ECE 532 Final Project Proposal

Jon King

Introduction

Recent advances in nanophotonic optimization have suggested huge potential for neural networks in the inverse design of nanophotonic structures[1][2][3]. This project will seek to build foundational familiarity with machine learning classifiers in preparation for machine learning applications to nanophotonic design. In this project, I will develop a few simple classifiers using a well-established dataset, and if time allows, I will also develop a generative model to pair with the classifiers to generate images, in a simplified manner similar to machine learning methods of nanophotonic inverse design.

Data set

I will use the minist database of handwritten digits [4] as my project dataset. The minst database is widely recognized as a keystone dataset for testing classification algorithms. I will investigate different combinations of training/testing and cross-validation schemes with my algorithms.

Algorithms

-Linear regression and ridge regression

-Least squares

-Neural networks

Deliverables

-Functioning python code of the four algorithms above and respective test error rates.

-A generative model that can generate a “3” that is recognizable to human eyes (time permitting).

Timeline

I have a major fellowship/grant proposal due Nov 3rd, most work will have to start after that deadline.

Nov 10th – completion of linear regression and ridge regression codes

Nov 17th – completion of least squares codes

Nov 24th – completion of neural network code

Dec 1st – completion of rough first draft of final project report (assuming no progress of generative model)

Dec 8th – completion of generative neural network code

Dec 10th – completion of final draft of final project report

Github link

https://github.com/jlking2/Neural_net_numbers

References

[1] D. Liu, Y. Tan, E. Khoram, and Z. Yu, “Training Deep Neural Networks for the Inverse Design of Nanophotonic Structures,” *ACS Photonics*, vol. 5, no. 4, pp. 1365–1369, Apr. 2018.

[2] W. Ma, Z. Liu, Z. A. Kudyshev, A. Boltasseva, W. Cai, and Y. Liu, “Deep learning for the design of photonic structures,” *Nat. Photonics*, pp. 1–14, Oct. 2020.

[3] S. So and J. Rho, “Designing nanophotonic structures using conditional deep convolutional generative adversarial networks,” *Nanophotonics*, vol. 8, no. 7, pp. 1255–1261, Jun. 2019.

[4] “MNIST handwritten digit database, Yann LeCun, Corinna Cortes and Chris Burges.” [Online]. Available: http://yann.lecun.com/exdb/mnist/. [Accessed: 22-Oct-2020].