Лабораторная №4

Вариант №3

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Метод градиентного спуска

Рабочий пример

График функции

In [ ]:

```
from lab4 import gradMethods
from numpy import exp
x0 = -1
y0 = 1
e = 0.0001
def f(x,y):
    return x**2+y**2-x+6+exp(x)
def fx(x):
    return 2*x-1+exp(x)
def fy(y):
    return 2*y
grad = gradMethods(x0,y0,e,f,fx,fy)
try:
    gradAnswer = grad.gradDescent()
    gradAnswer.print_result()
except OverflowError as e:
    print("Too many iterations. Try another starting point: this variant went to infinity.")
```

```
 k  |   xk     |   yk     |f'_x(xk)  |f'_y(yk)  |  xk+1    |  yk+1    |f(x(k+1)) | |gradf|  |
-------------------------------------------------------------------------------------
 1  | -1.0000  | 1.0000   | -2.6321  | 2.0000   | -0.3420  | 0.5000   | 7.4193   | 1.3956   |
 2  | -0.3420  | 0.5000   | -0.9736  | 1.0000   | -0.0986  | 0.2500   | 7.0769   | 0.5785   |
 3  | -0.0986  | 0.2500   | -0.2910  | 0.5000   | -0.0258  | 0.1250   | 7.0166   | 0.2616   |
 4  | -0.0258  | 0.1250   | -0.0771  | 0.2500   | -0.0065  | 0.0625   | 7.0040   | 0.1265   |
 5  | -0.0065  | 0.0625   | -0.0196  | 0.1250   | -0.0016  | 0.0312   | 7.0010   | 0.0627   |
 6  | -0.0016  | 0.0312   | -0.0049  | 0.0625   | -0.0004  | 0.0156   | 7.0002   | 0.0313   |
 7  | -0.0004  | 0.0156   | -0.0012  | 0.0312   | -0.0001  | 0.0078   | 7.0001   | 0.0156   |
 8  | -0.0001  | 0.0078   | -0.0003  | 0.0156   | -0.0000  | 0.0039   | 7.0000   | 0.0078   |
 9  | -0.0000  | 0.0039   | -0.0001  | 0.0078   | -0.0000  | 0.0020   | 7.0000   | 0.0039   |
10  | -0.0000  | 0.0020   | -0.0000  | 0.0039   | -0.0000  | 0.0010   | 7.0000   | 0.0020   |
11  | -0.0000  | 0.0010   | -0.0000  | 0.0020   | -0.0000  | 0.0005   | 7.0000   | 0.0010   |
12  | -0.0000  | 0.0005   | -0.0000  | 0.0010   | -0.0000  | 0.0002   | 7.0000   | 0.0005   |
13  | -0.0000  | 0.0002   | -0.0000  | 0.0005   | -0.0000  | 0.0001   | 7.0000   | 0.0002   |
14  | -0.0000  | 0.0001   | -0.0000  | 0.0002   | -0.0000  | 0.0001   | 7.0000   | 0.0001   |
15  | -0.0000  | 0.0001   | -0.0000  | 0.0001   | -0.0000  | 0.0000   | 7.0000   | 0.0001   |
```

Нерабочий пример (по варианту)

In [ ]:

```
x01 = 0
y01 = 3 #works only on y0 = 3
e1 = 0.0001
def f1(x,y):
    return x**2-y**2-4*x+6*y
def fx1(x):
    return 2*x-4
def fy1(y):
    return -2*y+6
grad1 = gradMethods(x01,y01,e1,f1,fx1,fy1)
try:
    gradAnswer1 = grad1.gradDescent()
    gradAnswer1.print_result()
except OverflowError as e:
    print("Too many iterations. Try another starting point: this variant went to infinity.")
```

```
 k  |   xk     |   yk     |f'_x(xk)  |f'_y(yk)  |  xk+1    |  yk+1    |f(x(k+1)) | |gradf|  |
-------------------------------------------------------------------------------------
 1  | 0.0000   | 3.0000   | -4.0000  | 0.0000   | 1.0000   | 3.0000   | 6.0000   | 2.0000   |
 2  | 1.0000   | 3.0000   | -2.0000  | 0.0000   | 1.5000   | 3.0000   | 5.2500   | 1.0000   |
 3  | 1.5000   | 3.0000   | -1.0000  | 0.0000   | 1.7500   | 3.0000   | 5.0625   | 0.5000   |
 4  | 1.7500   | 3.0000   | -0.5000  | 0.0000   | 1.8750   | 3.0000   | 5.0156   | 0.2500   |
 5  | 1.8750   | 3.0000   | -0.2500  | 0.0000   | 1.9375   | 3.0000   | 5.0039   | 0.1250   |
 6  | 1.9375   | 3.0000   | -0.1250  | 0.0000   | 1.9688   | 3.0000   | 5.0010   | 0.0625   |
 7  | 1.9688   | 3.0000   | -0.0625  | 0.0000   | 1.9844   | 3.0000   | 5.0002   | 0.0312   |
 8  | 1.9844   | 3.0000   | -0.0312  | 0.0000   | 1.9922   | 3.0000   | 5.0001   | 0.0156   |
 9  | 1.9922   | 3.0000   | -0.0156  | 0.0000   | 1.9961   | 3.0000   | 5.0000   | 0.0078   |
10  | 1.9961   | 3.0000   | -0.0078  | 0.0000   | 1.9980   | 3.0000   | 5.0000   | 0.0039   |
11  | 1.9980   | 3.0000   | -0.0039  | 0.0000   | 1.9990   | 3.0000   | 5.0000   | 0.0020   |
12  | 1.9990   | 3.0000   | -0.0020  | 0.0000   | 1.9995   | 3.0000   | 5.0000   | 0.0010   |
13  | 1.9995   | 3.0000   | -0.0010  | 0.0000   | 1.9998   | 3.0000   | 5.0000   | 0.0005   |
14  | 1.9998   | 3.0000   | -0.0005  | 0.0000   | 1.9999   | 3.0000   | 5.0000   | 0.0002   |
15  | 1.9999   | 3.0000   | -0.0002  | 0.0000   | 1.9999   | 3.0000   | 5.0000   | 0.0001   |
16  | 1.9999   | 3.0000   | -0.0001  | 0.0000   | 2.0000   | 3.0000   | 5.0000   | 0.0001   |
```

Метод наискорейшего спуска

Рабочий пример

In [ ]:

```
try:
    fasterGradAnswer = grad1.fastestDescent()
    fasterGradAnswer.print_result()
except OverflowError as e:
    print("Too many iterations. Try another starting point: this variant went to infinity.")
```

```
 k  |   xk     |   yk     |f'_x(xk)  |f'_y(yk)  |  xk+1    |  yk+1    |f(x(k+1)) |   h1       | |gradf|  |
-----------------------------------------------------------------------------------------------
 1  | 0.0000   | 3.0000   | -4.0000  | 0.0000   | 2.0000   | 3.0000   | 5.0000   | 0.5000   | 4.4721   |
 2  | 2.0000   | 3.0000   | 0.0000   | 0.0000   | 2.0000   | 3.0000   | 5.0000   | 0.0000   | 4.4721   |
```