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COMPE510 - Fall 2025
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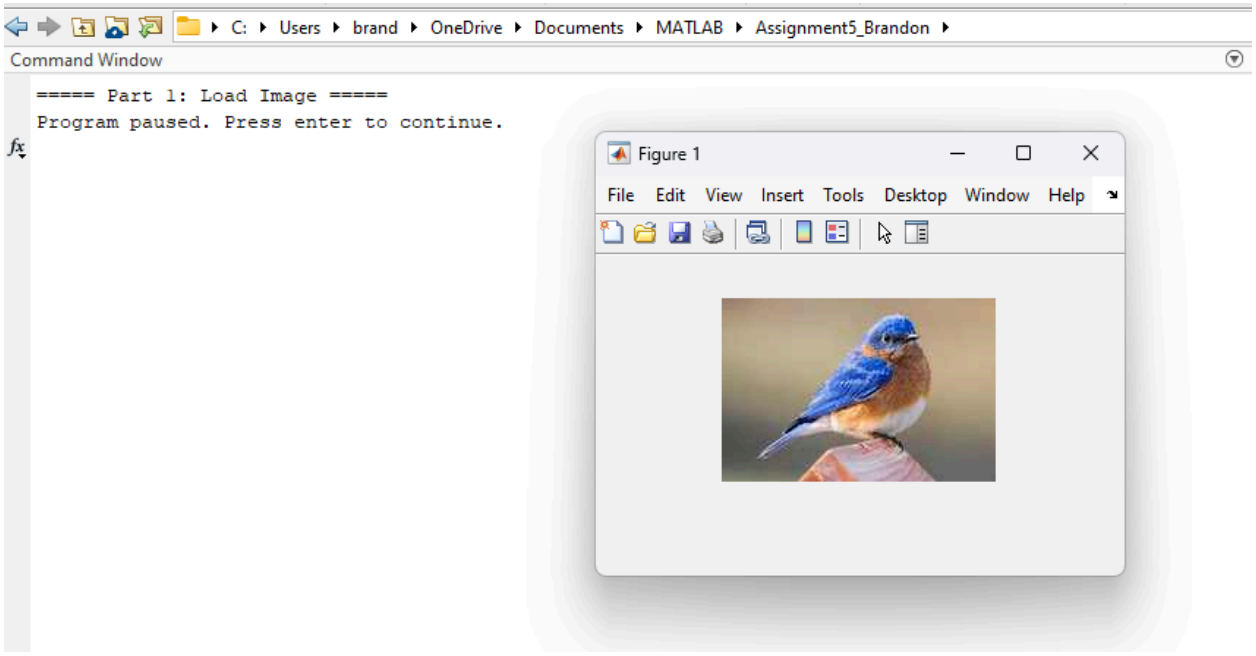
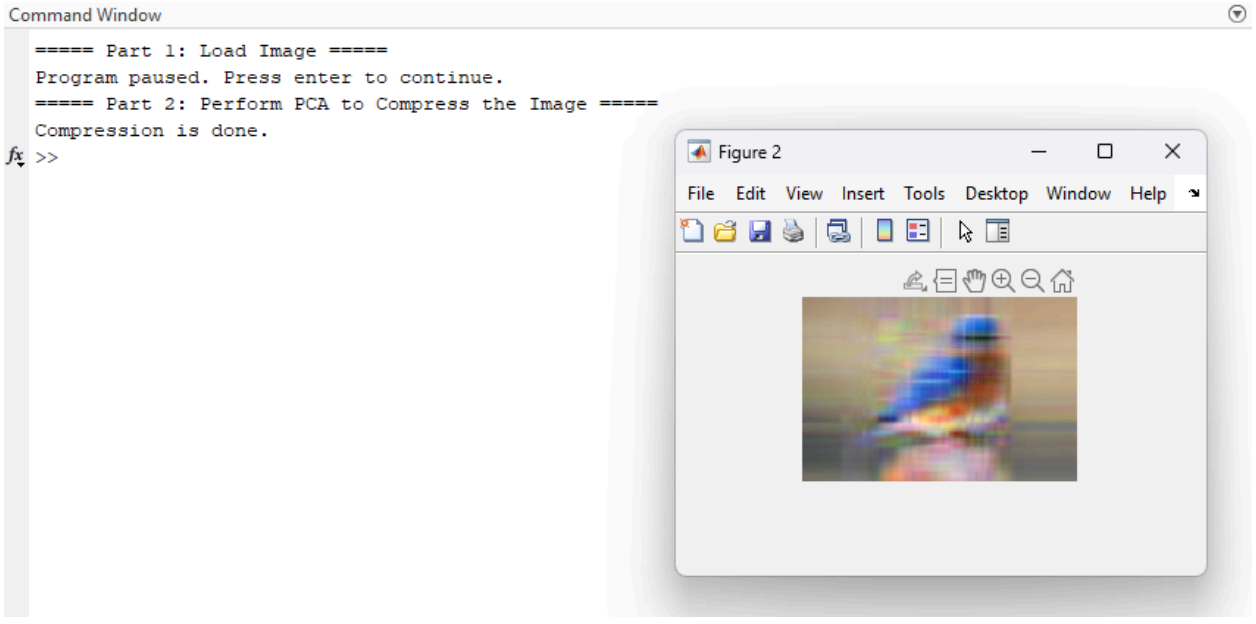
Programming Assignment 5 - PCA

A) Results

- **Load Image**



- **Perform PCA to Compress the Image (K = 5)**



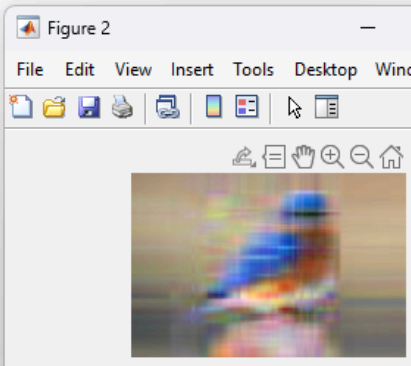
B) Questions

- **Compressed images when K = 5, 30, 100. Explain how the value of K affects image quality and compression. What changes did you observe visually and numerically as K increased?**

K = 5

Command Window

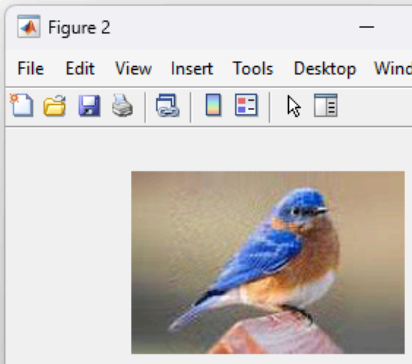
```
===== Part 1: Load Image =====
Program paused. Press enter to continue.
===== Part 2: Perform PCA to Compress the Image =====
Compression is done.
>>
```



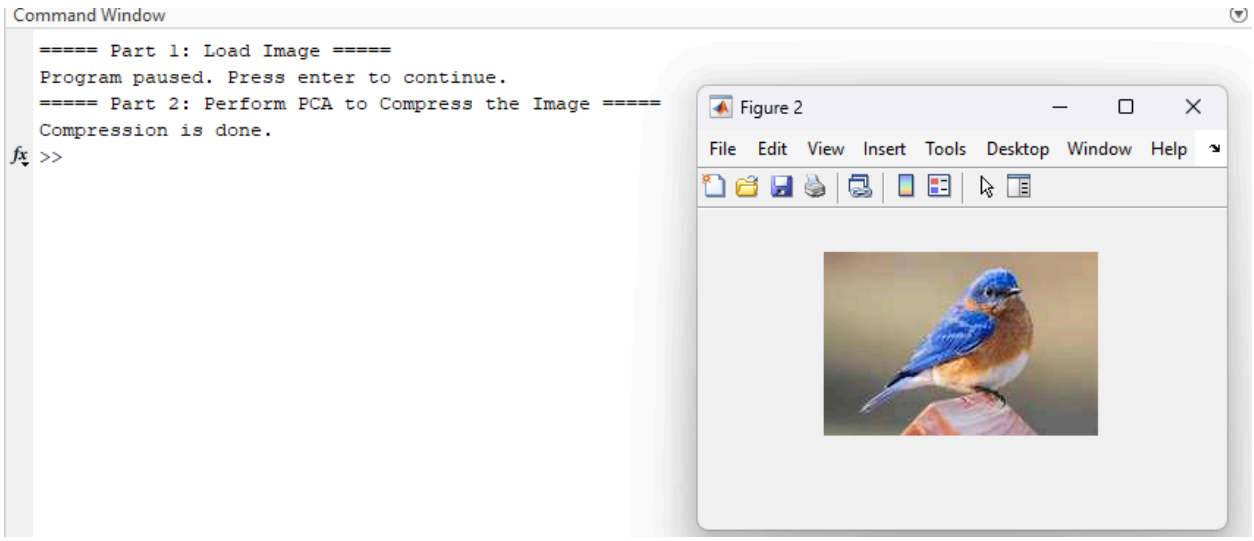
K = 30

Command Window

```
===== Part 1: Load Image =====
Program paused. Press enter to continue.
===== Part 2: Perform PCA to Compress the Image =====
Compression is done.
>>
```



K = 100



In terms of image quality and compression, the purpose of the K value in the main module code is that it represents the number of principal components kept, also known as eigenvectors. Additionally, as I increased the value of the K variable to test what would happen, we can notice from the output pictures above that increasing the value numerically caused the image to improve in quality after being compressed. This is because increasing the value of K means how much information or quality is kept from the original image for compression.

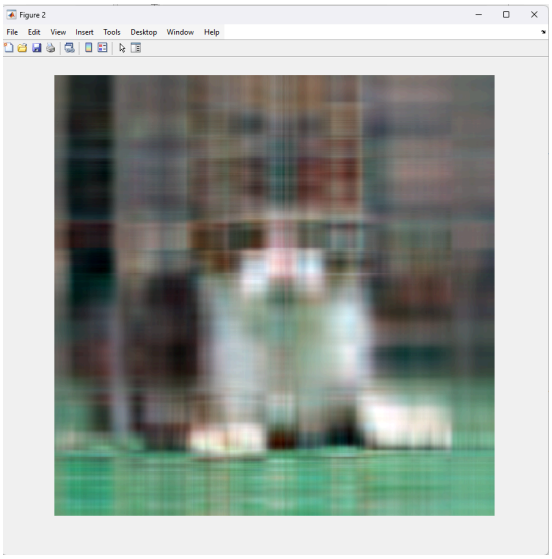
- **Compare PCA with other possible image compression techniques you're familiar with (e.g., JPEG). What advantages or limitations does PCA have in this context?**

Comparing PCA with other possible image compression techniques I know like Discrete Cosine Transform (DCT), Fourier Transform, and standardized codecs like JPEG, PNG, and WebP, PCA has its own advantages and limitations. For example, when compared to these other techniques, PCA's advantages include being better at adapting to images, maximizing variance per component, more applicable for machine learning, and doesn't rely on frequency or periods. On the other hand, PCA's limitations include being impractical, sometimes performs worse than other techniques, requires eigenvectors, and cannot guarantee lossless features compared to other techniques listed above.

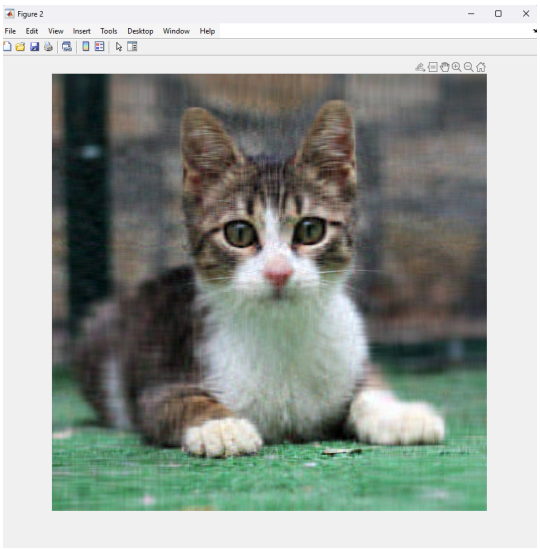
- **Apply PCA to a different image of your choice (e.g., one with more detail, texture, or color variation). What differences did you observe in the compression results compared to the original bird image?**

Chosen Image:

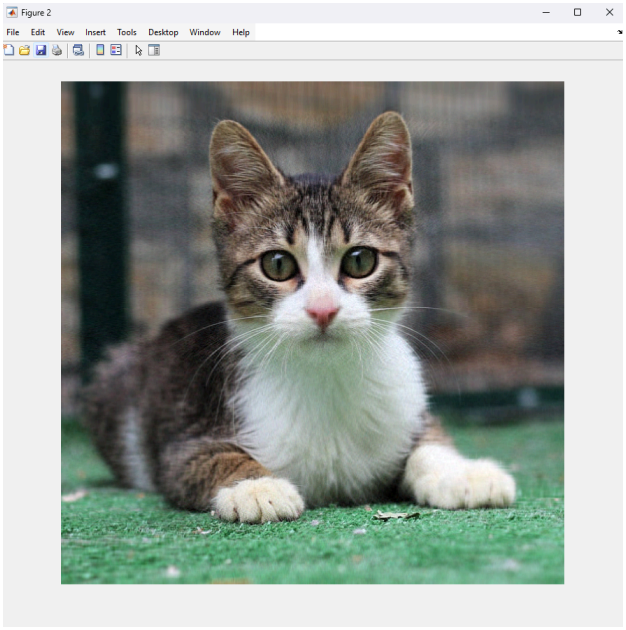
K = 5



K = 30



K = 100



After running the same tests with a different image with more details, I noticed quality differences between the two image types. Since the test image I selected had more quality, meaning it had more components to take into account when being compressed, the loss of quality was greater or more obvious to tell when we first tested for K = 5. Therefore, a conclusion I can make is that the clearer or more detailed an image is, the more quality it has to lose when being compressed by PCA.

C) Summary

In this fifth programming assignment, I believe that the implementation of each of the program files went well in connection to the main program file. The things that went well regarding this fifth assignment include loading the image, and compressing the image using various values of K. This can be seen in the pictures above as the differing values of K slowly improved the quality of the image per compression until it was somewhat similar to the original image. Overall, this fifth assignment was efficient in teaching me about new topics like PCA, how to load images and files of image type onto Matlab, how to compress images using Matlab, and how it relates to machine learning.