

Problem Set 12, Dec 8, 2022 (Theory Questions SVD)

Goals. The goal of this exercise is to

- familiarize yourself with the theory related to SVD.
- have time to discuss Project 2 with the assistants and teammates.

1 Theory Questions

Problem 1 (How to compute U and S efficiently):

In class, we saw that solving the eigenvector/value problem for the matrix $\mathbf{X}\mathbf{X}^\top$ gives us a way to compute U and S . But in some instances $D \gg N$. In those cases, is there a way to accomplish this computation more efficiently?

Problem 2 (Positive semi-definite):

Show that if \mathbf{X} is a $N \times N$ symmetric matrix then the SVD has the form $\mathbf{U}\mathbf{S}\mathbf{U}^\top$, where U is a $N \times N$ unitary matrix and S is a $N \times N$ diagonal matrix with non-necessarily positive entries. Show that if \mathbf{X} is positive semi-definite, then all entries of S are non-negative.

2 Generative Adversarial Networks

Recommended reading: explore how to implement a simple GAN in PyTorch using the Jupyter notebook [gans.ipynb](#):

- Open in Colab: colab.research.google.com/github/epfml/ML_course/blob/master/labs/ex12/template/gans.ipynb. This gives you access to a free GPU.
- Change the 'runtime type' to GPU under 'Runtime → Change runtime type'.