E&CE 355 Exam review Fall 2001

Electrical and Computer Engineering
E&CE 355 – Software Engineering
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Notes

The questions and solutions contained herein were suggested by ECE 355 students as candidates for the Fall 2001 final exam. The instructors may or may not use these or similar questions in preparing the final exam. We distribute these suggested questions to allow all students to prepare with equal advanced knowledge of the suggestions received by the instructors, not as an endorsement of particular questions or solutions.

Requirements analysis

A stop light system consists of a set of traffic lights as well as in-ground vehicle sensors.

1. UML

a) Give the Use Case diagram for this system.

b) Give the fully detailed Use Case for the case where a car arrives at an empty intersection and is presented with a red light. Assume that this occurs during 'off-hours' when the other direction is shown green unless the sensor is tripped. Include the Actor, Precondition, Description, Alternative(s) and Postcondition if appropriate.

The system is augmented with a pedestrian button. At this 4-way intersection there are several lights, 8 pedestrian buttons and several vehicle sensors.

c) Describe this system through the use of a Class Diagram.

d) Give a Collaboration Diagram and associated message sequence description that shows the flow of information involved in processing a traffic direction change initiated by a press of the pedestrian button. For this question, treat all lights as separate entities (ie. red north, green west, yellow east).

2. SDL

a) Describe the operation of the light control system under normal operation through the use of an SDL Process Diagram. Include internal timing considerations as well as external inputs, however DO NOT include the processing of the light changes (ie from green to red, red to green), instead call the appropriate procedure (you will define this in question *b* below) when a direction change is required.

b) Define an SDL procedure which performs the operation of changing the direction of traffic flow (red->green, green->yellow->red). Be sure to take the appropriate measures to insure a collision-free change (ie. red turns to green after green has transitioned to red).

Testing and reliability

The following questions on testing and reliability use Professor Naik's handout from September 24, 2001.

3. Path coverage

a) Refer to the first SDL diagram (top left). Write the sequence of output to achieve path coverage.

4. Control flow analysis

a) Refer to the second SDL diagram (top right). Draw the control flow graph.

b) Using the control flow graph from part (b), and McCabe's cyclomatic complexity, calculate the upper bound on the number of test cases needed. Show all of your work, including any intermediate calculations.

Question classification

During the lectures and tutorials leading up to the final exam, Norm outlined a four-level graduated scale for classifying exam questions.

1. *Definition* (~4)
   Definition questions confirm that the student understands the topic's essential vocabulary of discourse by asking them to recall a definition of a fundamental concept or term from the foundations of the material. Solutions should vary as little as possible from the standard definitions used in class. Marks generally reward accuracy and precision: 1 for any vague attempt; 2 for a directed attempt; 3 for a substantially-correct definition; and 4 for a precise definition matching very closely with the standard form from class.
2. *Routine application* (~12)
   Routine application questions apply concepts from the course to problems and situations considered specifically in lectures or tutorials. Often, these questions use a familiar problem as the basis, and present some incremental variation as the question. Routine application questions reflect the heaviest marking value since they represent the bulk of the application material considered in the course.
3. *Non-routine application* (~8)
   Non-routine application questions apply the concepts from the course to problems and situations outside what may have been considered specifically in lectures or tutorials. These questions require that the student recognize which concepts apply in a given context, and apply the concepts successfully. Non-routine application questions earn moderate weighting, since they demonstrate the student's capability to apply the course material in problems they may encounter in practice.
4. Advanced concepts (~5)
   Advanced concept questions require that the student expand on the material form the course by developing original methods or frameworks. These questions often require that the student override a simplifying assumption that underpinned the course material, and reason about the consequences of the change in premise. Advanced concept questions provide a means to discern among the students who understand the material well enough to apply it, versus those who truly understand its broader significance.

The numbers shown in parentheses show the relative marks weighting a question in each classification is likely to be worth.

5. Example questions

a) (*Definition*)
In a sentence or two, define *work breakdown* as it applies to project management. _______________ 4

b) (*Routine application*)
Recall a project plan we discussed in either lectures or tutorials, or a project plan from your work experience. Show the work breakdown from the plan. Clearly label the work items. Show any hierarchical structure, where higher-level work items are composed from lower-level ones. ________ 6

c) (*Non-routine application*)
During lectures and tutorials, we discussed the idea that the milestones from a large, high-level project can provide the goals for smaller, lower-level projects. For example, a top-level company (i.e., *prime contractor*) will secure the services of other companies (i.e., subcontractors) to perform the work leading up to milestones in the higher-level project. Name a real project that would likely include such an arrangement. Draw a few of the topmost levels in the work breakdown for this project. Identify the prime contractor's milestones that are also the subcontractors' goals. _________________________ 6

d) (*Advanced concepts*)
In the original PBX project work breakdown discussed in lectures, we used the *product composition* as the primary criteria in identifying milestones, such as the Call Manager process, the Call Process

process, Line Scan process, etc. In the SoHoPhone exchange case study, we used the *organizational functions* as the primary criteria, such as Marketing, Engineering, Production, etc. In a sentence or two, explain the essential difference between these two criteria. In three or four more sentences, explain the context in which each criteria is likely more appropriate than the other. _______________________ 5

Project management

Your client, *Southern Bell Research*, has decided to revise it's line of PBX control software by adding remote console access through a web browser.

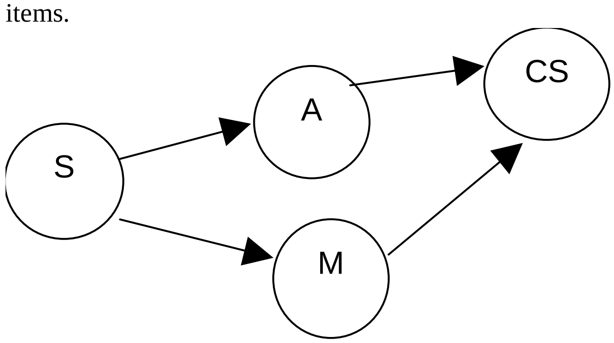
6. Information hiding

a) Define module interface.

b) Define *module implementation*.

7. Project planning

Assume that the original PBX development plan's PERT chart included the following service-related work items.



a) In two or three sentences, explain how you could use information hiding to add development of the web-based remote console access without changing the existing administration or maintenance development work.

b) Show the excerpt from the PERT chart in a plan that uses the development strategy described in your answer to part (a).

8. PERT versus Gantt charts

In class, we discussed the pro's and con's of the PERT and Gantt chart planning techniques. Discuss the merits of each and explain which you believe to be more appropriate for the following two situations.

a) Management of a team of three software developers designing a custom product.

b) Management of a team of 15 engineers designing an embedded solution reliant on outside vendors.

Partial solutions

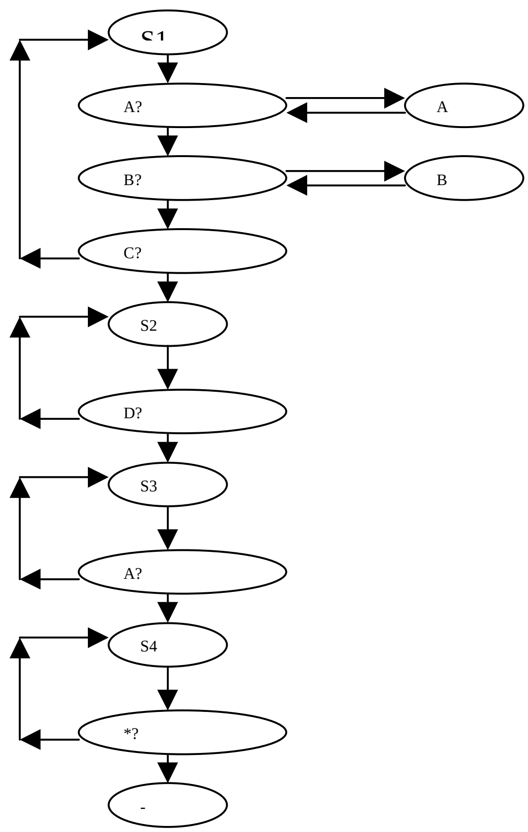
The following solutions are those provided by the students as who posed the sample questions, and are supplied here, as is. The instructors do not vouch for their accuracy or completeness, nor intend for them to be interpreted as exemplary solutions for examination purposes.

3. Path coverage

a) (a,b,d,d) (b,c,d,d) (b,d,d) (b, e, d, d) (c,b,d,d) (d,b,d,d)

4. Control flow analysis

a)



b) V(g) : # of predicate nodes + 1 = 6 + 1 = 7, *or*
V(g) : # regions = 7, *or*
V(g): # edges - # nodes + 2 = 18 – 13 + 2 = 7.
Therefore, 7 test cases should be the upper bound.

7. Project planning

b)