CSE 015: Discrete Mathematics
Fall 2021
Homework #4
Solution

Bryant Chon
Lab F21-CSE 015 02L

October 29, 2021

1. **Question 1:**
   (a) $A \cup B$, is the set of UCM students registered in CSE015 or who live in Merced County
   (b) $A \cap C$, is the set of UCM students who are registered in CSE015 and are freshman.
   (c) $C \setminus B$, is the set of UCM students who are freshmen but do not live in Merced County.
   (d) $\overline{A}$, is the set of all UCM students who are not registered in CSE015
   (e) $A \cap B \cap C$, is the set of all UCM students who are registered in CSE015, live in Merced county, and are freshmen.

2. **Question 2:**
   (a) $C \times A = \left\{ \begin{array}{cccc} \text{(True, 1)} & \text{(True, 2)} & \text{(True 3)} & \text{(True, 4),} \\ \text{(False, 1)} & \text{(False, 2)} & \text{(False, 3)} & \text{(False, 4)} \end{array} \right\}$
   (b) $B \times B = \left\{ \begin{array}{ccc} \text{(a,a)} & \text{(a,b,)} & \text{(a,c)} \\ \text{(b,a)} & \text{(b,b)} & \text{(b,c)} \\ \text{(c,a)} & \text{(c,b)} & \text{(c,c)} \end{array} \right\}$
   (c) $B \times A =$
   $\left\{ \begin{array}{cccc} \text{(a,1)} & \text{(a,2)} & \text{(a,3)} & \text{(a,4)} \\ \text{(b,1)} & \text{(b,2)} & \text{(b,3)} & \text{(b,4)} \\ \text{(c,1)} & \text{(c,2)} & \text{(c,3)} & \text{(c,4)} \end{array} \right\}$
   $B \times A \times C =$
   $\left\{ \begin{array}{cccc} \text{(a,1,True)} & \text{(a,2,True)} & \text{(A,3,True)} & \text{(a,4,True)} \\ \text{(b,1,True)} & \text{(b,2,True)} & \text{(,b,3,True)} & \text{(b,4,True)} \\ \text{(c,1,True)} & \text{(c,2,True)} & \text{(c,3,True)} & \text{(c,4,True)} \\ \text{(a,1,False)} & \text{(a,2,False)} & \text{(a,3,False)} & \text{(a,4,False)} \\ \text{(b,1,False)} & \text{(b,2,False)} & \text{(b,3,False)} & \text{(b,4,False)} \\ \text{(c,1,False)} & \text{(c,2,False)} & \text{(c,3,False)} & \text{(c,4,False)} \end{array} \right\}$

3. **Question 3:**
   Let $\cup$ = or, $\cap$ = and, X = and
   $A \times \ (B \cup C) = (A \times B) \cup (A \times C)$

Let (a,b) $\in A \times (B \cup C)$
$= a \in A$ *and* $b \in (B \cup C)$
= a ∈ A and b ∈ B or b ∈ C
= {a ∈ A and b ∈} or {a ∈ A and b ∈ C}
= (a,b) ∈ (A × B) or (a,b) ∈ (A × C)
= (a,b) ∈ (A × B) ∪ (a,b) ∈ (A × C)
= (a,b) ∈ (A × B) ∪ (A × C)
(A × B) ∪ (A × C) = A × (B ∪ C)

4. **Question 4:**

   (a) R_1 is symmetric and transitve.

   Symmetric:
   (a,b) $\in R_1$ and (b,a) $\in R_1$
   (a,c) $\in R_1$ and (c,a) $\in R_1$

   Transitive:
   (a,b),(b,a),(a,a) $\in R_1$
   (a,c),(c,a),(a,a) $\in R_1$

   (b) R_2 is anti symmetric and transitive

   Antisymmetric:
   (a,b)$\in R_2$ but (b,a) $\notin R_2$
   (a,c) $\in R_2$ but (c,a) $\notin R_2$
   (b,c) $\in R_2$ but (c,b) $\notin R_2$

   Transitive:
   (a,b),(b,c),(a,c) $\in R_2$

   (c) R_3 is none of the former because R_3 is an invalid set as (a,b) appears twice.

   (d) R_4 is symmetric, anti symmetric, and transitive.

   Symmetric:
   (a,a)
   (b,b)
   (c,c)

   Anti Symmetric:
   By definition: $\forall a \; \forall b$ ((a,b) ∈ R ∧ (b,a) ∈ R → (a=b))

   Transitive: (a,b) ∈ R and (b,c) $\in R$ then (a,c) ∈ R for all a,b,c, $\in A$

5. **Question 5:**

   (a) is surjective, onto, not one to one

f(m,n) = 2m -n
f(1,2) = 2(1) - 2 = 0
f(-1,-2) = 2(-1) + 2 = 0

(b) not surjective
f(m,n) = (m + n)(m-n)
(m + n) $\geqslant$ (m-n)

(c) surjective
let y $\in Z$
if y = f(y,0), y,0 $\in Z$
if y = f(0,y), 0,y $\in Z$
if y = 0, f(0,0), 0,0 $\in Z$

(d) not surjective, because there's no n variable in m^2 -4.