Computer Vision
Assignment 2

Image Warping using Feature Descriptors and Planar Homograhphies

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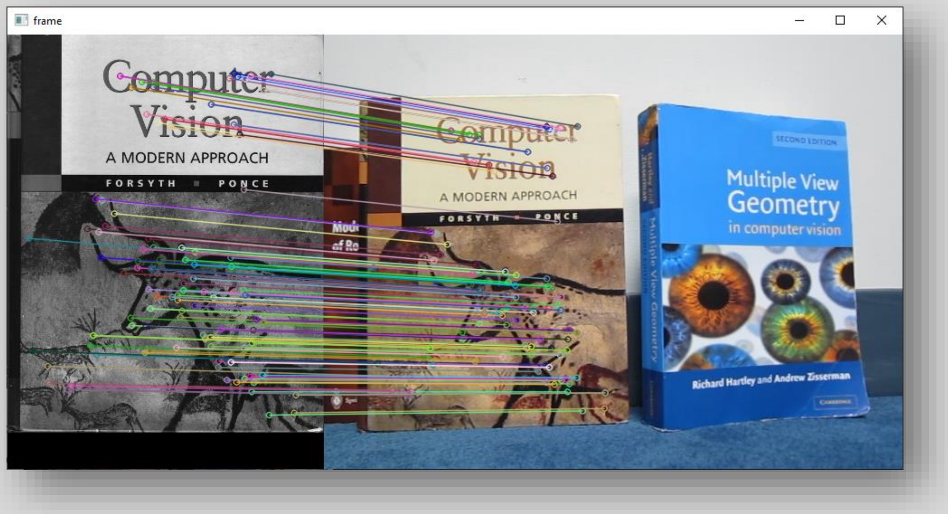
1. Process Description

1.1 Part one: Augmented Reality with Planar Homographies

- We start by getting the correspondences between the cover's image and the book video using SIFT detector, then compute KNN to get the matches. A threshold ratio is then used to filter out the weak matches and keep the strong ones. Then we visualize the good matches on the frames.


frame
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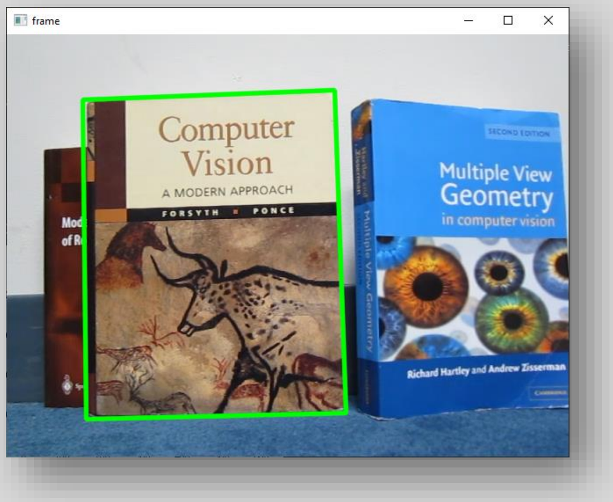
- Compute the homography matrix using the corresponding points in the image and the video frames.
- The homography matrix is used to get the coordinates of the image corners in the video frames which allows us to define the region where the movie trailer will be placed.


frame
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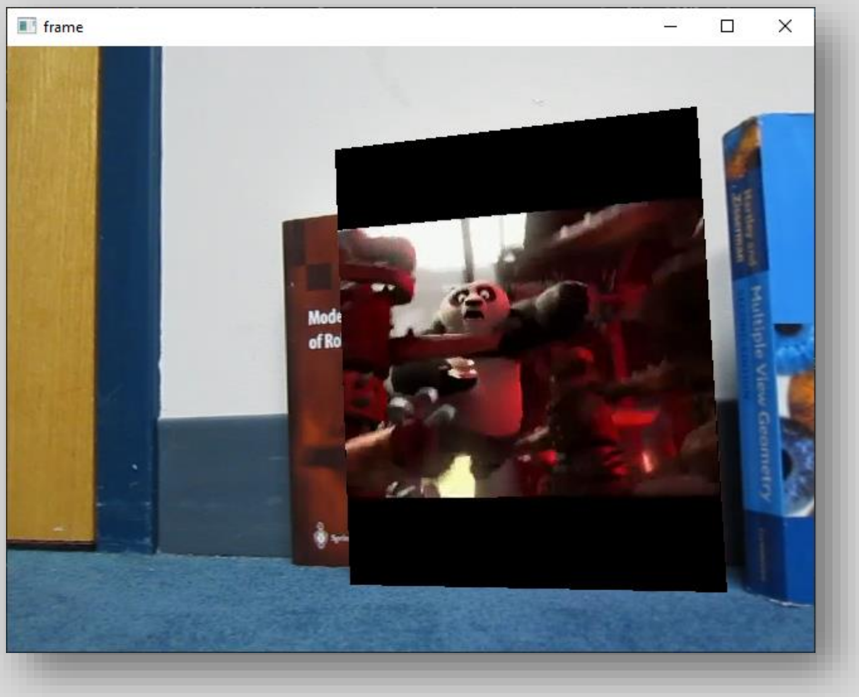
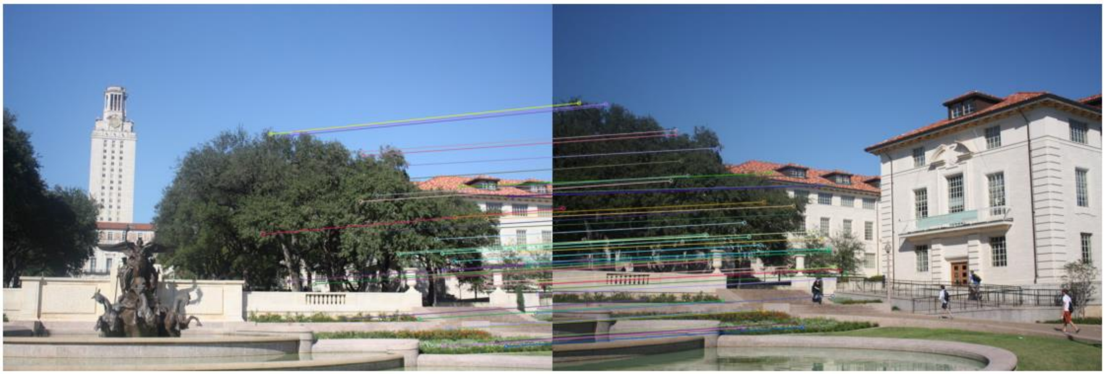
- Crop and pad the trailer video frames into given shape to fit the destination region.
- Warp each trailer video frame to the book region plane by using the same homography matrix computed previously. Then overlay the trailer video onto the main video using a suitable mask.

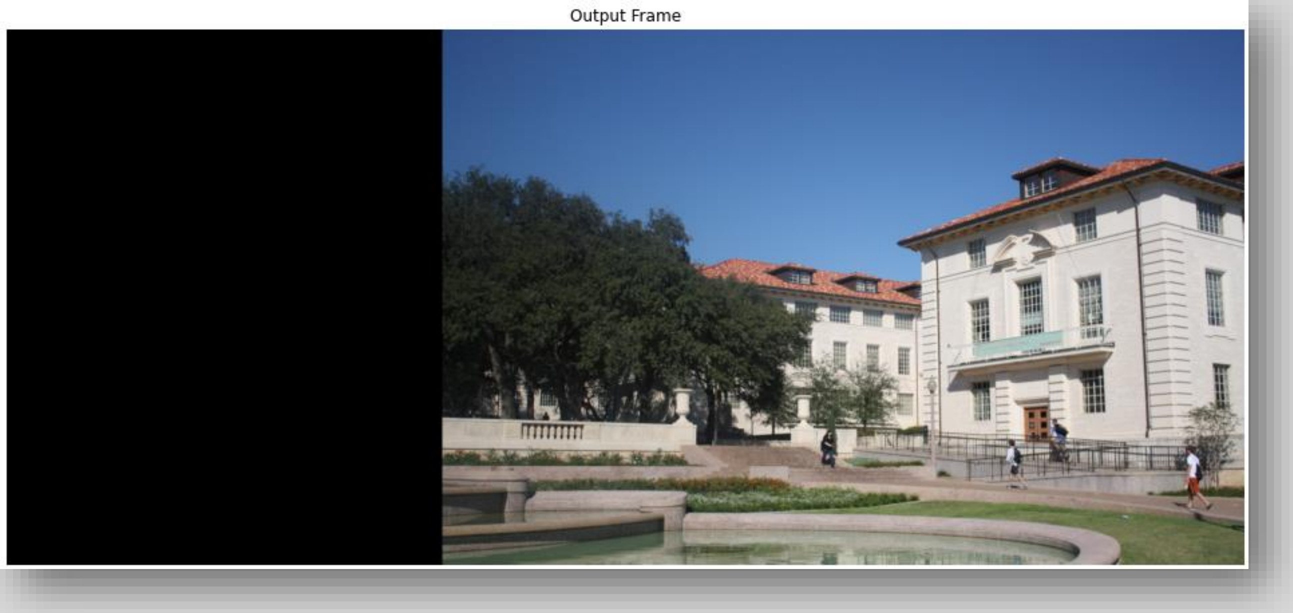


1.2 Part two: Image Mosaics

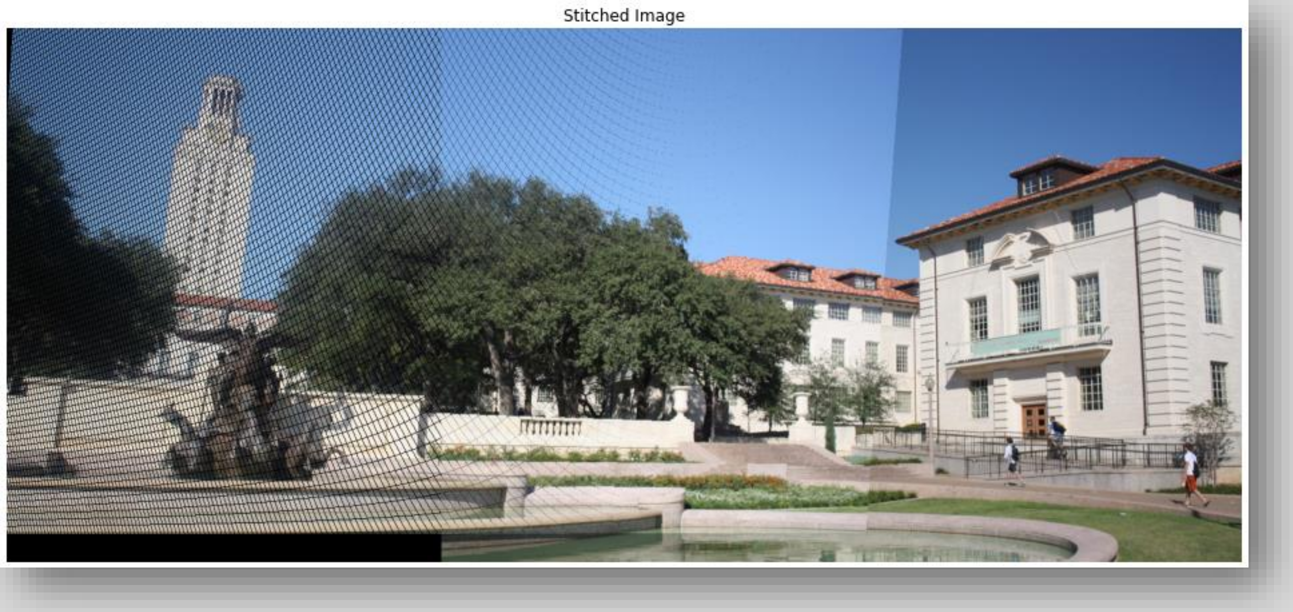
- Get the correspondences between the source image and the destination image by using SIFT detector, then compute KNN to get the matches. A threshold ratio is then used to filter out the weak matches and keep the strong ones. A sample of 50 good matches are visualized.



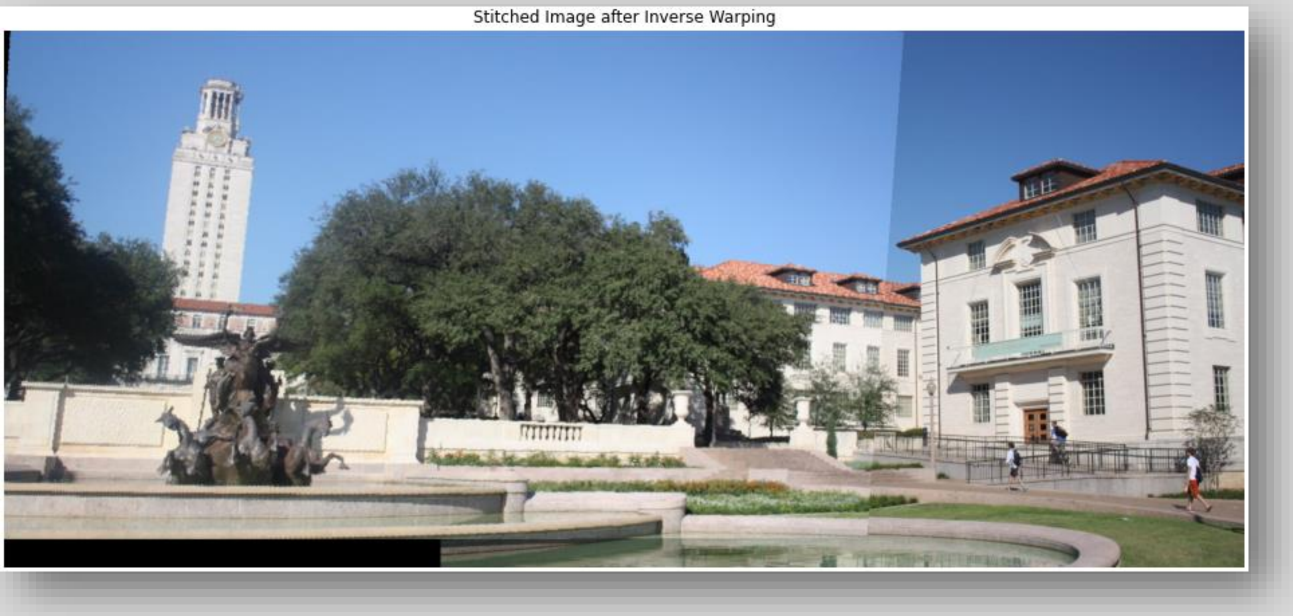
- Compute the homography matrix using the corresponding points in the images.
- Create frame for the stitched image with a suitable size and place the destination image in it.



- Create the stitched image by warping the source image to the frame. The resultant image will contain ‘black holes’ as a result of subpixel values being rounded when the new coordinates are calculated.



- In order to fill the black pixels with suitable values, we use inverse warping and bilinear interpolation to obtain the necessary pixel values from the source image.



2. Important Notes:

2.1 Matching Threshold:

We tested the possible ratios for the threshold used to determine the strong matches and found that the ratio of 0.3 resulted in the best results (closest homography matrix to built-in function and best stitch output) in most cases. However, some test cases didn't produce satisfactory result with ratio > 0.1.

2.2 Stitching Order:

The order of image stitching in multi affected the output in some images. This could be due to the number of matches found between different parts of the image which makes certain parts fit together better. The plane also depends on the plane of the base image, so it is better to select the base as which has the best angle. Stitching order can also affect the presence of certain (minor) objects in the image depending on which image the object was in.

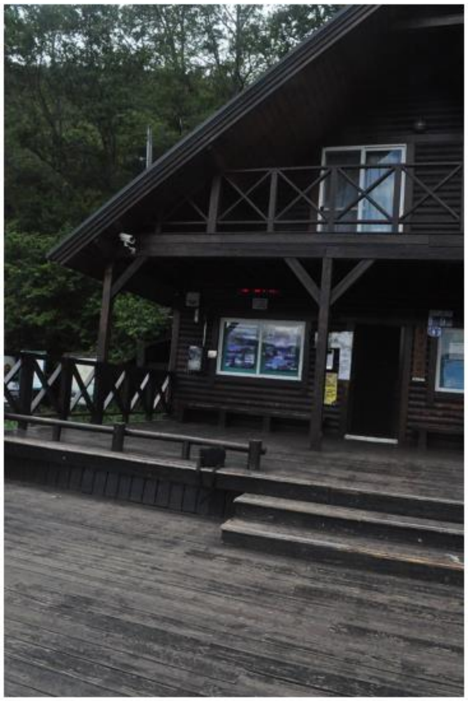
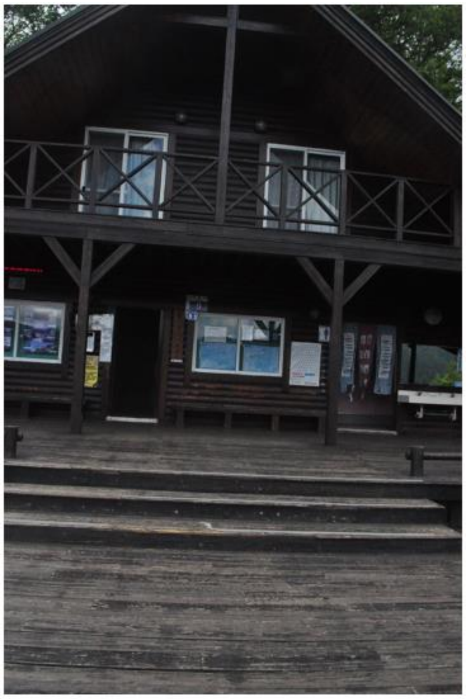
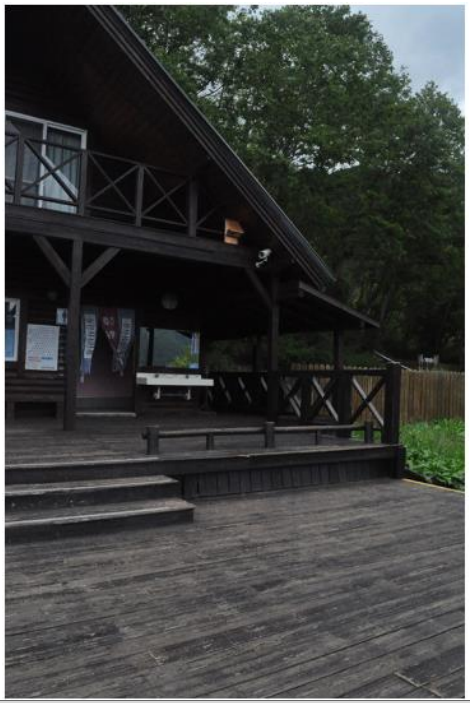
Image 1	Image 2	Image 3
		

Image 3 -> (Image 2 -> Image 1)

- Worse Perspective
- Some broken lines

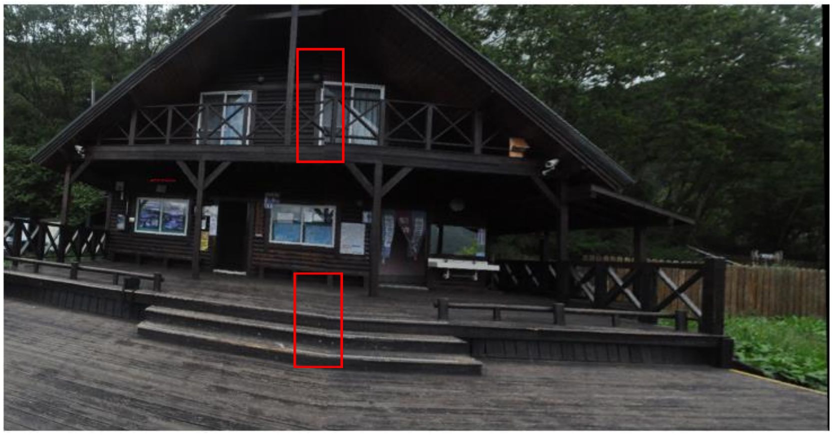
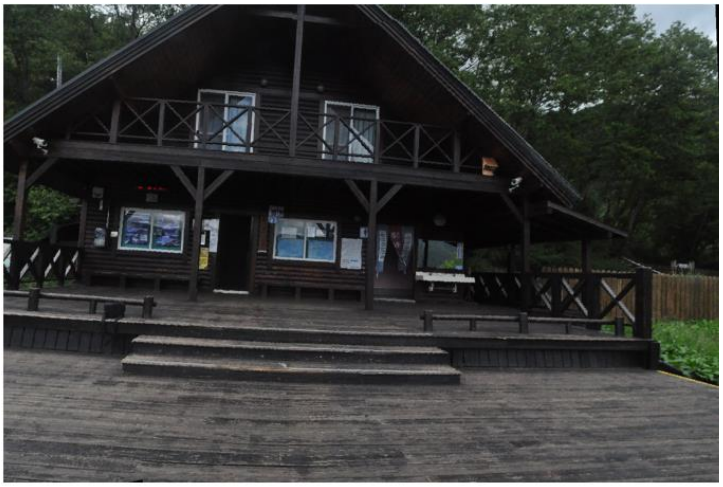


Image 3 -> (Image 1 -> Image 2)

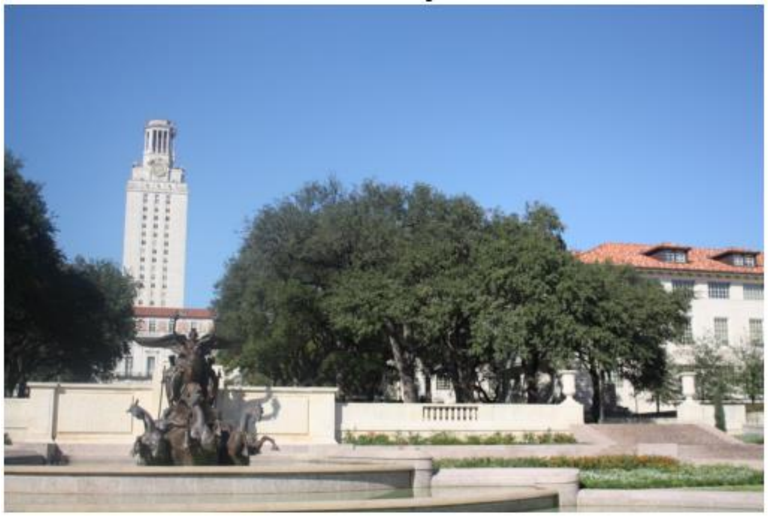
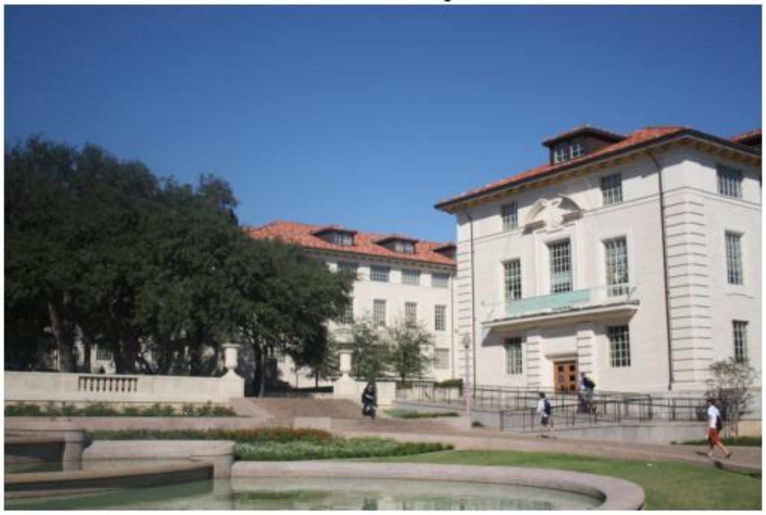
- Better Perspective
- Lines are much more fitting

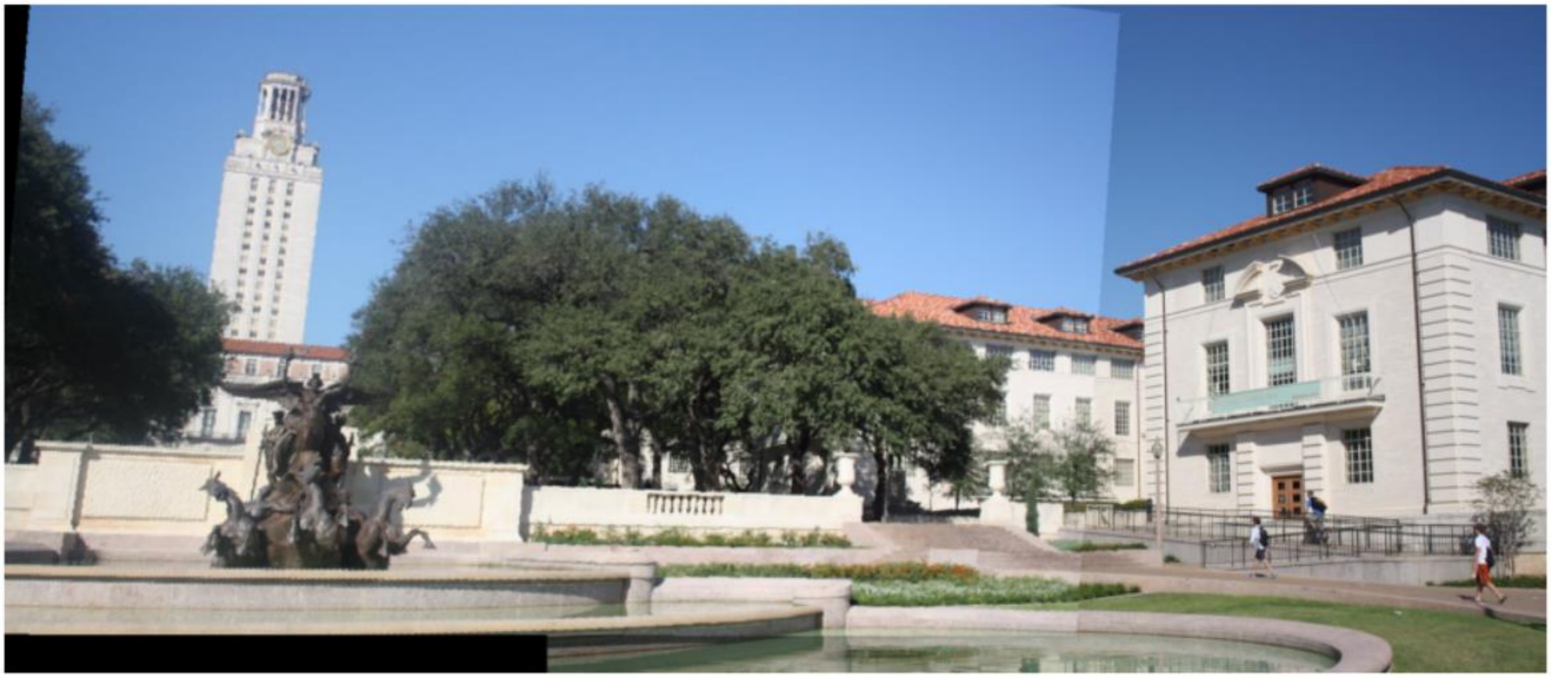


3. Sample Runs for Image Stitching

(Note: Image i -> Image j = image i (source) stitched onto image j (destination))

3.1 Provided example for 2 images:

Image 1	Image 2
	

Stitched Image (Image 1 -> Image 2)


3.2 Provided example for 3 images:

Image 1	Image 2

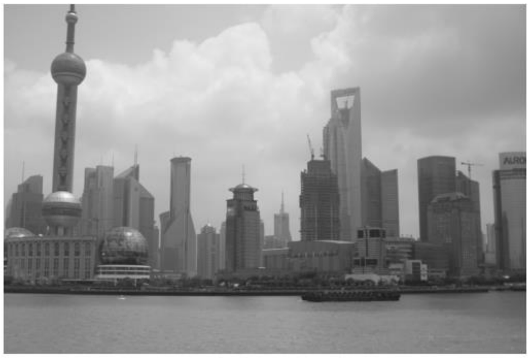
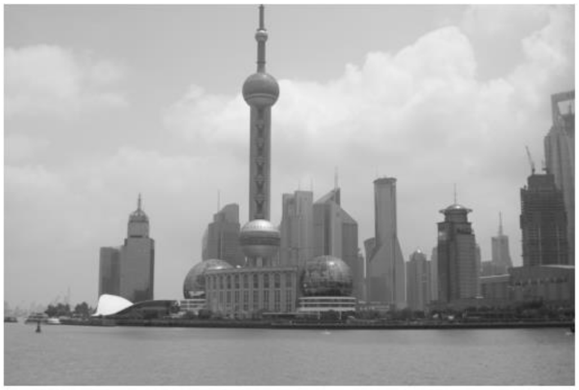
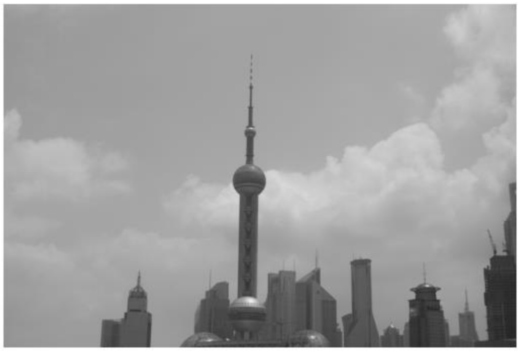
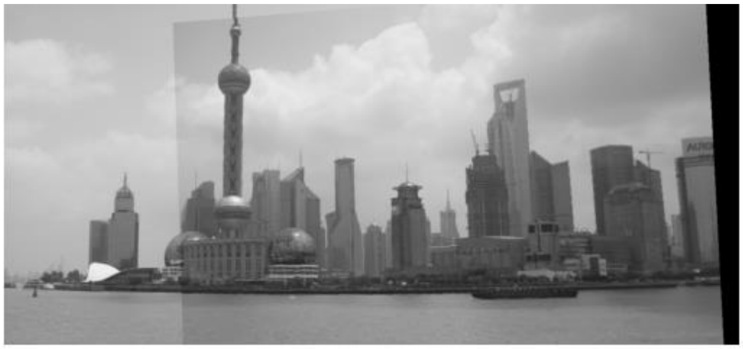
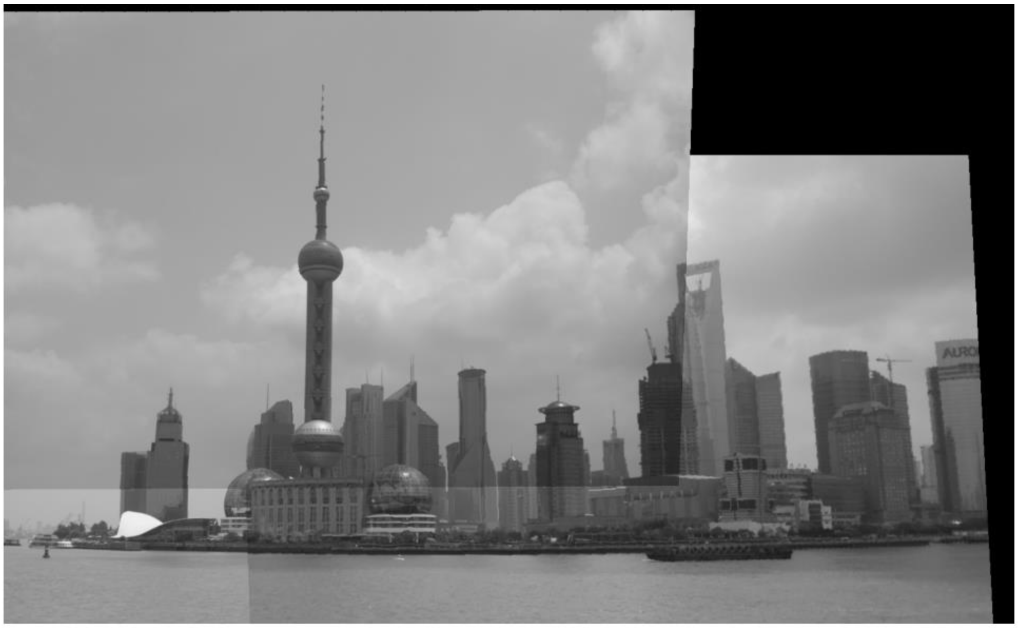
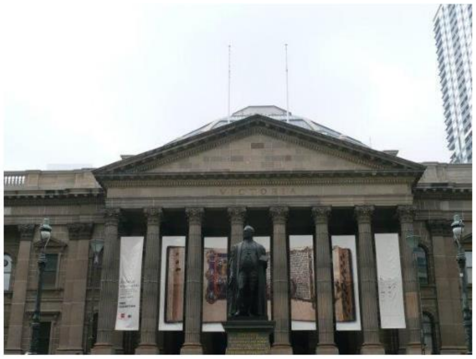
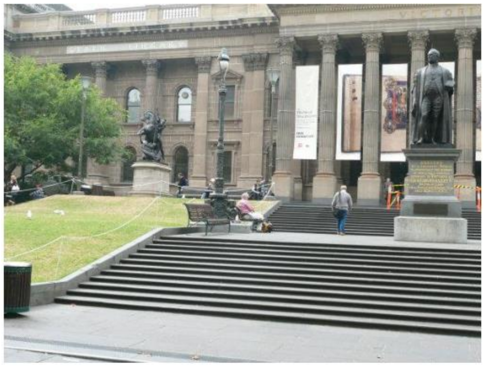
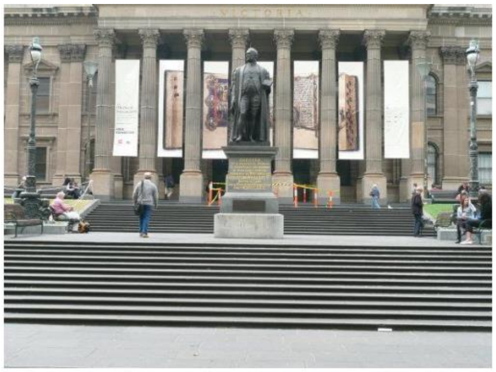
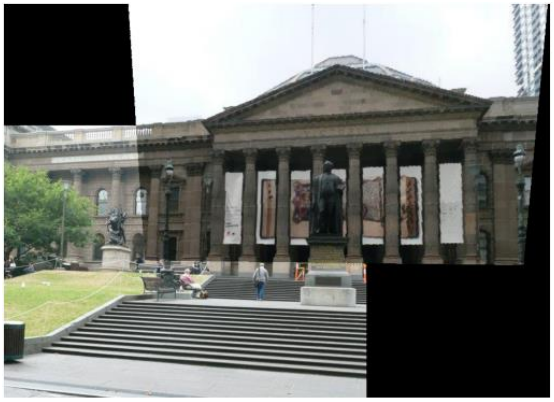
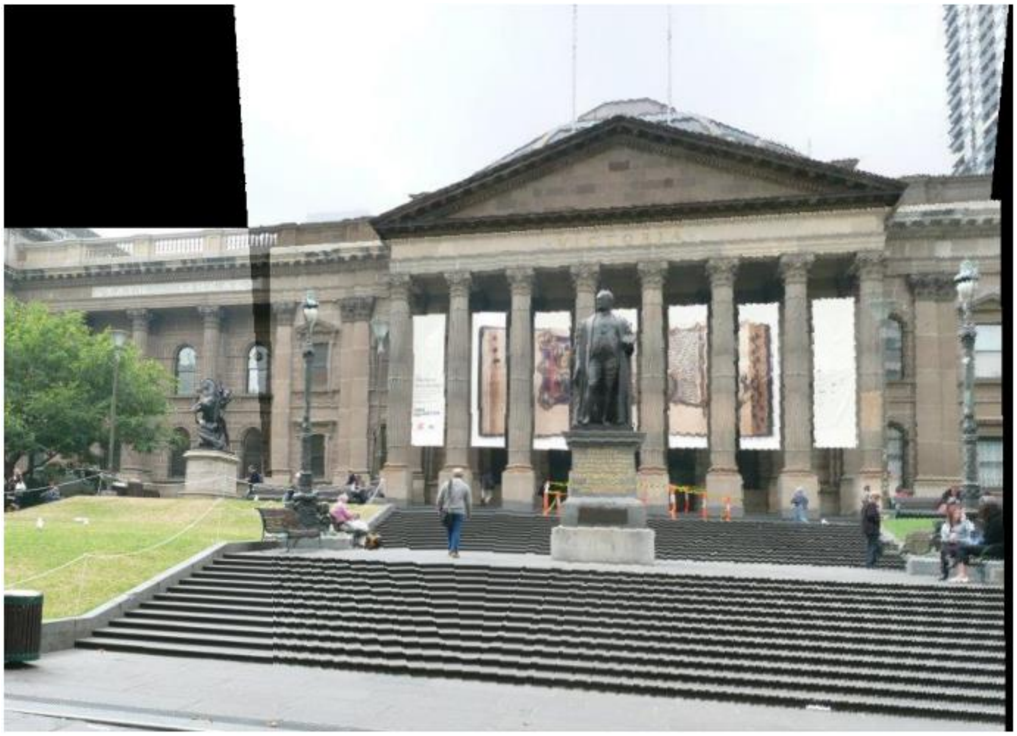

	

Image 3	**Output 1: Image 1 -> image 2**
	

Stitched Image: Image 3 -> Output 1



3.3 Additional Example 1: Stitching 3 Images on different axes

Image 1	Image 2	Image 3
		
Output 1: Image 1 -> Image 2	Stitched Image: Image 3 -> Output 1	
		

3.4 Additional Example 2: Stitching 3 Images on same axis

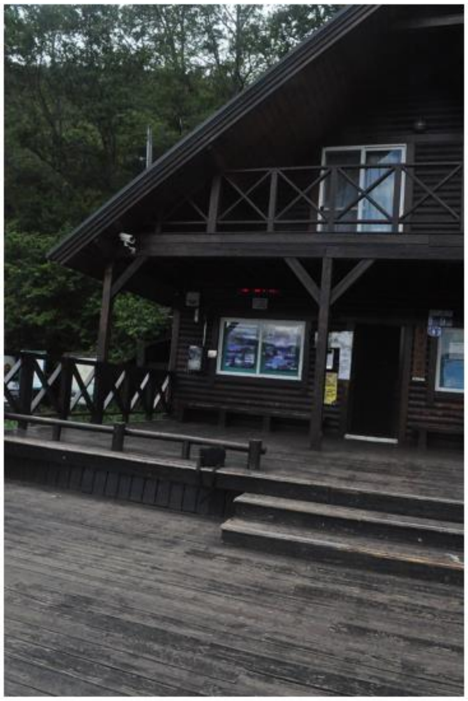
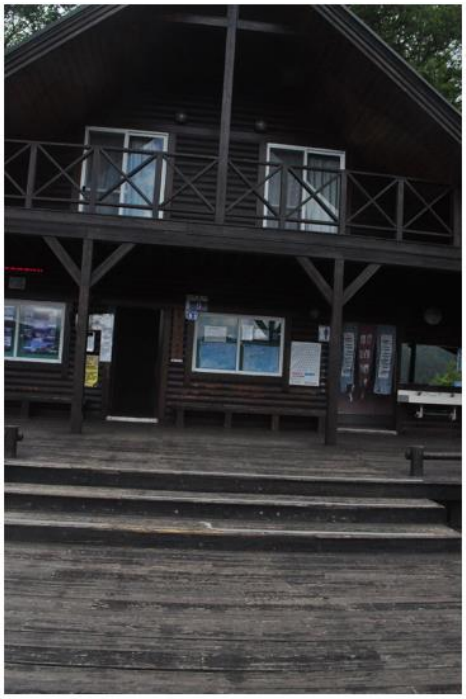
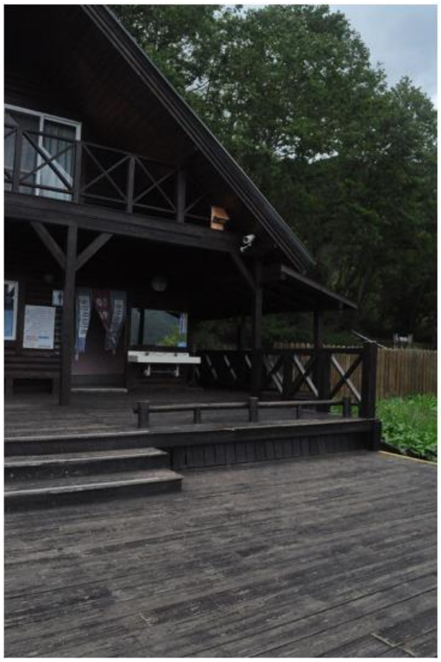
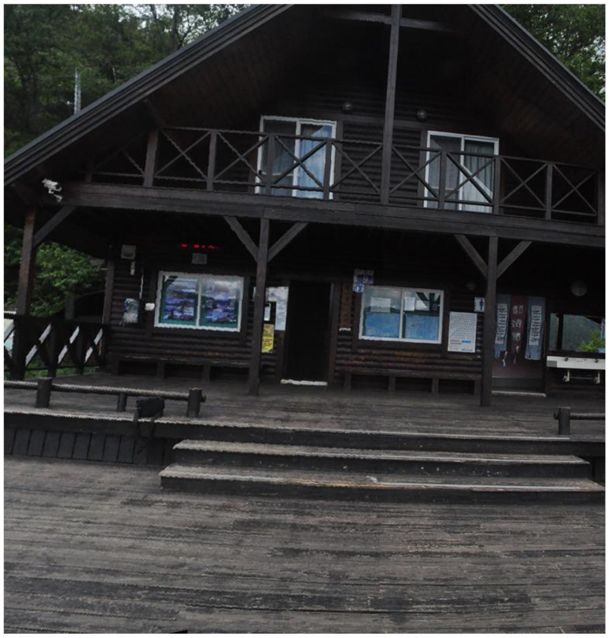
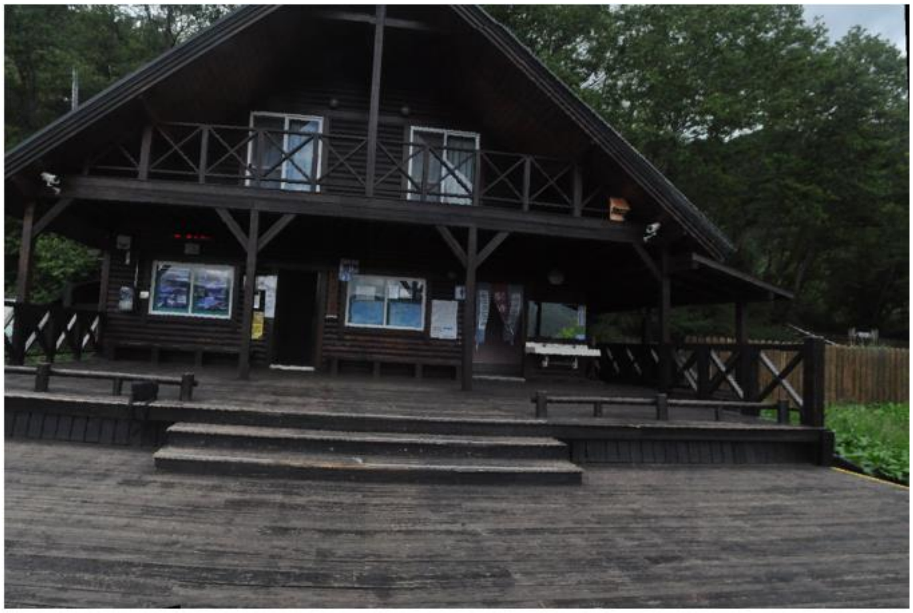
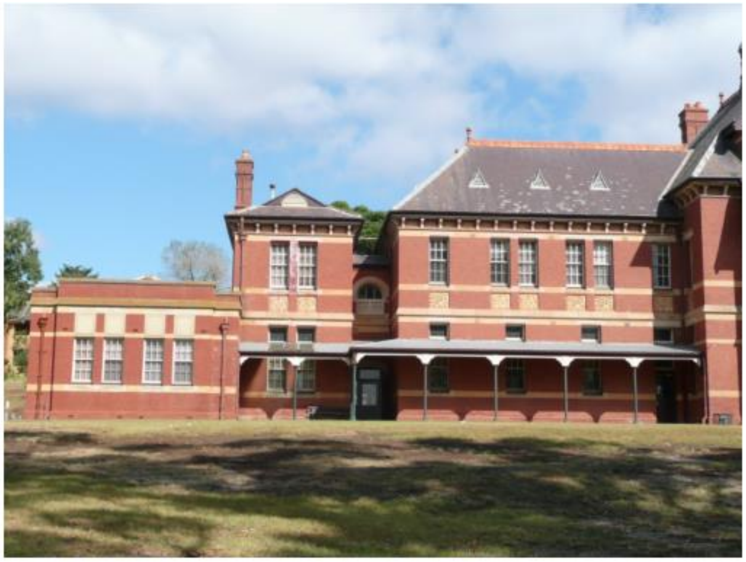
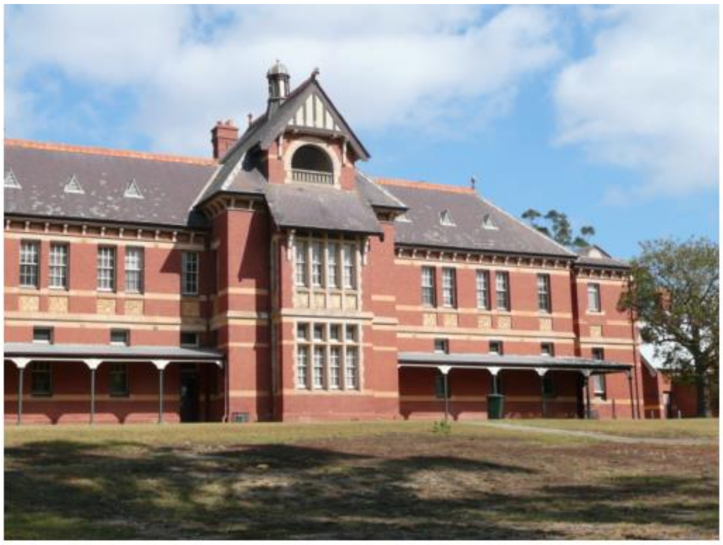
Image 1	Image 2	Image 3
		

Image 1 -> Image 2	Stitched Image: Image 3 -> Output 1
	

3.5 Additional Example 3: Stitching 2 Images

Image 1	Image 2
	

Stitched Image: Image 1 -> Image 2