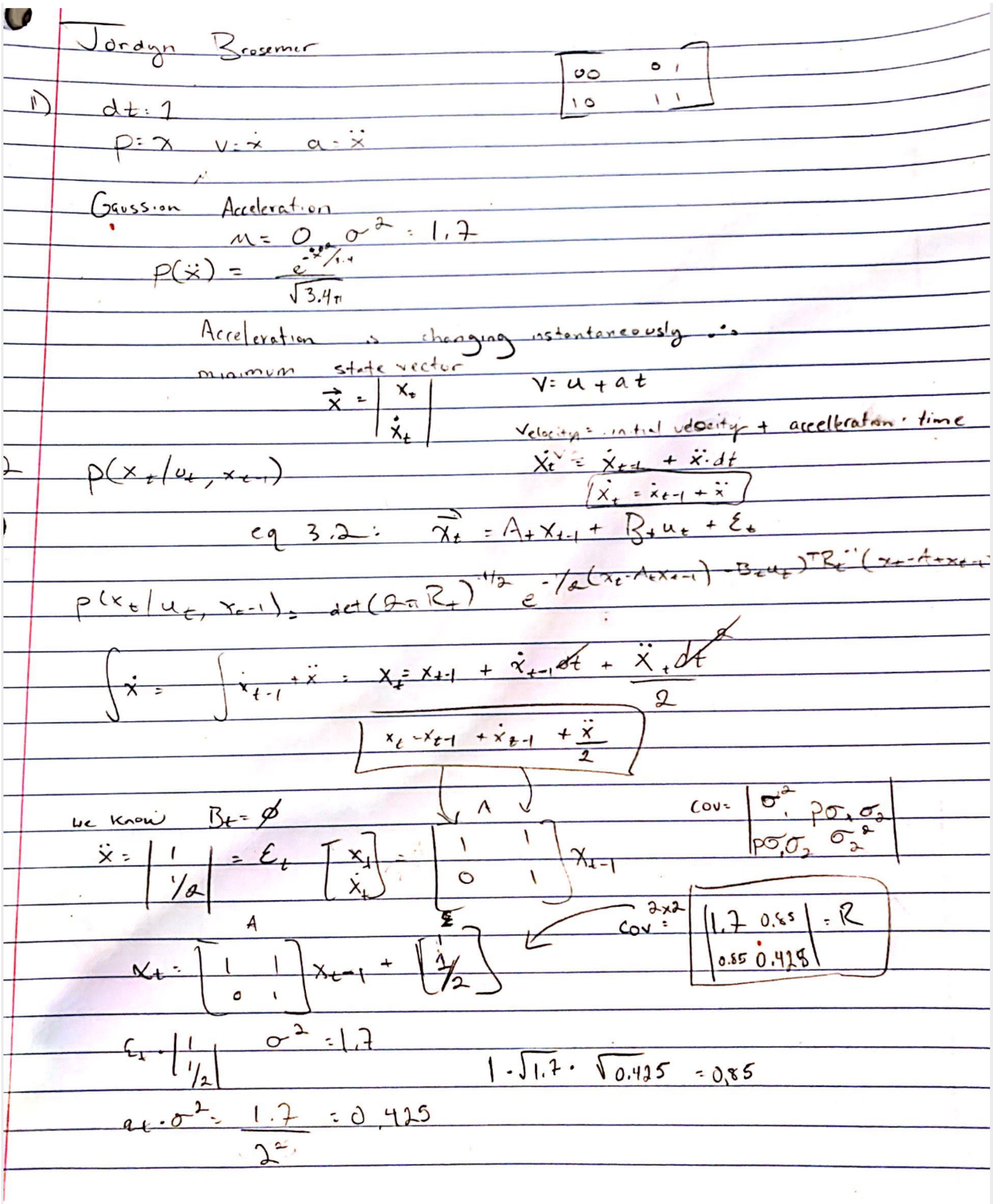
Jordyn Brosemer
Probabilistic Robotics HW 2



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$$\begin{bmatrix} 00 & 01 \\ 10 & 11 \end{bmatrix}$$

1) $dt = 1$

$p = x \quad v = \dot{x} \quad a = \ddot{x}$

Gaussian Acceleration

$\mu = 0, \ \sigma^2 = 1.7$

$$P(\ddot{x}) = \frac{e^{-\ddot{x}^2/3.4}}{\sqrt{3.4\pi}}$$

Acceleration is changing instantaneously $\therefore$ minimum state vector

$$\vec{x} = \begin{vmatrix} x_t \\ \dot{x}_t \end{vmatrix}$$

$V = u + at$

Velocity = initial velocity + accelleration · time

$\dot{x}_t = \dot{x}_{t-1} + \ddot{x} \cdot dt$

$\boxed{\dot{x}_t = \dot{x}_{t-1} + \ddot{x}}$

2 $p(x_t | u_t, x_{t-1})$

eq 3.2: $\vec{x}_t = A_t x_{t-1} + B_t u_t + \varepsilon_t$

$$p(x_t | u_t, x_{t-1}) = \det(2\pi R_t)^{-1/2} e^{-1/2(x_t - A_t x_{t-1} - B_t u_t)^T R_t^{-1} (x_t - A_t x_{t-1}}$$

$$\int \dot{x} = \int \dot{x}_{t-1} + \ddot{x} = x_t = x_{t-1} + \dot{x}_{t-1}\cancel{dt} + \frac{\ddot{x}_t \cancel{dt}^2}{2}$$

$$\boxed{x_t = x_{t-1} + \dot{x}_{t-1} + \frac{\ddot{x}}{2}}$$

we know $B_t = \emptyset$

$$\ddot{x} = \begin{vmatrix} 1 \\ 1/2 \end{vmatrix} = \varepsilon_t \quad \begin{bmatrix} x_t \\ \dot{x}_t \end{bmatrix} = \overset{A}{\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}} x_{t-1}$$

$$\text{cov} = \begin{vmatrix} \sigma_1^2 & p\sigma_1\sigma_2 \\ p\sigma_1\sigma_2 & \sigma_2^2 \end{vmatrix}$$

$$x_t = \overset{A}{\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}} x_{t-1} + \overset{\varepsilon}{\begin{bmatrix} 1 \\ 1/2 \end{bmatrix}}$$

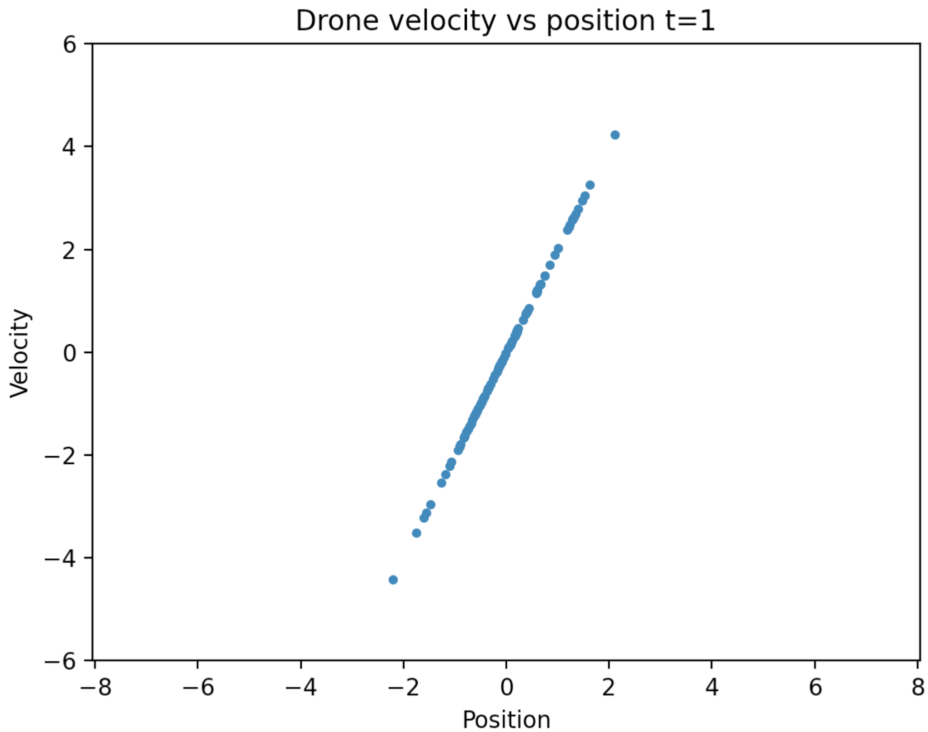
$$\boxed{\overset{2\times 2}{\text{cov}} = \begin{vmatrix} 1.7 & 0.85 \\ 0.85 & 0.428 \end{vmatrix} = R}$$

$\varepsilon_t \cdot \begin{vmatrix} 1 \\ 1/2 \end{vmatrix} \quad \sigma^2 = 1.7$

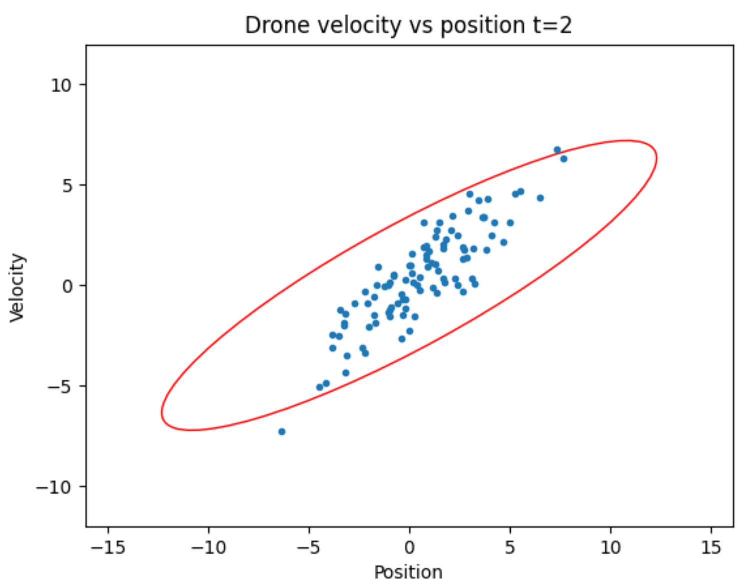
$1 \cdot \sqrt{1.7} \cdot \sqrt{0.425} = 0.85$

$a_t \cdot \sigma^2 = \frac{1.7}{2^2} = 0.425$

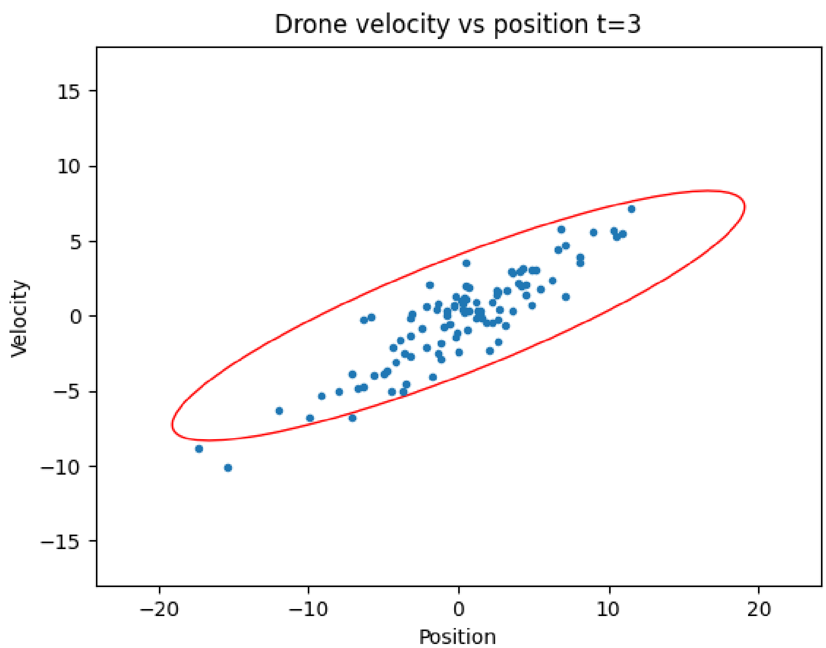
Fig, 1 Questions 1.1-1.3 Solving for Covariance and p(x|z)



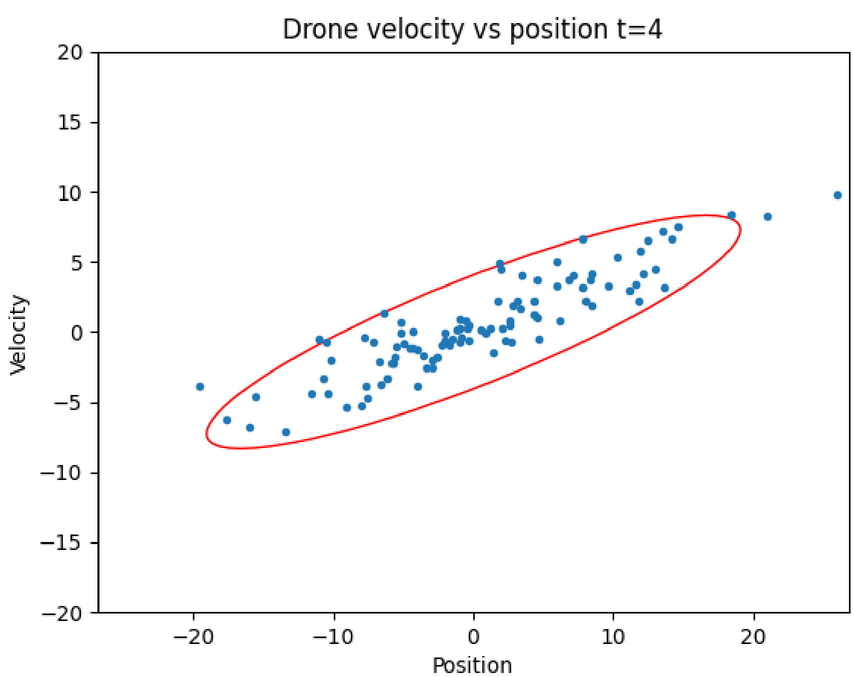
Fig, 2 Drone Velocity vs Position at t=1



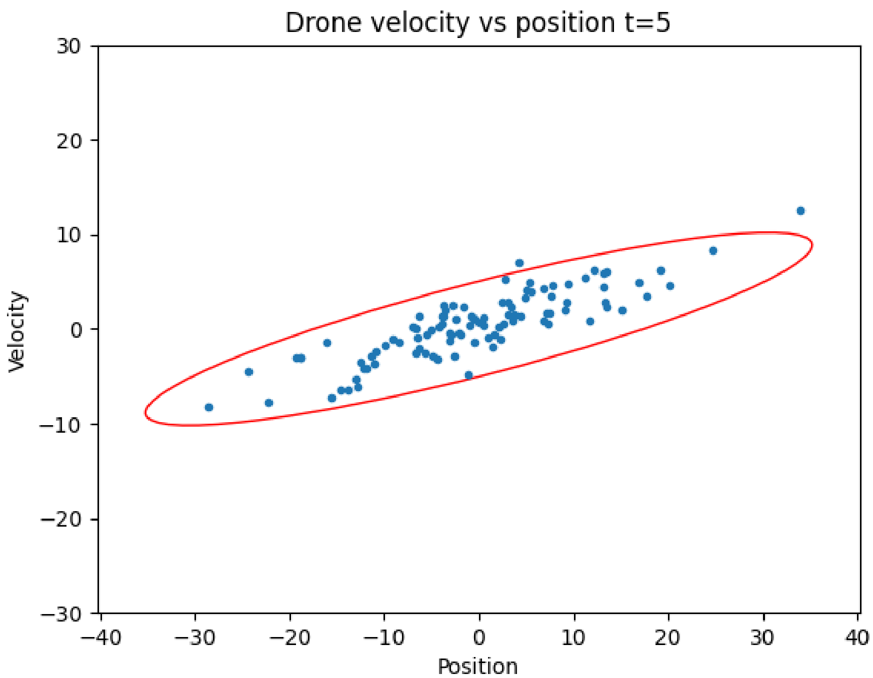
Fig, 3 Drone Velocity vs Position at t=2



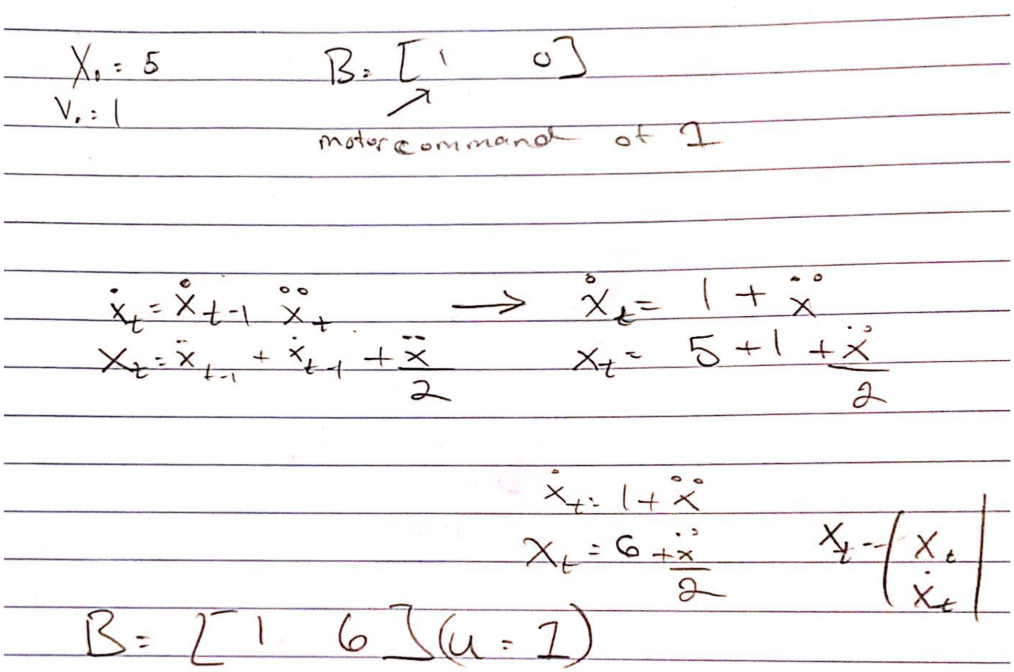
Fig, 4 Drone Velocity vs Position at t=4



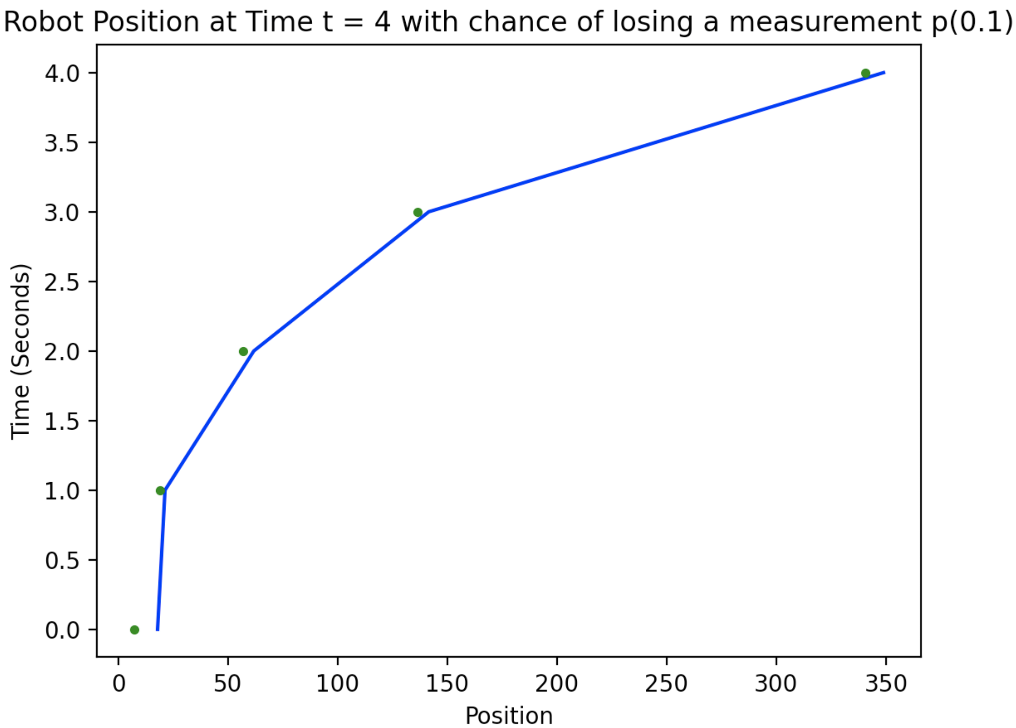
Fig, 5 Drone Velocity vs Position at t=4



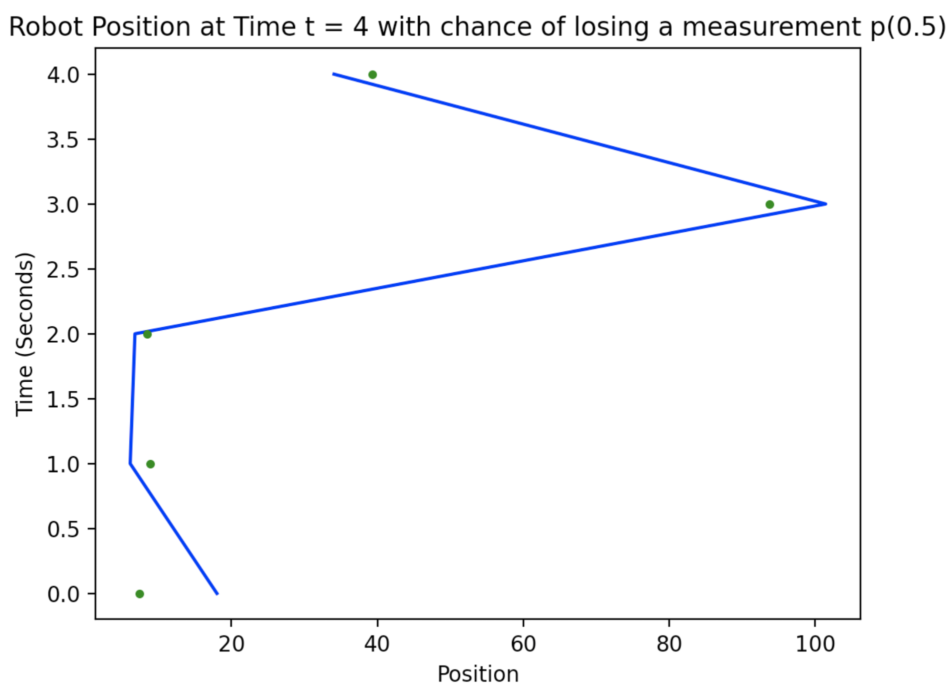
Fig, 6 Drone Velocity vs Position at t=5



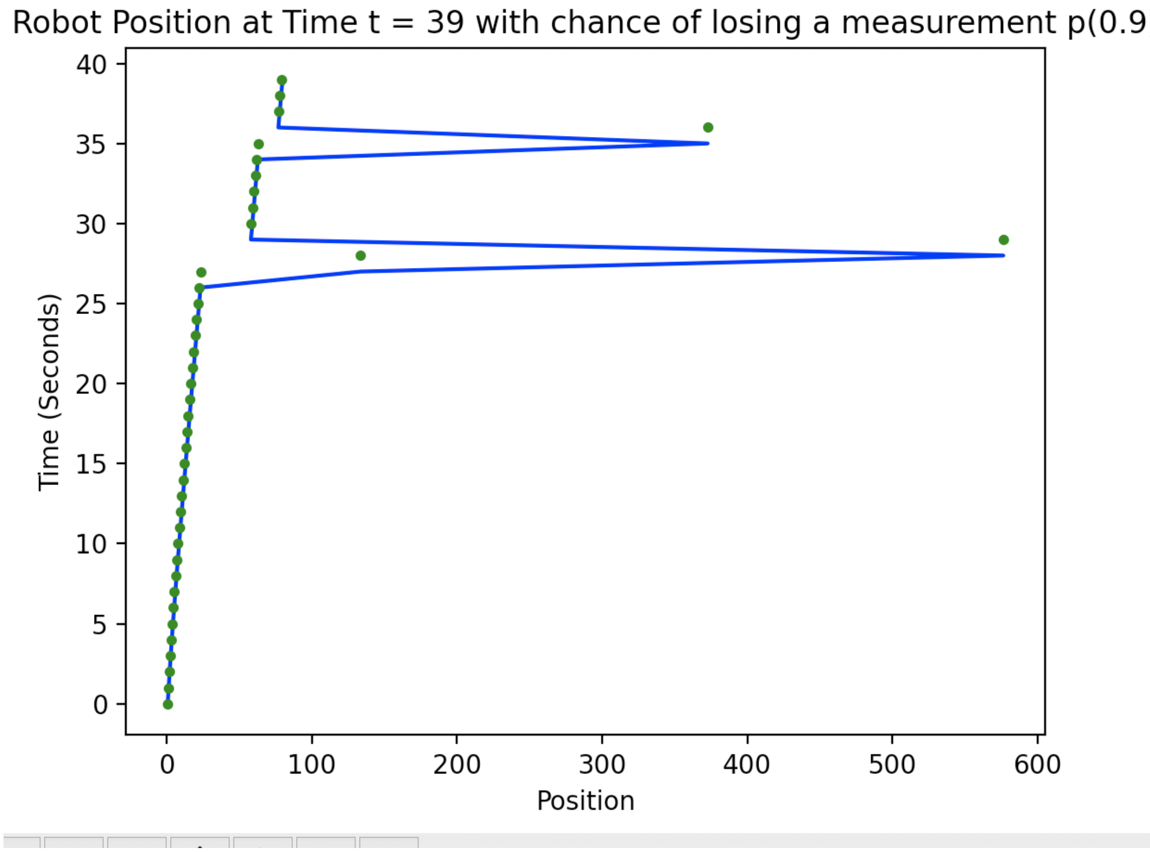
Fig, 7 Solving for B



Fig, 8 Plotting the kalman filter with a prob of losing measurement p(0.1)



Fig, 8 Plotting the kalman filter with a prob of losing measurement p(0.5)



Fig, 10 Plotting the kalman filter with a prob of losing measurement p(0.9)