# CS 321, Assignment 4

Cody Malick
malickc@oregonstate.edu

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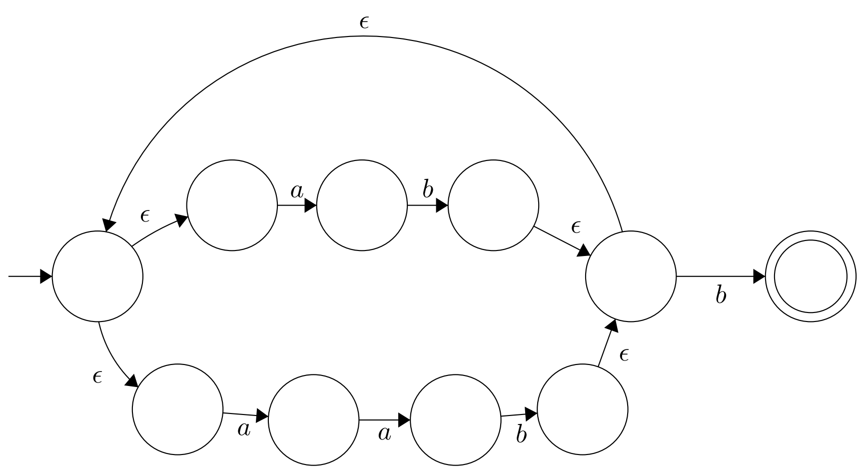
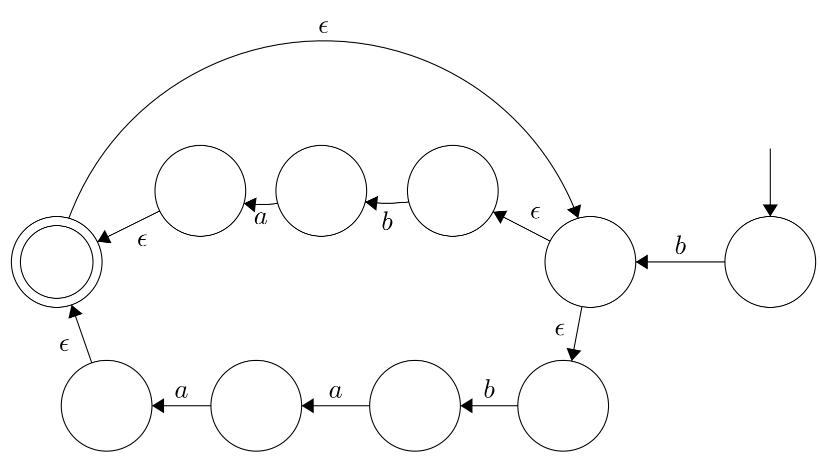
## 1

This is an interesting problem. To get the answer, we need to construct an NFA, reverse it, then construct a regex statement out of it. So, our initial NFA looks like this:

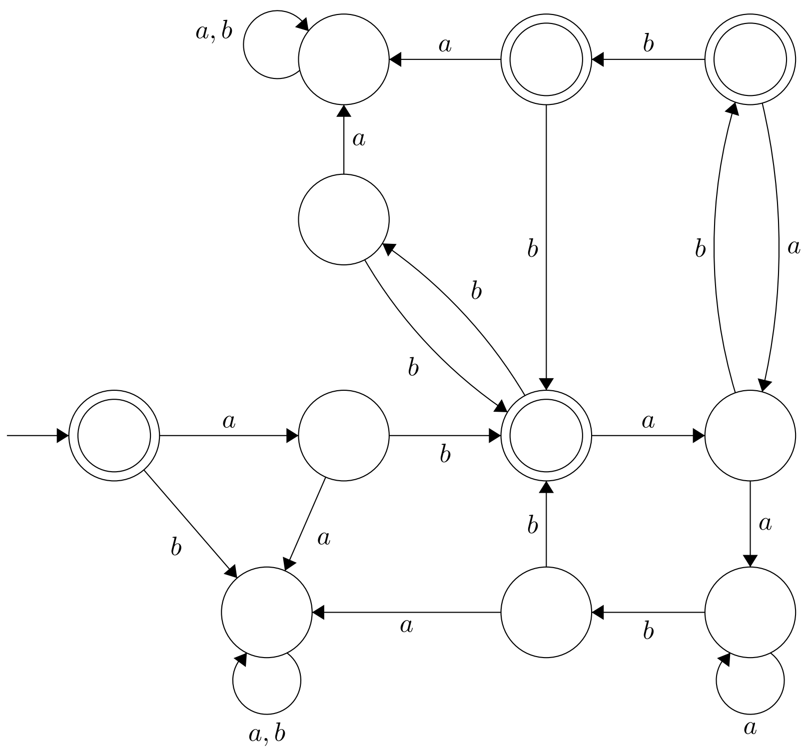



Reverse the NFA:




And then tranlate that into a new regex statement:
$b(ba + baa)^*$

# 2




# 3

To show that this DFA has at least 1024 states, we need to prove that having less that 1024 states rejects a string in $A$, or show that there is a string not in the language $A$ that the machine accepts. More specifically, we can show that if machine $M$ has $< 1024$ states, then feeding a string with 1024 characters must prove there is a cycle, showing that it is regular.

This can be shown by accounting for every possible combination after the cycle ends of alphabet $\{a, b\}^*$ leading up to the accepting state. This leaves us with $2^{10}$ combinations. If we propose that the machine $M$ has less than 1024 states, then we can provide a string of length: number of states + 1, then we can show there is a string that is rejected by $M$.

Given alphabet $A = \{a, b\}^*$, consider all strings of length 10, $w \in A$. Given a string of length ten, there are two possible combinations for each position in the string. Therefore, the total number of possible combinations of strings are $2^{10}$.

Given that the number of states is less than 1024, then there must be a combination in the alphabet $A$ that is not accepted.

# 4

Step 1:
Adversary picks $p$
Step 2:
I select $w = a^p b^p c^{p-p}$, where $|w| >= p$, and $w \in A$ and $w \in$ real numbers
Step 3:
Split into $w = xyz$ where $|xy| =< p$, and $|y| > 0$
Step 4:
I pick $i = 0$, I win if $xy^i z \notin A$
Then $xy^0 z = xz = a^{p-|y|} c^0 \notin A$ since $|y| > 0$
I win, A is not regular.