COMS 230: Discrete Computational Structures

Homework # 4

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1. **Question 1**
   Assume we have sets A,B,C
   A = (a,b,c) , B = (d,e,f) , C = (g,h,i)
   Then $B \cap C =$
   Then $A \cup (B \cap C) =$(a,b,c)
   Then $A \cup B =$(a,b,c,d,e,f) and $A \cup C =$(a,b,c,g,h,i)
   Then $(A \cup B) \cap (A \cup C) =$(a,b,c)
   Since (a,b,c) = (a,b,c) then $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

2. **Question 2**
   $A \cup U = U$
   $A \cup U$ can be expressed like $(x|(x \in A) \vee (x \in U))$
   then since we know $x \in U$, $(x|(x \in A) \vee T)$
   then $(x|T) = U$
   $A \cap \emptyset = \emptyset$
   $A \cap \emptyset$ can be expressed like $(x|(x \in A) \wedge (x \in \emptyset))$
   then since we know $x \notin \emptyset$, $(x|(x \in A) \wedge F)$
   then $(x|F) = \emptyset$

3. **Question 3**
   a) Counter Example:
   let $A = (2,3,4), B = (0,1,2), c = (0,1,3,4)$
   then $A \cup C = (0,1,2,3,4)$ and $B \cup C = (0,1,2,3,4)$
   so $A \cup C = B \cup C$ but $A \neq B$
   a) Counter Example:
   let $A = (2,4,6,8), B = (0,2,4,6), c = (2,4,6)$
   then $A \cap C = (2,4,6)$ and $B \cap C = (2,4,6)$
   so $A \cap C = B \cap C$ but $A \neq B$

4. **Question 4**
   Suppose $A \cup C = B \cup C \wedge A \cap C = B \cap C \rightarrow A \neq B$
   let $x \in A \wedge x \notin B \wedge x \in C$
   then $x \in (A \cup C = B \cup C)$ so that $x \in A \wedge x \notin B \wedge x \in C$
   then $x \in (A \cap C = B \cap C)$so that $x \in A \wedge x \in C \wedge x \notin B$ but by def of intersection $x \in B$ which is a contradiction.
   So therefore $A \cup C = B \cup C \wedge A \cap C = B \cap C \rightarrow A = B$

5. **Question 5**
   $S = A \cup (B \cap C), T = (A \cup B) \cap (A \cup C)$
   $S \subseteq T$ if $x \in S \wedge x \in T$
   Lets assume $x \in S \wedge x \notin T$
   then $x \in S = A \cup (B \cap C)$ and $x \notin T = (A \cup B) \cap (A \cup C)$
   Since by the assoc. law $T = A \cup (B \cap C)$ then $x \in T$
   which is a contradiction so $x \in S \wedge x \in T$
   So $S \subseteq T$

6. **Question 6**
   F is one to one because F(m,n) = F(x,y)
   so $m + n = x + y, m - n = x - y$
   by adding the equations together we get
   $2m = 2x \rightarrow m = x$ then substitute that in for m
   $(x) - n = x - y \rightarrow -n = -y \rightarrow n = y$
   so $m = x, n = y$
   F is not onto because the inverse function
   $(n - m, m + n)$ does not map to all real numbers.

7. **Question 7**
   F is one to one because F(m,n) = F(x,y)
   so $m + n = x + y$
   then if we assume $m+n$ is some real number m and $x+y$ is a real number x then $m = x$

   F is onto because the inverse function
   $n - m = x$ where x is any real number that the function maps to.