PROOFS AND FUNDAMENTALS:
THEMES FOR THE FINAL EXAM

- **Logic:**
  - Statements; Arguments; Propositional Connectives, Truth-Tables, Tautologies
  - Rules of Inference, Formal Derivations, Syntax and Semantics, Soundness and semantic Completeness
  - First-Order Logic: Predicates, Quantifiers, Instantiation and Generalization
  - Direct Proofs; Proofs by Contrapositive and by Contradiction.
- **Sets:**
  - Notation, Russell Paradox, Axioms of Exensionality, Separation and Well-Foundness;
  - Cardinality of sets, Cantor Theorem;
  - Boolean operation on sets, the Cartesian Product of sets.
- **Functions:**
  Domain and Codomain, Composition of functions; Invertible functions, image and inverse image, injective, surjective, and bijective functions.
- **Relations:**
  - Equivalence Relations; Equivalence Classes
  - Partial Order Relations; Partially Ordered Sets (Posets); isomorphism and (homo)morphism of posets.
- **Algebraic Operations:**
  Binary Operations; Groups of Permutations; Homomorphisms and Isomorphisms of Groups.
- **Arithmetic:**
  - Natural numbers, Integers; Rational Numbers; Real Numbers (as Dedekind Cuts); Complex Numbers;
  - Mathematical Induction