MAT 115: Finite Math for Computer Science
Problem Set 3

Due: 10/31/2017

Instructions:
I leave plenty of space on each page for your computation. If you need more sheet, please attach your work right behind the corresponding problem. If your answer is incorrect but you show the computation process, then partial credits will be given. Please staple your solution and use the space wisely.

First Name:

Last Name:

Group ID:

Score: **/115**

Problem 1 Venn Diagram: 10pts

For each of the following, draw a Venn Diagram. If the Venn Diagram does not exist, simply say it does not exist and explain why.
(a) $A \subseteq B, C \subseteq B, (A \cap B) = \emptyset$

(b) $C \subseteq A, B \subseteq A, (B \cup C) = \emptyset$

Problem 2 Subset Proof : 10pts

A, B and C are subsets of U, show that if $A \subseteq C$ and $B \subseteq C$ implies $(A \cup B) \subseteq C$. [Hint: Use definition of subset and then the union of two sets has three parts: 1. in A only 2. in B only, 3. in both A and B.

Problem 3 Use of Subtraction Trick: 20 pts

Prove each of the following identities from the basic algebraic rules for sets. You may want to use the fact that $D - E = D \cap \sim E$ [Here the $\sim$ means the complement].
(a) If A and B are subsets of U, then $(A - B) \cup (B - A) = (A \cup B) - (A \cap B)$.

(b) If A, B, and C are subsets of U, then $(A - B) - C = (A - C) - B$

Problem 4 Lexical Order: 10pts

Let $A = \{1, 2, 3\}, B = \{u, v\}$, and $C = \{m, n\}$. Take the linear order on A to be numeric and the linear orders on B and C to be alphabetic. List the elements in each of the following sets in lexicographic order.
(a) $(A \times B) \times C$

(b) $A \times B \times C$

Problem 5 Set Proof: 10pts

Prove or give a counterexample. Use algebraic rules to prove. For the counterexample, use a Venn diagram or use set specialization.
(a) If A, B, and C are subsets of U, then $(A - C) \cap (B - C) \cap (A - B) = \emptyset$.

(b) If A and B are subsets of U and if $A \subseteq B$, then $A \cap (U - B) = \emptyset$.

Problem 6 Set Partition : 10pts

Which of the following are partitions of $\{1, 2, ..., 8\}$? Explain your answers.
(a)$\{\{1, 3, 5\}, \{1, 2, 6\}, \{4, 7, 8\}\}$

(b)$\{\{1, 3, 5\}, \{2, 6, 7\}, \{4, 8\}\}$

(c)$\{\{1, 3, 5\}, \{2, 6\}, \{2, 6\}, \{4, 7, 8\}\}$

(d)$\{\{1, 5\}, \{2, 6\}, \{4, 8\}\}$

Problem 7 Power Set: 15pts

Compare the following pairs of sets. If they are equal, please proof. If not, please show an counter exampl. Here the $\mathbb{P}(A)$ means the power set of A.
(a) $\mathbb{P}(A \cup B)$ and $\mathbb{P}(A) \cup \mathbb{P}(B)$

(b)$\mathbb{P}(A \cap B)$ and $\mathbb{P}(A) \cap \mathbb{P}(B)$

(c) $\mathbb{P}(A \times B)$ and $(\mathbb{P}(A) \times \mathbb{P}(B)$

Problem 8 Permutation/Inverse In Various Forms: 5*3pts

This exercise lets you check your understanding of cycle form. A permutation is given in one-line, two-line or cycle form. Convert it to the other two forms. Give its inverse in all three forms.
(a) (1,5,7,8) (2,3) (4) (6).

(b) (5,4,3,2,1), which is in one-line form..

(c) (5,4,3,2,1), which is in cycle form.

Problem 9 Subsets Defintions: 5*3pts

Answer the following about the $\in$ and $\subseteq$ operators.
(a) Is $\{1, 2\} \in \{\{1, 2\}, \{3, 4\}\}$?

(b) Is $\{2\} \in \{1, 2, 3, 4\}$?

(c) Is $\{3\} \in \{1, \{2\}, \{3\}\}$

(d) Is $\{1, 2\} \subseteq \{1, 2, \{1, 2\}, \{3, 4\}\}$?

(e) Is $1 \in \{\{1\}, \{2\}, \{3\}\}$?

Problem 10 Practice Problems

For practice only. You do not have to turn in the solution.
Unit SF: 1.6, 1.8, 1.9, 1.14, 2.19