MATH 250 Discrete Math
Mid-Quarter Assessment
Spring 2025

The purpose of this assessment is to measure what you have learned in Discrete Math so far this quarter. This assessment is to be done **INDIVIDUALLY**. Any questions you have about this should be directed to Professor Cutter.

There are two parts to this assessment. **Part 1** is a set of questions (see below) designed to check your understanding of key concepts that have been covered in the class. Please read all questions carefully. Give explanations for all answers and write as clearly as possible. If a problem is not clear, write down any assumptions you need to make to do the problem. You may use your book, your notes, and/or your previous homework assignments to help you answer these questions. In real life, you may find yourself looking things up to help you figure out questions like these. Online resources are allowed, WITH CITATION. You must specify what resource(s) (*i.e.,* links to websites) you used to help answer the questions. You MAY NOT SPEAK to other people about these questions.

Part 2 is a self-reflection. Once you have submitted your answers to the questions in Part 1, you will be given a set of solutions to the problems to compare with your solutions. Your reflection should include your thoughts on each of the following:

- Assess each problem according to the following rubric:
  1 point: Meets expectations (All or most the problem is correct and demonstrates understanding)
  0.7 points: Partially correct response but shows some signs of misunderstanding.
  0 points: Problem missing or shows significant misunderstanding

- Report on your overall assessment. For which problems did you meet expectations? Which problems did you show some signs of misunderstanding? Do you understand what you missed? Explain.
- How has your knowledge of discrete math topics grown or been reinforced so far this quarter? What factors have contributed to your learning or lack of learning this quarter? Explain.
- What resources have been most helpful to you for learning the Discrete Math concepts this quarter? The book? Class discussions? Class exercises? Other books? Online resources? Give details.
- What strategies would be helpful to increase your learning this quarter? More practice problems to work before coming to class/after class? Reading the book more carefully? Going to office hours or the MPC or the CS Collaboration Center? Other ideas? Explain.

You should take some time to think about these questions before writing your answers. Your reflection should be written in complete sentences, giving an honest evaluation of your progress.

Questions for Part 1 (Understanding Logic, Sets, and Counting)

Understanding Logic

1. Define p↑q by the following truth table:

p	**q**	**p↑q**
T	T	F
T	F	F
F	T	F
F	F	T

   a. Prove or disprove: $p \uparrow (q \uparrow r) \equiv (p \uparrow q) \uparrow r$.

   b. Find an expression using $\wedge$, $\vee$, and $\neg$ to represent **p↑q**.

Understanding Sets

2. Consider the following operations defined on two multisets (sets allowing duplicate elements) P and Q:

   - $P \cup Q$ (union of multisets) = multiset where the multiplicity of an element is the maximum of its multiplicities in P and Q
   - $P \cap Q$ (intersection of multisets) = multiset where the multiplicity of an element is the minimum of its multiplicities in P and Q
   - P – Q (difference of multisets) = multiset where the multiplicity of an element is the multiplicity of the element in P less its multiplicity in Q, unless the difference is negative, in which case the multiplicity is 0.
   - P + Q (sum of multisets) = multiset where the multiplicity of an element is the sum of multiplicities in P and Q.

   The problem to work: Suppose that A is the multiset that has as its elements the types of computer equipment needed by one department of a university where the multiplicities are the number of pieces of each type needed, and B is the analogous multiset for a second department. Suppose A = {107 · personal computers, 44 · routers, 6 · servers, 1 · projector}, and B = {14 · personal computers, 6 · routers, 2 · projectors}.

   a) What operation on A and B represents the equipment the university should buy assuming both departments use the same equipment? Show the elements of this multiset.

b) What operation on A and B represents the equipment that the university should buy if the departments do not share equipment? Show the elements of this multiset.

c) What operation on A and B represents the equipment that will be used by both departments if both departments use the same equipment? Show the elements of this multiset.

d) What operation on A and B represents the equipment that the second department uses, but the first department does not, if both departments use the same equipment? Show the elements of this multiset.

Understanding Counting

3. a) How many 4-digit odd numbers less than 6000 can be formed using the digits 1, 2, 4, 6, 7, 8, 9?

b) How many ways can you answer a 25-question multiple-choice test if there are 4 choices for each question?

c) A mathematics exam consists of 10 multiple-choice questions and 5 open-ended problems in which all work must be shown. If an examinee must answer 8 of the 10 multiple-choice questions, and 3 of the open-ended problems, in how many ways can the questions be chosen?

d) How many ways can a committee of four be formed from four men and six women with at least two men and one woman? (Assume that people are distinguishable.)

e) Professor Cutter made 2 dozen chocolate chip cookies. In how many ways can the cookies be distributed to the 5 members of her family?

f) How many ways are there to arrange the letters in the word COOKIES?