# OnurOnel_Assignment02

September 29, 2024

[1]:
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# B.Sc. Software Engineering (1st year)
# Submitted 09/29/2024

# This import statement will allow to receive more than one output from a␣
↪single code cell.
from IPython.core.interactiveshell import InteractiveShell
InteractiveShell.ast_node_interactivity = "all"
```

[2]:
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# (Question 1) - Variable declaration
x = var('x')

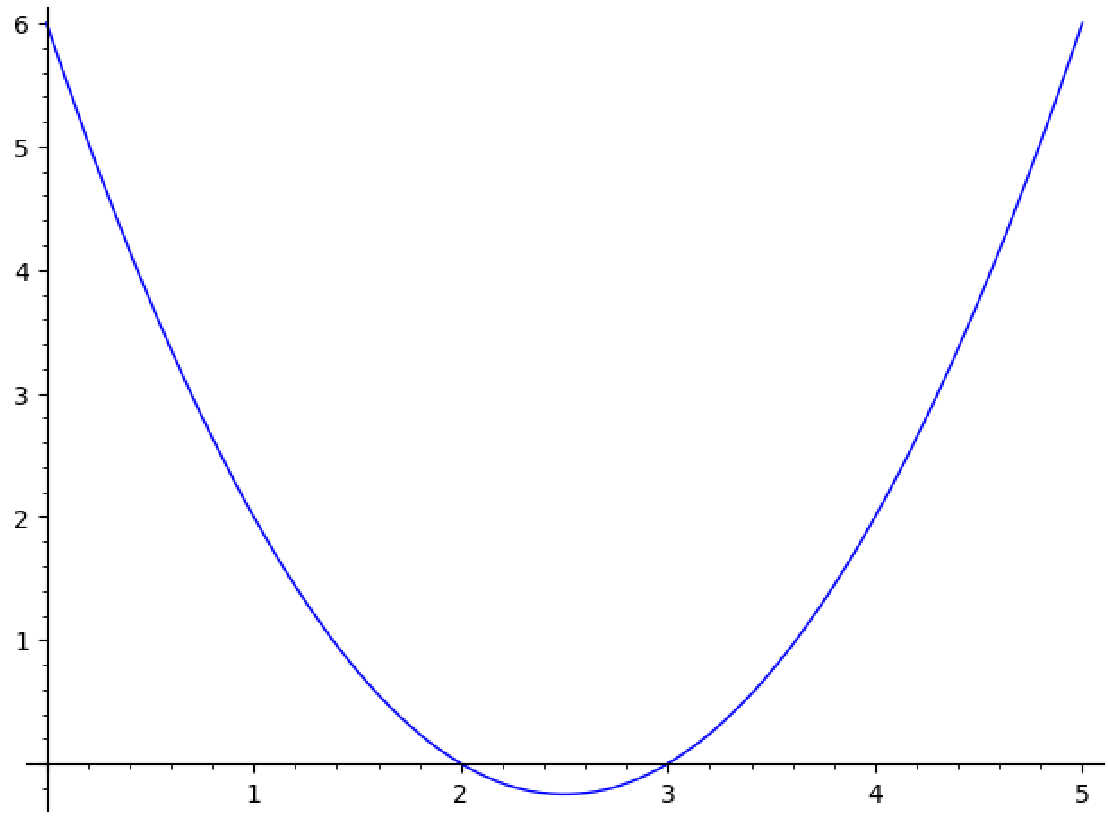
# (Question 1) - Quadratic expression
fx = x^2 - 5*x + 6

# (Question 1.a) - Graphing within the range of "0 <= x <= 5"
p =plot(fx, (x,0,5))
p.show()

# (Question 1.b) - Evaluate the function at x = 0
x_at_zero = fx.subs(x=0)
show("1.b) The roots of y = f(0) -> ",x_at_zero)

# (Question 1.c) - Solve the equation for x
roots = solve(fx,x)

# (Question 1.c) - Print the roots
show("1.c) The roots of y = f(x) -> ",roots)
```




1.b) The roots of y = f(0) -> $6$

1.c) The roots of y = f(x) -> $[x = 3, x = 2]$

[11]:
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clear_vars()

# Variable declaration
x = var('x')

# (Question 2) - Quadratic expressions
fx = x^2 - 5*x + 6
gx = x^4 - 10*x^3 + 35*x^2 - 50*x + 24

# (Question 1.a) - Graphing within the range of "0 <= x <= 5" and "-30 < y < 30"
p = plot(gx, (x,-5,5), ymin=-30, ymax=30)
p.show()
# (Question 2.b) - Finding roots of g(x) by solving g(x) = 0
roots = solve(gx == 0, x)
show("2.b) g(x) roots: ",roots)

# (Question 2.c) - Define polynomials over rational numbers (QQ) in variable x
R = QQ['x']
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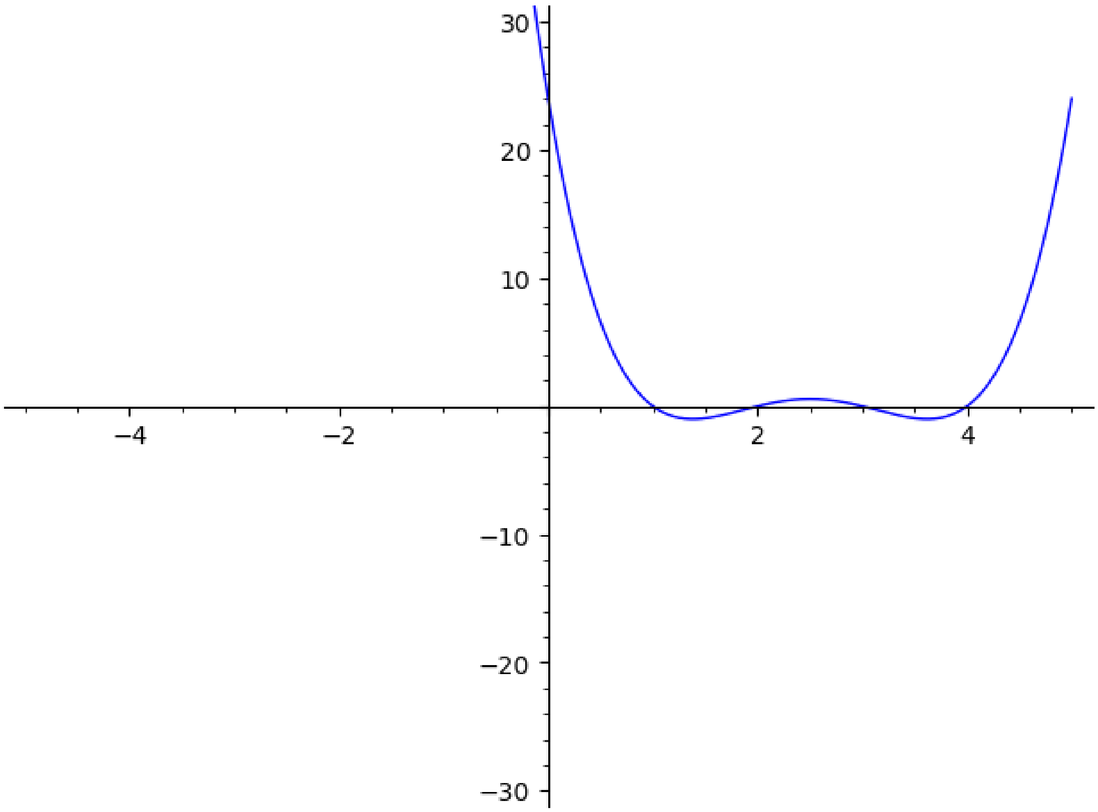
fx_poly = R(fx)
gx_poly = R(gx)

# (Question 2.c) - Polynomial division, gx_poly divided by fx_poly
quotient, remainder = gx_poly.quo_rem(fx_poly)
show("2.c) h(x) = ", quotient)
```




2.b) g(x) roots: $[x = 3, x = 4, x = 1, x = 2]$

2.c) h(x) =$x^2 - 5x + 4$

[9]:
```
clear_vars()

# Variable declaration
x = var('x')

# (Question 3.a) - Function y = x
f1 = x

# (Question 3.a) - Function y = sin(x)
f2 = sin(x)
```

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# (Question 3.a) - Graphing the functions
p1 = plot(f1, (x, -pi, pi), ymin=-2, ymax=2, color='blue')
p2 = plot(f2, (x, -pi, pi), ymin=-2, ymax=2, color='red')

# (Question 3.a) - Combining the plots
p1 + p2

# (Question 3.b) - Function y = |x|
f3 = abs(x)

# (Question 3.b) - Function y = |sin(x)|
f4 = abs(sin(x))

# (Question 3.b) - Graphing the absolute functions
p3 = plot(f3, (x, -pi, pi), ymin=-2, ymax=2, color='green')
p4 = plot(f4, (x, -pi, pi), ymin=-2, ymax=2, color='purple')

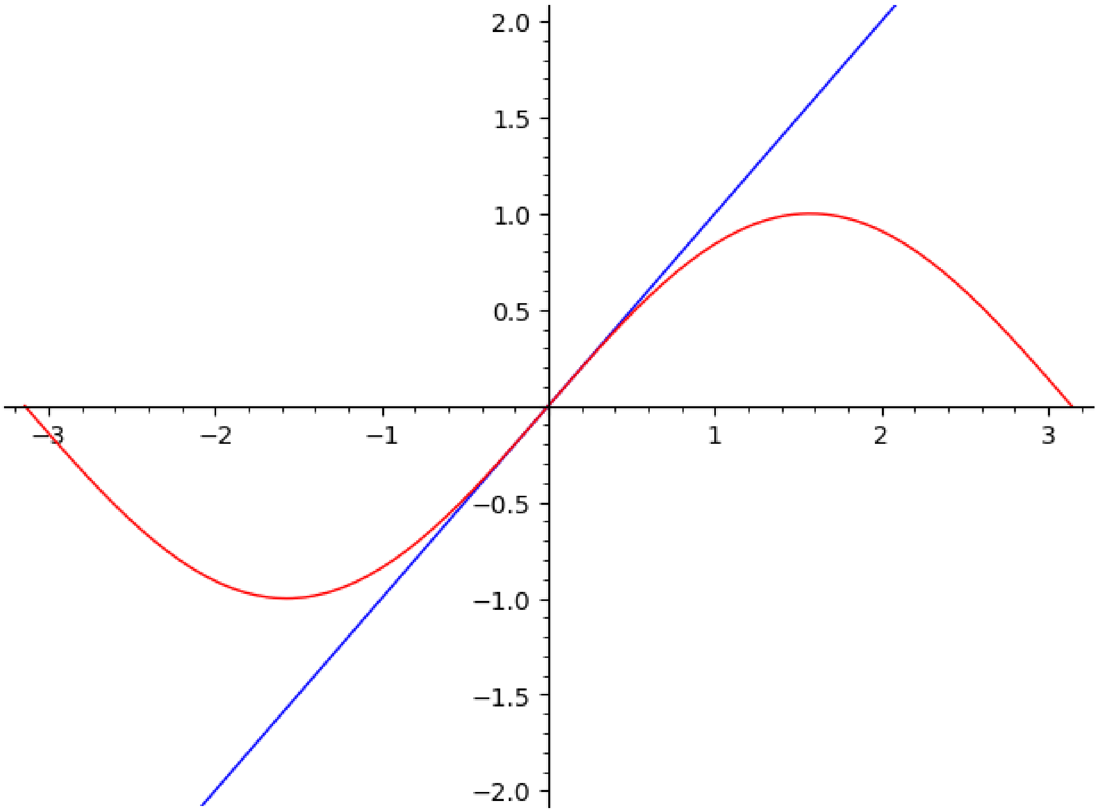
# (Question 3.b) - Combining the plots
p3 + p4

# (Question 3.c) - sin(x)|   |x| for all x, and that equality occurs only when␣
↪x = 0.
show("(3.c) Since sin(x) is bounded between -1 and 1, i.e., -1 <= sin(x) <= 1")
show(" We have -|x| <= sin(x) <= |x| for all x")
show(" Therefore, |sin(x)| <= |x| for all x, and equality occurs only when x =␣
↪0")

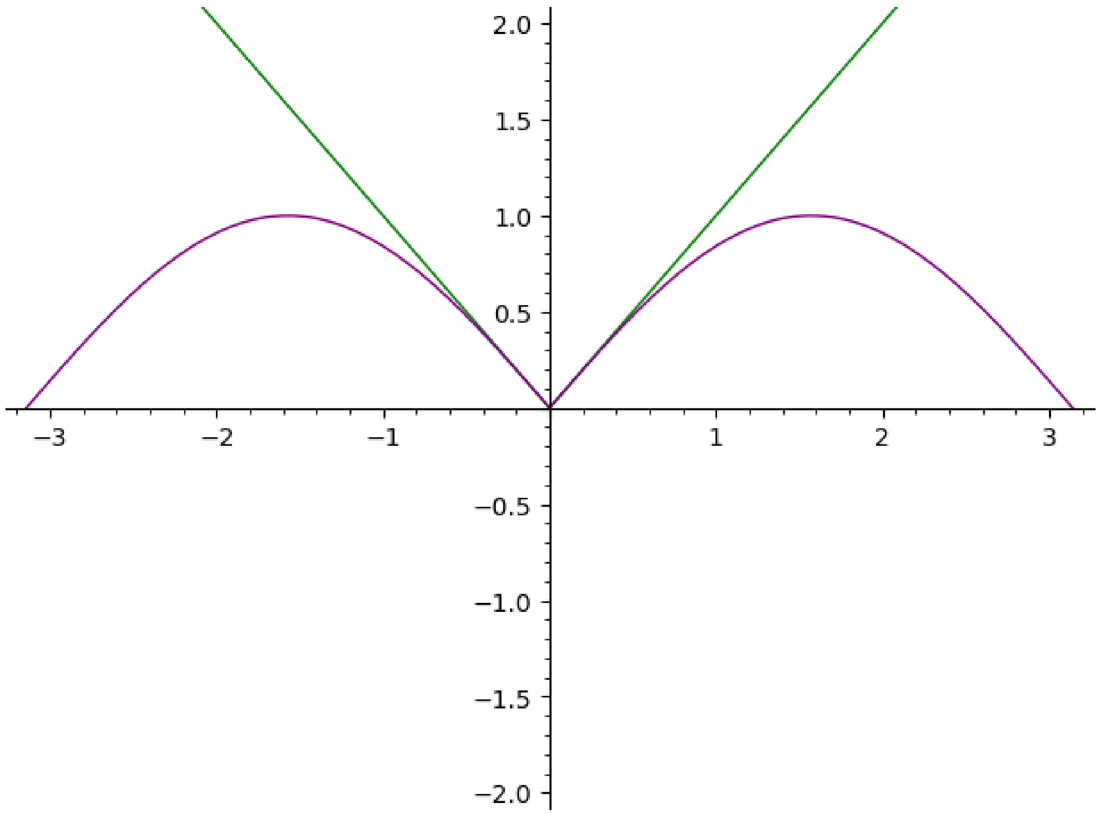
# (Question 3.c) - Graphing the absolute functions
p5 = plot(f3, (x, -2*pi, 2*pi), color='orange')
p6 = plot(f4, (x, -2*pi, 2*pi), color='pink')

# (Question 3.c) - Combining the plots
p5 + p6
```

[9]:




[9]:

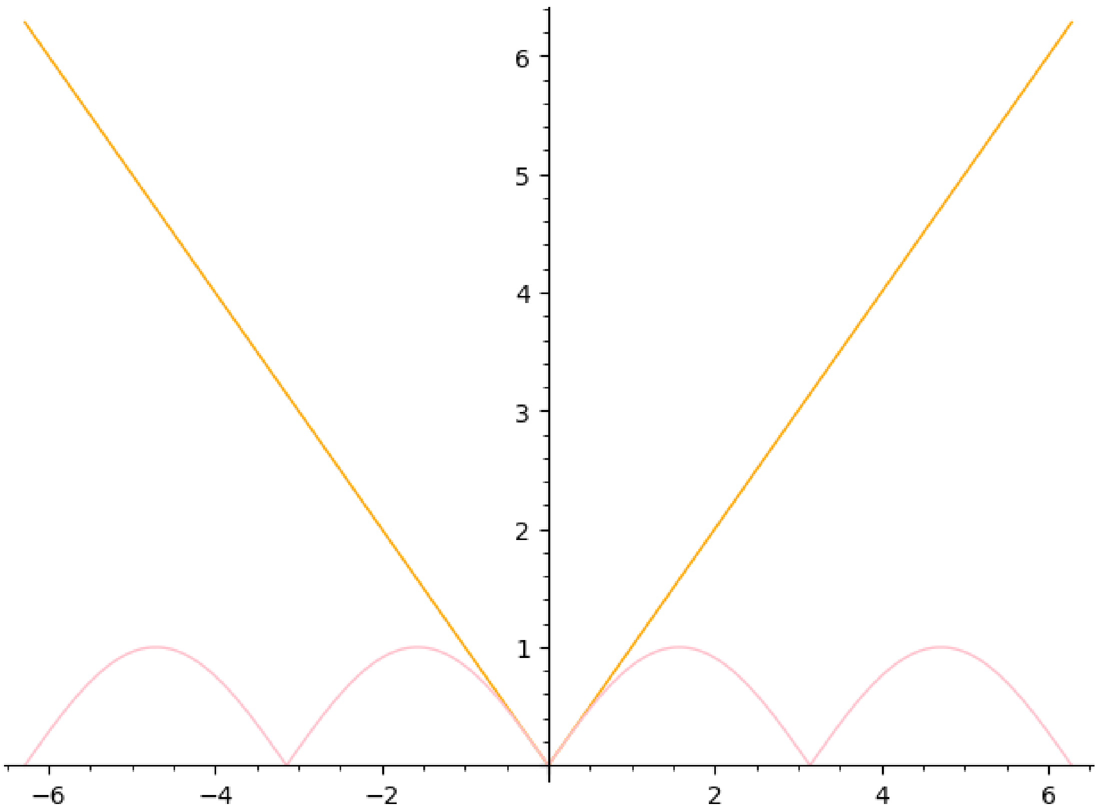



(3.c) Since sin(x) is bounded between -1 and 1, i.e., -1 <= sin(x) <= 1

We have -|x| <= sin(x) <= |x| for all x

Therefore, |sin(x)| <= |x| for all x, and equality occurs only when x = 0

[9]:




[8]:
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# (Question 4) - Definition of sinh(x)
s(x) = (exp(x) - exp(-x))/2

# (Question 4) - Display the function s(x)
show(s(x))

# (Question 4) - Solve for x in terms of y (which is s(x))
inverse_s = solve(s(x) == y, x)

# (Question 4) - Display the definition of arsinh(x)
show(inverse_s)
```

$$-\frac{1}{2}\,e^{(-x)}+\frac{1}{2}\,e^{x}$$

$$\left[x=\log\left(y-\sqrt{y^{2}+1}\right),x=\log\left(y+\sqrt{y^{2}+1}\right)\right]$$