Math 152 – Python Lab 5

March 7, 2023

0.1 MATH 152 Lab 5

MATH 152 Lab 5 Section Number: 571

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[1]:
```
from sympy import *
from sympy.plotting import plot, plot_implicit
```

0.1.1 Question 1

1a

[2]:
```
x=symbols("x")
A=symbols("A")
B=symbols("B")
C=symbols("C")
D=symbols("D")
E=symbols("E")
F=symbols("F")
fx=(x**3-4*x+3)/((x-5)**2*(x**2+3)*(x**2+5))
denom=((x-5)**2*(x**2+3)*(x**2+5))
numer=(x**3-4*x+3)
Ax=A*denom/(x-5)
Bx=B*denom/(x-5)**2
CDx=(C*x+D)*denom/(x**2+3)
EFx=(E*x+F)*denom/(x**2+5)
print(Ax.expand())
print(Bx.expand())
print(CDx.expand())
print(EFx.expand())

Matr1=Matrix([[1,0,1,0,1,0],[-5,1,-10,1,-10,1],[8,0,30,-10,28,-10],[-40,8,-50,30,-30,28],[15,0
Matr2=Matrix([0,0,1,0,-4,3])
```

```
print(Matr1.solve(Matr2))

A=-5/1176
B=9/70
C=-31/392
D=69/392
E=1/12
F=-17/60

Fx=A/(x-5)+B/(x-5)**2+(C*x+D)/(x**2+3)+(E*x+F)/(x**2+5)
print((integrate(A/(x-5),x)+integrate(B/(x-5)**2,x)+integrate((C*x+D)/
  ↪(x**2+3),x)+integrate((E*x+F)/(x**2+5),x)))
```

```
A*x**5 - 5*A*x**4 + 8*A*x**3 - 40*A*x**2 + 15*A*x - 75*A
B*x**4 + 8*B*x**2 + 15*B
C*x**5 - 10*C*x**4 + 30*C*x**3 - 50*C*x**2 + 125*C*x + D*x**4 - 10*D*x**3 +
30*D*x**2 - 50*D*x + 125*D
E*x**5 - 10*E*x**4 + 28*E*x**3 - 30*E*x**2 + 75*E*x + F*x**4 - 10*F*x**3 +
28*F*x**2 - 30*F*x + 75*F
Matrix([[-5/1176], [9/70], [-31/392], [69/392], [1/12], [-17/60]])
-0.00425170068027211*log(1.0*x - 5.0) - 1.0*(0.0395408163265306 +
0.0508127150179645*I)*log(1.0*x - 2.22044604925031e-16 - 1.73205080756888*I) -
1.0*(0.0395408163265306 - 0.0508127150179645*I)*log(1.0*x - 2.22044604925031e-16
+ 1.73205080756888*I) - 0.128571428571429/(1.0*x - 5.0)
```

1b

[3]:
```
print(integrate(apart(fx),x))
```

```
-5*log(x - 5)/1176 - 31*log(x**2 + 3)/784 + log(x**2 + 5)/24 +
23*sqrt(3)*atan(sqrt(3)*x/3)/392 - 17*sqrt(5)*atan(sqrt(5)*x/5)/300 - 9/(70*x -
350)
```

1c

[4]:
```
print(integrate(fx))
print("the parts in B and C are the same and are nearly equal to part A with␣
  ↪ou")
```

```
-5*log(x - 5)/1176 - 31*log(x**2 + 3)/784 + log(x**2 + 5)/24 +
23*sqrt(3)*atan(sqrt(3)*x/3)/392 - 17*sqrt(5)*atan(sqrt(5)*x/5)/300 - 9/(70*x -
350)
the parts in B and C are the same and are nearly equal to part A with ou
```

0.1.2 Question 2

2a

[5]:
```
x = symbols("x", positive=True)
a = symbols("a", positive=True)
```

```
f = x ** 2 / (x ** 4 + a ** 2)
F = integrate(f, (x, 0, oo))
ans = solve(F - 0.1, a)
print("our a value is:", ans)
```

```
our a value is: [123.370055013617]
```

2b

[6]:
```
fx = x ** 6 * exp(-(x ** 7))
Fx1 = integrate(fx, (x, 1, a))
Fx2 = integrate(fx, (x, a, oo))
ans = solve(Fx1 - Fx2, a)
print("our a value is:", ans)
```

```
our a value is: [log(2*E)**(1/7)]
```

2C

[7]:
```
newans = integrate(fx, (x, 1, ans))
print("the integral from 1 to the a value we got in part B is:", newans)
print("since the the integrals are equal integrating from 1 to infinity is just␣
 ↪double that at:", newans * 2)
```

```
the integral from 1 to the a value we got in part B is: exp(-1)/14
since the the integrals are equal integrating from 1 to infinity is just double
that at: exp(-1)/7
```

0.1.3 Question 3

3a

[8]:
```
# show that g(x) = 1/x^3 converges
# via the integral from 1 to inf
x = Symbol("x")
g = 1 / x ** 2

value = integrate(g, (x, 1, oo))

print(f"Via the integral, the value of the integral is {value}")
print("Since I got a finite value, the integral converges")
```

```
Via the integral, the value of the integral is 1
Since I got a finite value, the integral converges
```

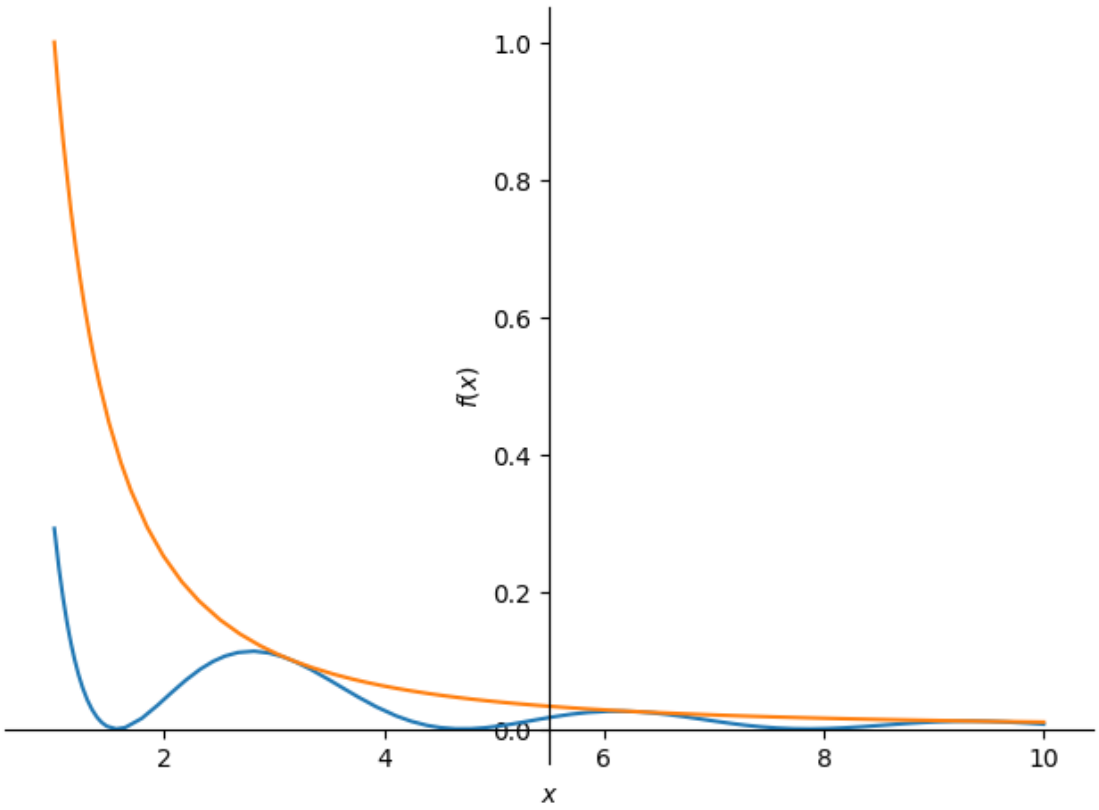
3b

[9]:
```
# plot f(x) and g(x) on the same axis in the domain x = [1, 10]
# to show f(x) <= g(x) on the given interval
f = (abs(x) * cos(x) ** 2) / (x ** 3)
```

```
p1 = plot(f, (x, 1, 10), show=False)
p2 = plot(g, (x, 1, 10), show=False)
p1.extend(p2)

p1.show()

print(f"Above is a plot of f(x) = {f} and g(x) = {g} on the interval [1, 10]")
print("As you can see, f(x) <= g(x) on the given interval")
print("The graph of f(x) is the blue line, and the graph of g(x) is the orange␣
 ↪line")
```




```
Above is a plot of f(x) = cos(x)**2*Abs(x)/x**3 and g(x) = x**(-2) on the
interval [1, 10]
As you can see, f(x) <= g(x) on the given interval
The graph of f(x) is the blue line, and the graph of g(x) is the orange line
```

3c

[10]:
```
# evaluate the integral of f(x) from 1 to inf
# f(x) = |x|*cos^2(x) / x^3

value = integrate(f, (x, 1, oo))
```

```
print(f"The value of the integral {f} from 1 to infinity is {value.evalf()} or␣
↪{value}")
```

```
The value of the integral cos(x)**2*Abs(x)/x**3 from 1 to infinity is
0.326543231734227 or sqrt(pi)*(-2*sqrt(pi) - (-4*Si(2) - 2*cos(2))/sqrt(pi))/4 +
1/2
```