COMP417, Fall 2019 Quiz 3

First Name:

Last Name:

Student #:

Q1: List 3 assumptions that were made by the Kalman filter (or inherited from previous ideas that it implements), by giving the name of the assumption and it's math/probability form:

Assumption 1:

Assumption 2:

Assumption 3:

Q2: Suppose a robot has a 3D state-space (x,y,z) and the motion model:

$$x_{t+1} = \cos(a) * x_t + y_t + \sqrt{\pi} * z_t$$
$$y_{t+1} = z_t * b^2$$
$$z_{t+1} = c$$

For constants a, b, c, and π. Would this motion model require the Kalman filter, or an EKF?

(the quiz continues on the back of this page!)

Q3: Consider the Kalman filter for a robot with 2D state made of position and velocity:
$x_t = [p, v]^T$
The belief distribution at time t has mean position=0, mean velocity=1, and co-variance:
$\Sigma_{t|t} = \begin{bmatrix} \sigma_p^2 & \sigma_{pv} \\ \sigma_{pv} & \sigma_v^2 \end{bmatrix} = \begin{bmatrix} 1^2 & 0 \\ 0 & 2^2 \end{bmatrix}$
The robot moves with constant under the motion model:
$p_{t+1} = p_t + v_t \delta t + w_p(t)$
$v_{t+1} = v_t + w_v(t)$
The motion noise is normally distributed with zero mean and variance 0.1 for both terms.
The robot moves under this model, making no measurements.

Starting from the belief at time t, which is provided, draw the approximate 1-sigma ellipses that describe the belief at times t+1, t+2 and t+3,. Pay attention to:

- The mean value (centre of the ellipse)
- The size of the p and v variances
- If the ellipse is axis aligned or not, and what is its angle?