NFA to DFA transformations described in terms of enormous vegetables

This pumpkin is angry with you because you do not know enough about NFA to DFA conversions (www.bigpumpkins.com)

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This machine is really simple. Just as many a's as you want before b, or a+b for short. Let's convert this to a DFA intuitively.
What do we do first in the NFA? We visit the start state. So we should do the same in the DFA.

A DEZ—a deterministic enormous zucchini
If it gets a b in the NFA, it must reject. So in the DFA we must go to a failure state— with no exits. This is a state with no NFA equivalent.
If it gets an a, the NFA goes to state two. But at the same time, it can also go to state 1 via the empty transition. We can't allow this in the DFA. So we create a state that means BOTH.
Now what if it gets a b at 2? Well, luckily 2 goes to 3. And 2 is a part of our latest DFA state. So \{1,2\} can go to \{3\}, which is a final state just like in the DFA.
To be deterministic, we need a transition for every input at every state. So we need to know what happens to a at \{1,2\}. We know that a at 1 goes to 2 in the NFA. Which is \{1,2\} in the DFA, due to the empty transition.
Our final state \{3\} is not exempt from the requirements of determinism. But anything after a b in this language has to go back to the null/reject state. And anything in the reject state stays there.
Formal Construction

- NFA: $N = (Q, \Sigma, \delta, q_0, F)$. We want DFA $M = (Q', \Sigma, \delta', q'_0, F')$.
- $Q' = P(Q)$, ie the power set of $Q$. So states in the DFA are sets of NFA states.
- For every $R$ in $Q'$ and $a$ in $\Sigma$, $\delta'(R, a) = \{q \in Q \mid q \in \delta(r, a) \text{ for some } r \in R\}$. In other words, since states in the DFA are sets, we take all the transitions in the NFA of the members of those sets for a given input... and send it to the state in the DFA that is the set of the destinations in the NFA.
Formal Construction

- $q'_0 = \{ q_0 \}$
- $F' = \{ R \text{ in } Q' \mid R \text{ contains an accept state of } N \}$.
- But we also need to consider the empty transitions in the NFA. So we amend to say $\delta'(R, a) = \{ q \text{ in } Q \mid q \text{ in } \delta(r, a) \text{ or reachable via empty transitions for some } r \text{ in } R \}$. Similar for $q'_0$.

I think we need a more formal pickle construction
Another example NFA – let's convert it together!
A DFA solution—painful, eh?