

CSCI3100 Software Engineering

Assignment 2

Due – 11:59:59pm, 28th Feb, 2021 (Sunday)

Please submit the homework online through Blackboard.

Late submission penalty within 24 hours: 50%; after 24 hours: 100%.

Remember to go through Veriguide for Academic Honesty Declaration.

Missing Veriguide report: 50% mark deduction.

Answer the following problems based on lecture Topics 4 notes, from which you can consider for solutions. Each question is assigned 25 points as its full marks.

1. Data Flow Diagram (DFD)

(25 points) To effectively block the spreading of the COVID-19 pandemic, Bernard University requires students to report their daily locations. By doing so, the university can know who has been to places where exist confirmed cases of affecting COVID-19. To facilitate the process, Bernard University has developed an application called Safe-Bernard. The following is the description of the Safe-Bernard application:

In Safe-Bernard, there are two types of users, which are students and teachers. To use the system, both students and teachers should first enter their student IDs or teacher IDs and passwords correctly to log in to the application. A common verification procedure for all users is conducted via the student database and the teacher database, respectively. If there is no matching information, the log-in operation will be rejected and a permission-denied output will be printed. For students who have been logged in, a request approval procedure of the application will instantly send a message to ask for their approval to access the GPS data in their smartphones. A student must send the approval message back by clicking an “approve” button. An approval token will be generated by the procedure of getting the student’s approval. With the approval token, the application can access the location file in the smart phone and get the location of the student. After getting the location, Safe-Bernard will generate a location report as output, which contains the student information verified before and the location of the student at that time. The report will be displayed to the student. Besides, from the report of the student, Safe-Bernard will generate an alert to his or her teacher if the report shows that the student is in a dangerous place. The list of dangerous places is stored in a database.

Question: According to the above description, draw a Data Flow Diagram (DFD) to describe the operation of the Safe-Bernard application. Note that the above English description may contain ambiguity. Your DFD can be made more specific and clearer as long as it meets the English description.

2. Unified Modelling Language (UML)

(25 points) Bernard, the headmaster of Bernard University, will deliver a lecture on how to properly read a research paper to all the students. He wants to visualize the process of paper reading to his listeners, but he is struggling to do so. Please help him visualize the following process using a UML activity diagram. The process is described as follows:

- a) Read the title and abstract of the paper.
- b) If you are not interested in the subject of the paper, just ignore it.
- c) If you are interested, conduct a “first pass” of the paper. The purpose of the “first pass” is to get a bird’s-eye view of the paper. Specifically, you should read the introduction, headings of sections and sub-sections, and the conclusion of the paper. Besides, you should glance over the references and mentally ticking off the ones you have already read. At the end of the “first pass”, you should be able to answer the 5 Cs: Category, Context, Correctness, Contributions, and Clarity.
- d) If the paper bores you, ignore it. If it still amuses you, you should conduct a “second pass”. Specifically, you should read the paper with greater care but ignore details such as proofs. You should make comments in the margins as you read. At the end of the “second pass”, you should be able to grasp the content of the paper.
- e) If the paper is not relevant to your research area, you can just ignore it. If the topic is relevant to you and there is much background knowledge that you do not understand, you should read some background materials to continue.
- f) Then, you should go for a “third pass.” In the third pass, you should virtually re-implement the paper in your mind as you read the details of it. After the third pass, you will understand the design details of the paper. Moreover, you will know all its advantages and disadvantages.

The above English description may contain ambiguity. Your UML activity diagram can be made more specific and clearer, as long as it meets the English description. For more information about the paper reading method mentioned above, please refer to <https://web.stanford.edu/class/cs244/papers/HowtoReadPaper.pdf>. *(If there are differences between the description and the referred link, please stick to the above description!)*

3. Finite State Machine (FSM)

(25 points) Bernard University is going to adopt cleaning robots to sanitize its buildings next semester. Bernard, the headmaster, wants to design his own cleaning robot. He needs to describe the behavior of the robot to the Meteor Corp. for the design and production of these robots. Please help him design the cleaning robot using FSM as a clearer specification. The following is the description:

A cleaning robot is usually equipped with a charging station. Initially, it will be under charging in the station. Users can set alarms or control them remotely to sanitize the whole floor. If it is the first time that the robot starts cleaning, it will first scan the storey and it will keep scanning until it knows the structure of the storey. Then the robot will start cleaning the storey. If it finds that it has finished cleaning, it will start returning to the station. Since the robot uses electricity to work, it carries a battery with it. However, the capacity of the battery is limited, so it needs to recharge if its battery capacity is low. Specifically, if the battery capacity is low when it is scanning or cleaning, it will start returning to the station. It will keep returning until it reaches the charge station. After it reaches the station, it will keep charging until it has enough battery capacity. After refuelling, if the robot has un-finished jobs, it will continue to clean or scan the storey. Else, it will stay in that way until the next invocation.

Questions:

- a) Draw an FSM to describe the behavior of the cleaning robot Mr. Bernard wants.
- b) Discuss the advantages and disadvantages of using FSM to define the actions of the cleaning robot.

4. FSM for String Operation

(25 points) Alice, a friend of Mr. Bernard's, wants to compose a song. She asks Mr. Bernard for help. Although Mr. Barnard knows nothing about music, he finds that the sequence of notes in a numbered musical notation can be expressed as an FSM with input the alphabet {1, 2, 3, 4, 5, 6, 7} ("do", "re", "mi", "fa", "so", "la", "ti").

- a) (10 points) Alice wants to compose a song that contains the pattern "15" an even number of times. Please draw an FSM that only accepts a sequence of notes that satisfies the above pattern.
- b) (15 points) Alice changes her mind. She finds that it would be enough to just use {1, 5} ("do", "so") in her new song. She wants to compose a song satisfying the following two conditions:
 - a) If the sequence of notes ends with "1", it should contain an even number of digits.
 - b) If the sequence of notes ends with "5", it should contain an odd number of digits.

Please draw an FSM that only accepts the sequences of notes that satisfy the above conditions.

Note that you should provide a detailed description of the FSMs in your design to show how it works. Specifically, you should describe the meaning of each state.