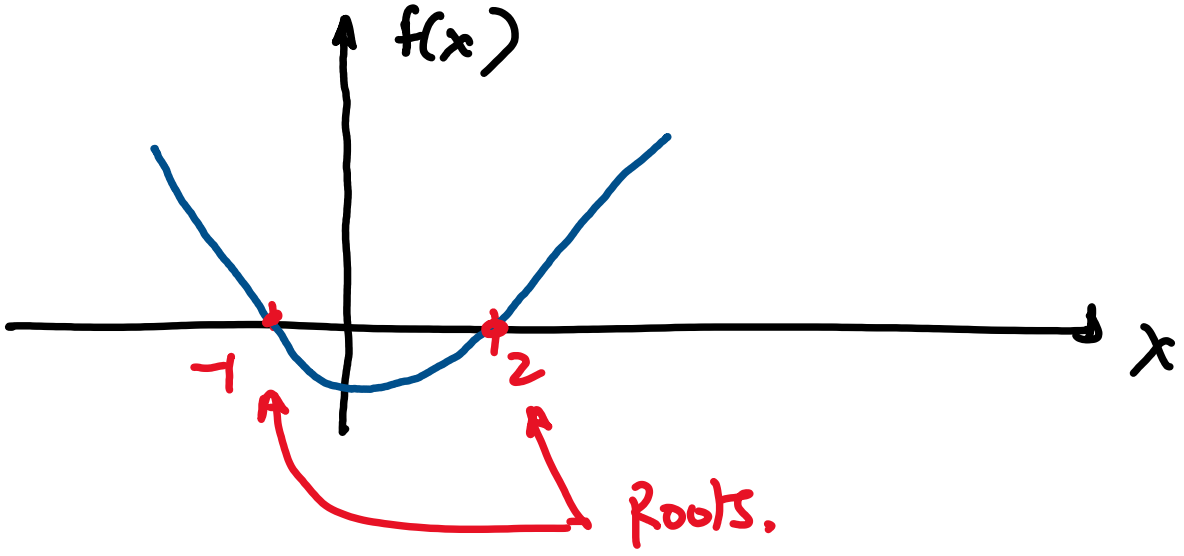
Root Finding (precursor to inverse kinematics)

discussed next

$f(x) = 0$

EXAMPLE: $f(x) = x^2 - x - 2 = 0$



- Graphing does not work in 3+ variables $f(x, y, z) = 0$ ⊗

We will use a numerical method to solve for the roots.

Function fsolve in python.

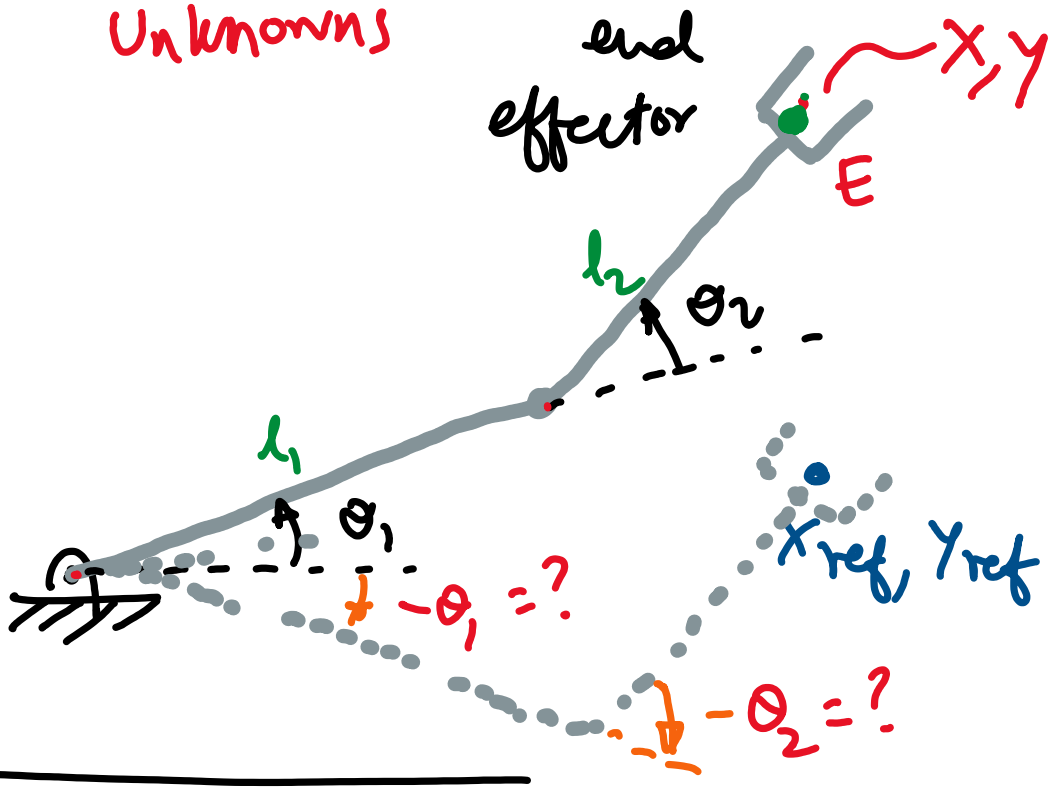
Function fsolve in python.

Inverse kinematics of a 2-link manipulator

IK

$x_{ref}, y_{ref} = f(\theta_1, \theta_2)$

Given — Unknowns



Compute θ_1, θ_2 such that the end effector is at x_{ref}, y_{ref}

$$E^0 = \underline{x}^0_e = l_1 \cos\theta_1 + l_2 \cos(\theta_1 + \theta_2) = x_{ref}$$

$$\underline{y}^0_e = l_1 \sin\theta_1 + l_2 \sin(\theta_1 + \theta_2) = y_{ref}$$

Rewriting

$$f_1(\theta_1, \theta_2) = l_1 \cos\theta_1 + l_2 \cos(\theta_1 + \theta_2) - x_{ref} = 0$$

$$f_2(\theta_1, \theta_2) = l_1 \sin\theta_1 + l_2 \sin(\theta_1 + \theta_2) - y_{ref} = 0$$

$$f(\theta_1, \theta_2) = \begin{bmatrix} f_1(\theta_1, \theta_2) \\ f_2(\theta_1, \theta_2) \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

We use fsolve to solve for θ_1 θ_2 given x_{ref}, y_{ref}, l_1, l_2