|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| n=9 | 算法 | 最小值点 | 最小值 | 迭代次数 | 耗时 |
| 优化工具箱 | -0.0003  0.9982  0.0338  0.1767  0.2394  0.0939  -0.0886  -0.1018  0.2052 | 3.8398e-05 | 69 | 0.689880 |
| 负梯度法 | -0.001218532233  0.9992186115  0.01391715526  0.2436273856  0.1863773564  0.03822309303  -0.05301787528  -0.02230772273  0.1484876779 | 0.00006807927911 | 1945 | 3966.431930 |
| FR法 | -0.0002794621499  0.9985556126  0.02994519184  0.1878530144  0.2310840085  0.08795113662  -0.08411951301  -0.09443589228  0.2000128821 | 0.00003861295642 | 672 | 1428.955968 |
|  | DFP法 | -0.00037666415  1.000555559  -0.02004613083  0.4867862092  -0.4570282157  0.5979506261  0.2780231098  -0.8082947869  0.4785233216 | 0.000006874124561 | 20037 | 10423.646181 |
|  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |

x0 =

0

0

0

0

0

0

0

0

0

----------------------------------------------------

优化工具箱

Local minimum found.

Optimization completed because the size of the gradient is less than

the value of the optimality tolerance.

<stopping criteria details>

x\_min =

-0.0003

0.9982

0.0338

0.1767

0.2394

0.0939

-0.0886

-0.1018

0.2052

f\_min =

3.8398e-05

eixt =

1

output =

包含以下字段的 struct:

iterations: 69

funcCount: 750

stepsize: 0.0045

lssteplength: 1

firstorderopt: 3.1942e-05

algorithm: 'quasi-newton'

message: '↵Local minimum found.↵↵Optimization completed because the size of the gradient is less than↵the value of the optimality tolerance.↵↵<stopping criteria details>↵↵Optimization completed: The first-order optimality measure, 4.744729e-07, is less ↵than options.OptimalityTolerance = 1.000000e-06.↵↵'

时间已过 0.535941 秒。

----------------------------------------------------

计算函数:

时间已过 3.853883 秒。

----------------------------------------------------

负梯度法

x1 =

-0.001218532233

0.9992186115

0.01391715526

0.2436273856

0.1863773564

0.03822309303

-0.05301787528

-0.02230772273

0.1484876779

f1 =

0.00006807927911

k1 =

1945

时间已过 3966.431930 秒。

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| n | 算法 | 最小值点 | 最小值 | 迭代次数 | 耗时 |
| 12 | 优化工具箱 | -0.0000  0.9985  0.0242  0.2315  0.1568  0.0602  0.0116  0.0038  0.0148  0.0258  0.0247  0.0055 | 1.3529e-05 | 73 | 0.696401 |
| 负梯度法 |  |  |  |  |
| FR法 | -0.0001051251268  0.9984187953  0.02508431608  0.2301208816  0.1551580683  0.06138623904  0.01410797582  0.005128318661  0.0136032718  0.02290565293  0.02288154158  0.008457939116 | 0.00001327875575 | 424 | 1267.132587 |
| DFP法 | 0.00009830574583  1.000602644  -0.007000691012  0.3508853596  0.02508899669  0.007603131081  0.08865500642  0.099211205  0.02653294802  -0.05910219534  -0.06553108135  0.09069291487 | 0.000001516667227 | 866 | 665.088313 |

n=20时，优化工具箱开始找不到

----------------------------------------------------

优化工具箱

Solver stopped prematurely.

fminunc stopped because it exceeded the function evaluation limit,

options.MaxFunctionEvaluations = 2.000000e+03.

x\_min =

0.0046

0.9940

0.0638

0.1717

0.1529

0.0953

0.0462

0.0159

0.0014

-0.0028

-0.0014

0.0022

0.0059

0.0086

0.0096

0.0089

0.0064

0.0023

-0.0029

-0.0093

f\_min =

1.2764e-04

eixt =

0

output =

包含以下字段的 struct:

iterations: 89

funcCount: 2016

stepsize: 0.0241

lssteplength: 1

firstorderopt: 0.0545

algorithm: 'quasi-newton'

message: '↵Solver stopped prematurely.↵↵fminunc stopped because it exceeded the function evaluation limit,↵options.MaxFunctionEvaluations = 2.000000e+03.↵↵'

时间已过 1.040835 秒。

----------------------------------------------------

计算函数:

时间已过 6.512599 秒。

----------------------------------------------------

FR法

x2 =

0.00009760083287

0.9985901039

0.02176617023

0.2413519701

0.1480593658

0.05589104702

0.01514829103

0.007870665659

0.01325349156

0.01923751884

0.02101608088

0.01797636544

0.01146510593

0.003488474926

-0.003949519679

-0.009135965544

-0.0107395727

-0.007804515986

0.0002968789956

0.01392398927

f2 =

0.00000582483572

k2 =

1158

时间已过 7754.039050 秒。

----------------------------------------------------

DFP法

x3 =

-0.0000372935882

0.9997000061

0.007665869316

0.2880492724

0.106718724

0.03104287261

0.02730049275

0.03543246717

0.0339412817

0.02304414361

0.009151152146

-0.002106140309

-0.007824254913

-0.007679414773

-0.003159096792

0.003222494093

0.008534025381

0.009839124248

0.004444964181

-0.009967895159

f3 =

0.0000003921275253

k3 =

838

时间已过 1272.538506 秒。

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| n | 算法 | 最小值点 | 最小值 | 迭代次数 | 耗时 |
| 20 | 优化工具箱 | 0.0046  0.9940  0.0638  0.1717  0.1529  0.0953  0.0462  0.0159  0.0014  -0.0028  -0.0014  0.0022  0.0059  0.0086  0.0096  0.0089  0.0064  0.0023  -0.0029  -0.0093 | 1.2764e-04 | 89 | 1.040835 |
| 负梯度法 |  |  |  |  |
| FR法 | 0.00009760083287  0.9985901039  0.02176617023  0.2413519701  0.1480593658  0.05589104702  0.01514829103  0.007870665659  0.01325349156  0.01923751884  0.02101608088  0.01797636544  0.01146510593  0.003488474926  -0.003949519679  -0.009135965544  -0.0107395727  -0.007804515986  0.0002968789956  0.01392398927 | 0.00000582483572 | 1158 | 7754.039050 |
| DFP法 | -0.0000372935882  0.9997000061  0.007665869316  0.2880492724  0.106718724  0.03104287261  0.02730049275  0.03543246717  0.0339412817  0.02304414361  0.009151152146  -0.002106140309  -0.007824254913  -0.007679414773  -0.003159096792  0.003222494093  0.008534025381  0.009839124248  0.004444964181  -0.009967895159 | 0.0000003921275253 | 838 | 1272.538506 |

n=31

----------------------------------------------------

优化工具箱

Solver stopped prematurely.

fminunc stopped because it exceeded the function evaluation limit,

options.MaxFunctionEvaluations = 3.100000e+03.

x\_min\_ =

-0.0085

0.9850

0.1057

0.1061

0.1177

0.1018

0.0739

0.0455

0.0220

0.0049

-0.0061

-0.0122

-0.0143

-0.0137

-0.0113

-0.0078

-0.0038

0.0002

0.0038

0.0069

0.0093

0.0108

0.0114

0.0110

0.0097

0.0075

0.0043

0.0003

-0.0046

-0.0102

-0.0166

f\_min\_ =

0.0011

eixt\_ =

0

output\_ =

包含以下字段的 struct:

iterations: 90

funcCount: 3104

stepsize: 0.0147

lssteplength: 1

firstorderopt: 0.1381

algorithm: 'quasi-newton'

message: '↵Solver stopped prematurely.↵↵fminunc stopped because it exceeded the function evaluation limit,↵options.MaxFunctionEvaluations = 3.100000e+03.↵↵'

时间已过 1.382036 秒。

----------------------------------------------------

计算函数:

时间已过 6.421879 秒。

----------------------------------------------------

FR法

x\_2 =

0.00006077663088

0.9990252029

0.01842628661

0.2473886752

0.1492560753

0.05227540383

0.01084849926

0.005304768792

0.01288058037

0.0206261276

0.02363528335

0.02148754842

0.01567595793

0.008154276647

0.0006462749842

-0.005608334732

-0.009885312533

-0.01190850936

-0.01174961493

-0.009727238192

-0.006319089361

-0.00209152301

0.002353847015

0.006418652926

0.009534149061

0.0111781314

0.01088473266

0.008249010426

0.002927845193

-0.005361684394

-0.01684557078

f\_2 =

0.000005058413059

k\_2 =

1744

时间已过 27000.007113 秒。

----------------------------------------------------

DFP法

x\_3 =

-0.00008544019766

0.9992764922

0.0141936884

0.2609270654

0.1378621129

0.04501892832

0.01336228375

0.01228207352

0.01879331421

0.02283063472

0.02204055666

0.01739447968

0.0107771158

0.00391765112

-0.001965307456

-0.006191798682

-0.008524191848

-0.00904192067

-0.008026946796

-0.005872805241

-0.003018248224

0.00009799963897

0.003065996543

0.005521198955

0.007152536339

0.007704725294

0.006976877765

0.004818872278

0.001126508629

-0.004163865387

-0.01108080591

f\_3 =

0.000003231746781

k\_3 =

146

时间已过 785.168383 秒。

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| n | 算法 | 最小值点 | 最小值 | 迭代次数 | 耗时 |
| 31 | 优化工具箱 | -0.0085  0.9850  0.1057  0.1061  0.1177  0.1018  0.0739  0.0455  0.0220  0.0049  -0.0061  -0.0122  -0.0143  -0.0137  -0.0113  -0.0078  -0.0038  0.0002  0.0038  0.0069  0.0093  0.0108  0.0114  0.0110  0.0097  0.0075  0.0043  0.0003  -0.0046  -0.0102  -0.0166 | 0.0011 | 90 | 1.382036 |
| 负梯度法 |  |  |  |  |
| FR法 | 0.00006077663088  0.9990252029  0.01842628661  0.2473886752  0.1492560753  0.05227540383  0.01084849926  0.005304768792  0.01288058037  0.0206261276  0.02363528335  0.02148754842  0.01567595793  0.008154276647  0.0006462749842  -0.005608334732  -0.009885312533  -0.01190850936  -0.01174961493  -0.009727238192  -0.006319089361  -0.00209152301  0.002353847015  0.006418652926  0.009534149061  0.0111781314  0.01088473266  0.008249010426  0.002927845193  -0.005361684394  -0.01684557078 | 0.000005058413059 | 1744 | 27000.007113 |
| DFP法 | -0.00008544019766  0.9992764922  0.0141936884  0.2609270654  0.1378621129  0.04501892832  0.01336228375  0.01228207352  0.01879331421  0.02283063472  0.02204055666  0.01739447968  0.0107771158  0.00391765112  -0.001965307456  -0.006191798682  -0.008524191848  -0.00904192067  -0.008026946796  -0.005872805241  -0.003018248224  0.00009799963897  0.003065996543  0.005521198955  0.007152536339  0.007704725294  0.006976877765  0.004818872278  0.001126508629  -0.004163865387  -0.01108080591 | 0.000003231746781 | 146 | 785.168383 |