hmwk3_p3

March 19, 2018

1 Homework 3 - Problem 3

```
In [1]: %matplotlib inline
        import numpy as np
        import matplotlib.pyplot as plt
        import pandas as pd
        import subprocess
```

2 Part (a)

```
In [2]: ns = [2**p for p in range(5,17)]
        for n in ns:
            print(n)
            cmd = 'mpirun -n 1 hmwk3_3c -n ' + str(n) + ' --itermax 100000 --tol 1e-10'
            f = open('hmwk3_3cN' + str(n) + '.csv','w')
            process = subprocess.call(cmd.split(), stdout=f)
            f.close()
```

```
32
64
128
256
512
1024
2048
4096
8192
16384
32768
65536
```

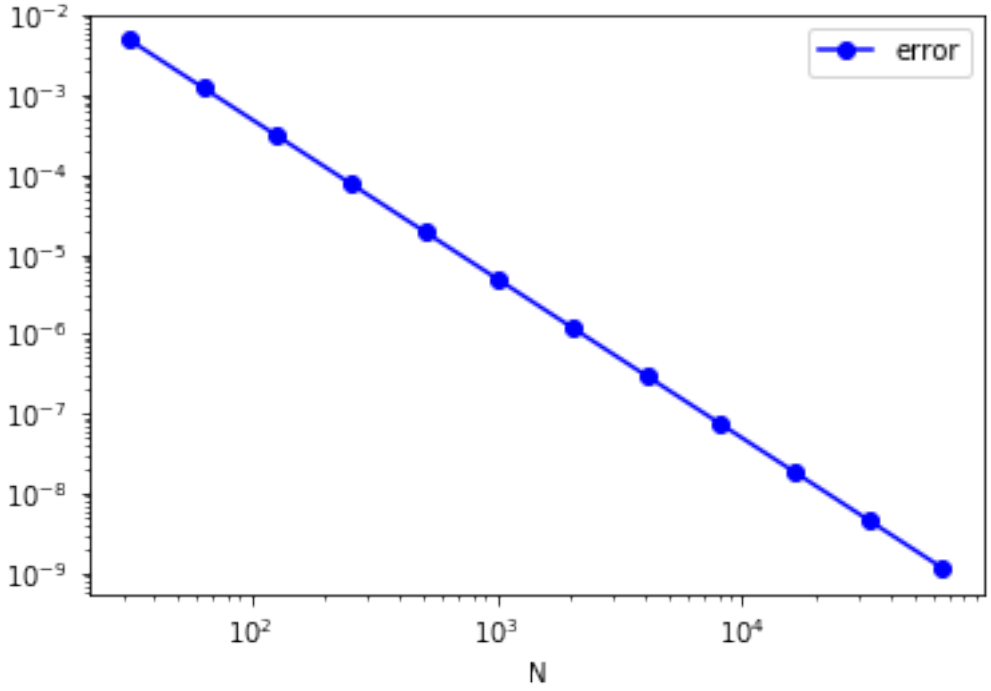
```
In [3]: data = {}
        columns = ['N', 'iterations', 'residual', 'error']
        df = pd.DataFrame(columns=columns)
        for n in [2**p for p in range(5,17)]:
            A = np.genfromtxt('hmwk3_3cN' + str(n) + '.csv', delimiter=',')
```

```
            iterations = A[-3]
            residual = A[-2]
            error = A[-1]
            A = A[:-3]
            cells = len(A)
            h = 1/cells
            x = np.linspace(0+h/2,1-h/2,len(A))

            data_row = {'N': (n), 'iterations': iterations, 'residual': residual, 'error':error}
            df = df.append(pd.Series(data=data_row, name=str(n)))
        print(df)
        df.plot(x='N', y='error', loglog=True, style='bo-')
```

	N	iterations	residual	error
32	32.0	16.0	1.559657e-14	4.815273e-03
64	64.0	32.0	4.599381e-14	1.204544e-03
128	128.0	64.0	7.503626e-14	3.011813e-04
256	256.0	128.0	1.107838e-13	7.529816e-05
512	512.0	256.0	1.418360e-13	1.882472e-05
1024	1024.0	512.0	4.231900e-13	4.706190e-06
2048	2048.0	1024.0	8.855576e-13	1.176548e-06
4096	4096.0	2048.0	2.240577e-12	2.941371e-07
8192	8192.0	4096.0	3.413523e-12	7.353428e-08
16384	16384.0	8192.0	6.141856e-12	1.838358e-08
32768	32768.0	16383.0	6.789233e-11	4.596604e-09
65536	65536.0	32767.0	1.697155e-11	1.149986e-09

Out[3]: <matplotlib.axes._subplots.AxesSubplot at 0x7f7d135b86d8>



3 Part (b)

```
In [4]: ps = [1,2,4]
        for p in ps:
            print(p)
            cmd = 'mpirun -n ' + str(p) + ' hmwk3_3c -n 65536 --itermax 100000 --tol 1e-10'
            f = open('hmwk3_3cp' + str(p) + '.csv','w')
            process = subprocess.call(cmd.split(), stdout=f)
            f.close()
```

```
1
2
4
```

```
In [5]: data = {}
        columns = ['Processes', 'iterations', 'residual', 'error']
        df = pd.DataFrame(columns=columns)
        for n in [1,2,4]:
            A = np.genfromtxt('hmwk3_3cp' + str(p) +'.csv', delimiter=',')
            iterations = A[-3]
            residual = A[-2]
            error = A[-1]
            A = A[:-3]
```

```
            data_row = {'Processes': n, 'iterations': iterations, 'residual': residual, 'error':
            df = df.append(pd.Series(data=data_row, name=str(n)))
        print(df)
```

```
   Processes  iterations      residual         error
1        1.0     32767.0  1.697154e-11  1.150236e-09
2        2.0     32767.0  1.697154e-11  1.150236e-09
4        4.0     32767.0  1.697154e-11  1.150236e-09
```