselves for performing operations with the system.

1. Draw a use case diagram for describing the functional requirements of the above system.
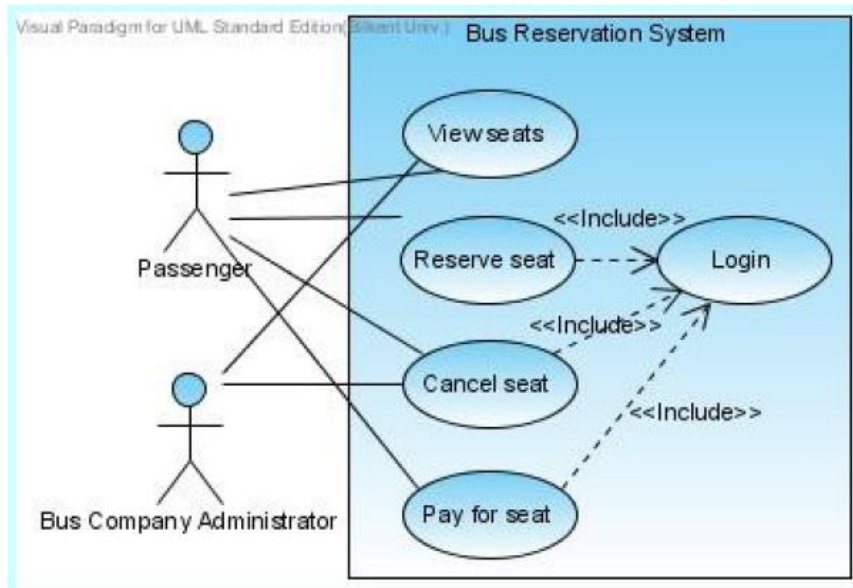
2. Draw a class diagram for the software system described above. You should use different elements of class diagrams such as classes, aggregation, composition, multiplicity, and generalization (inheritance); you should also include one significant attribute and operation on each class.
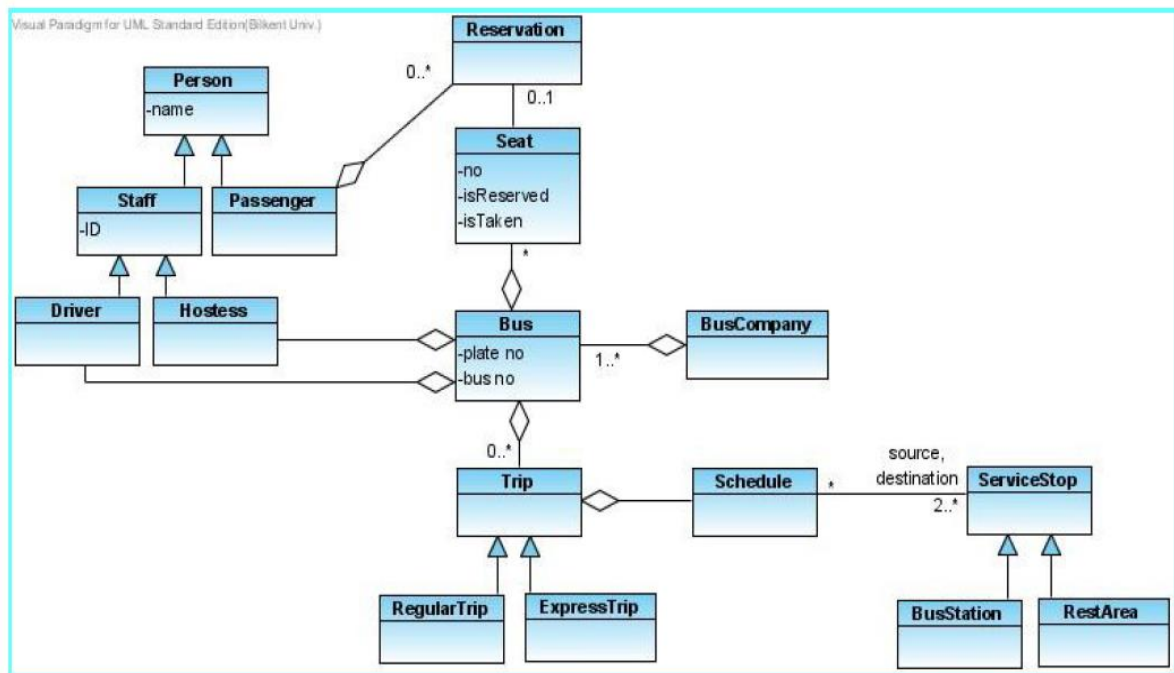
3. Draw a state diagram for describing the details of the `Seat` object of the above system.
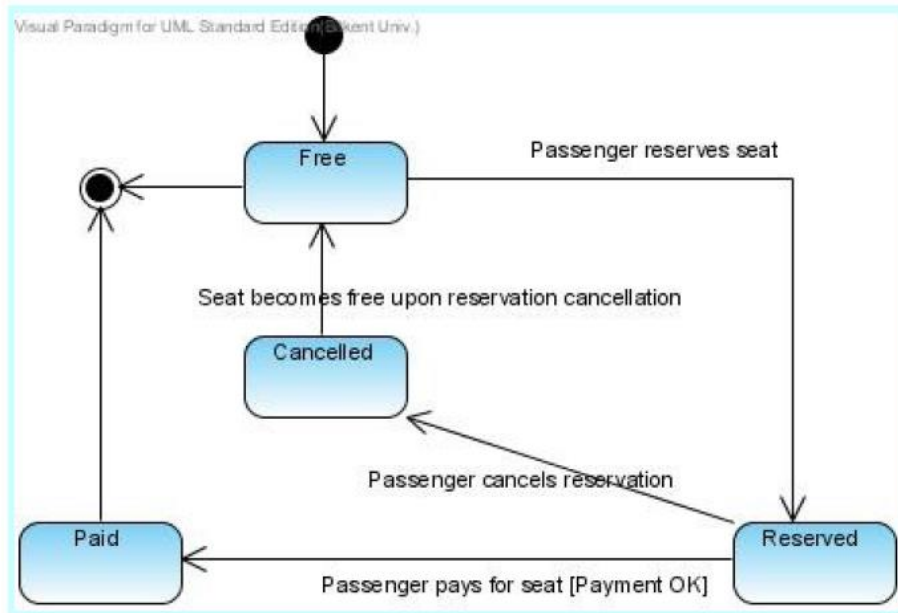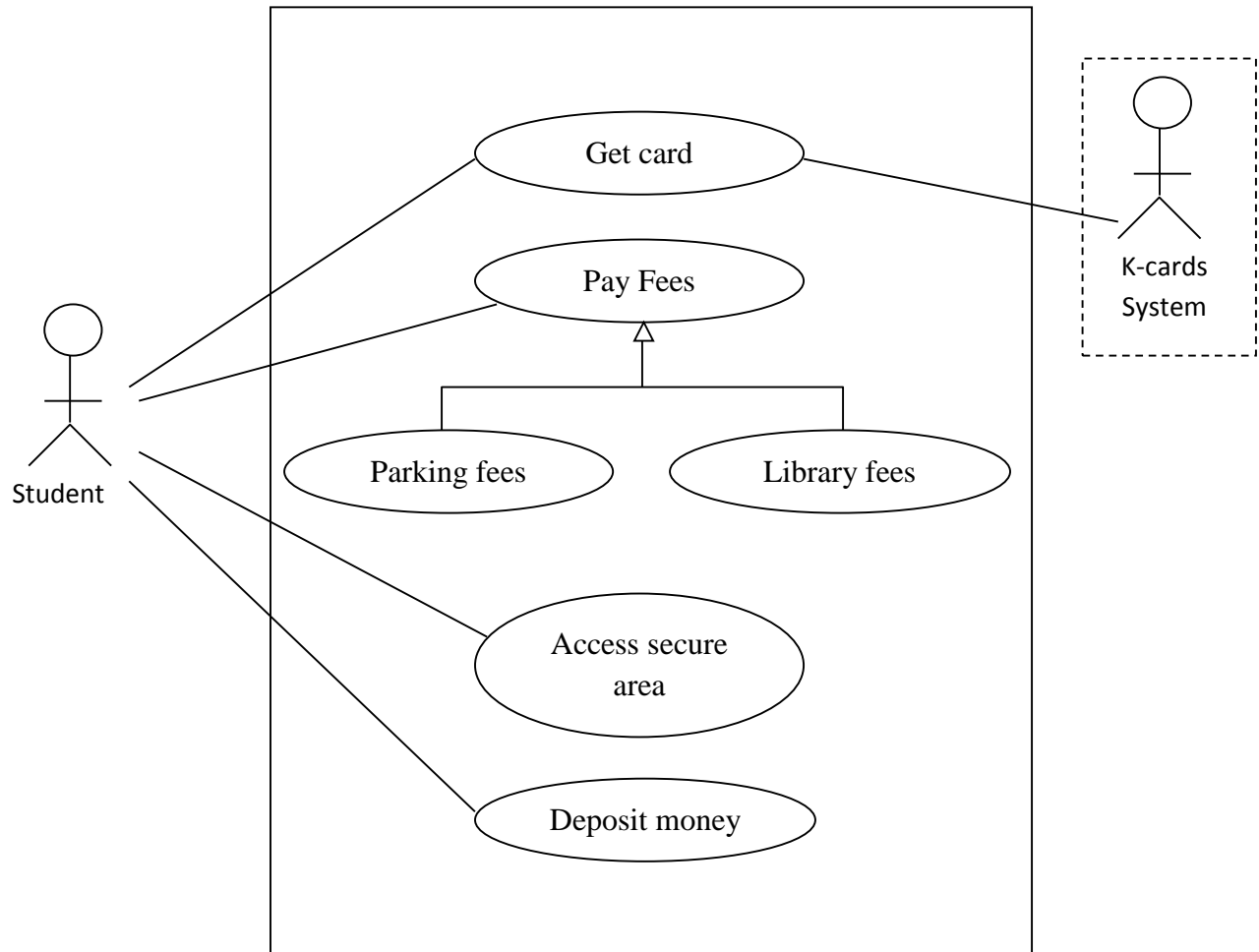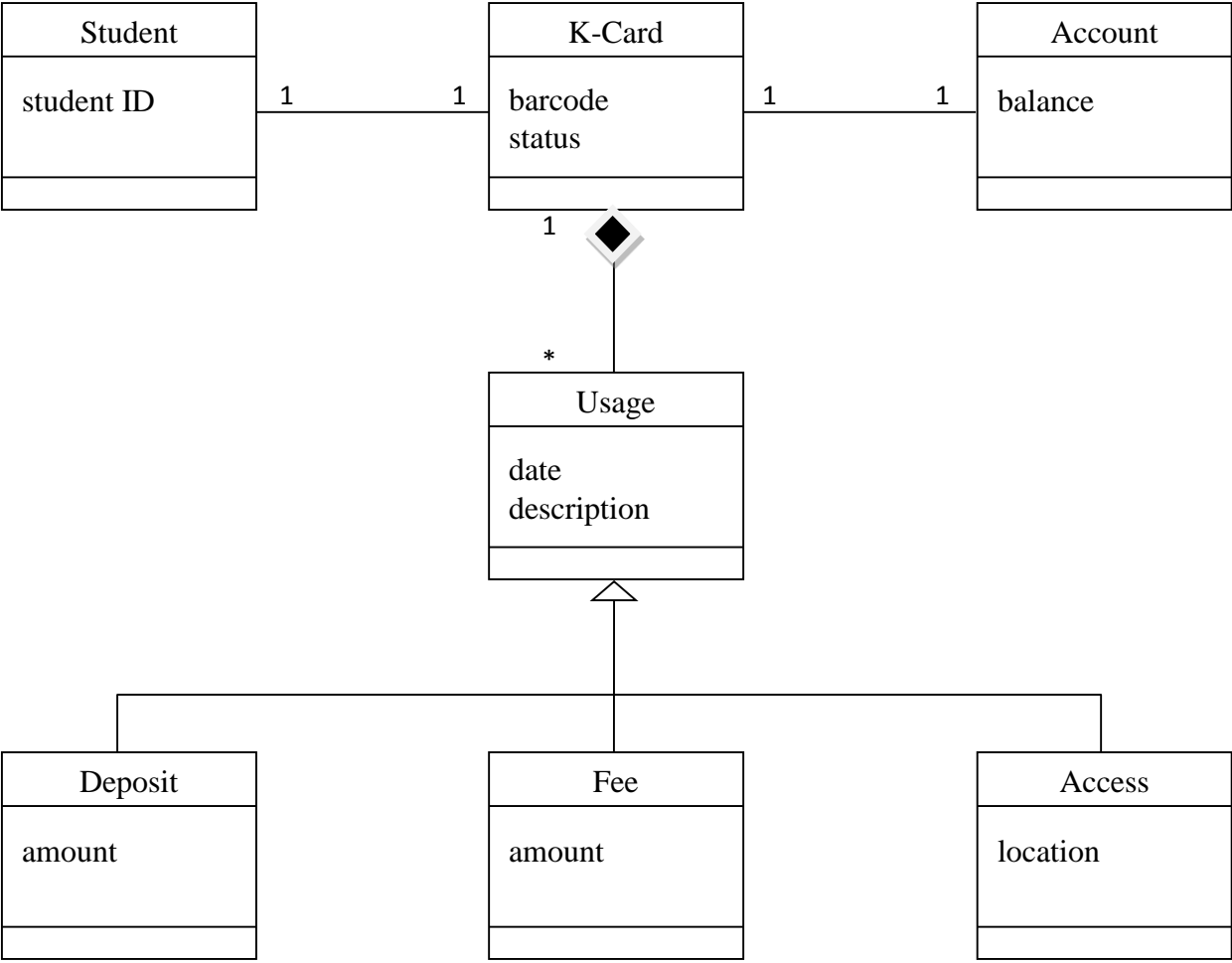

Exercise:

The ClubRiyadh Sport has decided to implement an electronic card system for its subscriber, so that subscribers can use their K-cards to access secure areas, and also as a debit card, linked to an account into which subscribers can deposit money to be used to pay club fees. For the initial release of the system, this will be limited to a few club usages: equipment rental at the sports centre, beverage fees, and library fees at club libraries. The system will keep a usage record for each K-card.

1. Identify use cases by providing the actors, use case names. Draw the use case diagram.
2. Identify possible classes and create a Domain Model (UML class diagram). You should use different elements of class diagrams such as classes, associations, multiplicity, and generalization (inheritance); you should also include one significant attribute on each class.

Answer 1:

Answer 2:

```
  Student                     K-Card                      Account

 student ID    1         1   barcode       1         1   balance
                             status


                              1  ◆

                              *
                            Usage

                            date
                            description

                              △

   Deposit                    Fee                        Access

 amount                     amount                     location
```
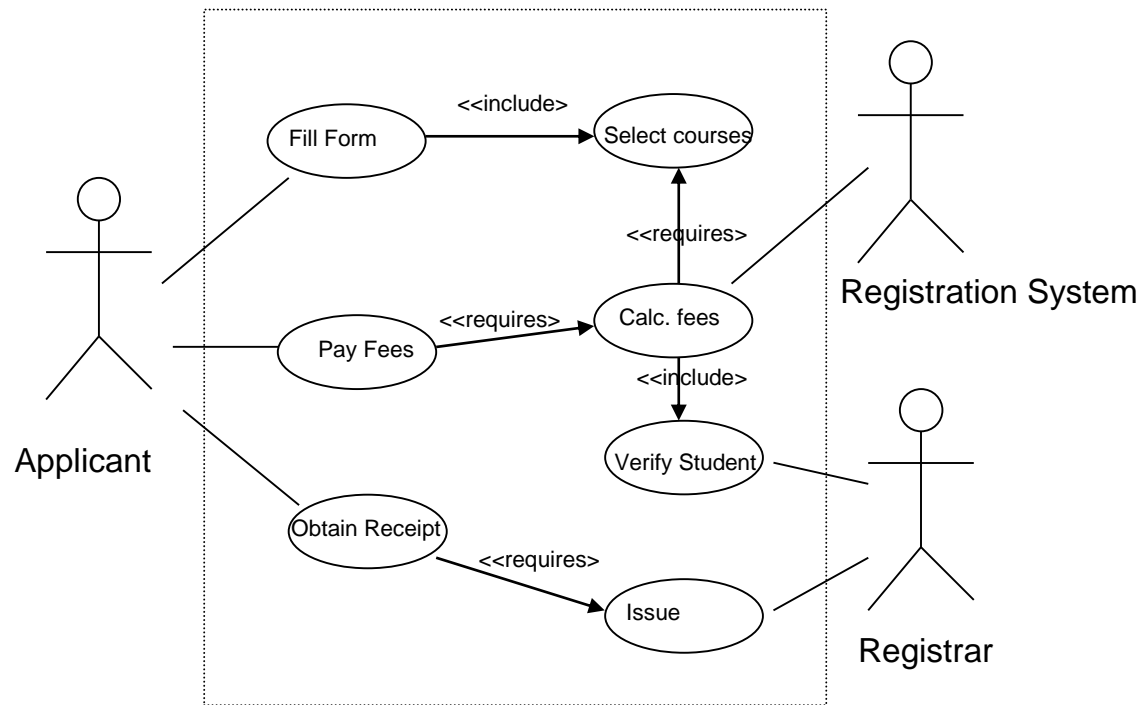
Exercise

Basic Course of Action for Enroll in University scenario:

An applicant wants to enroll in the university. The applicant hands a filled out copy of University Application Form to the registrar. The registrar clicks on the Create Student icon. The system displays Create Student Screen. The registrar inputs the name, address, and phone number of the applicant. The system checks whether the applicant is on the applicants list and whether they already exist within the system. If the student is on the applicants list but not already on the system, then a record is created. The student enrolls in courses. The system calculates the required initial payment. The system displays Fee Summary Screen. The student pays the initial fee. The system prints a receipt. The registrar validates and gives the student the receipt.

1. Draw a UML Use Case Diagram for the above system.
2. Draw a conceptual Class Diagram that is the high level class diagram without any data members or methods. A conceptual class diagram, describing the main parts of the system. You should use different elements of class diagrams such as classes, associations, roles, cardinality (multiplicity), and generalization.
3. Draw a UML sequence diagram for the enroll in University scenario above covering the all steps.
4. Draw a UML activity diagram for the enroll in University scenario above covering the different steps.

Answer:

1.

2.
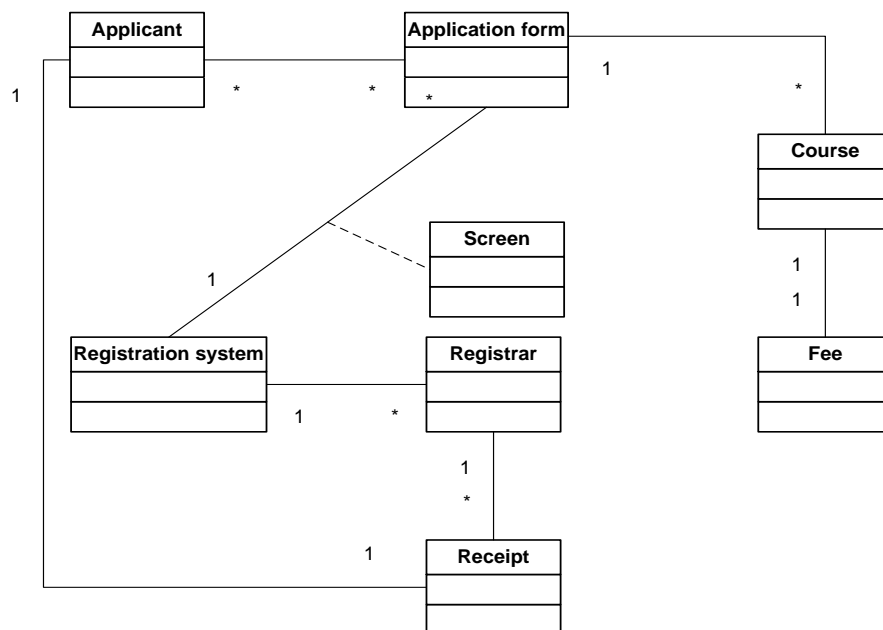
Exercise:

Consider the world of libraries. A library has books, videos, and CDs that it loans to its users. All library material has a id# and a title. In addition, books have one or more authors, videos have one producer and one or more actors, while CDs have one or more entertainers. The library maintains one or more copies of each library item (book, video or CD). Copies of all library material can be loaned to users. Reference-only material is loaned for 2hrs and can't be removed from the library. Other material can be loaned for 2 weeks. For every loan, the library records the

user, the loan date and time, and the return date and time. For users, the library maintains their name, address and phone number.

Draw a class diagram for the description above. Make sure to show attributes, multiplicities and aggregations/compositions, inheritance where appropriate. No need to show any operations.

Answer:
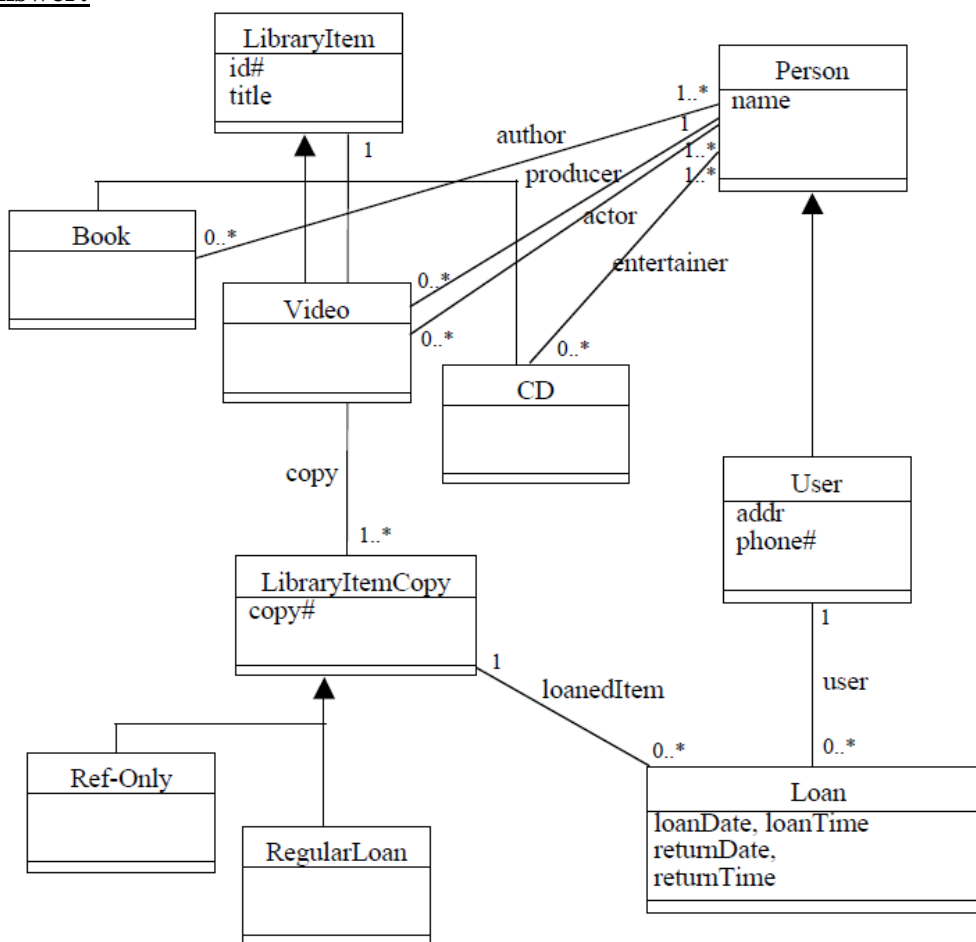
Exercise:

For the benefit of students working hard and late, a vending machine is installed at the first floor at CCIS, offering coffee, chocolates and water. The machine works in a way that the student first needs to insert an amount of money in form of coins. The vending machine memorizes the amount of money inserted. Secondly the customer needs to press a button representing a beverage. If the machine is out of beverage nothing happens, otherwise the machine gives the student the selected beverage. It also returns change if the amount inserted into the machine is greater than the cost of the beverage. The machine also has a button for returning the money inserted. Of course money that has been used to pay for beverage cannot be returned. If the student presses a button for some beverage and there's not enough money inserted, nothing happens.

1. Visualize the following use-cases with UML diagrams, (1) a student buys a soft drink and (2) A student orders the machine to return all inserted money. Every use case should besides graphical presentation contain an additional more detailed textual explanation.
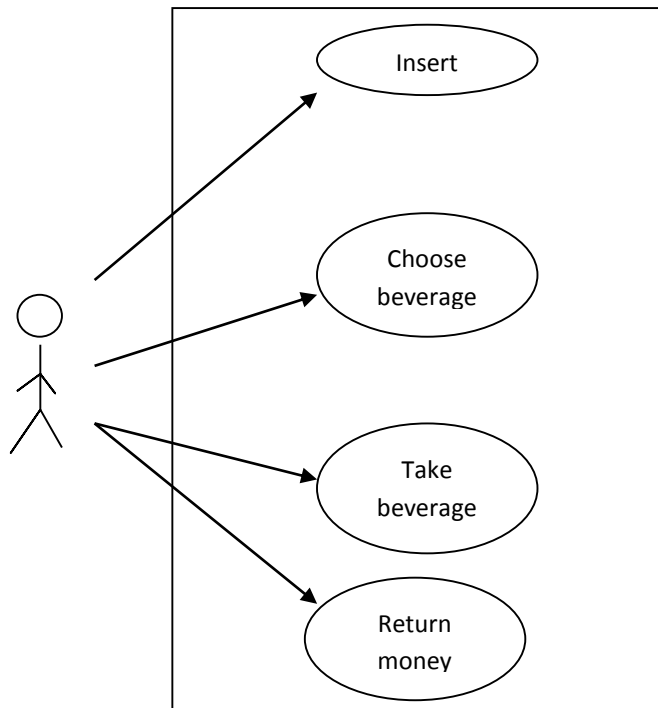
2. Create a *UML state chart* for the vending machine (only for the use-case (1)), the detail level should be low enough to constitute basis for a programmer's implementation of the system, without any additional sketches or bigger efforts required by the programmer.
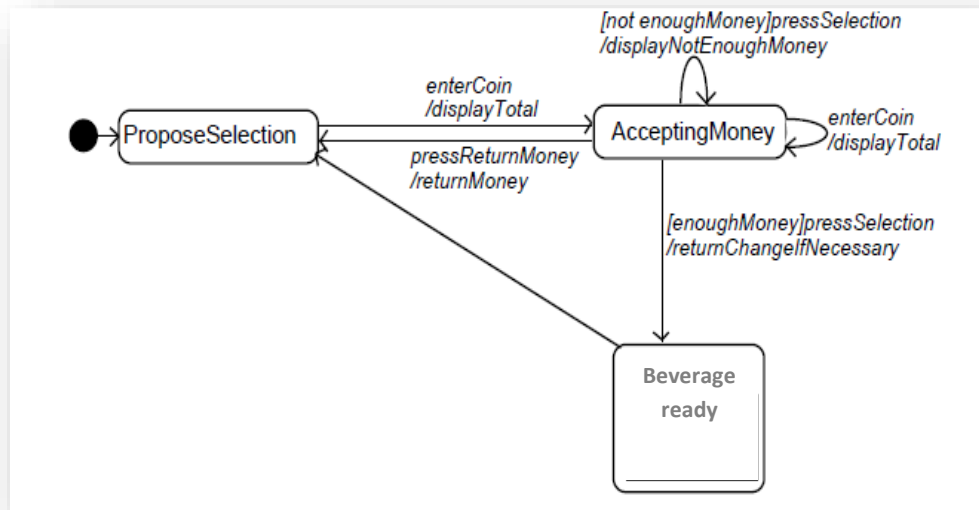
Exercise: Analysis and Design

Consider the software that controls a very simple cellular telephone. Such a phone has buttons for dialing digits, and a "send" button for initiating a call. It has "dialer" hardware and software that gathers the digits to be dialed and emits the appropriate tones. It has a cellular radio that deals with the connection to the cellular network. It has a microphone, a speaker, and a display.

1. Draw a class diagram for the description above. Make sure to show the aggregations/compositions/inheritance, where appropriate.
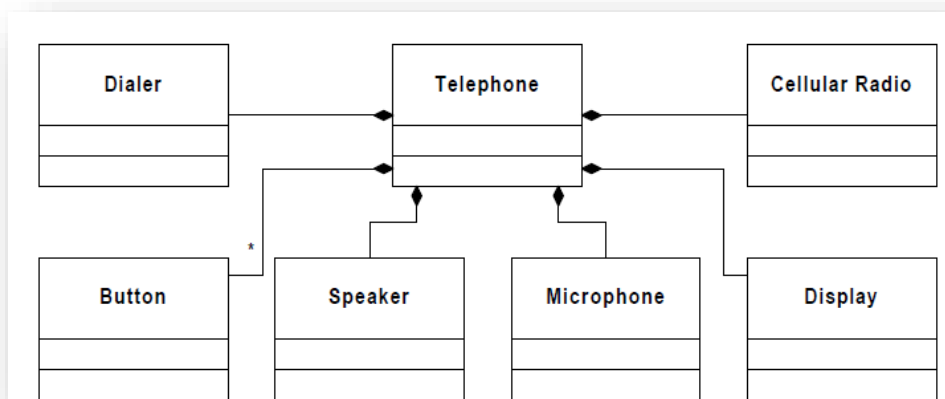
2. Given the following description of a use case "Make Phone Call" which shows how a customer might make a phone call, draw the collaboration diagram to show how do the objects in the static model collaborate to execute this procedure?

Use case: Make Phone Call

1. User presses the digit buttons to enter the phone number.
2. The Dialer receive the digit message
3. For each digit, the Dialer ask the Display to add the digit to the phone number.
4. For each digit, the Dialer generates the corresponding tone and emits it from the Speaker.
5. User presses "Send" using the Button
6. The Dialer sends a connect message to the Cellular Radio and passes along the accumulated phone number.
7. The Cellular Radio establishes a connection to the network.
8. The accumulated digits are sent to the network.
9. The connection is made to the called party.
10. The Cellular Radio then tells the Display to illuminate the "In Use" indicator.
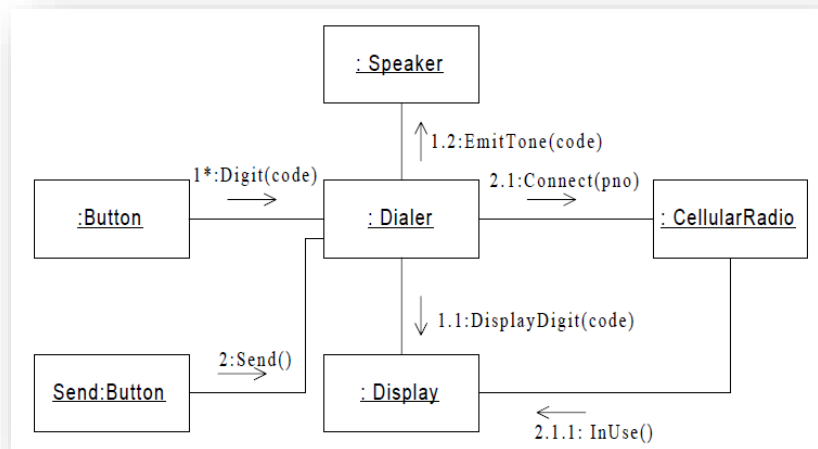
3. Is the structure of the objects in the dynamic model (question 2) looks like the structure of the classes in the static model (question 1)? If No, modify the class diagram (static model) that will be conform to the dynamic model, and add methods to classes.
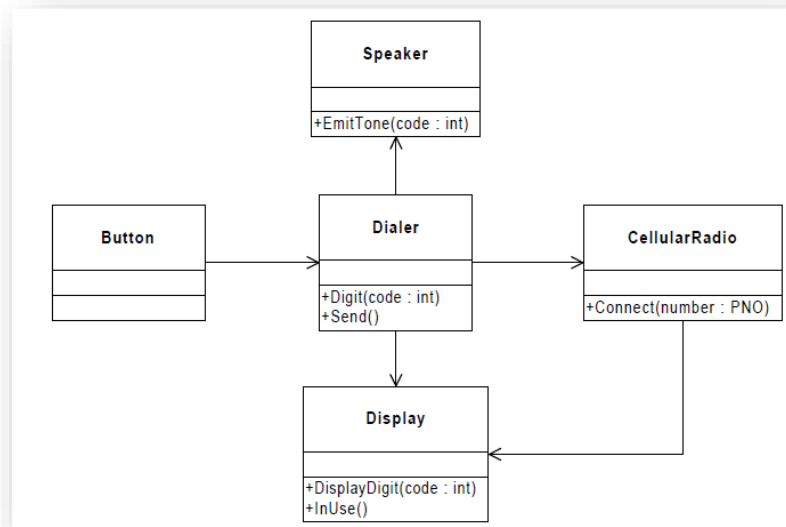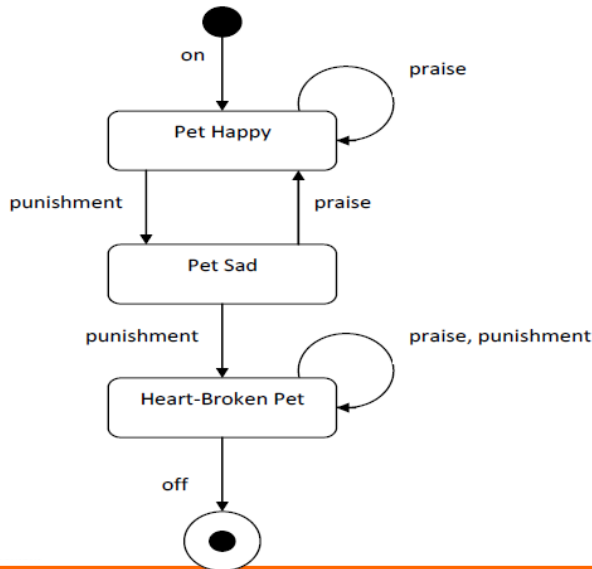
Exercise:

Digital Pet

You are creating a digital pet program. What happens to the pet when he receives different stimuli is determined by the state he's in, so you decide to model the digital pet with a state diagram.

The behavior of the digital pet program is as follows:

– When the pet is turned on, it starts out happy
– If the pet is happy and receives punishment, then he becomes sad
– If the pet is sad and receives praise, it becomes happy
– If the pet is sad and receives punishment, it is heart-broken

Identify the states and transitions of the digital pet and draw a state diagram.

Digital pet: statechart

Exercise:

Fuel pump

Model the behavior of a fuel pump controller.

- User can buy fuel after inserting a credit card, which is read and validated by the controller.
- Then the user takes the hose out of the holster, and pushes the nozzle trigger, to fuel his car.
- When the nozzle is off, the fuel flow is stopped and the price is charged on the credit card
- If invalid card or timeout the system returns to the initial waiting state..

Fuel pump: solution
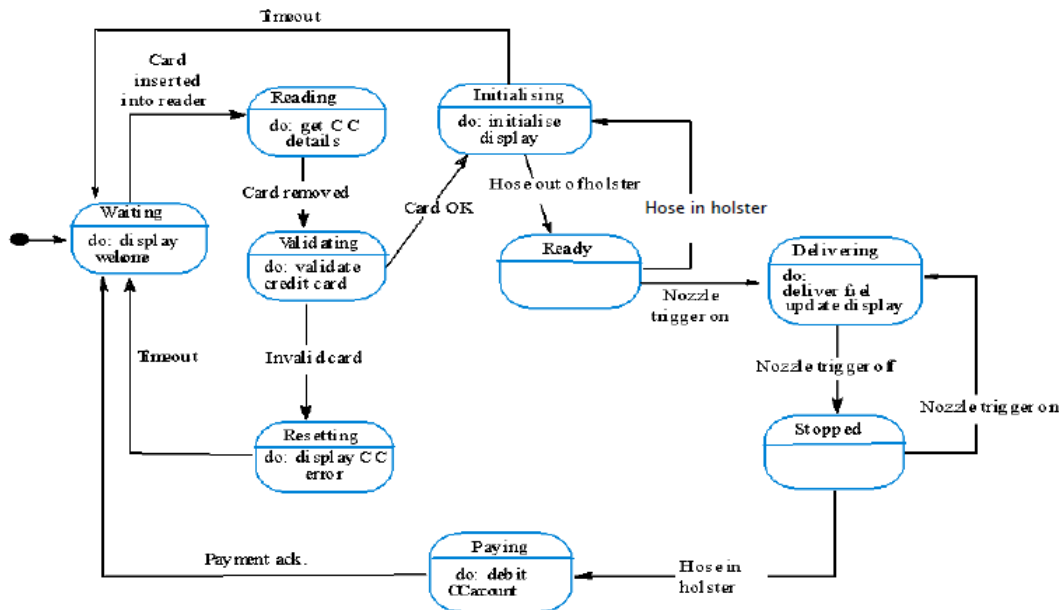
Exercise: 3

Booking a Room in a hotel

When customer requests a room, the hotel employee looks for room availability, then he inserts customer's data and verifies if the provided credit card number has enough credit to pay the room: in this case the booking is confirmed and we wait customer arrival.

The Hotel information system allows customer to modify or cancel his/her reservation. If customer arrives he uses the room and then he pays, in case of no-show a penalty is accounted on his credit card and the booking is canceled.

Model processes with activity diagram.

Solution
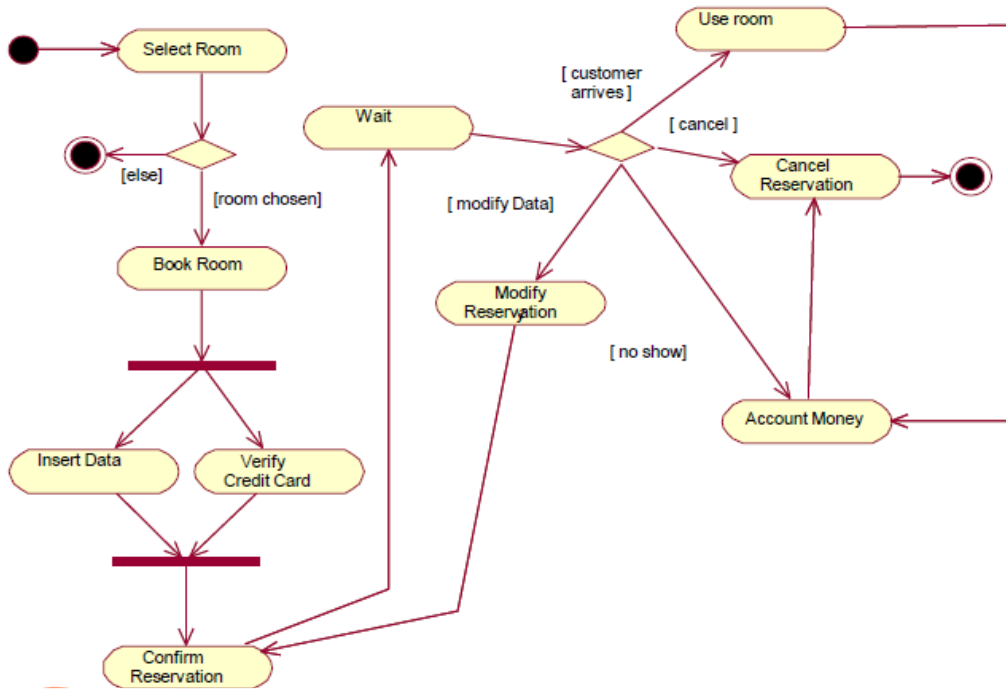
Exercise 4: *Analysis (Functional Requirements and Use Cases) (20 points)*

Consider the following problem description:

A Conference Management System (CMS) is to be designed and implemented to automate the review process for scientific events such as conferences and workshops as described below.

An author can submit papers using CMS. All papers should include a title, an abstract, a list of keywords, size, and a list of authors.

Not every paper submitted is to be selected for presentation and included in the proceedings. The review and selection process is performed by a scientific committee. The scientific committee consists of members. One of the members is assigned as a chair. The chair is responsible for checking the completeness of the submitted papers and assigning the papers to other members for reviewing. When the chair assigns a paper to a reviewer, it is first checked that the area of expertise of the reviewer matches the keywords provided in the paper. Each reviewer is responsible for reviewing the assigned paper(s) and writing a report. Based on the reports, papers to be included in the final proceedings are selected by the chair. Once the selection is completed, the chair can send notification emails about the decisions to all authors using CMS.

   a) *Identify functional requirements for the above situation.*
   b) *Draw the Use Case Diagram of the system*

Answer:
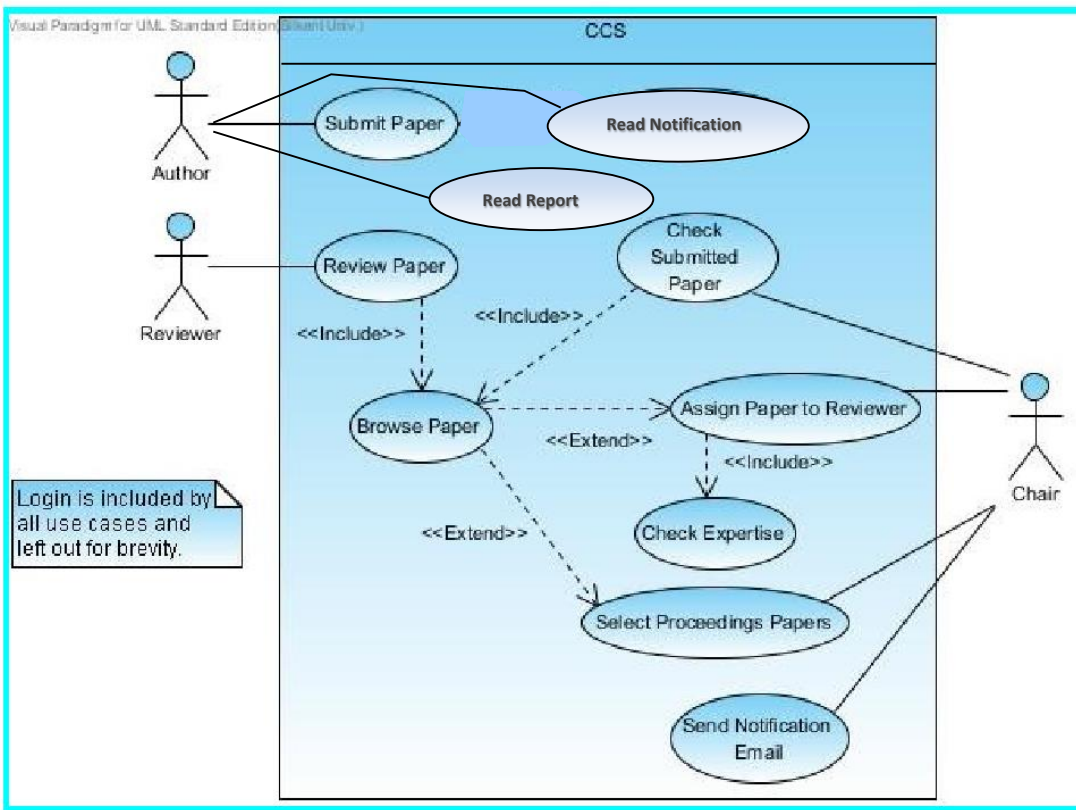
Exercise 2: *(Activity Diagram)* *(10 pts)*

Construct an activity diagram with swimlane for the following scenario.

This describes the business process to publish an academic paper:

- The author submits a paper to an editor of a journal.
- The editor first checks if the paper fit the theme of the journal. If not, the editor rejects the paper. Otherwise, the editor assigns the paper to a number of reviewers.
- The reviewers review the paper, and write a review. The review is sent to the editor.
- The editor then assesses the quality of the paper with the help of reviewers' comments. If the quality is bad, the editor rejects the paper. If the quality is good, the paper will be accepted, the author notified and the paper is forwarded to the publisher for publication.
- The publisher publishes the paper.

| Author	Editor	Reviewer	Publisher
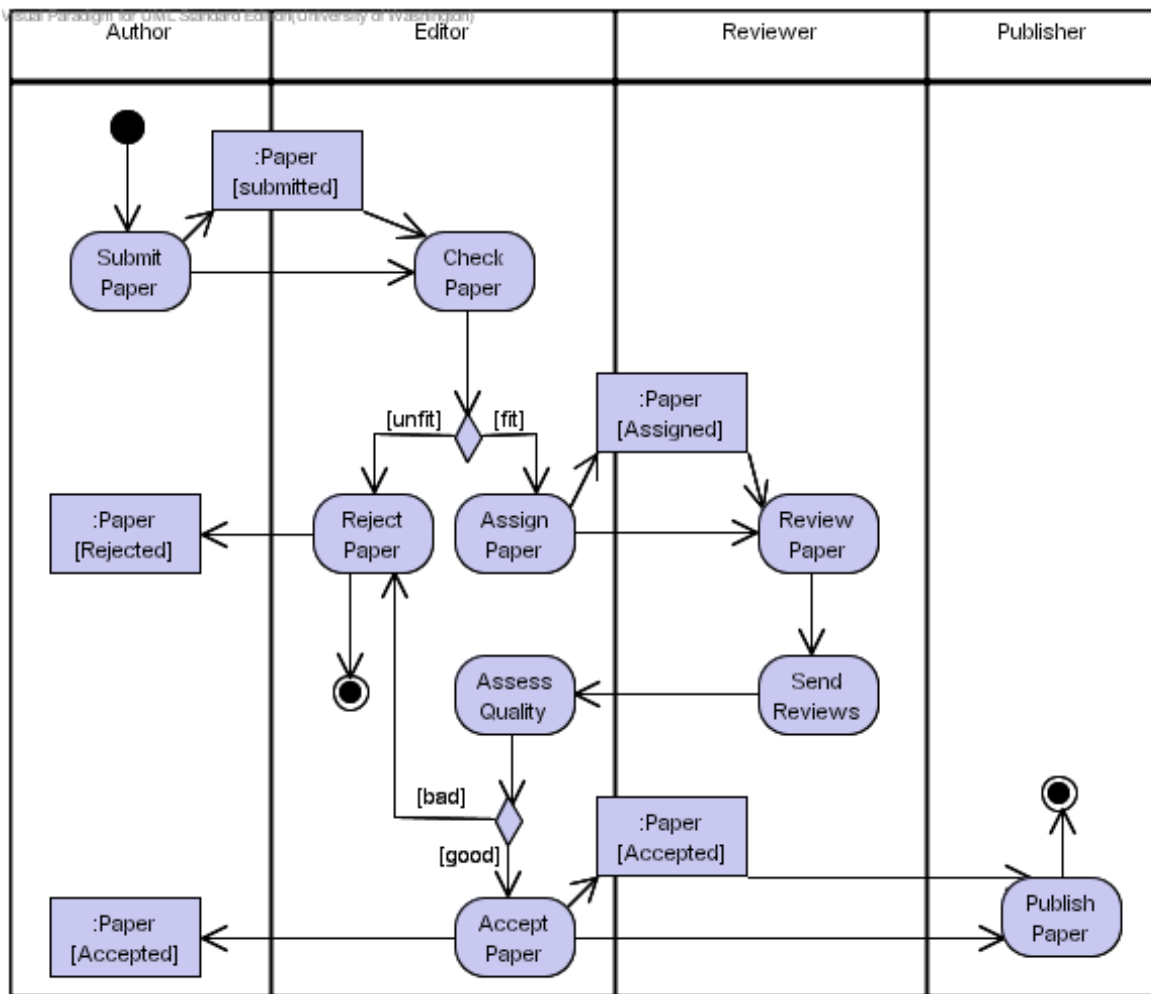
Exercise 3: *(Testing) (10 marks)*

Given the following sorting algorithm, it uses an array A of *n* integers A[1], A[2], ..., A[n] as input, and returns the same array output, with its contents rearranged in sorted (increasing) order. Statements and conditions (except for ``end'' statements) will be labeled for future reference.

S1	i := 2
C1	while (i is less than or equal to n) do
S2	j := i − 1
C2	while ((j is greater than or equal to 1) and (A[j] is greater than A[j+1])) do
S3	temp := A[j]
S4	A[j] := A[j+1]
S5	A[j+1] := temp
S6	j := j-1
	end while
S7	i := i + 1
	end while

On occasion a final statement labeled S8 (stop) will be used to identify the program's exit point.

Given the following flow graph of the previous algorithm:
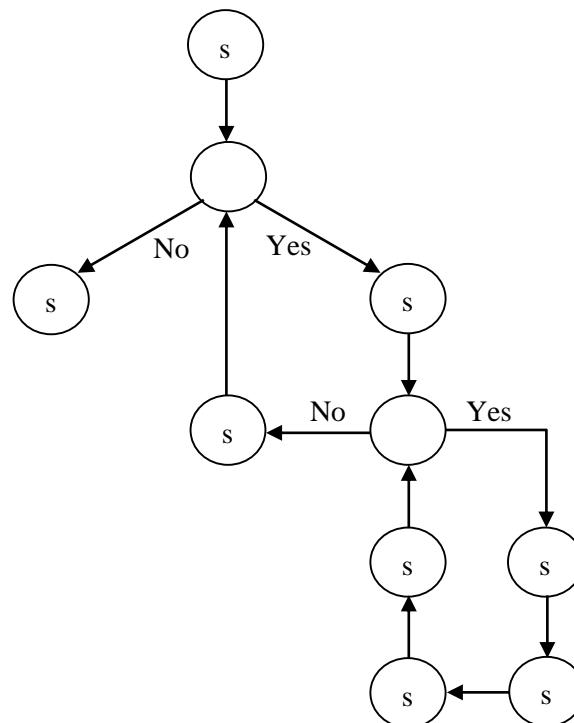
1. Determine the cyclomatic complexity of the flow graph.

11-10+2= 3

2. Determine the basis set of independent paths.

s1 c1 s8

s1 c1 s2 c2 s7 c1 s8

s1 c1 s2 c2 s3 s4 s5 s6 s2 c2 s7 c1 s8