Introduction to Software Engineering
SEng 5801 - Fall 2004

Final

Due Date:
6 AM, Monday December 20, 2004
(Email submission to TA and Instructor)

This is a take home test. You have all the time in the world. It is an open book test and you are free to use the textbook, any material handed out in class, and any other resources. Note, however, that plagiarism is unacceptable and will most likely be detected.

On all essay type questions you will receive points based on the quality of the answer - not the quantity. Be concise!

Illegible answers will not be graded and awarded 0 points; typeset your answers.

There are a total of 100 points available on the test. You can get (somewhat of) an indication of the relative difficulty and time requirements of the questions based on the points awarded per question.

Your submission of the final is taken as an assurance that all the answers represent your individual effort. Collaborative efforts and plagiarism are not acceptable and, if detected, will be punished in accordance with graduate school policy.

Thank you for a great year!
**Question 1 – 6 Points.**
Describe the difference between throwaway prototyping and evolutionary prototyping.

**Question 2 – 10 (6+4) Points.**

**Part 1:**
Explain the difference between validation and verification.

**Part 2:**
Validation is generally considered harder. Why?

**Question 3 – 6 Points.**
In your own words, describe the difference between a static and dynamic view of an OO system.

**Question 4 – 8 Points.**
Consider the short description of a stolen vehicle database application (see below).
Describe any two cases of ambiguity, incompleteness or excess implementation detail in the requirements that you would wish to resolve with the actual customer before you would tackle a specification effort, for example, before you start modeling this system in Z.

*The system is a small computer that maintains a database of stolen vehicles. Each car is identified by a registration number of three letters and three digits. The main function will be for the police officer to enter the registration number of a suspicious car and the computer will display details of the car if it is stolen or, if appropriate, will indicate that the car is not recorded. The user should also be able to add details about a stolen car to the database; delete the details of a car which has either been found or incorrectly entered; and, if a model and color is supplied, return all registration numbers of cars that match the description.*

**Question 5 – 5 Points.**
In the bazaar style of open source software development, the saying “Given enough eyeballs, all bugs are shallow” refers to the unique nature of this software development movement.
Briefly explain what is meant by the saying “Given enough eyeballs, all bugs are shallow”.
**Question 6 – Points.**
Pick two of the following key tenets of XP and briefly explain why each is important:

1. Pair Programming
2. Constant Unit Testing
3. Short Iterative Cycles
4. Stories as Requirements
5. The 40 Hour Week

**Question 7 – 4 Points.**
When is it appropriate to use the “basic type” in Z?
As an example, we represented names and dates with the basic type declaration [NAME, DATE] in the birthday book example.

**Question 8 – 20 Points (3 + 3 + 6 + 6 + 2).**
An airline is introducing a new computing system for allocating seats to passengers when the passengers arrive at the airport. The rest of this question concerns the formal specification of the system. As you might expect, I want you to use Z as the modeling language.

Part 1
Each seat on a flight has a seat number, a position (either by a window, by the aisle, or in the middle) and a passenger name (a character string). Define a type Seat to represent seats. How do you represent a seat that is not allocated to a passenger?

Part 2
For the purposes of this system, a flight is a collection of seats with no two distinct seats on the flight having the same seat number. Define a schema Flight to represent the system and capture an invariant that records this requirement.

Part 3
Give a definition of an operation FreeSeats that operates on Flight and generates the set of unallocated seats on the flight as output.

Part 4
The passenger will be asked which seat position (aisle, window or middle) they prefer. They will be allocated a seat that matches their preference, provided one is available. Give a specification of an operation GoodSeat which, given a preferred position pref, generates as output an unallocated seat on the Flight with the preferred position.

Part 5
Does your specification of GoodSeat deal with the possibility that there may be no unallocated seats in the preferred position? If so, describe how you deal with this possibility. If not, provide a modified version of GoodSeat (call it RGoodSeat) that does, in some way, deal with this case, and explain how it works.
Question 9 – 8 (4+4) Points.
In a requirements document we find the concept AltitudeStatus. In the document, this concept is described briefly in English and then with a short RSML-like specification (see below) defining precisely when we shall change altitude status. Viewed as a requirements statement, the requirement captured with this specification is both incomplete and inconsistent.

Part 1: Explain what incomplete and inconsistent means in the context of requirements.

Part 2: Where is this requirement incomplete and where is it inconsistent?

```
STATE_VARIABLE AltitudeStatus :
VALUES : { Above, Below, AltitudeBad }
INITIAL_VALUE : Below
EQUALS Below IF
   TABLE
      Altitude <= AltitudeThreshold : T;
      AltitudeQuality = Good        : T;
   END TABLE
EQUALS Above IF
   TABLE
      Altitude >= AltitudeThreshold : T;
      AltitudeQuality = Good        : T;
   END TABLE
END STATE_VARIABLE
```

Question 10 - 5 Points.
The class diagram on the next page captures the structure of the Home Heating System (or at least one plausible model not too dissimilar to the one we have discussed in class). Please answer the following questions related to this diagram. Make the following assumption:

1. There is only one Controller
   
   a. How many alarm temperature logs does the controller collaborate with?
   b. More than one operator can operate the switch at one time (true or false)?
   c. How many operators can review the log?
   d. How many Heat Sources are there?
   e. One room can have both a Water Valve and an Electric Range (true or false)?
   f. The Furnace Class is most likely responsible for choosing whether to use the Oil or Electric furnace when both are included in an installation (true or false)?
   g. Each Home Heating System must have a Burner and a Fuel Valve (true or false)?
   h. What kind of Heat Source is in a room (Electric, Water, Both, Cannot Tell)?
   i. The same operator must operate the Switch, Thermostat, and Review the Log (Yes or No)?
   j. Every operator must review at least one log (true or false)?
Question 11 – 20 Points.

In the classic paper “Seven Myths of Formal Methods1” Anthony Hall discusses what he considers a collection of common misconceptions regarding the use and applicability of formal methods. In short, he argues that formal methods are quite usable and should receive a lot more attention and practical use. Given your limited experience with formal modeling in this class, is Hall right or wrong?

Pick one of the paper titles below and write a critical essay addressing the issue above. Your essay may not be longer than 2 pages, single-spaced, 12 point text. Any figures are included in this page limit. The list of references, on the other hand, is not included in the page limit.

1. **Formal Modeling: A Tool for the Practicing Software Engineer.**

2. **Formal Modeling: High Cost and Uncertain Benefits.**

Please take a position (either for or against formal modeling) and back up your position with well-structured arguments (back them up with citations and/or your own experiences). There is no right answer to this question and you can argue your position from many different angles—your main problem is to formulate your position and focus on what you consider the key issue (or issues). Do not attempt to cover too many issues in your essay, you only have two pages so you better pick 1-3 issues you feel strongly about and base your discussion around them. Also, do not simply copy Hall’s argument—if you agree with him, back up his (and your) position with additional arguments and experiences.

The paper is available on the finals web page and some other resources are also posted. If you have questions regarding this question and your essay, please use the Phorum.

**Note:**
The answers will be graded both on content as well as organization and clarity of the writing.

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