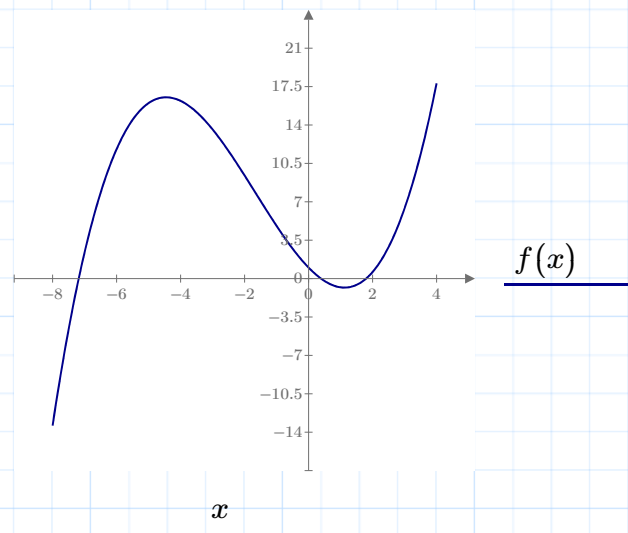# Lecture 20 Practice - Plotting and Nonlinear Equations

Plotting

(a) Plot the function $f(x) = \dfrac{1}{5} x^3 + x^2 - 3\,x + 1$ for x from -8 to 4.

$$f(x) := \frac{1}{5} x^3 + x^2 - 3\,x + 1$$

$f(x)$

x

Polyroots

(b) Find all of the roots of the polynomial in part a.

$$c := \begin{bmatrix} 1 \\ -3 \\ 1 \\ \dfrac{1}{5} \end{bmatrix} \qquad \text{polyroots}(c) = \begin{bmatrix} -7.185 \\ 0.387 \\ 1.797 \end{bmatrix}$$

Single Nonlinear Equation

(c) Use **root** to find one of the roots of the polynomial given in part a.

$$xg := 2$$

$$\mathbf{root}\left(f(xg), xg\right) = 1.797$$

System of Nonlinear Equations

(d) Solve the following system of equations:

$$y_1 \cdot P = x_1 \cdot exp\left(A_1 - \frac{B_1}{T + C_1}\right)$$

$$y_2 \cdot P = x_2 \cdot exp\left(A_2 - \frac{B_2}{T + C_2}\right)$$

$$y_1 + y_2 = 1$$

$$x_1 + x_2 = 1$$

I dropped the units on this problem to make it more simple. This is obviously a bad idea normally.

FYI: T is in degrees Celcius, P is in kPa. x and y are mole fractions (unitless)

for x1 and T, where

$$P := 120 \qquad y_1 := 0.33 \qquad A_1 := 13.7819 \qquad B_1 := 2726.81 \qquad C_1 := 217.572$$

$$A_2 := 13.9320 \qquad B_2 := 3056.96 \qquad C_2 := 217.625$$

Guess Values

$$x_1 := 0.5$$

$$T := 300$$

Constraints

$$y_1 \cdot P = x_1 \cdot exp\left(A_1 - \frac{B_1}{T + C_1}\right)$$

$$(1 - y_1) \cdot P = (1 - x_1) \cdot exp\left(A_2 - \frac{B_2}{T + C_2}\right)$$

<-- By subbing in x1 and y1, I only have 2 equations and 2 unknowns.

Solver

$$\mathbf{Find}\left(x_1, T\right) = \begin{bmatrix} 0.173 \\ 109.131 \end{bmatrix}$$