

CS 456/656 Study Guide for Examination November 20, 2024

1. True or False.

Answer the True/False questions given in the file “Tests/tfstd.pdf.”

2. Prove that $\sum_{i=1}^n i^3 = \frac{n^2(n+1)^2}{4}$ for every positive integer n . (Hint: The binomial theorem states that $(a+b)^2 = a^2 + 2ab + b^2$, and $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$.)
3. State the pumping lemma for context-free languages.
4. Give an example of a CFL that is not regular.
5. Give an example of a CFL that is not a DCFL.
6. Sketch the diagram of a DPDA which accepts the language of all strings over $\{a, b\}$ which have twice as many a 's as b 's.
7. Read and understand [Handout/complexityIII.pdf](#)
8. Prove that every language which is enumerated in canonical order by some machine is decidable.
9. Prove that every decidable language is enumerated in canonical order by some machine.
10. Prove that every recursively enumerable language is accepted by some machine.
11. Prove that every language accepted by a machine is recursively enumerable.
12. Write a (pseudo-code) program which accepts HALT. (Hint: You can write it in no more the four lines.)
13. Prove that HALT is undecidable.
14.
 - (a) Read Handout/lalrhandout1.
 - (b) That handout contains 8 questions. Answers to questions 1, 2, 3, and 6. are given in the handout. Understand those questions and answers.
 - (c) Work questions 4, 5, 7, and 8.
 - (d) Using the grammar on page 1 of the handout, give two *different* parse trees of the string $a*a+a$, showing that the grammar is ambiguous. Which one of those parse trees is “correct,” *i.e.*, respects the standard precedence of operators?