

ECE3073 Computer Systems

Practice Questions

Program Design and Analysis: Compilation

i) Design patterns list four programming design patterns and suggest one typical application for each pattern:

ii) Data Flow Graph

For each block of code given below rewrite in single assignment form and then draw the data flow graph for that form. From the graph determine the partial order.

a) $x = a + b$
 $y = c + d$
 $z = x + e$

b) $r = a + b - c$
 $s = 2 * r$
 $t = b + d$
 $r = d + e$

c) $w = a - b + c$
 $x = w - d$
 $y = x - 2$
 $w = a + b - c$
 $z = y + d$
 $y = b * c$

ii) Draw the Control Data Flow Graph for the following code fragments:

a) if ($y == 2$) { $r = a + b$; $s = c - d$; }
 else $r = a - c$;

b) $x = 1$;
 if ($y == 2$) { $r = a + b$; $s = c - d$; }
 else ($r = a - c$)

c) $x = 2$;
 while ($x < 40$) {
 $x = \text{foo}[x]$;
 }

d) for ($i = 0$; $i < N$; $i++$)
 $x[i] = a[1] * b[i]$;

- e) for (i = 0; i < N; i++) {
 if (a[i] == 0) x[i] = 5;
 else x[i] = a[i] * b[i];

Show the contents of the assembler's symbol table at the end of code generation for the following programs (Note that each instruction occupies 4 bytes)

a)

```
                ORG 200
p1      ADR r4,a
        LDR r0,[r4]
        ADR r4,e
        LDR r1,[r4]
        ADD r0,r0,r1
        CMP r0,r1
        BNE q1
p2      ADR r4,e
```

b)

```
                ORG 100
p1      CMP r0,r1
        BEQ x1
p2      CMP r0,r2
        BEQ x2
p3      CMP r0,r3
        BEQ x3
```

iii) Explain the difference between row major format and column major format for storing arrays.

iv) In code optimisation

a) In the context of expression simplification briefly explain:

- 1) Constant folding
- 2) Algebraic expression simplification
- 3) Strength reduction

b) Explain what is meant by dead code elimination and point out a situation where this could cause a problem.

c) Describe procedure inlining and explain its advantages and disadvantages

d) Describe loop unrolling and explain its advantages and disadvantages