

Assignment 0
CS289: Algorithmic Machine Learning, Spring 2021
NOT TO BE SUBMITTED

You need background in **linear algebra, probability theory, and algorithms** (all at a typical undergraduate upper-division level) to make the class fun and interesting for you as well as for me. You can judge your background with this problem set (not to be submitted). If you don't know these, you could even pick them up. If you have doubts about this please talk to me right away.

Linear algebra basics

1. Define a subspace and dimension of a subspace.
2. Let $S = \{x \in \mathbb{R}^d : \sum_{i=1}^d x_i = 0\}$. What is the dimension of S ?
3. Define an orthonormal basis for a subspace S .
4. Define rank of a matrix. Let $A \in \mathbb{R}^{m \times r}$, $B \in \mathbb{R}^{r \times n}$ and let $C = AB$. Prove that rank of C is at most r .

Probability basics

1. Define a random variable, expectation of a random variable, and variance of a random variable.
2. Suppose you toss a coin whose probability of heads is $1/10$. What is the expected number of tosses until you see a heads?
3. When are two random variables X, Y independent?
4. Suppose you roll a fair die n times. Let X be the number of 6's in the throws. What is the expectation of X ?
5. Suppose you toss a coin whose probability of heads is $1/10$ n times. Let X denote the number of heads. What is variance of X ?

Algorithms basics

1. Do you know big-Oh, little-oh, big-Omega notation?
2. What is the time complexity of the simplest way to implement matrix multiplication $A \times B$ where A is a $n \times n$ matrix, B is a $n \times n$ matrix. What if A is a $n \times r$ matrix, B is a $r \times n$ matrix?