“O‘zbekiston temir yo‘llari” AJ
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AXBOROT TEXNOLOGIYALARI VA JARAYONLARNI MATEMATIK MODELLASHTIRISH

Barcha ta’lim yo‘nalishlari 1-bosqich bakalavriat talabalari
uchun laboratoriya ishlarini bajarishga doir
uslubiy qo‘llanma

2-qism

Toshkent – 2019

UDK 628.15

Axborot texnologiyalari va jarayonlarni matematik modellashtirish. 2-qism. Uslubiy qo‘llanma. **X.M.Shadimetov, B.N.Abdikayimov, G.X.Nishanova.** ToshTYMI, T.: 2019, 44 bet.

Ushbu uslubiy qo‘llanma barcha ta’lim yo‘nalishlarida tahsil olayotgan 1-bosqich bakalavriat talabalariga “Axborot texnologiyalari va jarayonlarni matematik modellashtirish” fanidan laboratoriya ishlarini bajarish uchun mo‘ljallangan bo‘lib, talabalarning mazkur qo‘llanmada har bir laboratoriya ishi bo‘yicha qisqacha nazariy tushunchalar, laboratoriya ishlarini bajarish tartibi, savol va topshiriqlar keltirilgan. Laboratoriya ishlarini bajarish jarayoni rasmlar va boshqa turli obyektlar yordamida bayon etilgan.

Institutning Ilmiy-uslubiy kengashi tomonidan nashrga tavsiya etildi.

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12-LABORATORIYA ISHI

Bir o‘lchovli massivlar ustida amallar bajarishga doir dasturlar tuzish

Ishdan maqsad. C++ tilida bir o‘lchovli massivlar ustida amallar bajarishga doir dasturlar tuzishni o‘rganish.

Laboratoriya ishini bajarish tartibi

1. Nazariy qism bilan tanishib chiqing.
2. Variant bo‘yicha olgan misol va masalalar bo‘yicha dasturlar tuzishni o‘rganing.
3. C++ dasturini ishga tushiring va konsol ilova yarating.
4. Variant topshirig‘ingizdagi bir o‘lchovli massivlarga doir ifodalarga dastur tuzing va tuzilgan dasturlarni konsol ilovaga kiritib, natija oling.
5. Tuzilgan dasturlar va natijalar asosida laboratoriya ishi hisobotini tayyorlang.

Nazariy qism

Massiv – bu bir nom bilan belgilangan qiymatlar guruhi yoki jadvaldir. Massivlar bir o‘lchovli yoki ko‘p o‘lchovli bo‘lishi mumkin. Vektorni bir o‘lchovli massiv, matritsani ikki o‘lchovli massiv deb qarash mumkin.

Bir o‘lchovli a_i massiv elementlari dasturda *a*[*i*] kabi ishlatiladi va umumiy ko‘rinishda quyidagicha e’lon qilinadi:

t a[n]={boshlang‘ich elementlar};

bu yerda: *a* – massiv nomi;

n – massiv elementlari soni bo‘lib, ular aniq butun sonlar yoki o‘zgarmaslar bo‘lishi lozim;

t – massiv elementlari turi.

Masalan,

```
const int n=20;
int a[n];
float b[3]={7, -3, 5.6};
float c[10]= {2.5, 5, -6};
```

Bunda *a* – 20 ta butun sonlardan iborat bir o‘lchovli jadvaldir. *b* – qiymatlari oldindan berilayotgan, ya’ni initsializatsiya qilinayotgan 3 ta haqiqiy sondan iborat massiv. *c* – 3 ta qiymati initsializatsiya qilinayotgan, qolgan elementlari keyin kiritilishi mo‘ljallangan 10 ta haqiqiy sondan iborat massiv.

Bunda shuni ununtmaslik lozimki, massiv elementlari noldan boshlab raqamlanadi. Masalan, yuqoridagi b massivning 0-elementi 7, 1-elementi -3, 2-elementi 5.6 hisoblanadi. Shuningdek, a va c massivlarning initsializatsiya qilinmagan elementlari qiymatlar kiritilmagunga qadar 0 qiymatlarga ega bo‘ladi. Massivlarni e’lon qilishdan maqsad, massiv elementlari uchun operativ xotiradan joy ajratishdir.

Massiv elementlari qiymatlarini kiritish odatda *for* operatori orqali amalga oshiriladi. Masalan, for (int i=0; i<10;i++) cin<<a[i];

Bu misolda *a* massivning 10 ta elementi qiymati klaviaturadan ketma-ket kiritiladi.

Xuddi shuningdek, massiv elementlarini ekranga ketma-ket chiqarish ham mumkin. Masalan, for (int i=0; i<10;i++) cout<<a[i]<<" ";

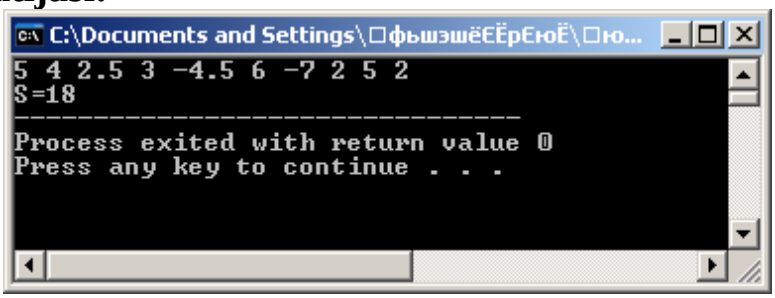
Misol

1. 10 ta haqiqiy sonlardan tashkil topgan bir o‘lchovli massiv elementlari yig‘indisini topish dasturini tuzing.

Dasturi:

```
#include <iostream>
#include <cmath>
using namespace std;
int main ()
{
float a[10], S; int i;
for (i=0; i<10; i++) cin>>a[i];
S=0;
for (i=0; i<10; i++) S=S+a[i];
cout<<"S="<<S;
return 0;
}
```

Dastur natijasi:



1-rasm. Dastur natijasi

Dinamik massivlar. Dinamik massivlar oldindan elementlari soni aniq bo‘lmagan massivlarni qo‘llashda ishlatiladi.

Bir o‘lchovli dinamik massiv umumiy ko‘rinishda quyidagicha e’lon qilinadi:

*t *b;*

bu yerda: *b* – massiv nomi;

t – massiv elementlari turi.

Masalan, *float *vek;*

Bunda haqiqiy sonlardan tashkil topgan *vek* nomli bir o‘lchovli massiv e’lon qilinmoqda.

Massiv uzunligi *new* protsedurasi yordamida aniqlanishi lozim.

Masalan, *vek=new float[5] ;*

Bunda vek nomli massiv uchun operativ xotiradan 0 dan 4 gacha bo‘lgan 5 ta joy ajratilmoqda. Demak, bu massiv elementlarini *vek*[0], *vek*[1],..., *vek*[4] lar tashkil etadi.

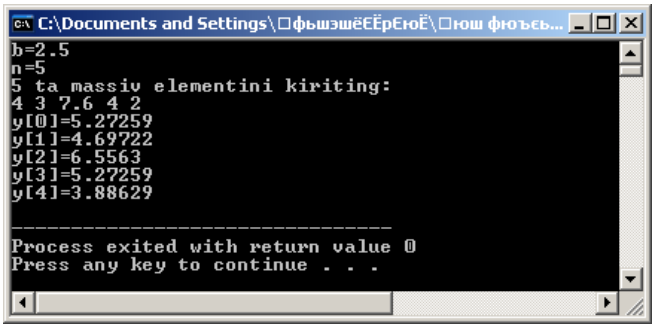
Misol

2. $y_i = 2\ln x_i + b, \quad i = \overline{0,n}$ ni hisoblash dasturini tuzing.

Dasturi:

```
#include <iostream>
#include <cmath>
using namespace std;
int main ()
{
float *x, *y, b; int i,n;
cout<<"b=";cin>>b;
cout<<"n=";cin>>n;
x=new float[n];y=new float[n];
cout<<n<<" ta massiv elementini kiriting:"<<endl;
for (i=0; i<n; i++) cin>>x[i];
for (i=0; i<n; i++)
{
y[i]=2*log(x[i])+b;
cout<<"y["<<i<<"]="<<y[i]<<endl;
}
return 0;
}
```

Dastur natijasi:



2-rasm. Dastur natijasi

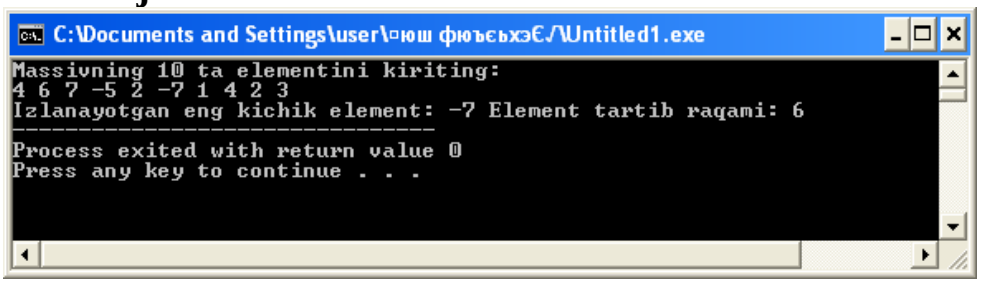
3. 10 ta butun sonlardan iborat bir o‘lchovli massivning eng kichik elementini va uning joylashgan o‘rnini topish dasturini tuzing.

Bajarish: Bu masalada dastlab birinchi element eng kichik deb olinib, keyin boshqa elementlar bilan solishtirib chiqiladi va kerakli o‘rinda almashtirishlar bajariladi.

Dasturi:

```
#include <iostream>
using namespace std;
int main ()
{
int i, min, a[10];
cout<<"Massivning 10 ta elementini kiriting:"<<endl;
for (i=0; i<10; i++) cin>>a[i];
min=0;
for (i=1; i<10; i++) if (a[i]<a[min]) min=i;
   cout<<"Izlanayotgan eng kichik element: "<<a[min]<<" Element
   tartib raqami: "<<min+1;
return 0;
}
```

Dastur natijasi:



3-rasm. Dastur natijasi

Dasturda e’tibor bersak, eng kichik element tartib tartib raqamini ekranga chiqarish uchun n+1 yozilgan. Bunda kompyuter raqamlashni 0 dan boshlashi hisobga olingan.

Variant topshiriqlari

№	Variantlar	№	Kirish	Chiqish
1	Bir o‘lchamli sonli massivning o‘rtacha qiymatidan kichik elementlarining o‘rtacha qiymati hisoblansin.	1	6 58 22 17 84 50 53	19.50
		2	13 8 37 42 64 16 7 40 12 13 21 24 11 8	12.00
2	Bir o‘lchamli sonli massiv [a,b] qismidagi elementlari massivning eng kichik elementiga bo‘lib chiqilsin, qolganlari o‘zgartirishsiz qoldirilsin.	1	4 44 99 55 12 1 3	3.7 8.3 4.6 12.0
		2	2 15 8 1 1	1.9 8.0
3	Bir o‘lchamli sonli massiv k – elementidan l – elementigacha bo‘lgan elementlarining o‘rtacha qiymati hisoblansin.	1	3 38 39 41 1 2	38.5
		2	10 6 93 73 62 26 28 65 74 53 59 8 9	63.5
4	Bir o‘lchamli sonli massivning minimum elementini massivning oxirgi elementi bilan o‘rin almashtirilsin.	1	4 74 0 1 33	74 33 1 0
		2	7 8 37 42 64 16 7 40	8 37 42 64 16 40 7
5	Bir o‘lchamli sonli massiv [a,b] qismda yotmaydigan elementlarining o‘rtacha qiymati hisoblansin.	1	6 51 49 9 76 56 78 1 4	67.00
		2	17 60 66 34 23 40 68 4 31 36 86 61 59 84 10 28 1 30 11 13	36.93
6	Bir o‘lchamli sonli massiv elementlari kvadratlarining yig‘indisi hisoblansin.	1	5 24 50 72 96 95	26501
		2	1 43	1849
7	Bir o‘lchamli sonli massivning barcha elementlari massiv eng katta elementiga bo‘lib chiqilsin.	1	9 37 23 51 47 12 23 90 85 98	0.38 0.23 0.52 0.48 0.12 0.23 0.92 0.87 1.00
		2	3 60 19 27	1.00 0.32 0.45
8	Bir o‘lchamli sonli massivni barcha elementlari massiv eng kichik elementiga bo‘lib chiqilsin.	1	9 69 48 58 45 57 55 88 89 85	1.53 1.07 1.29 1.00 1.27 1.22 1.96 1.98 1.89
		2	3 4 84 79	1.00 21.00 19.75
9	Bir o‘lchamli sonli massiv M dan kattta elementlarini ko‘paytmalarini logarifmi hisoblansin.	1	5 26 18 32 68 81 6	18.23
		2	10 49 39 42 12 53 35 94 21 35 12 12	29.96
10	Bir o‘lchamli sonli massiv K yoki M ga teng elementlari ko‘paytmasi hisoblansin.	1	5 7 11 83 18 31 31 3	31
		2	7 44 64 23 84 13 6 22 22 6	132
11	Bir o‘lchamli sonli massiv M dan katta elementlari yig‘indisi hisoblansin.	1	4 12 88 30 87 94	0
		2	9 9 72 18 48 75 32 29 78 25 76	78

12	Bir o‘lchamli sonli massivni toq o‘rindagi elementlari ko‘paytmasi juft o‘rindagi elementlari yig‘indisiga bo‘linsin.	1	2 32 8	4.00
		2	4 38 34 13 48	6.02
13	Bir o‘lchamli sonli massiv manfiy elementlarini o‘rtacha qiymati hisoblansin.	1	9 93 64 -90 74 62 -83 58 15 -37	-70.00
		2	10 63 89 -6 48 77 -19 16 73 -72 34	-32.33
14	Bir o‘lchamli sonli massivni 2 ga va 5 ga bo‘linadigan elementlari ko‘paytmasining sinusi topilsin.	1	6 44 34 42 83 43 64	0.02
		2	15 62 54 24 95 67 62 25 17 77 50 38 12 90 59 7	0.64
15	Bir o‘lchamli sonli massivni M dan kichik elementlarining kvadratlari yig‘indisi hisoblansin.	1	1 38 9	0
		2	14 85 15 57 68 18 67 7 45 69 21 1 5 98 34 92	28594
16	Bir o‘lchamli sonli massiv elementlari massivning eng katta elementiga bo‘lib chiqilsin.	1	5 91 51 75 85 29	1.00 0.56 0.82 0.93 0.32
		2	8 30 31 30 94 61 41 74 78	0.32 0.33 0.32 1.00 0.65 0.44 0.79 0.83
17	Bir o‘lchamli sonli massiv toq o‘rindagi elementlarini yig‘indisi hisoblansin.	1	10 93 64 63 8 50 24 32 80 3 76	241
		2	2 85 88	85
18	Bir o‘lchamli sonli massivning toq qiymatli elementlarini o‘rtacha qiymati hisoblansin.	1	5 76 12 51 50 98	51.00
		2	13 23 87 77 4 14 57 91 16 80 7 45 78 46	55.29
19	Elementlari soni N ($1 \le N \le 10000$) ta bo‘lgan butun sonli massiv berilgan. Ushbu massivning elementlarining qarama-qarshisini hamda necha marta ishora almashish amalga oshganligini aniqlovchi dastur tuzing. Massiv elementlarini qiymatlari [-1000,1000] oraliqda joylashgan.1	1	5 3 -3 9 -9 0	-3 3 -9 9 0 4
		2	10 0 1 2 3 4 5 0 7 8 -9	0 -1 -2 -3 -4 -5 0 -7 -8 9 8
20	Bir o‘lchamli sonli massiv elementlarini qiymati [x,y] oraliqda yotmaydigan elementlari soni aniqlansin.	1	10 14 51 -83 42 85 -77 91 70 -98 54 50 99	5
		2	3 1 77 -58 20 97	2

13-LABORATORIYA ISHI

Ikki o‘lchovli massivlar ustida amallar bajarishga doir dasturlar tuzish

Ishdan maqsad. C++ tilida ikki o‘lchovli massivlar ustida amallar

bajarishga doir dasturlar tuzishni o‘rganish.

Laboratoriya ishini bajarish tartibi

1. Nazariy qism bilan tanishib chiqing.
2. Variant bo‘yicha olgan misol va masalalarga dasturlar tuzishni o‘rganing.
3. C++ dasturini ishga tushiring va konsol ilova yarating.
4. Variant topshirig‘ingizdagi ikki o‘lchovli massivlarga doir ifodalarga dastur tuzing va tuzilgan dasturlarni konsol ilovaga kiritib, natija oling.
5. Tuzilgan dasturlar va natijalar asosida laboratoriya ishi hisobotini tayyorlang.

Ikki o‘lchovli massivlar. Ikki o‘lchovli b_{ij} massiv elementlari dasturda *b[i][j]* kabi ishlatiladi va quyidagicha e’lon qilinadi:

t b[m][n]={boshlang‘ich elementlar};

bu yerda: *b* – massiv nomi;

m, *n* – mos ravishda massiv elementlari qator va ustunlar soni bo‘lib, ular aniq butun sonlar yoki o‘zgarmaslar bo‘lishi lozim;

t – massiv elementlari turi.

Masalan,

```
const int m=5, n=6;
int a[m][n];
float b[3][2]={7, -3, 5.6, 3, 9, 2.8};
float c[3][2]={{7, -3}, {5.6, 3}, {9, 2.8}};
float d[m][2]= {2.5, 5, -6};
```

Bunda *a* – 5 ta qator va 6 ta ustunlarda joylashgan 30 ta butun sonlardan iborat bir o‘lchovli massiv. *b* – qiymatlari oldindan berilayotgan, ya’ni initsializatsiya qilinayotgan 3×2 o‘lchamli 6 ta haqiqiy sondan iborat 2 o‘lchovli massiv. c – b massivga ekvivalent bo‘lib, qiymatlari guruh shaklida initsializatsiya qilinmoqda. d – d[0][0], d[0][1], d[1][0] elementlari initsializatsiya qilinayotgan, qolgan elementlari keyin kiritilishi mo‘ljallangan 10 ta haqiqiy sondan iborat massiv.

Ikki o‘lchovli massiv elementlari qiymatlarini kiritish ham odatda *for* operatori orqali amalga oshiriladi.

Masalan,

```
for (int i=0; i<m; i++)
for (int j=0; j<4; j++) cin<<a[i][j];
```

Bu misolda *a* massivning *m*x4 ta elementi qiymati klaviaturadan ketma-ket kiritiladi.

Xuddi shuningdek, massiv elementlarini ekranga ketma-ket chiqarish ham mumkin.

Masalan,

```
for (int i=0; i<m; i++)
for (int j=0; j<4; j++) cout<<a[i][j]<<" ";
```

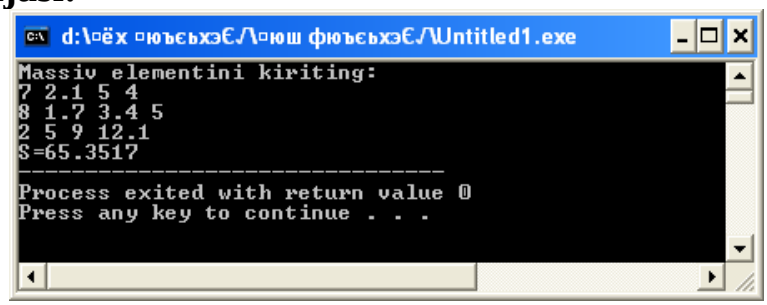
Misollar

1. $\sum_{i=1}^{3}\prod_{j=2}^{5}\sqrt{a_{ij}}$ ni hisoblash dasturini tuzing.

Dasturi:

```
#include <iostream>
#include <cmath>
using namespace std;
int main ()
{
float a[3][5], S,P; int i,j;
cout<<"Massiv elementini kiriting:"<<endl;
for (i=0; i<3; i++)
for (j=1; j<5; j++)
        cin>>a[i][j];
S=0;
for (i=0; i<3; i++)
{
P=1;
for (j=1; j<5; j++)
                P=P*pow(a[i][j],0.5);
S=S+P;
}
cout<<"S="<<S;
return 0;
}
```

Dastur natijasi:



4-rasm. Dastur natijasi

Ikki o‘lchovli dinamik massivlar. Ikki o‘lchovli dinamik massiv umumiy ko‘rinishda quyidagicha ikki bosqichda e’lon qilinadi:

*t **b;*

bu yerda: *b* – massiv nomi;

t – massiv elementlari turi.

Masalan, *float **matr;*

Bunda haqiqiy sonlardan tashkil topgan *matr* nomli ikki o‘lchovli massiv e’lon qilinmoqda.

Massiv uzunligi *new* protsedurasi yordamida ikki bosqichda aniqlanishi lozim.

Masalan,

*matr=new float *[m];*

for (i=0; i<m; i++) matr[i]=new float[n];

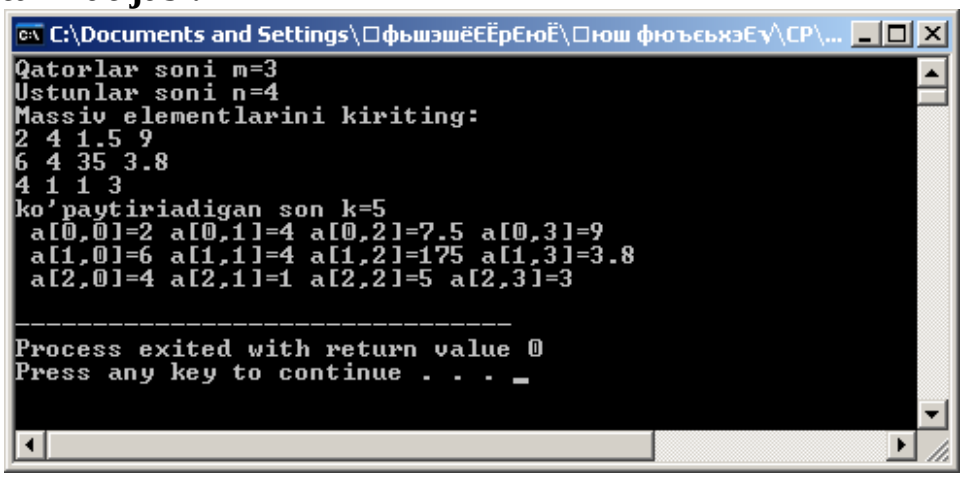
2. m × n o‘lchamli ikki o‘lchovli massivning 3-ustunini k soniga ko‘paytiring va o‘zgartirilgan massivni ekranga chiqarish dasturini tuzing.

Dasturi:

```
#include <iostream>
#include <cmath>
using namespace std;
int main ()
{
int i,j,m,n,k;
float **a;
cout<<"Qatorlar soni m="; cin>>m;
cout<<"Ustunlar soni n="; cin>>n;
a=new float *[m];
for (i=0; i<m; i++) a[i]=new float[n];
cout<<"Massiv elementlarini kiriting:"<<endl;
for (i=0; i<m; i++)
for (j=0; j<n; j++) cin>>a[i][j];
cout<<"ko‘paytiriadigan son k="; cin>>k;
for (i=0; i<m; i++) a[i][2]= a[i][2]*k;
for (i=0; i<m; i++)
{
for (j=0; j<n; j++)
cout<<" a["<<i<<","<<j<<"]="<<a[i][j];
cout<<endl;
}
```

```
    return 0;
}
```

Dastur natijasi:



5-rasm. Dastur natijasi

3. Ikki o‘lchovli *a* va *b* massivlar yig‘indisini topish dasturi tuzilsin.

```
#include <iostream>
#include <cmath>
using namespace std;
int main ()
{
int i,j,m,n;
float **a,**b,**c;
cout<<"Qatorlar soni m="; cin>>m;
cout<<"Ustunlar soni n="; cin>>n;
a=new float *[m];
for (i=0; i<m; i++) a[i]=new float[n];
b=new float *[m];
for (i=0; i<m; i++) b[i]=new float[n];
c=new float *[m];
for (i=0; i<m; i++) c[i]=new float[n];
cout<<"a massiv elementlarini kiriting:"<<endl;
for (i=0; i<m; i++)
for (j=0; j<n; j++) cin>>a[i][j];
cout<<"b massiv elementlarini kiriting:"<<endl;
for (i=0; i<m; i++)
for (j=0; j<n; j++) cin>>b[i][j];
cout<<"a va b massivlar yig‘indisi c massiv quyidagicha:"<<endl;
```

```
for (i=0; i<m; i++)
{
for (j=0; j<n; j++)
  cout<<" c["<<i<<","<<j<<"]="<<c[i][j];
cout<<endl;
}
   return 0;
}
```

Variant topshiriqlari

1 Uchga uch determinantni hisoblang
2 A matritsaga B matritsani qo‘shing
3 A matritsani transponirlang.
4 N×N birlik matritsa yarating
5 A matritsaning manfiy bo‘lmagan elementlarini chop qiling.
6 A kvadrat matritsaning determinantini hisoblovchi dastur tuzing
7 Bir o‘lchovli massivni Pufakcha usulida saralang
8 A matritsaning har bir satr elementlarining maximumini chop qiling
9 A matritsaning bosh diagonaldan pastda yotgan elementlarini 0 (nol) bilan almashtiring
10 A kvadrat matritsaga teskari matritsani toping
11 A matritsaning elementlari yig‘indisi eng katta bo‘lgan satr elementlarini chop qiling
12 Bosh diagonaldan yuqori va past qismi simmetrik bo‘gan matritsa hosil qiling
13 Elementlari soni tub bo‘lmagan a massiv elementlaridan matritsa hosil qiling
14 O‘lchamlari bir xil bo‘lgan A matritsa bosh diagonali elementlarini B matritsa bosh diagonali elementlari bilan mos ravishda almashtiring
15 A va B matritsa barcha elementlari yig‘indisi katta bo‘lgan matritsa elementlarini chop qiling
16 N×N matritsani ilon izi shaklida chiqaring. Misol:

$$A[3,3] = \begin{pmatrix} 1 & 2 & 3 \\ 6 & 5 & 4 \\ 7 & 8 & 9 \end{pmatrix}$$

17. A matritsaning ikkinchi diagonaldan yuqorida yotgan elementlarining yig‘indisini aniqlang
18. Berilgan n sonining kvadratigacha bo‘lgan natural sonlarni N×N kvadrat matritsaga oxiridan boshlab ketma –ket joylashtiring.
19. Berilgan A matritsaning eng katta qiymati va eng kichik qiymati

o‘rinlarini almashtiring (agar ular soni bittadan ko‘p bo‘lsa, birinchi uchragani bilan almashtiring)

20. A matritsaning ikki diagonalidan yuqorida joylashgan elementlari yig‘indisini aniqlang

14-LABORATORIYA ISHI

Mathcad dasturi interfeysi, Calculator va Calculus uskunalar panellari bilan ishlash

Ishdan maqsad. Mathcad dasturining imkoniyatlari va interfeysi bilan tanishish, unda **Calculator** va **Calculus** uskunalar panellaridan foydalanib turli masalalar yechishni o‘rganish.

Laboratoriya ishini bajarish tartibi

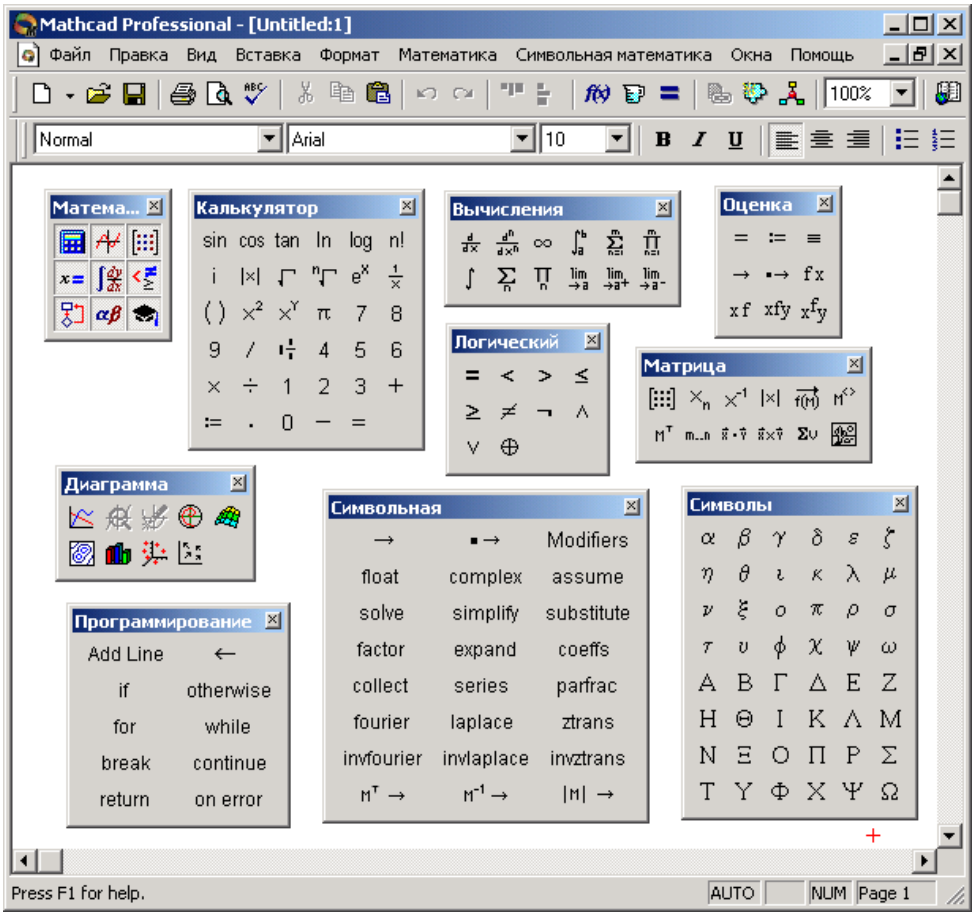
1. Nazariy qismdan Mathcad dasturi imkoniyatlarini bilib oling.
2. Mathcad dasturini ishga tushiring va dastur interfeysi bilan tanishib chiqing.
3. **Calculator** va **Calculus** panellari elementlarining har birini ishlatib ko‘ring.
4. Berilgan topshiriqlarni bajaring.
5. Bajarilgan laboratoriya ishi hisobotini tayyorlang.

Nazariy qism

Mathcad dasturi hisoblash matematikasi masalalarini kompyuterda yechishga mo‘ljallangan bo‘lib, natijalar eng aniq usullarda olinadi. Dastur interfeysining qulayligi sababli undan mutaxassis bo‘lmaganlar ham bemalol foydalanishlari mumkin. Unda muhandislik sohasining ko‘pgina masalalarini yechish imkoniyatlari mavjud. Dastur yordamida boshlang‘ich algebra masalalaridan tortib, matematik analizning murakkab masalalarigacha, jumladan, differensial va integral hisob, matritsalar ustida amallar, funksiyalar grafiklarini qurish, shuningdek, chiziqli dasturlash masalalarini yechish imkoniyatlari mavjud. Bundan tashqari foydalanuvchilar o‘z algoritmlari asosida masalani yechimga olib keluvchi mustaqil dastur tuzishlari ham mumkin.

Mathcad dasturi odatda **Пуск - Все программы - Mathsoft Apps -**

Mathcad menyular ketma-ketligi orqali ishga tushuriladi. Natijada Mathcad dasturi oynasi hosil bo‘ladi (1-rasm). Mathcad interfeysi boshqa dasturlar singari menyu satri, uskunalar paneli, ishchi soha va holatlar satridan iborat. Avtomatik hosil bo‘ladigan **Стандартные** (Standart) va **Форматирование** (Formating) uskunalar paneli fayllar bilan ishlash, ma’lumotlarni formatlash amallarini bajarishga mo‘ljallangan. Shuningdek, ekranda **Математика** (Math) uskunalar paneli ham bo‘lishi lozim. Bu panel **Вид - Панели инструментов - Математика** menyular-ketma-ketligi orqali hosil qilinadi. **Математика** paneliga turli bo‘limlarga oid 9 ta panel tugmalar yordamida biriktirilgan. Har bir tugmaning bosilishi mos panelni ekranga qo‘yadi yoki olib tashlaydi. 1-rasmda **Математика** (**Math**) paneli va uning barcha bo‘limlari ekranga joylashtirilgan.



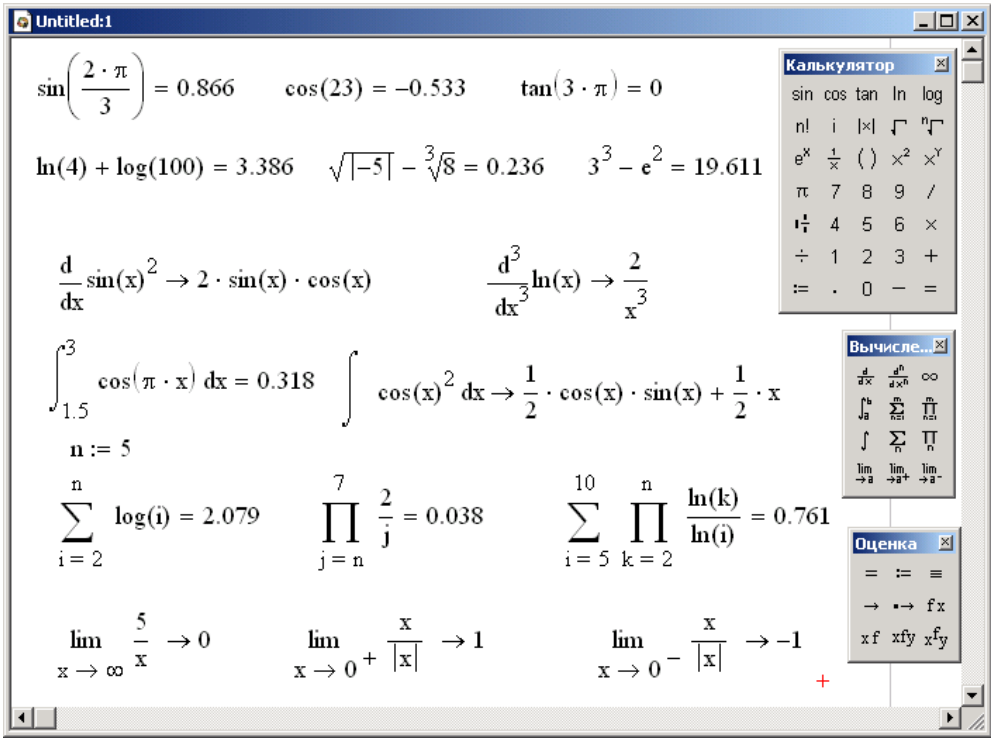
6-rasm. Mathcad dasturi oynasi va uning **Математика** panellari

Bunda:

- **Калькулятор (Calculator)** paneli matematikaning asosiy elementlari va standart funksiyalardan foydalanishni ta’minlaydi;
- **Вычисления (Calculus)** paneli matematik analiz funksiyalarini hisoblash imkonini yaratadi;

- **Матрица (Matrix)** paneli matritsalar ustida amallar bajarishni ta’minlaydi;
- **Логический** paneli ifodalarda mantiqiy belgilarni kiritishga imkon beradi;
- **Оценка** paneli o‘zlashtirish, natijalarni chiqarishda ishlatiladi;
- **Символы** paneli matematik ifodalarda yunon harflaridan foydalanishni ta’minlaydi;
- **Символьная** paneli turli matematik ifodalarni hisoblash, almashtirishlar bajarish imkonini beradi;
- **Диаграмма (Graph)** paneli yordamida funksiyalar grafiklarini hosil qilish mumkin;
- **Программирование** paneli mustaqil ravishda shartli va takrorlanuvchi turli murakkab jarayonlarni hisoblashlarda ishlatiladi.

Dasturda ifodalarni hisoblash uchun avvalo kerakli panellar ekranga joylashtiriladi. Ifodalardagi standart funksiyalarni panellardagi mos tugmalarni bosish orqali yoki bevosita klaviatura yordamida kiritish mumkin. Ifoda yozilgandan so‘ng natijani chiqarish uchun klaviaturadagi yoki **Калькулятор** panelidagi “=” belgisi bosiladi. Hosila, aniqmas integral, limit kabilarni hisoblashda esa **Оценка** panelidagi strelka belgisidan foydalaniladi. 7-rasmda **Калькулятор** va **Вычисления** panellari yordamida ifodalarni hisoblashga doir misollar keltirilgan.



7-rasm. Калькулятор va Вычисления panellari elementlari yordamida ifodalarni hisoblash

Variant topshiriqlari

Quyidagi ifodalarni Mathcad dasturida hisoblang:

1-variant

1) $\dfrac{\lg^3 0,7}{\sin^2\dfrac{2\pi}{3}-\sqrt{tg0,5}}$

2) $\dfrac{d}{dx}\ln^3\sqrt[3]{x}$, $\dfrac{d^3}{dx^3}\sin^2 x$

3) $\int\left(x^3+5\cos x\right)dx$, $\int\limits_{1,2}^{2}\dfrac{tg(x+2)}{x}dx$

4) $\prod\limits_{k=b}^{m}\sum\limits_{j=4}^{7}\dfrac{k-5}{j}-\sin b$

5) $\lim\limits_{x\to 1}\dfrac{x^3-1}{1-x^2}$

2-variant

1) $\dfrac{tg^3x+ctg^3x}{\lg^2 3,5}$

2) $\dfrac{d}{dx}tg^4x^2$, $\dfrac{d^3}{dx^3}\cos 3x$

3) $\int\sin^2 3xdx$, $\int\limits_{0}^{\frac{\pi}{2}}\sin x\cos^2 xdx$

4) $\sum\limits_{k=b}^{n}\prod\limits_{j=n}^{t}\log_k j$

5) $\lim\limits_{x\to 0}\dfrac{e^{x^2}-\cos x}{x^2}$

3-variant

1) $\dfrac{\cos\dfrac{\pi}{6}+ctg\sqrt[3]{x}}{e^{x+2}+\ln|x|}$

2) $\dfrac{d}{dx}ctg^3x^2$, $\dfrac{d^2}{dx^2}\arccos 4x$

3) $\int\dfrac{dx}{\sin^4 x+\cos^4 x}$, $\int\limits_{0}^{1}\dfrac{x^2dx}{\sqrt{4-x^2}}$

4) $\sum\limits_{j=a}^{10}\sum\limits_{k=3}^{m}\lg^k j$

5) $\lim\limits_{x\to 3}\dfrac{\sqrt[3]{x}-\sqrt[3]{3}}{\sqrt{x}-\sqrt{3}}$

4-variant

1) $\sqrt[3]{\dfrac{\sin^{-1}\left(\dfrac{\pi}{2}-\dfrac{x}{3}\right)+\sin\left(\dfrac{x}{2}-\dfrac{\pi}{3}\right)}{\cos^{-\sin\left(\frac{6\pi}{16}+\frac{x}{8}\right)}\left(\dfrac{\pi}{2}-\dfrac{\pi}{3}\right)+\cos\left(\dfrac{\pi}{2}-\dfrac{\pi}{3}\right)}}$

2) $\dfrac{d}{dx}arctg^3x^2$, $\dfrac{d^2}{dx^2}\arcsin^3 x$

3) $\int\dfrac{x^2+4x}{\sqrt{x^2+2x+2}}dx$, $\int\limits_{0}^{\frac{a}{2}}\sqrt{\dfrac{x}{a-x}}dx$

4) $\prod\limits_{k=2}^{n}\lg k^2+\sin b$

5) $\lim\limits_{x\to\infty}\left(\sqrt{x^2+x+1}-x\right)$

5-variant

1) $\dfrac{\sin^{2\left(x-\frac{1}{2}\right)}\left(\dfrac{9\pi}{2}-4x\right)+\sin\left(\left(\sqrt{\dfrac{7x}{2}}\right)^2+\dfrac{1}{\pi}\right)}{1+\sqrt[5]{\sin\left(\dfrac{3\pi}{2}-\dfrac{51\pi}{102}\right)}+tg\dfrac{x}{6}\cdot ctg\dfrac{\pi}{6}}$

2) $\dfrac{d}{dx}\log^3 x^2$, $\dfrac{d^3}{dx^3}arcctg^3x$

3) $\int\dfrac{xdx}{x^2+1}$, $\int\limits_{1}^{2}\dfrac{x^3+1}{\ln x}dx$

6-variant

1) $\dfrac{\sqrt{3\log_2{}^2\left(\sin\left(\dfrac{\pi}{2}-\dfrac{\pi}{3}\right)\right)+tg\left(\dfrac{x}{4}\right)}}{tg\left(\dfrac{x}{4}\right)+\dfrac{4}{3}\sqrt{3}\sin\left(x-\dfrac{\pi}{3}\right)\cos\left(x-\dfrac{\pi}{3}\right)}$

2) $\dfrac{d}{dx}\ln^3 x$, $\dfrac{d^3}{dx^3}\operatorname{arc}tg\sqrt[5]{x}$

3) $\int\dfrac{(x-1)^3dx}{x^2+x}$, $\int\limits_{0}^{+\infty}e^{-ax}\cdot\cos xdx$

4) $\prod_{k=2}^{m}\prod_{i=a}^{n}\log_k i$ 5) $\lim_{x\to 3}(3-x)tg\frac{\pi x}{6}$	4) $\prod_{k=2}^{m}\prod_{i=a}^{n}\frac{\sqrt[5]{k}+\sin a}{i}$ 5) $\lim_{x\to 0}\left(\frac{1-\cos 3x}{x\sin 5x}\right)$
7-variant	**8-variant**
1) $\frac{8^{-1}\sin^2\left(x+\frac{\pi}{2}\right)-x^{-3}\cos^2\pi}{\left(\sin^2 x+\cos^2 x\right)\left(4^{-1}+\frac{1}{2x}+x^{-2}\right)}$ 2) $\frac{d}{dx}x^2\ln(\sin x)$, $\frac{d^2}{dx^2}\sin^5 3x$ 3) $\int\sqrt{3+2x-x^2}dx$, $\int_a^{a\sqrt{3}}\frac{dx}{a^2+x^2}$ 4) $\sum_{j=a}^{m}\sum_{k=b}^{m}\sqrt[j]{k+t}$ 5) $\lim_{x\to 0}\left(\frac{x}{\log_3(1+x)}\right)$	1) $\sqrt[3]{\frac{\log_x\left(x^2+14x+50\right)^{\sqrt{x+7}}}{\sqrt{\ln e^{x+24}}}}$ 2) $\frac{d}{dx}\ln(\arcsin x)$, $\frac{d^3}{dx^3}e^{-\frac{1}{x}}\cos 3x$ 3) $\int\frac{\cos^3 x}{\sin^2 x}dx$, $\int_0^3 e^{\frac{x}{4}}dx$ 4) $\sum_{j=1}^{m}\sum_{k=2}^{m}\sqrt[j]{k^3+\sqrt{d}}$ 5) $\lim_{x\to 0}\frac{e^{3x}-e^{-2x}}{2\arcsin x-\sin x}$
9-variant	**10-variant**
1) $\frac{\cos^2\left(\pi+\frac{a}{4}\right)\left(1+tg^2\left(\frac{3a}{4}-\frac{3\pi}{2}\right)\right)}{\sin^{-1}\left(\frac{9\pi}{2}+\frac{a}{2}\right)\left(tg^2\left(\frac{5\pi}{2}-\frac{a}{4}\right)\right)}$ 2) $\frac{d}{dx}arctg^3x^2$, $\frac{d^3}{dx^3}\sin^2 x$ 3) $\int\frac{x^{10}}{x^2+x-2}dx$, $\int_1^2\left(x^3+\frac{1}{x^3}\right)dx$ 4) $\prod_{i=a}^{6}i+\sum_{j=3}^{m}\sqrt{j}$ 5) $\lim_{x\to 0}tg3x\cdot ctg5x$	1) $\sqrt{\frac{tg2x\cos^{-1}2y-tg2y\cos^{-1}2x}{\cos^{-1}2x+\cos^{-1}2y}}$ 2) $\frac{d}{dx}\cos x\ln x$, $\frac{d^2}{dx^2}ctg2x$ 3) $\int\frac{x^2-1}{(x-1)^2(x+1)}dx$, $\int_0^{2\pi}x^2\cos xdx$ 4) $\sum_{i=b}^{6}3x^i+t^2$ 5) $\lim_{x\to\infty}\frac{x^2+\sqrt{x^3+1}}{\sqrt[3]{x^6+2}+x}$
11-variant	**12-variant**
1) $\sqrt[3]{\left(\frac{\sqrt{tga}+\sqrt{ctga}}{\sin a+\cos a}\right)^2}$ 2) $\frac{d}{dx}arctg^2x^2$, $\frac{d^3}{dx^3}\cos 3x\cdot\ln x$	1) $\frac{\sin^2\left(\frac{\pi}{2}+a\right)-\cos^2\left(a-\frac{\pi}{2}\right)}{tg^2\left(\frac{\pi}{2}+a\right)-ctg^2\left(a-\frac{\pi}{2}\right)}$ 2) $\frac{d}{dx}arctgx$, $\frac{d^3}{dx^3}\cos\sqrt{3x}$

3) $\int \frac{dx}{\sin x}$, $\int\limits_{\frac{\pi}{4}}^{\frac{\pi}{3}} \frac{1+tg^2x}{(1+tgx)^2}dx$ 4) $\sum\limits_{i=a}^{4}\sum\limits_{j=2}^{m}\sqrt[i]{j}+\ln d$ 5) $\lim\limits_{x\to -1}\cos\left(\frac{\pi(x+1)}{\sqrt[3]{x}+1}\right)$	3) $\int \frac{dx}{\cos x}$, $\int\limits_{\frac{\pi}{4}}^{\frac{\pi}{3}} \frac{dx}{1+\sqrt{2x+1}}$ 4) $\prod\limits_{k=2}^{m}\cos^3 k - tgx$ 5) $\lim\limits_{x\to\frac{\pi}{2}} \frac{\sqrt{1+\cos 2x}}{\sqrt{\pi}-\sqrt{2x}}$
13-variant	**14-variant**
1) $\frac{\lg\cos^2\left(\frac{5\pi}{4}-2x\right)-\log_x\sin^2\left(\frac{5\pi}{4}-2x\right)}{\left(\cos\frac{x}{2}+\sin\frac{x}{2}\right)\left(\cos\left(2\pi-\frac{x}{2}\right)+tg\left(\frac{x}{2}+\frac{\pi}{2}\right)\right)}$ 2) $\frac{d}{dx}\ln x tg2x$, $\frac{d^2}{dx^2}ctg(\ln 2x)$ 3) $\int\sin^5 dx$, $\int\limits_a^b x^{-2}dx$ 4) $\prod\limits_{k=b}^{10}\sum\limits_{j=4}^{2k}\frac{k}{j}-b$ 5) $\lim\limits_{x\to 0}\frac{\frac{\pi}{x}}{ctg\frac{\pi x}{2}}$	1) $\frac{\log_a\left(x^4+2x^2+2\right)-\log_a\left(x^2+1\right)}{\ln\left(\frac{a^3+x^3}{a^2-ax+x^2}\right)\left(\cos x+2\cos^x a\right)}$ 2) $\frac{d}{dx}\left(x^2+ctgx\right)$, $\frac{d^3}{dx^3}arcctg\sqrt{x}$ 3) $\int\sqrt{4x+x^2}dx$, $\int\limits_1^4\left(\sqrt{x}+1\right)dx$ 4) $\prod\limits_{k=1}^{4}\prod\limits_{i=a}^{b}\log_k i$ 5) $\lim\limits_{x\to 0}\frac{\ln(\sin 3x)}{\ln\sin x}$
15-variant	**16-variant**
1) $\left(\sqrt[4]{x}\sqrt{\frac{\sqrt[4]{x}-1}{\left(\sqrt[4]{x}+1\right)^2}}+\frac{\sqrt[4]{x}-1}{\sqrt[3]{\left(\sqrt{x}-1\right)^2}}\right)^{\frac{3}{5}}\left(\sqrt{x}-1\right)^{\frac{4}{5}}$ 2) $\frac{d}{dx}\arcsin x^3$, $\frac{d^3}{dx^3}arcctg\sqrt{x}$ 3) $\int ctg^3 x dx$, $\int\limits_0^3\arcsin\sqrt{\frac{x}{1+x}}dx$ 4) $\prod\limits_{i=3}^{6}2i+\sum\limits_{j=3}^{m}\ln j$ 5) $\lim\limits_{x\to\infty}\frac{x\sqrt{x}+\sqrt[3]{x^6+1}}{(3x+1)\sqrt[3]{x^3+1}}$	1) $\frac{\sin^2\left(\pi+\frac{a}{4}\right)\left(1+tg^2\left(\frac{3a}{4}-\frac{3\pi}{2}\right)\right)}{\sin^{-1}\left(\frac{9\pi}{2}+\frac{a}{2}\right)\left(tg^2\left(\frac{5\pi}{2}-\frac{a}{4}\right)\right)}$ 2) $\frac{d}{dx}arctg^3x^2$, $\frac{d^3}{dx^3}\sin^2 x$ 3) $\int\frac{x^{10}}{x^2+x-2}dx$, $\int\limits_1^2\left(x^3+\frac{1}{x^3}\right)dx$ 4) $\prod\limits_{i=a}^{6}i+\sum\limits_{j=3}^{m}\sqrt{j}$ 5) $\lim\limits_{x\to 0}tg3x\cdot ctg5x$
17-variant	**18-variant**
1) $\sqrt{\frac{tg2x\cos^{-1}2y-tg2y\cos^{-1}2x}{\cos^{-1}2x+\cos^{-1}2y}}$ 2) $\frac{d}{dx}\cos x\ln x$, $\frac{d^2}{dx^2}ctg2x$	1) $\sqrt[3]{\frac{\lg_x\left(x^2+14x+50\right)^{\sqrt{x+7}}}{\sqrt{\lg e^{x+24}}}}$ 2) $\frac{d}{dx}\ln(\arcsin x)$, $\frac{d^3}{dx^3}e^{-\frac{1}{x}}\cos 3x$

3) $\int \frac{x^2-1}{(x-1)^2(x+1)}dx$, $\int_0^{2\pi} x^2\cos x dx$ 4) $\sum_{i=b}^{6} 3x^i + t^2$ 5) $\lim_{x\to\infty} \frac{x^2+\sqrt{x^3+1}}{\sqrt[3]{x^6+2}+x}$	3) $\int \frac{\cos^3 x}{\sin^2 x}dx$, $\int_0^3 e^{\frac{x}{4}}dx$ 4) $\sum_{j=1}^{m}\sum_{k=2}^{m} \sqrt[j]{k^3+\sqrt{d}}$ 5) $\lim_{x\to 0} \frac{e^{3x}-e^{-2x}}{2\arcsin x - \sin x}$
19-variant	**20-variant**
1) $\frac{8^{-5}\sin^2\left(x+\frac{\pi}{2}\right)-x^{-7}\cos^4\pi}{\left(\sin^3 x+\cos^3 x\right)\left(4^{-1}+\frac{1}{2x}+x^{-2}\right)}$ 2) $\frac{d}{dx}x^2\ln(\sin x)$, $\frac{d^2}{dx^2}\sin^5 3x$ 3) $\int\sqrt{3+2x-x^2}dx$, $\int_a^{a\sqrt{3}} \frac{dx}{a^2+x^2}$ 4) $\sum_{j=a}^{m}\sum_{k=b}^{m}\sqrt[j]{k+t}$ 5) $\lim_{x\to 0}\left(\frac{x}{\log_3(1+x)}\right)$	1) $\sqrt[3]{\frac{\sin^{-1}\left(\frac{\pi}{2}-\frac{x}{3}\right)+\sin\left(\frac{x}{2}-\frac{\pi}{3}\right)}{\cos^{-\sin\left(\frac{6\pi}{16}+\frac{x}{8}\right)}\left(\frac{\pi}{2}-\frac{\pi}{3}\right)+\cos\left(\frac{\pi}{2}-\frac{\pi}{3}\right)}}$ 2) $\frac{d}{dx}arctg^3 x^2$, $\frac{d^2}{dx^2}\arcsin^3 x$ 3) $\int\frac{x^2+4x}{\sqrt{x^2+2x+2}}dx$, $\int_0^{\frac{a}{2}}\sqrt{\frac{x}{a-x}}dx$ 4) $\prod_{k=2}^{n}\lg k^2+\sin b$ 5) $\lim_{x\to\infty}\left(\sqrt{x^2+x+1}-x\right)$

15-LABORATORIYA ISHI

Mathcad dasturida Matrix, Graph va boshqa uskunalar panellari bilan ishlash

Ishdan maqsad. Mathcad dasturida **Matrix**, **Graph** va boshqa uskunalar panellaridan foydalanib turli masalalar yechishni o‘rganish.

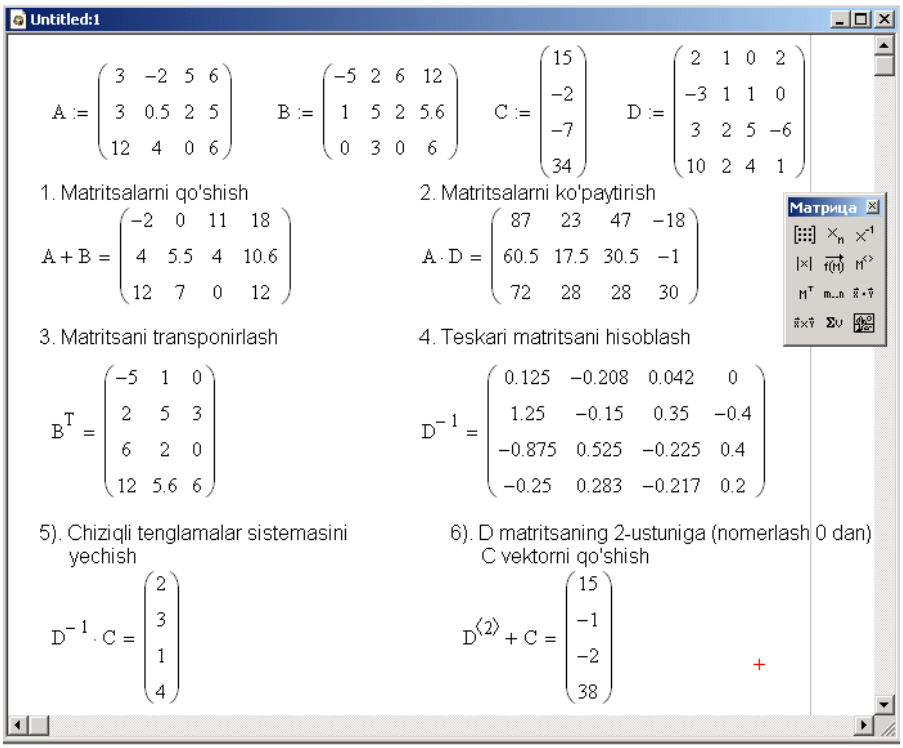
Laboratoriya ishini bajarish tartibi

1. Nazariy qismdan **Mathcad** dasturi imkoniyatlarini bilib oling.
2. **Mathcad** dasturini ishga tushiring va dastur interfeysi bilan tanishib chiqing.
3. **Matrix, Graph** va boshqa uskunalar panellari elementlarining har birini ishlatib ko‘ring.
4. Berilgan topshiriqlarni bajaring.

5. Bajarilgan laboratoriya ishi hisobotini tayyorlang.

Nazariy qism

Mathcad dasturida matritsalar hosil qilish uchun odatda biror kattalik kiritilib, ikki nuqtali tenglikdan so‘ng **Матрица** panelidagi tugma bosiladi. Ochilgan muloqot oynadan qator va ustunlar soni aniqlanadi va hosil bo‘lgan shablonga matritsa elementlari kiritiladi. 8-rasmda matritsalar ustida ba’zi amallarning bajarilishi keltirilgan.

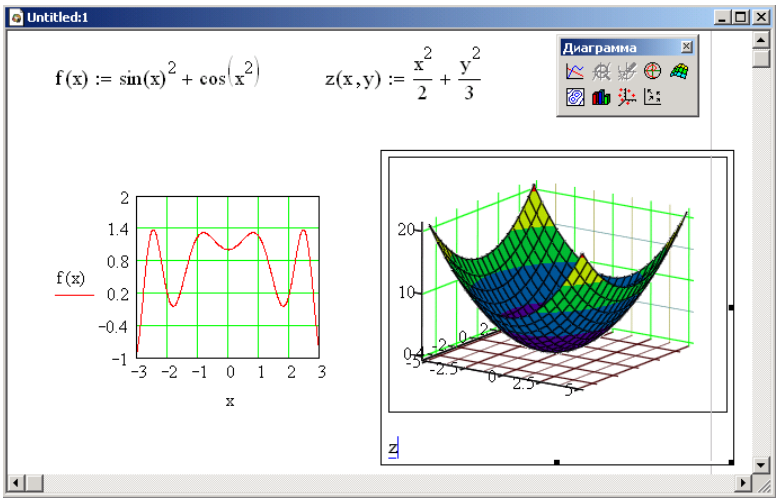


8-rasm. **Матрица** paneli elementlari yordamida amallar bajarish

Funksiyalar grafiklarini hosil qilish uchun avvalo funksiya kiritib olinadi. Shundan so‘ng **Диаграмма** panelidagi mos diagramma turi tanlanadi. Hosil bo‘lgan shablonga kerakli parametrlar kiritiladi. Masalan, ikki o‘lchovli funksiya grafigini hosil qilishda argument va funksiya ko‘rsatilib, **Enter** tugmasi bosiladi. Uch o‘lchovli funksiya grafigini hosil qilishda esa funksiya nomi ko‘rsatilib, Enter tugmasini bosish yetarli bo‘ladi (9-rasm).

Hosil bo‘lgan diagrammani tahrirlash uchun diagrammaning kontekst menyusidan kerakli buyruq tanlanadi va hosil bolgan muloqot oynada o‘zgartirish va qo‘shimchalar kiritilib, OK tugmasi bosiladi.

Bundan tashqari standart uskunalar panelidagi **f(x)** piktogrammasini bosish orqali hosil qilingan funksiyalar panelidan yuqorida ko‘rib o‘tilgan funksiyalar bilan birgalikda boshqa ko‘plab funksiyalardan foydalanish imkoniyatlari mavjud.



9-rasm. **Диаграмма** paneli elementlari yordamida diagrammalar qurish

Variant topshiriqlari

Quyidagi ifodalarni Mathcad dasturida hisoblang:

1-variant	**2-variant**
1) $A=\begin{pmatrix}9&5&4&7\\4&6&8&7\\5&8&7&6\\5&6&8&7\end{pmatrix}, B=\begin{pmatrix}0\\6\\3\\7\end{pmatrix}$, $A\times B$, A^T, A^{-1}, B^3, $\lvert A\rvert$ ifodalarni hisoblang. 2) $y=2\sin x$, $f=x^2+\ln z$ funksiyalar grafiklarini hosil qiling	1) $A=\begin{pmatrix}5&9&6\\2&-7&5\\-8&5&4\end{pmatrix}$, $B=\begin{pmatrix}3&-7&6\\2&7&4\\-4&8&4\end{pmatrix}$ $A+B, A/B^{-1}, A^T, B^T+A$ ifodalarni hisoblang. 2) $y=3x^3+5, z=\frac{x^4}{3x}+\frac{y}{2}$ funksiyalar grafiklarini hosil qiling
3-variant	**4-variant**
1) $A=\begin{pmatrix}-5&19&16\\-2&-17&5\\-8&5&14\end{pmatrix}$, $B=\begin{pmatrix}13&-7&-6\\22&7&4\\-14&8&14\end{pmatrix}$ A^T+B, A/B^{-1}, A^T+B ifodalarni hisoblang 2) $y=3x^3+5tgx^2$, $z=\cos x+y^3$ funksiyalar grafiklarini hosil qiling	1) $A=\begin{pmatrix}21&15&0\\-28&-9&5\\-12&2&20\end{pmatrix}$, $B=\begin{pmatrix}-21&-4&-15\\41&15&5\\-8&3&0\end{pmatrix}$ B^T-A, A^{-1}, $A-B^T$, B^T-A ifodalarni hisoblang 2) $y=\frac{5x^4}{3}-2\cos x, z=\frac{x^2}{5}+3\sqrt{y}$ funksiyalar grafiklarini hosil qiling
5-variant	**6-variant**
1) $A=\begin{pmatrix}51&13&10\\-8&9&5\\-12&22&20\end{pmatrix}$, $B=\begin{pmatrix}15&41&0\\-48&19&5\\-12&2&20\end{pmatrix}$ $B^T+A, A-B^T, B^T-A, B^{-1}$ ifodalarni hisoblang. 2) $y=3x^3+5tgx^2$, $z=\frac{\sin x}{3x}+\frac{3y}{2}$	1) $A=\begin{pmatrix}-3&2&4&1\\6&1&9&5\\5&4&7&6\\3&6&8&7\end{pmatrix}$, $B=\begin{pmatrix}7&2&4&1\\0&1&1&5\\6&4&7&6\\3&6&8&7\end{pmatrix}$ $A\times B, B^T+A, A/B^{-1}$ ifodalarni hisoblang. 2) $y=ctg2x+5tgx, z=\frac{\cos^2 x}{x}+\frac{y}{5}$ funksiyalar grafiklarini hosil qiling

funksiyalar grafiklarini hosil qiling	
7-variant	**8-variant**
1) $A=\begin{pmatrix} 31 & 13 & 10 \\ -7 & -9 & 15 \\ -12 & 22 & 20 \end{pmatrix}$, $B=\begin{pmatrix} 11 & 10 & 20 \\ 8 & 19 & 5 \\ -12 & 2 & 20 \end{pmatrix}$ $B^T+A, A-B^T, B^T-A, B^{-1}$ larni hisoblang. 2) $y=5tgx+\sin^2 x$, $z=\frac{tgx}{x^2}+\frac{3y}{2}$ funksiyalar grafiklarini hosil qiling	1) $A=\begin{pmatrix} 3 & -23 & 10 \\ 17 & -9 & 16 \\ -12 & 22 & 25 \end{pmatrix}$, $B=\begin{pmatrix} 14 & 10 & 20 \\ 8 & 89 & 54 \\ 12 & -2 & 20 \end{pmatrix}$ $A-B^T, B^T-A, B^{-1}, B^T+A$ larni hisoblang 2) $y=\frac{x^3+5tgx}{x}$, $z=\frac{7\cos x}{3x}+\frac{3y}{2}$ funksiyalar grafiklarini hosil qiling
9-variant	**10-variant**
1) $A=\begin{pmatrix} 3 & -2 & 10 \\ -7 & -9 & 16 \\ -12 & 2 & 5 \end{pmatrix}$, $B=\begin{pmatrix} 74 & 10 & 29 \\ 8 & 7 & 54 \\ 12 & -2 & 20 \end{pmatrix}$ $A-B^T, B^T-A, B^{-1}, B^T+A$ larni hisoblang. 2) $y=\frac{5tgx+4}{x^3}$, $z=\frac{\cos 5x}{3x}+y^3$ funksiyalar grafiklarini hosil qiling	1) $A=\begin{pmatrix} 31 & 13 & 10 \\ -7 & -9 & 15 \\ -12 & 22 & 20 \end{pmatrix}$, $B=\begin{pmatrix} 11 & 10 & 20 \\ 8 & 19 & 5 \\ -12 & 2 & 20 \end{pmatrix}$ $B^T+A, A-B^T, B^T-A, B^{-1}$ larni hisoblang. 2) $y=5tgx+\sin^2 x$, $z=\frac{tgx}{x^2}+\frac{3y}{2}$ funksiyalar grafiklarini hosil qiling
11-variant	**12-variant**
1) $A=\begin{pmatrix} 4 & -13 & 10 \\ 7 & -9 & 15 \\ -12 & 24 & 20 \end{pmatrix}$, $B=\begin{pmatrix} -13 & 22 & 20 \\ 18 & 19 & 5 \\ -12 & 42 & 20 \end{pmatrix}$ $B^T+A, B^T-A, B^{-1}, A-B^T$ larni hisoblang. 2) $y=5x+\sin^4 x$, $z=\frac{arctgx}{x^2}+\frac{y}{5}$ funksiyalar grafiklarini hosil qiling qiling	1) $A=\begin{pmatrix} -3 & 13 & 10 \\ 7 & -9 & 35 \\ -12 & 42 & 20 \end{pmatrix}$, $B=\begin{pmatrix} 51 & 10 & 20 \\ 28 & -9 & 5 \\ -12 & 2 & 24 \end{pmatrix}$ $B^T+A, A-B^T, B^T-A, B^{-1}$ larni hisoblang. 2) $y=tg^3x+\sin x$, $z=\frac{5}{x^2}+\frac{y}{2}$ funksiyalar grafiklarini hosil qiling
13-variant	**14-variant**
1) $A=\begin{pmatrix} 7 & 13 & -10 \\ -71 & -9 & 15 \\ -12 & 29 & 20 \end{pmatrix}$, $B=\begin{pmatrix} 3 & 10 & 20 \\ 28 & 19 & -3 \\ -12 & 2 & 20 \end{pmatrix}$ $B^T+A, A-B^T, B^T-A, B^{-1}$ ifodalarni hisoblang. 2) $y=x^3+\sin^2 x$, $z=x^4+\frac{3y}{2}$ funksiyalar grafiklarini hosil qiling	1) $A=\begin{pmatrix} 27 & -3 & 1 \\ 3 & 9 & 15 \\ 12 & 22 & 20 \end{pmatrix}$, $B=\begin{pmatrix} 12 & 13 & 22 \\ -8 & 19 & 5 \\ -12 & 2 & -2 \end{pmatrix}$ $B^T+A, A-B^T, B^T-A, B^{-1}$ ifodalarni hisoblang. 2) $y=\cos x+\sin x$, $z=x\sin x+\frac{3y}{2}$ funksiyalar grafiklarini hosil qiling
15-variant	**16-variant**
1) $A=\begin{pmatrix} 3 & 13 & 10 \\ 7 & -9 & 5 \\ 2 & 32 & 2 \end{pmatrix}$, $B=\begin{pmatrix} 71 & 17 & 20 \\ 8 & 9 & 5 \\ -12 & -2 & 20 \end{pmatrix}$, B^T+A, $A-B^T, B^T-A, B^{-1}$ ifodalarni hisoblang.	1) $A=\begin{pmatrix} 31 & 13 & 10 \\ -7 & -9 & 15 \\ -12 & 22 & 20 \end{pmatrix}$, $B=\begin{pmatrix} 11 & 10 & 20 \\ 8 & 19 & 5 \\ -12 & 2 & 20 \end{pmatrix}$ $B^T+A, A-B^T, B^T-A, B^{-1}$ larni hisoblang.

2) $y = x^3 + \sin x$, $z = x^2 + y^3$ funksiyalar grafiklarini hosil qiling	2) $y = 5tgx + \sin^2 x$, $z = \frac{tgx}{x^2} + \frac{3y}{2}$ funksiyalar grafiklarini hosil qiling
17-variant	**18-variant**
1) $A = \begin{pmatrix} -5 & 19 & 16 \\ -2 & -17 & 5 \\ -8 & 5 & 14 \end{pmatrix}$, $B = \begin{pmatrix} 13 & -7 & -6 \\ 22 & 7 & 4 \\ -14 & 8 & 14 \end{pmatrix}$ $A^T + B$, A / B^{-1}, $A^T + B$ ifodalarni hisoblang 2) $y = 3x^3 + 5tgx^2$, $z = \cos x + y^3$ funksiyalar grafiklarini hosil qiling	1) $A = \begin{pmatrix} 21 & 15 & 0 \\ -28 & -9 & 5 \\ -12 & 2 & 20 \end{pmatrix}$, $B = \begin{pmatrix} -21 & -4 & -15 \\ 41 & 15 & 5 \\ -8 & 3 & 0 \end{pmatrix}$ $B^T - A$, A^{-1}, $A - B^T$, $B^T - A$ ifodalarni hisoblang 2) $y = \frac{5x^4}{3} - 2\cos x$, $z = \frac{x^2}{5} + 3\sqrt{y}$ funksiyalar grafiklarini hosil qiling
19-variant	**20-variant**
1) $A = \begin{pmatrix} -5 & 19 & 16 \\ -2 & -17 & 5 \\ -8 & 5 & 14 \end{pmatrix}$, $B = \begin{pmatrix} 13 & -7 & -6 \\ 22 & 7 & 4 \\ -14 & 8 & 14 \end{pmatrix}$ $A^T + B$, A / B^{-1}, $A^T + B$ ifodalarni hisoblang 2) $y = 3x^3 + 5tgx^2$, $z = \cos x + y^3$ funksiyalar grafiklarini hosil qiling	1) $A = \begin{pmatrix} 21 & 15 & 0 \\ -28 & -9 & 5 \\ -12 & 2 & 20 \end{pmatrix}$, $B = \begin{pmatrix} -21 & -4 & -15 \\ 41 & 15 & 5 \\ -8 & 3 & 0 \end{pmatrix}$ $B^T - A$, A^{-1}, $A - B^T$, $B^T - A$ ifodalarni hisoblang 2) $y = \frac{5x^4}{3} - 2\cos x$, $z = \frac{x^2}{5} + 3\sqrt{y}$ funksiyalar grafiklarini hosil qiling

16-LABORATORIYA ISHI

Differensial tenglamalarni Eyler va Runge-Kutta usullari yordamida taqribiy yechish algoritmi va dasturi

Ishdan maqsad. Differensial tenglamalarni Eyler va Runge-Kutta usullari yordamida taqribiy yechish algoritmi va dasturini tuzishni o‘rganish.

Laboratoriya ishini bajarish tartibi

1. Nazariy qismdan differensial tenglamalarni Eyler va Runge-Kutta usullari yordamida taqribiy yechish algoritmi va dastur tuzish jarayoni bilan tanishib chiqing.
2. Variant bo‘yicha olgan masala bo‘yicha Eyler va Runge-Kutta formulasidan foydalanib algoritm va dastur tuzing.
3. C++ dasturlash muhitida tuzilgan dasturni kiriting va natija oling.
4. Ikkita usul yordamida olingan natijalarni taqqoslang.

5. Bajarilgan laboratoriya ishi hisobotini tayyorlang.

Nazariy qism

Eyler formulasi. Differensial tenglamalarni yechishning eng qulay usullaridan biri Eyler usuli hisoblanadi. Birinchi tartibli differensial tenglama

$$y' = \varphi(x, y) \tag{1}$$

va uning boshlang‘ich sharti

$$y(x_0) = y_0 \tag{2}$$

berilgan bo‘lsin. Bu yerda x o‘zgaruvchi $[a,b]$ oraliqda o‘zgarsin.

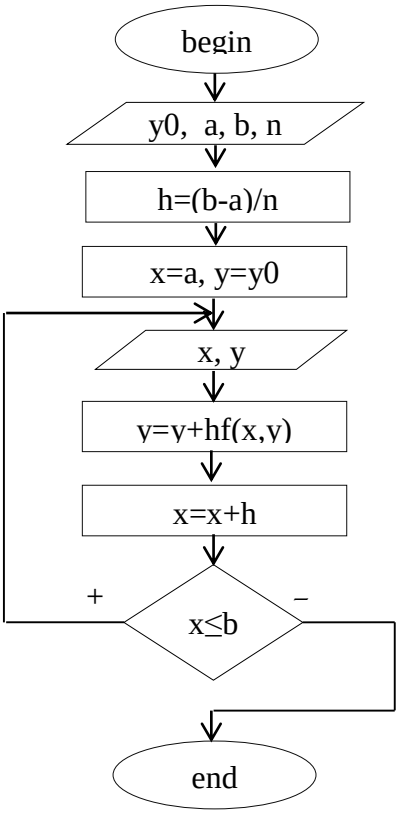
Bu kabi Koshi masalalarini taqribiy yechish uchun quyidagi ko‘rinishidagi ***Eyler formulasi*** mavjud:

$$y_i = y_{i-1} + f(x_{i-1}, y_{i-1})h, \quad i = \overline{1,n} \tag{3}$$

bunda $x_i = x_{i-1} + h, \ i = \overline{1,n-1}, \qquad h = \dfrac{b-a}{n}$

Misol. $y' = 0{,}5y - x2, \ y0 = 1{,}5, \ x \in [2,3], n = 10$ differensial tenglamani Eyler usuli yordamida taqribiy yechish algoritmi va dasturi tuzilsin.

Algoritmi.

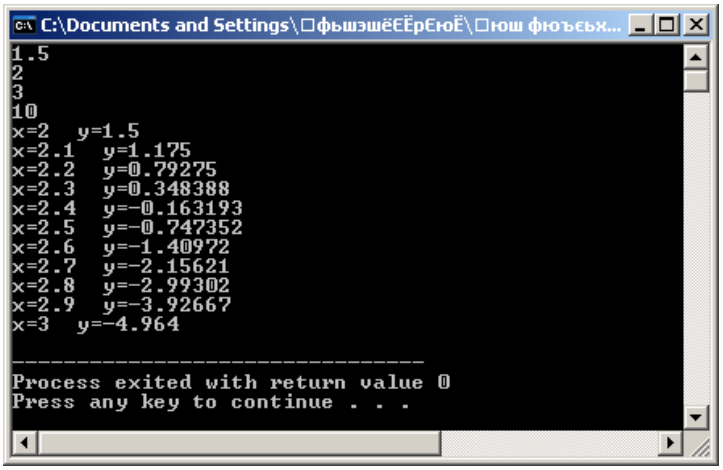


Dasturi. Dev-C++ dasturini ishga tushiramiz. Oynaga quyidagi dastur matnini kiritamiz:

```
#include <iostream>
#include <cmath>
using namespace std;
```

```
int main ()
{
float x,y,y0,a,b,h;  int n;
cin>>y0>>a>>b>>n;
h=(b-a)/n;
x=a; y=y0;
do
{
        cout<<"x="<<x<<"  y="<<y<<endl;
        y=y+h*(0.5*y-pow(x,2));
        x=x+h;
} while (x<b);
return 0;
}
```

Dasturni ishlatib natija olamiz (10-rasm):



10-rasm. Differensial tenglamaning Eyler usulida natijasi

Runge-Kutta usuli formulasi. Differensial tenglamalarni Runge-Kutta usulida hisoblash formulalarida $y(x)$ funksiyani Teylor qatoriga yoyish va bu qator bir qismini hosila qatnashmaydigan qilib o‘zgartirish lozim bo‘ladi. Agar hisoblash formulalari Teylor qatorining $m-$tartibli hosilasini o‘zgartirish yo‘li bilan hosil qilingan bo‘lsa, bu $m-$tartibli usul deyiladi. Runge-Kutta usulida ixtiyoriy $i-$qadamdagi taqribiy hisoblash quyidagi formula orqali bajariladi

$$y_{i+1} = y_i + \Delta y_i. \qquad (4)$$

Bu yerda Δy_i ni tanlanishiga qarab Runge-Kutta usulini turli tartibdagi hisoblash yo‘llarini hosil qilish mumkin.

Masalan, to‘rtinchi tartibli hisoblash formulalari uchun Δy_i quyidagi ko‘rinishni oladi

$$\Delta y_i = \frac{1}{6}\left[k_1^{(i)} + 2\left(k_2^{(i)} + k_3^{(i)}\right) + k_4^{(i)}\right], \qquad (5)$$

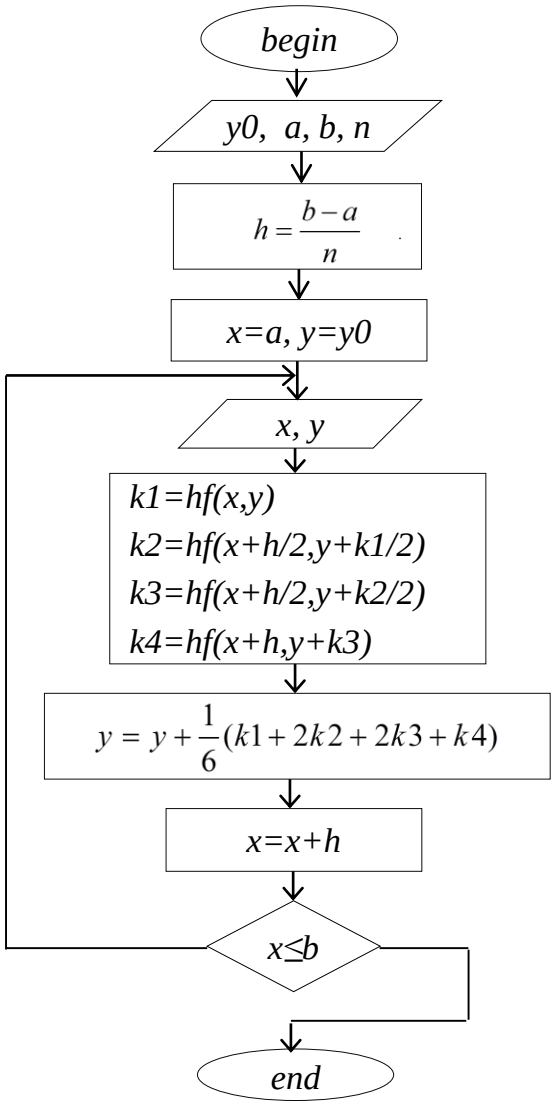
bu yerda $k_1^{(i)}, k_2^{(i)}, k_3^{(i)}, k_4^{(i)}$ lar quyidagicha hisoblanadi

$$\begin{cases} k_1^{(i)} = hf(x_i, y_i), \\ k_2^{(i)} = hf(x_i + \frac{h}{2}, y_i + \frac{k_1^{(i)}}{2}), \\ k_3^{(i)} = hf(x_i + \frac{h}{2}, y_i + \frac{k_2^{(i)}}{2}), \\ k_4^{(i)} = hf(x_i + h, y_i + k_3^{(i)}). \end{cases} \qquad (6)$$

(4)-(6) formulalar 4-tartibli ***Runge-Kutta formulasi*** deyiladi.

Мисол. Yuqoridagi $y' = 0{,}5y - x2$, $y0 = 1{,}5$, $x \in [2,3]$, $n = 10$ differensial tenglama Runge-Kutta usuli yordamida taqribiy yechilsin.

Algoritmi.



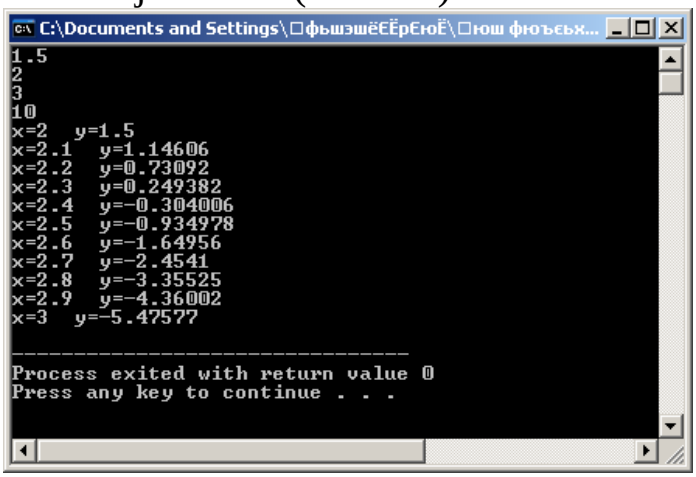
Dasturi.

Dastur tuzishda yuqoridagidek konsol ilovadan foydalanamiz. Dastur

matni quyidagicha bo‘ladi:

```
#include <iostream>
#include <cmath>
using namespace std;
float f(float t1,float t2)
{ return0.5*t2-pow(t1,2); }
int main ()
{
float x,y,y0,a,b,h,k1,k2,k3,k4;  int n;
cin>>y0>>a>>b>>n;
h=(b-a)/n;
x=a; y=y0;
do
{
   cout<<"x="<<x<<"  y="<<y<<endl;
   k1=h*f(x,y);    k2=h*f(x+h/2,y+k1/2);
   k3=h*f(x+h/2,y+k2/2);    k4=h*f(x+h,y+k3);
   y=y+(k1+2*k2+2*k3+k4)/6;
   x=x+h;
} while (x<b);
return 0;
}
```

Dasturni ishlatib natija olamiz (11-rasm):



11-rasm. Differensial tenglamaning Runge-Kutta usulida natijasi

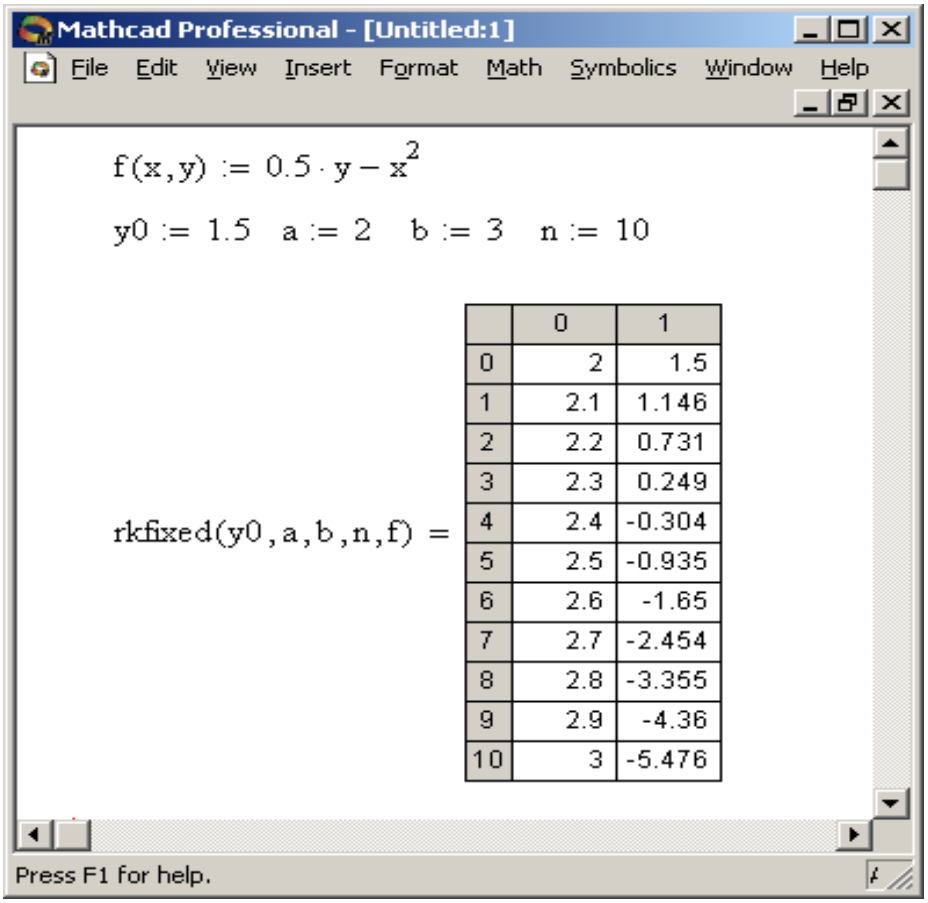
Differensial tenglamalarni Mathcad dasturida yechish

Differensial tenglamalarni Mathcad dasturida yechish uchun avvalo funksiya kiritiladi. Masalan, $y' = 0{,}5y - x2,\ y0 = 1{,}5,\ x \in [2,3],\ n = 10$

differensial tenglamani Mathcad dasturida yechish uchun quyidagi amallar ketma-ketligi bajariladi.

- Mathcad dasturi oynasiga differensial tenglama funksiyasi $f(x,y) := 0.5 \cdot y - x^2$ kabi kiritiladi va tasdiqlash uchun Enter tugmasi bosiladi.
- differensial tenglamaning $y0, a, b, n$ paramaetrlari qiymatlari ketma-ket kiritiladi.
- natijani chiqarish uchun $\text{rkfixed}(y0, a, b, n, f)$ protsedurasi yoziladi va tenglik belgisi bosiladi.

Natijada dastur oynasida differensial tenglamaning natijasi hosil bo‘ladi (12-rasm):



	0	1
0	2	1.5
1	2.1	1.146
2	2.2	0.731
3	2.3	0.249
4	2.4	-0.304
5	2.5	-0.935
6	2.6	-1.65
7	2.7	-2.454
8	2.8	-3.355
9	2.9	-4.36
10	3	-5.476

12-rasm. Differensial tenglamani *Mathcad* dasturida yechish

Natijalarni solishtirib, Runge-Kutta usuli va Mathcad dasturlarida olingan natijalarning Eyler usuliga nisbatan aniqroq ekanligini ko‘rish mumkin.

Variant topshiriqlari

Quyidagi differensial tenglamalarni Eyler va Runge-Kutta formulalari

yordamida yechish algoritmi va dasturini tuzing.

1) $y' = 1+0{,}2y\sin x - y^2$, $y_0=0$, $x \in [0;1]$, $n=10$

2) $y' = \cos(x+y)+0{,}5(x-y)$, $y_0=0$, $x \in [0{,}5;2]$, $n=18$

3) $y' = \frac{\cos x}{x+1} - 0{,}5y^2$, $y_0=0$, $x \in [1;1{,}7]$, $n=7$

4) $y' = (1-y^2)\cos x+0{,}6y$, $y_0=0$, $x \in [0;1]$, $n=9$

5) $y' = 1+0{,}4y\sin x - 1{,}5y^2$, $y_0=0$, $x \in [1;1{,}5]$, $n=15$

6) $y' = \frac{\cos y}{x+2} - 0{,}3y^2$, $y_0=0$, $x \in [0{,}5;1]$, $n=10$

7) $y' = \cos(1{,}5x+y)+(x-y)$, $y_0=0$, $x \in [0;1{,}5]$, $n=12$

8) $y' = 1-\sin(x+y)+\frac{0{,}5y}{x+2}$, $y_0=0$, $x \in [2;3]$, $n=8$

9) $y' = \frac{\cos y}{1{,}5+x} + 0{,}1y^2$, $y_0=0$, $x \in [0{,}2;1{,}2]$, $n=9$

10) $y' = 0{,}6\sin x - 1{,}25y^2 + 1$, $y_0=0$, $x \in [0{,}5;1{,}1]$, $n=10$

11) $y' = \cos(2x+y) + 1{,}5(x-y)$, $y_0=0$, $x \in [0;1]$, $n=15$

12) $y' = 1+\frac{0{,}1y}{x+2} - 0{,}1y^2$, $y_0=0$, $x \in [1{,}4;2{,}4]$, $n=12$

13) $y' = \frac{\cos y}{1{,}25+x} - 0{,}1y^2$, $y_0=0$, $x \in [1;1{,}6]$, $n=9$

14) $y' = 1+0{,}8y\sin x - 2y^2$, $y_0=0$, $x \in [0{,}3;1{,}3]$, $n=10$

15) $y' = 1=(0{,}8+y^2)\cos x+0{,}3y$, $y_0=0$, $x \in [0;1]$, $n=12$

16) $y' = \sin(x+2y)+5(x-y)$, $y_0=0$, $x \in [5;15]$, $n=10$

17) $y' = \frac{\cos^3 x}{x^2+1} - 5{,}5y^2$, $y_0=0$, $x \in [1;2]$, $n=12$

18) $y' = (x-y^3)tgx+2{,}6y$, $y_0=0$, $x \in [10;12]$, $n=20$

19) $y' = xy+4{,}5y^3\sin x - 1{,}5y^2$, $y_0=0$, $x \in [1;2{,}5]$, $n=15$

20) $y' = \frac{\cos y^3}{x^3+2y} - 0{,}3y^2$, $y_0=0$, $x \in [0{,}5;1]$, $n=10$

17-LABORATORIYA ISHI

Aniq integrallarni to‘g‘ri to‘rtburchaklar usuli yordamida taqribiy hisoblash algoritmi va dasturi

Ishdan maqsad. Aniq integrallarni to‘g‘ri to‘rtburchaklar usuli yordamida taqribiy hisoblash algoritmi va dasturini tuzishni o‘rganish.

Laboratoriya ishini bajarish tartibi

1. Nazariy qismdan aniq integrallarni taqribiy hisoblashning to‘g‘ri to‘rtburchaklar usuli, formulasi, algoritmi va dasturi bilan tanishib chiqing.
2. Variant topshirig‘i bo‘yicha to‘g‘ri to‘rtburchaklar formulasidan foydalanib algoritm va dastur tuzing.
3. C++ dasturlash muhitida tuzilgan dasturni kiriting va natija oling.
4. Delphi dasturlash muhitida tuzilgan dasturni kiriting va natija oling.
5. Bajarilgan laboratoriya ishi hisobotini tayyorlang.

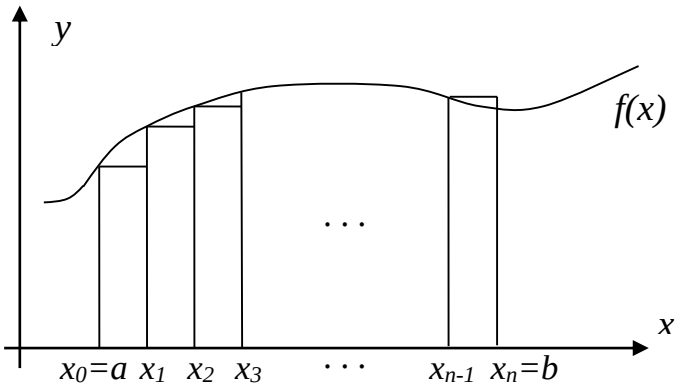
Nazariy qism

Amaliy va nazariy masalalarning ko‘pchiligi biror [a;b] oraliqda uzluksiz bo‘lgan $f(x)$ funksiyadan olingan $\int_a^b f(x)dx$ aniq integralni hisoblashga keltiriladi, ammo integral hisobning asosiy formulasini

$$\int_a^b f(x)dx = F(b) - F(a), \quad bunda \;\; F'(x) = f(x)$$

amaliyotda ko‘pincha qo‘llab bo‘lmaydi, chunki boshlang‘ich funksiya $F(x)$ ni elementar usullar yordamida toppish mumkin emas, yoki topilsa ham murakkab ko‘rinishda bo‘lgani uchun aniq integralni hisoblash qiyin bo‘ladi. Bunday hollarda aniq integralni taqribiy hisoblashga to‘g‘ri keladi. Integrallarni taqribiy hisoblashning bir necha usullari mavjud.

To‘g‘ri to‘rtburchaklar formulasi. Faraz qilaylik, bizga $f(x)$ funksiyaning grafigi 13-rasmda keltirilgan ko‘rinishda berilsin.



13-rasm. Sohani to‘g‘ri to‘rtburchaklar ko‘rinishida tasvirlash

[*a*,*b*] kesmani teng qadamlar bilan *n* ta teng bo‘lakka bo‘lamiz va bo‘limish nuqtalarini $x_k = a + kh$ bilan belgilaymiz. Bu yerda $h = (b-a)/n$, $k = 0, 1, \ldots, n$. y_k bilan $f(x)$ funksiyaning x_k nuqtadagi qiymatini belgilaymiz, ya’ni $y_k = f(x_k)$. U holda $f(x)$ funksiyaning [*a*,*b*] kesmadagi aniq integrali hosil qilingan to‘g‘ri to‘rtburchaklarning yig‘indisiga taqriban teng bo‘ladi:

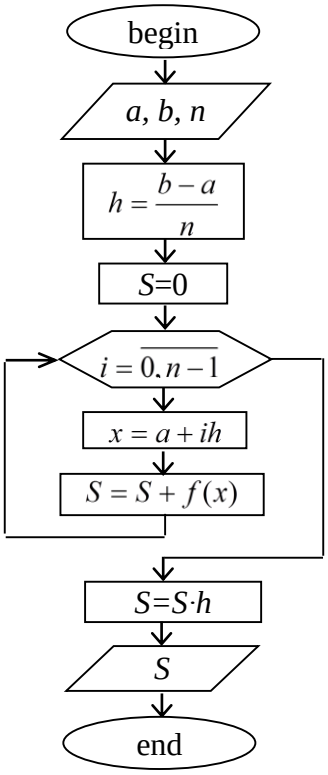
$$\int_a^b f(x)dx \cong h\sum_{k=0}^{n-1} f(x_k) \qquad (1)$$

Hosil qilingan kvadratur formulaga *chap to‘g‘ri to‘rtburchaklar formulasi* deyiladi. Xuddi shu usul bilan *o‘ng to‘g‘ri to‘rtburchaklar formulasi* ham hosil qilinadi:

$$\int_a^b f(x)dx \cong h\sum_{k=1}^{n} f(x_k) \qquad (2)$$

Misol. $\int_{0,25}^{0,75} \frac{dx}{\sqrt{|\cos x - x^2|}}$ aniq integralni to‘g‘ri to‘rtburchaklar formulasi yordamida taqribiy hisoblash algoritmi va dasturi tuzilsin.

Algoritmi.



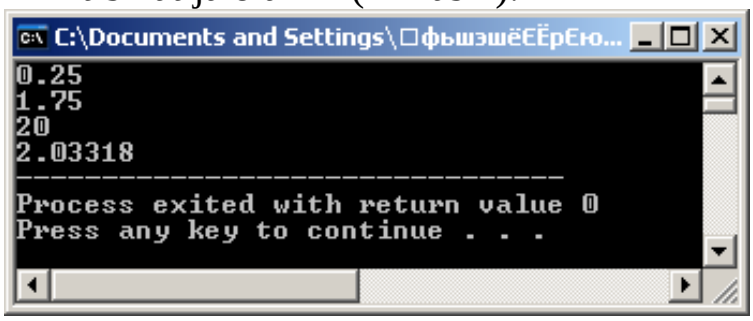
Dasturi.

Dev-C++ dasturini ishga tushiramiz. Oynaga quyidagi dastur matnini kiritamiz:

```
#include <iostream>
#include <cmath>
using namespace std;
int main ()
{
float S,a,b,h,x;  int n,i;
cin>>a>>b>>n;
h=(b-a)/n;
S=0;
for (i=0;i<n;i++)
{
x=a+i*h;
S=S+1/sqrt(abs(cos(x)-x*x)));
}
S=S*h;
cout<<S;
return 0;
}
```

Dasturni kiritib bo‘lgandan so‘ng klaviaturadagi F9 tugmasi yordamida

kompilyatsiya qilamiz. F10 tugmasi yordamida hosil bo‘lgan oynada a,b,n larga qiymatlar kiritib natija olamiz (14-rasm):



14-rasm. Aniq integralni to‘g‘ri to‘rtburchaklar formulasida hisoblash

Variant topshiriqlari

Quyidagi integrallar n=10 da taqribiy hisoblansin

№	Интеграл	Жавоби	№	Интеграл	Жавоби
1	$\int_0^{\sqrt{3}} x^3\sqrt{1+x^2}\,dx.$	*1,78.*	11	$\int_0^{12\sqrt{3}} \frac{12x^5dx}{\sqrt{x^6+1}}.$	*2,60*
2	$\int_0^1 \frac{x^2dx}{x^2+1}.$	*0,21*	12	$\int_0^{\pi/2} \sin x\cos^2 x dx.$	*0,33*
3	$\int_0^{\pi/2} \frac{\cos x}{1+\cos x}dx.$	*0,57*	13	$\int_{3/4}^{4/3} \frac{dx}{x^2+1}$	*0,41*
4	$\int_0^{-3} \frac{dx}{\sqrt{25+3x}}.$	*-0,67*	14	$\int_0^2 \frac{x^3dx}{\sqrt{x^4+4}}.$	*1,24*
5	$\int_1^e \frac{1+\ln x}{x}dx.$	*1,50*	15	$\int_0^1 \frac{z^3}{z^8+1}dz.$	*0,20*
6	$\int_{\pi/4}^{\pi/2} \frac{dx}{1-\cos^2 x}.$	*0,50*	16	$\int_2^5 \frac{dx}{\sqrt{5+4x-x^2}}.$	*1,57*
7	$\int_0^1 x^3\sqrt{4+5x^4}\,dx.$	*0,63*	17	$\int_{-\pi}^{\pi} \sin^2\frac{x}{2}dx.$	*3,14*
8	$\int_1^2 \frac{e^{1/x}}{x^2}dx.$	*1,07*	18	$\int_0^{1/2} \frac{xdx}{\sqrt{1-x^2}}.$	*0.13*
9	$\int_0^1 3\left(x^2+x^2e^{x^3}\right)dx.$	*2,72*	19	$\int_{\pi^2/9}^{\pi^2} \frac{\cos\sqrt{x}}{\sqrt{x}}dx.$	*1,73*
10	$\int_1^{\sqrt{3}} \frac{x^2dx}{1+x^6}.$	*0,20*	20	$\int_1^e \frac{\sin\ln x}{x}dx.$	*0,46*

18-LABORATORIYA ISHI

Aniq integrallarni Simpson usuli yordamida taqribiy hisoblash algoritmi va dasturi

Ishdan maqsad. Aniq integrallarni Simpson usuli yordamida taqribiy hisoblash algoritmi va dasturini tuzishni o‘rganish.

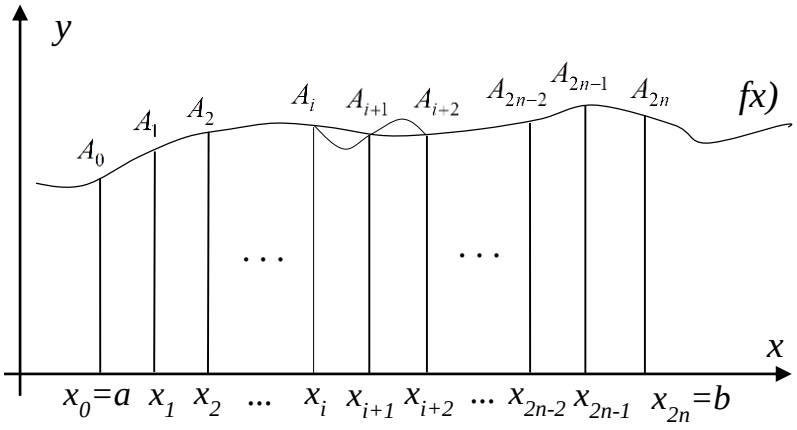
Laboratoriya ishini bajarish tartibi

1. Nazariy qismdan aniq integrallarni taqribiy hisoblashning Simpson usuli, formulasi, algoritmi va dasturi bilan tanishib chiqing.
2. Variant bo‘yicha olgan masala bo‘yicha Simpson formulasidan foydalanib algoritm va dastur tuzing.
3. C++ dasturlash muhitida tuzilgan dasturni kiriting va natija oling.
4. Bajarilgan laboratoriya ishi hisobotini tayyorlang.

Nazariy qism

Simpson formulasi. Bu formulani hosil qilish uchun [*a*,*b*] kesmani *2n* ta teng bo‘laklarga ajratamiz, ya’ni $x_i = a + i\,h$, $h = \frac{b-a}{2n}$, $i = \overline{0,2n}$.

Shu x_i nuqtalardagi $f(x)$ funksiyaning qiymatlarini $y_i = f(x_i)$ bilan belgilaymiz. $f(x)$ funksiyaning grafigi 15-rasmda keltirilgan ko‘rinishda bo‘lsin.



15-rasm. Egri chiziq bo‘laklarini parabolalar bilan almashtirish

Ma’lumki, A_i nuqtaning koordinatalari x_i, y_i bo‘ladi. Shuningdek, A_i, A_{i+1}, A_{i+2} nuqtalardan yagona $y = ax^2 + bx + c$ parabola o‘tadi. Bu yerdagi

a,b,c noma'lumlarni x_i va y_i lar orqali topamiz. Parabolani $[x_i, x_{i+2}]$ kesmada integrallaymiz. Natijani berilgan $f(x)$ ning shu kesmadagi integrali sifatida qabul qilamiz. Ya'ni

$$\int_{x_i}^{x_{i+2}} f(x)dx \cong \frac{h}{3}\left[\left(f(x_i)+4f(x_{i+1})+f(x_{i+2})\right)\right] \qquad (1)$$

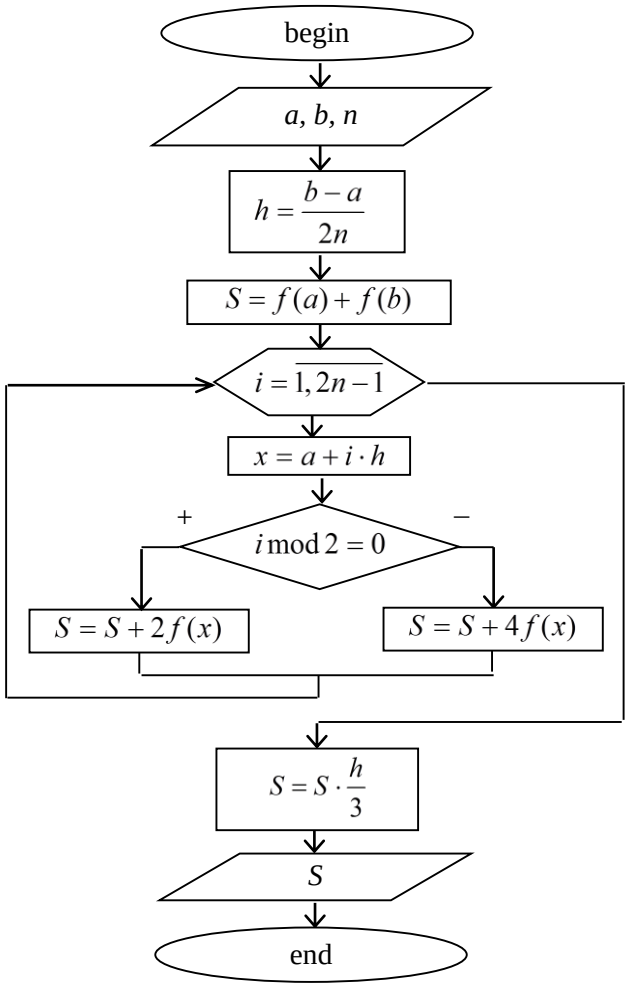
Topilgan formulada *i* ga 0, 2, 4,…,2n-2 qiymatlar berib, ularni qo‘shib chiqsak, quyidagi formula hosil bo‘ladi:

$$\int_a^b f(x)dx \cong \frac{h}{3}\left[f(a)+f(b)+4(f(x_1)+f(x_3)+\ldots+f(x_{2n-1}))+\right.$$
$$\left.+2(f(x_2)+f(x_4)+\ldots+f(x_{2n-2}))\right] \qquad (2)$$

Bu formula *Simpson kvadratur formulasi* deyiladi.

Misol. Yuqoridagi $\int_{0,25}^{0,75} \frac{dx}{\sqrt{|\cos x - x^2|}}$ aniq integralni *Simpson formulasi* yordamida taqribiy hisoblash algoritmi va dasturi tuzilsin.

Algoritmi.

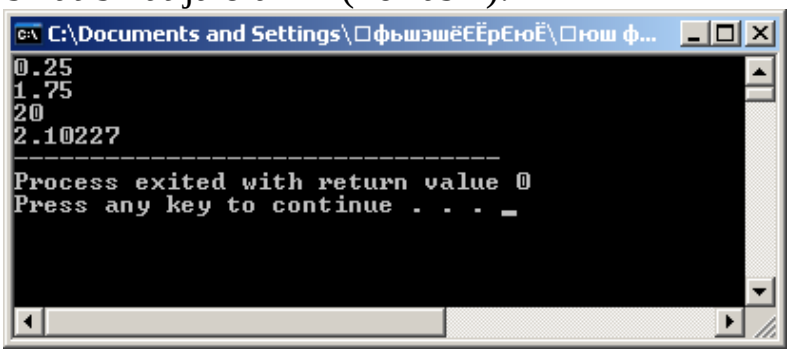


Dasturi.

Dastur tuzishda yuqoridagidek konsol ilovadan foydalanamiz. Dastur matni quyidagicha bo‘ladi:

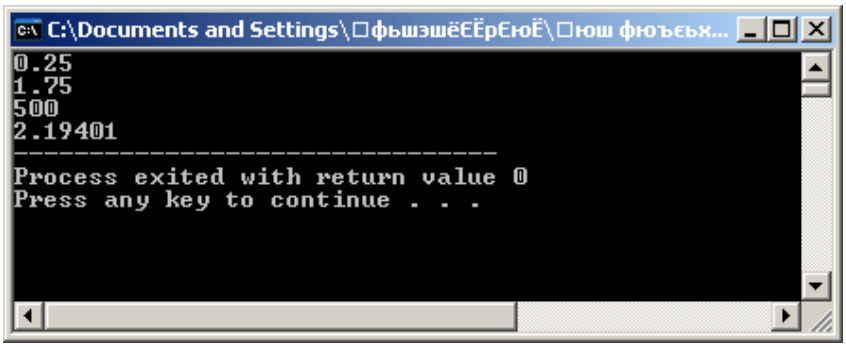
```
#include <iostream>
#include <cmath>
using namespace std;
float f(float t)
{  return  1/sqrt(abs(cos(t)-t*t));  }
int main ()
{
float S,a,b,h,x;  int n,i;
cin>>a>>b>>n;
h=(b-a)/(2*n);
S=f(a)+f(b);
for (i=1;i<2*n;i++)
{
    x=a+i*h;
    if (i%2==0) S=S+2*f(x); else S=S+4*f(x);
}
S=S*h/3;
cout<<S;
return 0;
}
```

Dasturni ishlatib natija olamiz (16-rasm):



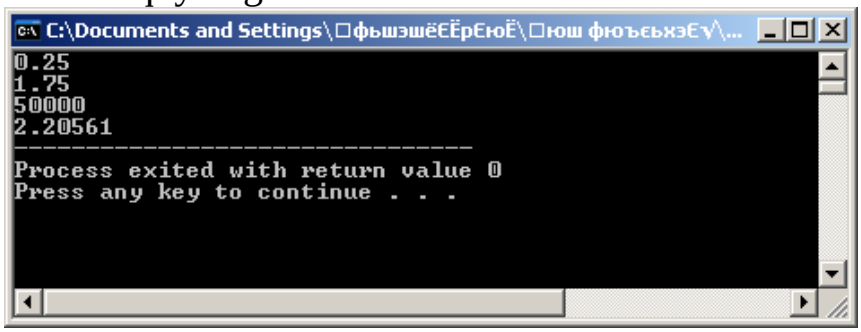
16-rasm. Aniq integralni Simpson formulasida hisoblash

Bu dasturlarda natijaning aniqligini oshirish uchun bo‘laklashlar sonini yetarli darajada oshirish lozim. Masalan, n=500 da natija quyidagicha bo‘ladi (17-rasm):



17-rasm. Aniq integralni Simpson formulasida hisoblash

Natija n=50000 da quyidagidek bo‘ladi:

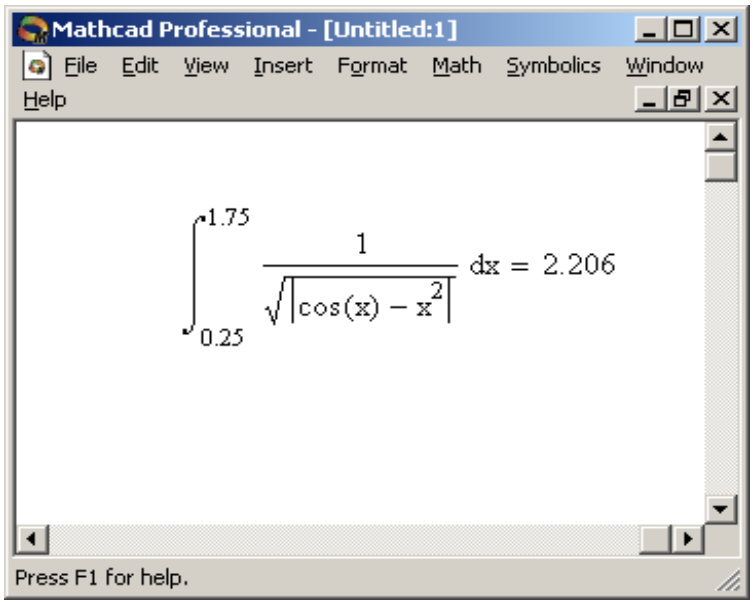


18-rasm. Aniq integralni Simpson formulasida hisoblash

Aniq integrallarni Mathcad dasturida hisoblash

Mathcad dasturida boshqa masalalar qatori aniq integralni hisoblashni ham ko‘rib o‘tgan edik. Bunda Mathcad dasturini ishga tushirib, **Вычисления (Calculus)** panelidan aniq integral belgisini tanlaymiz. Hosil bo‘lgan shablonga integralning quyi va yuqori chegaralari hamda integral osti funksiyasini kiritib, tenglik belgisi bosilsa, natija hosil bo‘ladi.

Misol. Yuqoridagi $\int_{0,25}^{0,75} \frac{dx}{\sqrt{|\cos x - x^2|}}$ aniq integralni Mathcad dasturida hisoblaymiz (19-rasm):



19-rasm. Aniq integralni Mathcad dasturida hisoblash

Mathcad dasturidagi natija eng optimal formula yordamida olingani shubhasiz. Shuning uchun Mathcad dasturida olingan natijani eng aniq deb olib, to‘g‘ri to‘rtburchaklar va Simpson formulalaridan foydalanib tuzilgan dastur naijalarini Mathcad dasturida olingan natijaga nisbatan solishtiramiz.

Demak, $\int_{0,25}^{0,75} \frac{dx}{\sqrt{|\cos x - x^2|}}$ aniq integralning Mathcad dasturida olingan natijasi taqriban 2,206 ga teng. Bu integralni to‘g‘ri to‘rtburchaklar formulasidan foydalanib tuzilgan dasturda n=20 da natija olsak, bu qiymat taqriban 2,033 ga teng. Mathcad dasturida olingan natijaga nisbatan xatolik 0,173 ga teng. Xuddi shu integralni Simpson formulasidan foydalanib tuzilgan dasturda n=20 da natija olinsa, bu qiymat taqriban 2,102 ga teng. Mathcad dasturida olingan natijaga nisbatan xatolik 0,103 ga teng.

Albatta, yuqori aniqlik talab qilingan hollarda bu xatoliklar katta hisoblanadi. Ammo tuzilgan dasturlarda bo‘laklashlar sonini oshirib, aniq yechimga istalgancha yaqinlashish mumkin. Masalan, Simpson formulasidan foydalanib tuzilgan dasturda n=50000 da natija olsak, bu qiymat taqriban 2,20561 ga teng ekanligini bundan oldingi mashg‘ulotda ko‘rdik. Bu natija Mathcad dasturida olingan natijaga nisbatan solishtirganda kamida mingdan bir aniqdaligini ko‘rsatadi.

Variant topshiriqlari

Quyidagi integrallar n=10 da taqribiy hisoblansin

№	Интеграл	Жавоби	№	Интеграл	Жавоби
1	$\int_{1}^{\sqrt{e}} \frac{dx}{x\sqrt{1-\ln^2 x}}.$	*0,52*	11	$\int_{\pi/6}^{\pi/2} \cos\alpha \sin^3 \alpha d\alpha.$	*0,23*

2	$\int_0^{\sqrt{\pi}/4} \frac{xdx}{\cos^2(x^2)}.$	*0,50*	12	$\int_2^3 y\ln(y-1)dy.$	*1,02*
3	$\int_{-2}^{0} x^2 e^{-x/2}dx.$	*5,76*	13	$\int_0^{\pi/2} x\cos xdx.$	*0,57*
4	$\int_0^{\pi} x^2\sin xdx.$	*5,86*	14	$\int_{-1/2}^{1/2} \arccos 2xdx.$	*3,14*
5	$\int_1^2 (y-1)\ln ydy.$	*0,25*	15	$\int_{-1/2}^{0} xe^{-2x}dx.$	*-0,25*
6	$\int_{-\pi}^{\pi} x\sin x\cos xdx.$	*1,57*	16	$\int_{-1/3}^{-2/3} \frac{x}{e^{3x}}dx.$	*0,82*
7	$\int_1^e \frac{\ln^2 x}{x^2}dx.$	*0,16*	17	$\int_1^{e^2} \sqrt{x}\ln xdx.$	*18,33*
8	$\int_0^1 arctg\sqrt{x}\,dx.$	*0,57*	18	$\int_0^{\pi} (x+2)\cos\frac{x}{2}dx.$	*6,28*
9	$\int_0^{\pi/8} x^2\sin 4xdx.$	*0,17*	19	$\int_1^2 y^2\ln ydy.$	*1,07*
10	$\int_1^2 \frac{\ln(x+1)}{(x+1)^2}dx.$	*0,15*	20	$\int_{3/2}^{2} arctg(2x-3)dx.$	*0,21*

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AXBOROT TEXNOLOGIYALARI VA JARAYONLARNI MATEMATIK MODELLASHTIRISH

(2-qism)

Uslubiy qo‘llanma

Muharrir: S.A.Mullamuxamedov
Texnik muharrir va sahifalovchi: M.X.Tashbaeva

Nashrga ruxsat etildi 16.01.2019 y.
Qog‘oz bichimi 60×84/16. Hajmi 2 b.t.
Adadi 30 nusxa. Buyurtma № 6-2/2018
ToshTYMI bosmaxonasida chop etildi
Toshkent sh., Odilxo‘jayev ko‘chasi,1

Toshkent temir yo‘l muhandislari instituti, 2019y.