ECE 901: Quiz 0

Name: **Email:**
Dept: **Year:**

Question 1. *If A is an $n \times n$ matrix with rank $r < n$, how can one compute its null space?*
Answer:

Question 2. *Give an example of a function $f : \mathbb{R}^d \to \mathbb{R}$ that is negative everywhere and is also concave.*
Answer:

Question 3. *Let $X_1, \ldots, X_n$ be independent, mean 1, Gaussian random variables with variance 10, and $Z = \sum_{i=1}^n X_i$. Please compute: i) $\mathbb{E}\{Z\}$, ii) var$\{Z\}$, and iii) $\mathbb{E}\{Z|X_2, \ldots, X_n\}$.*
Answer:

Question 4. *Let a coin with 1/4 probability of turning heads (H), and 3/4 tails (T). What is the most likely sequence of events after 5 random tosses?*
Answer:

Question 5. *You wish to build a classifier that works well on images of cats and dogs (what else?). You decide to use a neural network because your #tensorbro friend says they are cool. You are given a data set ($\mathcal{S}$) that consists of 50K test examples ($\mathcal{S}_{test} \subset \mathcal{S}$) and 50K training examples ($\mathcal{S}_{train} \subset \mathcal{S}$). Before using on real data, you want to tune the architecture of the model, and try a few different ones with the goal of maximizing accuracy on real (unseen) data. On what part of the data set will you optimize the network's architecture, and why?*
Answer:

Question 6. *Let $c_i \in \mathbb{R}$. Can you solve either of the following problems in polynomial time in n? If so, how? If not, why?*

$$\mathcal{A} : \max_{x_i \in \{-1,1\}} \left| \sum_{i=1}^n c_i \cdot x_i \right| \qquad \mathcal{B} : \min_{x_i \in \{-1,1\}} \left| \sum_{i=1}^n c_i \cdot x_i \right|$$

Answer: