- 1. Integers
  - 1. divisibility
  - 2. prime, composite, relatively prime
  - 3. modular arithmetic
- 2. Statements
  - 1. if-then, if and only if
  - 2. and, or, not connectives
  - 3. quantifiers
    - 1. exists (there is)
    - 2. for all (every)
    - 3. compound statements
    - 4. negations
- 3. Proofs and Counterexamples
  - 1. direct proofs
    - 1. if-then statements
    - 2. if and only if statements
  - 2. indirect proofs
    - 1. contrapositive
    - 2. proof by contrapositive
    - 3. proof by contradiction
  - 3. mathematical induction
    - 1. standard form
    - 2. strong form
    - 3. formulas (equalities) vs. inequalities
    - 4. recursive definitions
- 4. Boolean Algebra
  - 1. operations
  - 2. truth tables
  - 3. logical equivalence
  - 4. properties
  - 5. tautology
- 5. Lists
  - 1. multiplication principle
  - 2. counting: with and without repetition
  - 3. factorials

- 6. Sets
  - 1. Venn diagrams
  - 2. inclusion-exclusion principle
    - 1. |A B| = |A| + |B| |A B|
    - 2. extension to more than two sets
    - 3. applications
    - 4. derangements
  - 3. subsets
  - 4. binomial coefficients
    - 1. properties
    - 2. binomial theorem
    - 3. Pascal's triangle, Pascal's identity
    - 4. formula
    - 5. applications: lottery, card hands, probability
  - 5. power set
  - 6. set operations
    - 1. union, intersection
    - 2. difference, symmetric difference
    - 3. Cartesian product
  - 7. properties
    - 1. associative, commutative, distributive
    - 2. others
  - 8. proofs of A B and A = B
    - 1. showing set containment
    - 2. using logical operations
    - 3. using Venn diagrams
- 7. Relations
  - 1. subsets of the Cartesian product
  - reflexive, irreflexive, symmetric, antisymmetric, transitive
  - 3. inverse relation
  - 4. equivalence relations
    - 1. examples: modular arithmetic, subsets
    - 2. reflexive, symmetric, transitive
    - 3. partitions
    - 4. equivalence classes
    - 5. counting equivalence classes
      - 1. subsets of a fixed size
      - 2. anagrams
- 8. Functions
  - 1. domain, image
  - 2. inverse function
  - 3. one-to-one, onto, bijection
  - 4. counting functions
  - 5. composition