python_julia_optim2

January 5, 2023

[1]:
```
import time
import numpy as np
import scipy
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.graph_objects as go
import plotly.express as px
from scipy.optimize import minimize
from scipy.optimize import differential_evolution
```

We seek to find the minimum value of the function $f(x,y) = (2*x*sin(x^3) - x*cos(x^3/12))*(2*y*sin(y^3) - y*cos(y^3/12))$ on x in $[-2\pi, 2\pi]$ and y in $[-2\pi, 2\pi]$. We call this function "the stalactite intersection".

[2]:
```
#def f(x,y):
    #f = ( 2*x*np.sin(x**3) - x*np.cos(x**3/12))*(2*y*np.sin(y**3) - y*np.
 ↪cos(y**3/12))
    #return f
```

[11]:
```
f = lambda x: ( 2*x[0]*np.sin(x[0]**3) - x[0]*np.cos(x[0]**3/12))*(2*x[1]*np.
 ↪sin(x[1]**3) - x[1]*np.cos(x[1]**3/12))
```

[12]:
```
[f([-2*np.pi,-2*np.pi]),f([-2*np.pi,0]),f([-2*np.pi,2*np.pi]),f([0,2*np.
 ↪pi]),f([0,0]),f([2*np.pi,2*np.pi])]
```

[12]:
```
[0.01997641401901208, 0.0, 0.46025026427859966, 0.0, 0.0, 10.604020599839208]
```

[20]:
```
xlb=-2*np.pi
xub=2*np.pi

ylb=-2*np.pi
yub=2*np.pi

xdisc = 200
ydisc = 200

xv = np.outer(np.linspace(xlb,xub,xdisc),np.ones(xdisc))
yv = np.outer(np.linspace(ylb,yub,ydisc),np.ones(ydisc)).T
```

```python
#yv = xv.copy().T

surf_data=[go.Surface(x=xv, y=yv, z=f([xv,yv]))]

fig = go.Figure(surf_data)

fig.show()
```

[14]:
```python
print(f'xlb = {xlb:.5f}','&',f'xub = {xub:.4f}')
print(f'ylb = {ylb:.5f}','&',f'yub = {yub:.4f}')

print(f'Min(f) = {np.min(f([xv,yv])):.4f}')
```

```
xlb = -6.28319 & xub = 6.2832
ylb = -6.28319 & yub = 6.2832
Min(f) = -249.0703
```

[15]:
```python
np.argmin(f([xv,yv]))
```

[15]:
```
1815
```

[16]:
```python
#Using Differential Evolution global search Algorithm
#%%time
x0 = (-6.28,-6.28)
bnds = ((xlb, xub),(ylb, yub))
de = differential_evolution(f,x0=x0, bounds=bnds, maxiter=1000, tol=1e-15,␣
 ↪seed=123)
#print(f'(x = {de.x[0]:.4f}',',',f'y = {de.x[1]:.4f})','&',f'Min(f)_de = {de.
 ↪fun:.4f}')
print(f'Minimum value of {de.fun:.4f}','was found for pair', f'(x={de.x[0]:.
 ↪4f}',',',f'y={de.x[1]:.4f}).')
```

```
Minimum value of -332.2155 was found for pair (x=6.0789 , y=-6.1070).
```

[17]:
```python
de
```

[17]:
```
     fun: -332.2155440254075
 message: 'Optimization terminated successfully.'
    nfev: 4341
     nit: 142
 success: True
       x: array([ 6.07887981, -6.10699036])
```

[18]:
```python
#Using Nelder Mead local search Algorithm
#%%time
x0 = (de.x[0],de.x[1])
#bnds = [(xlb, xub),(ylb, yub)]
bnds = ((xlb, xub),(ylb, yub))
```

```python
res = minimize(f, x0, method='Nelder-Mead', tol=1e-9, bounds=bnds,␣
 ↪options={'maxiter':1e11})
print(f'Minimum value of {res.fun:.5f}','found for', f'x = {res.x[0]:.5f}.')
```

```
Minimum value of -332.21554 found for x = 6.07888.
```

[ ]:

```python

```