$$\begin{bmatrix}\delta x\\ \delta y\end{bmatrix} = \left(\begin{bmatrix}x_{in}\\ y_{in}\end{bmatrix} - \begin{bmatrix}320 & 240\end{bmatrix}\right) \cdot \begin{bmatrix}89.5/640\\ 71.5/480\end{bmatrix}$$

$$\begin{bmatrix}l_{(1)t}\\ l_{(2)t}\\ l_{(3)t}\\ l_4\end{bmatrix} = MotorPositionToLength\left(\begin{bmatrix}p_{(1)t}\\ p_{(2)t}\\ p_{(3)t}\\ p_4\end{bmatrix} + 0.3533 + tension\right) + startingLengths$$

$$\begin{bmatrix}x_t\\ y_{current}\end{bmatrix} = forward_{kinematics}\left(\begin{bmatrix}l_{(1)t}\\ l_{(2)t}\\ l_{(3)t}\\ l_4\end{bmatrix}\right)$$

Check boundaries
Proportional control

$$\begin{bmatrix}\delta l_1\\ \delta l_{(2)t}\\ \delta l_{(3)t}\\ \delta l_4\end{bmatrix} = inversekinematics\left(\begin{bmatrix}x_t + \delta x\\ y_{current} + \delta y\end{bmatrix}\right) - \begin{bmatrix}l_{(1)t}\\ l_{(2)t}\\ l_{(3)t}\\ l_4\end{bmatrix}$$

$$\begin{bmatrix}p_{(1)t+1}\\ p_{(2)t+1}\\ p_{(3)t+1}\\ p_4\end{bmatrix} = motorLengthToPosition\left(\begin{bmatrix}\delta l_1\\ \delta l_{(2)t}\\ \delta l_{(3)t}\\ \delta l_4\end{bmatrix}\right) + \begin{bmatrix}p_{(1)t}\\ p_{(2)t}\\ p_{(3)t}\\ p_4\end{bmatrix} - tension$$

$$\vec{l_t} = Pos2Len\left(\vec{p_t} + 0.3533 + tension\right) + startingLength$$

$$(x_t, y_t) = forwardKinematics\left(\vec{l_t}\right)$$

Boundary check
Proportional control:

$$x = \begin{bmatrix}\delta x_t\\ \delta y_t\end{bmatrix}$$

$$g = \vec{x} \cdot \vec{x}^{\intercal} \cdot 0.0394444$$

$$\delta\vec{l_t} = inverseKinematics\left(\begin{bmatrix}x_t\\ y_t\end{bmatrix} + \begin{bmatrix}\delta x_t\\ \delta y_t\end{bmatrix}\right) - \vec{l_t}$$

$$\vec{p_{t+1}} = Len2Pos\left(\delta\vec{l_t}\right) + \vec{p_t} - tension$$

Global speed scalar function: proportional control:
global speed scalar =

$$g = \begin{bmatrix} \delta x_t \\ \delta y_t \end{bmatrix} \cdot \begin{bmatrix} \delta x_t & \delta y_t \end{bmatrix} \cdot 0.03944444$$

Motor speed stuff

$$\vec{l} = \begin{bmatrix} l_1 \\ l_2 \\ l_3 \\ l_4 \end{bmatrix} \qquad x = \max\left(\vec{l}\right)$$

$$x = \max \vec{l} \tag{1}$$

$$\vec{s} = \frac{g}{x} \cdot \vec{l}$$

---

motor position to length:

$$l = \frac{(180/\pi) \cdot p \cdot 4 \cdot \pi}{360}$$

$$length = (position - pi) * 20$$

motor length to position:

$$p = \frac{360 * l}{\pi * spoolD * (180/\pi) * 4}$$

$$p = \frac{len}{20}$$

---

xin,yin = data in
dx,dy = scaled(xin,yin)
new lengths = findnewlengths(dx,dy):

$$\vec{l_t} = Pos2Len\left(\vec{p_t} + 0.3533 + tension\right) + startingLength$$

$$(x_t, y_t) = forwardKinematics\left(\vec{l_t}\right)$$

check boundaries
proportional control:

$$g = \begin{bmatrix}\delta x_t \\ \delta y_t\end{bmatrix} \cdot \begin{bmatrix}\delta x_t & \delta y_t\end{bmatrix} \cdot 0.03944444$$

$$\delta\vec{l_t} = inverseKinematics\left(\begin{bmatrix}x_t \\ y_t\end{bmatrix} + \begin{bmatrix}\delta x_t \\ \delta y_t\end{bmatrix}\right) - \vec{l_t}$$

newlengths = findnewlengths(dx,dy) = speeds = calcSpeeds(newlengths)

$$x = \max\left(\delta\vec{l_t}\right)$$

$$\vec{s} = \frac{g}{x} \cdot \vec{l}$$

set speeds

$$\vec{p}_{t+1} = Len2Pos\left(\delta\vec{l_t}\right) + \vec{p_t} - tension$$