Software Design and Architecture – 3650U
Midterm 1

Question 1: Design Principles (True/False)

[10 Marks: 2 Marks Each]

a) 'Usability' is a design principle that is mainly not concerned by how the packages and their classes are structured by how the user interface is designed. — T

b) The 'Reliability' design principle refers to ability of the software to keep operating despite erroneous input. — T

c) Abstraction is a key towards achieving flexibility in the design. — T

d) Experienced designers will need to perform less design work before programming than inexperienced designers regardless of the complexity of the system at hand. — T

e) The 'Flexibility' design principle refers to the ability of the design to be edited by anyone. — F

Question 2: System Context Modeling: **[15 Marks]**

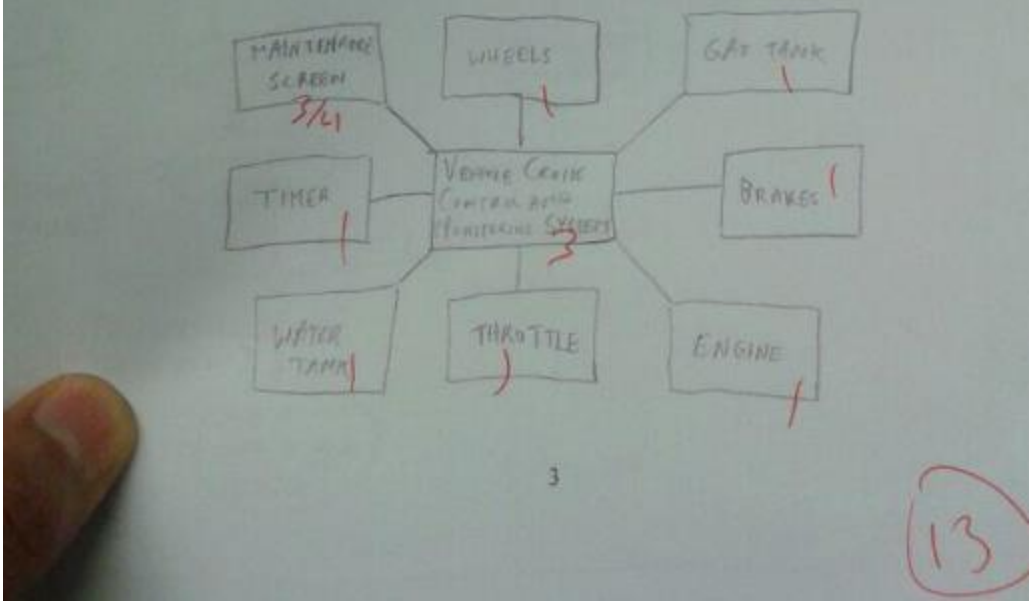
Assume the following description:

The target system is used for a vehicle cruise control and monitoring. The cruise control functionality starts when the driver puts the cruise control lever to the ON position. The cruise control functionality is immediately disable once the driver pushes on the brakes. In order to determine the current speed, the system needs to receive the number of shaft rotations from the wheel and receive input from the timer to calculate the current speed. If the speed is too high, the system reduced the pressure on the throttle. If the current speed is too low, the system increases the pressure on the throttle.

The maintenance functionality makes sure the car is monitored well. The system receives input from the engine and the water tank to determine if the engine's oil needs to be changed or if the washing water is too low. The system also receives input from the gas tank to determine if the gas is too low. Any warnings to the driver are displayed on the maintenance screen. For each of the three monitoring features it performed (engine oil, water tank and gas tank), there is a separate button for each monitoring feature that the driver can push to indicate that the corresponding service has been completed. For example, after an oil change is performed, the driver can push a button to indicate to the system that an oil change service has been performed.

Draw the system context diagram corresponding to the above description

Hint: These two main functionalities will be performed by one system



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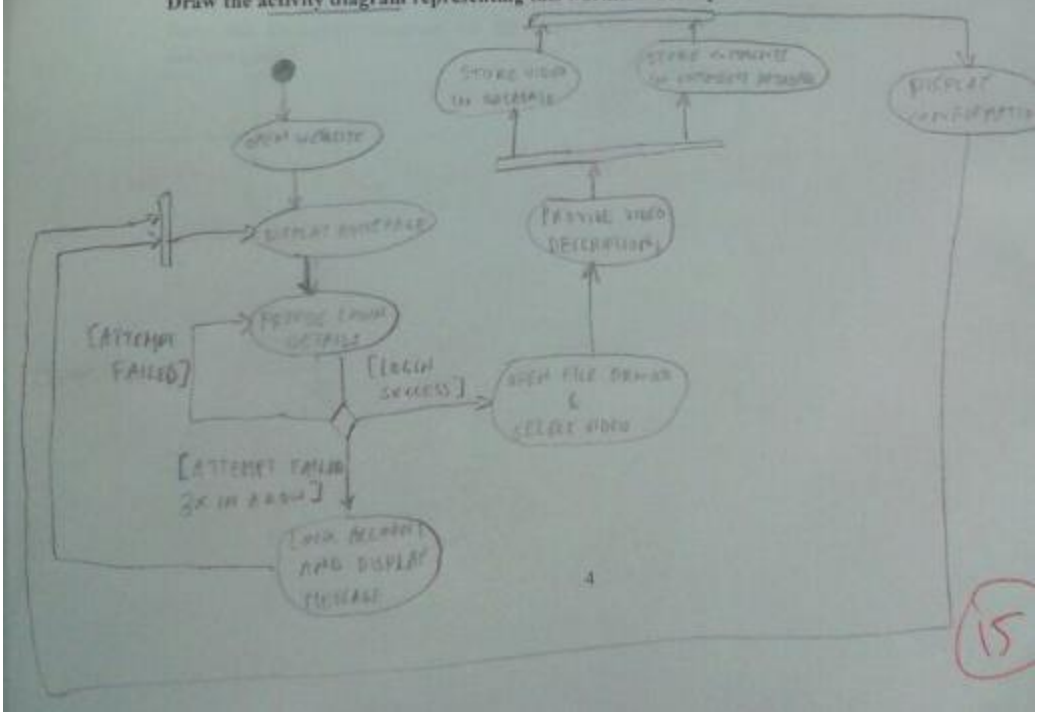
Question 3: Activity Diagrams **[15 Marks]**

For the "Upload video", "Login" and "Lock account" use cases in question 4, assuming the following the following is the description of the workflow combining these use cases.

- The student opens the website.
- The system displays the homepage.
- The student provides login details.
- If the login attempt failed them prompt to re-enter login details.
- If the login fails three times in a row, then the system locks the account and displays an appropriate message to the user before returning to the homepage.
- Once logged in, the user opens his file browser to select a video to upload.
- Once uploaded the system asks the user to provide a description of the uploaded video.
- The system stores the video in the videos database.
- At the same time the system stores the comment in the comments database.
- Once the two databases confirm the addition of the information, the system displays a confirmation message.
- The system then returns to the homepage.

Draw the activity diagram representing this workflow description



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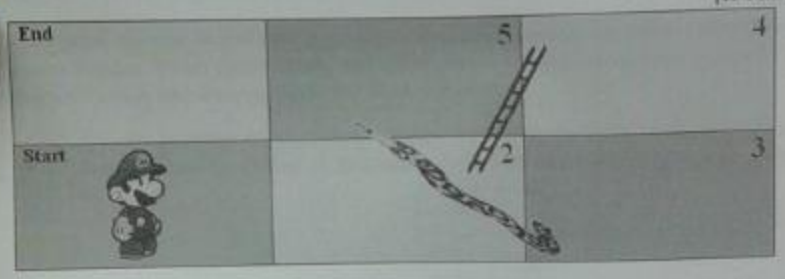
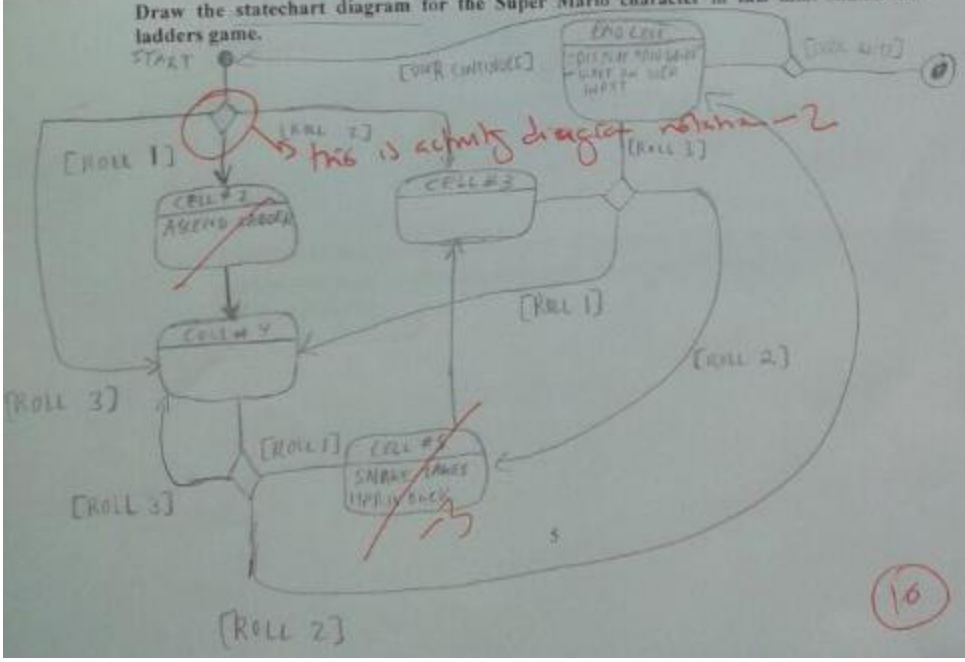
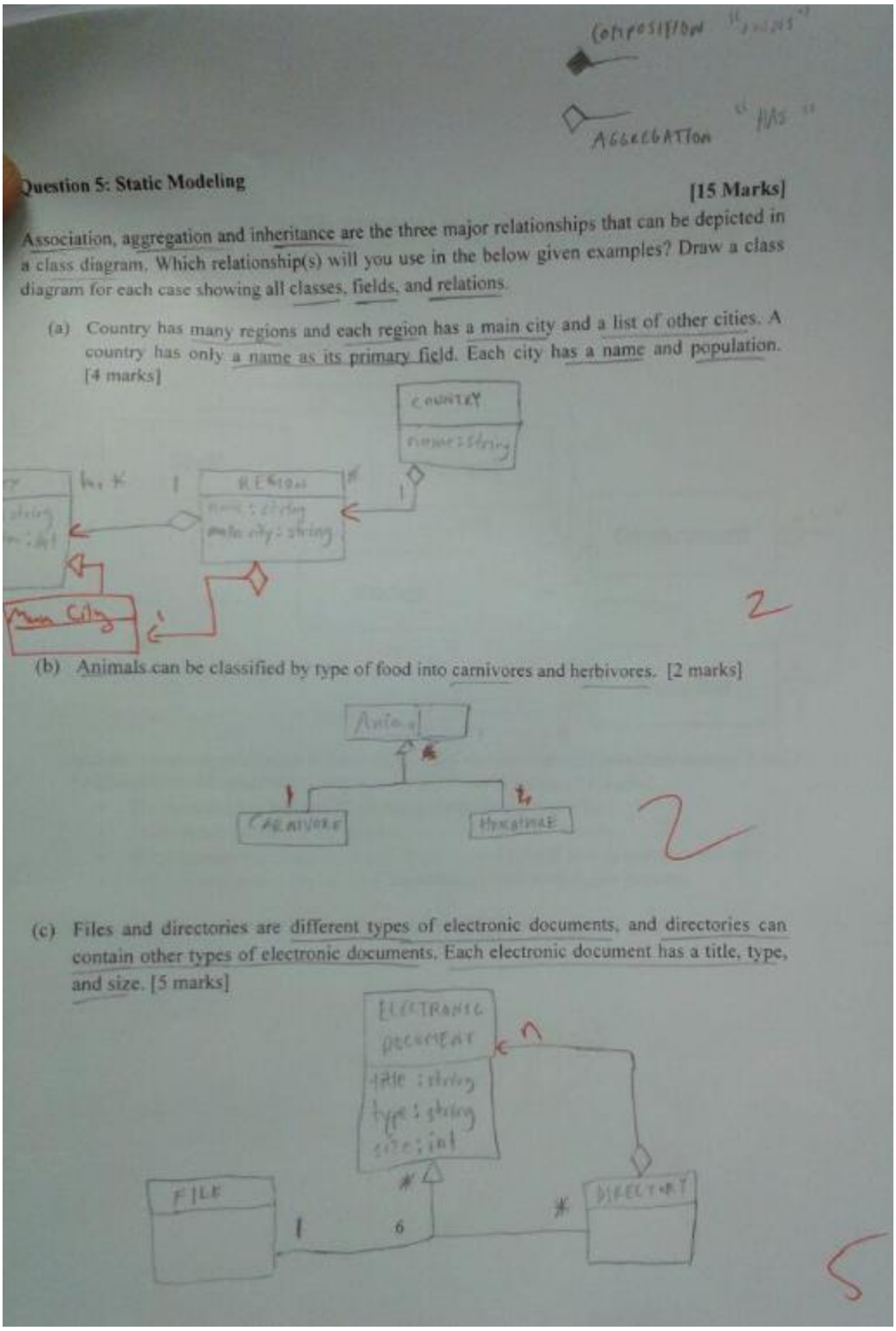
Question 4: Statechart Diagrams [15 Marks]



For this mini snakes-and-ladders game, the Super Mario® character moves by in ascending order from one cell to the other. The game starts with Super Mario in the 'Start' cell. The number of steps Super Mario® moves in each play moves is randomly generated by a computer. The number of steps can be either one, two or three. If Super Mario lands on the '2' cell, then the ladder takes him to the '4' cell. If Super Mario® lands on the '5' cell, then the snakes takes him to the '3' cell. If super Super Mario lands on cell 'End' then the game shows a "You Win" message and waits for input from the user to continue or quit. If the user selects to quit, then the game ends, otherwise the game restarts with Super Mario in the 'Start' cell again.

Draw the statechart diagram for the Super Mario character in this mini snakes-and-ladders game.





Question 5: Static Modeling **[15 Marks]**

Association, aggregation and inheritance are the three major relationships that can be depicted in a class diagram. Which relationship(s) will you use in the below given examples? Draw a class diagram for each case showing all classes, fields, and relations.

(a) Country has many regions and each region has a main city and a list of other cities. A country has only a name as its primary field. Each city has a name and population. [4 marks]

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(b) Animals can be classified by type of food into carnivores and herbivores. [2 marks]

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(c) Files and directories are different types of electronic documents, and directories can contain other types of electronic documents. Each electronic document has a title, type, and size. [5 marks]

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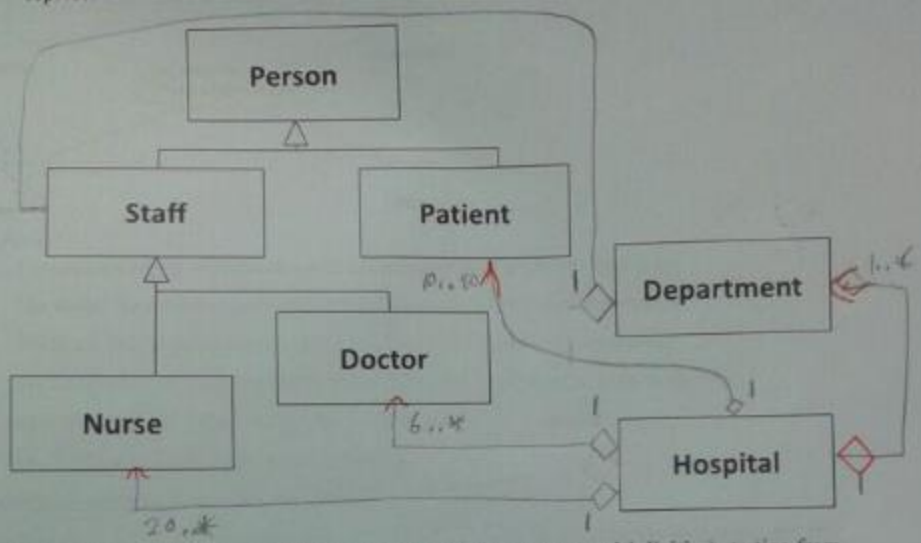
(d) FROM IN-CLASS EXERCISE: Any person in a hospital is either a patient, nurse or a doctor. Nurses and doctors are considered staff. Below is the current class diagram that represents the above information:



Add the correct **aggregation relationships (and the correct multiplicities)** starting from the Hospital and Department classes to represent the following: [4 marks]

- The hospital can have multiple departments but at least one
- Each department has staff, at least one doctor and two nurses
- The hospital must have in total at least six doctors and twenty nurses working
- The hospital must have at least ten patients but at most eighty patients.

Hint: you will only need to create aggregation relationships for this question

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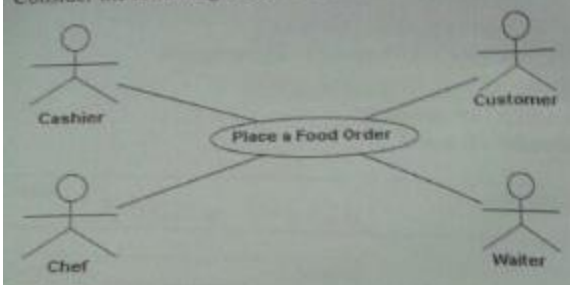
Question 6: Sequence Diagrams **[10 Marks]**

Consider the following use case describes how a food order is placed at a restaurant.



Basic Flow:

1. The use case begins with the customer providing the waiter with his food order.
2. The waiter forwards the food order to the restaurant chef who starts to prepare it.
3. While the food is being prepare, the waiter serves the customer his drink order.
4. The waiter then picks up the food order from the chef and delivers it to the customer.
5. After the customer completes his meal, he asks the waiter for the bill.
6. The waiter provides the customer with the bill
7. The customer takes the bill to the cashier to pay his bill.

Draw a sequence diagram that corresponds to the scenario described by this use case using only the objects shown below: