## **Final Project**

Welcome to your final project! For this last bit, you will be doing pretty much everything by yourself. But don’t worry, we will break this down step-by-step and also link some resources for help.

Your task will be to: create a notebook, load in a color image, convert it to grayscale, add gaussian noise to the image, and then denoise that image using a convolution.

**Resources**

* **Past Notebooks** - a lot of the steps needed for this project can be found in the past notebooks
* **Your Instructor** - As always, your instructor will be happy to help guide you towards the answer
* [**w3schools**](https://www.w3schools.com/python/)- If you need Python review, visit this website for help.
* **Documentation** - Documentation are the websites that the creators of the packages have made to help you understand how to use it - to find documentation just look up the package name and function
* [**Stack Overflow**](https://stackoverflow.com/questions) **-** Stack Overflow is a website where people have posted coding questions that they need help with, most likely a question you have has already been asked and answered on Stack Overflow is
* **ChatGPT** - Generative AI is a great tool to help with coding, but be careful. Please, please, please don’t ask the AI to code the whole thing you need, just ask it for help in coding something. When people ask AI to code everything for them the project often doesn’t work well together and they have no idea how to fix issues that come up.

**Steps**

* **Create a Google Colab notebook and share it with @instructor** - to do this go to google drive, click new, go down to more and create the notebook - title it “[CIG Course] Final Project - Your Name” - afterwards, share the notebook with your instructor by clicking share in the top right and entering their email address
* **Load in needed packages** - this step has been done for you - copy paste the code below into your notebook to load in the packages

import numpy as np

import matplotlib.pyplot as plt

from skimage import data

from scipy.ndimage import convolve

plt.rcParams['image.cmap'] = 'gray' #this bottom line is not a package, but still run it - don't worry about why

* **Load in the image**  - run the same function that we have been using to load in Chelsea, but for a different image - instead of chelsea, use *your* pick of coffee or rocket (here is the [documentation](https://scikit-image.org/docs/0.25.x/api/skimage.data.html) for the image options)- then display the image

*To show the image* at any step run the following code, where *image\_variable\_name* is whatever the image variable is named

plt.imshow(image\_variable\_name)

plt.show()

* **Convert the image to grayscale** - hint: you have written a function for this before! - afterwards display the image
  + After you convert the image to grayscale, run this line of code:

grayImage = grayImage[:, :, 0]

but replace *grayImage* with whatever your grayscale image variable is named

* **Pad the image with zero padding -** add one extra layer of 0’s to the image - create a new variable for the padded image called paddedImage - the pad\_widthshould be set to ((1, 1), (1, 1))-display the image after padding
* **Add gaussian noise to the image** - gaussian noise tends to have one mean, use that mean, and for standard deviation use 0.05 - definitely look at the most recent notebook for this one - display the noisy image

#here is the function that generates gaussian noise

np.random.normal(loc=mean, scale=standard\_deviation, size=paddedImage.shape)

* **Denoise the image with a blur convolution** - either blur is fine, but for better results use a gaussian blur
* **Display the denoised image and relish in your accomplishment**

Once again, you are **not** expected to know how to do all of this. Programming is not about knowing things though, it is about being able to figure them out. If you don’t know how to do something at first, spend some time thinking about it, consult your resources and try again. It might take a while but you *will* get it in the end.

**Extra Challenge**

Open this image link and download the image:

[noisy\_WashU\_Image.jpg](https://drive.google.com/file/d/1UbMdNGk7CT5ftFIFDrPiFEuDzxlVzYVL/view?usp=drive_link)

Once you have done that, navigate to your notebook. On the left side of the notebook, there should be a file/folder icon–click it. Then click the icon with the arrow on it, the one that says ‘Upload to session storage’ when you hover over it. Upload the image you just downloaded to your notebook (note, if you want to come back and try this challenge later, you will have to upload the image each time).

Create a new cell block and run this block of code:

from PIL import Image

noisy\_image = Image.open(“noisy\_WashU\_Image.jpg”)

Now denoise this image!

The solution notebook will be shared later today after class. It is highly recommended that you do not view the solution notebook until after you have attempted everything by yourself a few times. (the solution notebook does not contain a solution for the extra challenge)