

**NANDINI BAJAJ 18CY20020****LAB 2**

```
1 import numpy as np
2 import math
3 import matplotlib.pyplot as plt
4 from matplotlib.pyplot import figure

1 def simpson(f,h):
2     sum = f[0]
3     for i in range(1, len(f)-1):
4         if i % 2 == 0:
5             c = 2
6         else:
7             c = 4
8         sum = sum + (c * f[i])
9     sum = sum * (h/3)
10    return sum

1 def trapezoidal(f,h):
2     sum = f[0]
3     for i in range(1, len(f)-1):
4         sum = sum + f[i]
5     sum = sum * h
6     return sum

1 def series(n, x):
2     temp = x
3     sum = x
4     for i in range(2, n + 1):
5         temp = ((-1 * temp) * ((x ** 2))) / ((2 * i - 2) * (2 * i - 1))
6         sum = sum + temp
7     return sum

1 def calculate(func, t, area, n, method):
2
3     if method == "simpson":
4         simp_err = []
5
6         for i in range(3, n, 2):
7             x = np.linspace(0, 1, i)
8             if(func == 'x'):
9                 y = x
10            elif(func == 'sin(x)'):
11                y = np.sin(x)
12            elif(func == 'series'):
13                x = np.linspace(0, np.pi, i)
14                y = [series(t, x) for x in x]
15            sum_simp = simpson(y, (1 / (i-1)))
```

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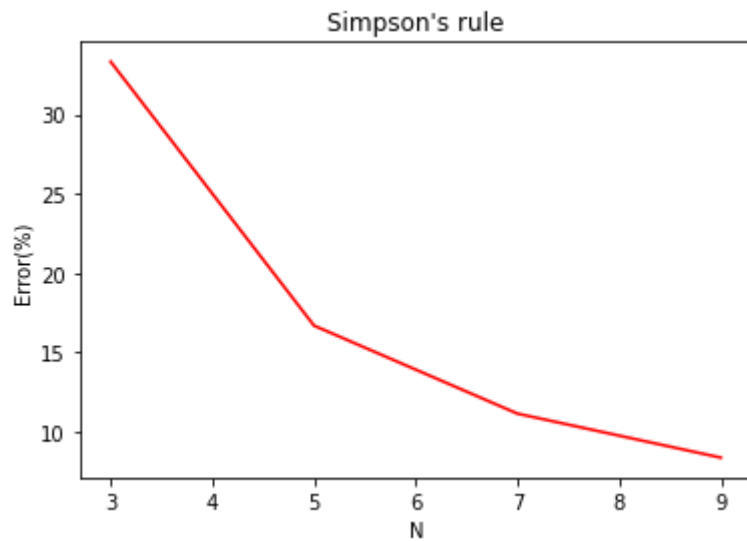
16     er = abs(((sum_simp - area) / (area)) * 100)
17     simp_err.append(er)
18
19     plt.plot(range(3, n, 2), simp_err, 'r')
20     plt.xlabel("N")
21     plt.ylabel("Error(%)")
22     plt.title("Simpson's rule")
23     plt.show()
24     print("The exact area is: ",area)
25     print("Area by simpson's rule= " + str(sum_simp) + " for iteration = " + st
26
27 elif method == "trapezoidal":
28     trap_err = []
29
30     for i in range(2, n):
31         x = np.linspace(0, 1, i)
32         if(func == 'x'):
33             y = x
34         elif(func == 'sin(x)'):
35             y = np.sin(x)
36         elif(func == 'series'):
37             x = np.linspace(0, np.pi, i)
38             y = [series(t, x) for x in x]
39             sum_trap = trapezoidal(y, 1 / (i - 1))
40             er = abs(((sum_trap - area) / (area)) * 100)
41             trap_err.append(round(er, 4))
42
43     plt.plot(range(2, n), trap_err)
44     plt.xlabel("N")
45     plt.ylabel("Error(%)")
46     plt.title("Trapezoidal rule")
47     plt.show()
48     print("The exact area is: ",area)
49     print("Area by trapezoidal rule= " + str(sum_trap) + " for iteration = " + :
50

```

```

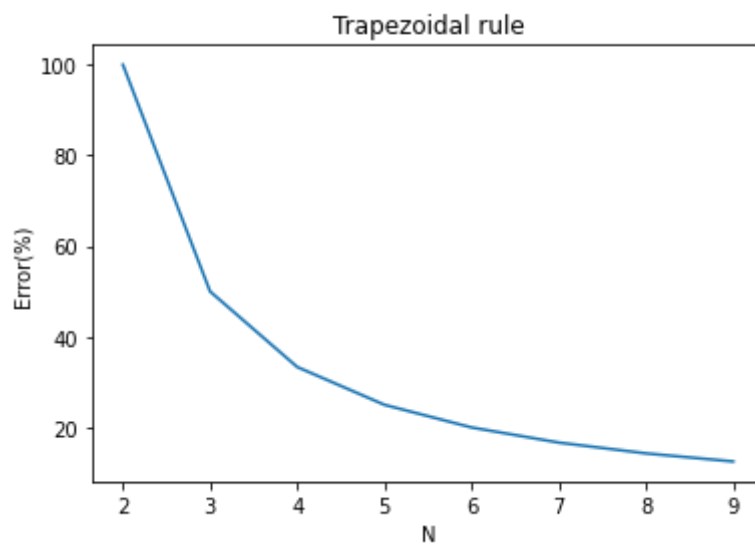
1 calculate('x', 0, 0.5, 10, 'simpson')
2 calculate('x', 0, 0.5, 10, 'trapezoidal')
3 calculate('sin(x)', 0, -np.cos(1)+1, 6, 'simpson')
4 calculate('sin(x)', 0, -np.cos(1)+1, 6, 'trapezoidal')
5 calculate('series', 2,-np.cos(np.pi)+1, 50, 'simpson')
6 calculate('series', 2,-np.cos(np.pi)+1, 50, 'trapezoidal')
7 calculate('series', 3,-np.cos(np.pi)+1, 100, 'simpson')
8 calculate('series', 3,-np.cos(np.pi)+1, 100, 'trapezoidal')
9 calculate('series', 4,-np.cos(np.pi)+1, 100, 'simpson')
10 calculate('series', 4,-np.cos(np.pi)+1, 100, 'trapezoidal')
11
12 calculate('series', 5,-np.cos(np.pi)+1, 100, 'simpson')
13 calculate('series', 5,-np.cos(np.pi)+1, 100, 'trapezoidal')
14
15 calculate('series', 100,-np.cos(np.pi)+1, 1000, 'simpson')
16 calculate('series', 100,-np.cos(np.pi)+1, 1000, 'trapezoidal')

```



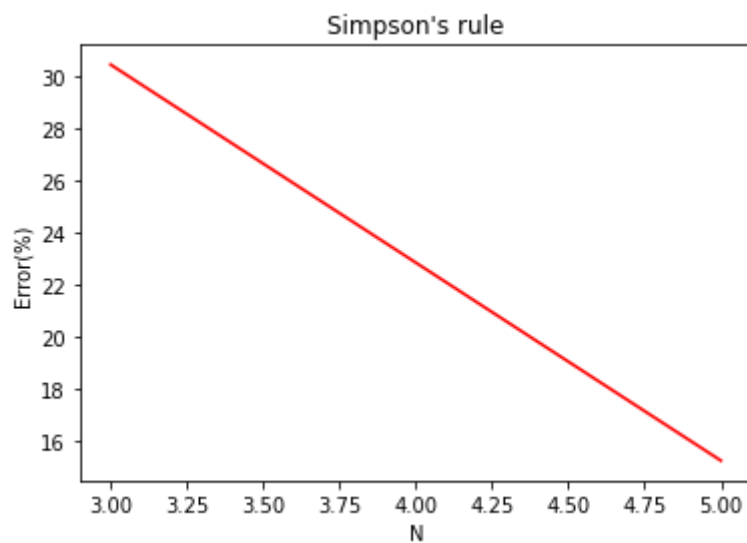
The exact area is: 0.5

Area by simpson's rule= 0.4583333333333333 for iteration = 7 Error = -8.33333



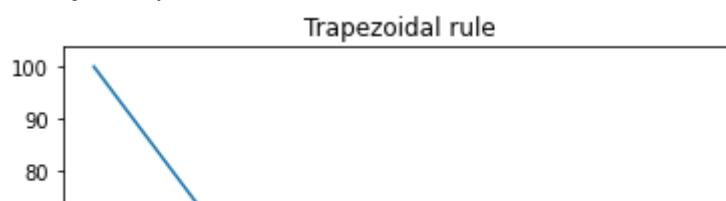
The exact area is: 0.5

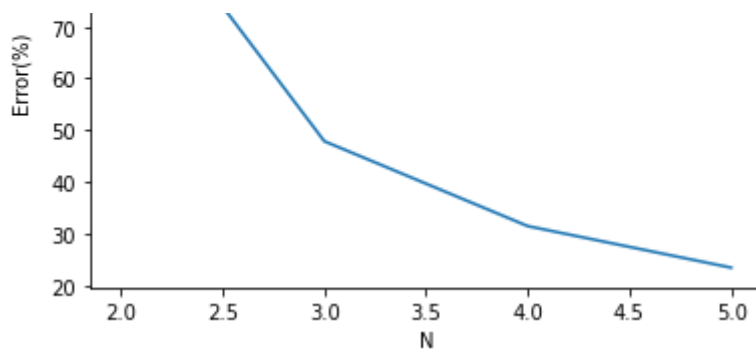
Area by trapezoidal rule= 0.4375 for iteration = 7 Error = -12.5



The exact area is: 0.45969769413186023

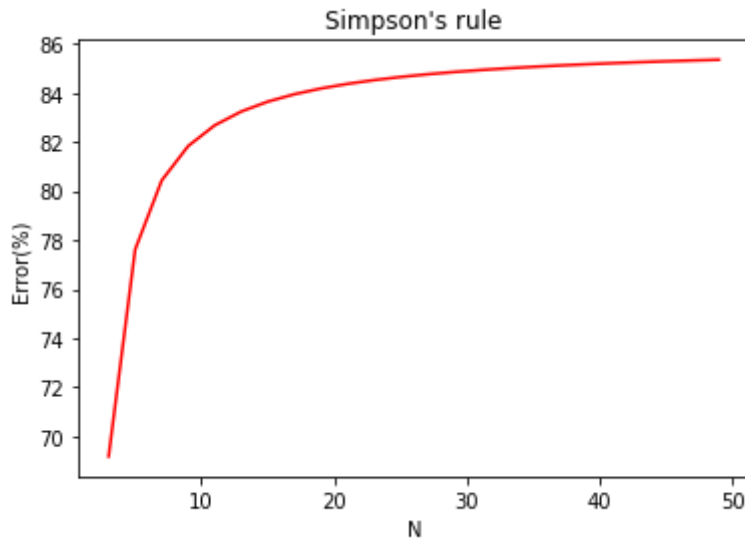
Area by simpson's rule= 0.38958516285998623 for iteration = 3 Error = -15.251





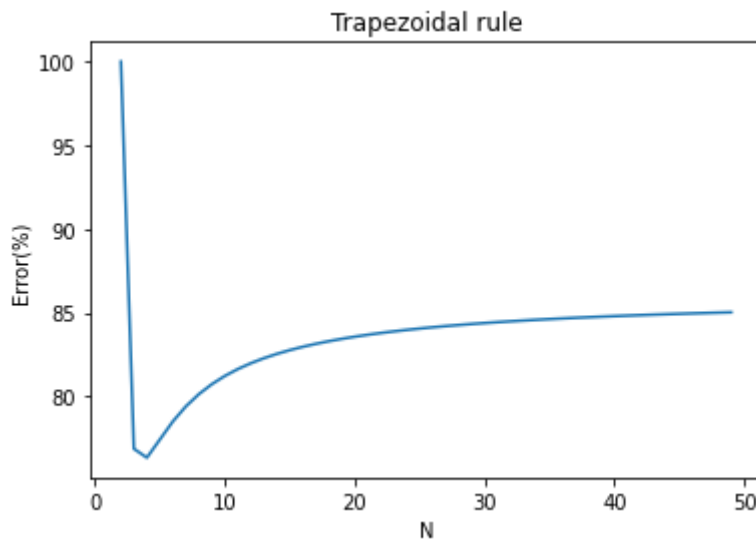
The exact area is: 0.45969769413186023

Area by trapezoidal rule= 0.35211706447051505 for iteration = 3 Error = -23.4



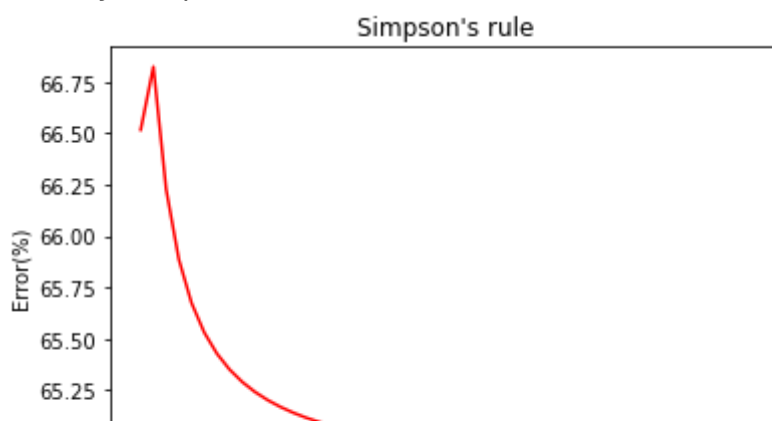
The exact area is: 2.0

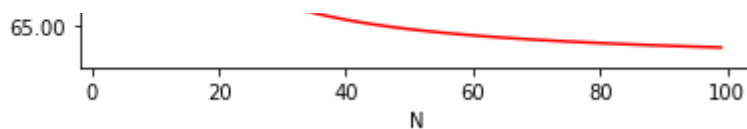
Area by Simpson's rule= 0.29293841043837787 for iteration = 47 Error = -85.35



The exact area is: 2.0

Area by trapezoidal rule= 0.29941281704283496 for iteration = 47 Error = -85.

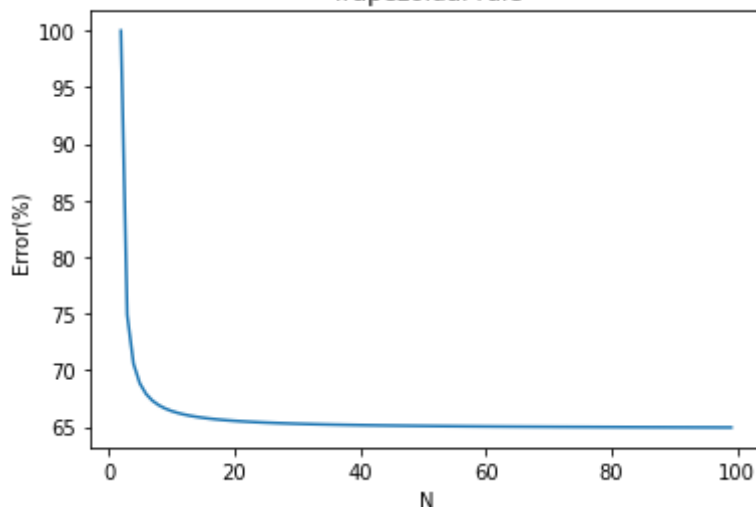




The exact area is: 2.0

Area by simpson's rule= 0.7021130186874293 for iteration = 97 Error = -64.894

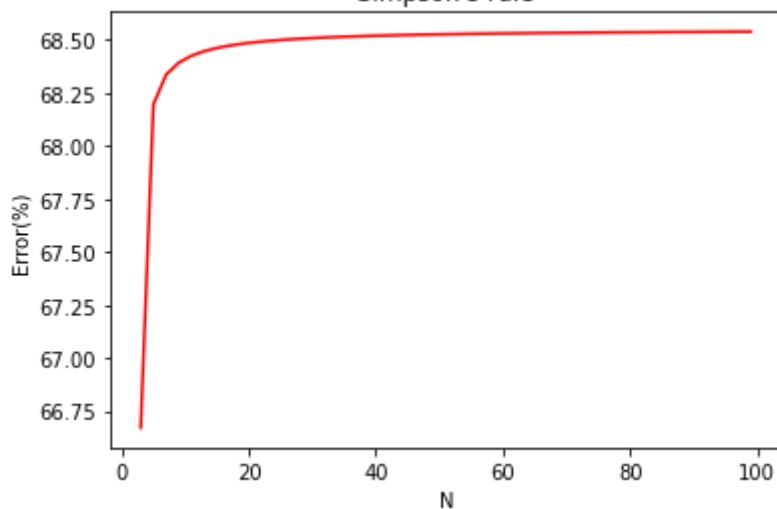
Trapezoidal rule



The exact area is: 2.0

Area by trapezoidal rule= 0.7011978943223398 for iteration = 97 Error = -64.9

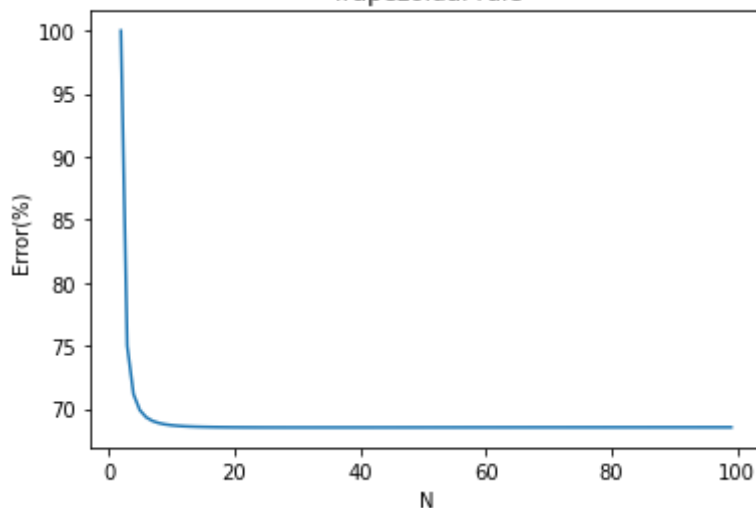
Simpson's rule



The exact area is: 2.0

Area by simpson's rule= 0.6292432596691806 for iteration = 97 Error = -68.537

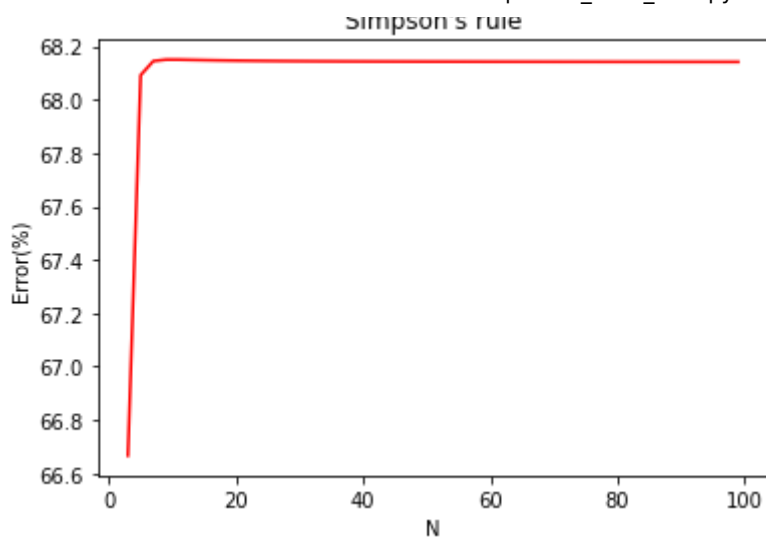
Trapezoidal rule



The exact area is: 2.0

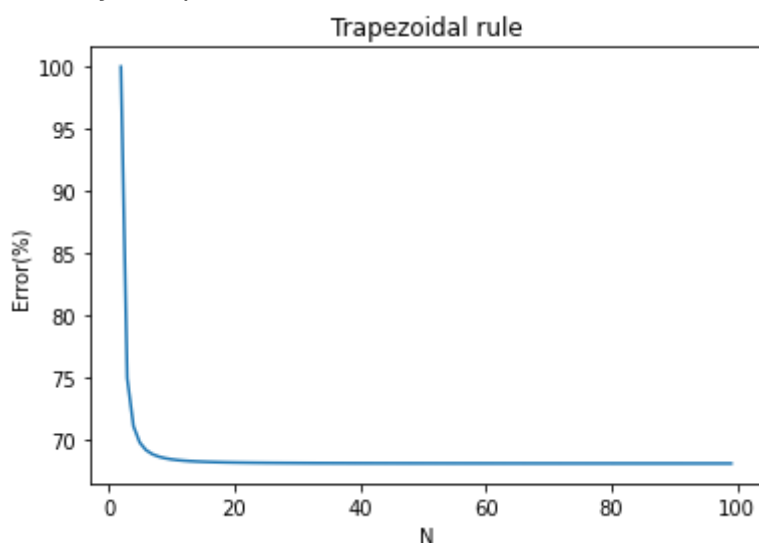
Area by trapezoidal rule= 0.629310903663278 for iteration = 97 Error = -68.53

Simpson's rule



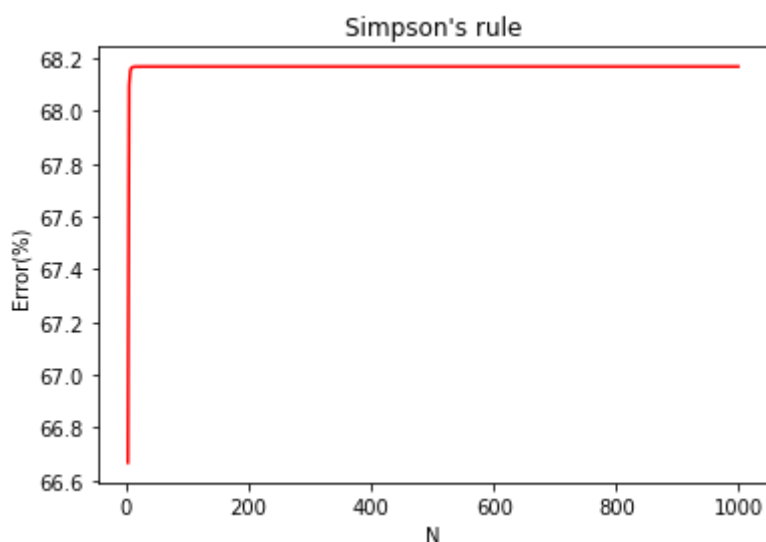
The exact area is: 2.0

Area by Simpson's rule= 0.6371784430454508 for iteration = 97 Error = -68.141



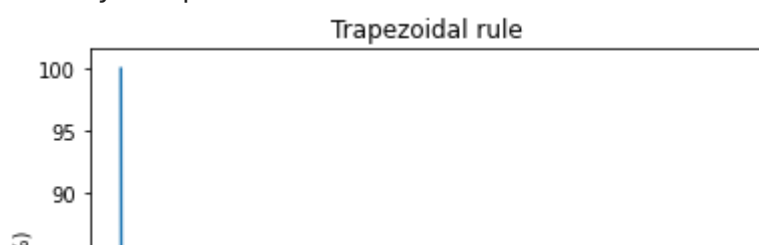
The exact area is: 2.0

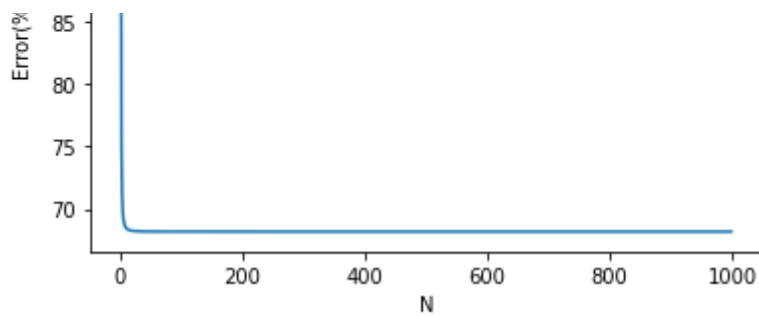
Area by trapezoidal rule= 0.6371127950091212 for iteration = 97 Error = -68.1



The exact area is: 2.0

Area by Simpson's rule= 0.6366197723679285 for iteration = 997 Error = -68.16





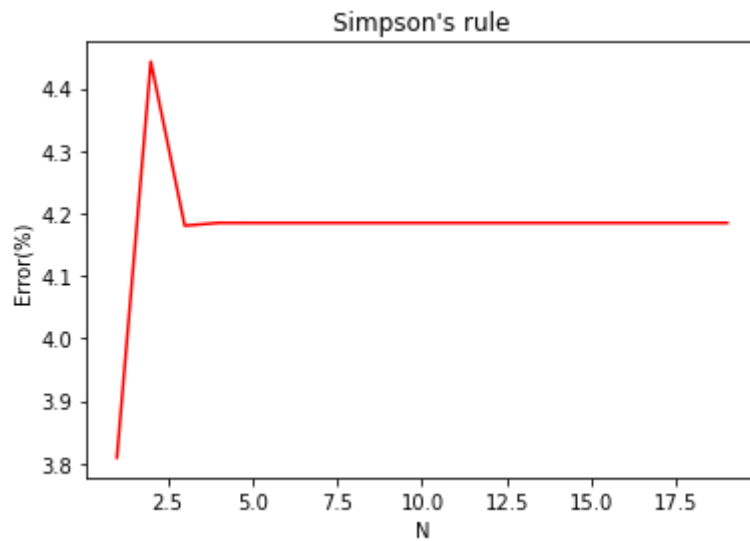
The exact area is: 2.0

Area by trapezoidal rule= 0.6366192466680224 for iteration = 997 Error = -68.

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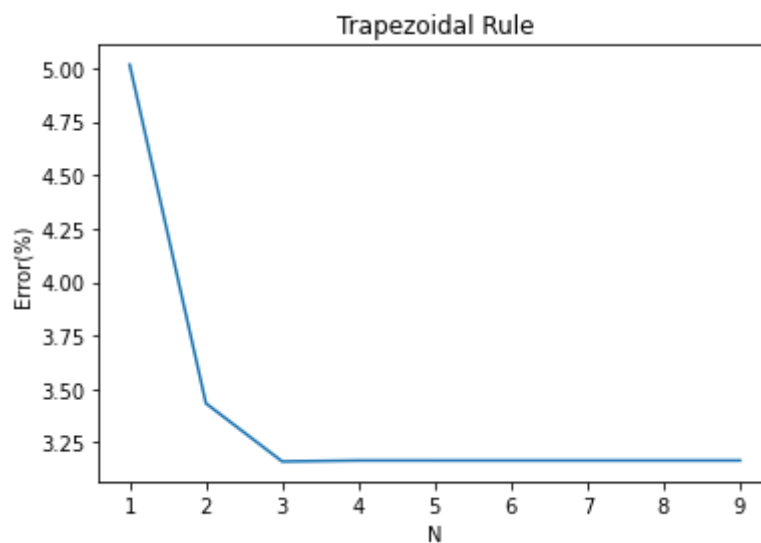
1 n = 30
2 area = -np.cos(1)+1
3
4 S1_E = []
5 S2_E = []
6
7 for i in range(1, 20):
8     x = np.linspace(0, 1, n)
9     y = [series(i, x) for x in x]
10    sum_simp = simpson(y, (1 / (n - 1)))
11    er = abs(((sum_simp - area) / area) * 100)
12    S1_E.append(er)
13
14 #print(S1_E)
15
16 plt.plot(range(1, 20), S1_E, 'r')
17 plt.xlabel("N")
18 plt.ylabel("Error(%)")
19 plt.title("Simpson's rule")
20 plt.show()
21 print("The exact area is: ",area)
22 print("Area by simpson's rule= " + str(sum_simp) + " for iteration = " + str(i-:
23
24
25
26
27 for i in range(1, 10):
28     x = np.linspace(0, 1, n)
29     y = [series(i, x) for x in x]
30     sum_trap = trapezoidal(y, (1 / (n - 1)))
31     er = abs(((sum_trap - area) / area) * 100)
32     S2_E.append(er)
33
34 plt.plot(range(1,10),S2_E)
35 plt.xlabel("N")
36 plt.ylabel("Error(%)")
37 plt.title("Trapezoidal Rule")
38 plt.show()
39 print("The exact area is: ",area)
40 print("Area by trapezoidal rule= " + str(sum_trap) + " for iteration = " + str(:
41
42

```



The exact area is: 0.45969769413186023

Area by simpson's rule= 0.44046062315188883 for iteration = 17 Error = -4.184



The exact area is: 0.45969769413186023

Area by trapezoidal rule= 0.4451440220984571 for iteration = 7 Error = -3.165



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