Another example of constructing an NFA and converting it to an equivalent DFA.

I want an NFA accepting strings on \{a, b\} where in any run of a's, the # of a's is odd and in any run of consec. b's, the # of b's is even.

E.g. \textcolor{red}{aaabbabbb} is good
\textcolor{green}{aaabbbbbb} is good
\textcolor{red}{aaabb} \textcolor{red}{aaabbbb} is bad.

Oh I guess I managed to get a DFA

after an odd # of a's I end up here.

after an even # of b's I end up here.
Construct an NFA that accepts all strings that have an even # of a's or an odd # of b's, and also accepts the string 'bab'.

Convert this to a DFA:
extra states
Redraw to keep track of the "ba b" possibility.

keeping track of parity of a's and b's so far.
Our every class visit to formalism leads us to think about a proof that our method of constructing a DFA from an NFA works, i.e. they both accept exactly the same strings. However, i.e. M accepts w if and only if \( M \) accepts w.

\[ \text{i.e. } \delta^*(w, q_0) \text{ contains a final state if and only if } \overline{\delta^*(w, q_0)} \text{ is a final state} \]

This is true b/c we constructed \( \overline{\delta} \) in such a way so that \( \overline{\delta}(l, q)'' = \delta(l, q) \)
Outline of proof: We need to show that $M$ accepts $w$ if and only if $\overline{M}$ accepts $w$. But $\overline{\delta}^*(w, q_0)$ is the set of states we get to in $\overline{M}$ starting at $q_0$ and reading $w$, which, by how we constructed $\overline{M}$ from $M$, is precisely the set of states corresponding to the set of states in $M$ which are reachable from $q_0$ reading $w$. In symbols, 

$$\overline{\delta}^*(w, q_0) = \delta^*(w, q_0)$$

By our definition of $F$, $\overline{\delta}^*(w, q_0) \in F$ if and only if $\delta^*(w, q_0) \cap F \neq \emptyset$. Hence $w$ is accepted by $\overline{M}$ if and only if $w$ is accepted by $M$. 


so $S^*(w, q_0) = \overline{S^*(w, \bar{q_0})}$, and $\overline{q}$ is a final state of $M$ precisely if $\overline{q}$ contains a final state of $M$.

We have set up our notation so that $\overline{q}$ can be thought of as either a state of $\overline{M}$ or as a set of states of $M$. 