Root finding

→ $y = f(x)$

Given x find y (forward problem)

Given y find x (reverse problem)

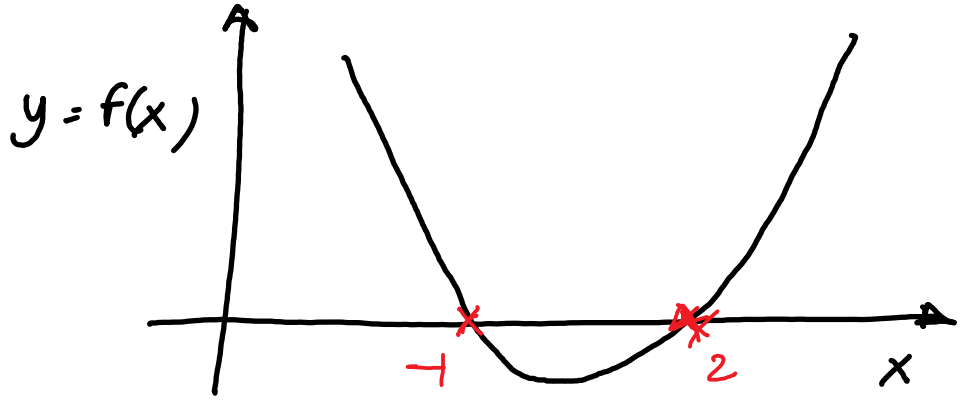
Example

$$y = f(x) = x^2 - x - 2 \Leftarrow$$

Find x such that $y = 0$

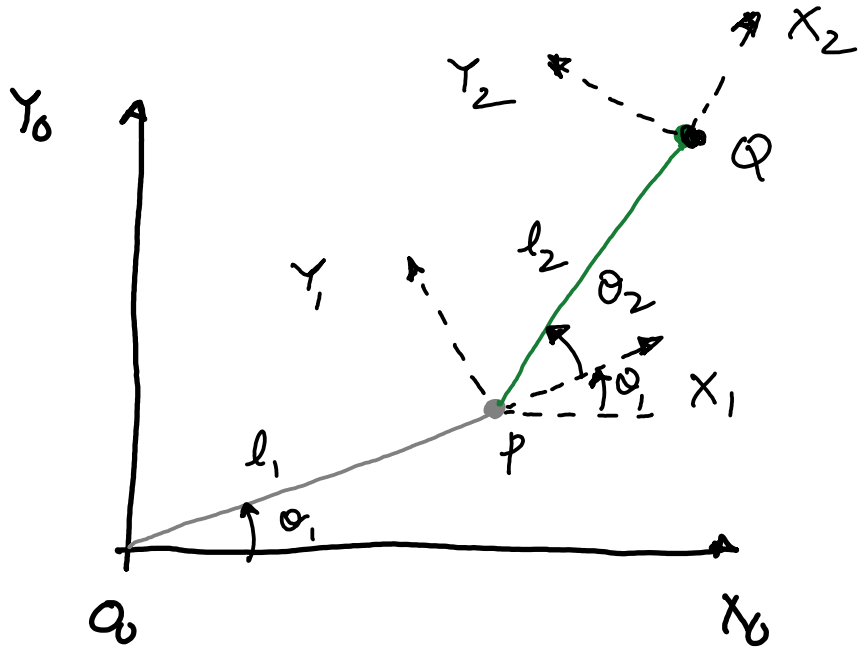
Solution: $x = -1$ and $x = 2$

$f(-1) = 0$ $\quad$ $f(2) = 0$



Introduction to fsolve (MATLAB)

Inverse Kinematics



Problem: Given l_1, l_2, $x_q^0 = x_{ref}$, $y_q^0 = y_{ref}$

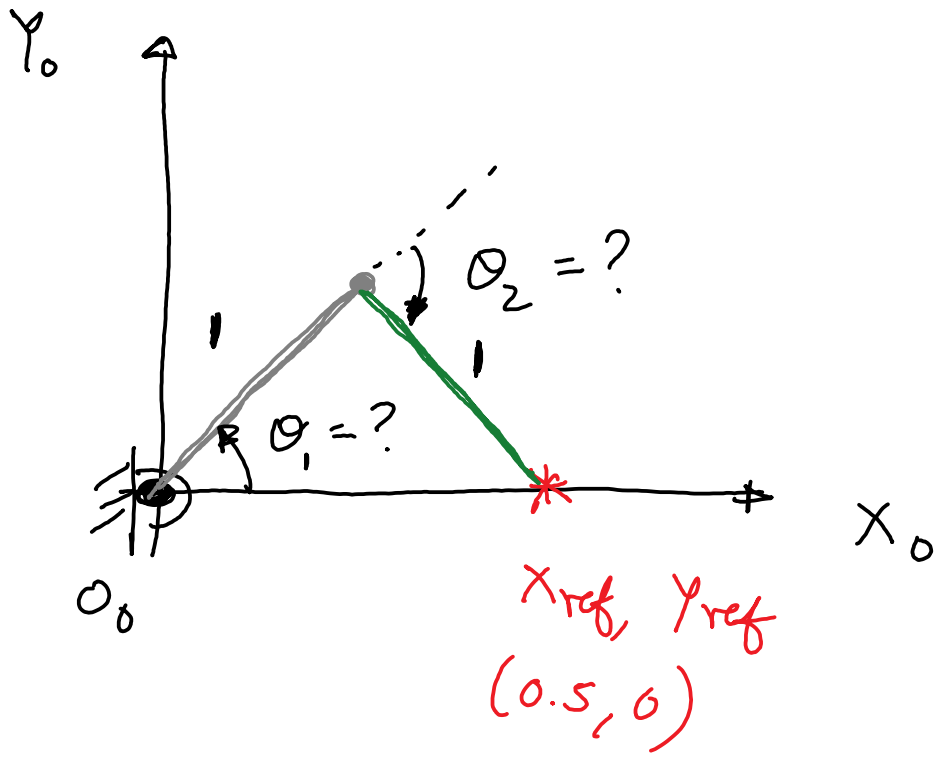
Find θ_1 and θ_2

$$\begin{cases} x_q^0 = l_1 \cos\theta_1 + l_2 \cos(\theta_1+\theta_2) = x_{ref} \\ y_q^0 = l_1 \sin\theta_1 + l_2 \sin(\theta_1+\theta_2) = y_{ref} \end{cases}$$

Root finding problem

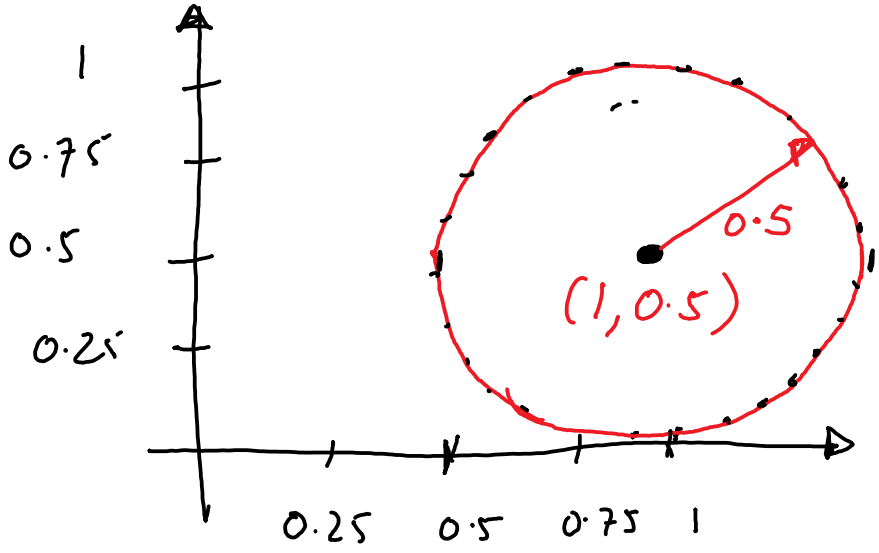
$$\begin{bmatrix} f_1 \\ f_2 \end{bmatrix} = \begin{matrix} l_1 \cos\theta_1 + l_2 \cos(\theta_1+\theta_2) - x_{ref} = 0 \\ l_1 \sin\theta_1 + l_2 \sin(\theta_1+\theta_2) - y_{ref} = 0 \end{matrix}$$

θ = fsolve(@fun, $[\theta_1\ \theta_2]$)



MATLAB to solve for θ_1 and θ_2 using fsolve

Tracing a curve



$$x_{ref} = 1 + 0.5\cos\phi$$
$$y_{ref} = 0.5 + 0.5\sin\phi$$
$$0 \le \phi \le 2\pi$$

parametric equation of a circle

$$x = x_{center} + r\cos\phi$$
$$y = y_{center} + r\sin\phi$$