MATH 151 Lab 4

Put team members' names and section number here.

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Section number 576

In [1]:
```
from sympy import *
from sympy.plotting import (plot,plot_parametric)
```

Question 1

1a

In [2]:
```
#tangent line
x, t, n = symbols('x, t, n')
expr0 = (2 * x + 1) / (x ** 2 + 2)
tangent = expr0.subs(x, 2) + diff(expr0, x).subs(x, 2) * (x - 2)
print(f"The equation of the tangent line where x = 2 is y = {tangent}")
```

```
The equation of the tangent line where x = 2 is y = 23/18 - 2*x/9
```

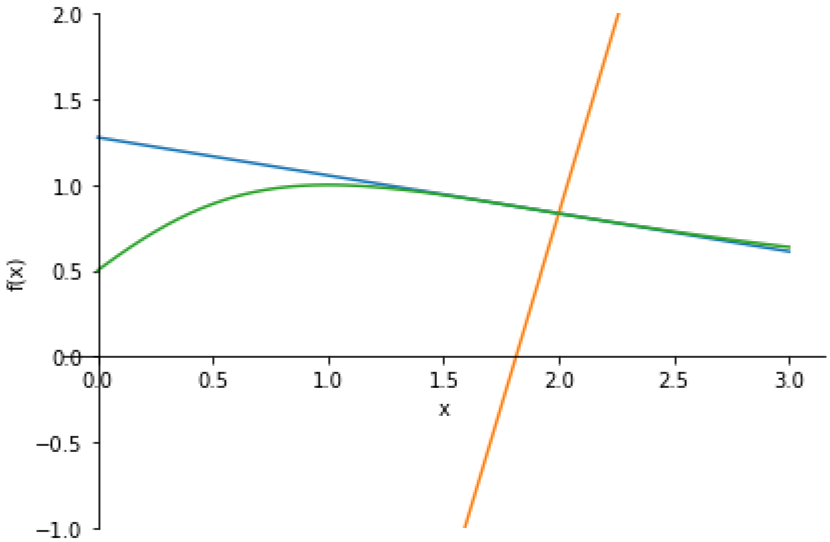
1b

In [3]:
```
#normal line
normal = expr0.subs(x, 2) + -1 / (diff(expr0, x).subs(x, 2)) * (x - 2)
print(f"The equation of the normal line where x = 2 is y = {normal}")
```

```
The equation of the normal line where x = 2 is y = 9*x/2 - 49/6
```

1c

In [4]:
```
#graph
plot((tangent, (x, 0, 3)), (normal, (x, 0, 3)), (expr0, (x, 0, 3)), ylim = (-1, 2))
```

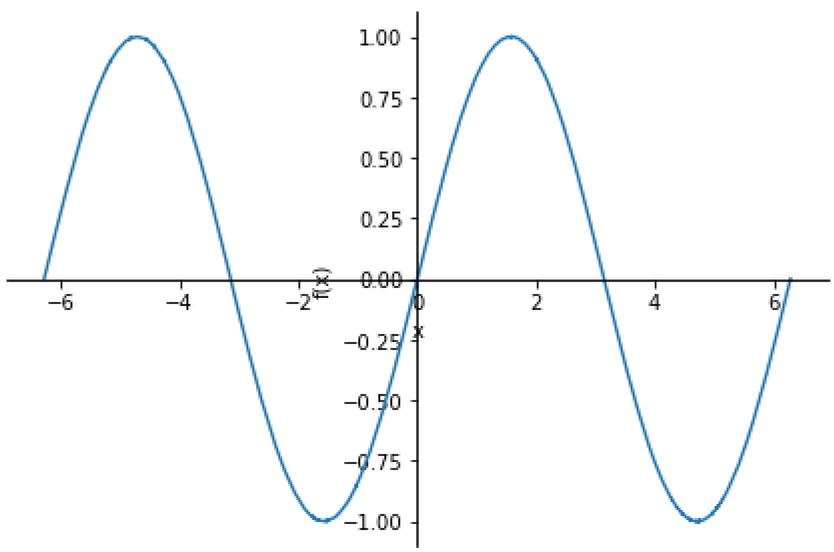


Out[4]: <sympy.plotting.plot.Plot at 0x1bcf4828d60>

Question 2

2a

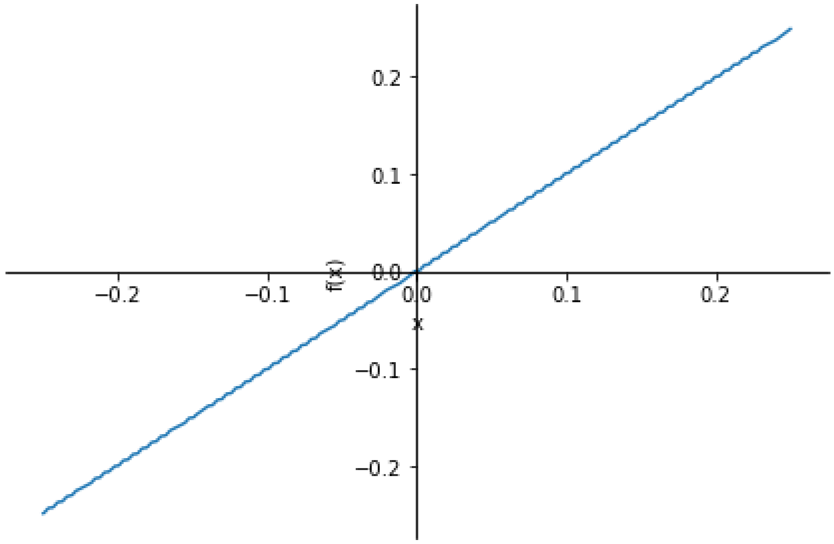
In [5]:
```
#[-2pi,2pi]
expr1 = sin(x) - (1/1000) * sin(1000 * x)
plot(expr1, (x, -2 * pi, 2 * pi))
print("Slope of y look like about 1 near x = 0")
```




```
Slope of y look like about 1 near x = 0
```

2b

In [6]:
```
#[-0.25,0.25]
plot(expr1, (x, -0.25, 0.25))
print("Slope of y looks like about 1 near x = 0")
```



Slope of y looks like about 1 near x = 0

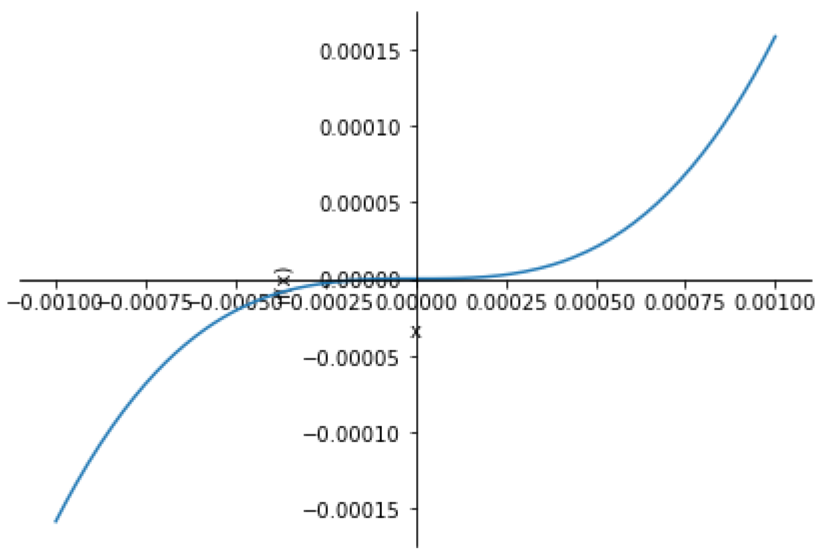
2c

In [7]:
```
#Evaluate slope of tangent line
print(f"The actual slope of the tangent line of y at x = 0 is {diff(expr1, x).subs(x,
```

The actual slope of the tangent line of y at x = 0 is 0

2d

In [8]:
```
#[-0.001,0.001]
plot(expr1, (x, -0.001, 0.001))
```



Out[8]: <sympy.plotting.plot.Plot at 0x1bcf711f0a0>

Question 3

3a

In [9]:
```
#AROC
expr2 = 100000 * (1 - (1/60) * t) ** 2
```

```
print(f"The average rate of change of V from 0 to 10 minutes is {(expr2.subs(t, 10) -
```

```
The average rate of change of V from 0 to 10 minutes is -3055.55555555555
```

3b

In [10]:
```
#IROC
print(f"The instantaneous rate of change of V with respect to t is V'(t) = {diff(expr2
```

```
The instantaneous rate of change of V with respect to t is V'(t) = 55.5555555555556*t
- 3333.33333333333
```

3c

In [11]:
```
#relationship?
print(f"The instantaneous rate of change of V at t = 10 minutes is {diff(expr2, t).sub
print("The answers in parts (a) and (c) are different because part (a) is asking for t
```

```
The instantaneous rate of change of V at t = 10 minutes is -2777.77777777778 gallons
per minute
The answers in parts (a) and (c) are different because part (a) is asking for the ave
rage rate of change over a period of time, while part (c) is asking for the instantan
eous rate of change at a specific point in time. The two are different because the fu
nctions rate of change changes with time since it is a quadratic and not a linear fun
ction.
```

Question 4

4a

In [12]:
```
#8 derivatives
expr3 = E ** x * (1 + x ** 2)
i = 1
while i <= 8:
    print("f", end = "")
    for j in range(i):
        print("'", end = "")
    print(f"(x) = {diff(expr3, x, i)}")
    i += 1
```

```
f'(x) = 2*x*exp(x) + (x**2 + 1)*exp(x)
f''(x) = (x**2 + 4*x + 3)*exp(x)
f'''(x) = (x**2 + 6*x + 7)*exp(x)
f''''(x) = (x**2 + 8*x + 13)*exp(x)
f'''''(x) = (x**2 + 10*x + 21)*exp(x)
f''''''(x) = (x**2 + 12*x + 31)*exp(x)
f'''''''(x) = (x**2 + 14*x + 43)*exp(x)
f''''''''(x) = (x**2 + 16*x + 57)*exp(x)
```

4b

In [13]:
```
#formula for derivative
nthderiv = E ** x * (x ** 2 + 2 * n * x + (n ** 2 - n + 1))
print(f"The formula for the nth derivative of f is {nthderiv}")
```

```
The formula for the nth derivative of f is (n**2 + 2*n*x - n + x**2 + 1)*exp(x)
```

4c

In [14]:
```
#50th
print(f"{diff(expr3, x, 50)}")
print(f"{nthderiv.subs(n, 50)}")
```

```
(x**2 + 100*x + 2451)*exp(x)
(x**2 + 100*x + 2451)*exp(x)
```

In [ ]:

In [ ]: