

UNIVERSITY OF EDINBURGH  
COLLEGE OF SCIENCE AND ENGINEERING  
SCHOOL OF INFORMATICS

**INFORMATICS 2C: INTRODUCTION TO SOFTWARE  
ENGINEERING**

**Wednesday 1<sup>st</sup> December 1897**

**00:00 to 01:00**

**INSTRUCTIONS TO CANDIDATES**

**Answer any TWO questions.**

**All questions carry equal weight.**

**CALCULATORS MAY NOT BE USED IN THIS EXAMINATION**

## 1. Design

- (a) What is an *abstract class*, and what is an *interface*? In Java, what is the main difference? [3 marks]
- (b) Draw a UML class diagram to show all of the following information.

- An interface `Graph` which provides two public operations:
  - `draw()` returning no result
  - `getSlope()` returning a `Float`.
- A class `SimpleGraph` which conforms to the interface `Graph`.
- An abstract class `GraphAnnotator` which conforms to the interface `Graph` and also has an association with `Graph`. Use multiplicity notation to indicate that each `GraphAnnotator` object is linked to exactly one `Graph` object, while a `Graph` object may be linked to any number of `GraphAnnotator` objects.
- A class `XAxisScaleGraphAnnotator`, specialising `GraphAnnotator` and providing an extra operation `drawXAxisScale()` returning no result. [8 marks]

- (c) Suppose that the following is a constructor for `GraphAnnotator`

```
public GraphAnnotator (Graph annotatedGraph) {
    this.annotatedGraph = annotatedGraph;
}
```

that the following is a constructor for `XAxisScaleGraphAnnotator`

```
public XAxisScaleGraphAnnotator (Graph annotatedGraph) {
    super(annotatedGraph);
}
```

and that the following is `XAxisScaleGraphAnnotator`'s implementation of `getSlope()`:

```
public Float getSlope() {
    return annotatedGraph.getSlope();
}
```

Draw a UML sequence diagram to show what happens when the following method (say, of an object called `t` of class `Test`) is invoked:

```
public void annotatedGraphTest() {
    // create an annotated Graph with a vertical scrollbar
    Graph annotatedGraph =
        new XAxisScaleGraphAnnotator(new SimpleGraph());
    // print the Graph's slope
}
```

```
    System.out.println(annotatedGraph.getSlope().toString());  
}
```

[8 marks]

- (d) Instead of the design considered above, we could have used just two classes, say **Graph** and **GraphWithXAxisScale**. Explain how the classes would be related, and how a test with user-visible behaviour similar to that described in part (c) would be achieved. [3 marks]
- (e) By considering a situation in which Y-axis scaling may also be required, or otherwise, explain why one might want to use the design considered in parts (a)-(c) rather than the design considered in part (d). [3 marks]

## 2. Ethics, Quality, Security, Licensing and Testing

(a) You are a member of the software engineering team working on proprietary software written in Java and using the JUnit regression testing framework. This is the first project you've worked on where the product has become successful in the market (all the previous projects were shelved or failed in the marketplace), and you are enjoying working on code that is in daily use, solving an important problem. Nevertheless, you are aware that a new competitor has entered the market and is doing very well - your product's position is under threat.

i. You have found a security bug in the upcoming release of the product, a bug that is not present in the current version. Since use of the product involves entering personal financial details into a server, you are concerned that some customers could have their financial data stolen, although the bug is pretty obscure. The new version is to be released in three days, and marketing regards this release as crucial to maintaining market share. You know your boss will be angry if you bring this up now. Which section or sections of the ACM/IEEE Code of Ethics are relevant here (name each and give some detail of what it is about)? What are the arguments in favour of notifying your boss of this potential bug now? What mitigating factors might there be to keep quiet. [5 marks]

ii. You are browsing the competitor's public website and come across a page that describes a new feature they plan to introduce in their next release in three months. You think it must be an internal document that was never intended to be made public, although it is not marked "Private" or "Confidential" or the like. As you read, you realise this is a fantastic idea that will really appeal to customers, and you also realise that it could be added to your product in just a few days. But since this information was obviously not supposed to be released, you wonder about the ethics of using it. You quickly consult the ACM/IEEE Code of Ethics. What does it tell you? [3 marks]

- (b) Your CEO has decided that the company needs to introduce a quality improvement process, so that over time she can be sure that the product quality is getting better. She asks you to look into it - she suggests ISO 9000 and CMMI as two to start with. You tell her right away that only one of these is suitable. Which is it? What is it about the other one that makes it unsuitable for her purposes? [3 marks]
- (c) Your boss wants to focus the next release on security improvements.
- i. You are put in charge of this. You look at the Monster Mitigations from CWE. One of the principles is to: “Establish and maintain control over all of your outputs”. What are the other four? [2 marks]
  - ii. The product includes a component that accepts input typed in by the user and displays it back to the user on a web page. What should the component do to adhere to the principle given above? what can happen if the component does not do this? [3 marks]
- (d) The product is a consumer oriented web-application that enables easier searching of retail websites such as supermarket sites. There is a new enterprise prospect (a large supermarket chain) in the sales pipeline. The sales team tell you that they are pretty sure this potential customer will want some statistics on reliability. Assuming the customer has a short attention span and you can only provide one statistic, what would it be? Name it and describe it. [3 marks]
- (e) Your boss has read about an open source library that learns from shopper interactions what sort of products the shopper likes to buy. He thinks this would be a killer feature, and asks you to look into including it in the product. He says he thinks it might be LGPL’ed but he’s not sure what that means or if he’s right. What do you do? [3 marks]
- (f) Your CEO is taking an unhealthy interest in the details of product development. She wants to know what the development team is doing about verification and validation, having heard these terms from one of the Directors of the company. First you have to explain to her what these mean. What do they mean? You explain that the JUnit test framework helps with both of them. How does it help with each of them? [6 marks]

### 3. Processes and Use Cases

NOT SHOWN