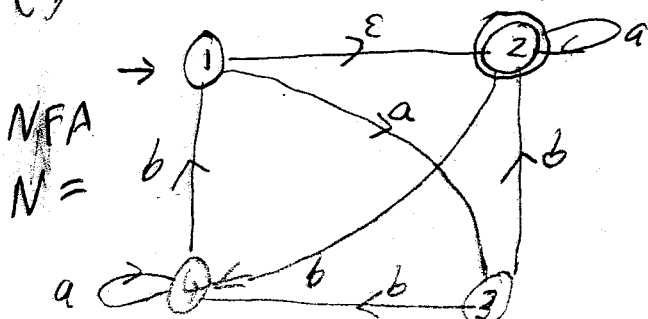


(4) Convert the following NFA into an equivalent DFA:



"Whenever ①, then ②"

$F = \{\text{any set-state with } \textcircled{2}\}$

$\Delta(R, c) = \bigcup_{r \in R} \delta(r, c)$

$S = \{1, 2\}$ so we iterate:

$\Delta(S, a) = \delta(1, a) \cup \delta(2, a) = \{3\} \cup \{2\} = \{2, 3\}$
 $\Delta(S, b) = \delta(1, b) \cup \delta(2, b) = \emptyset \cup \{4\} = \{4\}$

We got two new states, so we expand them in turn:

$\Delta(\{2, 3\}, a) = \delta(2, a) \cup \delta(3, a) = \{2\} \cup \emptyset = \{2\}$
 $\Delta(\{2, 3\}, b) = \delta(2, b) \cup \delta(3, b) = \{4\} \cup \{2, 4\} = \{2, 4\}$

$\Delta(\{4\}, a) = \delta(4, a) = \{4\}$ $\Delta(\{4\}, b) = \delta(4, b) = \{1, 2\}$
 $\Delta(\{2, 3\}, a) = \delta(2, a) = \{2\}$, $\Delta(\{2, 3\}, b) = \delta(2, b) = \{4\}$

$\Delta(\{2, 4\}, a) = \delta(2, a) \cup \delta(4, a) = \{2\} \cup \{4\} = \{2, 4\}$
 $\Delta(\{1, 2, 4\}, b) = \delta(1, b) \cup \delta(2, b) \cup \delta(4, b) = \{4\} \cup \{4\} \cup \{1, 2\} = \{1, 2, 4\}$

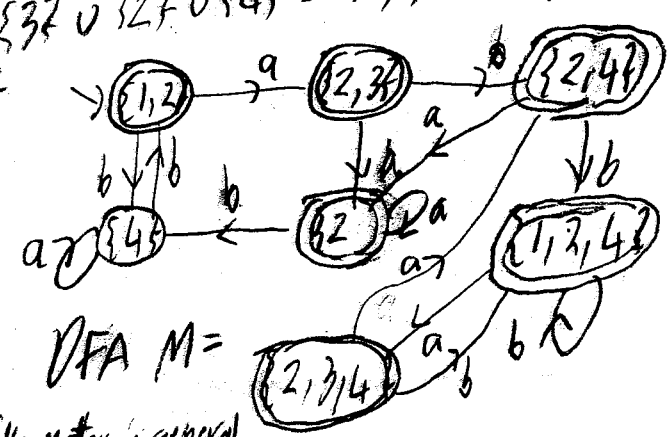
$\Delta(\{1, 2, 4\}, a) = \delta(1, a) \cup \delta(2, a) \cup \delta(4, a) = \{3\} \cup \{2\} \cup \{4\} = \{2, 3, 4\}$ New too.
 $\Delta(\{1, 2, 4\}, b) = \delta(1, b) \cup \delta(2, b) \cup \delta(4, b) = \{4\} \cup \{4\} \cup \{1, 2\} = \{1, 2, 4\}$

$\Delta(\{2, 3, 4\}, a) = \{2\} \cup \emptyset \cup \{4\} = \{2, 4\}$ are we done?
 $\Delta(\{2, 3, 4\}, b) = \{4\} \cup \{2, 4\} \cup \{1, 2\} = \{1, 2, 4\}$ Yes!

Footnote: Can we economize on the latter states? They're not quite a "Live Zone" - eg from $\{1, 2, 4\}$ the chars $aaab$ escape to the nonaccepting state $\{4\}$. A tricky matter in general...

$\delta(1, a) = \{3\}$ ← Note. we don't need to call this $\{2, 3\}$, even though N can process a from 1 to 2 with a leading ϵ . By the rule "whenever ① then ②" - which we enforce right away by taking $S = \{1, 2\}$, ① will never occur apart from ②, and $\delta(2, a)$ "covers" that case. This isn't vital - it's AOK to put $\delta(1, a) = \{2, 3\}$. But as a visual shortcut it enables you to avoid "look ahead" - you can just use the info in the diagram. But anyway you slice it, including ② or $\delta(4, b) = \{1, 2\}$ is vital, since $E(1) = \{1, 2\}$.

We got two more new states, yep!
 - No new states here.
 Datto! So "last one" is $\{2, 4\}$ now.
 Deja vu - hdd your breath now.
 Darn! New state - the beat goes on...
 New too.



DFA $M =$