INF2080
Oblig 1

Deadline: February 20, 2017

Hand-in and deadline

Hand in a single PDF file in Devilry. Deadline is **February 20, at 23:59**.

We recommend LaTeX, but all major text editors allows exporting to PDF. You can get help with LaTeX at the group sessions. You can also download the LaTeX source (`.tex`) for this assignment at the assignments page.

Problem 1: Regular languages

Let A and B be regular languages defined by DFAs $\mathcal{A}$ and $\mathcal{B}$. Let $n_{\mathcal{A}}$ and $n_{\mathcal{B}}$ be the number of states in $\mathcal{A}$ and $\mathcal{B}$.

Problem 1a

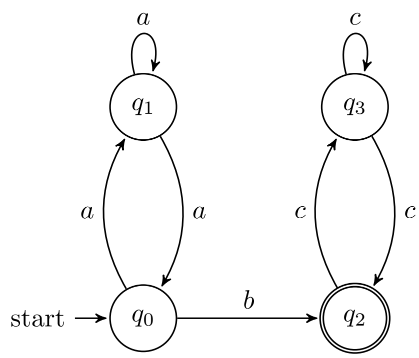
What are the highest number of states you would need in **DFAs** for the languages $A \cap B$ and A^*?

Problem 1b

What are the highest number of states you would need in **NFAs** for the languages $A \cap B$, AB and A^*?

Problem 1c

Create a regular expression defining the same language as the NFA



Problem 1d

Create a DFA for the language

$$\{w \mid w \text{ contains equally many occurences of the substrings 01 and 10}\}.$$

Problem 2: all-NFAs

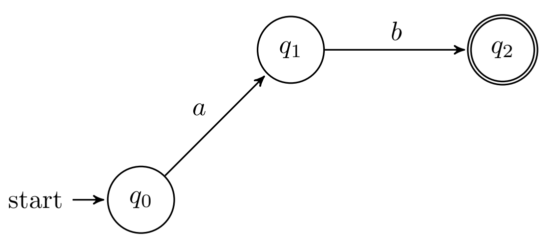
An all-NFA is defined in Sipser, problem 1.43 as a 5-tuple $(Q, \Sigma, \delta, q_0, F)$ that accepts $x \in \Sigma^*$ if *every* possible state that M could reach after reading input x is in F (as opposed to *at least one*).

If any brach in an all-NFA computation reaches an inplicit or explicit sink state, the input is not accepted.

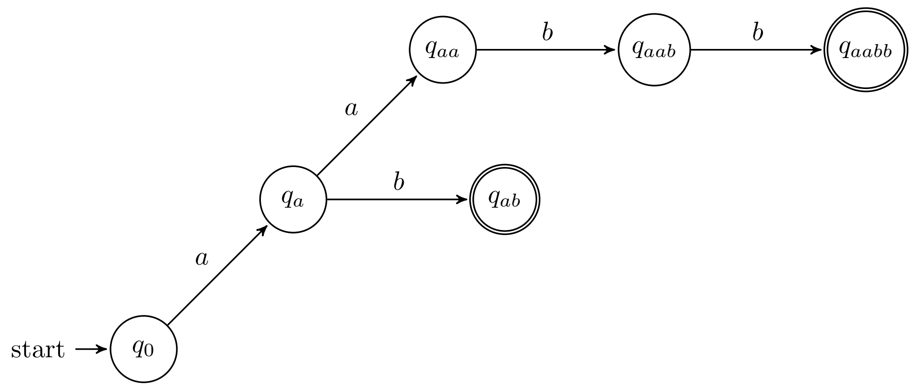
Show how any all-NFA can be converted to a DFA.

Problem 3: Non-regular languages

The DFA



defines the language $\{ab\}$. The DFA



defines the language $\{ab, aabb\}$.

Problem 3a

Create a DFA that defines the language $\{ab, aabb, aaabbb\}$.

Problem 3b

Create a deterministic *infinite* automaton that defines the language

$$\{a^n b^n \mid n \in \mathbb{N}\}.$$

Problem 3c

Using the pumping lemma, give a detailed proof that $\{a^n b^n \mid n \in \mathbb{N}\}$ is not a regular language; that is, no deterministic *finite* automaton may define it.

Problem 3d

Show that $\{a^n b^n \mid n \in \mathbb{N}\}$ is a context free language.