

# University of Nevada, Las Vegas Computer Science 456/656 Spring 2026

## Assignment 2: Due Saturday February 28, 2026, 11:59:59 PM

Name: \_\_\_\_\_

You are permitted to work in groups, get help from others, read books, and use the internet. Turn in the assignment as instructed by the Graduate Assistant, Shubhashish Kar, [shubhashish.kar@unlv.nevada.edu](mailto:shubhashish.kar@unlv.nevada.edu)

1. True(T) or False(F).
  - i \_\_\_\_\_ If  $\Sigma$  is any alphabet, then  $\Sigma^*$  is a regular language.
  - ii \_\_\_\_\_ Every language is countable.
  - iii \_\_\_\_\_ If  $\Sigma$  is any alphabet, then there are countably many languages over  $\Sigma$ .
  - iv \_\_\_\_\_ If  $\Sigma$  is any alphabet, then there are countably many context-free languages over  $\Sigma$ .
  - v \_\_\_\_\_ The intersection of any regular language with any context-free language is context-free.
  - vi \_\_\_\_\_ Every context-free language over the unary alphabet is regular.
  - vii \_\_\_\_\_ If  $L$  is any language, then  $L + \{\lambda\} = L$ .
  - viii \_\_\_\_\_ If  $L$  is any language, then  $L\{\lambda\} = L$ .
  - ix \_\_\_\_\_ If  $L$  is any language, then  $L + \emptyset = L$ .
  - x \_\_\_\_\_ If  $L$  is any language, then  $L\emptyset = L$ .
  - xi \_\_\_\_\_ If there is some program which enumerates a language  $L$ , then  $L$  must be recursively enumerable.
  - xii \_\_\_\_\_ The well-known game *Rush Hour* (look it up on the internet) on a board of unbounded size is  $\mathcal{P}$ -TIME, that is, there is a  $\mathcal{P}$ -TIME algorithm which determines whether a solution exists for a particular configuration.
  - xiii \_\_\_\_\_ Every context-free language is generated by some unambiguous context-free grammar.
2. State the pumping lemma for regular languages.
3. Use the pumping lemma to prove that  $\{a^n b^n\}$  is not regular.
4. Give a context-free grammar for  $L = \{w \in \{a, b\}^* : \#_a(w) = \#_b(w)\}$ , that is, all strings over  $\{a, b\}$  which have the same number of  $a$ 's as  $b$ 's.
5. Sketch a DPDA which accepts  $L = \{w \in \{a, b\}^* : \#_a(w) = \#_b(w)\}$ , that is, all strings over  $\{a, b\}$  which have the same number of  $a$ 's as  $b$ 's.
6. Sketch a PDA which accepts the language of all palindromes over  $\{a, b\}$ .
7. Give two different right-most derivations for the string  $x + x * x$  generated by the ambiguous grammar:
  1.  $E \rightarrow E + E$
  2.  $E \rightarrow E * E$
  3.  $E \rightarrow x$The start symbol of this grammar is  $E$ .
8. Work problems 1. through 8. on pages 3 through 6 of lalrhandout1.