COMP417

Quiz on GraphSLAM

First Name:

Last Name:

Student ID:

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Each of the following questions is worth 1 point

1. Suppose the 1D random variable x has variance $\sigma_x^2 = 10$. Then the random variable $z = 2x + 1$ has variance: **40**

2. Suppose the 1D random variable x has mean $\mu_x = 10$. Then the random variable $z = 2x + 1$ has mean: **21**

3. Suppose the 2D random variable $\mathbf{x}$ has covariance matrix $\mathbf{\Sigma}_x$. Then the covariance matrix of the random variable $\mathbf{z} = \mathbf{A}\boldsymbol{x} + \mathbf{b}$, where $\mathbf{b}$ is a constant vector is: $\mathbf{A\Sigma A}^T$

4. Suppose the 2D random variable $\mathbf{x}$ has mean $\boldsymbol{\mu}_x$. Then the mean of the random variable $\mathbf{z} = \mathbf{A}\boldsymbol{x} + \mathbf{b}$, where $\mathbf{b}$ is a constant vector is: $\mathbf{A}\boldsymbol{\mu}_x + \mathbf{b}$

5. Write down the terms of the GraphSLAM cost function $J(\mathbf{x}_1, \mathbf{x}_2, \mathbf{x}_3, \mathbf{m}_0, \mathbf{m}_1)$ for the scenario shown in Figure 1:

$$\begin{aligned}
J(\mathbf{x}_1, \mathbf{x}_2, \mathbf{x}_3, \mathbf{m}_0, \mathbf{m}_1) \quad = \quad & ||\mathbf{x}_1 - f(\mathbf{x}_0, \mathbf{u}_0)||_{\mathbf{Q}}^2 + \\
& ||\mathbf{x}_2 - f(\mathbf{x}_1, \mathbf{u}_1)||_{\mathbf{Q}}^2 + \\
& ||\mathbf{x}_3 - f(\mathbf{x}_2, \mathbf{u}_2)||_{\mathbf{Q}}^2 + \\
& ||\mathbf{z}_0^{(0)} - h(\mathbf{x}_0, \mathbf{m}_0)||_{\mathbf{R}}^2 + \\
& ||\mathbf{z}_1^{(0)} - h(\mathbf{x}_1, \mathbf{m}_0)||_{\mathbf{R}}^2 + \\
& ||\mathbf{z}_1^{(1)} - h(\mathbf{x}_1, \mathbf{m}_1)||_{\mathbf{R}}^2 + \\
& ||\mathbf{z}_2^{(1)} - h(\mathbf{x}_2, \mathbf{m}_1)||_{\mathbf{R}}^2
\end{aligned}$$

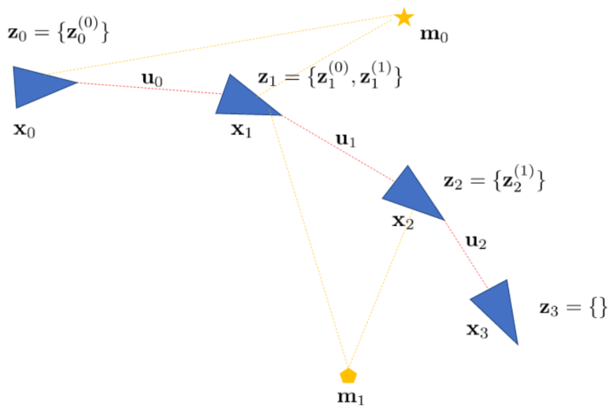

Figure 1: State $\mathbf{x}_0$ is known and fixed. The dynamics model is assumed to be $\mathbf{x}_{t+1} = f(\mathbf{x}_t, \mathbf{u}_t) + \mathbf{w}_t$ with $\mathbf{w}_t \sim \mathcal{N}(\mathbf{0}, \mathbf{Q})$. The observation model is assumed to be $\mathbf{z}_t^{(k)} = h(\mathbf{x}_t, \mathbf{m}_k) + \mathbf{n}_t$ where $\mathbf{n}_t \sim \mathcal{N}(\mathbf{0}, \mathbf{R})$.