**Name (netid):** Jack Gentile (jtg2)
**CS 445 - Project 1: Hybrid Images**

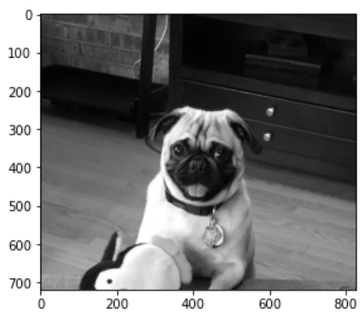
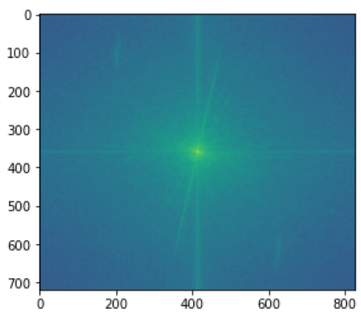
| **Total Points Claimed** | **105** | **/ 130** |
|---|---|---|
| 1. Hybrid image main result | | |
| a. Main result and description | 45 | / 45 |
| b. FFT images of main result | 15 | / 15 |
| 2. Hybrid images: two additional results | 10 | / 10 |
| 3. Image enhancement tasks (3rd is B&W) | | |
| a. Contrast enhancement | 10 | / 10 |
| b. Color enhancement | 10 | / 10 |
| c. Color shift | 5 | / 10 |
| 4. Quality of results / report | 10 | / 10 |
| 5. Color Hybrid Image w/ explanation (B&W) | 0 | / 5 |
| 6. Gaussian / Laplacian Pyramids (B&W) | 0 | / 15 |

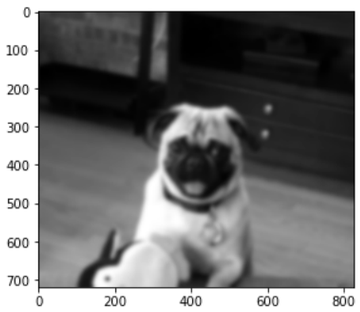
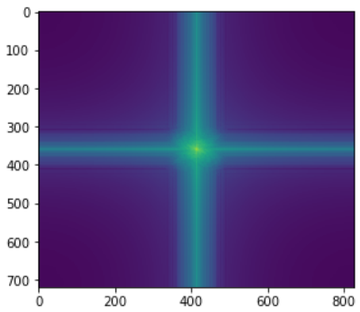
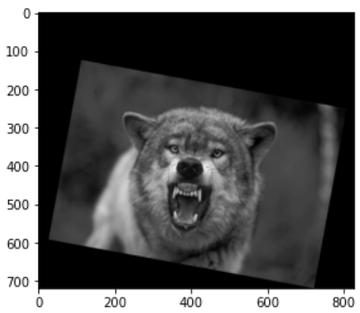
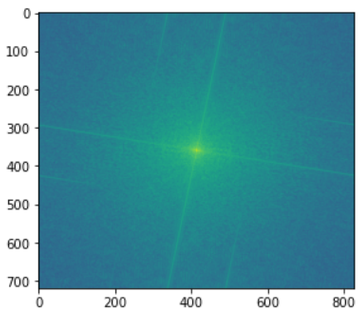
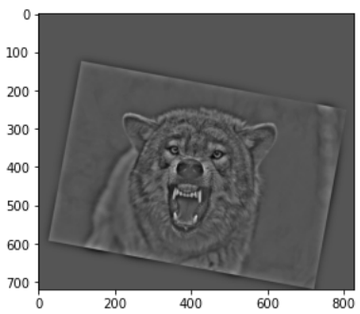
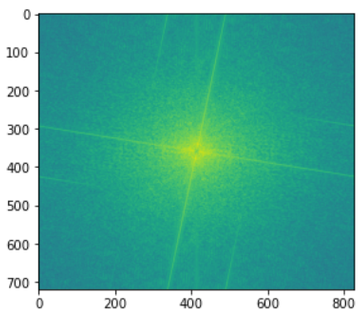
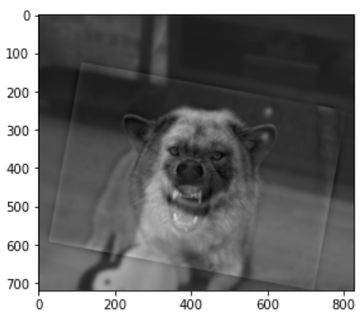
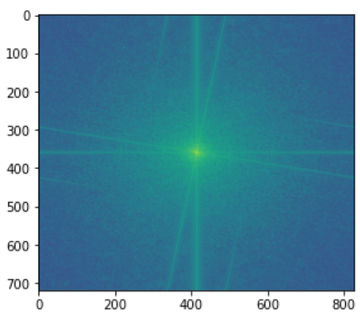
**1. Hybrid image main result**

Hybrid images combine two images to create an optical illusion where you see one image from afar, and the other image up close. The process takes the low-frequency features, blurred, non-specific shapes, from the first image, and the high-frequency features, like lines and borders, from the latter. Up close, your mind focuses on the specific details, so the high-frequency features dominate. Conversely, from far away, you can't make out the finer details, so the low-frequency features dominate instead.

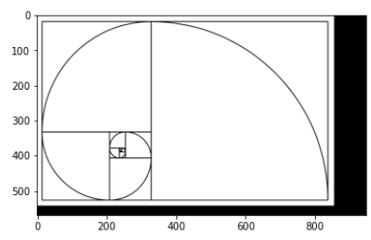
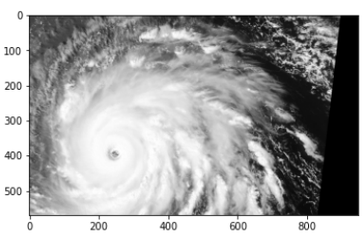
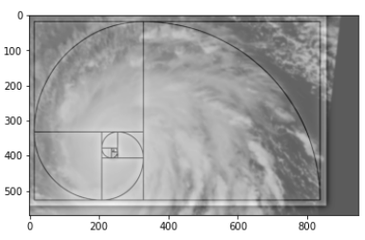
For the low-pass filter, a greater sigma value leads to a greater blur effect, i.e. less recognizable. This is because each pixel combines intensities from a greater radius away. for the high-pass filter, a greater sigma value produces more general borders, rather than all the lines in the image. With the wolf example, you can see the teeth and shape clearly, but you can't see his whiskers.

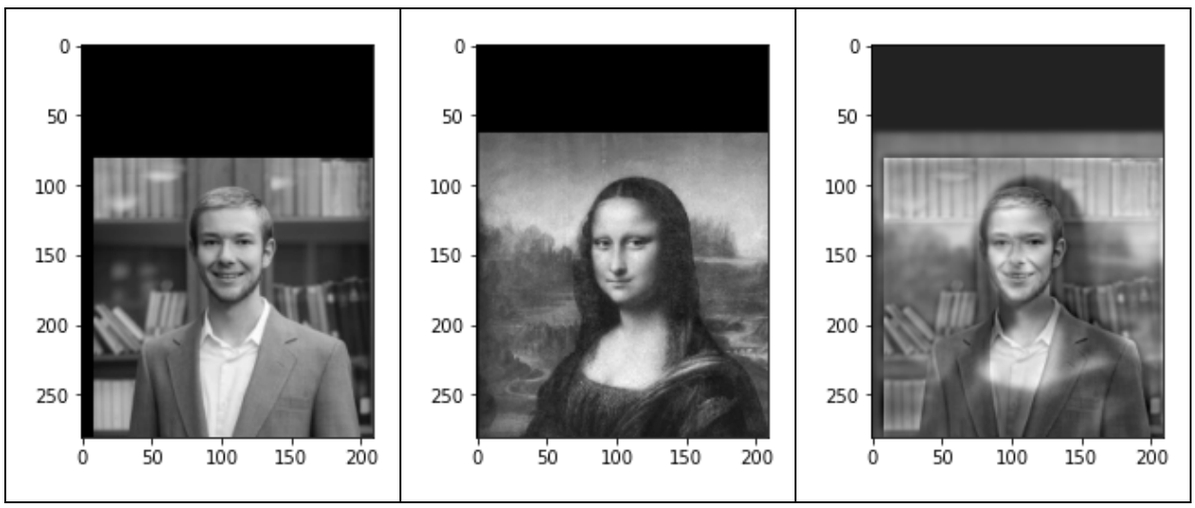
I chose a picture of my dog--a pug named Maverick, after Tom Cruise's character in Top Gun--as the low-frequency input, and a stock image of a wolf as the high-frequency input. From a distance, Maverick appears playful and sweet, but up close, you can see his inner wolf!

| Description of image | Image | FFT |
|---|---|---|
| Maverick, original |  |  |

| | | |
|---|---|---|
| Maverick, low-pass filtered |  |  |
| Wolf, original |  |  |
| Wolf, high-pass filtered |  |  |
| Hybrid |  |  |

**2. Hybrid image additional results**

| High-frequency input | Low-frequency input | Hybrid |
|---|---|---|
|  |  |  |



**2. Image enhancement tasks (2 required, 3 for B&W)**

Contrast Enhancement

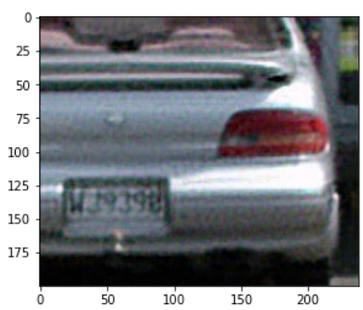
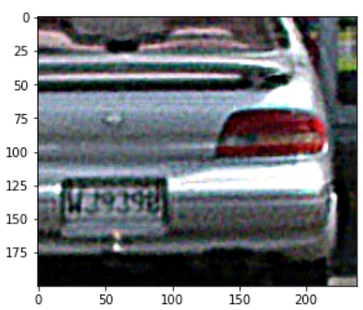
> The contrast enhancement function uses a simple Laplacian filter to obtain the high frequency features. Then the features are added back to the original image to make them look more emphasized.

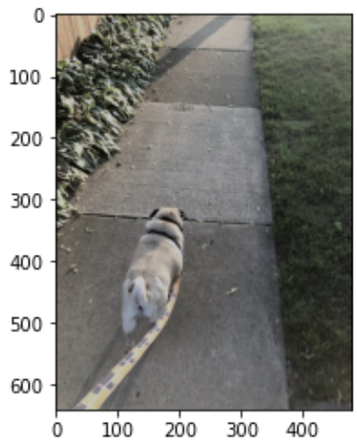
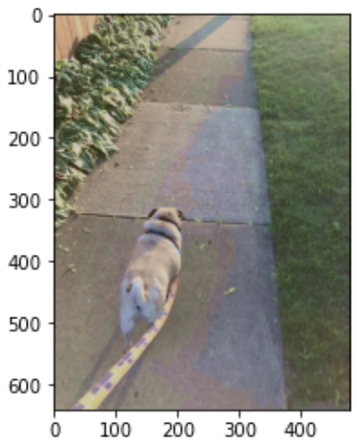
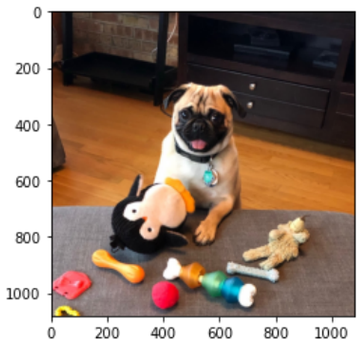
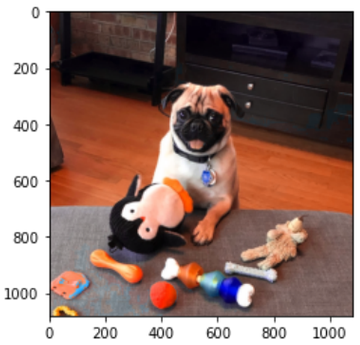
Color Enhancement

> Using HSV, the color enhancement function increases the saturation and value of each pixel. Since these values can only be in the range 0-255, you can't just double them and expect an intelligible result. The function instead reduces the quantity 255-x by some factor delta, where x is the saturation and/or value attribute of a pixel. This increases the attributes without exceeding the upper limit.

Color Shift

> In HSV, hue is measured in degrees from 0 to 360. To make an image more red, you need to shift the hue of each pixel towards 0, either by increasing or decreasing the measure. The function reduces the absolute radial distance from the target by a factor of the parameter delta. To make an image less yellow, you shift the hue away from 60, which is the same as shifting towards 240=180+60.

| | Original image | Enhanced image |
|---|---|---|
| Contrast enhancement |  |  |

| | | |
|---|---|---|
| Color enhancement |  |  |
| Color shift (less yellow) |  |  |

**Acknowledgments / Attribution**

Image sources-

- Wolf- https://s-i.huffpost.com/gen/1313827/images/o-WOLF-facebook.jpg
- Fibonacci spiral- https://upload.wikimedia.org/wikipedia/commons/thumb/7/79/Fibonacci_spiral.svg/1280px-Fibonacci_spiral.svg.png
- Hurricane Igor- https://upload.wikimedia.org/wikipedia/commons/thumb/8/8e/Hurricane_Igor_at_1640z_on_September_13%2C_2010.jpg/1200px-Hurricane_Igor_at_1640z_on_September_13%2C_2010.jpg
- Mona Lisa- https://cdn.britannica.com/24/189624-050-F3C5BAA9/Mona-Lisa-oil-wood-panel-Leonardo-da.jpg
- License- https://www.focusmagic.com/wp-content/uploads/2019/09/forensic-car-3-after.jpg
- All images not cited are original pictures of me or my dog