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TO'PLAM ICHIDA ANIQLANGAN BINAR MUNOSABATLARNING BERILISH USULLARI HAQIDA

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Annotatsiya: Usbu maqolada to'plamlar o'rtasida va to'plam ichida aniqlangan binar munosabatlarning xossalari hamda berilish usullari misollar yordamida ochib berilgan.

Kalit so'zlar: Tartiblangan juftlik, to'plamlarning dekart ko'paytmasi, to'plamlarning dekart darajasi, binar munosabat, refleksivlik, simmetriklik, tranzitivlik, ekvivalentlik munosabatlari, binar munosabatlarning tartiblangan juftliklar to'plami, graflar, matritsa usullari.

BINARY RELATIEFINED WITHIN A COLLECTION ABOUT THE METHODS OF DELIVERY

Abstract: In this article, the properties of binary relations defined between sets and within a set and their methods are revealed with the help of examples.

Keywords: Ordered pair, Cartesian product of sets, Cartesian degree of sets, binary relation, reflexivity, symmetry, transitivity, equivalence relation, set of ordered pairs of binary relations, graphs, matrix methods.

Binar munosabatlar hisobi 1860-yilda De Morgan tomonidan kiritilgan va keyinchalik Prays va Shridder tomonidan mukammal ishlab chiqilgan. Yarim asr o'tgach Tarski,Jonsson,Lindon va Monk lar zamonaviy model nuqtai nazardan hisobni yanada rivojlantirgan.

Ikkita bo'sh bo'lmagan A va B to'plamlar berilgan bo'lsin. A to'plamga tegishli bo'lgan biror a elementni va B to'plamga tegishli bo'lgan biror b elementni olamiz. Birinchi elementi a, ikkinchi elementi b, bo'lgan tartiblangan (a, b) juftlikni hosil qilamiz. Barcha (a, b) ko'rinishdagi juftliklardan tashkil topgan $\{(a, b)|a \in A, b \in B\}$

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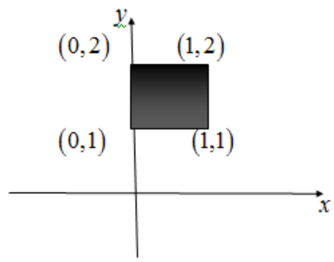
to‘plam A va B to‘plamlarning dekart (to‘g‘ri) ko‘paytmasi deyiladi va $A \times B$ kabi belgilanadi.

Misol 1. $A = B = R$ bo‘lsa, $R^2 = R \times R$ dekart ko‘paytma tekislikdagi barcha nuqtalar to‘plamidan iboratdir.

Misol 2. $A = [0,1]$ va $B = [1,2]$ segment nuqtalaridan iborat to‘plamlarni olaylik. Bu to‘plamlarning dekart ko‘paytmasi $A \times B = \{(x,y)|0 \leq x \leq 1, 1 \leq y \leq 2\}$ to‘plam 1-chizmada tasvirlangan kvadrat nuqtalaridan iborat to‘plam bo‘ladi:



1-chizma.

Shuni ta’kidlash lozimki, ikkita (a,b) va (c,d) juftliklar, $a = c$ va $b = d$ bo‘lgandagina teng deb qaraladi. Xuddi shunday bir nechta to‘plamlarning dekart ko‘paytmasini $A_1 \times A_2 \times A_3 \times \dots \times A_n$ kabi qarashimiz mumkin. Agar $A_1 = A_2 = A_3 = \cdots = A_n$ bo‘lsa, u holda ularning dekart ko‘paytmasini qisqacha $A^n = A \times A \times A \times \dots \times A$ shaklda yozish mumkin va uni n-darajali dekart ko‘paytma deb yuritiladi. A^n ning elementlari uzunligi n ga teng bo‘lgan $(x_1, x_2, \dots, x_n), x_i \in A$ satrli elementdan iborat bo’ladi.

1-Ta’rif. Ixtiyoriy bo’sh bo’lmagan $A \times B$ to’plamning ixtiyoriy R qism to’plami $(R \subset A \times B)$ A va B to‘plamlar orasidagi *binar munosabat* deyiladi. Xususan, $A = B$ bo‘lsa, $R \subset A \times B$ binar munosabat A da aniqlangan binar munosabat deyiladi. Binar munosabatlar, odatda R, P, Q kabi harflar bilan belgilanadi. Agar $R \subset A \times A$ binar munosabat aniqlangan bo‘lib, $(\mathrm{x}, \mathrm{y}) \in \mathrm{R}$ bo‘lsa, u holda x element y element bilan R munosabatda deyiladi va xRy kabi belgilanadi.

Misol 3. Haqiqiy sonlar to’plami R da $x = y$ tenglik munosabati binar munosabat bo’ladi.

Misol 4. $A = \{2,5,4,6\}$ bo’lsin, $R = \{(x,y)\backslash x < y\}$ to’plam binar munosabat bo’ladi. Ravshanki, bu holda:

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

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Chekli to'plamlarda binar munosabatlar soni ham chekli bo'lib, u $2^n - 1$ formula orqali topiladi. Bu yerda n A to'plamdagi barcha tartiblangan juftliklar soni ya'ni $A^2 = A \times A$ to'plamning elementlari sonidir.

Bizga ma'lumki elementlari soni n ta bo'lgan to'plamning barcha qism to'plamlari 2^n formula orqali aniqlandi (bo'sh to'plam bilan birgalikda).

Masalan, 4-misolda 2^4 ta ya'ni 16 ta tartiblangan juftliklar bor. Binar munosabatlar esa $2^{16} - 1$ ta.

2-Ta'rif. A to'plamda aniqlangan R binar munosabati uchun quyidagi shartlar bajarilsa, A to'plamning ekvivalentlik munosabati aniqlangan deyiladi:

1. ∀x ∈ A uchun xRx munosabat o'rinli (refleksivlik);

2. xRy munosabatdan yRx munosabatning o'rinliligi kelib chiqsa (simmetrik);

3. xRy munosabatdan yRz munosabatdan xRz munosabat o'rinli ekanligi kelib chiqsa (tranzitivlik).

A to'plamning x va y elementlari orasida R ekvivalentlik munosabati qisqachasi x~y shaklda yoziladi.

R to'plam elementlari orasidagi R munosabat Dekart ko'paytmaning har qanday qism to'plami, ya'ni elementlari tartiblangan juftliklar to'plami bo'lganligi uchun munosabatlarning berilish usullari to'plamning berilish usullari bilan bir xil bo'ladi.

A to'plamdan olingan va shu munosabat bilan bog'langan barcha element juftliklarini sanab ko'rsatish bilan berish mumkin. Masalan, $A = \{4,5,6,8\}$ to'plamdagi biror munosabatni quyidagi juftliklar to'plami orqali berish mumkin: $\{(5,4), (6,5)\}$.

Shu munosabatning o'zini matritsa usuli bilan berish mumkin. Buning uchun biz matritsaning satr va ustunlariga to'plam elementlarini joylashtiramiz. So'ngra $A = \{< 5,4 >, < 6,5 >\}$ binar munosabatni matritsasini tuzamiz.

Juftliklardagi 1-elementni satrdan 2-elementni ustundan olib, ular kesishgan joyga *1* qo'yamiz qolgan joylarga esa *0* . Shunda biz qidirgan matritsa paydo bo'ladi (2-chizma).

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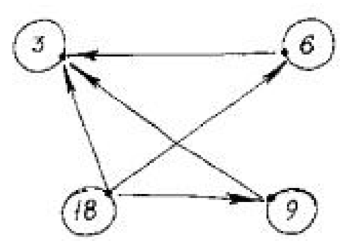
$$\begin{pmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

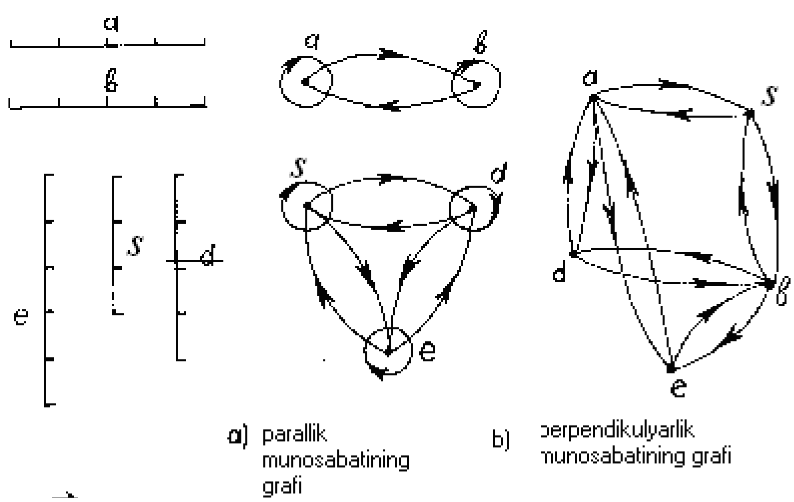
2-chizma.

Munosabatlarni graflar yordamida ko'rgazmali tasvirlash mumkin. Masalan, $A = \{3,6,9,18\}$ to'plam elementlari uchun karrali munosabatini ko'ramiz va uning grafini chizamiz (3-chizma). 18 soni 3 ga karrali, 18 soni 6 ga karrali, 18 soni 9 ga karrali va hakazo. A to'plamdagi ixtiyoriy son o'z-o'ziga karrali bo'lgani uchun oxiri ustma-ust tushadigan strelkalar mavjud. Bunday strelkalar sirtmoqlar deyiladi.



3-chizma.

Munosabatlarni xossalarini ajratib ko'rsatish uchun matematikada yuqorida aytib o'tilgan munosabatlarni kesmalar to'plamida graflar yordamida tasvirlaymiz. *a, b, s, d, e* kesmalar berilgan bo'lsin (4- a, b, v, g chizmalar).



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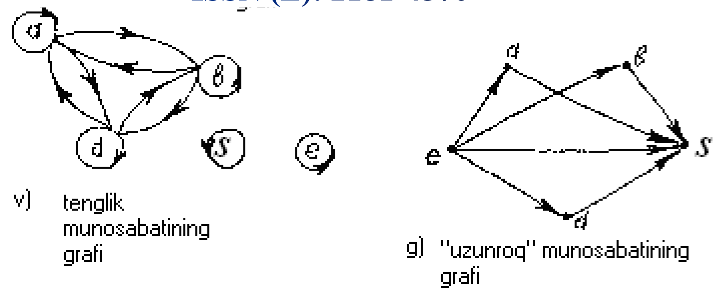
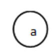
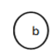
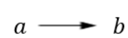
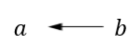
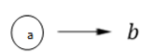
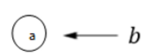
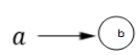


4-chizma.

Misol 5. Endi $A = \{a, b\}$ to'plamni olib undagi barcha munosabatlarni 3 xil ko'rinishda ifodalab chiqamiz:

Tartiblangan juftliklar	Graflar	Matritsalar
$A_1 = \{<a,a>, <b,b>, <a,b>, <b,a>\}$		$\begin{pmatrix}1 & 1\\1 & 1\end{pmatrix}$
$A_2 = \{<a,a>\}$		$\begin{pmatrix}1 & 0\\0 & 0\end{pmatrix}$
$A_3 = \{<b,b>\}$		$\begin{pmatrix}0 & 0\\0 & 1\end{pmatrix}$
$A_4 = \{<a,b>\}$		$\begin{pmatrix}0 & 1\\0 & 0\end{pmatrix}$
$A_5 = \{<b,a>\}$		$\begin{pmatrix}0 & 0\\1 & 0\end{pmatrix}$
$A_6 = \{<a,a>, <b,b>\}$		$\begin{pmatrix}1 & 0\\0 & 1\end{pmatrix}$
$A_7 = \{<a,a>, <a,b>\}$		$\begin{pmatrix}1 & 1\\0 & 0\end{pmatrix}$
$A_8 = \{<a,a>, <b,a>\}$		$\begin{pmatrix}1 & 0\\1 & 0\end{pmatrix}$
$A_9 = \{<b,b>, <a,b>\}$		$\begin{pmatrix}0 & 1\\0 & 1\end{pmatrix}$
$A_{10} = \{<b,b>, <b,a>\}$		$\begin{pmatrix}0 & 0\\1 & 1\end{pmatrix}$

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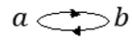
$A_{11} = \{<a,b>, <b,a>\}$



$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

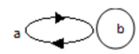
$A_{12} = \{<a,a>, <b,b>, <a,b>\}$

$\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$

$A_{13} = \{<a,a>, <b,b>, <b,a>\}$

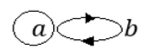
$\begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$

$A_{14} = \{<b,b>, <a,b>, <b,a>\}$



$\begin{pmatrix} 0 & 1 \\ 1 & 1 \end{pmatrix}$

$A_{15} = \{<a,a>, <a,b>, <b,a>\}$



$\begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}$

Ko’rinadiki bu to’plamda 15 ta binar munosabat bo’lib bulardan 4 tasi ya’ni A_1, A_6, A_{11}, A_{12} lar *refleksiv*, 4 tasi ya’ni A_1, A_{13}, A_{14}, A_{15} *simmetrik*, 3 tasi ya’ni A_1, A_{13}, A_{14} lar *tranzitiv* munosabatlardir. Bundan kelib chiqadiki 1 ta A_1 *ekvivalentlik* munosabatidir.

Xulosa qilib aytganda binar munosabatlarni 3 xil usuldan biridan foydalanib tasvirlashimiz mumkin. Ko’p hollarda matritsa usuli qulay hisoblanadi.

Foydalanilgan adaboyotlar ro’yxati:

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