# CSC 456/656 Spring 2022 Final Examination 8:00-10:00 May 11, 2022

1. True/False/Open.
2. Alphabets, strings, languages.
3. Give an NFA for a regular language.
4. Convert an NFA into an equivalent DFA.
5. Minimize a DFA.
6. Equivalence of Regular Grammars and NFAs.
7. Find a regular expression which describes the language accepted by an NFA.
8. Give a PDA for a context-free language.
9. Give a context-free grammar for a context-free language.
10. Chomsky normal form and the CYK algorithm.
11. Grammar classes: regular, context-free, context-sensitive, unrestricted.
12. Parse trees and derivations.
13. Ambiguous and unambiguous CF grammars. Inherently ambiguous CF languages.
14. LALR parsing.
15. Complexity classes: $\mathcal{NC}$, $\mathcal{P}$–complete, $\mathcal{P}$–TIME, $\mathcal{NP}$, co–$\mathcal{NP}$, $\mathcal{NP}$–complete, $\mathcal{P}$–SPACE, recursive, recursively enumerable, co-RE, undecidable.
16. Closure of language classes under various operations.
17. Machine classes and language classes.
18. Enumeration, enumeration in canonical order.
19. Both pumping lemmas.
20. Reduction definition of $\mathcal{NP}$.
21. Certificate/verifier definition of $\mathcal{NP}$.
22. Guide strings.
23. $\mathcal{NP}$–complete problems.
24. Finding new $\mathcal{NP}$–complete problems using reduction.
25. Give a polynomial time reduction of 3-SAT to the independent set problem.
26. Give a polynomial time reduction of the subset sum problem to the partition problem.

27. $\mathcal{NC}$ problems.

28. $\mathcal{P}$–completeness.

29. Problems known or believed to be harder than $\mathcal{NP}$.

30. Undecidable problems.

31. Prove that the halting problem is undecidable.

32. Turing Machines.

33. Church-Turing thesis.

34. Countable and uncountable sets.

35. Uncomputable functions.

36. Recursive real numbers. https://www.ams.org/journals/proc/1954-005-05/ S0002-9939-1954-0063328-5/S0002-9939-1954-0063328-5.pdf

37. Truth vs Reason.