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| **Project Title** | Image Compressions | | |
| **Course Code** | **Math301i** | **Course Name** | **Linear Algebra** |
| **Professor** | **Dr. Samah Mohamed ElShafeiy** | | |
| **TA** | Sief Eldeen Farag AbdElrazik | **Mentor Name** | Text. |
| **Team Name** | **Absolute Error** | | |
| **Team Members** | **Mohamed Yousry** | **Nora Ibrahim** | **Abdelrahman Issam** |
| **Rawan Ramdan** | **Omar Mohamed El-Habbak** |  |
| **Problem Summary** | The redundancy of the image and to store or transmit data in an efficient form. At its core, image compression is when you remove or group together certain parts of an image file to reduce its size. Image compression has advantage and disadvantage. In our paper we will try to reduce disadvantage by using Linear Algebra. | | |
| **Methodology** | We consider an important technology of linear algebra, aimed at reducing the size of files intended for storing images and transmitting them over the network. The technology involves the use of elements of tensor analysis based on singular decomposition. A feature of the technology used is the representation of the image by the matrix triad, which includes the tensor core and a pair of unitary matrices containing right and left singular vectors, respectively. Compression is achieved by one recurrent procedure, which involves lowering the rank of the triad to the level of allowable errors while maintaining the original image size. We will follow SVD powerful tool in linear algebra. The singular value decomposition or SVD is a powerful tool in linear algebra. Understanding what the decomposition represents geometrically is useful for having an intuition for other matrix properties and helps us better understand algorithms that build on the SVD. The SVD is related to many other matrix properties. The number of nonzero singular values is equal to the rank of the matrix. Therefore, the spectral norm is a convex surrogate for low-rank approximations. | | |
| **Achievements and Skills Gained** | Spacecraft send information and pictures back to Earth using the Deep Space Network (DSN), a collection of big radio antennas. The antennas also receive details about where the spacecraft are and how they are doing. NASA also uses the DSN to send lists of instructions to the spacecraft. In our paper we will make compression of image on DSN using SVD powerful tool. | | |
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| **Main Results** | Overall, these results show why the JPEG format uses the DCT. The DCT retains more quality overall because it affects the whole image the same way, so everything stays somewhat visible even at single percentages of data remaining. However, since the SVD removes entire vectors, parts of the image become quite messed up, such as the streaks in the sky at 10%, whereas other parts are less affected. | | |
| **Discussion and Conclusion** | The SVD and DCT techniques are both very useful for data compression and can easily compress an image to 30% of its original size with almost no visual difference. However, based on these results, the DCT appears to be more effective because it takes its losses throughout the entire photo evenly, instead of removing entire vectors of data at a time. To create a high-quality image that loses almost no important data, the 30% mark seems to be about the spot to stay, as very little differences can be seen between that point and the original image. For images that don’t worry about quality, about 15% for the SVD and 10% DCT is where the line should likely be drawn, as quality becomes too poor past those points to be worth it. | | |
| **References** | <http://ceur-ws.org/Vol-2488/paper14.pdf>  <https://www.youtube.com/watch?v=HeGdlgB8450>  <https://www.freecodecamp.org/news/how-machine-learning-leverages-linear-algebra-to-optimize-model-trainingwhy-you-should-learn-the-fundamentals-of-linear-algebra/> | | |
| **Future Work and Suggestions** | Explain linear algebra for deep learning. We can see linear algebra in action across all the major applications today. So, we will use deep learning in   * data and learned model representation * word embeddings * dimensionality reduction | | |
| **Group Photo** |  | | |

**(Cont.)**