lec 14:- $A = \{0,1,2,3,4\}$

$B = \{0,1,2,3\}$.

Ex 1 / 466

$R = \{(a,b) \mid a = b\}$ = ?

$R = \{(a,b) \mid a > b\}$ = ?

$R = \{(a,b) \mid \gcd(a,b) = 1\}$ = ?

Q24 onwards :-

$\bar{R} = \{(a,b) \mid (a,b) \notin R\}$. ✓

$R = \{(1,2),(2,2),(3,1)\}$. $A = \{1,2,3\}$.

$\bar{R} = A \times A - R$

$= \{(1,1),(1,2),(1,3),(2,1),(2,2),(2,3),$
$(3,1),(3,2),(3,3)\} - \{(1,2),(2,2),(3,1)\}$.

$= \{(1,1),(1,3),(2,1),(2,3),(3,2),(3,3)\}$.

if $|A| = 5$

$|R| = 15$

$|\bar{R}| = ?$

$|\bar{R}| = |A \times A| - |R|$ ✓

$= 5 \times 5 - 15 = 10$

$R^{-1} = \{(b,a) \mid (a,b) \in R\}$. ✓

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

$R^{-1} = \{(2,1),(1,1),(1,3)\}$.

$|R| = |R^{-1}|$

$|R| = |R^{-1}|$

$R^{-1} = \{(b,a) \mid (a,b) \in R\}$

$\bar{R} = \{(a,b) \mid (a,b) \notin R\}$.

P465 Relation = Set.

$\cap$ $\cup$ — define it based on Relation.

Ex17 465 $R_1 = \{(1,1),(2,2),(3,3)\}$.

$R_2 = \{(1,1),(1,2),(1,3),(1,4)\}$.

$R_1 \cup R_2 = \{(1,1),(2,2),(3,3),(1,2),(1,3),(1,4)\}$

$R_1 \cap R_2 = \{(1,1)\}$.

$R_1 - R_2 = \{(2,2),(3,3)\}$.

$R_2 - R_1 = \{(1,2),(1,3),(1,4)\}$.

Ex14- $R_1 = \{(a,b) \mid a < b\}$

$R_2 = \{(a,b) \mid a > b\}$.

$R_1 \cup R_2 = ?$ $R_1 \cap R_2 = ?$ $R_1 - R_2 = ?$ $R_2 - R_1 = ?$

$R_1 \cup R_2 = \{(a,b) \mid a < b \text{ or } a > b\}$

$R_1 \cup R_2 = \{(a,b) \mid a \neq b\}$.

$R_1 \cap R_2 = \{(a,b) \mid a < b \text{ and } a > b\}$.

$= \phi$

$R_1 - R_2 = R_1 - R_1 \cap R_2$

$= R_1 - \phi = R_1$

$R_1 - R_2 = R_1 - R_1 \cap R_2$

$= R_1 - \phi = R_1$

$R_2 - R_1 = R_2 - R_1 \cap R_2$

$= R_2 - \phi = R_2.$

$R_1 \oplus R_2 = R_1 \cup R_2 - \underline{R_1 \cap R_2}$

$- \phi$

$R_1 \oplus R_2 = R_1 \cup R_2 = \{(a,b) \mid a \neq b\}.$

N-Ary Relations.

Binary Relation = 2-Ary Relation.

$= A \times B.$

Binary Relation $\subseteq A \times B.$

How many Relations = $\text{pow}(A \times B) = 2^{|A| \times |B|}$

Ternary Relation = 3-Ary Relation.

Ternary Relation $\subseteq A \times B \times C.$

How many ternary Relation

$= \text{pow}(A \times B \times C) = 2^{|A| \times |B| \times |C|}$

$|A| = 2, \quad |B| = 3 \quad C = |5|.$

How many Relations on $A \times B \times C.$

$|\text{pow}(A \times B \times C)| = 2^{|A| \times |B| \times |C|}$

$= 2^{2 \times 3 \times 5}$

$A = \{1, 2\}$

$B = \{a, b\}$

$|A \times B \times C|$

$= |A| \times |B| \times |C|$

$B = \{a, b\}$

$C = \{X, Y\}$.

$A \times B \times C = \{(1,a,X), (1,a,Y),$
$(1,b,X), (1,b,Y)$
$(2,a,X), (2,a,Y),$
$(2,b,X), (2,b,Y)\}$.

$= |A| \times |B| \times |C|$

$= 2 \times 2 \times 2$

$= 8$.

$|pow(A \times B \times C)|$

$= 2^{|A| \times |B| \times |C|}$

$= 2^{2 \times 2 \times 2} = 2^8$

Ex1 / 469 $R = \{(a,b,c) \mid a < b < c\}$

$\mathbb{N} \times \mathbb{N} \times \mathbb{N}$

$(1,2,3) \in R$ = ? Yes.

$a \; b \; c$

$a < b < c$

$(2,4,3) \in R$ = ? No.

$(2,4,3) \notin R$

Ex2 / 469 :- $R = \{(a,b,c) \mid$ if $\exists k \; k \in \mathbb{Z}$ $(b = a+k, \; c = a+2k)\}$.

$(1,3,5) \in R$?

$3 = 1 + k \Rightarrow k = 2$

$5 = 1 + 2 \times 2$

$5 = 1 + 4$

$5 = 5$

$(1,3,5) \in R$

$a \; b \; c$

$(2,5,9) \in R$?

$R = \{(a,b,c) \mid \exists k \; k \in \mathbb{Z}$ $b = a+k, \; c = a+2k\}$

$R = \{(a,b,c) \mid \exists k \quad k \in \mathbb{Z} \quad b = a+k, \; c = a+2k\}$

$5 = 2+k \Rightarrow k = 3.$

$9 = 2 + 2\times 3$ $\quad (2,5,9) \notin R.$

$9 = 2+6$

$9 \neq 8$

Ex 3
469

$R = \{(a,b,m) \mid a \equiv b \bmod(m)\}$

$(8,2,3) \in R$ True.

$a \quad b \quad m$

$b \bmod m = 2 \bmod 3 = 2.$

$a \bmod m = 8 \bmod 3 = 2.$

$2 \times 2 \times \mathbb{Z}^+$

Positive.

$m \geq 1.$

Home work #1.

$(-1,9,5) \in R?$ $(14,0,7) \in R?$

$(11,0,6) \in R?$ $(-2,-8,5) \in R?$

Relational Database. (A whole Course)

Discrete Structure.

→ N-Ary Relation.

4-Ary Relation.

5- " 4

!

N-Ary Relation.

N Sets.

$A_1 \times A_2 \times A_3 \times \cdots \times A_n.$

$(a_1, a_2, a_3, \dots a_n) \in$

Student Names $\times$ IDs $\times$ Subjects $\times$ GPA.

$\downarrow$

$A_1 \quad \times \quad A_2 \quad \times \quad A_3 \quad \times \quad A_4.$

Relation in a table form $\Rightarrow$ Relational table

$\Rightarrow$ any Relation.