

# Non-Deterministic Finite Automata (NFAs)

aka: why we want (need)  $\lambda$

NFAs are finite automata with less strict requirements than DFAs:

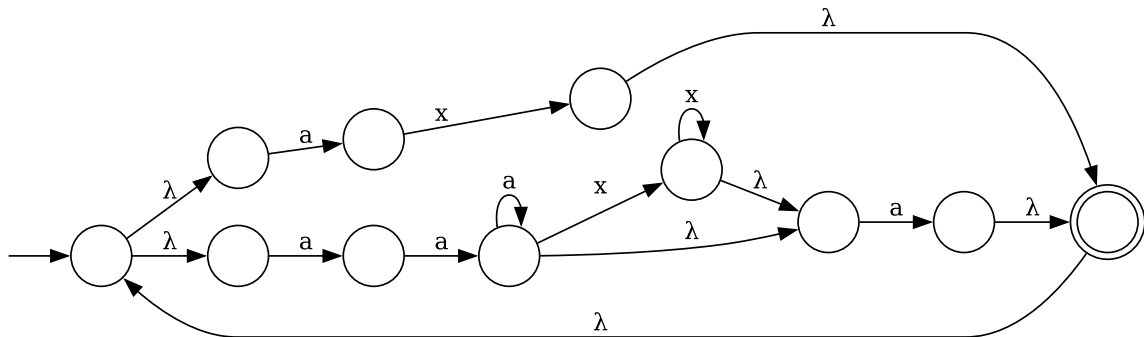
- ▶ NFAs have " $\lambda$  edges" (DFA edges are letters from  $\Sigma$ )
- ▶ NFAs can have more than one transition from a state for the same letter (DFAs can have only one)

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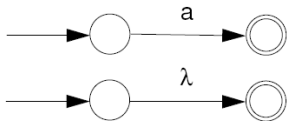
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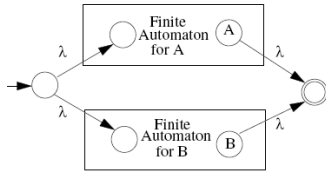


RE  $(ax|aa^+x*a)^+$  (from the challenge question) as an NFA

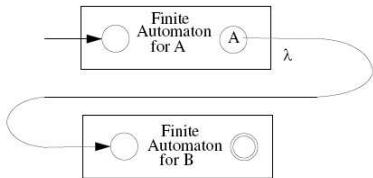
# NFAs for Fundamental REs



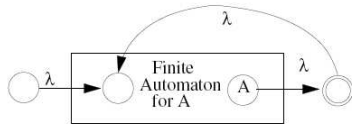
NFAs for REs  $a$  and  $\lambda$  ( $a \in \Sigma$ )



NFA for RE  $A|B$  ( $A, B$  arbitrary REs)

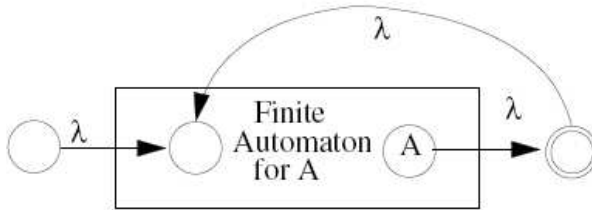


NFA for RE  $AB$  ( $A, B$  arbitrary REs)



NFA for RE  $A^+$  ( $A$  an arbitrary RE)

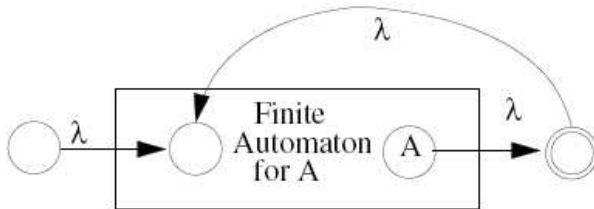
## NFAs for Fundamental REs



NFA for RE  $A^+$  ( $A$  an arbitrary RE)

What about an NFA for  $A^*$ ?

## NFAs for Fundamental REs



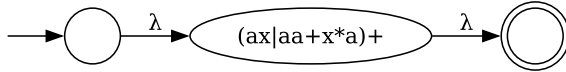
NFA for RE  $A^+$  ( $A$  an arbitrary RE)

What about an NFA for  $A^*$ ?

**BEWARE:** figure 3.22 of the text is missing this lambda transition!

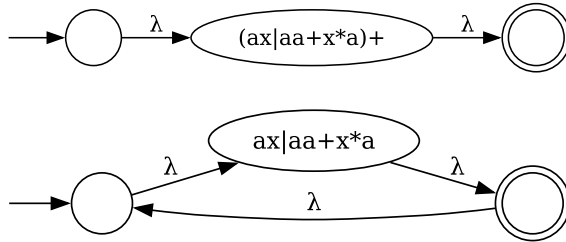
## From REs to NFAs

$(ax|aa^+x^*a)^+$  (from the challenge question) as an NFA



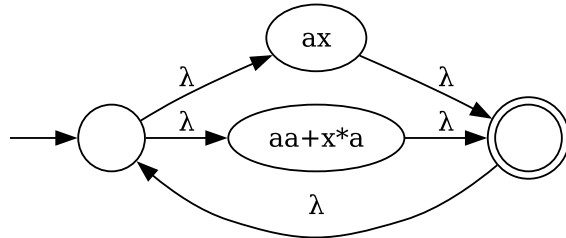
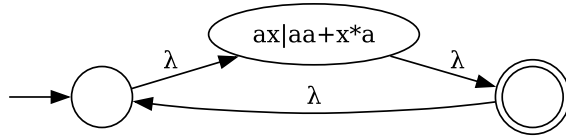
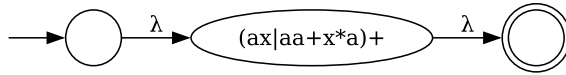
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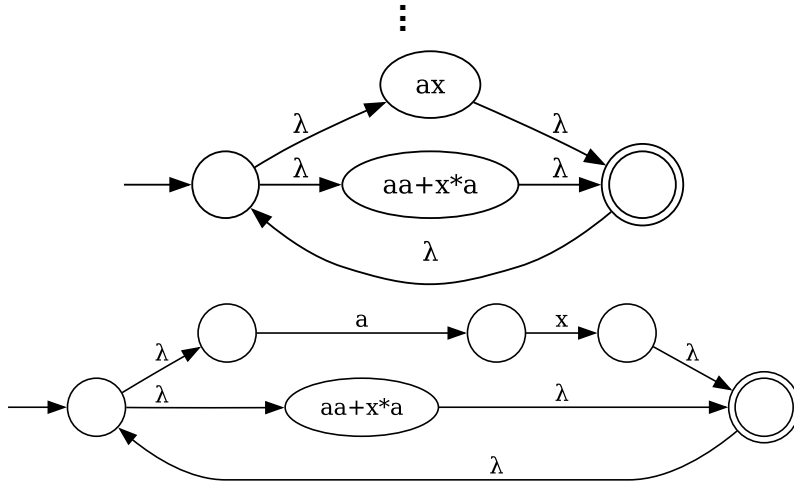
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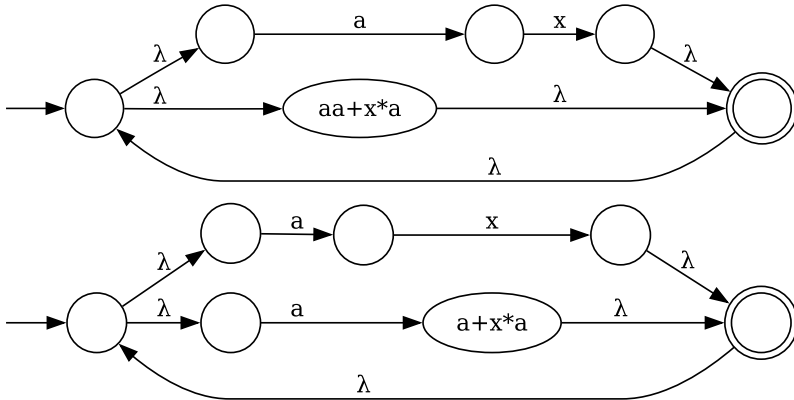
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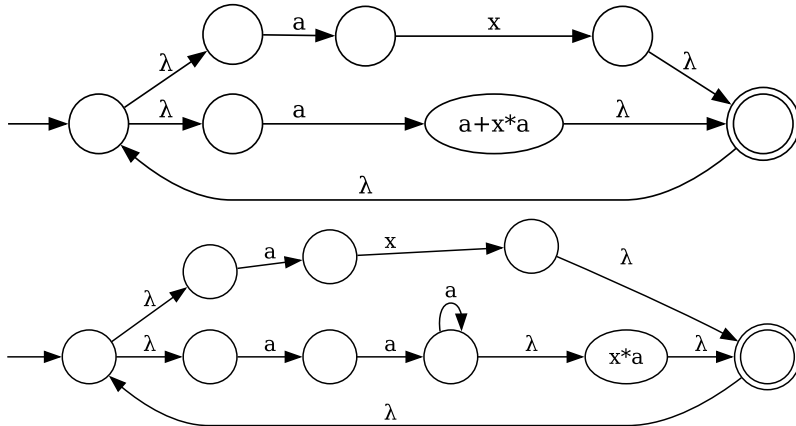
⋮



# From REs to NFAs

$(ax|aa^+x*a)^+$  (from the challenge question) as an NFA

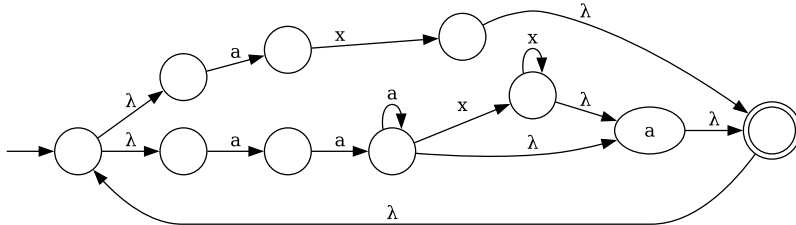
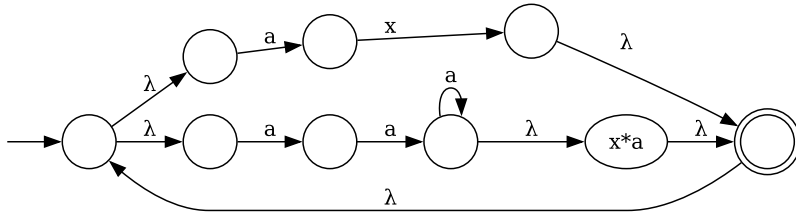
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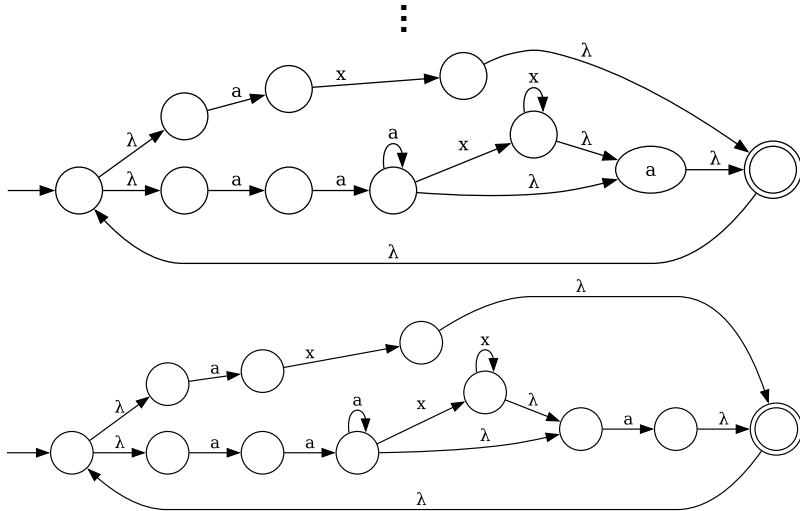
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# From REs to NFAs

$(ax|aa^+x*a)^+$  (from the challenge question) as an NFA



## ...next lecture

How might we convert this NFA to a DFA ( $\equiv$  **transition table**)?

