UNIVERSITY of STIRLING

Computing Science Examination - Spring Semester 2018

Faculty of Natural Sciences

CSCU9P6: Software Engineering II

Date TBA **Time TBA (2 hours)**

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

All questions carry equal marks (25 marks each).

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.

Please do not leave your seat unless you are given permission by an invigilator.

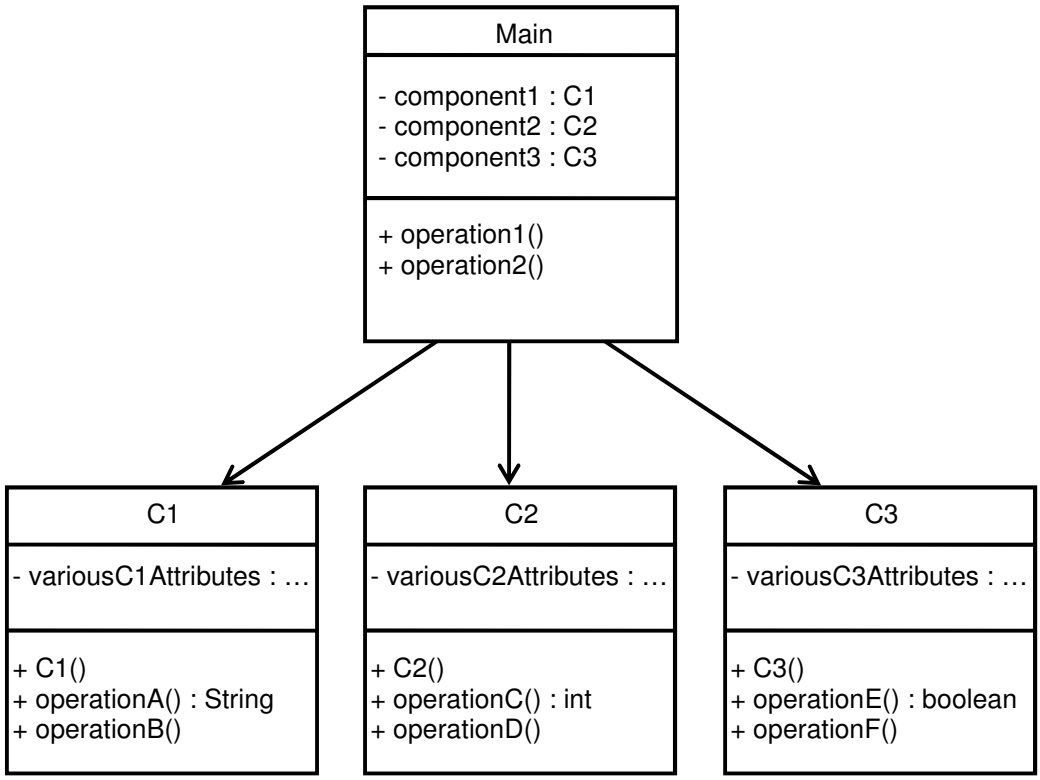
Section A

Question 1: Implementation [Total marks: 25]

(a) *Verification* and *validation* are essential aspects of the software engineering process. Describe both *verification* and *validation*, highlighting their differences. **[6]**

(b) Complex object-oriented systems may consist of many interdependent classes. Explain the weakness of only testing the system *as an integrated whole* in this context. Describe the approaches that software engineers have devised to carry out systematic testing of such systems. **[9]**

(c) Here is a class diagram for an object-oriented system comprising a Main class (perhaps a visible user interface), and three other classes, C1, C2 and C3, which provide the types for its three attributes:



Note: Instances of Main *contain instances of the classes* C1*,* C2 *and* C3 *in attributes* component1*,* component2 *and* component3*. The implementations of* operation1(), operation2(),... *in* Main *contain assorted calls of the operations offered by the objects in attributes* component1*,* component2 *and* component3*. The public operations* C1(), C2() *and* C3() *are constructors for their classes.*

Outline a *test plan* in which *stubs* and *drivers* would be used in order to fully, and systematically, test this system.

For full credit, give sample Java JUnit code for a driver to test class C1. **[10]**

Section B

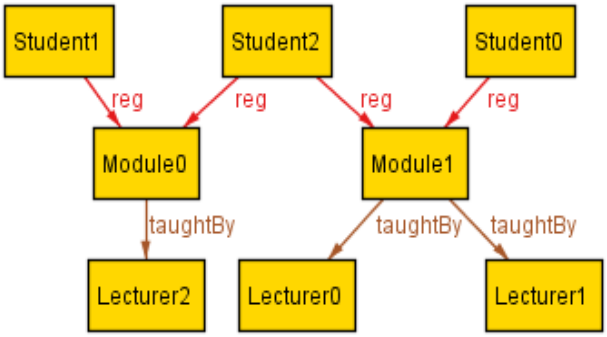
Question 2: Formal Specification [Total marks: 25]

The Alloy code below is part of a specification of a University system, described as follows: *The university employs lecturers who teach modules. The university has students, each of whom may be registered for one or more modules.*

```
sig Lecturer { }
sig Module { taughtBy : some Lecturer }
sig Student { reg : set Module }
```

(a) How many lecturers teach each module? How many modules can a student be registered for? **[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) Student$2.reg **[1]**
(ii) Module.taughtBy **[1]**
(iii) # taughtBy.Lecturer$1 **[2]**
(iv) Student$2.reg.taughtBy **[2]**
(v) Student$2.reg & Student$1.reg **[2]**

(c) Write general expressions to denote the following:

(i) All modules taken by Student$2 but not taken by Student$0 **[2]**
(ii) All students registered for Module$0 or Module$1 **[2]**
(iii) All students taught by Lecturer$0 **[2]**

(d) Alloy models can contain *predicates* and *assertions*.

(i) Briefly explain what these are and what they are used for. **[2]**
(ii) Give a simple example of each based on the given specification. **[2]**
(iii) Explain the difference between running a predicate and checking an assertion. Use the examples you gave for part (ii) to illustrate your answer. **[3]**
(iv) When a predicate is run, the Alloy Analyser may conclude that it is consistent, or that it may be inconsistent. Explain why it is possible to be sure of the first outcome but not the second. **[2]**

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Question 3: Software Project Management [Total marks: 25]

The *Stirling Reporter* is a well-established local newspaper with a modest print circulation among customers in the Stirling area. Sales are declining because readers increasingly prefer to read the news online, so the *Stirling Reporter* has decided they need to create a website to complement the printed paper. The aims of the proposed website are: to provide timely news reporting through hourly updates; to attract new subscribers with a combination of free and subscriber-only content; to encourage reader involvement through blogs and comment forums; and to earn money from online advertising.

You have been hired to manage the *Stirling Reporter* website development project. Answer **ONE** of the six questions listed below.

A. **Cost and effort estimation.** **[25]**

(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 you would go about estimating cost and effort for the *Stirling Reporter* project.

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) Identify activities and sketch a possible activity plan for the *Stirling Reporter* 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 staff to make up a new team.
(c) Write a list of guidelines for project managers to follow when managing teams, giving reasons for each guideline.
(d) Discuss how you would go about selecting and managing a team for the *Stirling Reporter* project. **[25]**

D. Risk management.

(a) Explain why it is important to foresee and manage risks 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 to the *Stirling Reporter* 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) Describe techniques that have been proposed for software quality assurance. **[25]**
(d) Explain what approach you would use for quality assurance in the *Stirling Reporter* project.

F. Project management tools.

(a) Explain why software tools might be helpful in project management.
(b) Describe in general the kinds of functions that a project management tool should provide.
(c) Give a detailed description of at least two specific project management tools, explaining what functions they provide and discussing their strengths and weaknesses.
(d) State whether you would recommend one of these tools for use in the *Stirling Reporter* project, explaining your reasons. **[25]**