

1.  $A = \{0, 1, 2\}$                        $B = \{a, b\}$

$A \times B$ ?

2. List the ordered pairs of the relations.
3. Which of the above are functions?

**Reflexive** relation  $R$  on  $A$ , if  $\forall a \in A, (a, a) \in R$ .

**Symmetric** relation  $R$  on  $A$ , if  $\forall a \forall b \in A, (a, b) \in R \rightarrow (b, a) \in R$ .

**Antisymmetric** relation  $R$  on  $A$ , if  $\forall a \forall b \in A, (a, b) \in R \wedge (b, a) \in R \rightarrow a = b$ .

**Transitive** relation  $R$  on  $A$ , if  $\forall a \forall b \forall c \in A, (a, b) \in R \wedge (b, c) \in R \rightarrow (a, c) \in R$ .

### 3. $R_1 - R_6$

Relations on the set  $A = \{1, 2, 3, 4\}$

	<i>reflexive</i>	<i>symmetric</i>	<i>antisymmetric</i>	<i>transitive</i>
$R_1 = \{(2,2), (2,3), (2,4), (3,2)\}$				
$R_2 = \{(1,1), (1,2), (2,1), (2,2), (3,3), (4,4)\}$				
$R_3 = \{(2,4), (4,2)\}$				
$R_4 = \{(1,2), (2,3), (1,3)\}$				
$R_5 = \{(1,1), (2,2), (3,3), (4,4)\}$				
$R_6 = \{(1,3), (1,4), (2,3), (2,4), (3,1)\}$				

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

$$R^2 = R \circ R$$

$R^2$  contains  $(a,c)$  if  $(a,b)$  and  $(b,c) \in R$ .

R	(1,1)	(2,1)	(3,2)	(4,3)
R	(1,1)	(1,1)	(2,1)	(3,2)
$R^2$	(1,1)	(2,1)	(3,1)	(4,2)

$$R^2 = \{(1,1), (2,1), (3,1), (4,2)\}$$

3.5 Find  $R^2$  for  $R = \{(a,a), (b,a), (c,a), (d,a)\}$

**TABLE 7** Teaching\_schedule.

<i>Professor</i>	<i>Department</i>	<i>Course_number</i>	<i>Room</i>	<i>Time</i>
Cruz	Zoology	335	A100	9:00 A.M.
Cruz	Zoology	412	A100	8:00 A.M.
Farber	Psychology	501	A100	3:00 P.M.
Farber	Psychology	617	A110	11:00 A.M.
Grammer	Physics	544	B505	4:00 P.M.
Rosen	Computer Science	518	N521	2:00 P.M.
Rosen	Mathematics	575	N502	3:00 P.M.

4. Could *Time* serve as a primary key?  
 Could *Time*  $\times$  *Room* serve as a primary key?
5. Where C is condition *Time* = "3:00 P.M." what is the result of the selection operator  $s_C$ ?
6. What is  $P_{1,4}$ ?

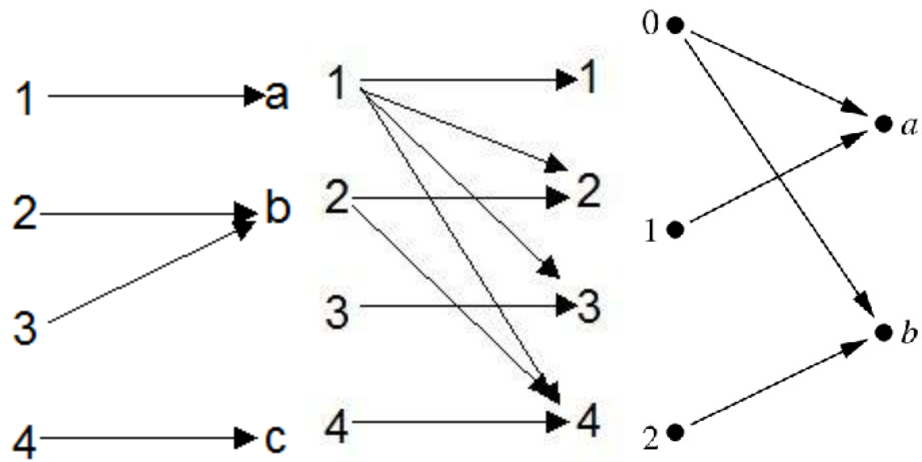
Table 1

Professor	Course_number
Cruz	335
Cruz	412
Farber	501
Farber	617
Grammer	544
Grammer	551
Rosen	518
Rosen	575

Table 2

Course_number	Room
518	N521
575	N502
611	N521
544	B505
501	A100
617	A110
335	A100
412	A100

7. What is the result of: Table1  $\Join$  Table2



1.  $A = \{0,1,2\}$   $B = \{a,b\}$   
 $A \times B$ ?

$\{(0,a), (1,a), (2,a), (0,b), (1,b), (2,b)\}$

2. List the ordered pairs of the relations

$\{(1,a), (2,b), (3,b), (4,c)\}$

$\{(1,1), (1,2), (1,3), (1,4), (2,2), (2,4), (3,3), (4,4)\}$

$\{(0,a), (0,b), (1,a), (2,b)\}$

3. Which of the above are functions?

The left one. The middle has  $f(1) = 1, 2, 3, 4$

Right has  $f(0) = a, b$

**Reflexive** relation  $R$  on  $A$ , if  $\forall a \in A, (a,a) \in R$ .

**Symmetric** relation  $R$  on  $A$ , if  $\forall a \forall b \in A, (a,b) \in R \rightarrow (b,a) \in R$ .

**Antisymmetric** relation  $R$  on  $A$ , if  $\forall a \forall b \in A, (a,b) \in R \wedge (b,a) \in R \rightarrow a=b$ .

**Transitive** relation  $R$  on  $A$ , if  $\forall a \forall b \forall c \in A, (a,b) \in R \wedge (b,c) \in R \rightarrow (a,c) \in R$ .

Relations on the set  $A = \{1, 2, 3, 4\}$

	<i>reflexive</i>	<i>symmetric</i>	<i>antisymmetric</i>	<i>transitive</i>
$R_1 = \{(2,2), (2,3), (2,4), (3,2)\}$	No	No (4,2)	No (2,3) (3,2)	(3,2) (2,4) No (3,4)
$R_2 = \{(1,1), (1,2), (2,1), (2,2), (3,3), (4,4)\}$	Yes	Yes	No (1,2) (2,1)	Yes
$R_3 = \{(2,4), (4,2)\}$	No	Yes	No	No (2,2)
$R_4 = \{(1,2), (2,3), (1,3)\}$	No	No	Yes	Yes
$R_5 = \{(1,1), (2,2), (3,3), (4,4)\}$	Yes	Yes	Yes	Yes
$R_6 = \{(1,3), (1,4), (2,3), (2,4), (3,1)\}$	No	No	No (1,3) (3,1)	(1,3) (3,1) No (1,1)

3.5 Find  $R^2$  for  $R = \{(a,a), (b,a), (c,a), (d,a)\}$

$R$ (a,b)	(d,a)
$R$ (b,c)	(a,b)
	(a,c)
$R^2$ (a,c)	(d,b)
	(d,c)

Char  $R^2 = \{(a,c), (d,b), (d,c)\}$

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Cruz	Zoology	335	A100	9:00 A.M.
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Farber	Psychology	617	A110	11:00 A.M.
Grammer	Physics	544	B505	4:00 P.M.
Rosen	Computer Science	518	N521	2:00 P.M.
Rosen	Mathematics	575	N502	3:00 P.M.

4. Could Time serve as a primary key? NO, duplicates  
Could *Time x Room* serve as a primary key? YES
5. Where C is condition Time = "3:00 P.M." what is the result of the selection operator  $s_C$ ?  
5-tuples numbered 3 and 7
6. What is  $P_{1,4}$ ?  
2-tuple of fields Professor and Room for all unique records

Table 1

Professor	Course_number
Cruz	335
Cruz	412
Farber	501
Farber	617
Grammer	544
Grammer	551
Rosen	518
Rosen	575

Table 2

Course_number	Room
518	N521
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611	N521
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7. What is the result of: Table1  $\Join$  Table2

Professor	Course_number	Room
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Cruz	412	A100
Farber	501	A100
Farber	617	A110
<u>Grammer</u>	544	B505
Rosen	518	N521
Rosen	575	N501