Final Exam

**Below is a suggested guide and review list for the final exam. This is not a comprehensive list, but highlights many of the things that we discussed from different sections.**

**In addition to demonstrating a basic understanding, the final exam also serves as an opportunity to show mastery of the course material. Consequently you may expect “new” style problems that combine the material from different sections and/or ask you to apply the material in a “new” way.**

* Discrete Math Review

Including but not limited to:

* + Relations
  + Modulo m.
  + Representations of relations
  + Properties of relations (symmetry, anti-symmetry, etc.)
  + Closure (e.g. symmetric closure, transitive closure, etc.)
  + Representation of properties (e.g. matrices, directed graphs, etc.)
  + Equivalence Relations
  + Equivalence classes
  + Partitions
  + Partitions of a set
  + Partial order
  + Composition of Relations
  + Powers of a Relation
  + String properties
  + Sets of strings
  + Codomain, Domain, Image, Preimage of Functions
  + Surjection, Injection, Bijection
  + Function inverse, Function composition
  + Total function
  + Floor, ceiling functions
  + Sets (union, intersection)
  + Proofs
* [1 - Recursive Definitions and Induction 1 - Recursive Definitions and Induction](https://cle.nps.edu/portal/site/ae354e11-e491-4f1e-aca5-dc28bde923f2/tool/66792ae1-3ab3-4a74-88eb-9a6ff7c64e07?panel=Main)

Including but not limited to:

* + Weak Induction & use cases
  + Strong Induction & use cases
  + Mutual Induction & use cases
  + Choosing the correct induction for a proof
  + Automata
  + Peterson’s Algorithm
  + Recursive Definitions and motivation for Post Systems
  + Post Systems
  + Deriving a Post System given statements, writing statements given a Post System
  + Proofs using Post Systems
  + Soundness and Completeness
  + Induction proofs (i.e. writing a complete induction proof)
  + Rooted Trees
  + Axioms, Consequents, and Antecedents in Post Systems
  + Strings in Post Systems
  + Post Systems and subsets (e.g Lab 4 #3)
  + Post Systems to/from set comprehension notation
  + Proofs
* [2 - Circuit Design 2 - Circuit Design](https://cle.nps.edu/portal/site/ae354e11-e491-4f1e-aca5-dc28bde923f2/tool/66792ae1-3ab3-4a74-88eb-9a6ff7c64e07?panel=Main)

Including but not limited to:

* + Propositional Logic
  + Boolean Operators
  + Formulas as Trees
  + Inorder tree traversal
  + Primary Operators
  + Interpretations
  + Models
  + Logical Consequence
  + Values of formulae
  + Equivalent formulae
  + Satisfiability and Validity
  + Falsifiability and Unsatisfiability
  + Simultaneously satisfiable sets
  + Theorems on Validity and Satisfiability
  + Closed under Logical Consequence
  + Axiomatizable
  + Atoms, Literals, Clauses, Formulae
  + Commutativity, Distributivity
  + Proofs
  + Drawing circuits and translating circuits to logical formulae
* [3 - Computational Complexity Primer 3 - Computational Complexity Primer](https://cle.nps.edu/portal/site/ae354e11-e491-4f1e-aca5-dc28bde923f2/tool/66792ae1-3ab3-4a74-88eb-9a6ff7c64e07?panel=Main)

Including but not limited to:

* + Decision Procedures
  + Decidable/Semi-decidable/Undecidable
  + Halting problem
  + Refutation procedure
  + Clausal form
  + CNF
  + NNF
  + DPLL
  + Resolution
  + Validity checking in propositional logic
  + Clashing literals
  + Clashing clauses
  + Measuring complexity – exponential time, polynomial time, linear time, time, etc.
  + Deterministic programs
  + Non deterministic programs
  + P, NP, NP-complete, NP-hard, coNP, etc.
  + The SAT and VAL problem in complexity
  + Turing reductions
  + Proofs
* 4 - Access control systems (minus FOL Computation Complexity and Decidable Subclasses)

Including but not limited to:

* + Quantifiers
  + Predicates, variables, constants
  + First order logic trees
  + Variable scope, bounded and free variables
  + Name conflicts and resolving name conflicts
  + Universal closure, existential closure
  + Closed formulae
  + Interpretations in FOL
  + Substring as a relation
  + Assignments
  + Values of formulae
  + Satisfiability and Validity
  + Falsifiability and Unsatisfiability
  + Models
  + Logical equivalence
  + Duality, Commutativity, Distributivity
  + Basic formulae equivalences
  + Proofs
  + PCNF
  + Functions in FOL, terms
  + Interpretations with functions
  + Atomic formulae in FOL
  + Suffix and prefix as relations
  + ‘Matrix’ in PCNF
  + Clausal form for FOL
  + Skolemization
  + One-to-many, many-to-many, and many-to-one for relations vs. functions
  + Writing statements into FOL
  + Writing statements from FOL
  + Duality, reflexivity, symmetry, etc.
  + PCNF to resolution, determining satisfiability and unsatisfiability
* 5 - Concurrent systems

Including but not limited to:

* + Always/Eventually/Next
  + Transition State Diagram
  + Interpretations
  + Models
  + Linear Propositional Temporal Logic
  + Total
  + Finding a truth value given a PTL formula
  + Satisfiability and Validity
  + Substitution Instances
  + Duality
  + Basic formulae equivalences
  + Linear and total relations vs functions
  + Induction in Linear Temporal Logic
  + Translating statements to/from Temporal Logic
  + FOL to/from Temporal Logic
  + Given state diagram and formulae, determine the truth value under and interpretation