Program Optimisation
Solutions of Homework 10

1. (a) Rather than computing all states and transitions, we compute them only as they are needed for our expression. This leads us to:

$$\begin{aligned}
\delta_c &= \{R \mapsto 1, I \mapsto 2, c \mapsto 0\} = q_0 \\
\delta_R &= \{R \mapsto 0, I \mapsto 1\} = q_1 \\
\delta_+(q_0, q_1) &= \{R \mapsto 1, I \mapsto 1, I + c \mapsto 0, R_1 + R_2 \mapsto 0, R_1 + I \mapsto 1\} = q_2 \\
\delta_+(q_2, q_0) &= \{R \mapsto 2, I \mapsto 1, I + c \mapsto 0, R_1 + R_2 \mapsto 1, R_1 + I \mapsto 2\} = q_3 \\
\delta_M(q_3) &= \{R \mapsto 0, I \mapsto 1\} = q_1
\end{aligned}$$

   (b) The corresponding piece of code is:

$$\begin{aligned}
R_1 &= c_1 \\
R_2 &= R + R_1 \\
R_3 &= c_2 \\
R_4 &= R_2 + R_3 \\
R_5 &= M[R_4]
\end{aligned}$$

   (c) The cost of storing $(...(R + c_1) + ...) + c_i$ to I and R is $i + 2$ and $2i$ respectively. Thus, the cost difference is $i - 2$, i.e. it is not constant. The number of states containing the cost differences is not bounded. The generation of the code selection automaton does not terminate without instruction 6.