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Ethan Gil

Discrete Math Review

1. a. $[A \cup (A \cap B)] \cap C$
   - $A \cap B = \{0,2,4,6\}$
   - $A \cup (A \cap B)] \cap C = A \cap C = \{4,6,8,10\}$

   b. $(A \cap B) \cap (A - C) \cap (B - C)$
   - $A \cap B = \{0,2,4,6\}$
   - $A - C = \{0,2\}$
   - $B - C = \{0,1,2,3\}$
   - $(A \cap B) \cap (A - C) = \{0,2\}$
   - $(A \cap B) \cap (A - C) \cap (B - C) = \{0,2\}$

   c. $((C \cap A) - (A' \cup B')) \cap C$
   - $C \cap A = \{4,6,8,10\}$
   - $A' = U - A = \{1,3,5,7,9\}$
   - $B' = U - B = \{7,8,9,10\}$
   - $A' \cup B' = \{1,3,5,7,8,9,10\}$
   - $(C \cap A) - (A' \cup B') = \{4,6\}$
   - $((C \cap A) - (A' \cup B')) \cap C = \{4,6\}$

2.
- Cardinality of $P(X)$ is 2^n; where n is the num. elements of X
- Since X has 4 members cardinality of $P(X)$ is $2^4 = 16$
- The num. of proper subsets $2^4 - 1 = 15$

3.
- If A and B are sets then: $|A \cup B| = |A| + |B| - |A \cap B|$, Inclusion-exclusion principle.

4.

$A = \{o, q, t, m, v\}$
$B = \{o, q, p, r, s\}$
$C = \{o, t, n, r, s\}$

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Relations Seatwork

1. $R_1 = \{(a,b), (b,a), (a,a), (b,b), (c,d)\}$
2. $R_2 = \{(1,1), (3,3), (4,4), (4,5), (5,3), (3,4)\}$
3. $R_3 = \{(a,b), (b,c), (c,b), (a,a), (c,c)\}$
4. $$M = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$
5. $$M = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

6. $R \{(1,1), (1,2), (1,3), (1,4), (1,5), (2,1), (2,2), (2,3), (2,4), (3,1), (3,2), (3,3), (4,1), (4,2), (5,1)\}$

7. $R = \{(1,2), (2,3), (3,4), (4,5)\}$

8.
R1. Reflexive, Symmetric, Transitive
R2. Reflexive, Transitive
R3. Symmetric, Transitive
R4 Reflexive, Symmetric, Transitive
R5. None
R6. Reflexive, Symmetric, Transitive
R7. Reflexive, Symmetric, Antisymmetric

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Graphs and trees

1. a.) cycle
   b.) simple
   c.) cycle
   d.) simple cycle
   e.) cycle
   f.) cycle

2.) $x_1 \to x_2 \to x_3 \to x_4 \to x_1$
    $x_1 \to x_2 \to x_3 \to x_4 \to x_5 \to x_6 \to x_1$

3.) a:.3
    b: 2
    c:.3
    d: 3
    e: 2

4.) 4 vertices of odd degrees : a, c, d, and e

5.) Not possible, Sum of all degrees are always even

6.) Sum of degrees of all vertices twice the number of edges, therefore the graph has (4+3+3+2+2)/2 = 7 edges

7.) a.) 2: c, d
    b.) 3: c, a, d
    c.) 4: c, b, a, d
    d.) 5: c, e, b, a, d
    e.) 6: c, e, d, b, a, d
    f.) 7: Not possible

9.) a.) Root: a
    b.) Internal: a, b, c, d, e, f, g, h, i, j
    c.) leaves: o, p, q, r, s, t, u
    d.) children of j: k, l
    e.) Parent of h: f
    f.) Siblings of o: p, q
    g.) Ancestors of m: a, b, c, d, e, f, g
    h.) Descendants of b: c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u