Last time: nondet. fin. automata.

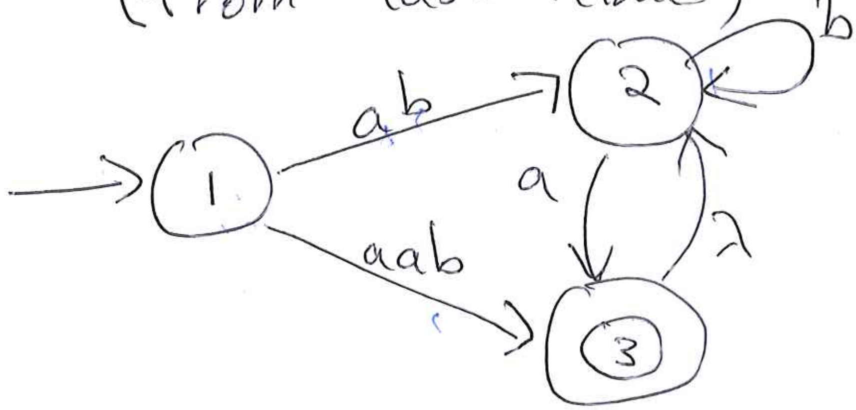
- we have choice of which way to go in some situations
- if ~~on~~ there is a path to~~ward~~ a final state, the string is accepted
- if no path to a final state, the string is rejected.

Reason for non-det automata - they are easier to construct.

<u>Goal</u>: Show how to take an NFA M and construct a DFA M' ~~that accepts and rejects~~ where M and M' accept and reject the same strings.

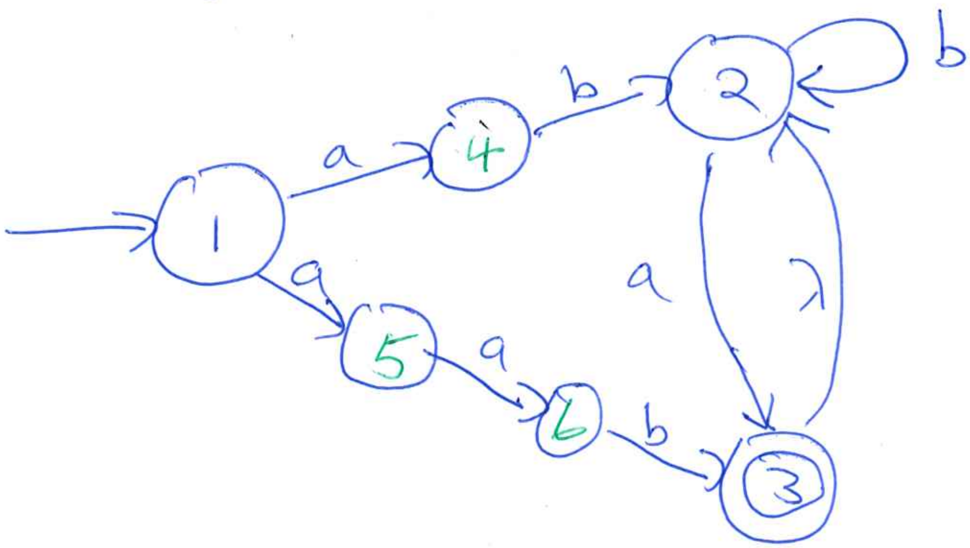
Easiest in an example:

(from last time)

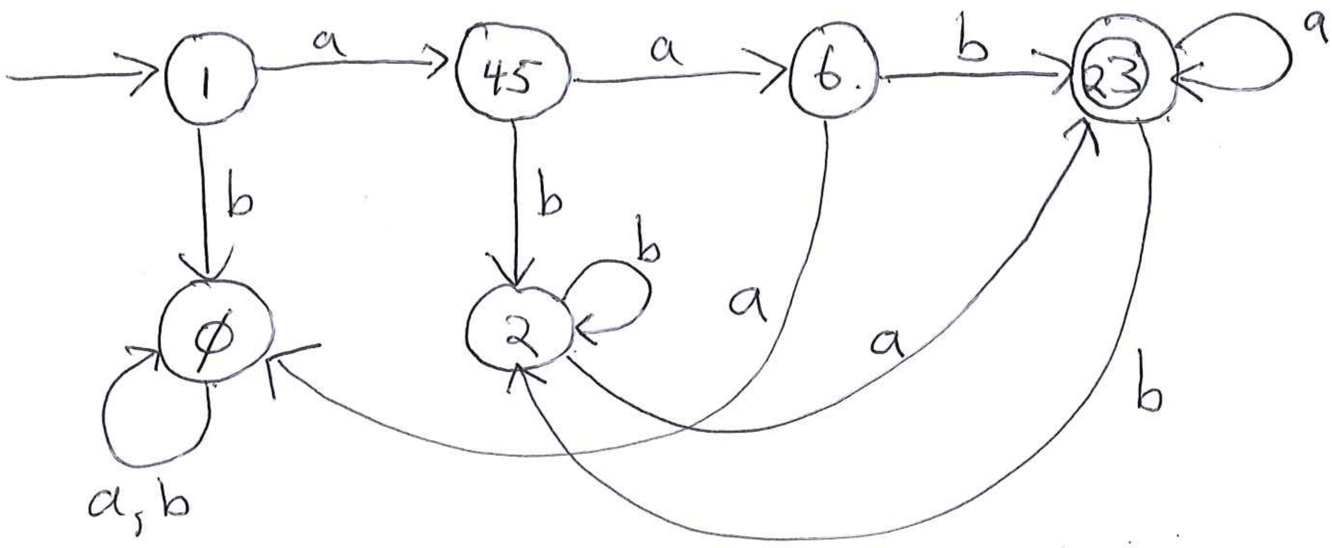


<u>Idea:</u> Keep track of the set of states we could be in.

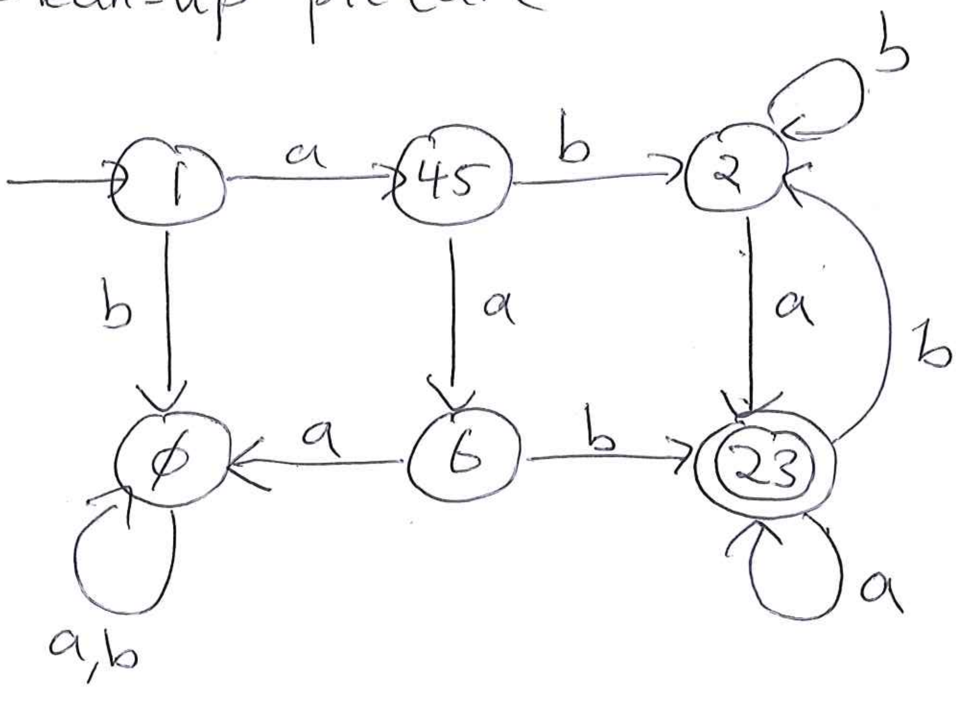
Before we do this, it's easiest to work with single letter transitions - change the NFA to an equivalent one:



(by sticking new states into the middle of arrows w/ long strings)



Clean-up picture



Write this in math:

Given an NFA $M = (Q, \Gamma, \delta, q_0, F)$, construct a DFA $\overline{M} = (\overline{Q}, \overline{\Gamma}, \overline{\delta}, \overline{q_0}, \overline{F})$ as follows:

$\overline{\Gamma} = \Gamma$

$\overline{Q} = \mathcal{P}(Q) = \{\text{all subsets of } Q\}$

(In our example, we would have $2^6 = 32$ states, but most of them were unreacheable, so we didn't bother drawing them)

$\overline{F} = \{ S \in \mathcal{P}(Q) = \overline{Q} \mid S$ has some state in ~~of~~ F in it

$\parallel$

$S \cap F \neq \cancel{Q}\ \emptyset \}$

$\overline{q_0} = \{$all states in Q reacheable from q_0 by λ-transitions$\}$

$\overline{\delta}$ is defined by

$$\bar{\delta}(\bar{q}, \ell) = \bigcup_{q \in \bar{q}} \{ \cancel{((q,\ell),q')} \; q' \mid ((q,\ell),q') \in \delta \}$$

State of $\bar{M}$ - the DFA, which "is" a set of states of M - the NFA

fixed on next page.

recall - δ is a relation; $((q,\ell),q') \in \delta$ means we have

$$\textcircled{q} \xrightarrow{\ell} \textcircled{q'}$$

in NFA

But, in $\bar{\delta}$, so far, I've forgotten about using λ's to move other places after reading my letter.

Anytime you face the same problem twice, define a function to take care of it: Let

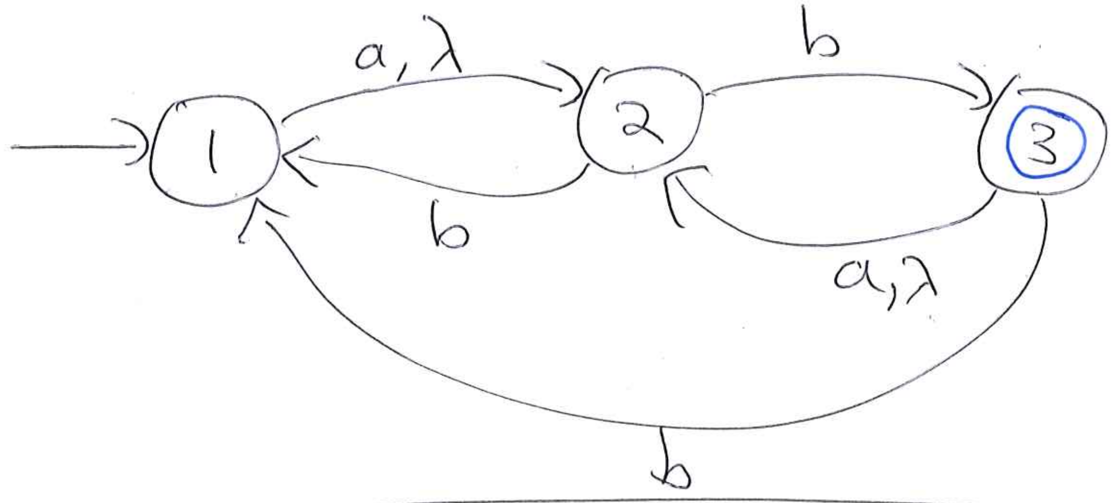
$$E(q) = \{\text{all states in } Q \text{ reachable from } q \text{ by } \lambda\text{-transitions}\}$$

Then

$$\bar{q}_0 = E(q),$$

$$\bar{\delta}(\bar{q}, \ell) = \bigcup_{q \in \bar{q}} \; \bigcup_{q' \in \{q' \mid ((q,\ell), q') \in \delta\}} E(q')$$

Another example



DFA: