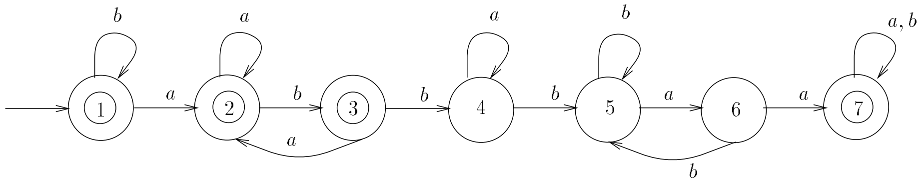
1.



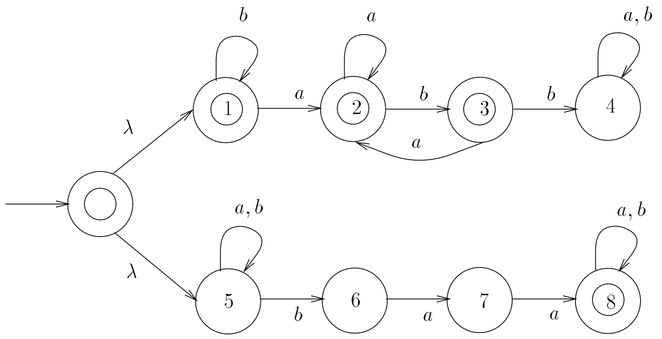
Claim 1: On input w, we reach state 4 iff w contains abb as a substring. Hence if w does not contain abb, w is acceptable.

Claim 2: We can move from state 4 to state 7 by a string w iff w contains baa.

Claim 3: On input w, we reach state 7 iff $w = (a+b)^*abb(a+b)^*baa$.

Proof: We can only reach state 7 if we first reach state 4. We reach state 7 iff we first reach state 4 (by some substring $(a+b)^*abb$) and then move from state 4 to state 7 (by some substring $(a+b)^*baa$).

2.



By propositional reasoning we accept w if either w does not contain abb as a substring OR (i.e. inclusive OR) if w contains baa as a substring. We guess (by the λ moves from state 0) whether or not w contains abb. States 1, 2, 3, 4 verify that w does not contain abb as a substring and accepts if this is the case. States 5, 6, 7, 8 verify that w contains baa as a substring and accepts if this is the case.

3. $R = bb^*(ab)^*$

We terminate on state q_1 iff $w = bb^*$. We terminate on state q_3 iff we first reach state q_1 and then terminate in st ate 3 iff $w = bb^*(ab)^*$. Thus

$$\begin{aligned} L &= L(bb^* + bb^*(ab)^*) \\ &= L(bb^*(ab)^*) \end{aligned}$$

4. Let $L_1 = L(\mathcal{M}_1)$ and $L_2 = (\mathcal{M}_2)$ with deterministic
   $\mathcal{M}_1 = < Q^1, \sum, \delta_1, q_0^1, F_1 >$
   $\mathcal{M}_2 = < Q^2, \sum, \delta_2, q_0^2, F_2 >$
   We construct a non det $\mathcal{M} = < Q, \sum, \delta, q_0, F >$ accepting $\mathcal{M}$.
   $Q = Q^1 \times Q^2$
   $\delta(< q_i^1, q_j^2 >, \sigma) = \{< \delta_1(q_i^1, \sigma), q_j >, < q_i, \delta_2(q_j, \sigma) >\}$.
   (In words, we guess whether σ is part of the L_1 subsequence or part of the L_2 subsequence.)
   $q_0 = < q_0^1, q_0^2 >$
   $F = \{< q_i, q_j > \mid q_i \in F_1 \text{ and } q_j \in F_2\}$.

5. The proof that L is not regular is almost exactly the same proof as in Example 4.8 on page 121. Namely, consider the string $w = a^n b^n a^n b^n \in L$ for n sufficiently lareg and then use the punping lemma to derive a contradiction.