**MATH 4W03 Journal**

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**January 11th, 2024:**

* Met with Dr. Kevlahan to discuss how the Reading course would be set up.
* Received past report from Lilly to act as a starting place for research.
* Discussed looking into extensions of her research, and references of her paper.
* Read Lilly’s paper; it was a review of Singular Value Decomposition (SVD), with applications of facial recognition, image compression and latent semantic analysis (LSA).

**January 12th, 2024:**

* Looked into references of Lilly’s paper,
* [IEEE Xplore Full-Text PDF:](https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6178280) After reading, the math is too complicated to do for this time.
* [Singular Value Decomposition and Neural Networks | SpringerLink](https://link.springer.com/chapter/10.1007/978-3-030-30484-3_13) Talked about the link between SVD and neural networks, however there is not enough math in the paper to write my own paper on.

**January 15th, 2024:**

* [neural\_nets 2.pptx (cmu.edu)](https://www.cs.cmu.edu/~aarti/Class/10701_Spring14/slides/NeuralNetworks.pdf) Did not contain full math steps to write programs with, not a good source to write my paper.
* [nonlinear-predictors.pdf (stanford-cs221.github.io)](https://stanford-cs221.github.io/spring2021-extra/modules/machine-learning/nonlinear-predictors.pdf) Did not contain full math steps to write programs with, not a good source to write my paper.
* [IEEE Xplore Full-Text PDF:](https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1165576) Contained basic algorithm steps for Neural networks.

**January 18th, 2024:**

* Met with Dr. Kevlahan to review findings of the week.
* Agreed that the Noise cancelling algorithm was too difficult to continue.
* Dr. Kevlahan gave a few topics to research for this week; Compressive sampling, sensor placement.
* Started up a GitHub account to store MATLAB and journal files.

**January 19th, 2024:**

* Find a study that links the topics of compressive sampling, svd and machine learning together through the link of big data. Smart Sampling and Optimal Dimensionality Reduction of Big Data Using Compressed Sensing. [Smart Sampling and Optimal Dimensionality Reduction of Big Data Using Compressed Sensing | SpringerLink](https://link.springer.com/chapter/10.1007/978-3-319-30265-2_12#Bib1)
* Read up on Compressive sampling. [An Introduction To Compressive Sampling | IEEE Journals & Magazine | IEEE Xplore](https://ieeexplore.ieee.org/document/4472240) , [978-3-031-09745-4\_1.pdf (springer.com)](https://link.springer.com/content/pdf/10.1007/978-3-031-09745-4_1.pdf?pdf=inline%20link)
* Downloaded the l1 magic MATLAB toolbox and code that gives examples for compressive sampling of reconstructing images.
* Algorithm called hierarchical compressed sampling mixes compressed sampling with svd steps.

**January 22nd, 2024:**

* Read up on the k-svd algorithm that was mentioned in the Big Data paper. [doi:10.1016/j.jvcir.2008.03.001 (sciencedirectassets.com)](https://pdf.sciencedirectassets.com/272324/1-s2.0-S1047320308X00033/1-s2.0-S1047320308000254/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEID%2F%2F%2F%2F%2F%2F%2F%2F%2F%2FwEaCXVzLWVhc3QtMSJIMEYCIQCCMCptx07mlSI0%2BsMEu9%2FkfepiH2EFU75T%2BhRAcoX0WQIhALZjhqxoRft2AzoK6a329sI6HNCjw6TjCG2uoR7d5mUeKrMFCDkQBRoMMDU5MDAzNTQ2ODY1IgyDsq%2BusVplCoxzMEAqkAXmJwgZ1s8x265mQjrnshutJId3MwW9QWH8AGA5AjJ50lSVwKCKu2mnkmGFR9Rw2YhMZANxVt7sGhnyCn12QPsBzl1kAEwB3xoJP2dJPmuLo%2BUQvHQLb5n3lx7WPXxl8eyOQi5sa%2BJAmdDqErpnpSALsyrYcSLw%2FQpsK4eZZfnPGBRlm4nUDRDRQICsPDPoiSet9y9IBuCV%2BLJ7BTssluaK7eUSIVWb5EBx%2FT15C1w%2F6PgBvztc6O4T3JDwDwHjbrJ%2FvAyO2fsf%2B45Wyqb1i59%2BqxMeEU7Trjvy3VUD4NAW4Zg%2BzQ90zpHtwzybY9ZUeB%2BLrgq3ZkzXvQCuGk6pfBUKUisjHyfclbpXzaq5ewpc8Rs8LdxncQHnG7rj9oZNc1DhJbh1FlRdU2oGGWHQOsRCYsD2aLl%2FT1rUkq8IQmGoXUdRYspGoAvUJyV7J5edZg6LORcT%2Bt86q6cQX85JqeYJgHjCcovOIjhYpdIxebPtnxnCAsZYwuJyVx6QyDSoaZtHj2au5mZmkQm0IEsIcFi8r5yEGYHCtet2mK39Hu6N5nEf%2B%2Bg7p%2FAe0Qm4FP5u7GjhdXMrE7vdnMjL%2BMnNY8tSGzFtngpk%2BneEy3RJKakLLb26WmWUVKWSjAqnqojWk8xtWZFNRnKtBZukPtSuxVdObB4YwiRGPHGsldheKdfLnrQWF7Yk3wxHpo6GUgPLgfmJSuyj7nIiRhYTZ4rC%2FnvhfEBfMGtDyfUB%2Bj3hfMdMs69RwiyfUJtG15OAji2XytMf1RgZBT2%2BhMRSqZO03xgZY1KS2iZFvqtyj9r8uFq%2F7RCqZR%2B4xl71idcJno29%2FaI3mKC8nejFa2W8EJRRuzHFj6CxZUZeRGc7OtBJ%2FC0kyzC63batBjqwAfctF7%2FtMCQk2veLl4exvxTwLhSqwLcyrC9Qc%2Blx4vysPmYCmFRHHV3PP3b%2BY4g4uX%2FBKKNyMQQjAmxYkntGwUg3U4ZQ9YgezD7KDVqSIZjIjDRNY6QAKhtFMyduZVgsAEzvqHiGTuelE4Nxy8mmXImgLSennDPfVL9wIDYuOwtqBvBo8sfEJP5myfOXcxi6alerMzyQVPuithEDaAsDOz2aBNeL089u01xeYcbGfqK4&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20240122T004856Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTYSXJSKPUI%2F20240122%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=8093a5cc32cca17fc15b582348eb680b5b191c9a029381953e30b9f9449bde5d&hash=311568f1493a2170d7b4cdb80cdf46344802f7002d5e6a715ec3f8d5f5502841&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S1047320308000254&tid=spdf-dd6b76d1-bc5f-4af8-8f93-a1632c1c24b8&sid=766ceda03dd97345fb6b66394debc74e450bgxrqa&type=client&tsoh=d3d3LnNjaWVuY2VkaXJlY)
* K-svd algorithm has links to image denoising. [Image Denoising | SpringerLink](https://link.springer.com/chapter/10.1007/978-1-4419-7011-4_14)

**January 25th, 2024:**

* Meet with Dr. Kevlahan to discuss progress. For this week, start to format the research paper and write the abstract and introduction.

**January 30th, 2024:**

* Formatted the paper using the springer nature template for LATEX, wrote the beginning of the abstract and intro, will need further editing when other sections have been written.

**February 1st, 2024:**

* Met with Dr. Kevlahan to discuss progress. Formatting needed a few changes; however, structure is okay. Work for this week is to start to write the beginnings of the mathematical sections.

**February 6th, 2024:**

* Started to write the SVD and CS sections, starting with their equations and the background information of the algorithms.

**February 8th, 2024:**

* Meet with Dr. Kevlahan to discuss progress. Formatting of Mathematical Writing needs work, to have complete sentence structure, i.e. formulas are not disconnected.
* Read the CS paper Dr. Kevlahan sent to me to gain more information on the topic.

**February 15th, 2024:**

* Skip Meeting with Dr. Kevlahan to continue to work on the two sections of SVD and CS.

**February 16th-25th, 2024:**

* Work on the SVD and CS sections.

**February 26th, 2024:**

* Finish the SVD and CS sections, share the link to the LATEX document as well as the GITHUB repository where code will be stored.

**February 29th, 2024:**

* Met with Dr. Kevlahan to discuss the finished SVD and CS sections.

**March 7th, 2024:**

* Met with Dr. Kevlahan to discuss adding small section in the SC section dedicated to sparsity and incoherence.
* Start to work on a MATLAB compressed sensing example. First writing code to determine if a signal is sparse in a Fourier basis using pre-made MATLAB functions.

**March 10th, 2024:**

* Finish a MATLAB program that tests a random image in the Fourier basis and reconstruct it using matching pursuit.

**March 14th, 2024:**

* Met with Dr. Kevlahan to discuss having the program be able to detect which sensing basis has the highest sparsity, (Fourier basis, Wavelet basis, Gaussian). Since images are sparse mostly in the wavelet basis.
* As well, the random images do not allow for a comparison by inspection, the images must be switched to one that is taken by a camera.

**March 21st, 2024:**

* Met with Dr. Kevlahan to discuss the switch to real images.
* Discussed that I learned how to navigate the GitHub system and upload images into files and download from other people’s repositories.

**March 28th, 2024:**

* Met with Dr. Kevlahan to discuss the compressed sensing code only being able to handle a small section of the total picture (cameraman).
* This week should be focused on generating a one-dimensional signal that is sparse in a Fourier Basis so that it can easily be reconstructed in a spike basis, according to the Candes paper.

**April 4th, 2024:**

* Met with Dr. Kevlahan to discuss that the Fourier one dimensional basis works.
* Discussed starting to investigate the applications of svd in compressing a neural network as per the Cai paper.

**April 6th, 2024:**

* Start to create an ipynb program that can compress a neural network’s final weights.

**April 9th, 2024:**

* Complete the compressed neural network code to run off a randomly generated data set.

**April 11th, 2024:**

* Met with Dr. Kevlahan to present the python example of a compressed neural network that runs off randomly generated data.
* Discussed extending the example to have images as the input.

**April 13th, 2024:**

* Finished the model change to run off the mnist image dataset for number 0-9.

**April 15th, 2024:**

* Start to explore the K-SVD ipynb program to determine where the sparsity affects the overall accuracy of the algorithm; in the reconstruction stage vs. the dictionary defining stage.

**April 17th, 2024:**

* The K-SVD program’s output accuracy is not significantly affected by increasing the maximum sparsity of the reconstruction stage but is mostly determined by the sparsity of the dictionary.

**April 18th, 2024:**

* Had a short meeting with Dr. Kevlahan to show the completed K-SVD ipynb file, which applies the algorithm to a random signal and dictionary.

**April 19th, 2024:**

* Complete the Abstract since all programs are completed and just need to be added into the report.
* Complete the Introduction to the research report.

**April 22nd, 2024:**

* Take pictures of all the code outputs for the compressed neural network and upload them to the research paper and complete the application section of svd in machine learning.
* Take pictures of all the code outputs for the K-SVD program and upload them to the research paper and complete the application section of K-SVD in machine learning.

**April 23rd, 2024:**

* Take pictures of all the code outputs for the different compressed sensing programs and upload them to the research paper and complete the application section of compressed sensing in machine learning.
* Complete the Conclusion and Future Work sections. Extensions that could be made to the code were suggested.

**April 24th, 2024:**

* Final read through of research paper, upload all files to GitHub and email the links of all documents to Dr. Kevlahan.