BU CS 332 – Theory of Computation

Lecture 8:
Test 1 Review

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Test 1 Topics
Sets, Strings, Languages (0)

• Know the definition of a string and of a language (and the difference between them)
• Understand operations on strings: Concatenation, reverse
• Understand operations on languages: Union, intersection, concatenation, reverse, star, complement
• Know the difference between $\emptyset$ and $\varepsilon$
Deterministic FAs (1.1)

• Given an English or formal description of a language $L$, draw the state diagram of a DFA recognizing $L$ (and vice versa)

• Know the formal definition of a DFA (A DFA is a 5 tuple...) and convert between state diagram and formal description

• Know the formal definition of how a DFA computes

• Construction for closure of regular languages under complement
Nondeterministic FAs (1.2)

• Given an English or formal description of a language $L$, draw the state diagram of an NFA recognizing $L$ (and vice versa)
• Know the formal definition of an NFA
• Know the power set construction for converting an NFA to a DFA
• Proving closure properties: Know the constructions for union, concatenation, star
• Know how to prove your own closure properties
Regular Expressions (1.3)

• Given an English or formal description of a language $L$, construct a regex generating $L$ (and vice versa)
• Formal definition of a regex
• Know how to convert a regex to an NFA
• Know how to convert a DFA/NFA to a regex
Non-regular Languages (Myhill-Nerode Note)

• Understand the statements of the distinguishing set method for proving DFA size lower bounds / non-regularity

• Understand the proof of why the distinguishing set method works, and be able to use it to prove similar statements

• Know how to apply the method to specific languages

• Know how to show languages are non-regular by combining distinguishing set method with closure properties
Test format

Half in-class (Thursday 9/30)
- “Check your type checker”
  E.g., Is aabba a string, language, or a regex?
  How about \{ab\} U \{aab\}?
- True/false with **justification**
  Either provide a convincing explanation or a specific counterexample
- Homework-style problems

Half take-home (due Tuesday, 10/5 11:59PM)
- More homework-style problems
Test tips

• You may cite without proof any result...
  ▪ Stated in lecture
  ▪ Stated and proved in the main body of the text (Ch. 0-1.4)
  ▪ These include worked-out examples of state diagrams, regexes

• Not included above: homework problems, discussion problems, (solved) exercises/problems in the text

• Showing your work / explaining your answers will help us give you partial credit

• Make sure you’re interpreting quantifiers (for all / there exists) correctly and in the correct order
Practice Problems
Name six operations under which the regular languages are closed
Prove or disprove: All finite languages are regular
Prove or disprove: The non-regular languages are closed under union
Give the state diagram of an NFA recognizing the language \((01 \cup 10)^*\)
Give an equivalent regular expression for the following NFA
Is the following language regular?
\{a^n a^n \mid n \geq 0\}
Is the following language regular?
\[\{0^n1^n \mid 0 \leq n \leq 2021\}\]
How many states does a DFA recognizing \( \{0^n1^n \mid 0 \leq n \leq 2021\} \) require?