Topics

To-Do Date: Jan 12 at 3:59pm

Predicate and propositional logic (pre-recorded lectures 1-4 and problem sessions 1-2)

Mathematics for Computer Science, chapters 1.1–1.2, 3
Learning to Reason, chapter 1
236/240 course notes, chapters 5, 6

propositional logic: negation, conjunction, disjunction, implication
truth tables
contrapositive, converse
predicate logic: universal quantification, existential quantification

O, Ω, Θ, o
disjunctive and conjunctive normal forms
prenex normal form
validity, satisfiablility

Proofs (pre-recorded lectures 5-6 and problem session 3)

Mathematics for Computer Science, chapters 1.3–1.9
How to Read and Do Proofs
Learning to Reason, chapter 2

substitution
modus ponens
specialization
direct proof
indirect proof
proof by contradiction
proof by cases
generalization
construction
instantiation
existence proofs

Induction

lectures 4-6
Mathematics for Computer Science, chapters 2, 5, 7
236/240 course notes, chapters 1, 4
How to Read and Do Proofs
Learning to Reason, chapter 2

(weak) induction
strong induction
inductive definitions
structural induction
well-ordering principle

Diagonalization and the Halting Problem

lecture 6
Mathematics for Computer Science, chapters 4.1, 8.1–8.2
Learning to Reason, chapter 3

countability
diagonalization
halting problem

Correctness and Analysis of Iterative and Recursive Algorithms

lectures 7-10
Mathematics for Computer Science, chapter 22
236/240 course notes chapters 2, 3
Introduction to Algorithms, chapters 2, 3, 4

worst case and average case time complexity of algorithms
upper bounds and lower bounds on time complexity of algorithms
worst case analysis of iterative algorithms
preconditions, postconditions
partial correctness, termination, total correctness,
loop invariants
correctness of iterative algorithms
correctness of recursive algorithms
divide and conquer algorithms
worst case analysis of recursive algorithms
solution of recurrences:

- guess and verify
- plug and chug
- divide and conquer recurrences
- Master theorem
- linear recurrences
- domain and range transformations

Languages and Automata Theory

lectures 10-12
An Introduction to Formal Languages and Automata, chapters 2-4
236/240 course notes, chapter 7

regular expressions
deterministic and nondeterministic finite automata
subset construction
closure results
proof of equivalence of finite automata and regular expressions
proving languages nonregular: pumping lemma
right linear grammars