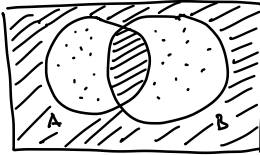


Solutions to
Fundamentele Informatica 1 / Foundations of Computer Science
Mid-term 21/10/2019

QUESTION 1

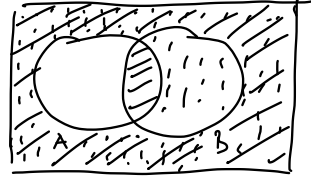
NOTE, LISTING FACTORS OF DIAGRAMS IS ACCEPTABLE AS WELL.

①



= $A \oplus B$

= $(A \oplus B)^c$

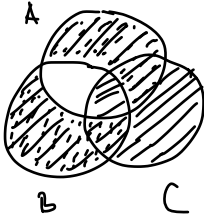


= A^c

= $A^c \oplus B$

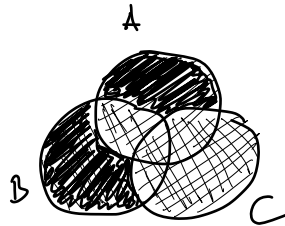
THEY ARE EQUAL, $(A \oplus B)^c = A^c \oplus B$

②



= $A \oplus B$

= $(A \oplus B) \cup C$



= $A \cup C$

= $B \cup C$

= $(A \cup C) \oplus (B \cup C)$

$(A \oplus B) \cup C$ IS A SUPERSET OF $(A \cup C) \oplus (B \cup C)$

OR: $(A \cup C) \oplus (B \cup C)$ IS A SUBSET OF $(A \oplus B) \cup C$

$(A \cup C) \oplus (B \cup C) \subseteq (A \oplus B) \cup C$

QUESTION 2

NOTE, MULTIPLE DERIVATIONS POSSIBLE

$$((B^c \cup A^c \cup B) \cup B)$$

$$= ((B \cap A^c) \cup B) \cup B = (B \cap A^c) \cup (B \cup B)$$

$$= (B \cap A^c) \cup B = B$$

OR

$$\dots = (B \cap A^c) \cup B = (B \cup B) \cap (A^c \cup B) = B \cap (B \cup A^c) \\ = B$$

QUESTION 3

NOTE, MULTIPLE COUNTEREXAMPLES POSSIBLE

(1) IT IS REFLEXIVE, ALL PAIRS (x, x) , $x \in \{a, b, c, d\}$ ARE ELEMENTS OF R

(2) NOT SYMMETRIC: $(a, b) \in R$ but $(b, a) \notin R$

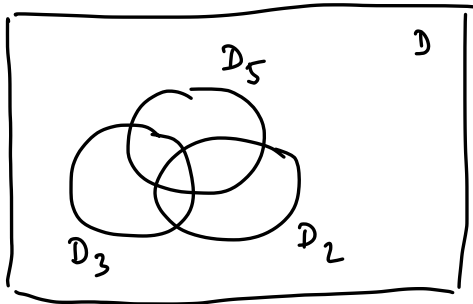
(3) NOT ANTISYMMETRIC $(a, d) \& (d, a) \in R$, but $a \neq d$.

(4) NOT TRANSITIVE: $(b, d) \& (d, a) \in R$ but $(b, a) \notin R$

(5) NOT EQUIVALENCE RELATION AS NOT TRANSITIVE
(OR SYMMETRIC)

(6) NOT A PARTIAL ORDER AS NOT TRANSITIVE
(OR ANTISYMMETRIC)

QUESTION 4



$$|D_{\text{tot}}| = 300$$

$$|D_2| = 150 \quad |D_3| = 100 \quad |D_5| = 60$$

$$|D_2 \cap D_3| = |D_6| = 50 \quad |D_3 \cap D_5| = |D_{15}| = 20 \quad |D_2 \cap D_5| = |D_{11}| = 30$$

$$|D_2 \cap D_3 \cap D_5| = |D_{30}| = 10$$

$$D_{\text{solution}} = D_{\text{tot}} - |D_2 \cup D_3 \cup D_5|$$

$$= D_{\text{tot}} - (|D_2| + |D_3| + |D_5| - |D_2 \cap D_3| - |D_3 \cap D_5| - |D_2 \cap D_5| + |D_2 \cap D_3 \cap D_5|)$$

$$= 300 - (150 + 100 + 60 - 50 - 20 - 30 + 10) = 300 - 220 = 80.$$

QUESTION 5

NOTE: MANY SOLUTIONS POSSIBLE

$$(1) f = \{(1, a), (2, a), (3, a), (4, a)\}; \quad V = \{1\}$$

$$f^{-1}(f(V)) = f^{-1}(a) = \{1, 2, 3, 4\} \neq V.$$

$$(2) g = f. \quad W = \{a, b\}$$

$$g(g^{-1}(W)) = g(\{1, 2, 3, 4\}) = \{a\} \neq W$$

(3) f is not injective nor surjective, so g is not either.