Lecture 08: Discrete Mathematics

Course Title: Discrete Mathematics **Course Code:** MTH211 **Class:** BSM-II

Objectives

The main aim of the lecture is to discuss

- *Pictorial representation of relation*

References:

- S. Lipschutz and M. Lipson, Schaum's Outlines Discrete Mathematics, Third Edition, McGraw-Hil, 2007.
- K.H. Rosen, Discrete Mathematics and its Application, MeGraw-Hill, 6th edition. 2007.
- K.A. Ross, C.R.B. Wright, Discrete Mathematics, Prentice Hall. New Jersey, 2003.

Review:

Let A and B be sets. A *binary relation* or, simply, *relation* from A to B is a subset of $A \times B$.

For example:

If $A = \{1, 2, 3\}$ and $B = \{x, y, z\}$, then

$R = \{(1, y), (1, z), (3, y)\}$,

$S = \{(2, y), (2, z), (3, y), (3, z)\}$ and

$T = \{(1,x)\}$

are the examples of relations from A to B as these are the subset of $A \times B$.

Pictorial Representation of Relation:

There are various ways of picturing relations.

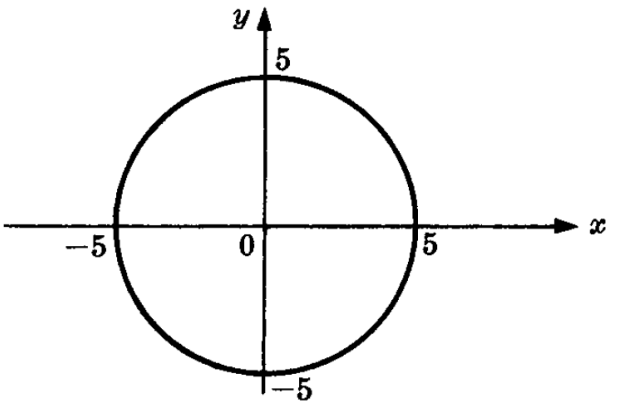
Relation on R

Let S be a relation on the set **R** of real numbers; that is, S is a subset of $\mathbf{R}^2 = \mathbf{R} \times \mathbf{R}$ such that S consists of all ordered pairs of real numbers which satisfy some given equation

$E(x, y) = 0$ such as $x^2 + y^2 = 25$.

Since $\mathbf{R}^2$ can be represented by the set of points in the plane, we can picture S by emphasizing those points in the plane which belong to S. The pictorial representation of the relation is sometimes called the *graph* of the relation.

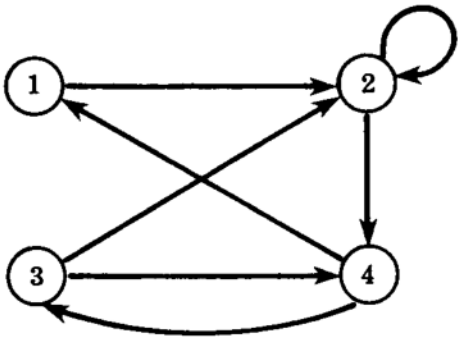
For example, the graph of the relation $x^2+y^2 = 25$ is a circle having its center at the origin and radius 5.



$x^2 + y^2 = 25$

Directed Graphs of Relations on Sets

There is an important way of picturing a relation R on a finite set. First, we write down the elements of the set, and then we draw an arrow from each element x to each element y whenever x is related to y. This diagram is called the *directed graph* of the relation.



For example, consider $A = \{1, 2, 3, 4\}$ and

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

In a figure given on right, observe that there is an arrow from 2 to itself, since 2 is related to 2 under R.

Pictures of Relations on Finite Sets

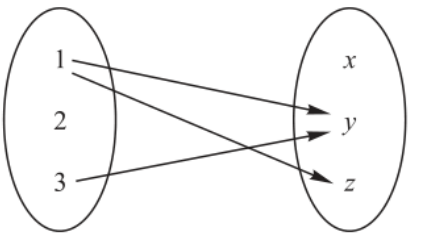
Suppose A and B are finite sets. There are two ways of picturing a relation R from A to B.

(i) Form a rectangular array (matrix) whose rows are labelled by the elements of A and whose columns are labelled by the elements of B. Put a 1 or 0 in each position of the array according as $a \in A$ is or is not related to $b \in B$. This array is called the *matrix of the relation*.

	x	y	z
1	0	1	1
2	0	0	0
3	0	1	0

(ii) Write down the elements of A and the elements of B in two disjoint disks, and then draw an arrow from $a \in A$ to $b \in B$ whenever a is related to b. This picture will be called the *arrow diagram* of the relation.

For example, see for $R = \{(1, y), (1, z), (3, y)\}$.



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