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

Study Guide for Second Examination Thursday October 29, 2026

Throughout, $\mathcal{P}$–TIME is usually abbreviated $\mathcal{P}$, and $\mathcal{NP}$–TIME is usually abbreviated $\mathcal{NP}$.

1. In the context of $\mathcal{NP}$, What is a certificate?
2. Rreduction and $\mathcal{NP}$-completeness.
3. What is 3-SAT? What is the Independent Set problem? Give the reduction of the first of those to the other.
4. Nick's Class, $\mathcal{P}$-completeness, and CVP.
5. Reductions and $\mathcal{P}$-completeness.
6. What well-known problems are known to be $\mathcal{NC}$?
7. Why is the open problem about $\mathcal{NC}$ of enormous practical importance nowadays, as opposed to in the past?
8. Enumeration and Canonicval enumeration. Proves of one of the four theorems:
   (i) A language is decidable if and only if ...
   (ii) A language is $\mathcal{RE}$ if and only if ...
9. Which of the following sets are countable?
10. Chomsky normal form grammars and the CYK algorithm.
11. Which of the following languages/problems are known to be $\mathcal{NP}$-complete?
12. Ambiguous and unambiguous context-free grammars.
13. Push-down automata and deterministic push-down automata.
14. Regular expressions.
15. One-way functions, cryptography, factoring integers, and $\mathcal{NP}$-completeness.
16. What is SHA256 used for? Is it secure?

The remaining questions/topics are much harder.

17. The continuum hypothesis.
18. Discuss the following two logical paradoxes.
    (i) Russell's paradox.
    (ii) "You can't win, Professor! It's turtles all the way down!." Legendary statement from the audisence after a lecture by a prominent philosopher. The professor may have been Russell himself.