Homework 2

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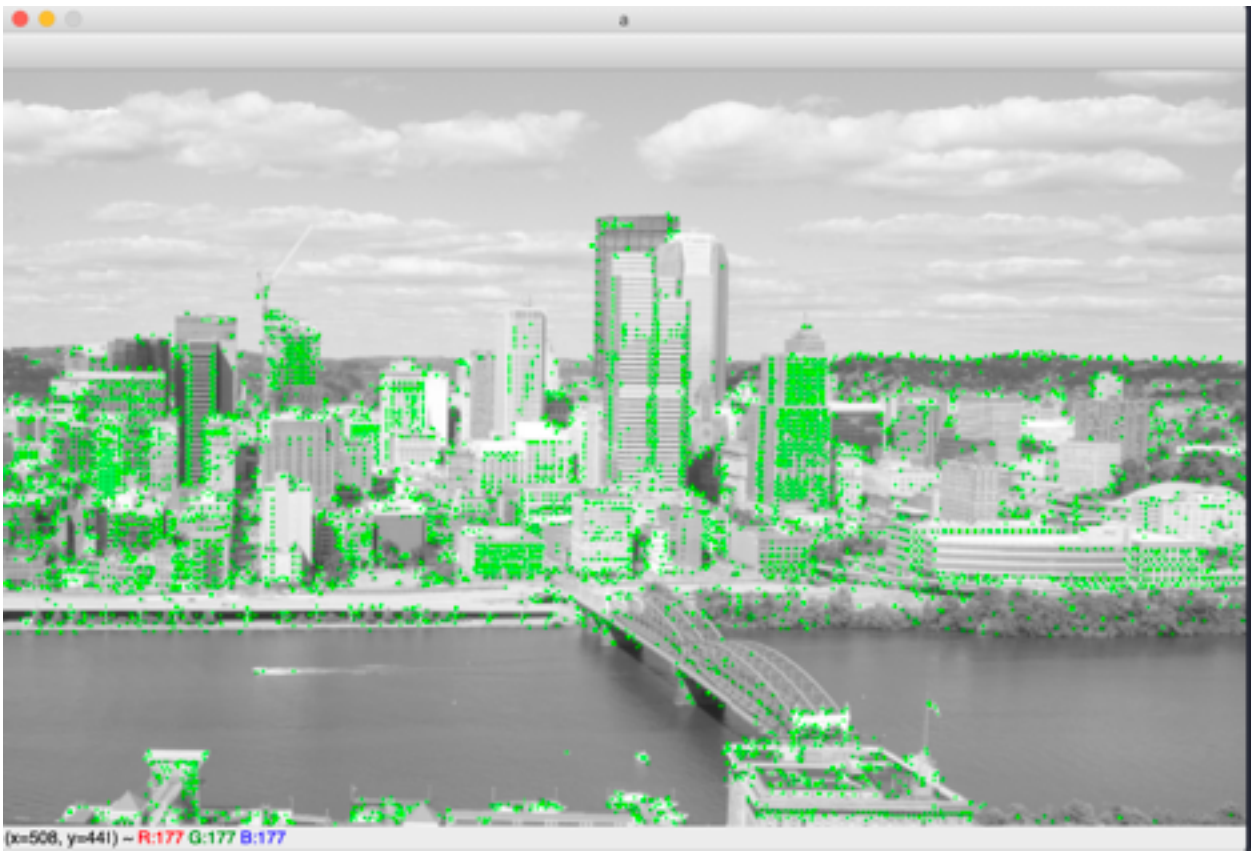
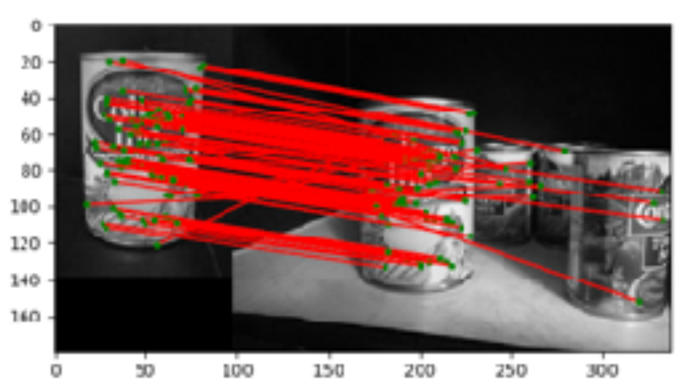
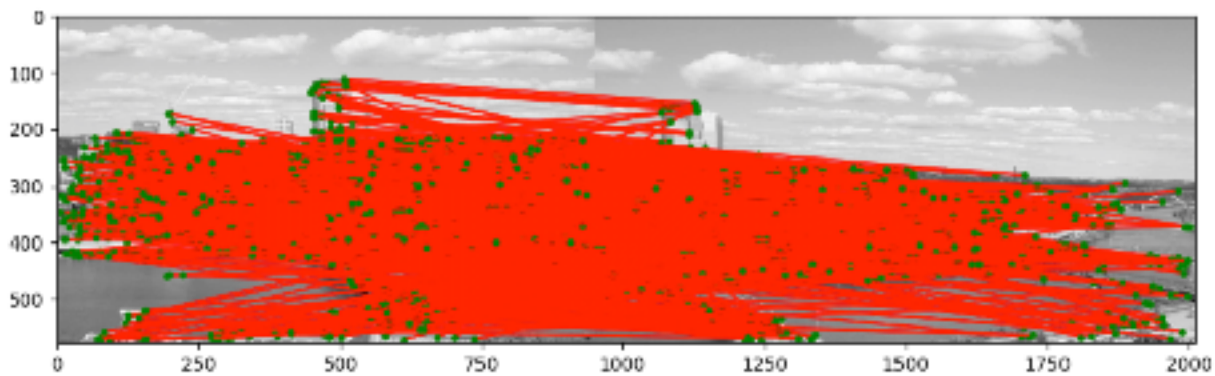
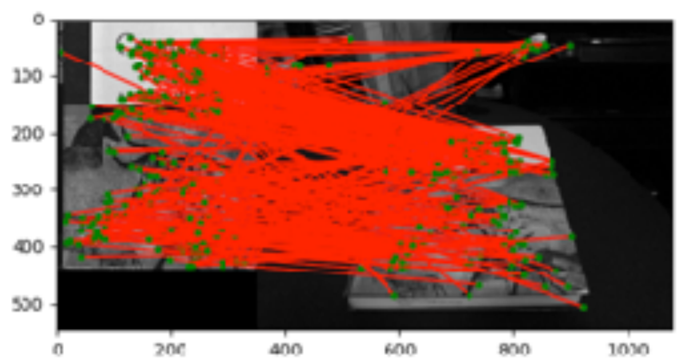
Q 1.5



Q 2.4







Among all the three groups of experimental images, the chickenbroth images performs the best. The points with in the same positions of the jar are batched perfectly. The matching lines are basically parallel. For the incline images, there are many matching points. I think the reason for this result is because that there are some similar object within the two images, like they both contain buildings, bridges, etc. Therefore, the point from one building in one image might be matched to many points of other buildings in the other image. Therefore, there are many mismatched points in incline images. For textbook images, the matching result is better than the incline images. The points from the textbook are mainly matched to the points of the textbook in the other image. But there are also some points that are matched with other object, like objects on the shelf. I think this might be caused by the fact that the other objects have similar features with the textbook after gaussian blurring and thus influence the performance of the BRIEF descriptor.

Q 2.5

With the increase of the rotating angle, the number of correct matches decrease quickly. This is because the rotation destroy the spatial point distribution near the interesting point. When choosing testing points pair, the (x, y) coordinate is highly relative to the spatial location around the interesting point. If one image is rotated with a large angle, the encoding bits vectors of two matching points will be significantly different. So with the increase of the rotating angle, the number of correct matched decrease significantly.

Q 3.1

(a)

Assume that $\tilde{x}_i = \begin{bmatrix} x_{i1} \\ x_{i2} \\ 1 \end{bmatrix}$ $\tilde{u}_i = \begin{bmatrix} u_{i1} \\ u_{i2} \\ 1 \end{bmatrix}$

then $A = \begin{bmatrix} u_{11} & u_{12} & 1 & 0 & 0 & 0 & -x_{11}u_{11} & -x_{11}u_{12} & -x_{11} \\ 0 & 0 & 0 & u_{11} & u_{12} & 1 & -x_{12}u_{11} & -x_{12}u_{12} & -x_{12} \\ & & & & \vdots & & & & \\ u_{N1} & u_{N2} & 1 & 0 & 0 & 0 & -x_{N1}u_{N1} & -x_{N1}u_{N2} & -x_{N1} \\ 0 & 0 & 0 & u_{N1} & u_{N2} & 1 & -x_{N2}u_{N1} & -x_{N2}u_{N2} & -x_{N2} \end{bmatrix}$

the shape of A is $(2N, 9)$

(b) There are 9 elements in the column vector **h**.

(c) Though there are 9 elements in **h**, **h** is in homogeneous space and the scale factor doesn't matter. So the degree of freedom is 8 for **h**. Each point pair gives two linear equations. In order to solve this system with 8 degree of freedom, 4 point pairs are needed.

(d)

$Ah=0$

since h has 9 elements, but only 8 degree of freedom,

Add a constraint $\|h\|_2=1$

Least square: $\min_h \|Ah\|_2$, s.t. $\|h\|_2=1$

$\|h\|_2=1 \Rightarrow h^Th=1$

$\min_h \|Ah\|_2 = \min_h h^TA^TAh$

let $V=A^TA$

$E=\min_h h^TVh+\lambda(1-h^Th)$

$\frac{\partial E}{\partial h}=0$ $\quad 2Vh-2\lambda h=0$

$\therefore Vh=\lambda h$

$E=\min_h h^TVh+\lambda-\lambda h^Th=\lambda_{min}$

Therefore, the least square solution to $Ah=0$ is to find the minimum eigen value λ_{min} of the matrix A^TA

Q 6.1

Warp image:

Blend image:

Q 6.2

Warp images:

Blend Image:

Q 6.3