

COMPUTER SCIENCE TRIPOS Part IA – 2023 – Paper 1

3 Object-Oriented Programming (rgu20)

- (a) This question covers the concept of variance in Java.
- (i) Explain what is meant by Java arrays being covariant. [2 marks]
 - (ii) Provide a code example which type checks at compile time but yields a runtime exception due to covariant arrays. [2 marks]
 - (iii) Explain what is meant by Java generics being invariant and how it contrasts to the previous example. [2 marks]
- (b) Explain the notion of *cohesion* in the context of classes. What is meant by high cohesion and low cohesion? Why is high cohesion desirable? [2 marks]
- (c) Explain the notion of *coupling* in the context of classes. What is meant by high coupling and loose coupling? Why is low coupling desirable? [2 marks]
- (d) Suppose we have a stock trading application that needs to notify users of changes in stock prices but allows users to choose how they want to be notified (e.g. via email or text message).
- (i) Explain the intent and relevance of the observer design pattern for this problem. [1 mark]
 - (ii) Explain the intent and relevance of the strategy design pattern for this problem [1 mark]
 - (iii) Draw a UML diagram describing the key components of the observer design pattern. You do not need to recall the exact UML specification, instead you may provide a key explaining your notation. [2 marks]
 - (iv) Provide a skeleton of Java code for the subject as a class called `Stock`. Detail any methods required to notify and manage the users as well as an example of setting up at least two notification strategies for two different users. Explain any assumptions and tradeoffs of your approach. [6 marks]