Homework Assignments
Math 163: Discrete Mathematics
Spring 2013

All homework is due at the beginning of class on the day indicated. I encourage you to discuss the homework problems with your classmates, Learning Center tutors, and me, even problems you're curious about but haven't been assigned. Your submitted written work should be your own.

Due Thursday 1/17:
   Reading: Sections 1.3, 1.4, and 1.5.
   Reading problems:

1. At the Bistro, you can buy either Bistro or Special coffee, small or large, and then add either regular sugar, sugar in the raw, artificial sweetener, or no sweetener, and skim, half and half, or no dairy. How many different coffee combinations are possible?

2. Alice, Bob, Charlie, and Dana buy some Bistro cookies, and they each take some. How many do they need to buy to ensure that someone gets at least 3 cookies?

Due Tuesday 1/22:
   Reading: Sections 2.1 and 2.2.
   Reading problems:
   For the sets $A = \{duck, goose\}$, $B = \{1, 2, 3, duck\}$, $C = \{n \in \mathbb{Z} \,|\, -1 \leq n \leq 2\}$,

1. List the elements of C.

2. Find $A \cup B$.

3. Find $A \cap B$.

4. Find $B \backslash C$.

5. Find $A \times B$.

Due Thursday 1/24:
   Reading: Section 2.3.
   Reading problems:

1. Let P be the statement "Josh is doing mathematics," Q be the statement "Josh is drinking coffee," and R be the statement "Josh is drinking tea." Write $P \Rightarrow (Q \vee R)$ as an English sentence.

2. Negate the statement "All sets are boring."

3. Which of these statements are logically equivalent? (a) I will not both go to the movies and go out to dinner. (b) I will not go to the movies and I will not go out to dinner. (c) I will not go to the movies or I will not go out to dinner. (d) If I go to the movies I will not go out to dinner.

Due Tuesday 1/29:

Homework assignment #1: Section 1.7: 12, 17, 20, 22, Section 2.9: 6, 8, 13, 14, 20.
Reading: Section 2.5. (and Section 1.4 if you haven't read that one yet.)
Reading problems:
Fill in the blanks in the following proofs. Use the Templates in Sections 1.4 and 2.5 to help.

1. **Theorem.** If $x = 3$, then $2x + 2 = 8$.

    Proof. We use a direct proof. Assume _____. Since $2(3) + 2 = 8$, we conclude that _____. □

2. **Theorem.** If $x = 3$, then $2x + 2 = 8$.

    Proof. We prove the statement by contradiction. Assume _____ and _____. Since $2(3) + 2 = 8$, we have derived a contradiction. Therefore _____. □

Thursday 1/31:

Quiz #1.
No assignments.

Due Tuesday 2/5:

Reading: Sections 3.1 and 3.2.
Reading problems:
For the following functions, determine whether they're one-to-one, onto, both, or neither.

1. $f : \mathbb{N} \to \mathbb{N}$ defined by $f(x) = 2x$.

2. $f : \{duck, goose, heron\} \to \{lake, river\}$ defined by $f(duck) = lake$, $f(goose) = lake$, $f(heron) = lake$.

Due Thursday 2/7:

Reading: Sections 3.4 and 3.5.
Reading problems:
Draw the following graphs.

1. C_6.

2. K_6.

3. $K_{3,4}$.

4. Any tree with 8 vertices.

Due Tuesday 2/12:

Reading: Sections 3.6 and 3.7.
Reading problems:

1. Are C_4 and C_5 isomorphic? Why or why not?

2. Are $K_{2,5}$ and $K_{5,2}$ isomorphic? Why or why not?

3. Draw all nonisomorphic subgraphs of P_3.

4. What graph is $C_5 \backslash v$?

Due Thursday 2/14:
    Homework assignment #2: Section 2.9: 16, 18, Section 3.13: 4, 6, 7, 12, 13, 14
    No reading assignment.

Due Tuesday 2/19:
    Reading: Sections 4.1 and 4.2.
    Reading problems:

1. Fill in the blanks in the following proof. Use the template in Section 4.2 to help.

   Theorem. For all $n \in \mathbb{N}$, $2n + 4$ is even.

   Proof. We prove the statement by induction.
   (Base case) If $n = 1$, _____.
   (Inductive hypothesis) We assume that if $n \leq k$, _____.
   (Induction step) We show that $2(k+1) + 4$ is even. We know that $2(k+1) + 4 = (2k+4) + 2$. Since _____ by the inductive hypothesis, 2 is even, and the sum of two even numbers is even, we conclude that $2(k+1) + 4$ is even. □

2. Find $\sum_{i=2}^{5} i^2 - 3$.

Due Thursday 2/21:
    Reading: Section 4.5.
    No reading problems, just think about the section and be ready to talk about it.

Tuesday 2/26:
    Quiz #2.
    No assignments.

Due Thursday 2/28:
    Reading: Sections 5.1 and 5.2.
    Reading problems:
    Explain what the following algorithms do.

    Algorithm FRED: (Input a natural number n)

1. Let $k = 0$.

2. Replace the value of n with $n - 1$.

3. Replace the value of k with $k + 2$.

4. If $n > 0$ go to step 2; otherwise, continue to step 5.

5. Output k.

Algorithm STEVE: (Input a natural number n)

1. Let $k = 0$.

2. Let $m = 1$.

3. Replace the value of m with $10m$.

4. Replace the value of k with $k + 1$.

5. If $m < n$ go to step 3; otherwise, continue to step 6.

6. Output k.

Due Tuesday 3/5:
Reading: Sections 5.3 and 5.4.
Reading problems:

1. Find three numbers that are congruent to 4 mod 5.

2. Decrypt the message "TBBQJBEX", encrypted in the ROT13 cipher.

Due Thursday 3/7:
Reading: Section 5.7.
No reading problems.

Due Tuesday 3/12:
Reading: Sections 6.1 and 6.2.
Reading problems:

1. Find $\binom{7}{1}$.

2. Find the number of ways of choosing two donuts from a box of six donuts (rainbow sprinkles, lemon filled, raspberry filled, powdered, chocolate frosting, vanilla frosting).

Due Thursday 3/14:
Reading: Sections 6.4 and 6.5.
Reading problems:

1. Find $\binom{8}{5}$.

2. If the sum of the degrees of all the vertices of a graph G is 84, how many edges does G have?

3. If I shuffle a hand of five cards (A♠, K♠, Q♠, J♠, 10♠) and deal them out one at a time, how many different orders could they come out in?

Due Tuesday 3/19:
   Homework assignment #3: Section 4.11: 2, 17, Section 5.9: 9, 12, 17, 19abc, 23, 24.
   No reading assignment.

Due Thursday 3/21:
   Quiz #3.
   Reading: Sections 6.7 and 6.8.
   Reading problems:

1. Find the coefficient of $x^4 y^5$ in $(x+y)^9$.

2. Explain in your own words why $\binom{n}{k} = \binom{n}{n-k}$.

Tuesday 4/2:
   No assignments.

Due Thursday 4/4:
   Reading: Sections 7.1 and 7.2.
   Reading problems:

1. In how many ways can you give 7 catnip toys to 5 cats, if each cat can get at most one toy?

2. In how many ways can you place 5 unlabeled balls into 7 unlabeled boxes if each box can get at most one ball?

3. Rephrase the following problem as a "balls-in-boxes" problem: In how many ways can you line up 5 geese and 7 herons?

Due Tuesday 4/9:
   Reading: Sections 10.1 and 10.2.
   Reading problems:

1. What's the smallest number of leaves a tree with 8 vertices can have?

2. What's the largest number of leaves a tree with 8 vertices can have?

3. For every possible number of leaves a tree with 8 vertices can have, draw one.

Thursday 4/11:
  No assignments.

Due Tuesday 4/16:
Homework assignment #4: Section 6.13: 4, 9, 13, 15, 18, 25, Section 7.9: 1, 5, 6.
No reading assignment.

Due Thursday 4/18:
  No assignments.

Due Tuesday 4/23:
  Quiz #4.
  Reading: Sections 11.5 and 11.6.
  Reading problems:

  1. Verify Euler's formula for the two graphs in Figure 11.2.

  2. What's the largest number of edges a simple planar connected graph with 7 vertices can have? Draw an example of such a graph.

Due Thursday 4/25:
  Homework assignment #5: Section 10.11: 2, 7, 8, Section 11.10: 12, 13, 21, 23.
  No reading assignment.

Due Tuesday 4/30:
  Reading: Section 13.7. No reading problems.

Tuesday 5/7, 2:00-5:00 PM:
  Final exam.