

```

1. import numpy as np
2.
3. ## Integral module from comphy209 github
4. from gaussQuad2 import *
5. from triangleQuad import *
6.
7. ## Problem 1
8.
9. print("\n          ##### Problem 1. #####")
10.
11. def printIntegral(f,xs,ys,m=5):
12.     gauss = gaussQuad2(f,xs,ys,m)
13.     triangle = triangleQuad(f,xs[:2]+xs[3:4],ys[:2]+ys[3:4])\
14.         + triangleQuad(f,xs[1:4],ys[1:4])
15.     print(" Gauss      Integral      ",gauss)
16.     print(" Triangle Integral      ",triangle)
17.     return gauss, triangle
18.
19. print(" 1) f(x,y) = (1 - x^2)(1 - y^2)")
20. f = lambda x,y:(1 - x**2)*(1 - y**2)
21. printIntegral(f,[-1, 1, 1,-1],[-1,-1, 1, 1])
22.
23. print("\n 2) f(x,y) = x^2 y^2")
24. f = lambda x,y:x**2*y**2
25. printIntegral(f,[0,3,3,0],[0,0,2,2])
26.
27. print("\n 3) f(x,y) = exp(-(x^2+y^2))")
28. f = lambda x,y:np.exp(-(x**2+y**2))
29. printIntegral(f,[-1, 1, 1,-1],[-1,-1, 1, 1])
30.
31. print("\n 4) f(x,y) = cos(pi(x-y)/2)")
32. f = lambda x,y:np.cos(np.pi*(x-y)/2)
33. printIntegral(f,[-1, 1, 1,-1],[-1,-1, 1, 1])
34.
35.
36. ## Problem 2
37. print("\n\n          ##### Problem 2. #####")
38. f = lambda x,y:x
39. printIntegral(f,[-1, 1, 4, 0],[ 0, 0, 4, 4])
40.
41.
42. ## Problem 3
43. print("\n\n          ##### Problem 3. #####")
44. f = lambda x,y:x**2
45. printIntegral(f,[ 0, 3, 0, 0],[-2, 0, 4, 4])
46.
47. ## Problem 4
48. print("\n\n          ##### Problem 4. #####")
49.
50. xs = [-3, 1, 3,-1]; ys = [-2,-2, 2, 2]
51.
52. print(" 1) f(x,y) = (2 - x^2)(2 - x*y)")
53. f = lambda x,y:(2-x**2)*(2-x*y)
54. printIntegral(f,xs,ys)
55.
56. print("\n 2) f(x,y) = xy exp(-x^2)")
57. f = lambda x,y:x*y*np.exp(-x**2)
58. printIntegral(f,xs,ys)

```

out

```
##### Problem 1. #####
1) f(x,y) = (1 - x^2)(1 - y^2)
Gauss    Integral    1.777777777728277
Triangle Integral    1.6355555555555554

2) f(x,y) = x^2 y^2
Gauss    Integral    23.99999999392585
Triangle Integral    23.520000000000014

3) f(x,y) = exp(-(x^2+y^2))
Gauss    Integral    2.2310319079502987
Triangle Integral    2.005408235168953

4) f(x,y) = cos(pi(x-y)/2)
Gauss    Integral    1.6211391170197167
Triangle Integral    1.1209041432289477

##### Problem 2. #####
Gauss    Integral    13.333333332986866
Triangle Integral    13.333333333333336

##### Problem 3. #####
Gauss    Integral    13.499999999664036
Triangle Integral    13.5

##### Problem 4. #####
1) f(x,y) = (2 - x^2)(2 - x*y)
Gauss    Integral    38.39999999906208
Triangle Integral    38.39999999999999

2) f(x,y) = xy exp(-x^2)
Gauss    Integral    0.3952044648231357
Triangle Integral    -0.8070124608470459
```

I made function printIntegral

It print results of gauss-legendre integral and triangle integral

```
1. def printIntegral(f,xs,ys,m=5):
2.     gauss = gaussQuad2(f,xs,ys,m)
3.     triangle = triangleQuad(f,xs[:2]+xs[3:4],ys[:2]+ys[3:4])\
4.         + triangleQuad(f,xs[1:4],ys[1:4])
5.     print(" Gauss    Integral    ",gauss)
6.     print(" Triangle Integral    ",triangle)
7.     return gauss, triangle
```

In problem 1., gauss-legendre integral is larger than triangle integral.

but In other problem, gauss-legendre integral and triangle integral is same.

Because triangle integral not evaluate value of diagonal of integrate range.

problem 2

$$\int_0^4 \int_{\frac{y}{4}-1}^{\frac{3}{4}y+1} x dx dy = \int_0^4 \frac{1}{2} \left(\left(\frac{3}{4}y + 1 \right)^2 - \left(\frac{y}{4} - 1 \right)^2 \right) dy = \frac{40}{3}$$

$$40/3 = 13.3333...$$

Gauss	Integral	13.333333332986866
Triangle	Integral	13.333333333333336

problem 3

$$\int_0^3 \int_{\frac{2}{3}x-2}^{-\frac{4}{3}x+4} x^2 dy dx = \int_0^3 \frac{1}{3} \left(\left(-\frac{4}{3}x + 4 \right)^3 - \left(\frac{2}{3}x - 2 \right)^3 \right) dx = \frac{27}{2}$$

$$27/2 = 13.5$$

Gauss	Integral	13.499999999664036
Triangle	Integral	13.5