12 Optimising Compilers (TMJ)

(a) Describe a procedure’s flowgraph and the concept of basic blocks. What language construct makes flowgraph construction imprecise? [3 marks]

(b) Describe the principle of dominance within a flowgraph, including strict dominance, dominance trees and the dominance frontier. [4 marks]

(c) Define data-flow equations to find each node’s dominators and an algorithm to compute this. [5 marks]

(d) Describe how to use dominance information to find loops in a flowgraph. [2 marks]

(e) What is static single assignment (SSA) form? [1 mark]

(f) Use the dominance frontier to place $\phi$ nodes into the following code and thereby convert it to SSA form.

```
b1:    LDR  x, #0xFF00
       LDR  y, #0xFF08
       BEQ  x, #0, b9
b2:    BEQ  x, #1, b4
b3:    ADD  x, x, #2
       BR   b5
b4:    ADD  x, x, y
b5:    BEQ  x, #8, b7
b6:    STR  x, #0xFFA0
       BR   b8
b7:    STR  y, #0xFFA0
b8:    ADD  x, x, y
       BR   b10
b9:    ADD  y, y, #1
b10:   ADD  x, x, #1
       STR  x, #0xFF00
```