

**MATLAB Exploration #5 for MATH 1554**

For each MATLAB assignment, follow the step-by-step formatting guidelines we provided. You will be graded on completeness, following directions, proper usage of comments, and overall readability of your code and published .pdf submission. We recommend **format bank**

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For Week 14: MATLAB #5 *SVD exploration*. Download the file `buzz.jpg` from my website and place a copy in your MATLAB directory, and then copy the following code into MATLAB (or download .txt file here <https://sbarone7.math.gatech.edu/matlab5.txt>).

```
clc
RGB=imread('buzz.jpg');
gray=rgb2gray(RGB);
A=im2double(gray);
[U,S,V]=svd(A);
sz=size(A);
Approx=zeros(sz);
r=50
for i=1:r
    u=U(:,i);
    s=S(i,i);
    v=V(:,i);
    Approx=Approx+s*u*v';
end
Approx;
subplot(1,2,1),imshow(A),title('original');
subplot(1,2,2),imshow(Approx),title(['low rank r=',num2str(r)]);
```

Run the code in MATLAB. Add comments to the code to indicate what the code-lines are doing to create the image file (not every line needs a comment - google any commands you are not sure about from the command name - hint:  $v'$  is the MATLAB command for  $v^T$ ). Next, make some changes to the  $r$ -value in order to determine what changing the  $r$ -value does to the image file. Make a comment in your code about what you discover.

Answer the questions below as comments in your MATLAB document:

- \* Why is it important that the image file is converted to grayscale?
- \* What is the practical effect of having a low  $r$ -value?
- \* Compute the **Approx** matrix for  $r = 10$  and then compute the rank of the matrix **Approx**. Do this for several more  $r$ -values, adding code and comments to your MATLAB document. What do you notice?

- \* State a small  $r$ -value that still results in a clear image, explain in a sentence or two why such a clear image can be obtained from a low rank image matrix.
- \* (\*optional\*) Can the process be modified to deal with color images?
- \* (\*optional\*)HARD How is each row of the image being calculated when  $r = 1$ ? When  $r = 2$ ?
- \* (\*optional\*)ADVANCED Describe in words how each row of the image is being calculated for arbitrary  $r$ . *Hint: each row is a linear combination of the vectors  $v_1, \dots, v_r$ .*

Your grade will be determined by how well you annotate the code above with appropriate comments and your answers to the first four questions above.