

Exercise Set 4

Due by 4:00 p.m. on Tuesday, November 6

Exercise 1 (50 points)

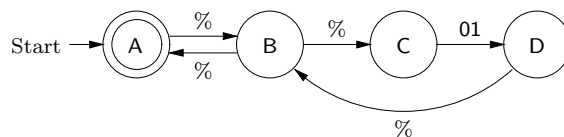
Let $X = \{ w \in \{0, 1\}^* \mid \text{for all } x, y \in \{0, 1\}^*, \text{ if } w = x000y, \text{ then } 111 \text{ is a substring of } y \}$.

(a) Find a DFA M such that $L(M) = X$. [15 points]

(b) Prove that your answer to Part (a) is correct. [35 points]

Exercise 2 (50 points)

Let M_1 be the finite automaton



(a) Find a regular expression that is turned by our regular expression-to-FA conversion algorithm into an FA that is isomorphic to M_1 . Use Forlan to check that your answer is correct. (Here, and in the rest of this exercise, always include a Forlan transcript.) [12 points]

(b) Give a step-by-step explanation of how our FA-to-EFA conversion algorithm turns M_1 into an EFA, M_2 . Draw M_2 and use Forlan to check that your final answer is correct. [12 points]

(c) Use the Forlan function `EFA.renameStatesCanonically` to turn M_2 into an EFA, M_3 , that is isomorphic to M_2 , but whose states are A, B, C, etc. Draw M_3 . [1 point]

(d) Give a step-by-step explanation of how our EFA-to-NFA conversion algorithm turns M_3 into an NFA, M_4 . Draw M_4 and use Forlan to check that your final answer is correct. [12 points]

(e) Give a step-by-step explanation of how our NFA-to-DFA conversion algorithm turns M_4 into a DFA, M_5 . Draw M_5 and use Forlan to check that your final answer is correct. [12 points]

(f) Use the Forlan function `DFA.renameStatesCanonically` to turn M_5 into a DFA, M_6 , that is isomorphic to M_5 but whose states are A, B, C, etc. Draw M_6 . [1 point]