

## 1998 Paper 8 Question 7

### Optimising Compilers

- (a) Define the notion of an expression being available at a node in a flowgraph in terms of possible execution flows of control; explain carefully the form which available expressions might take in your framework. [4 marks]
- (b) Demonstrate that calculating exactly which expressions are available at a given node is uncomputable (you may assume that it is uncomputable to determine whether two given boolean expressions involving arithmetic always yield the same result value). [4 marks]
- (c) Give an algorithm to calculate available expressions and state carefully how the algorithmic result is related to the set of expressions which are available according to your definition in part (a). [4 marks]
- (d) Justify any discrepancy in (c) by reference to safety of the approximation with respect to the usual use of available expressions in optimisation. [4 marks]
- (e) On a machine with four registers available for register allocation (by colouring), give a program for which common sub-expression elimination (CSE) results in worse code being generated than if CSE had not been performed, noting any assumptions of timing factors for the target machine which justify the code being worse. [4 marks]