COMPUTER SCIENCE TRIPOS Part IA – 2014 – Paper 1

2 Foundations of Computer Science (LCP)

(a) Write brief notes on the queue data structure and how it can be implemented efficiently in ML. In a precise sense, what is the cost of the main queue operations? (It is not required to present ML code.) [6 marks]

(b) Run-length encoding is a way of compressing a list in which certain elements are repeated many times in a row. For example, a list of the form $[a, a, a, b, a, a]$ is encoded as $[(3, a), (1, b), (2, a)]$. Write a polymorphic function `rl_encode` to perform this encoding. What is the type of `rl_encode`? [6 marks]

(c) The simple task of testing whether two lists are equal can be generalised to allow a certain number of errors. We consider three forms of error:

- *element mismatch*, as in [1,2,3] versus [1,9,3] or [1,2,3] versus [0,2,3]
- *left deletion*, as in [1,3] versus [1,2,3] or [1,2] versus [1,2,3]
- *right deletion*, as in [1,2,3] versus [1,3] or [1,2,3] versus [1,2]

Write a function `genEquals n xs ys` that returns `true` if the two lists `xs` and `ys` are equal with no more than `n` errors, and otherwise `false`. You may assume that n is a non-negative integer. [8 marks]

All ML code must be explained clearly and should be free of needless complexity.