Final Topics  CS220

Propositional & Predicate Logic
- Definition of a proposition
- Definition of a predicate
- Logic connectors such as: negation, and, inclusive or, exclusive or, conditional, bi-conditional
- How to prove equivalence using truth tables
- Definition of a tautology, contingency, & contradiction and how to show in a truth table
- Universal quantifier, Existential quantifier
- Equivalences involving negation of universal and existential quantifiers

Rules of Inferences
- Definition of rules of inference
- Use truth tables to determine if a rule of inference is valid or not valid
- Be able to derive a conclusion by applying rules of inferences to the premises

Proof techniques
- Direct Proofs
  - Definition of a direct proof
  - Be able to prove statement using direct proof technique
- Indirect Proofs
  - Contraposition
    - Know the principles behind a contraposition proof
    - Be able to prove statement using contraposition proof
  - Contradiction
    - Know the principles behind a contradiction proof
    - Be able to prove statement using contradiction proof
- Proof by cases
  - Know the principle behind proof by cases
  - Be able to prove statement using proof by cases

Program Correctness
- Pre and post conditions
- Loop invariants
  - Proof rule for while loops

Sets & Functions
- \( N, Z, Q, R \)
- Sets: equivalence, union, intersection, difference, universal set
- Cardinality
- Subsets and Proper Subsets
- Tuples
- Cartesian product
- Power set
- Function
  - Definition
  - Increasing, Strictly increasing
  - Injection, surjection, bijection
  - Composition, inverse
Sequences
  Definitions, geometric Series, arithmetic series

Induction
  Linear induction
  Strong Induction
  Structural Induction

Counting
  Product rule, sum rule
  Permutations, combinations
  Inclusion / exclusion
  k to 1 rule, bijection rule
  Pigeonhole principle

Orders of Magnitude
  $O$ of functions
    - constant, log, sqrt, linear, polynomial, exponential
  $O$ of programs, loops, recursion

Relations, binary relations, graph representation, partial orders and directed graphs

Graphs
  traversals, DFS, cycles, BFS, distance, paths, shortest paths, exchange argument,
  (minimum) spanning trees, cut property