HW 2
Due : Sep 19, 2023

In this homework we look at a (naive but we will get better) way of computing homographies between images.

1. image1 shows a picture on a wall. Our goal is to replace that picture with image2.
In order to do this we will compute the H matrix that defines the transformation between the two images and then map image2 in place on image1.

Several things to consider. You can use the four corner points in each image to setup up the computation of the H matrix and then map every pixel as needed.

2. Given what we learned about homographies and how they warp images can you pick four additional points from the two images. How would you modify the computation of the H matrix when you have an over constrained problem (8 points as opposed to 4). Recompute H with these 8 points and comment on the differences in the H matrix. Map another image (of your own – please keep it PG-13) on image1 with this new homography.

Please write up your work and put all your code in a python notebook and check into your class Gitlab folder

Note 0: Feel free to use a cursor to hand pick the corners in the image
Feel free to use the matplotlib.pyplot.ginput function

Note 1: Pixel values may not fall on exact integer values. You can use the following call (or something like it to warp the image).

```
# Warp source image to destination based on homography
im_out = cv2.warpPerspective(im_src, h,(im_dst.shape[1],im_dst.shape[0]))
```

Note 2: Of course we can do the homography calculation very easily in openCV as well with the following call (below) but in this homework we want to peek under the hood and figure it out for ourselves.

```
# Calculate Homography
h, status = cv2.findHomography(pts_src, pts_dst)
```

3. Can you now take multiple images (five?) and stitch them together into a mosaic. Try and stand in a spot and rotate the camera to take multiple overlapping images and then compute the homographies and map the images onto each other while blending them. Please do this for a scene where have a certain distance between yourself and the scene. Doing it indoors is going to make it really hard on you. Please do it outside!
Again we are hand picking four points (or more) common across each image.

Think about how you would pick the points – collinearity, spacing etc.

To do a simple blend you can follow the instructions here.
https://docs.opencv.org/3.4/d5/dc4/tutorial_adding_images.html

On the topic of blending check out the classic paper by Burt and Adelson (attached)

And the real imagery that goes with it
http://graphics.cs.cmu.edu/courses/15-463/2005_fall/www/Lectures/Pyramids.pdf

In your python notebook write a 4-5 line explanation of how this method differs from the link above.

Also here is a hint for your panorama: Use the center image as image 0 and map the homographies from the center outwards.