

## CSCI 2824 – Discrete Structures – Midterm 1 Concept Guide

Note that this is an incomplete guide through the material we have covered thus far in CSCI 2824. It is not meant to be an exhaustive listing of material to study for the midterm exam.

- **Binary Arithmetic**
  - Converting integers and fractions from decimal to binary
  - Originally, we started using these tools because operating bit-wise makes sense from a computational perspective. But it turns out that binary is also a useful introduction to propositional logic, where propositions take one of two values, True or False
  - How many bits does it take to encode a piece of information?
- **Propositional Logic and Applications**
  - This was our first step into formally “thinking like a computer” (at least for this class). Computers don’t see any shade of gray – that bit is either a 0 or a 1 – it’s either True or False. And so, using propositional logic, we were able to construct propositional statements and assess their truth values. We used these to solve puzzles and represent declarative statements, which we later used to construct arguments and proofs.
  - Logical connectives and compound propositions
  - Truth values and truth tables
  - Conditionals, and conditionals in English language (necessary and/or sufficient conditions, “only if”)
  - Logic Puzzles – Knights and Knaves! Who wants coffee?
- **Logical Equivalences** – from propositional logic, we found that, just like in spoken word, two statements might appear/sound different, but they mean the same thing.
  - Logical equivalences were our first step into the world of manipulating propositional statements, which ultimately led to us writing out full-blown proofs.
  - Propositional Satisfiability – a great application of our propositional logic skills, we were able to deduce where the Scooby Doo gang should go on vacation. But also, satisfiability connects our propositional statements to reality – is it actually possible for this proposition to be true?
- **Predicate Logic**
  - Propositional logic lacked the flexibility to make many statements that we would find useful in computational science. For example, it would be cumbersome to say “all computer science instructors ride a unicorn to work every morning and enjoy asparagus” via propositional logic. But predicate logic, by combining propositional functions and quantifiers, can handle these things.
  - Nested Quantifiers
    - Get comfortable translating to/from quantifiers from/to English.

- **Rules of Inference**
  - Convenient “mini-proofs” that we found to be useful again and again in the next section (Proofs), especially by linking together common sets of propositions and compound propositions
- **Proofs**
  - Proof Methods and Strategies (direct/conditional proof, proof by contradiction, proof by cases, contrapositive proof, proof by construction)
  - We brought everything from propositional logic and predicate logic together here.

### **What should I be doing to prepare?**

1. Review the homework problems. Reattempt tricky ones, and make sure you understand how to do any problems you couldn't do before.
  - a. Homework solutions will be posted under Piazza, Resources tab
2. Review the Workgroup worksheets (Piazza, Resources tab)
  - a. Solutions are not available. The point is for you to actually sink your teeth into tougher problems. Often, if solutions are available, students are too quick to give up. But in order to really master anything, you must persevere.
3. Read the [slides](#)
  - a. Can you do the examples from the lecture slides?
4. If any concept is unclear, go to an Instructor or a CA for help.
  - a. Office Hours are [posted](#).
  - b. Post to Piazza (strongly encouraged)
5. Use Piazza for constructive discussion.
  - a. The problems you're studying to prepare for the midterm aren't graded work. We strongly encourage you to discuss the problems with each other via Piazza! If you are stumped, that means you've found a nice challenging problem and others would probably benefit from studying it.
6. Attend the review session (Monday February 17<sup>th</sup>, in class)
7. Attend class (this should be a no-brainer, but is worth mentioning)
8. Look at the textbook for additional problems.
9. Look at the [Midterm Exam 1 Partial Study Tool](#) problem set.
10. Use this guide as a checklist, not as your only study tool.