

UNIVERSITY OF EDINBURGH
COLLEGE OF SCIENCE AND ENGINEERING
SCHOOL OF INFORMATICS

**INFR08019 INFORMATICS 2C - INTRODUCTION TO
SOFTWARE ENGINEERING**

Monday 18th December 2017

14:30 to 15:30

INSTRUCTIONS TO CANDIDATES

Answer QUESTION 1 and ONE other question.

**Question 1 is COMPULSORY. If both QUESTION 2 and
QUESTION 3 are answered, only QUESTION 2 will be marked.**

All questions carry equal weight.

CALCULATORS MAY NOT BE USED IN THIS EXAMINATION

Convener: I. Simpson
External Examiner: I. Gent

THIS EXAMINATION WILL BE MARKED ANONYMOUSLY

1. THIS QUESTION IS COMPULSORY

- (a) The Big Bang company has asked you to produce an OO design for a system for automatically running fireworks shows. Consider the following system description and include in your design a class for each of the italicised nouns.

A *show* consists of a sequence of *events*, each involving the explosion of a *firework* some particular *time* after the show starts. A *show controller* device can be programmed with a number of shows. In order to set up a show performance, the controller is wirelessly connected to one or more *firing module* devices, each responsible for setting off up to 10 fireworks. Show performance begins when a start signal is given to the controller.

Draw a UML class diagram for the design. Include attributes and operations directly suggested by the description. As appropriate, include one or more classes simply as attribute types. Do not indicate navigability of associations, but do show multiplicities.

[9 marks]

- (b) Non-functional requirements cover aspects such as *security*, *safety*, *usability*, *reliability* and *performance*. Considering the system described in part 1a, pick three of these aspects and for each briefly describe the issues that it is important for the overall design to address.

[6 marks]

- (c) Many version control systems make use of a *3-way merge* operation. Describe what happens with a 3-way merge of three source files, mentioning what happens when there are conflicts. Give an example of when a 3-way merge is used.

[6 marks]

- (d) Ant and Maven are two popular build tools for Java.

- i. Compared to Ant, what is the main restriction mentioned in class that Maven puts on users and what is the benefit of this restriction?
- ii. Give two examples of build tasks that Maven can be used for.

[2 marks]

[2 marks]

2. ANSWER EITHER THIS QUESTION OR QUESTION 3

- (a) When designing a system with several classes or software components, an important characteristic to consider is the *coupling* between the classes or components. What is coupling? Is higher or lower coupling more desirable? Explain your answer. [5 marks]
- (b) Consider the following fragment of a class for the time of day in a 24hr format.

```
public class Time {
    private int hour;
    private int minute;

    public Time(int hour, int minute) { ... }

    public addMinute() { ... }
    public subtractMinute() { ... }
    ...
}
```

Write a suitable JML class invariant for this class. At what points of execution of the `addMinute()` and `subtractMinute()` methods would it be appropriate to do run-time checks of the invariant? [6 marks]

- (c) Write a JUnit 4 test class `SubtractTest` that includes two tests of the `subtractMinute()` method of the `Time` class introduced above. In one test the hour value should stay the same, in the other it should change. Assume the `Time` class defines an appropriate `equals()` method. Make use of the JUnit `assertEquals()` static method. Why is this to be preferred over using `assertTrue()` method on the result of a call to `equals()`? There is no need to include any import statements in the class description. [7 marks]
- (d) At first sight, the three phases *Inception*, *Elaboration* and *Construction* of a cycle of the Unified Process appear rather close in spirit to the *Requirements*, *Design* and *Implementation* activities of the traditional Waterfall process model. In broad terms, without going into specifics of the individual phases, how are they different? [4 marks]
- (e) A software development team is considering whether to adopt an Extreme Programming (XP) approach. What team characteristics might make the adoption of XP more suitable? [3 marks]

3. ANSWER EITHER THIS QUESTION OR QUESTION 2

- (a) i. What is a *refactoring*? [2 marks]
ii. Why might applying refactorings to a design be strongly desirable and what would the refactorings change? [3 marks]
iii. Why is refactoring particularly important with Agile software development processes? [2 marks]
- (b) Describe the kinds of information that are most important to include in a bug report. Include a brief discussion of whether a bug report should include ideas on the bug cause. [6 marks]
- (c) Imagine you are reviewing some Java code for a shopping application that contains the following code.

```
boolean inputProcessed = false;
while (!inputProcessed) {
    try {
        fetchAndProcessCustomerInfo();
        inputProcessed = true;
    } catch (Exception e) {
        window.openPopupWindow(e.getMessage());
    }
}
```

Here method `fetchAndProcessCustomerInfo()` prompts a customer to enter some information about himself or herself and accesses a database of customer information in order to add the new information. Explain the security risk posed by this code and name a CWE Monster Mitigation that it violates. [4 marks]

QUESTION CONTINUES ON NEXT PAGE

QUESTION CONTINUED FROM PREVIOUS PAGE

(d) Imagine you are working on software for the control system of a self-driving car. The system has passed all the required tests set by the regulatory authorities and it is a week before the car goes on the market. The car launch is timed to take place during an important car trade show and your company's financiers are keen for the launch to go ahead.

i. In re-running previous simulations with input data that has new random small differences, you observe a scenario in which any human driver would cope fine but in which the control system loses control of the car and the car overturns. In many millions of previous similar tests the control system has functioned perfectly. Name two sections of the ACM/IEEE Code of Ethics that are relevant here, giving a sentence about what each is about. What are the arguments in favour of notifying your boss of this potential issue now? What mitigating factors might there be to keep quiet?

[6 marks]

ii. You subscribe to a competing company's various social-media feeds and you happen to be viewing one of these feeds when a post appears concerning a new drive-comfort feature the competing company plans to include in their self-driving cars in 3 months time. This post vanishes in under a minute and you realise that it must have been posted in error. Your company had not been planning on introducing a similar feature for another year, but work on it is already underway. You realise you could accelerate its development so your cars too could have this feature in 3 months time. What does the ACM/IEEE Code of Ethics tell you about the ethics of doing so?

[2 marks]