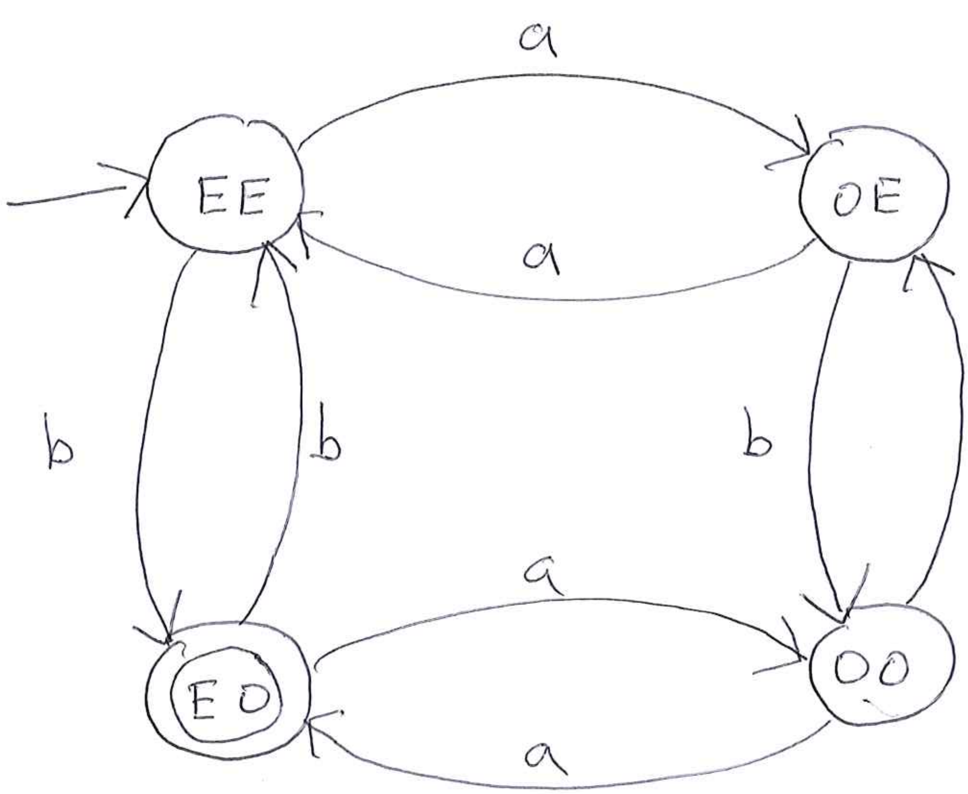
Deterministic Finite Automata (DFAs)

Takes as input a string - says "Yes" or "No"

Finite set of states - no other memory - when it reads a character - it will move from current state to another state based on some rule. When it has read the whole string, it will be in some state - either this state will be a "Yes" state or a "No" state.

"Deterministic" means that, from each state, there is one arrow going out for each letter.

<u>E.g.</u> Make a DFA that $\boxed{\text{accepts}}$ (say "Yes" to) the strings w/ an even # of a's and an odd number of b's.



Does this accept "abaabab"

E.g. Our automaton accepting even #a's odd #b's strings

$Q = \{EE, EO, OE, OO\}$

$\Gamma = \{a, b\}$

δ is the function with

$\cancel{\delta(OE}$ $\delta(EE, a) = OE$

$\delta(EE, b) = EO$

$\delta(OE, a) = EE$

$\delta(OE, b) = OO$

$\delta(EO, a) = OO$

$\delta(EO, b) = EE$

$\delta(OO, a) = EO$

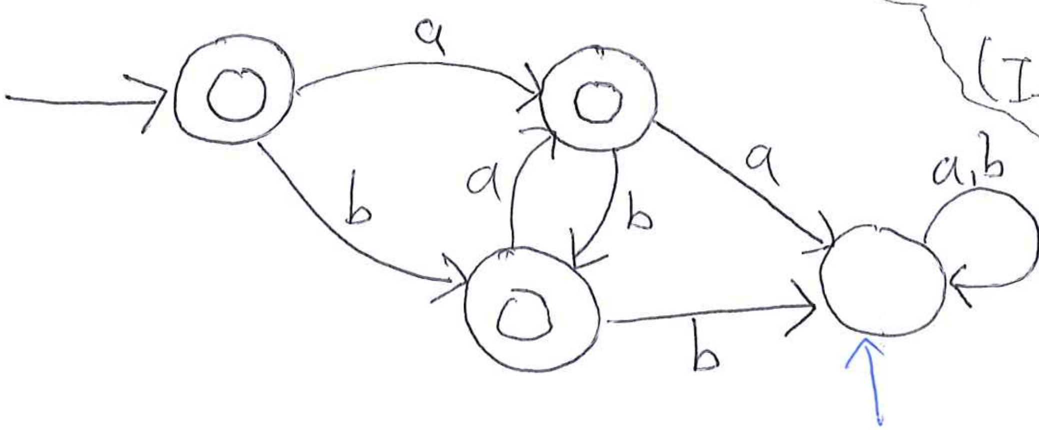
$\delta(OO, b) = OE$

$q_0 = EE$

$F = \{EO\}$.

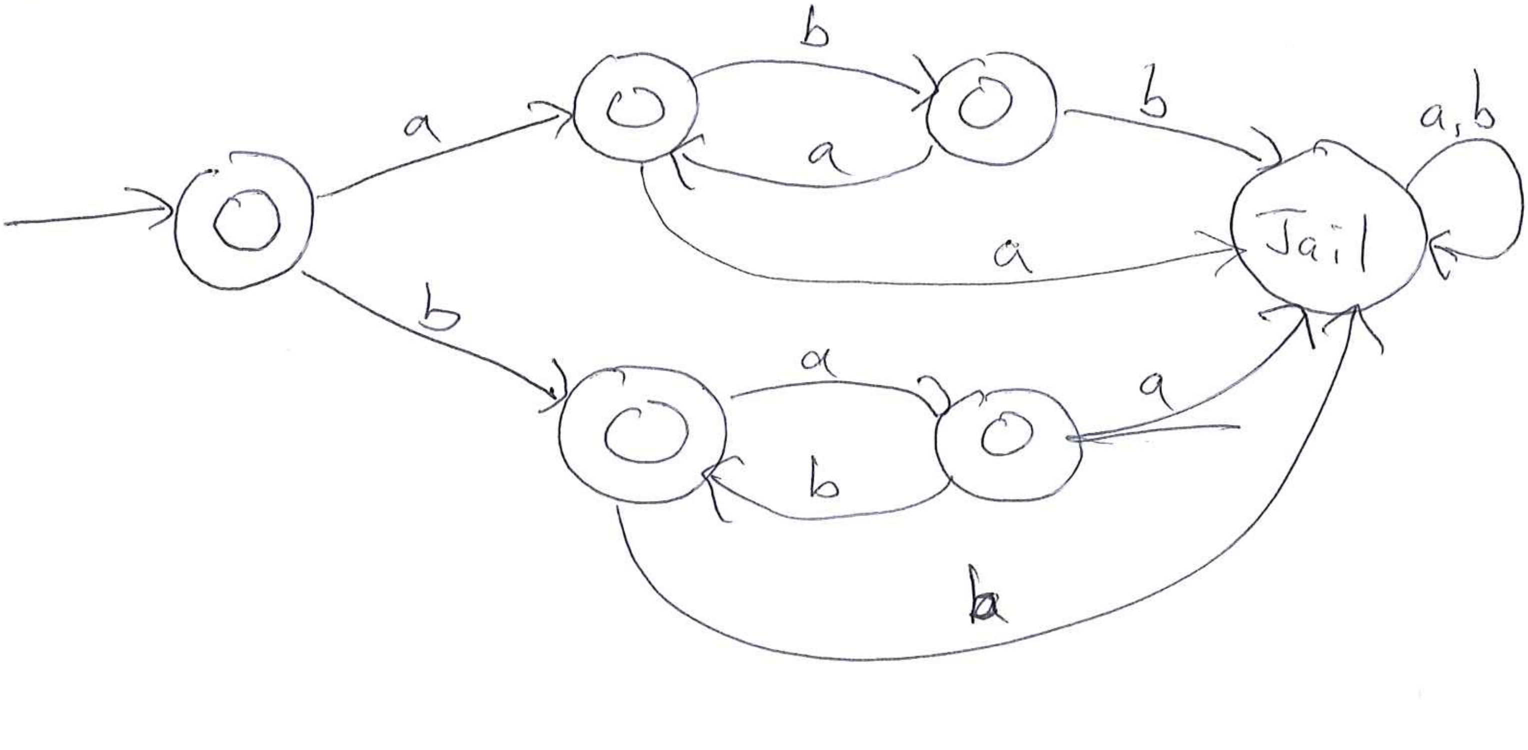
<u>E.g.</u> Make a DFA that accepts the strings where a's & b's alternate. (empty string ~~cou~~ should be accepted) (E.g. ~~ab | ba~~ a, b, ab, ba should all be accepted)

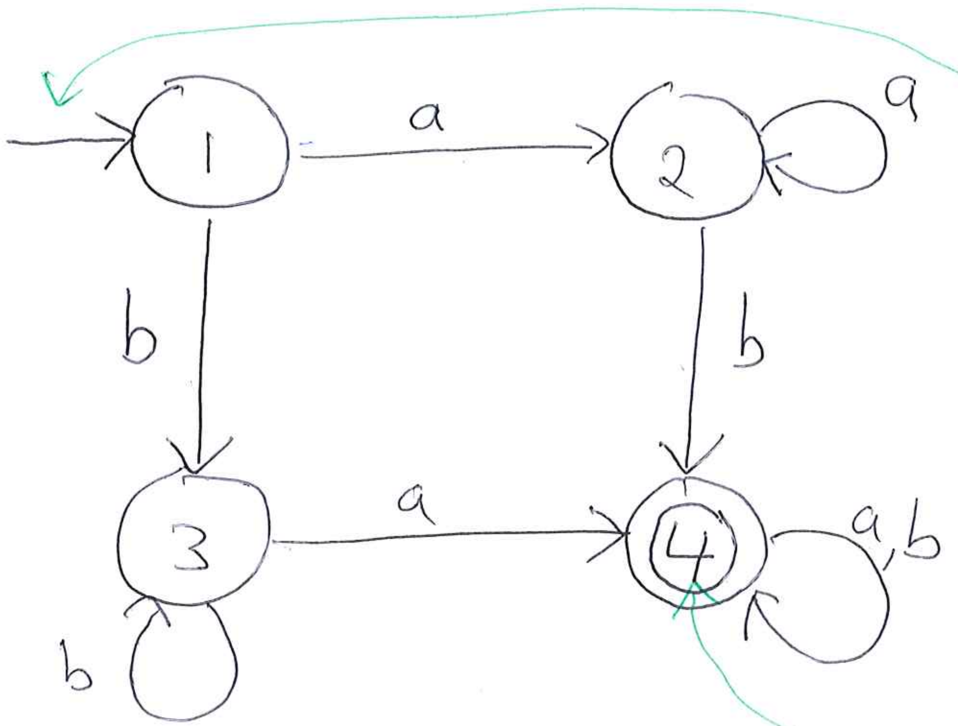
(If you have bb and aa anywhere, you should ~~say~~ ~~#~~ reject.)



"trap state" or "jail state"

Or:





Conventions:

tells you where we start

We follow the arrows when we read a letter.

"Yes" states have an extra circle.

alphabet: { a, b }

If the string is "abaabaa"

This automaton says "Yes" to any string that has both an a and a b. (and "No" to every other string)

~~Forma~~ Mathematical formalization of DFAs

"Data structure of a DFA":

The data we have:

1) An alphabet (finite)
2) Set of states (finite),
   ~~out~~ of which
   a) one state is the initial state (or start state)
   b) some of the states are accept states (or final states)
3) A rule telling us, given a letter and a state, what the next state is.

Gamma delta

So: A DFA is a 5-tuple

$$M = (Q, \Gamma, \delta, q_0, F), \text{ where}$$

Q is a finite set (of states)

Γ is a finite set (the alphabet)

δ is a function $Q \times \Gamma \longrightarrow Q$

$q_0 \in Q$ is the initial state

$F \subseteq Q$ is the set of final states.

HW for Friday: Design a DFA that accepts ~~all~~ the strings on $\{a,b\}$ that have at most 2 a's after the first b.

Notes will show up at

webpages.uidaho.edu/AlexanderWoo/385