EP2Final

October 15, 2016

0.1 Instruções de execução:

Primeiro execute todas as células, uma unidade de teste será exutada junto. Para calcular e imprimir o potencial e campo elétrico, basta utilizar o método printElectric(). A sintaxe é:

printElectric(res)

res - type: integer Resolution of the grid. If the resolution is odd, it will be rounded to the closest even integer.

In [ ]:
```
''' x, numIter = conjGrad(Av,x,b,tol=1.0e-9)
Conjugate gradient method for solving [A] { x } = { b } .
The matrix [A] should be sparse. User must supply
the function Av(v) that returns the vector [A] { v } .
'''
import numpy as np
from math import sqrt
import matplotlib.pyplot as plt
from matplotlib.pyplot import cm
%matplotlib inline

def conjGrad(a,x,b,tol=1.0e-9):
    def Av(x):
        return np.dot(a, x)
    n = len(b)
    r = b - Av(x)
    s = r.copy()
    for i in range(n):
        u = Av(s)
        alpha = (1.0*np.dot(s,r))/np.dot(s,u)
        x = x + alpha*s
        r = b - Av(x)
        if(sqrt(np.dot(r,r))) < tol:
            break
        else:
            beta = -np.dot(r,u)/np.dot(s,u)
            s = r + beta*s
    return x,i
```

In [3]:
```
def generateMatrix(size = 5):
    potential = 100
```

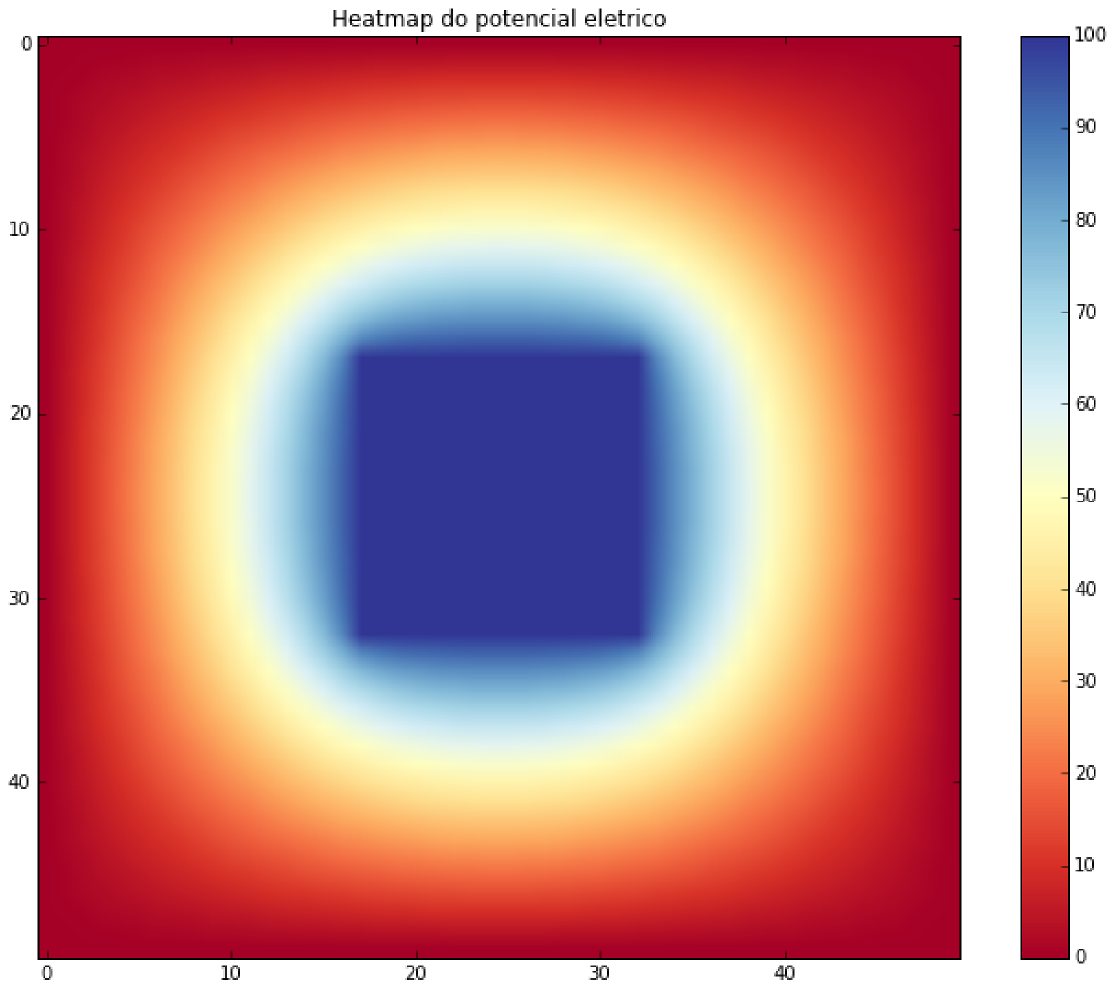
```python
h = 1.0/(2*size - 1)
pointMatrix = []

for i in range(0, size):
    for j in range(0, size):
        y = h * i
        x = h * j
        if not (x == 0 or y == 0 or (x >= 1.0/3 and y >= 1.0/3)):
            pointMatrix.append([j, i])
#print pointMatrix

silkMatrix = []
for i in range(0, 2*size):
    silkMatrix.append([])
    for j in range(0, 2*size):
        y = h * i
        x = h * j
        if x >= 1.0/3 and y >= 1.0/3 and x <= 2.0/3 and y<= 2.0/3:
            silkMatrix[i].append(potential)
        elif i == 0 or j == 0 or i == 2*size - 1 or j == 2*size - 1:
            silkMatrix[i].append(0)
        else:
            silkMatrix[i].append(-1)
for point in pointMatrix:
    silkMatrix[point[0]][point[1]] = 2

#for line in silkMatrix:
    #print line

finalMatrix = []
finalMatrix2 = [0]*len(pointMatrix)

for i in range(0, len(pointMatrix)):
    finalMatrix.append([])
    for j in range(0, len(pointMatrix)):
        finalMatrix[i].append(0)

for i in pointMatrix:
    x = i[0]
    y = i[1]
    finalMatrix[pointMatrix.index(i)][pointMatrix.index(i)] = -4
    points = [[x + 1, y], [x - 1, y], [x, y + 1], [x, y - 1]]
    for j in points:
        if silkMatrix[j[0]][j[1]] == 2:
            finalMatrix[pointMatrix.index(i)][pointMatrix.index(j)] +=
        if silkMatrix[j[0]][j[1]] == potential:
            finalMatrix2[pointMatrix.index(i)] -= potential
        if silkMatrix[j[0]][j[1]] == -1:
```

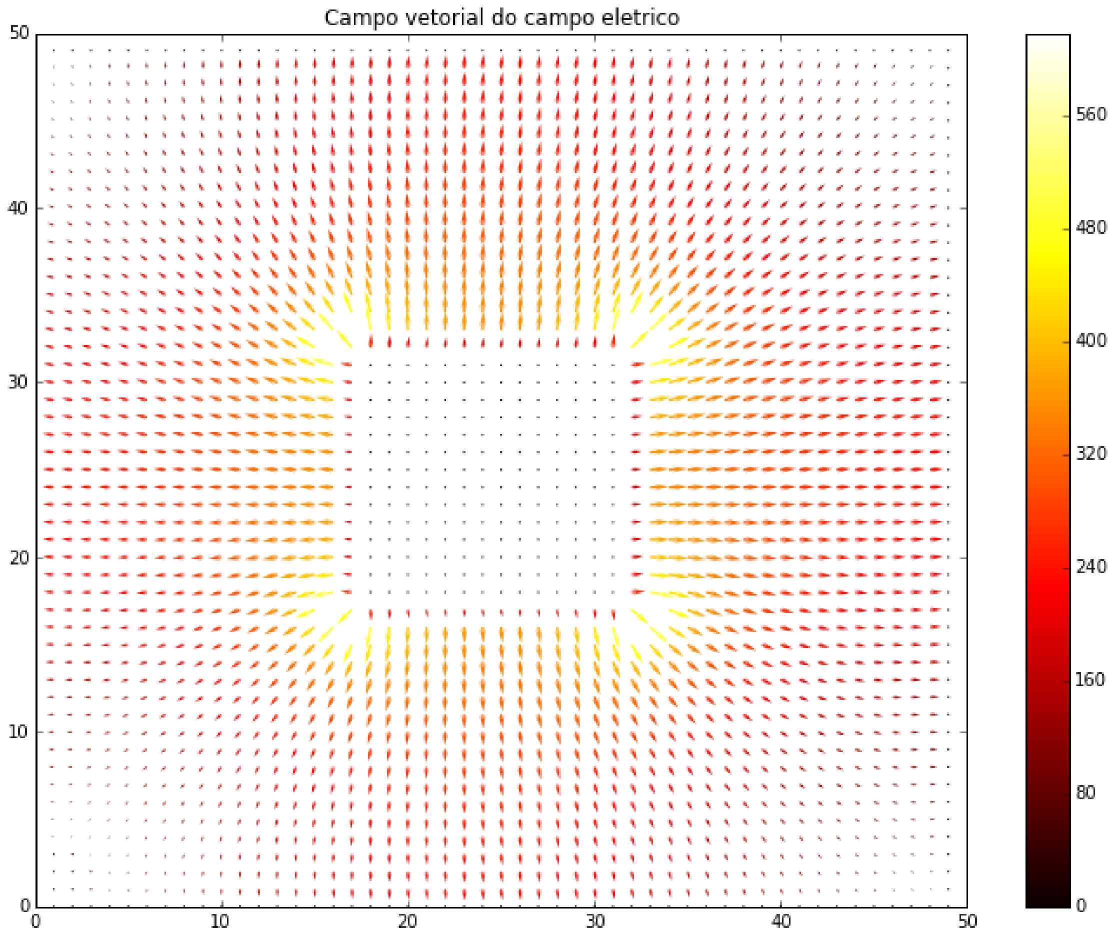
```
            finalMatrix[pointMatrix.index(i)][pointMatrix.index(i)] +=

#for line in finalMatrix:
    #print line

#print finalMatrix2
#print conjGrad(finalMatrix, [0]*len(pointMatrix), finalMatrix2)

answer = conjGrad(finalMatrix, [0]*len(pointMatrix), finalMatrix2)[0]

for i in range(0, len(answer)):
    point = pointMatrix[i]
    silkMatrix[point[0]][point[1]] = answer[i]
#for line in silkMatrix:
    #print line

#copy the 1/4 of the matrix to a temporary one for pasting
tmpMatrix = []
for i in range(0, len(silkMatrix)/2):
    tmpMatrix.append([])
    for j in  range(0, len(silkMatrix)/2):
        tmpMatrix[i].append(silkMatrix[i][j])
#print
#rotates the list, but i got no idea how it works
tmpMatrix = zip(*tmpMatrix[::-1])

#for line in tmpMatrix:
    #print line

offsetList = [[0, len(silkMatrix)/2], [len(silkMatrix)/2, len(silkMatri

for offsets in offsetList:
    offLine = offsets[0]
    offColu = offsets[1]
    for i in range(0, len(silkMatrix)/2):
        for j in range(0, len(silkMatrix)/2):
            silkMatrix[i + offLine][j + offColu] = tmpMatrix[i][j]
    tmpMatrix = zip(*tmpMatrix[::-1])

#print
#for line in silkMatrix:
    #print line

p1 = plt.figure(num=None, figsize=(12, 9), dpi=160, facecolor='w', edge
plt.imshow(silkMatrix, cmap=plt.cm.RdYlBu)
plt.title("Heatmap do potencial eletrico")
plt.colorbar()
plt.show(p1)
```

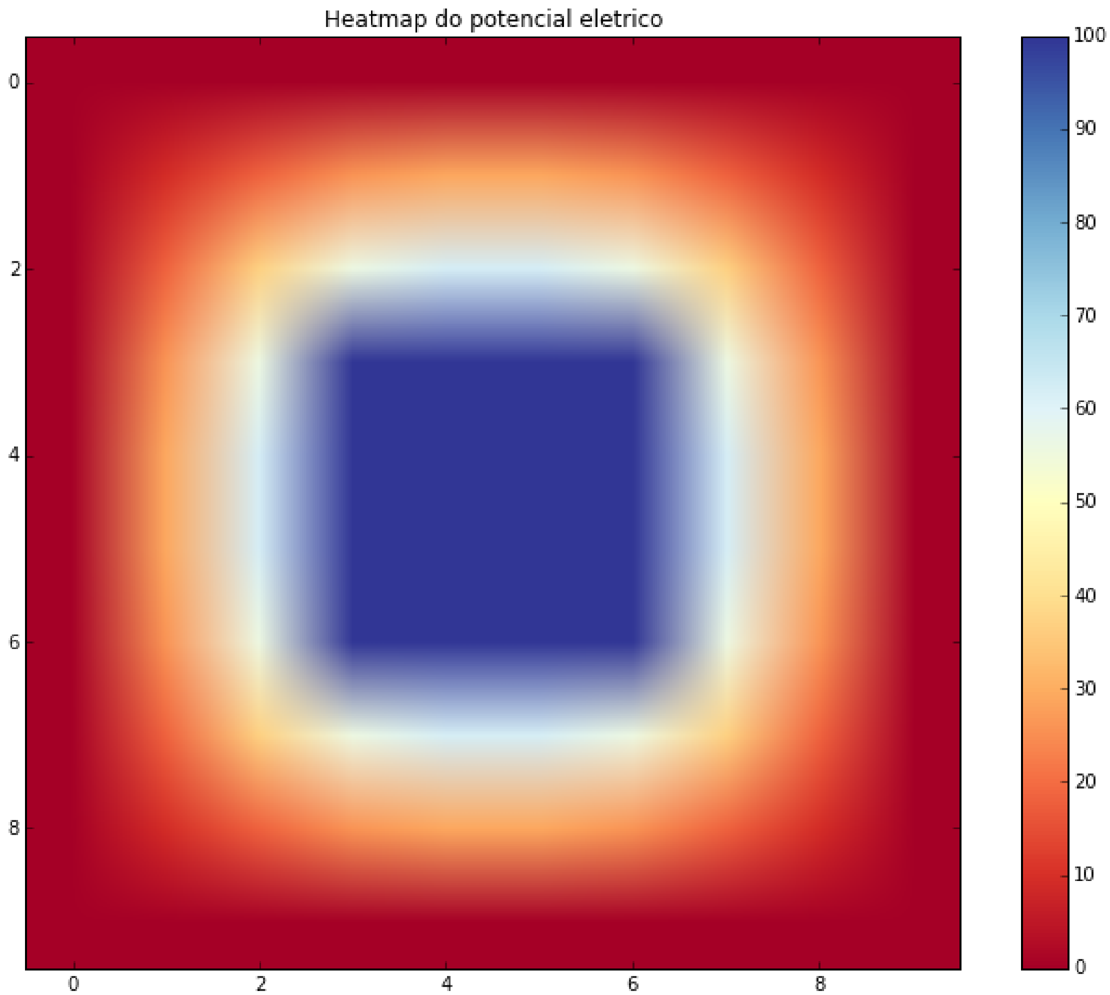
```
        #generate vector field
        U = []
        V = []
        UN = []
        VN = []
        speed = []
        for i in range(0, len(silkMatrix)):
            for j in range(0, len(silkMatrix)):
                U.append(i)
                V.append(j)
                if(i == 0 or j == 0 or i == len(silkMatrix) - 1 or j == len(sil
                    UN.append(0)
                    VN.append(0)
                    speed.append(0)
                else:
                    UN.append(i + ((silkMatrix[i - 1][j] - silkMatrix[i + 1][j]
                    VN.append(j + ((silkMatrix[i][j - 1] - silkMatrix[i][j + 1]
                    speed.append(sqrt(((silkMatrix[i - 1][j] - silkMatrix[i + 1

        p = plt.figure(num=None, figsize=(12, 9), dpi=160, facecolor='w', edgec
        plt.quiver(U, V, UN, VN, speed, cmap=cm.hot, headlength=7)
        plt.colorbar()                    # adds the colour bar

        plt.title('Campo vetorial do campo eletrico')
        plt.show(p)                       # display the plot
```

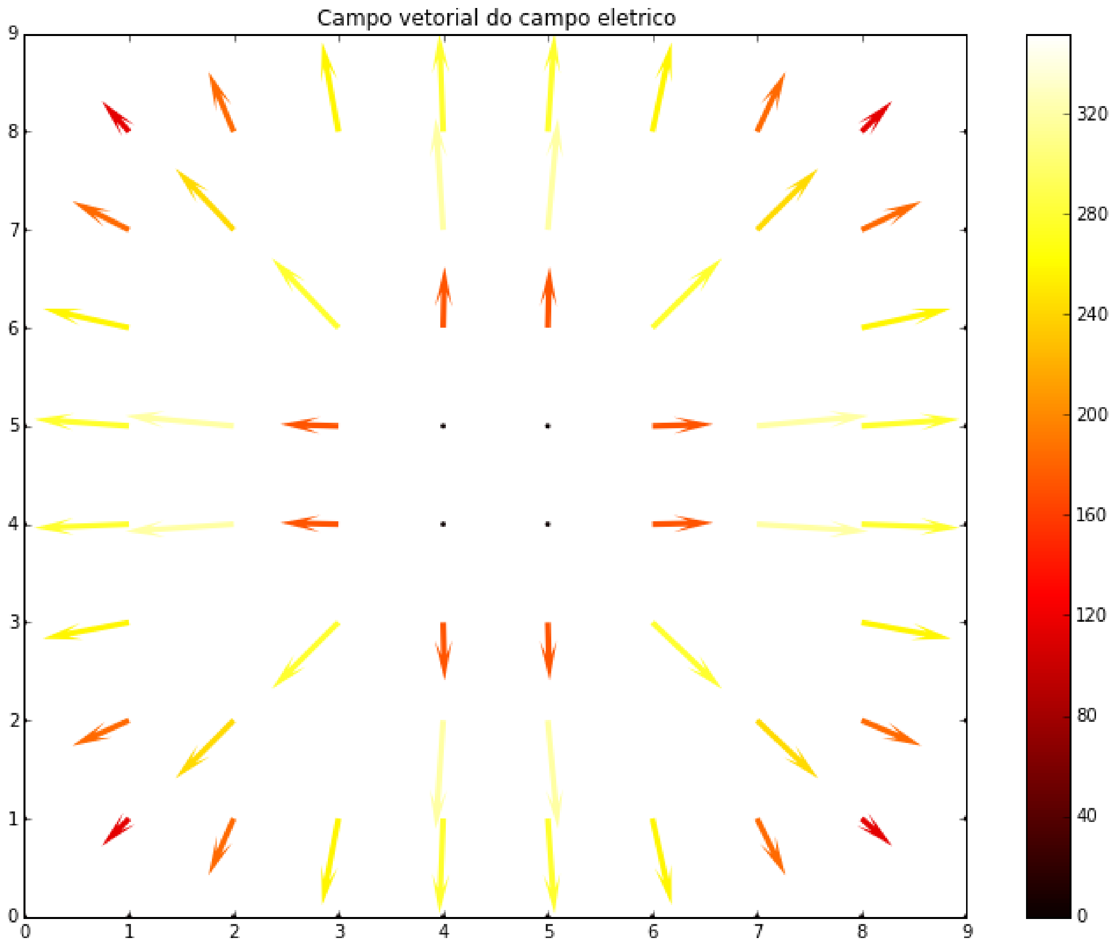
In [4]:
```
def printElectric(size = 10):
    generateMatrix(size/2)
```

In [5]:
```
#printElectric(50)
printElectric(10)
```


Heatmap do potencial eletrico
0
10
20
30
40
0
10
20
30
40
100
90
80
70
60
50
40
30
20
10
0


Campo vetorial do campo eletrico
0
10
20
30
40
50
0
80
160
240
320
400
480
560


Heatmap do potencial eletrico
0
2
4
6
8
0
2
4
6
8
100
90
80
70
60
50
40
30
20
10
0


Campo vetorial do campo eletrico
0
1
2
3
4
5
6
7
8
9
0
40
80
120
160
200
240
280
320

```
In [ ]:
```