

**Computing Science Examination
Spring Semester 2017**

CSCU9P6: Software Engineering II

Thursday 27 April 2017

14:00 – 16:00 hours

This paper contains **THREE** questions. Attempt **ALL THREE** questions.

All questions carry equal marks.

The distribution of marks among the parts of each question is indicated.

Please use separate answer books for Section A and Section B.

IMPORTANT NOTE

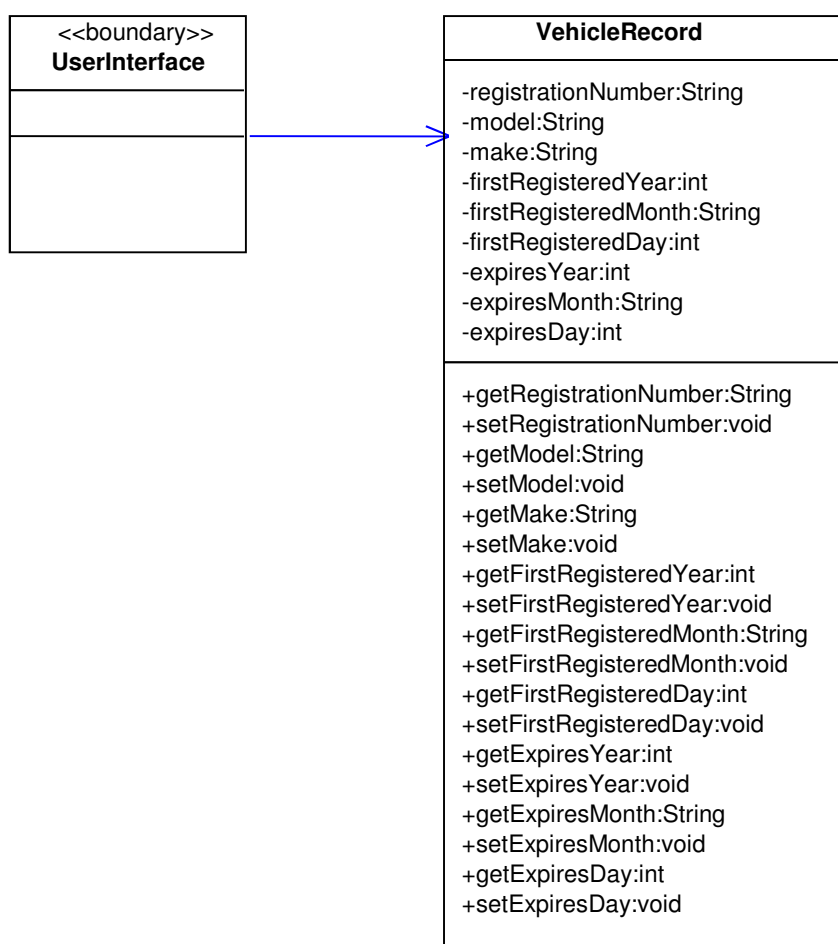
Read the instructions on the front of each answer book carefully.

It is essential that you write your student number on the front of each answer book.

Also, when you have completed the examination, the number of answer books that you have used must be prominently written on the front of one book.

Section A Question 1: Software Implementation [Total Marks 25]

- (a) Explain what is meant by “refactoring” an object oriented design. [5]
- (b) For what reasons might refactoring an object oriented system be beneficial? [5]
- (c) Below is a UML class diagram for part of a vehicle license records system. Each VehicleRecord comprises a number of private attributes, and a number of public operations that the boundary UserInterface calls to access the attributes (the “get” and “set” operations carry out the standard actions on the appropriate attributes).



At a late stage in the process it is decided that it would be better not to have two similar groups of attributes in VehicleRecord for the two dates (first registration and expiry), but to refactor the VehicleRecord class to give a separate Date class. The intention is to leave the *services offered* by the VehicleRecord class *unaltered*.

- (i) Why is it important not to alter the services offered by VehicleRecord? [2]
- (ii) Draw the refactored class diagram (for convenience, you may use abbreviated lists of operations, provided that it is clear what is included, e.g. “get/setFirstRegisteredYear/Month/Day”). [4]
- (iii) Give example Java code definitions for the getMake, setMake, getExpiresYear and setExpiresYear methods in your new VehicleRecord class, and for typical get and set methods in your new Date class. [6]
- (iv) What may be considered beneficial about this refactoring? [3]

Section B

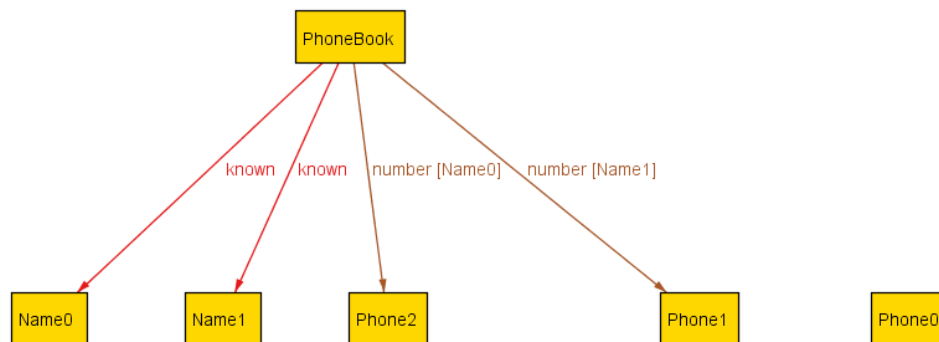
Question 2: Formal Specification

[Total Marks 25]

The Alloy code below is part of a specification of a Phone Book, which is used to keep track of friends' names and telephone numbers:

```
sig Name { }
sig Phone { }
sig PhoneBook {
    known : set Name,
    number : known -> some Phone
}
```

- (a) How many phone numbers can be associated with a name in the **known** set? How many names can be associated with a phone number? **[2]**
- (b) The diagram below shows a model of this specification.



What would be the result of evaluating the following expressions in this model?

- (i) # PhoneBook\$0.known **[1]**
- (ii) PhoneBook\$0.number **[1]**
- (iii) PhoneBook\$0.number[Name\$0] **[2]**
- (iv) PhoneBook\$0.number.Phone **[2]**
- (v) Phone – PhoneBook\$0.number[Name] **[2]**
- (c) Write general expressions to denote the sets described below:
- (i) All phone numbers associated with both Name\$0 and Name\$1 in PhoneBook\$0. **[3]**
- (ii) All names that are associated with Phone\$1 in PhoneBook\$0. **[3]**
- (d) Describe in detail how predicates and assertions can be used to check the correctness of an Alloy specification. With reference to the “small scope hypothesis”, explain the limitations of the checks that the Alloy Analyzer can carry out, and discuss whether the Alloy approach is still useful despite these limitations. **[4,5]**

Question 3: Software Project Management.

[Total Marks 25]

You have been hired by the University of Stirling to manage the reimplementation of the Student Portal system. The Student Portal is a large and complex software system consisting of a web interface connected to a database holding student records, teaching and examination timetables, and other miscellaneous information such as university announcements and advertisements of events. The Student Portal is used regularly by around 11,000 students to register for classes, check their records and timetables, self-certify absence from classes, and many other functions. Information Security and Data Protection are important concerns, because the Student Portal holds confidential personal data. Another concern is that the system must remain available during periods of heavy use, such as the start of semester and the examination period.

Answer ONE of the six questions listed below.

A. Cost and effort estimation.

- (a) Explain why it is important to be able to estimate the effort and cost that a software project will involve.
- (b) Discuss what the difficulties are in making such estimates.
- (c) Describe two methods that have been proposed for project cost estimation.
- (d) Discuss how these methods might be applied to the Student Portal project.

[25]

B. Activity planning.

- (a) Explain the reasons for producing a project activity plan.
- (b) Discuss what is meant by an “activity” and how a project manager might go about identifying the different activities that make up a project.
- (c) Describe in detail the general structure of a project activity plan, the kinds of diagrams that it might contain, and the ways in which it might be analyzed.
- (d) Sketch a possible activity plan for the Student Portal project.

[25]

C. Team management.

- (a) Explain why project team management has been described as one of the most challenging aspects of software project management.
- (b) Discuss what factors should be considered in selecting and training new staff for a team.
- (c) Write a list of guidelines for project managers to follow, giving reasons for each guideline.
- (d) Discuss how you would go about selecting and managing a team for the Student Portal project.

[25]

D. **Risk management.**

- (a) Explain why it is important to foresee and manage risk in software projects.
- (b) Discuss the kinds of risks that affect software projects.
- (c) Describe in detail techniques that project managers can use to foresee risk, measure its impact, and monitor and mitigate its effects.
- (d) Discuss how you would apply these risk management techniques in the Student Portal project.

[25]

E. **Quality assurance.**

- (a) Discuss what is meant by “quality” in the context of software.
- (b) Describe some ways in which quality can be measured.
- (c) Discuss various techniques that have been proposed for software quality assurance.
- (d) Explain what approach you would use to assure quality in the Student Portal project.

[25]

F. **Project management tools.**

- (a) Explain why software tools might be of help in project management.
- (b) Describe some of the functions that a project management tool should provide.
- (c) Give detailed descriptions of at least two project management tools, explaining what features they provide and discussing their strengths and weakness.
- (d) State whether you would recommend one of these tools for use in the Student Portal project, explaining your reasoning.

[25]

END OF EXAMINATION