МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РФ

ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ПРОФЕССИОНАЛЬНОГО ОБРАЗОВАНИЯ

МОСКОВСКИЙ АВИАЦИОННЫЙ ИНСТИТУТ

(национальный исследовательский университет)

«МАИ»

Кафедра 806

Отчет по расчетно-графической работе

По дисциплине «Численные методы»

Вариант 10

Задание 4

Выполнил студент группы 30-210Б:

Кофман М.С.

Принял:

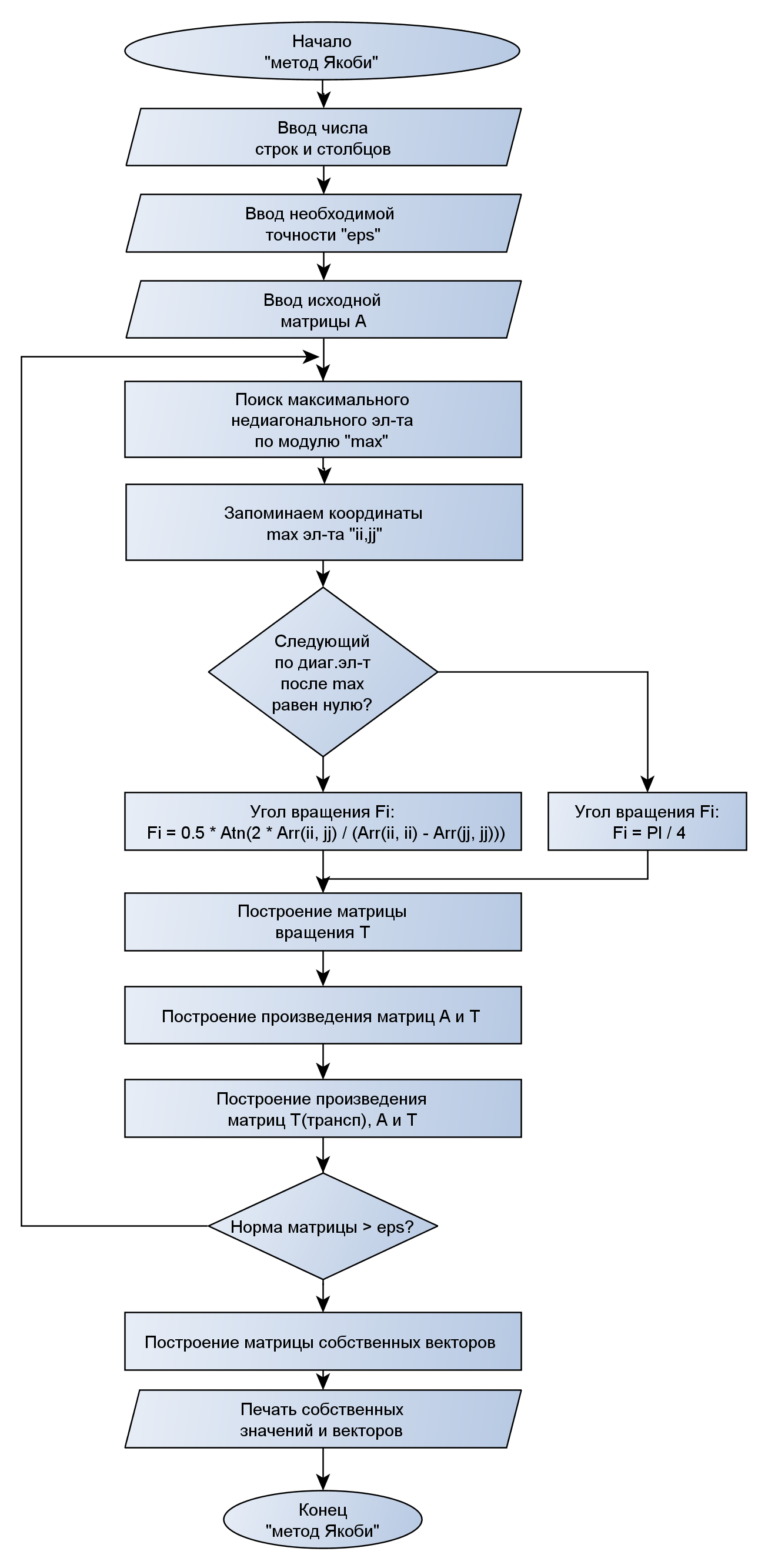
Кринецкий Олег Евгеньевич

Москва, 2015

**Задание.**

1) Методом вращения (Якоби) с точностью Е = 0,01 вычислить собственные значения и собственные вектора симметрической матрицы А.

**Структурная схема метода вращения (Якоби):**



**Текст программы для метода вращения на языке Visual Basic 6.0:**

Dim Arr() As Double, tmp As Double, ttmp As Double

Dim snum As Integer, eps As Double

Dim T() As Double, Temp() As Double, U() As Double

Const PI As Double = 3.14159265358979

Private Sub Command1\_Click()

snum = Val(Text1.Text)

eps = Val(Text3.Text)

ReDim Arr(snum, snum)

ReDim T(snum, snum, 0)

ReDim Temp(snum, snum)

ReDim U(snum, snum)

Frame2.Visible = True

End Sub

Private Sub Command2\_Click()

Dim sFile As String, sWhole As String, outstr As String

Dim v As Variant

sFile = ".\InputA.txt"

Open sFile For Input As #1

sWhole = Input$(LOF(1), 1)

Close #1

v = Split(sWhole, vbNewLine & " ")

outstr = ""

For Each Item In v

outstr = outstr & Item

Next

Text4.Text = outstr

End Sub

Private Sub Command4\_Click()

Dim sFile As String, sWhole As String, outstr As String

Dim v As Variant

sFile = ".\InputB.txt"

Open sFile For Input As #1

sWhole = Input$(LOF(1), 1)

Close #1

v = Split(sWhole, vbNewLine & " ")

outstr = ""

For Each Item In v

outstr = outstr & Item

Next

Text5.Text = outstr

End Sub

Private Sub Command3\_Click()

Dim sFile As String, sWhole As String, oustr As String, outd As Double

Dim v() As String, str As String

Dim s As String, i As Integer, j As Integer, k As Integer, r As Integer

Dim ii As Integer, jj As Integer

Dim max As Double, Fi As Double

sFile = ".\Output.txt"

Open sFile For Output As #1

Print #1, Text4.Text

Close #1

sFile = ".\Output.txt"

Open sFile For Input As #1

sWhole = Input$(LOF(1), 1)

Close #1

v = Split(sWhole, vbNewLine & " ")

outstr = ""

For Each Item In v

outstr = outstr & Item

Next

outstr = outstr & "\n"

k = 0

Do While (True)

i = 1

l = 0

s = vbNullString

c:

j = i

Do While (True)

s = Mid(outstr, j, 1)

If StrComp(s, " ") = 0 Then GoTo A 'ïåðåõîä ñ j=íîìåð êðàéíåé öèôðû+1

If StrComp(s, vbLf) = 0 Then GoTo b 'ïåðåõîä j=ïîçèöèÿ ïåðåõîäà íà ñëåä.ñòðîêó

If StrComp(s, vbNullString) = 0 Then GoTo D

j = j + 1

Loop

A:

Arr(k, l) = Val(Mid(outstr, i, j - i))

l = l + 1

i = j + 1

GoTo c

b:

Arr(k, l) = Val(Mid(outstr, i, j - 1 - i))

l = 0

k = k + 1

i = j + 1

GoTo c

Loop

D:

'äîïîñòðîåíèå ìàòðèöû è îïðåäåëåíèå êîîðäèíàò ìàêñèìàëüíîãî ýëåìåíòà:

For i = 0 To snum - 1

For j = 0 To snum - 1

If j > i Then

Arr(i, j) = Arr(j, i)

End If

Next

Next

'Ìåòîä âðàùåíèÿ:

k = 0

tmp = 0

Do

max = Arr(0, 1)

ii = 0

jj = 1

For i = 0 To snum - 1

For j = 0 To snum - 1

If j > i And Abs(Arr(i, j)) > max Then

max = Arr(i, j)

ii = i

jj = j

End If

Next

Next

'âû÷èñëåíèå Fi:

If Abs(Arr(ii, ii) - Arr(jj, jj)) <= 10 ^ (-eps) Then

Fi = PI / 2

Else

Fi = 0.5 \* Atn(2 \* Arr(ii, jj) / (Arr(ii, ii) - Arr(jj, jj)))

End If

str = str & "Fi(" & k & ")=" & Round(Fi, eps) & vbCrLf & vbCrLf

'çàïîëíåíèå ìàòðèöû T:

ReDim Preserve T(snum, snum, k + 1)

For i = 0 To snum - 1

For j = 0 To snum - 1

If i = j Then T(i, j, k) = 1

Next

Next

T(ii, ii, k) = Cos(Fi)

T(ii, jj, k) = -Sin(Fi)

T(jj, ii, k) = Sin(Fi)

T(jj, jj, k) = Cos(Fi)

str = str & "T(" & k & "):" & vbCrLf

For i = 0 To snum - 1

For j = 0 To snum - 1

str = str & Round(T(i, j, k), eps) & vbTab

Next

str = str & vbCrLf

Next

str = str & vbCrLf & "A\*T:" & vbCrLf

'Óìíîæåíèå À\*Ò:

For i = 0 To snum - 1

For j = 0 To snum - 1

Temp(i, j) = 0

Next

Next

For i = 0 To snum - 1

For j = 0 To snum - 1

For r = 0 To snum - 1

Temp(i, j) = Temp(i, j) + Arr(i, r) \* T(r, j, k)

Next

str = str & Round(Temp(i, j), eps) & vbTab

Next

str = str & vbCrLf

Next

'Óìíîæåíèå transp.T\*(A\*T):

str = str & vbCrLf & "A(" & k + 1 & ")=transp.T\*A\*T:" & vbCrLf

For i = 0 To snum - 1

For j = 0 To snum - 1

Arr(i, j) = 0

Next

Next

For i = 0 To snum - 1

For j = 0 To snum - 1

For r = 0 To snum - 1

Arr(i, j) = Arr(i, j) + T(r, i, k) \* Temp(r, j)

Next

str = str & Round(Arr(i, j), eps) & vbTab

Next

str = str & vbCrLf

Next

'ïðîâåðêà ïîãðåøíîñòè:

k = k + 1

tmp = 0

ttmp = 0

For i = 0 To snum - 1

For j = i + 1 To snum - 1

tmp = tmp + Arr(i, j) ^ 2

ttmp = ttmp + T(i, j, k - 1) ^ 2

Next

Next

tmp = Sqr(tmp)

ttmp = Sqr(ttmp)

str = str & vbCrLf

Loop Until tmp <= (10 ^ (-eps)) Or ttmp <= 10 ^ (-eps)

'íàõîæäåíèå ìàòðèöû ñîáñòâåííûõ âåêòîðîâ:

For i = 0 To snum - 1

For j = 0 To snum - 1

U(i, j) = T(i, j, 0)

Next

Next

For l = 0 To k - 2

For i = 0 To snum - 1

For j = 0 To snum - 1

Temp(i, j) = 0

Next

Next

For i = 0 To snum - 1

For j = 0 To snum - 1

For r = 0 To snum - 1

Temp(i, j) = Temp(i, j) + U(i, r) \* T(r, j, l + 1)

Next

Next

Next

For i = 0 To snum - 1

For j = 0 To snum - 1

U(i, j) = Temp(i, j)

Next

Next

Next

'Ïå÷àòü ñîáñòâåííûõ çíà÷åíèé è ñîîòâ. èì ñîáñòâ. âåêòîðîâ:

For k = 0 To snum - 1

str = str & "Lambda(" & k + 1 & ")=" & Round(Arr(k, k), eps) & vbCrLf

For i = 0 To snum - 1

str = str & Round(U(i, k), eps) & vbTab

Next

str = str & vbCrLf & vbCrLf

Next

Text6.Text = str

Frame4.Visible = True

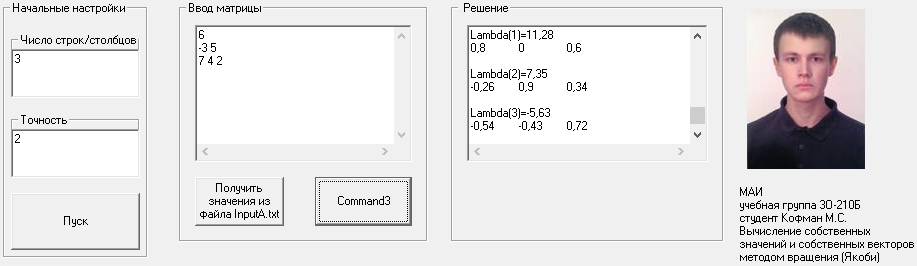
sFile = ".\Output.txt"

Open sFile For Output As #1

Print #1, Text6.Text

Close #1

End Sub

**Скриншот программы для метода вращения (Якоби):**

**Лог решения:**

Fi(0)=0,65

T(0):

0,8 0 -0,6

0 1 0

0,6 0 0,8

A\*T:

9,01 -3 1,98

0,01 5 5

6,79 4 -2,62

A(1)=transp.T\*A\*T:

11,28 0,01 0

0,01 5 5

0 5 -3,28

Fi(1)=0,44

T(1):

1 0 0

0 0,9 -0,43

0 0,43 0,9

A\*T:

11,28 0,01 -0,01

0,01 6,65 2,4

0 3,13 -5,1

A(2)=transp.T\*A\*T:

11,28 0,01 -0,01

0,01 7,35 0

-0,01 0 -5,63

Fi(2)=0

T(2):

1 0 0

0 1 0

0 0 1

A\*T:

11,28 -0,02 -0,01

0,04 7,35 0

-0,01 0 -5,63

A(3)=transp.T\*A\*T:

11,28 0 -0,01

0 7,35 0

-0,01 0 -5,63

# Литература:

1. Пирумов У. Г. Численные методы, Москва, издательство МАИ 1998г.
2. 4us Самоучитель Visual Basic 6.0, http://vbzero.narod.ru (18.04.2015)