EXERCISES ON REGISTER ALLOCATION

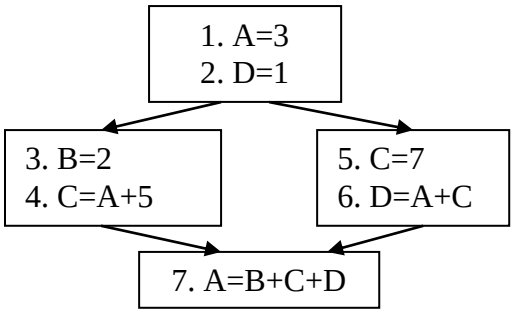
1 a) Consider the following basic block.

```
1. load r1, @x
2. load r2, @y
3. add  r3, r1, r2
4. mult r4, r1, r2
5. add  r5, r3, 1
6. add  r6, r4, r3
7. sub  r7, r6, r4
8. mult r8, r5, r7
```

(i) Identify the live ranges for all register values. (3 marks)

(ii) Draw the interference graph and apply a colouring algorithm of your choice to colour the graph with the smallest number of colours.
(5 marks)

b) Given the following control flow graph and basic blocks, identify the live ranges for all values.



(4 marks)

2. a) Explain the difference between register allocation and register assignment.
(2 marks)

b) In the context of register allocation, explain what spilling is. Suggest two approaches that can be used to decide what to spill.
(4 marks)

c) The following piece of code makes use of 7 temporary variables.

```
1. a = 1
2. b = a + 3
3. c = a + b
4. d = b + 5
5. e = c + 7
6. f = e + d
7. return f
```

Draw an interference graph and apply a graph colouring algorithm of your choice to find the fewest number of variables that may be used to write this piece of code. Show the resulting code. State any assumptions you make.
(6 marks)

3. a) Consider the following basic block.

```
1. load r1, @x
2. load r2, @y
3. add r3, r1, r2
4. mult r4, r1, r2
5. add r5, r3, 1
6. add r6, r4, r3
7. sub r7, r6, r4
8. mult r8, r5, r7
```

(ii) Explain why a processor with only 4 registers would be sufficient to execute this block without the need to do any spilling.

(4 marks)

(ii) Explain how Best's algorithm can be used for register allocation in the above basic block. Show what the basic block would look like after applying the algorithm.

(4 marks)