mini_hw2

December 3, 2024

1 Mini-hw2

[ ]:
```
import numpy as np
from scipy.sparse import dia_array
from scipy.sparse import dia_matrix
from numba import jit, njit, prange
import matplotlib.pyplot as plt
from scipy import linalg
from scipy.linalg import solve
import numpy as np
from mylinalg import solveLowerTriangular, solveUpperTriangular, lu, lu_solve
```

[ ]:
```
def generate_the_laplace_matrix_with_size(N):
    nsq = N * N
    A = np.zeros((nsq, nsq))

    for i in range(N):
        for j in range(N):
            index = i * N + j
            A[index, index] = 4
            if j > 0:
                A[index, index - 1] = -1
            if j < N - 1:
                A[index, index + 1] = -1
            if i > 0:
                A[index, index - N] = -1
            if i < N - 1:
                A[index, index + N] = -1

    return A

def generate_the_rhs_vector_with_size(N, top, bottom, left, right):
    b = np.zeros(N * N)

    for i in range(N):
        b[i] += left
        b[N*i] += bottom
```

```
    for j in range(N):
        b[-N+j] += right
        b[j * N + (N - 1)] += top

    return b

def convert_solution(x, N):
    u = x.reshape(N, N)
    return u
```

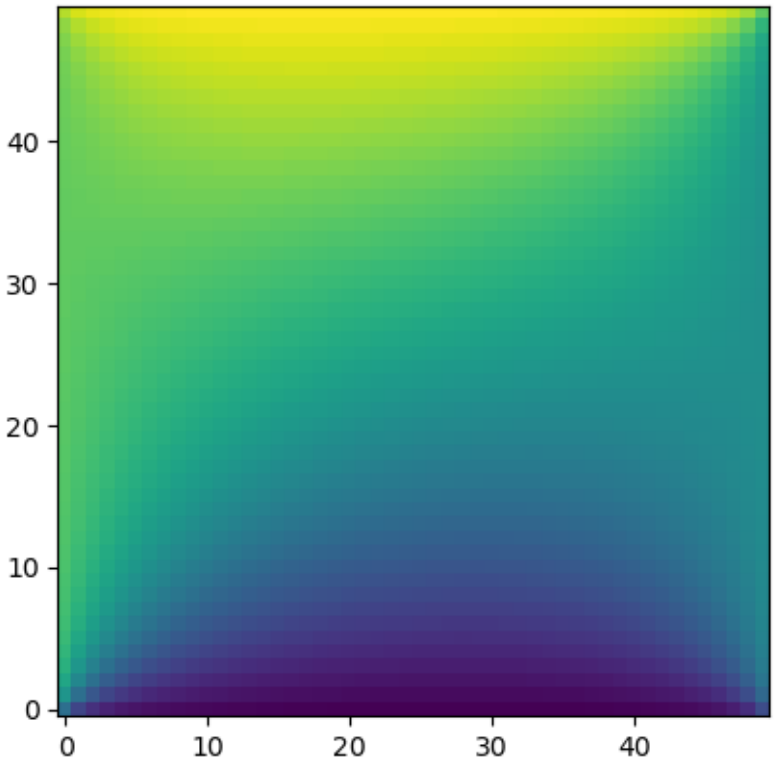
2 Use the linear albrgra solver we developed in class.

[27]:
```
def solve_laplace(N, top, bottom, left, right):
    A = generate_the_laplace_matrix_with_size(N)
    b = generate_the_rhs_vector_with_size(N, top, bottom, left, right)
    x = lu_solve(A, b)
    u = convert_solution(x, N)
    return u
```

[28]:
```
N = 50  # Grid size
top, bottom, left, right = 100, 0, 75, 50

# Solve and visualize
u = solve_laplace(N, top, bottom, left, right)
plt.imshow(u.T,origin="lower")
```

[28]:
```
<matplotlib.image.AxesImage at 0x19fe8964110>
```



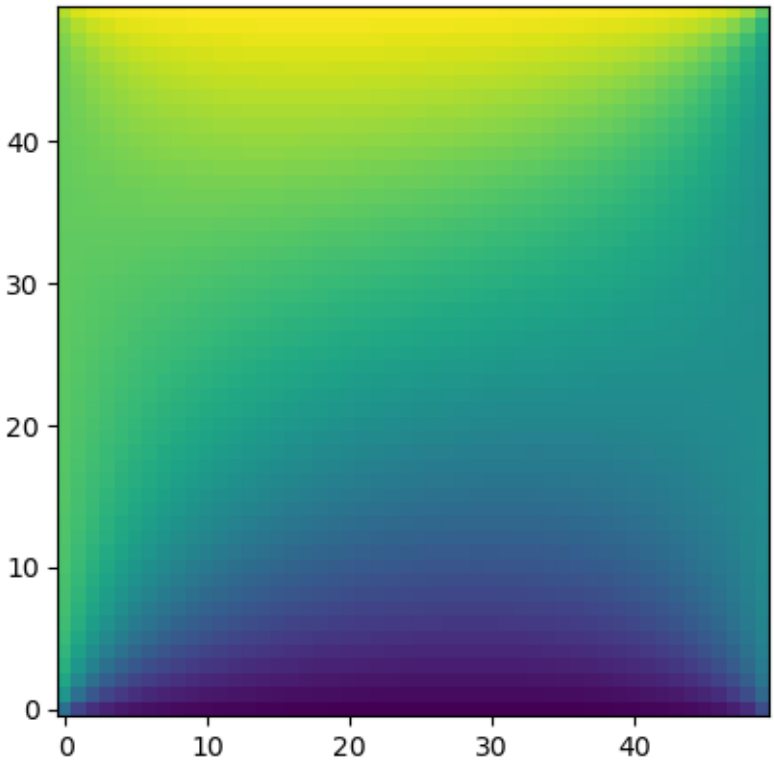
3 Use scipy.linalg

[29]:
```
def solve_laplace(N, top, bottom, left, right):
    A = generate_the_laplace_matrix_with_size(N)
    b = generate_the_rhs_vector_with_size(N, top, bottom, left, right)
    x = solve(A, b)
    u = convert_solution(x, N)
    return u
```

[30]:
```
N = 50  # Grid size
top, bottom, left, right = 100, 0, 75, 50

# Solve and visualize
u = solve_laplace(N, top, bottom, left, right)
plt.imshow(u.T,origin="lower")
```

[30]:
```
<matplotlib.image.AxesImage at 0x19fe8b23090>
```


0
10
20
30
40
0
10
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30
40