Discrete Structures	Prelim 1 Review
CS2800 Fall 2013	Sunday, October 6, 2013

Our first prelim will be Friday, October 11, in class. The exam will be 50 minutes and will consist of short answer questions. It will cover all material up to and including the lecture of October 4 (Recursive Definitions and Structural Induction). This material is covered in the following chapters and sections of the course text: 1, 2.1-5, 4.1-4, 5.1-3, 9.1, 9.3-6.

1. Chapter 1 covers propositional logic, predicate logic, and proof construction.

   For propositional logic, you should know the definitions of the following concepts: proposition, propositional variable, propositional operator, truth value, truth assignment, truth table, logical equivalence, tautology, contradiction, satisfiability, converse, contrapositive. You should understand the intuitive meanings of the propositional operators and how to express informal English statements formally using them. You should know the inductive definitions of the meaning of the propositional operators and how to use these definitions to fill in a truth table. You should be familiar with basic logical equivalences such as associativity, commutativity, distributive laws, De Morgan laws, etc.

   For predicate logic, you should know the definitions of the following concepts: quantifier, existential, universal, domain of discourse, scope, free and bound occurrence of a variable. You should understand the intuitive meanings of the quantifiers and how to express informal English statements formally using them. You should be familiar with the basic logical equivalences involving quantifiers. You should know what the abbreviations $\forall x \in A\ P(x)$, $\exists x \in A\ P(x)$ and $\exists! x\ P(x)$ stand for.

   For proof construction, you should understand the meaning and use of the following: premise, conclusion, direct proof, proof by contradiction, proof by contraposition, proof by cases. You should be familiar with the instantiation and generalization rules for quantifiers and how they are used. You should understand when to use "without loss of generality." You should know what *modus ponens* is.

   Study the Review Questions on p. 111.

   Practice problems:
   pp. 12ff: 1, 7, 13, 17, 27, 35
   pp. 34ff: 11, 55, 61
   pp. 53ff: 1, 7, 9, 15, 29, 35, 53
   pp. 64ff: 1, 9, 33, 39
   pp. 78ff: 7, 13, 27
   pp. 91ff: 33
   pp. 108ff: 5, 17

2. Chapters 2 and 9 cover sets, functions, and relations.

   For sets, you should be thoroughly familiar with the notion of a set and set notation. You should know the definitions of the following concepts: the member relation, the subset relation, proper subset, intersection, union, complement, set difference, power set, cardinality, finite, countable, countably infinite, uncountable, Cartesian product, ordered pair, extensionality, comprehension, Venn diagrams. You should understand how unrestricted comprehension leads to Russell's paradox. You should know what the following sets are: $\mathbb{N}$, $\mathbb{Z}$, $\mathbb{Q}$, $\mathbb{R}$, $\mathbb{C}$. You should be familiar with the basic set identities on p. 130.

   For functions, you should know what a function is. You should know the definitions of the following concepts: domain, codomain, one-to-one, injective, onto, surjective, bijective, inverse, composition, sequence. You should be familiar with summation notation with bounds, e.g. $\sum_{i=1}^{n} f(i)$.

   For relations, you should know what a binary relation is. You should be familiar with the following concepts: relational composition, reflexive, symmetric, transitive, antisymmetric, equivalence relation, partition, partial order, total order, reflexive transitive closure, lexicographic order, comparable, incomparable.

   Study the Review Questions on pp. 186-7 and 634-5.

Practice problems:
pp. 136ff: 3, 23, 47, 59
What is the power set of $\{\varnothing, \{\varnothing\}\}$?
pp. 152ff: 10, 11, 33, 71
pp. 167ff: 19
pp. 176ff: 1, 15, 29
pp. 581ff: 3, 7, 33, 49
pp. 596ff: 1, 15
pp. 606ff: 1, 19
pp. 615ff: 1, 7, 9, 15, 55
pp. 630ff: 1, 15, 17

3. Chapter 4 covers basic number theory and modular arithmetic.

   You should know the definition of the following concepts: integer division with remainder, ceiling and floor functions, divisibility, prime, prime factorization, relative primality, greatest common divisor, least common multiple, statement of the fundamental theorem of arithmetic, statement of the Chinese remainder theorem, Euclidean algorithm, statement of Bézout's theorem.

   Study the Review Questions on p. 307.

   Practice problems:
   pp. 244ff: 7, 13, 29, 45
   pp. 272ff: 1, 15, 31
   pp. 284ff: 1, 5, 11, 31

4. Chapter 5 covers mathematical induction.

   You should understand the following terminology: base case, inductive step, inductive hypothesis, weak induction, strong induction, structural induction. You should be able to state formally the induction principle on $\mathbb{N}$. You should know how to prove a theorem of the form $\forall n\ P(n)$ by induction. You should be able to identify the following parts: base case(s), inductive step. In the inductive step, you should be able to show where the inductive hypothesis is used. You should know how and when to use strong induction.

   Study the Review Questions on p. 378.

   Practice problems:
   pp. 329ff: 3, 5, 7, 61
   pp. 341ff: 3, 7, 25
   pp. 357ff: 7, 13