

2008 Paper 1 Question 10

Programming in Java

The following is one of the examples from the Foundations of Computer Science course:

```
exception Change;
fun change (till, 0) = []
  | change ([], amt) = raise Change
  | change (c::till, amt) =
    if amt<0 then raise Change
    else (c :: change(c::till, amt-c))
      handle Change => change(till, amt);
```

- (a) Define a Java class of your own (i.e. do not use any library class that you may be aware of) to represent linked lists of integers. Provide it with methods that can be used to reverse a list and to append two lists. Comment on whether your design has led you to make the methods for append and reverse static. [7 marks]
- (b) Prepare a method called `change` that works in the same way as the ML code shown above. Provide the class that you define it in with a `main` method that uses it to try to make change for 73p using 2p, 5p and 20p coins, printing the result neatly. [7 marks]
- (c) If you have lists of non-zero integers such that all the values in them are less than 256 and you have at most 8 items in any list you can pack eight 8-bit fields into a single 64-bit “long”. That gives a representation that some people might expect to be faster than using lists represented by chained up instances of a class. Re-work your change-giving code based on the above idea, and modelling the use of exceptions by making the change function return `-1L` in the exceptional case. [6 marks]