

Fundamental Algorithms 7

Exercise 1

Consider the following RAM program:

```
0  R0 ← 1
1  R1 ← 8
2  R2 ← 1
3  R8 ← R8 + R0
4  R8 ← R8 - R0
5  R3 ← R8 - R2
6  IF R3 = 0 GOTO 24
7  R4 ← R2
8  R5 ← R2 + R0
9  R3 ← R5 - R8
10 IF R3 > 0 GOTO 4
11 R4 ← R4 + R1
12 R5 ← R5 + R1
13 R6 ← RR4
14 R7 ← RR5
15 R3 ← R7 - R6
16 IF R3 > 0 GOTO 19
17 RR4 ← R7
18 RR5 ← R6
19 R4 ← R4 - R1
20 R5 ← R5 - R1
21 R4 ← R4 + R0
22 R5 ← R5 + R0
23 GOTO 9
```

For an input sequence (x_1, x_2, \dots, x_n) , the starting configuration of the RAM shall be given by:

$$\begin{aligned}\langle Ri \rangle &:= 0 \quad \text{for } 0 \leq i \leq 7 \quad \text{and} \quad i \geq n + 9 \\ \langle R8 \rangle &:= n \\ \langle Ri \rangle &:= x_{i-8} \quad \text{for } 9 \leq i \leq n + 8 \\ \langle PC \rangle &:= 0\end{aligned}$$

After the RAM has finished, registers R9 to R($n + 8$) contain the input sequence in sorted (ascending) order.

Exercises:

- (a) Execute the RAM program for the input sequence $(3, 7, 3, 2)$, and denote the contents of the registers for each step (steps where different registers are modified one after another may be combined into one step).
- (b) What is the task of register R5?
- (c) The given RAM program is a variant of one of the sorting algorithms discussed in the lectures. State the name of this algorithm, and discuss how this version differs from the version given in the lectures.