

Homework 1

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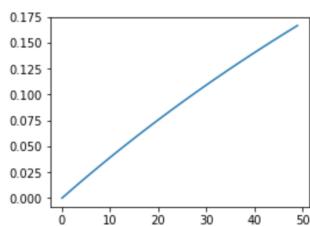
(a) Plot the integrand for $a = 5$ and $n = 1, 5, 10, 20, 30, 50$ in the domain $0 \leq x \leq 1$.

Codes:

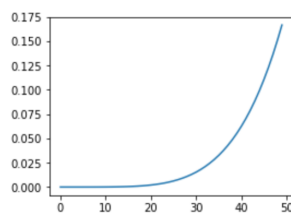
```
import numpy as np
from scipy import integrate
import matplotlib.pyplot as plt
for n in (1,5,10,20,30,50):
    plt.figure(figsize=(4,3))
    x = np.linspace(0, 1, 50)
    y=x**n/(x+5)
    plt.plot(y)
    print('when n is',n)
plt.show()
```

Results:

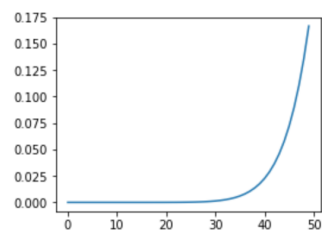
when n is 1

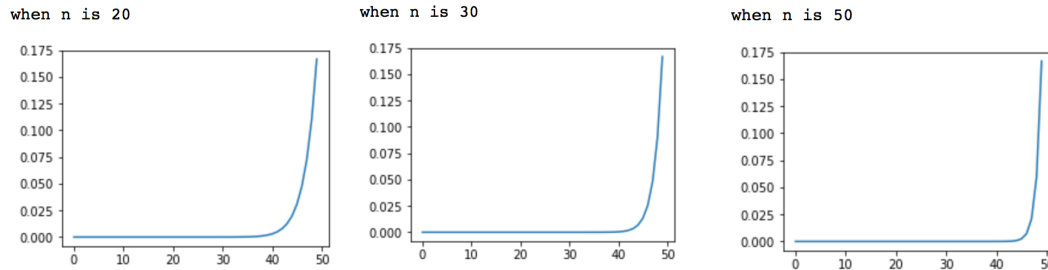


when n is 5



when n is 10





(b) Write a compute program that reads the value of a , the starting values n_0 and y_0 , and the final value n_1 , and performs the iteration from n_0 to n_1 (either backward or forward, depending on whether $n_1 < n_0$ or $n_1 > n_0$).

Codes:

```
import numpy as np
a=int(input('Please enter a :'))
y0=int(input('Please enter y0 :'))
n0=int(input('Please enter n0 :'))
n1=int(input('Please enter n1 :'))
```

```
if n0>n1:
    c=n1
    n1=n0
    n0=c
for i in np.arange(n0,n1+1):
    y0=1/(n0+1)-a*y0
    print(i,y0)
```

Results:

```
Please enter a :5
Please enter y0 :2
Please enter n0 :5
Please enter n1 :2
2 -9.666666666666666
3 48.666666666666664
4 -242.99999999999997
5 1215.3333333333333
```

(c) Experiment how this series behaves for iteration from $n_0 = 0$ to $n_1 = 30$ for $y_0 = \ln[(1+a)/a]$ with $a = 5$. Also try starting with $n_0 = 50$ and integrate back to $n_1 = 30$ for any starting value y_0 .

Codes:

```
import numpy as np
import math
a=int(input('Please enter a :'))
n0=int(input('Please enter n0 :'))
n1=int(input('Please enter n1 :'))
y0=math.log((1+a)/a)

if n0>n1:
    c=n1
    n1=n0
    n0=c
for i in np.arange(n0,n1+1):
    y0=1/(n0+1)-a*y0
    print(i,y0)
```

Results:

from $n_0 = 0$ to $n_1 = 30$:

```
Please enter a :5
Please enter n0 :0
Please enter n1 :30
0 0.08839221603022707
1 0.5580389198488647
2 -1.7901945992443231
3 9.950972996221616
4 -48.75486498110808
5 244.7743249055404
6 -1222.871624527702
7 6115.3581226385095
8 -30575.79061319255
9 152879.95306596273
10 -764398.7653298137
11 3821994.8266490684
12 -19109973.13324534
13 95549866.66622671
14 -477749332.3311336
15 2388746662.6556683
16 -11943733312.278341
17 59718666562.39171
18 -298593332810.95856
19 1492966664055.7927
20 -7464833320277.964
21 37324166601390.82
22 -186620833006953.1
23 933104165034766.5
24 -4665520825173831.0
25 2.3327604125869156e+16
26 -1.1663802062934578e+17
27 5.831901031467288e+17
28 -2.9159505157336443e+18
29 1.457975257866822e+19
30 -7.28987628933411e+19
```

from $n_0 = 50$ to $n_1 = 30$:

```
Please enter a :5
Please enter n0 :50
Please enter n1 :30
30 -0.8793497194536439
31 4.429006661784348
32 -22.112775244405615
33 110.5961342865442
34 -552.9484133682049
35 2764.7743249055407
36 -13823.839366463186
37 69119.22909038044
38 -345596.11319383763
39 1727980.5982272527
40 -8639902.958878199
41 43199514.826649055
42 -215997574.10098723
43 1079987870.5371943
44 -5399939352.653713
45 26999696763.300823
46 -134998483816.47186
47 674992419082.3916
48 -3374962095411.926
49 16874810477059.662
50 -84374052385298.28
```