

# University of Nevada, Las Vegas Computer Science 456/656 Spring 2022

## Topics Covered on the Examination on April 13, 2022

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1. Review Assignments 3, 4, and 5. Any type of question on one of those assignments could be on the examination.
2. Read the handouts.
3. Try to answer the true false questions on the long list without first looking at the answers. Some of the answers simply have to be memorized. But in most cases, the answer follows logically from something you should know.
4. I expect you to know the following reductions and other proofs.
  - (a) Reduction of 3-SAT to IND, the independent set problem.
  - (b) Reduction of Subset Sum to Partition.
  - (c) The halting problem is undecidable.
  - (d) A language is recursively enumerable if and only if it accepted by some machine. (2 proofs.)
  - (e) A language is recursively enumerable in canonical order if and only if it is decided by some machine. (2 proofs.)
  - (f) The problem of finding the sum of the entries of an array is in Nick's Class.
5. You should know the definitions of these terms.
  - (a) Accept
  - (b) Decide
  - (c)  $\mathcal{P}$ -TIME
  - (d)  $\mathcal{P}$ -SPACE
  - (e)  $\mathcal{NP}$
  - (f)  $co - \mathcal{NP}$
  - (g)  $\mathcal{NP}$ -complete
  - (h)  $\mathcal{NC}$
  - (i)  $\mathcal{P}$ -complete
  - (j) Decidable
  - (k) Undecidable
  - (l) Recursively Enumerable (RE)
  - (m) co-RE
  - (n) Context-free (language or grammar)
  - (o) Context-sensitive (language or grammar)
  - (p) Unrestricted grammar

- (q) Guide string
  - (r) Turing machine
  - (s) Church Turing Thesis
  - (t) Recursive function
6. Know a short list of  $\mathcal{NP}$ -complete problems that I've mentioned in class.
- (a) SAT
  - (b) 3-SAT
  - (c) TSP
  - (d) IND
  - (e) Subset Sum
  - (f) Partition
  - (g) Block sorting
  - (h) Placing a set of shapes into a given space
7. Know a short list of problems which are believed to be harder than  $\mathcal{NP}$  that I've mentioned in class.
- (a) Sliding block problems
  - (b) Chess, checkers, *etc.*.
8. Questions that will *definitely* be on the test.
- (a) Prove that the halting problem is undecidable.
  - (b) Give a Context-sensitive grammar for  $\{a^n b^n c^n : n \geq 1\}$ .
  - (c) State the pumping lemma for context-free languages accurately. The quantifiers must be properly expressed, and in the correct order. If your statement contains all the correct words but in the wrong order, you might still get no credit.