

# DFAs & NFAs

CS 103ACE Day 10 – 5/10/24

Agenda:

- Recap strings, languages, and rules for DFAs and NFAs
- Strategies for DFA and NFA problems

# Announcements

- Thank you for providing feedback on Monday!
- Midterm 2 is on 5/21
  - Topics: everything up to and including induction
  - **You can start studying now!**
    - Set aside time to study throughout next week
    - Slides: most of the symbols from lectures 6-13
      - Use this as a guide for assembling your notes sheet and identifying topics you feel less strong in
    - Try doing the ACE extra problems for practice
    - Let me know how I can help! I still have Calendly slots open
    - ACE review sessions: morning of 5/18, evening of 5/19, probably in 320-109 with Zoom option

# Strings and Languages

- An **alphabet** is a non-empty set of letters/characters/symbols
  - Typical symbol:  $\Sigma$
- A **string** is a finite sequence of characters
  - Typical symbol:  $w$
  - $\epsilon$  is the **empty string**:  $|\epsilon| = 0$
- A **language** is a set of strings
  - Languages are defined over alphabets, meaning the strings in the language are made of symbols from the alphabet
  - $\Sigma^*$  is **the set of all strings** made from symbols in  $\Sigma$
  - Typical symbol:  $L$

*Languages represent problems*

# Problem 1. Deterministic Finite Automata

*Finite automata represent computer programs with limited memory*

DFA properties:

- Exactly one start state, any number of accept states
- Every state has exactly one transition for every alphabet symbol
- = deterministic: we always know what to do!

Tips and tricks:

- Write out strings in the language & not in the language
- Try out a simpler language first
- Use a self-loop on Sigma to always reject/accept
- Figure out what the computer needs to “remember”

# Problem 3. Nondeterministic Finite Automata

NFA properties:

- Exactly one start state, any number of accept states
- Can have  $\epsilon$ -transitions
  - Use these for “either or”
- No restrictions on transitions: a state can have any number of transitions on the same symbol
- = non-deterministic: accepts if **any route** through the NFA leads to an accept state **after the string is fully read**

Intuitions:

- Trying every option at once
- Perfectly guessing which option to take

# Post-section suggestions

- Start early on problem set 6 so you can start studying for midterm 2!