**Homework Assignment 2: Window-based Stereo Matching**

**NOTE:** Before running my code, please install progressbar by running “pip install progressbar” - it will display a progress bar for each part and estimate how long it will run.

**NOTE:** Parts 2 through 5 may take over 3 hours to run each because “real images” are large.

1. Basic stereo algorithm on simple grayscale image
   1. Ps2-1-a-1/2.png
2. Basic stereo algorithm on real image
   1. Ps2-2-a-1/2.png
   2. Compare your results to pari1-D\_dropL/R.png

**In the ground truth you can clearly tell one object from another – every object has its own depth (darkness of object background) and it’s consistent throughout the object. However, in the images from 2A you can only see some resemblance of these objects but can’t tell where one object ends and another one begins; everything is very pixelated. The images in 2A also capture a lot of details from the background (e.g. patterns in the paintings) whereas ground truth only concentrates on the shapes of the main objects.**

1. Basic stereo algorithm on simple grayscale image with added noise/brightness
   1. Ps2-3-a-1/2.png: analysis of results compared to question 2

**Results from 3A capture a lot more differences between L and R than in 2A. Object outlines in D\_R also become a little bit more visible compared to 2A whereas results in D\_L are uninformative.**

* 1. Ps2-3-b-1/2.png: analysis of results compared to question 2

**Results from 3B capture a lot more differences between L and R than in 2A and 3A. Object outlines in D\_R also become a little bit more visible compared to 2A and 3A and images seem less pixelated whereas results in D\_L stayed uninformative.**

1. Normalized correlation
   1. Ps2-4-a-1/2.png: describe how it compares to SSD and to ground truth

**Results from 4A seem less pixelated than SDD but the shapes formed in these images do not resemble the real objects that are clearly visible in the ground truth.**

* 1. Ps2-4-b-1/2/3/4.png: analyze results comparing original to noise and contrast-boosted images

**Results from performing normalized correlation on noisy images shows much improved results. Although objects have a lot of noise, most of them are still easy to tell apart. These images look the closest to the ground so far. The images are much smoother than when using SSD. Results from performing normalized correlation on contrast-boosted images shows even more defined and uniform objects than with the noisy images.**

1. Normalized correlation on smooth/sharp/etc. images
   1. Ps2-5-a-1/2.png: analyze what it takes to make stereo work using window-based approach

**I first tried modifying just one of the two images (image L). If I made L too smooth and too bright, results illustrated unrecognizable shapes (similar to 4A). If I made L a little bit smooth and a little bit bright or just bright, results were better for D\_R and D\_L didn’t capture a lot. If I added some noise and made it a little bit bright, results were worse than when using just brightness.**

**If both images were modified (images L and R), results were uninformative.**

**I got the best results when using a mix of modified and not modified (both images L and R). This is how it looked: D\_L = disparity\_ncorr (L\_original, R\_modified), D\_R = disparity\_ncorr (R\_original, L\_modified). If original and modified images switched places, results would be uninformative. After smoothing, results look even more like the ground truth but not quite there yet. However, just like in all other maps, we are missing details about smaller objects. Maps are calculated based on color/brightness and these intensities do not signify how close or far the object is to the camera (e.g. head is bright but it’s farther, pot is dark but it’s closer. So, even though this image is our best version it doesn’t correctly illustrate the depth of objects.**