

10 Optimising Compilers (TMJ)

- (a) Liveness and available expression analyses are instances of a general data-flow analysis framework. Describe this framework and contrast its use in these two analyses. [5 marks]
- (b) Describe how liveness analysis can be used to identify two types of data-flow anomaly. [2 marks]
- (c) Describe the difference between semantic and syntactic expression availability, giving example pseudo-code. Explain why available expression analysis is safe. [5 marks]
- (d) Available expression analysis can be used to inform common subexpression elimination. Explain why it might be useful to run copy propagation after the this. [3 marks]
- (e) Considering the following code, show that five registers are sufficient to hold its variables. Transform the code to determine the minimum number of registers required.

```
a = func(1);
b = func(2);
c = a * b;
print(b, c);
d = c - a;
print(a, d);
e = d - 1;
b = c + a;
d = e + b;
print(d, e);
f = e - 5;
print(b, f);
return;
```

[5 marks]