3 Object-Oriented Programming (RKH)

An online retailer uses custom Java software to manage their inventory and sales.

(a) Each product sold is represented using an immutable Product object. Explain what is meant by immutable, how immutability is typically achieved in Java and the advantages of using immutable objects in general. [4 marks]

(b) Product objects are requested through a Product getProduct(long code) method, which returns a reference to a Product object given a valid product code. Product information is often re-requested as customers make their selections so the 10,000 most recently accessed Product objects are cached in memory. Uncached Product objects are created with information retrieved from a database when requested.

(i) The cache uses a java.util.HashMap and a custom implementation of a doubly-linked list. The list keeps an ordering over the Product objects where more recently used objects are at the front. The HashMap provides fast lookup into the list. Show that this scheme gives a constant (O(1)) running cost for getProduct(), ignoring the cost of the database lookup. [3 marks]

(ii) Create a class Store that implements the cache as described. You need only define getProduct and any state or definitions it needs. All other state and methods can be ignored. You may assume the existence of a method loadFromDatabase(long code) that will create a Product object for product code code or return null if the code is invalid, and that a Product object has a long getProductCode() method that returns its product code. [10 marks]

(c) A customer’s basket of items, represented by a class Basket, can be viewed as a list of products. Therefore Basket might extend LinkedList<Product>. Compare this approach to a Basket that contains (“has-a”) LinkedList<Product> instead. [3 marks]