Exercise 1: From NBA to $\omega$-regular expressions

Construct for each of the following NBA an $\omega$-regular expression that describes the same language. The alphabet of each automaton is $\Sigma = \{A, B\}$.

(a) Apply the construction from the lecture (slide 42 ff. of lecture 19). You do not have to write down each NFA $A_{q,p}$ that you construct, but you have to write down the regular expression for each NFA that you construct.

(b) This time you need not apply the construction from the lecture. You may use optimizations like omitting automata whose language is empty.
Exercise 2: From $\omega$-regular expression to NBA

Construct an NBA for the following $\omega$-regular expression over the alphabet $\Sigma = \{A, B\}$.

\[ (A + BA^*) \cdot A^\omega + BB \cdot (A + AB)^\omega \]

Apply the construction from the lecture (slide 56 ff. of lecture 19) by executing the following steps for $i = 1, 2$.

(a) Construct an NFA $A_i$ for each regular expression $\alpha_i$, resp. an NFA $B_i$ for each regular expression $\beta_i$.

(b) Use the NFA $B_i$ to construct an NBA $B_i^\omega$ (for each $\beta_i$).

(c) Use the NFA $A_i$ and the NBA $B_i^\omega$ to construct an NBA $C_i$ for each $\alpha_i \beta_i^\omega$.

(d) Construct the final NBA by taking the union of all NBA $C_i$.

Exercise 3: From GNBA to NBA

Consider the GNBA outlined below with acceptance sets $F_1 = \{q_1\}$ and $F_2 = \{q_2\}$.

Construct an NBA that accepts the same language.