1 Instructions

Please save your code for the following exercises as an m-file or Jupyter Notebook file and email the file to me (at `m3becker@ucsd.edu`). Download a file called `lab5start.m` (at `http://topex.ucsd.edu/rs/labs2019/lab5/lab5start.m`), which includes some lines of MATLAB code to get you started. Please be sure to provide an answer for each and every component of each exercise!

2 Exercises

2.1 Exercise 1

1) Go to `http://topex.ucsd.edu/rs/labs2019/lab5/imagery/` and download the individual `*.raw` files for the seven bands of a Landsat image of San Diego, acquired in August 1990. The spectral range and other file characteristics are provided in the NLAPS header file. (See Appendix A of the course Image Processing notes.) The table below gives a summary of the characteristics of the spectral bands.

Band #	Min. λ (μm)	Center λ (μm)	Color
1	0.45	0.485	Blue-Green
2	0.52	0.56	Green
3	0.63	0.66	Red
4	0.76	0.83	Near-IR
5	1.55	1.65	Mid-IR
6	10.40	11.45	Thermal-IR
7	2.08	2.255	Mid-IR

Table 2.1: Landsat spectral bands

Display the thermal infrared (thermal-IR) band three ways: a) without a contrast enhancement; b) with a linear stretch applied; c) and with a histogram equalization. Display your results with a grayscale colormap. What do you see in the ocean areas? Compare the original image histogram with the equalized image histogram. (Use the built-in MATLAB function `imhist()` to display histograms.)

2.2 Exercise 2

Use the appropriate bands and contrast enhancement to make a natural-looking RGB image. Without histogram equalization, the picture looks blue. Why? Combine the processed bands into a single image using the `cat()` command, and then plot them with `imshow()`, as in Lab 3.

2.3 Exercise 3

Apply the following operations to Band 1: a) image smoothing; b) image sharpening; and c) southwest illumination (using the Sobel filter). (Follow Section 11.2.2.2 in the third edition of Rees.) Display your results with a grayscale colormap. You can run a convolution with the built-in MATLAB function `filter2()`.

2.4 Exercise 4

Compute and display the normalized difference vegetation index. (See page 373 in Rees.) Does the output match what you would expect? You will need to convert the integer bytes to `double()`, then compute the NDVI ratio between -1 and 1, and, finally, map the numbers back to between 0 and 255 with `imagesc()`.

2.5 OPTIONAL: Exercise 5

For extra credit, follow the methods in Section 11.2.3.1 of Rees to decompose the seven bands into their principal components.