hmwk3_p2

March 19, 2018

1 Homework 3 - Problem 2

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

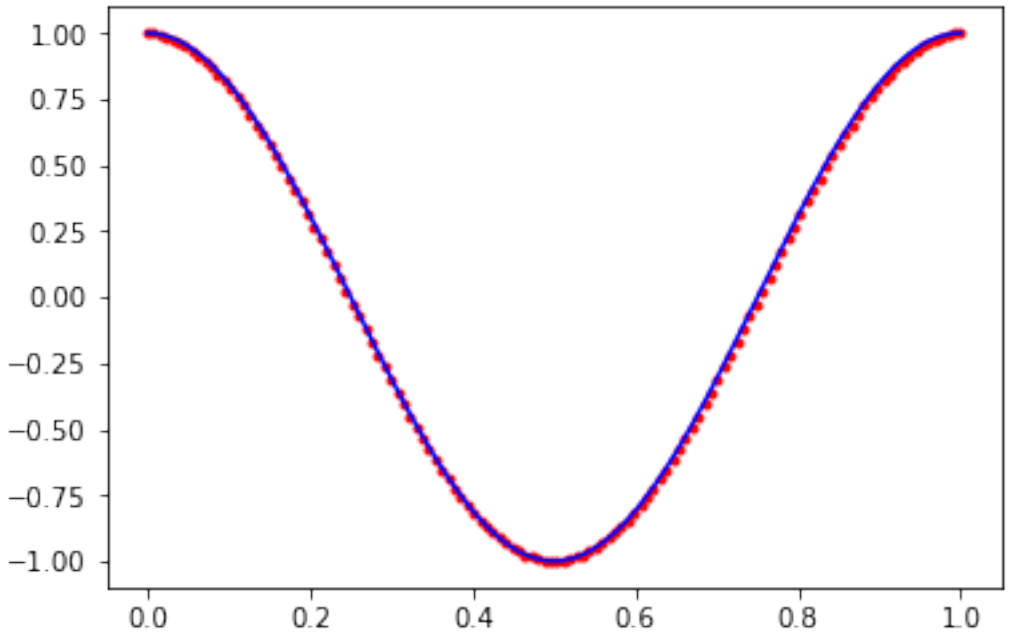
2 Parts (a & b)

In [2]:
```
%%bash
mpirun -n 1 hmwk3_2c -n 128 --itermax 100000 --tol 1e-10 > hmwk3_2c.csv
```

In [3]:
```
A = np.genfromtxt('hmwk3_2c.csv', delimiter=',')
print("iterations: %d" % A[-3])
print("residual: %g" % A[-2])
print("error: %g" % A[-1])
A = A[:-3]
print("cells: %d" % len(A))
x = np.linspace(0,1,len(A))
plt.plot(x,A,'r.')
plt.plot(x, np.cos(2*np.pi*x), 'b-')
```

```
iterations: 24491
residual: 9.99457e-11
error: 0.000301183
cells: 128
```

Out[3]:
```
[<matplotlib.lines.Line2D at 0x7fd2952c07b8>]
```

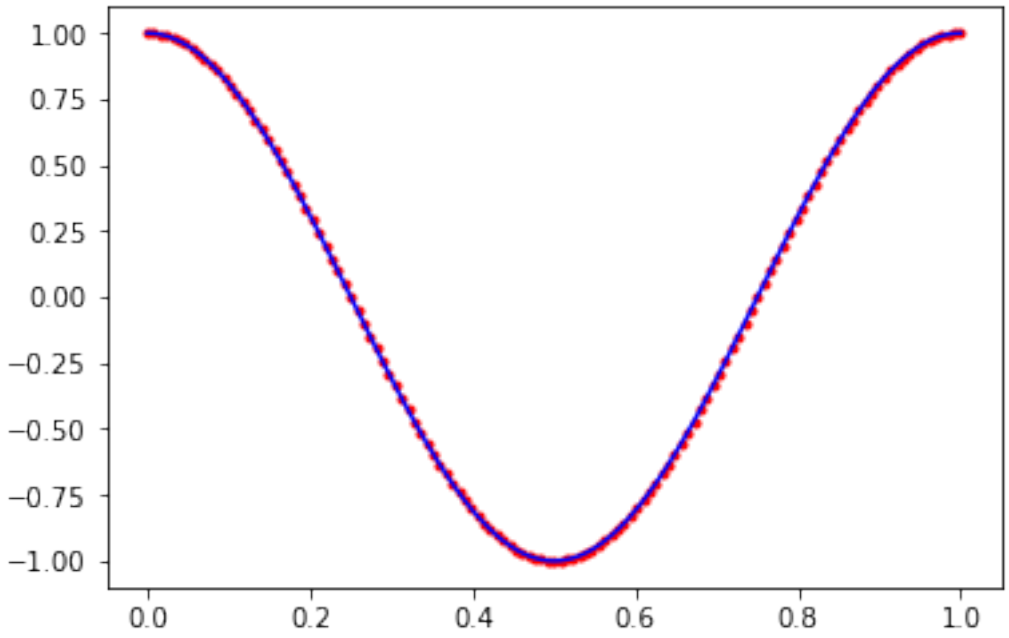



```
In [4]: %%bash
        mpirun -n 1 hmwk3_2n -n 128 --itermax 100000 --tol 1e-10 > hmwk3_2n.csv
```

```
In [5]: A = np.genfromtxt('hmwk3_2n.csv', delimiter=',')
        print("iterations: %d" % A[-3])
        print("residual: %g" % A[-2])
        print("error: %g" % A[-1])
        A = A[:-3]
        print("nodes: %d" % len(A))
        x = np.linspace(0,1,len(A))
        plt.plot(x,A,'r.')
        plt.plot(x, np.cos(2*np.pi*x), 'b-')
```

```
iterations: 24493
residual: 9.99518e-11
error: 0.000401478
nodes: 129
```

```
Out[5]: [<matplotlib.lines.Line2D at 0x7fd28cb49588>]
```




```
In [6]: %%bash
        mpirun -n 1 hmwk3_2c -n 128 --itermax 100000 --tol 1e-10 > hmwk3_2c_1.csv

In [7]: %%bash
        mpirun -n 2 hmwk3_2c -n 128 --itermax 100000 --tol 1e-10 > hmwk3_2c_2.csv

In [8]: %%bash
        mpirun -n 4 hmwk3_2c -n 128 --itermax 100000 --tol 1e-10 > hmwk3_2c_4.csv

In [9]: data = {}
        columns = ['Processes', 'iterations', 'residual', 'error']
        df = pd.DataFrame(columns=columns)
        for n in [1,2,4]:
            A = np.genfromtxt('hmwk3_2c_' + str(n) +'.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     24491.0  9.994566e-11  0.000301
```

```
2         2.0         64.0  0.000000e+00  0.000000
4         4.0       1945.0  9.984334e-11  0.968655
```

```
In [10]: %%bash
         mpirun -n 1 hmwk3_2n -n 128 --itermax 100000 --tol 1e-10 > hmwk3_2n_1.csv
```

```
In [11]: %%bash
         mpirun -n 2 hmwk3_2n -n 128 --itermax 100000 --tol 1e-10 > hmwk3_2n_2.csv
```

```
In [12]: %%bash
         mpirun -n 4 hmwk3_2n -n 128 --itermax 100000 --tol 1e-10 > hmwk3_2n_4.csv
```

```
In [13]: data = {}
         columns = ['Processes', 'iterations', 'residual', 'error']
         df = pd.DataFrame(columns=columns)
         for n in [1,2,4]:
             A = np.genfromtxt('hmwk3_2n_' + str(n) +'.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     24493.0  9.995176e-11  0.000401
2         2.0      6864.0  9.984119e-11  0.984369
4         4.0      1887.0  9.976262e-11  0.968744
```

3 Part (c)

```
In [14]: %%bash
         mpirun -n 1 hmwk3_2c -n 32 --itermax 10000000 --tol 1e-10 > hmwk3_2c_N32.csv
```

```
In [15]: %%bash
         mpirun -n 1 hmwk3_2c -n 64 --itermax 10000000 --tol 1e-10 > hmwk3_2c_N64.csv
```

```
In [16]: %%bash
         mpirun -n 1 hmwk3_2c -n 128 --itermax 10000000 --tol 1e-10 > hmwk3_2c_N128.csv
```

```
In [17]: %%bash
         mpirun -n 1 hmwk3_2c -n 256 --itermax 10000000 --tol 1e-10 > hmwk3_2c_N256.csv
```

```
In [18]: %%bash
         mpirun -n 1 hmwk3_2c -n 512 --itermax 1000000000 --tol 1e-10 > hmwk3_2c_N512.csv
```

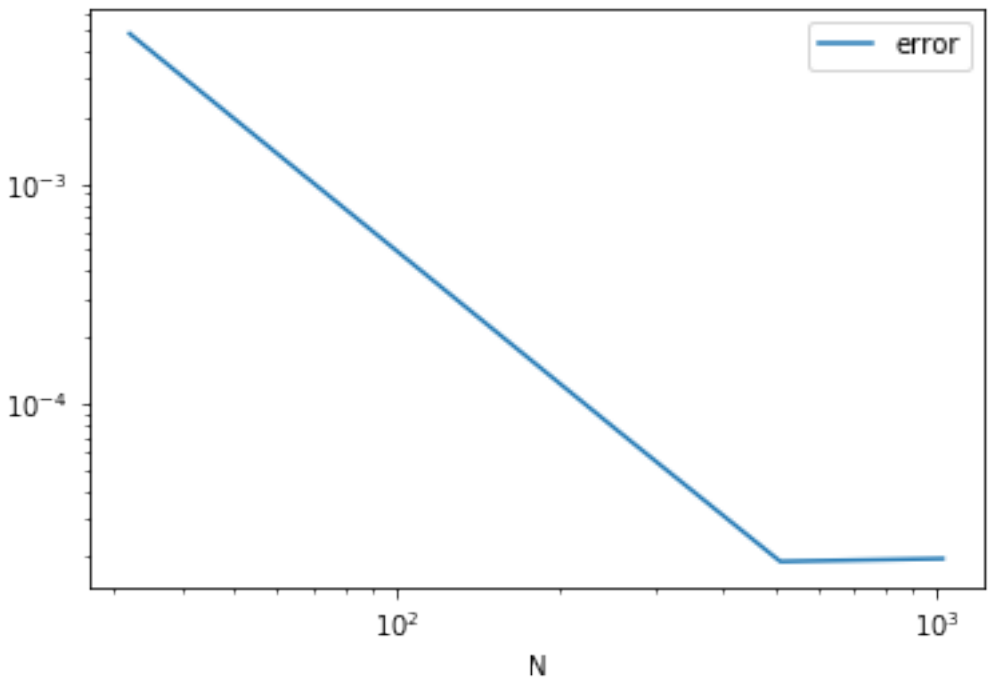
In [19]:
```
%%bash
mpirun -n 1 hmwk3_2c -n 1024 --itermax 1000000000 --tol 1e-10 > hmwk3_2c_N1024.csv
```

In [20]:
```
data = {}
columns = ['N', 'iterations', 'residual', 'error']
df = pd.DataFrame(columns=columns)
for n in [32,64,128,256,512,1024]:
    A = np.genfromtxt('hmwk3_1c_N' + str(n) + '.csv', delimiter=',')
    iterations = A[-3]
    residual = A[-2]
    error = A[-1]
    A = A[:-3]

    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)
```

```
            N  iterations      residual     error
32       32.0      3487.0  9.969658e-11  0.004815
64       64.0     12816.0  9.990297e-11  0.001205
128     128.0     46678.0  9.999701e-11  0.000301
256     256.0    168320.0  9.999890e-11  0.000075
512     512.0    599655.0  9.999979e-11  0.000019
1024   1024.0   2104071.0  9.999990e-11  0.000020
```

Out[20]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd28ca3b518>



In [21]:
```
%%bash
mpirun -n 1 hmwk3_2n -n 32 --itermax 10000000 --tol 1e-10 > hmwk3_2n_N32.csv
```

In [22]:
```
%%bash
mpirun -n 1 hmwk3_2n -n 64 --itermax 10000000 --tol 1e-10 > hmwk3_2n_N64.csv
```

In [23]:
```
%%bash
mpirun -n 1 hmwk3_2n -n 128 --itermax 10000000 --tol 1e-10 > hmwk3_2n_N128.csv
```

In [24]:
```
%%bash
mpirun -n 1 hmwk3_2n -n 256 --itermax 10000000 --tol 1e-10 > hmwk3_2n_N256.csv
```

In [25]:
```
%%bash
mpirun -n 1 hmwk3_2n -n 512 --itermax 1000000000 --tol 1e-10 > hmwk3_2n_N512.csv
```

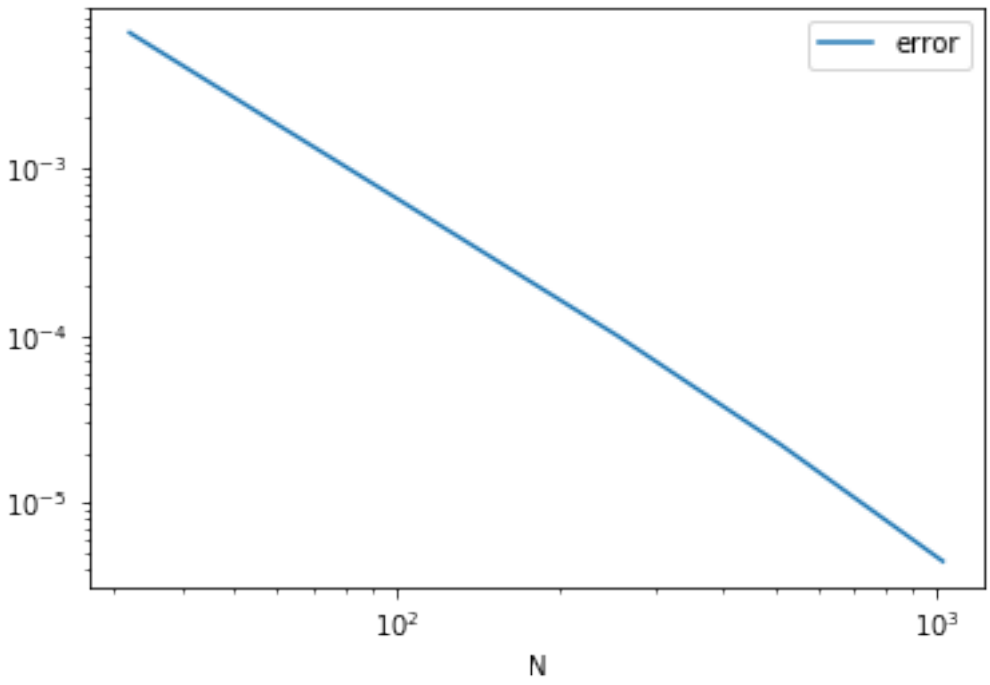
In [26]:
```
%%bash
mpirun -n 1 hmwk3_2n -n 1024 --itermax 1000000000 --tol 1e-10 > hmwk3_2n_N1024.csv
```

In [27]:
```
data = {}
columns = ['N', 'iterations', 'residual', 'error']
df = pd.DataFrame(columns=columns)
for n in [32,64,128,256,512,1024]:
    A = np.genfromtxt('hmwk3_2n_N' + str(n) + '.csv', delimiter=',')
    iterations = A[-3]
    residual = A[-2]
    error = A[-1]
    A = A[:-3]

    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)
```

```
           N  iterations      residual     error
32      32.0      1818.0  9.953100e-11  0.006438
64      64.0      6698.0  9.995121e-11  0.001607
128    128.0     24493.0  9.995176e-11  0.000401
256    256.0     88766.0  9.998733e-11  0.000100
512    512.0    318241.0  9.999830e-11  0.000022
1024  1024.0   1125679.0  9.999939e-11  0.000004
```

Out[27]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd28c9e0518>
```


error
10^{-3}
10^{-4}
10^{-5}
10^{2}
10^{3}
N