Quiz Section 9: Minimization, NFAs, Subset Construction

Task 1 – DFAs, Stage 1

Let $\Sigma = \{0, 1, 2, 3\}$. Construct DFAs to recognize each of the following languages.

For all states in your DFA, include "documentation" for them by describing, in English, the set of strings that *end* in that state.

a) All binary strings.

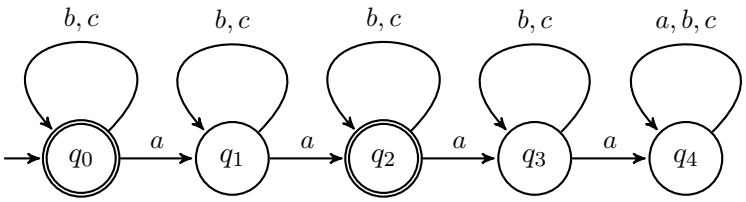
b) All strings whose digits sum to an even number.

c) All strings whose digits sum to an odd number.

Task 2 – DFAs & Minimization

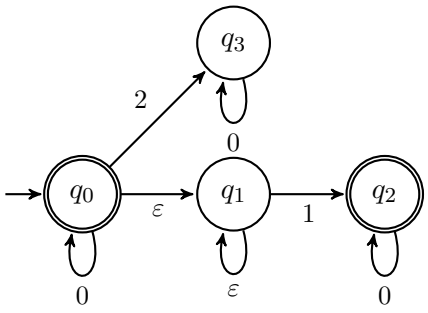
Minimize the following DFA.

For each step of the algorithm, write down the groups of states, which group was split in that step and the reason for splitting that group. At the end, write down the minimized DFA, with each state named by the set of states of the original machine that it represents (e.g., "B, C" if it represents B and C).



Task 3 – NFAs

a) What language does the following NFA accept?



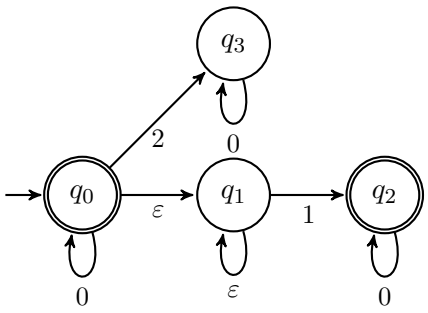
b) Create an NFA for the language "all binary strings that have a 1 as one of the last three digits".

Task 4 – RE to NFA

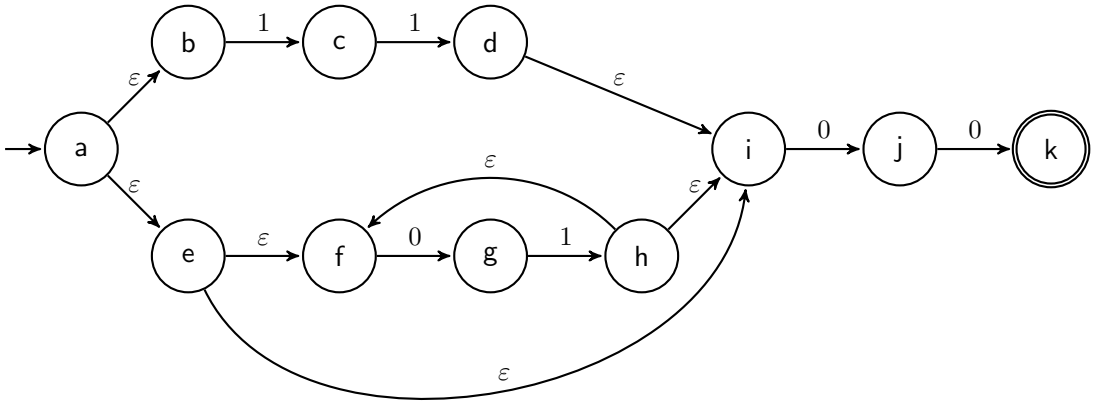
Convert the regular expression "$(11 \cup (01)^*)00$" to an NFA using the algorithm from lecture. You may skip adding ε-transitions for concatenation if they are obviously unnecessary, but otherwise, you should *precisely* follow the construction from lecture.

Task 5 – NFAs to DFAs

a) Convert the following NFA to a DFA for the same language:



b) Convert the following NFA to a DFA for the same language:



Task 6 – DFAs, Stage 2

Let $\Sigma = \{0, 1\}$. Construct DFAs to recognize each of the following languages.

For all states in your DFA, include "documentation" for them by describing, in English, the set of strings that *end* in that state.

a) All strings that do not contain the substring 101.

b) All strings containing at least two 0's and at most one 1.

c) All strings containing an even number of 1's and an odd number of 0's and not containing the substring 10.

Task 7 – Irregularity

Prove that $L := \{0^n 1 0^n \ : \ n \geqslant 0\}$ is not regular.