

ASSIGNMENT 9 (DUE ON 10 OCTOBER 2025)

MATH2301, SEMESTER 2, 2025

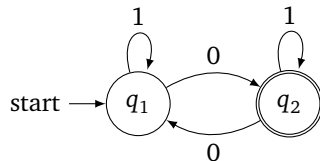
1. GENERAL REMARKS

- (1) The assignment is due on gradescope.
- (2) Please read the academic integrity policy for assignments. Remember that if you want an extension, you must ask at least 24 hours ahead of the deadline.
- (3) The words “show” and “prove” are synonyms. You may not be used to writing formal mathematical proofs, which is OK. Write a justification in plain language that would convince the reader.
- (4) If you are having trouble with any of the points, come and discuss with me in office hours. It is part of my job to help you understand this stuff, so please use my time!

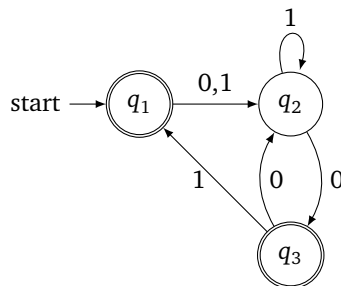
2. PROBLEMS

2.1. **Problem.** Convert the following DFAs into equivalent regular expressions. Show your work, but you need not give full justification.

(1)



(2)



2.2. **Problem.** Show that the following languages are not regular using the pumping lemma and the Myhill-Nerode theorem (both). For the pumping lemma, assume (for contradiction) that there is a recognising DFA with n states. Clearly state the string you use for pumping. For the Myhill-Nerode theorem, clearly describe an infinite set of non-equivalent strings.

- (1) $L = \{0^k 1^l \mid k < l\}$.
- (2) $L = \{0^n \mid n \text{ is a square.}\}$

2.3. **Problem.** Let L be the language described by $(0|1)^*11$.

- (1) Find the Myhill-Nerode equivalence classes for L (give one string in each equivalence class).
- (2) Construct a DFA that recognises L with exactly as many states as the number of equivalence classes.