Exercise 8

Exercise 8

- Suppose you have two image below. Which image do you think is better for feature extraction?

Exercise 8

- Determine whether the pixel in red can be a feature when FAST is used. The radius is set to 3.

12	13	14	15	16	17	18	19	20	21	22	23
12	13	14	15	16	17	18	19	20	21	22	23
12	13	14	15	16	17	18	19	20	21	22	23
15	15	15	16	15	16	17	13	15	16	12	11
15	14	13	13	13	12	12	12	12	12	12	12
15	14	13	11	10	9	10	10	10	10	10	10
15	14	13	11	10	9	8	8	8	8	8	8
15	14	13	11	10	9	8	7	7	7	7	7
15	14	13	11	10	9	8	6	6	6	6	6

Answer:
The pixel in red can be a feature when FAST is used because 9 consecutive pixels' intensities are higher then center pixel

12	13	14	15	16	17	18	19	20	21	22	23
12	13	14	15	16	17	18	19	20	21	22	23
12	13	14	15	16	17	18	19	20	21	22	23
15	15	15	16	15	16	17	13	15	16	12	11
15	14	13	13	13	12	12	12	12	12	12	12
15	14	13	11	10	9	10	10	10	10	10	10
15	14	13	11	10	9	8	8	8	8	8	8
15	14	13	11	10	9	8	7	7	7	7	7
15	14	13	11	10	9	8	6	6	6	6	6

Exercise 8

- Suppose you performed feature matching and calculated the distance of the best matching and the second best matching. Find the final matching pairs when NNDR = 0.4 is used

Feature index	The corresponding feature index	The best matching dist.	The second matching dist.	NNDR
1	3	3	10	0.3
2	4	2	4	0.5
3	4	2	3	0.67
4	2	4	7	0.57
5	6	1	8	0.125
6	6	2	7	0.29
7	7	5	15	0.34

Answer:
1, 5,6,and 7

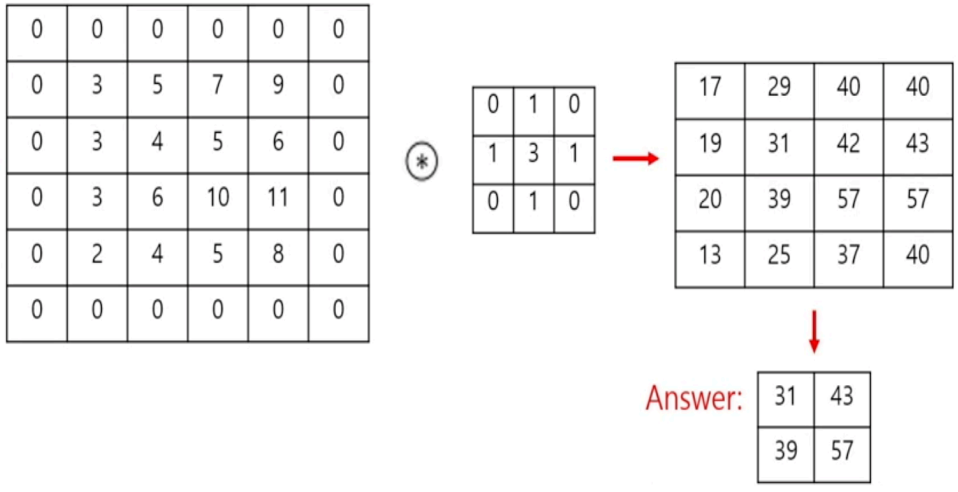
Because there NNDR is lower than 0.4

Exercise 8

- Compute the result of convolution and max pooling on the input image below using the 3X3 kernel. Zero padding is used, and stride is set to 1.

3	5	7	9
3	4	5	6
3	6	10	11
2	4	5	8

0	1	0
1	3	1
0	1	0



Exercise 9

Exercise 9

- Calculate the integral image of the input image

1	1	1	1	1
1	3	7	2	1
1	8	4	1	1
1	2	3	5	1
1	1	1	1	1

Answer:

1	2	3	4	5
2	6	14	17	19
3	15	27	31	34
4	18	33	42	46
5	20	36	46	51

Exercise 9

- Explain the meaning of the last two parameters.

```
void cv::CascadeClassifier::detectMultiScale ( InputArray          image,
                                               std::vector< Rect > & objects,
                                               std::vector< int > & numDetections,
                                               scaleFactor =
                                               double              1.1,
                                               minNeighbors =
                                               int                 3,
                                               int                 flags = 0,
                                               Size                minSize = Size(),
                                               Size                maxSize = Size()
```

Answer:
minSize - minimum possible object size, Object smaller than that are ignored.

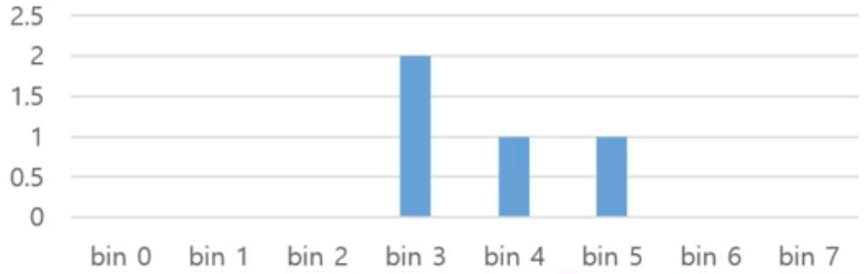
maxSize - maximum possible object size, Object larger than that are ignored.

Exercise 9

- Perform histogram back-projection for the current image (on the right). The ROI is set as bold rectangle area on the left. Assume dynamic range of image is from 0 to 7, and set the number of bins as 8.

1	1	1	1	1
1	1	**3**	**4**	1
1	2	**3**	**5**	1
1	2	2	2	1
1	2	2	2	2

1	1	1	1	1
1	3	4	2	2
1	3	3	5	2
1	1	1	1	2
1	1	1	1	1



Answer:

0	0	0	0	0
0	0.5	0.25	0	0
0	0.5	0.5	0.25	0
0	0	0	0	0
0	0	0	0	0

Exercise 9

- Explain the meaning of the 7th and 8th parameters.

◆ calcOpticalFlowPyrLK()

```
void cv::calcOpticalFlowPyrLK ( InputArray         prevImg,
                                InputArray         nextImg,
                                InputArray         prevPts,
                                InputOutputArray   nextPts,
                                OutputArray        status,
                                OutputArray        err,
                                Size               winSize = Size(21, 21),
                                int                maxLevel = 3,
                                TermCriteria       criteria = TermCriteria(TermCriteria::COUNT+TermCriteria::EPS, 30, 0.01),
                                int                flags = 0,
                                double             minEigThreshold = 1e-4
                              )
```

Answer:
minSize - minimum possible object size, Object smaller than that are ignored.

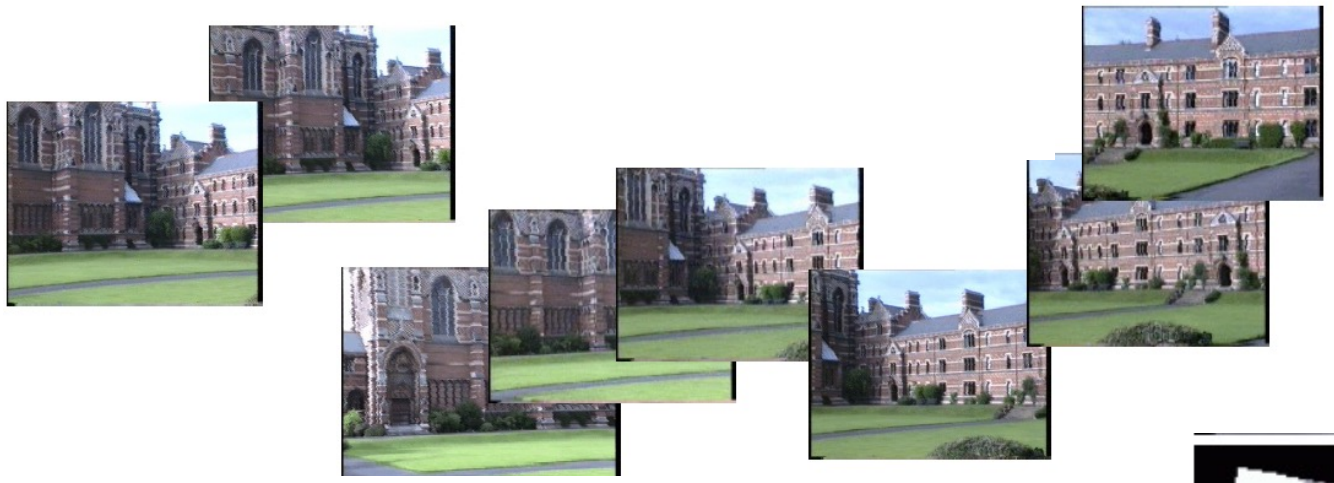
maxSize - maximum possible object size, Object larger than that are ignored.

Exercise 10

Sung Soo Hwang

Exercise 10

- Explain how you can generate a panoramic image from these images step by step.

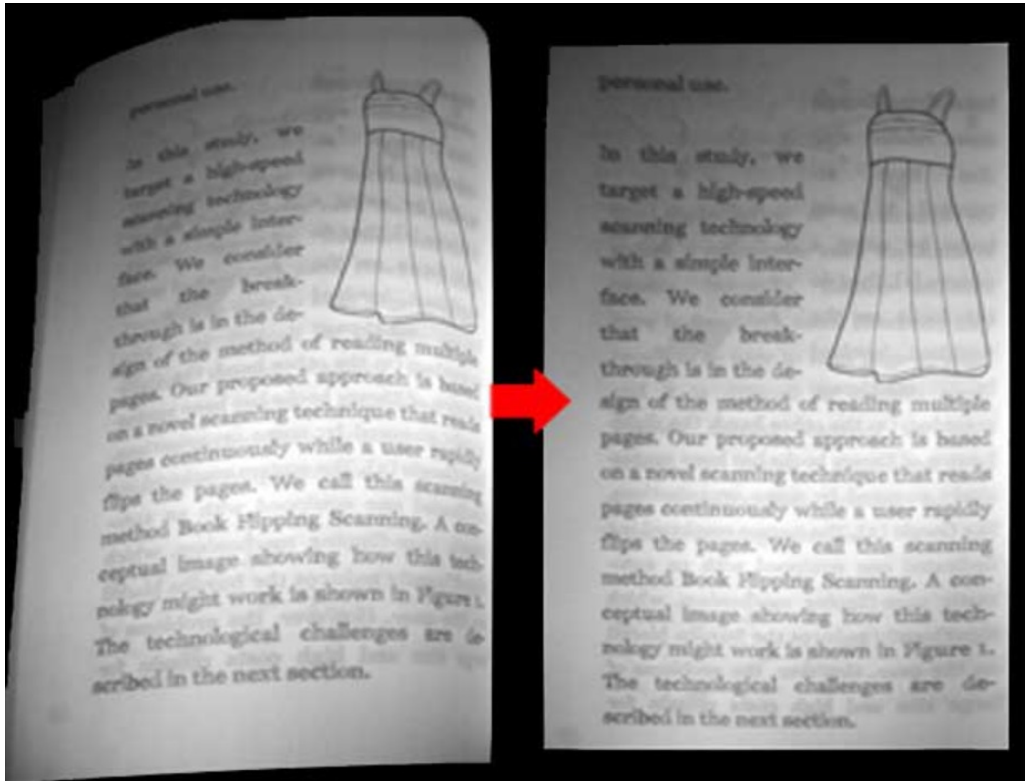


Answer:

1. Extract the features of the two images entered.
2. Compare and match the features between the entered images.
3. Make a homography matrix using matching points between images.
4. Convert the image through the created homograph matrix.
5. Connects the converted images.
6. Repeat the above process when a new image comes in.

Exercise 10

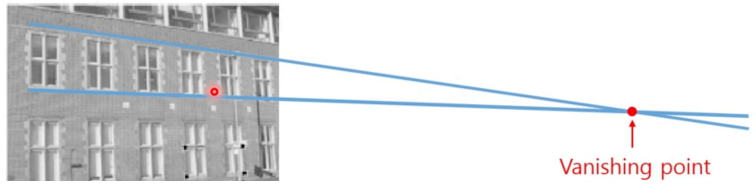
- Explain how you can transform the left image to the right image using perspective transform. If you cannot, explain why.



Answer:
A homography can only transform straight lines into new straight lines. It can not transform a curved line into a straight line. Since a curved line in the left image has been transformed to a straight line, we can conclude that a transform other than a homography has been used.

Exercise 10

- Explain how to obtain the right image from the left image without having 4 corresponding pairs. Assume that we know the lines in blue on the left are actually parallel.



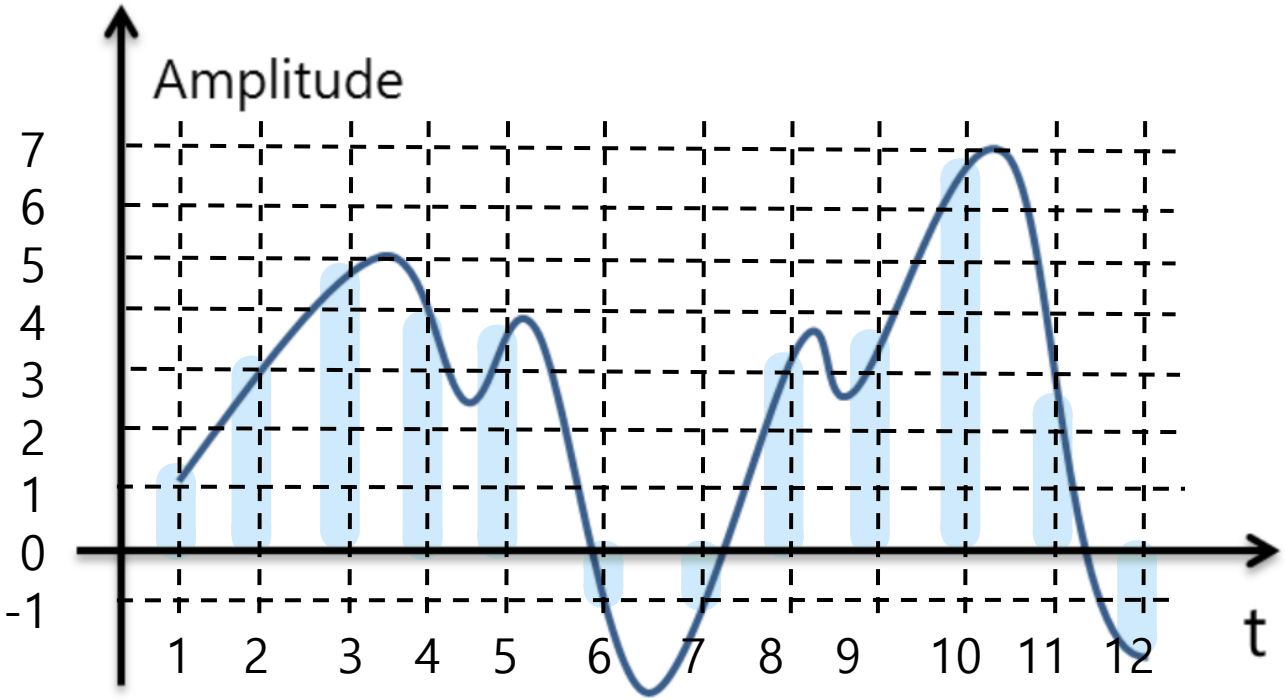
Answer:
Parallel lines are only met in the infinite region, but as a result of affine transform, parallel lines are met in the finite region. The intersection between parallel lines in finite region is called a vanishing point. If we are able to find a transform which maps the vanishing point to a point in the infinite region, we may get the image on the right by applying the transform to the image on the left.

Exercise 11

Sung Soo Hwang

Exercise 11

- Perform sampling and quantization on the signal below step by step. Set both sampling period and quantization step as 1. For quantization, we round down the value.



Exercise 11

- Assume that we have a camera whose focal length is 5, number of pixels per unit distance in x and y direction is as 200, skew parameter is 0, and the position of principal point in the image plane is (100,100). The camera is located at (0,0,5) in 3D world coordinate, and the principle axis is parallel to z-axis of 3D world coordinate. Show camera projection matrix of this camera. What is the position of the projected point when a 3D point is (10, 20, 10, 1).

$$K = \begin{bmatrix} f_x S_{xx} & f_x S_{xy} & u_0 \\ 0 & f_x S_{yy} & v_0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 5 \cdot 200 & 5 \cdot 0 & 100 \\ 0 & 5 \cdot 200 & 100 \\ 0 & 0 & 1 \end{bmatrix}$$

$$P = K[\tilde{R} | t] = \begin{bmatrix} 1000 & 0 & 100 \\ 0 & 1000 & 100 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -5 \end{bmatrix} = \begin{bmatrix} 1000 & 0 & 100 & -500 \\ 0 & 1000 & 100 & -500 \\ 0 & 0 & 1 & -5 \end{bmatrix}$$

$$X' = PX = \begin{bmatrix} 1000 & 0 & 100 & -500 \\ 0 & 1000 & 100 & -500 \\ 0 & 0 & 1 & -5 \end{bmatrix} \begin{bmatrix} 10 \\ 20 \\ 10 \\ 1 \end{bmatrix} = \begin{bmatrix} 10000 + 0 + 1000 - 5000 \\ 0 + 20000 + 1000 - 500 \\ 0 + 0 + 10 - 5 \end{bmatrix} = \begin{bmatrix} 10500 \\ 20500 \\ 5 \end{bmatrix} = 5 \begin{bmatrix} 2100 \\ 4100 \\ 1 \end{bmatrix}$$

$$(x, y) = (2100, 4100)$$

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Exercise 12

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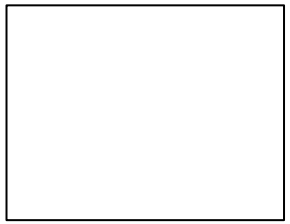
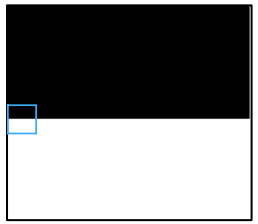
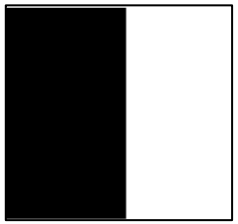
Exercise 12

- Estimate the result of DCT on those 4 images
  - Assume that DCT is applied on each 8X8 sub block
  - Assume the resolution of each image is 72X72







0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

8	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0