COMPSCI 2AC3, Automata and Computability
Assignment 1, Winter 2023

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Due date: Monday, Feb 6, 11pm

Notes. Your solutions **MUST be typeset in Latex** (refer to the first tutorial if you have missed it and not sure how to use Latex). Only upload a single pdf file as your solution to Avenue (avoid compressing your file). For drawing state machines use the the https://finsm.io/ website as discussed in the tutorial (also see the quick guide https://github.com/CSchank/finsm/wiki/QUICKSTART), and export the result to latex.

If you have questions about the assignment, post them in the dedicated Students Questions channel on MS teams.

1. No proof is required for this question.

   (a) [**10 points**] Draw an NFA with 2 states for the following language: $A = (\{a,b\}^*)(\{b,c\})(\{a,b\}^*)$

   (b) [**10 points**] Draw an NFA with 2 states for the following language: $B = (\{a,c\}^*)(\{b\})(\{a,c\}^*)$

   (c) [**5 points**] Draw an NFA for $C = A \cup B$ with 4 states.

   (d) [**25 points**] Use the subset construction game to create a DFA for C out of its NFA. Label each state with subsets of C.

2. [**25 points**] Is the following statement true? "Let $N_1 = (Q, \Sigma, \Delta, S, F)$ be any non-deterministic finite state machine. Let $N_2 = (Q, \Sigma, \Delta, S, Q \setminus F)$. Then $L(N_1) =\sim L(N_2)$". If you think it is true, then prove it. Otherwise, provide a counterexample.

3. [**25 points**] "Prove" that the following language is regular: $A = \{xy | x, y \in \{a,b\}^*, \#a(x) = \#b(y)\} \subseteq \{a,b\}^*$.