

**CS446/E&CE452: Software Design and Architecture**  
(Spring, 2002)  
**Final Examination**

INSTRUCTOR: G. E. Weddell

TIME: 3 hours

Name: \_\_\_\_\_

Student ID \_\_\_\_\_

This is an open book examination. For example, class text, copies of overhead slides and printed notes may be used. Do all questions.

**NOTE 1:** Some of the questions in this examination are open ended; however, they can be answered to the level discussed in class by short organized answers. It is recommended that you spend part of your time organizing your answer, rather than writing down ideas in the order they occur to you. The conciseness and organization of your answers will be taken into consideration in the grading.

**NOTE 2:** There are 100 marks in total. As a guide to managing your time, the marks awarded for each question are indicated in parenthesis at the start of each question.

**NOTE 3:** The exam booklet consists of 14 pages.

**I.** (20 marks) Some general questions on a variety of topics. Answer each part using at most a few sentences in each case.

(a) Suggest two advantages with each of the following:

(i) the democratic team structure, and

(ii) the use of chief-programmer teams.

What are the two main disadvantages of the hierarchical team structure?

(b) Ideally, the task of translating detailed design to statements in various source languages should be straightforward. Outline the three basic problems that can surface in performing this task.

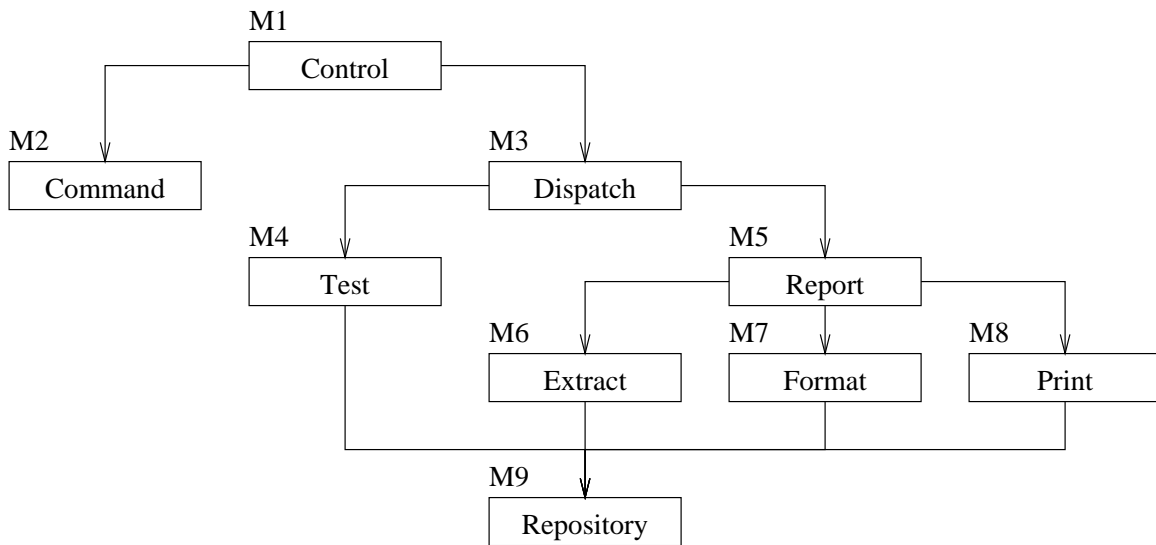
(c) Define the synesthetic characteristic of linearity as it relates to a source language. Give an example of a source language construct that usually leads to a violation of the linearity property.

(d) Describe a software system for which validation should be viewed as an indispensable activity. In what circumstance is it possible to conduct a formal verification?

(e) What is the main disadvantage of bottom-up integration testing? Outline one circumstance in which bottom-up integration testing would be required.

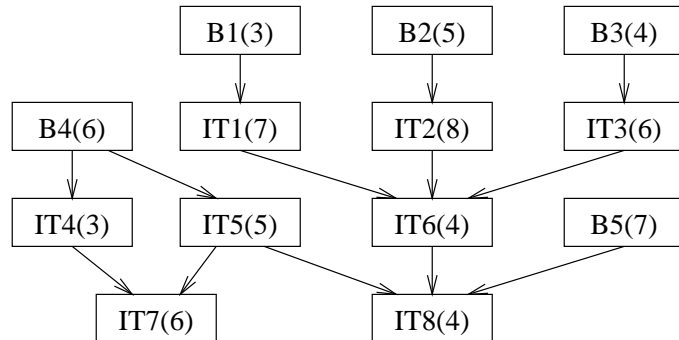
(f) Contrast architectural design with detailed design, giving at least one example of a design decision appropriately classified as architectural, and another design decision appropriately classified as detailed.

**II.** (20 marks) The detailed design for a simple OA&M communications subsystem consists of nine modules. The module names and their interdependence is reflected in the following class diagram.



(a) Outline an integration test plan consisting of six integration tests, indicating in each case the test thread and scaffolding. Your plan should reflect an overall strategy based on top-down and bottom-up testing. Draw the test priority chart.

- (b) A schedule priority chart for an alternative design of the system to be implemented by three programmers is given below. (Note that duration estimates in days for the tasks are included in parenthesis.)



- (i) Specify an task assignment for the three programmers, and draw the CPM graph for this task assignment that also reflects the constraints indicated by this schedule priority chart.

- (ii) For each task, indicate the earliest possible starting day and latest possible starting day that will not delay the project completion on the CPM graph. Indicate below the earliest possible completion date, and the activities that lie on the critical path.

**III.** (20 marks) Your company is planning the development of a new case tool to be called DBCompile. Using DBCompile, a user will be able to interactively do the following:

- (i) Modify a database description in a global repository called DATASPEC;
- (ii) Define a new query and add the query to the repository;
- (iii) Delete an existing query from the repository;
- (iv) Invoke a query compiler to add an efficient plan for evaluating a given query to the repository;
- (v) Generate Java source code conforming to the iterator design pattern for each query plan in the repository. The code is written to a file called ACCESS.class.

Based on this simple requirements specification for DBCompile, answer each of the following.

- (a) Draw a class diagram that represents a flow-oriented view of an architectural design for DBCompile. Your diagram should include at most a dozen classes that represent either activities or data sets. (Note: such class diagrams are also called “data flow diagrams”.)



- (b) Derive a first-level structure chart with a collection of modules that characterize a detailed design by using structured design methodology. In terms of data flow, is your architecture transform centered or transaction driven? Identity the activity class in your architectural design that represents the transform or transaction center.

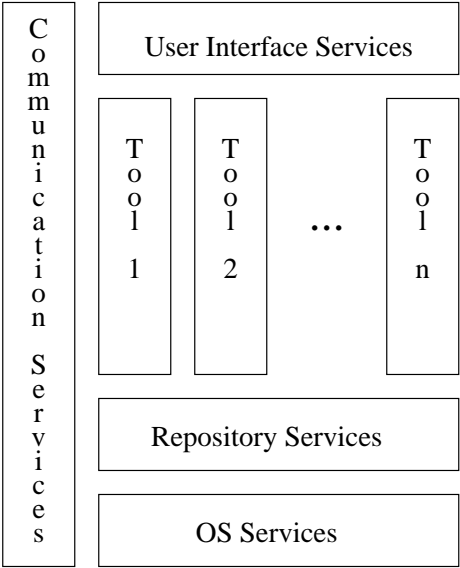
**IV.** (16 marks) Questions on architectural styles and design patterns. Answer each part with no more than a few sentences in each case.

(a) Is it true that design patterns are only relevant during detailed design? Justify your answer.

(b) In what ways are an implicit invocation style of architecture and a repository style using a blackboard similar? In what way are they different?

(c) Is it necessary to use object oriented programming languages when implementing object oriented architectural styles and design patterns? Again, justify your answer.

(d) Consider the following “toaster” reference model for a generic software engineering environment architecture.



What style or combination of styles best describes this model? Justify your answer.

**V.** (12 marks) Questions about object-oriented design. Answer each part.

**(a)** Two of the four typical generic components of the object-oriented design model include the subsystems responsible for human interaction and for task management. What are the other two?

**(b)** Recall that “system design” and “object design” are the two levels of granularity in object-oriented design. One of the activities performed during system design is the selection of an appropriate strategy for implementing data management in the software system. Briefly describe three other activities also performed during system design.

- (c) With regard to the data management component of a system design, what are two kinds of problems that are addressed by modern relational DBMS technology?

**VI.** (12 marks) Questions about software tools in general. Answer each part.

- (a) In class, we talked about the “how to get there from here” problem; that is, the problem of incorporating new software languages and tools into an existing product. Explain what this problem is.

- (b) Assume that a company called Sirius Corporation has successfully developed and is marketing a fifth-generation software development environment called SuperCASE. Essentially, their product will compile a formal requirements specification directly into efficient executable code for various computers. The efficiency of the resulting code is comparable to the efficiency of code that is produced by manual design and coding. Discuss how the availability of their product affects the systems life cycle. Suggest an alternative process model suitable for project teams that decide to use SuperCASE.