CSCI 463: Spring 2024

Exam I

Due March 3 by 11:59 pm, 2024

Take Home Exam
(Total Point: 100)

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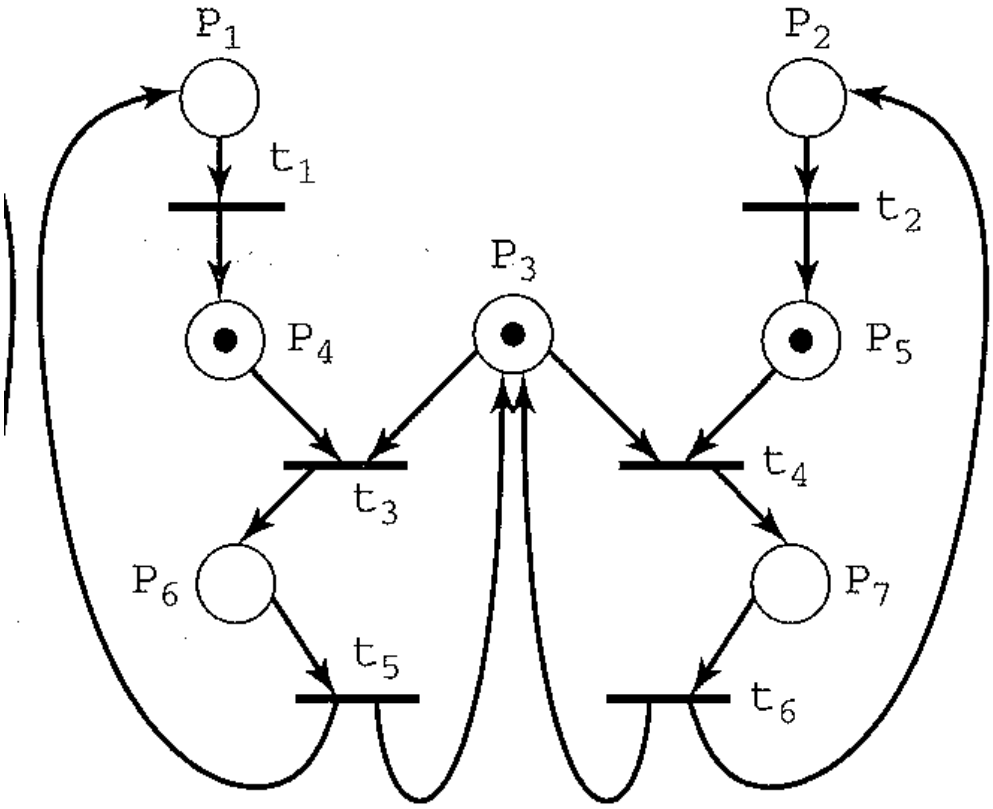
PLEASE NOTE: This is a take-home exam. The solutions must be typed and spell-checked. No Handwriting or handdrawing is acceptable.

1. (10 points) What do we mean by external and internal product qualities? What seems to be the main issues in modeling either external or internal product qualities? Furthermore, in what way availability may affect the security of the system.

    1. External product qualities refer to the experience and attributes of a program that are directly interacted with by a user. Features like the product functionality, its performance, usability, and security. All these qualities show how well a system fulfills its intended purpose and how well it can satisfy a customer's needs.
    2. Internal product qualities refer to the product design and development side of software, they include things like scalability, modularity, efficiency, and reusability. These qualities are not directly interacted with by the end user but instead help to build software with a strong foundation that outlasts many generations of hardware.
    3. A software package or project that is widely available is exposed to more people and therefore has a higher chance to be tampered with or changed which can pose a security threat if safeguards are not put in place to protect user data or to prevent unauthorized access.

2. (20 points) What are the main limitations of Petri nets and what are their main benefits? Furthermore, give two or more examples of firing sequences of transition for the following net.
    1. A Petri net is a graphical tool that can help develop a system by mapping out its functionality through graphical representation. Some of the benefits of a petri net include its analysis capabilities as well as its flexibility and modularity. Some of the complications that come with a petri net include that they do not model complex systems well as amount of states goes up exponentially the more functionality a system has. A Petri net is also limited by its ability to represent data, and specific system features.
    2. One example I could think of was an assembly line, p1 is the raw material input p4 would be a processing workstation p6 would also be another processing workstation that would further refine a product. P3 would be a buffer for the inspection line and p7 would be the final product line and p2 would be the buffer for incoming returns. T1 would be the transition where a raw material is moved to workstation 1, t2 would take a returned product and put it into the inspection line again. T3 would be a transition from workstation one to a buffer to await further processing or inspection. T4 is when a product gets taken from the buffer and moved to workstation 2, t5 is a transition that moves a finished product from workstation 2 and sent to the inspection line finally t6 is a transition where a product is removed from the buffer and shipped out or goes to the next stage in its cycle.



(d)

3. (20 points) what are the factors that may require the project to be re-estimated? (Just list them.). Furthermore, Function Point offers many advantages over other software sizing techniques. What are the pros and cons of using function points to estimate the effort?
    a. Changes in the project scope or requirements
    b. Discoveries of new technical complexities
    c. Inaccurate estimates
    d. Changes in a team composition or availability
    e. Unexpected delays
    f. Waiting on dependencies
    g. Changes in priorities
    h. Changes in deadlines

2. Some of the pros of using function points include a more standardized measure of a software project's size. It allows for comparisons across different projects to measure the amount of effort that must go into them. Some of the cons to this method include time consuming calculations to accurately estimate a projects size, in order to properly do these calculations training is required, and this method may not be suitable for every project as well as requiring a complete functional specification documents.

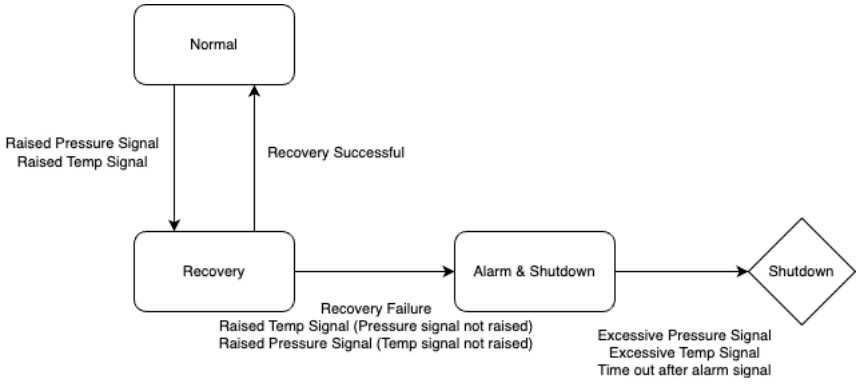
4. (30 points) Consider the control of a nuclear power plant system. In this system, temperature and pressure levels must be constantly monitored for safety reasons. Assuming that sensors are installed to detect and generate appropriate signals when either of these levels (pressure or temperature) exceeds some **predefined threshold** values.

The requirements and assumptions for managing the plant are the following:

a) When one of the two signals is raised the system must enter a recovery state in which it tries to apply a recovery procedure.
b) If, after a while, the recovery action succeeds, the system is automatically entering into the "normal" state, and sends an appropriate message (e.g., everything is OK) to the external environment.
c) Otherwise, the alarm signal must be raised, and the plant MUST be shut off. In this case, the system must also be switched off if it is trying to recover from one kind of anomaly (i.e., excessive pressure or temperature) and the other signal is raised.
d) It is assumed that the two signals (excessive pressure or excessive temperature) cannot occur simultaneously.

Can you use **Statecharts** to specify the above system?

The system would have three states Normal, Recovery, and Alarm/Shutdown. The system would have the following transitions, a Raised Pressure Signal, a Raised Temperature Signal, a Recovery successful signal, a Recovery failure signal, and a Raise an additional signal. The system actions would be Entering a recovery state, sending the all clear, Raising the alarm and finally a Shutdown Plant. Finally the one guard would be checking if one of the two signals has already been raised unless the system is in recovery.



(20 points) Consider the following memo published in the Personnel Information Bulletin for the **U.S. Army Corps of Engineers and discussed in the class**. The discussion centers on the procedures for determining employee holidays. Read it and **WEEP!**

Executive Order 10358 provided in the case of an employee whose work week varied from the normal **Monday through Friday** work week that **Labor Day**, **Thanksgiving** Day, and any of the **new Monday holidays** each were to be observed on the next succeeding or preceding workdays when the holiday fell on a day outside the employee's regular basic work week as follows:

1) When Labor Day, Thanksgiving Day, or any of the new Monday holidays are outside an employee's basic workweek, the immediately preceding workday will be his/her holiday when the non-working day on which the holiday falls is the **second** non-working day, or the non-working day designated as the employee's day off instead of **Saturday.**

2) When Labor Day, Thanksgiving Day, or any of the new Monday holidays are outside an employee's basic workweek, the next succeeding workday will be his holiday when the non-working day on which the holiday falls is the **first** non-working or the non-working day designated as the employee's day off instead of **Sunday**.

Can you refine the above high-level description to create more rigorous requirement specifications by resolving the ambiguity and incompleteness in a way that the requirements can be verified for employees whose working day is not typical **Monday-Friday**? More specifically, you need to specify ALL possible inputs such as working days and non-working, and the corresponding output (preceding or succeeding day).

Key assumption:
For simplicity, we assume that an employee's working days and non-working days are both ***consecutive*** *days. For example, one possible working day may include* ***Tuesday, Wednesday, Thursday, Friday, and Saturday****. The non-working days are* ***Sunday and Monday****.*

In this situation there are three inputs the employee workweek, the date of the holiday and the non-working day. The output would be the observed holiday. The logic behind selecting holidays would first come from determining the location of the non-working days. If the employee was on their first non-working day the observed holiday would be the next succeeding workday. If the employee was on their second non-working day or it was the employee's designated day off the observed holiday would be the next immediate workday. Some of the edge cases would be if the holiday fell on a day within the employee work week the holiday would be on the same day as the holiday. If the holiday fell outside of the employee's work week and is on a non-working day, then there would not be an observed holiday. For example, an employee works Tue-Sun labor days falls on a Monday then there would be no observed holiday since the holiday falls on a non-

working day. If the employee works a Sun-Tue and Labor Day falls on a Monday, then there is also no observed holiday since the holiday falls on a workday outside the work week. If the employee worked all days except Sunday and Monday, then the there is no observed holiday since both days are non-working days. If the holiday fell on any other day except Monday, then the observed holiday would precede the holiday so if the holiday was Tuesday, then the employee would have an observed holiday on Monday.