

## 2000 Paper 1 Question 6

### Foundations of Computer Science

Describe how ML lists are represented in storage. Your answer should include diagrams illustrating how the representation of  $[a, b]@ [c, d]$  is derived from those of the lists  $[a, b]$  and  $[c, d]$ , indicating any sharing of memory. How efficient is the evaluation of  $[a, b]@l$  if the list  $l$  is very long? [4 marks]

What are *cyclic lists* and how can they be created in ML? [2 marks]

Describe ML's reference types and their applications. In particular, compare mutable data structures with ordinary ML datatypes. [6 marks]

Code an ML function that takes a mutable list and returns true if the list is cyclic, otherwise returning false. Explain why your function is correct.

[Hint: in ML, the equality test  $p = q$  is permitted on references and is true if  $p$  and  $q$  refer to the same location in memory.] [8 marks]