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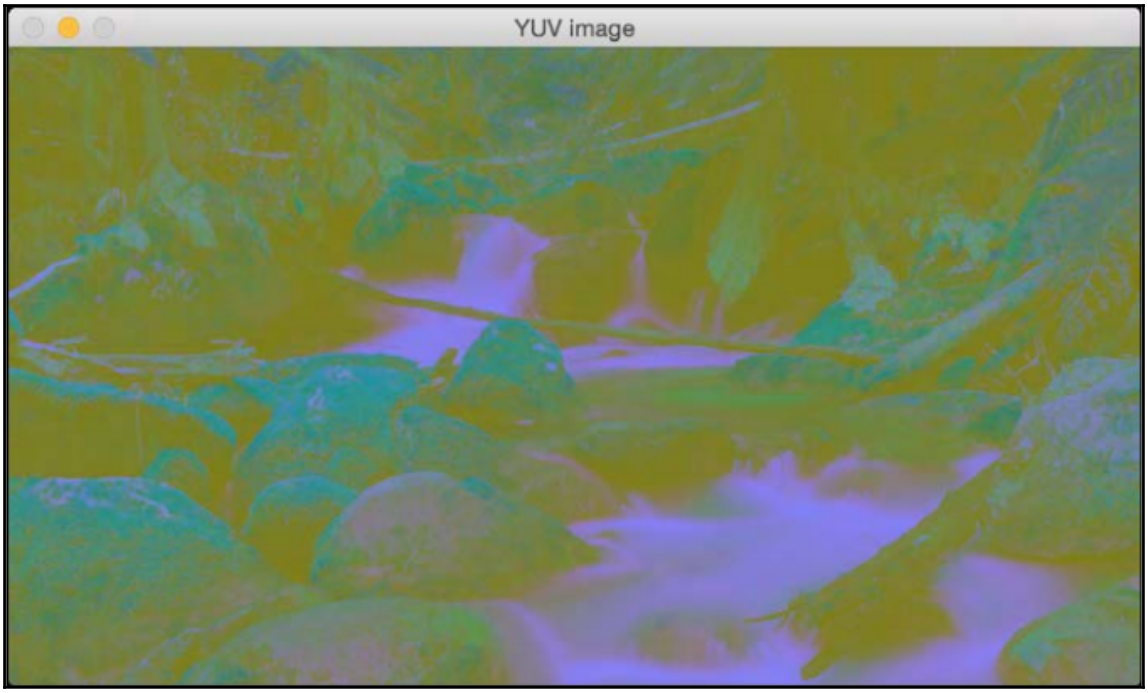
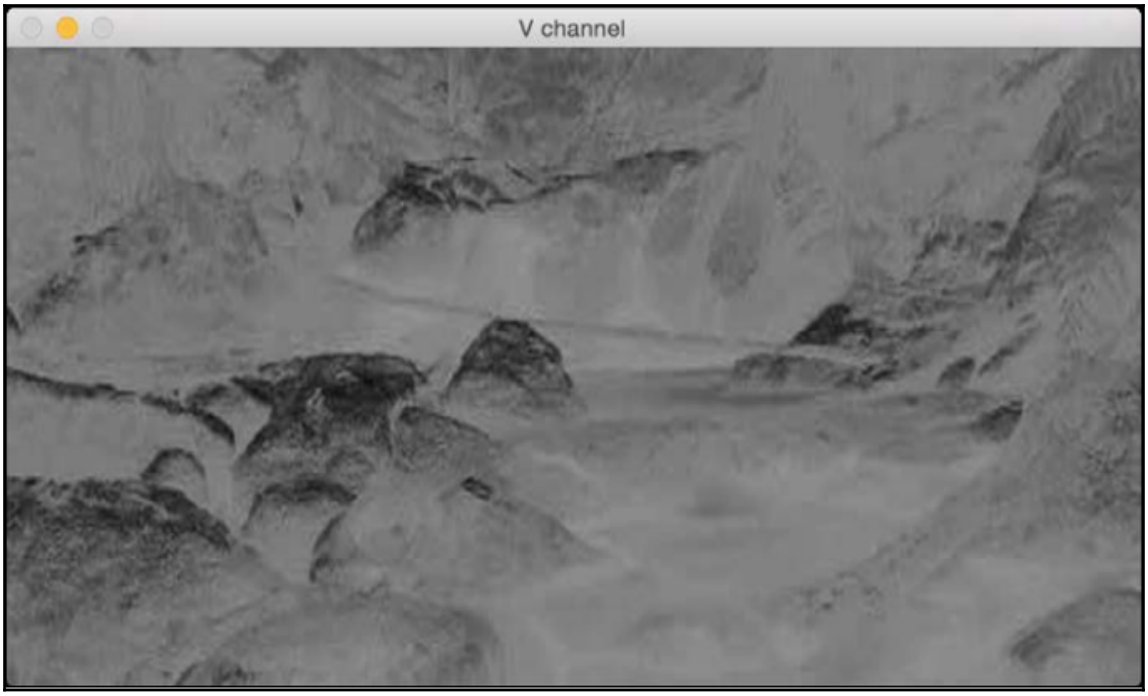
Chapter 1 - Applying Geometric Transformations to Images

Grayscale image

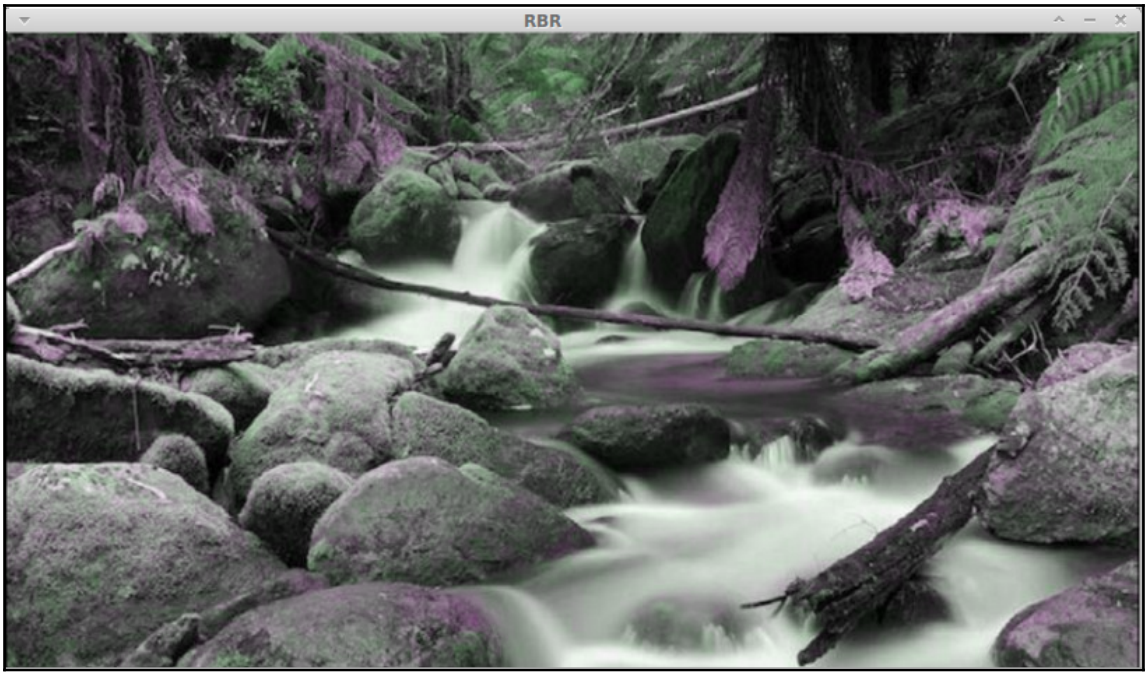

YUV image

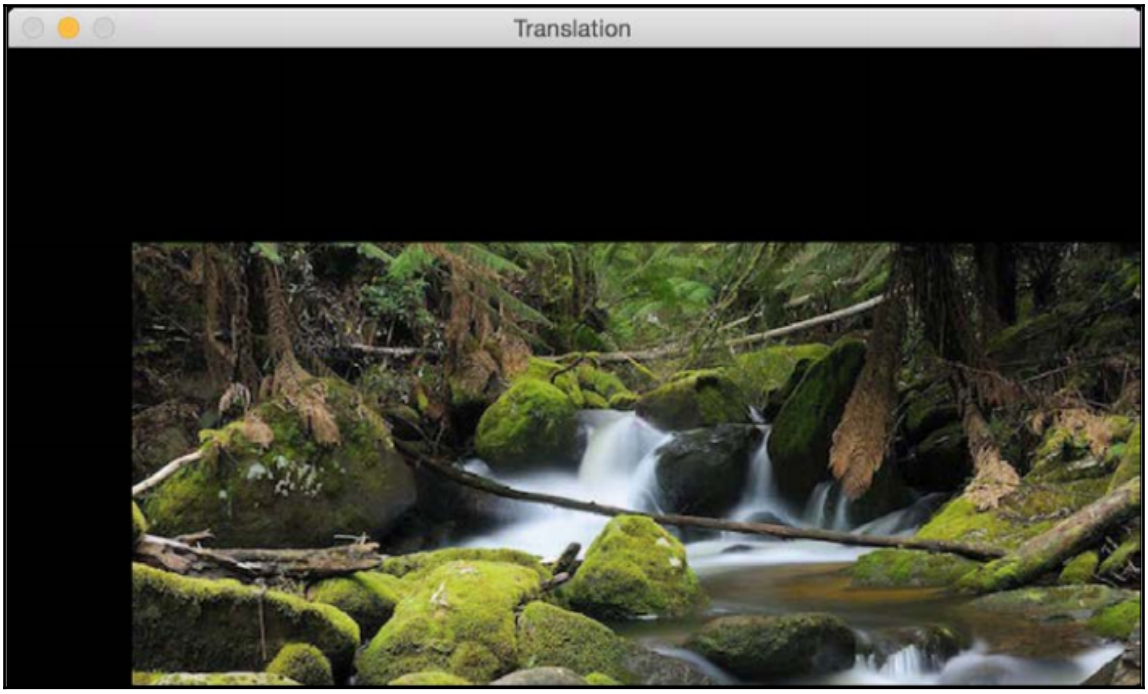
Y channel

U channel

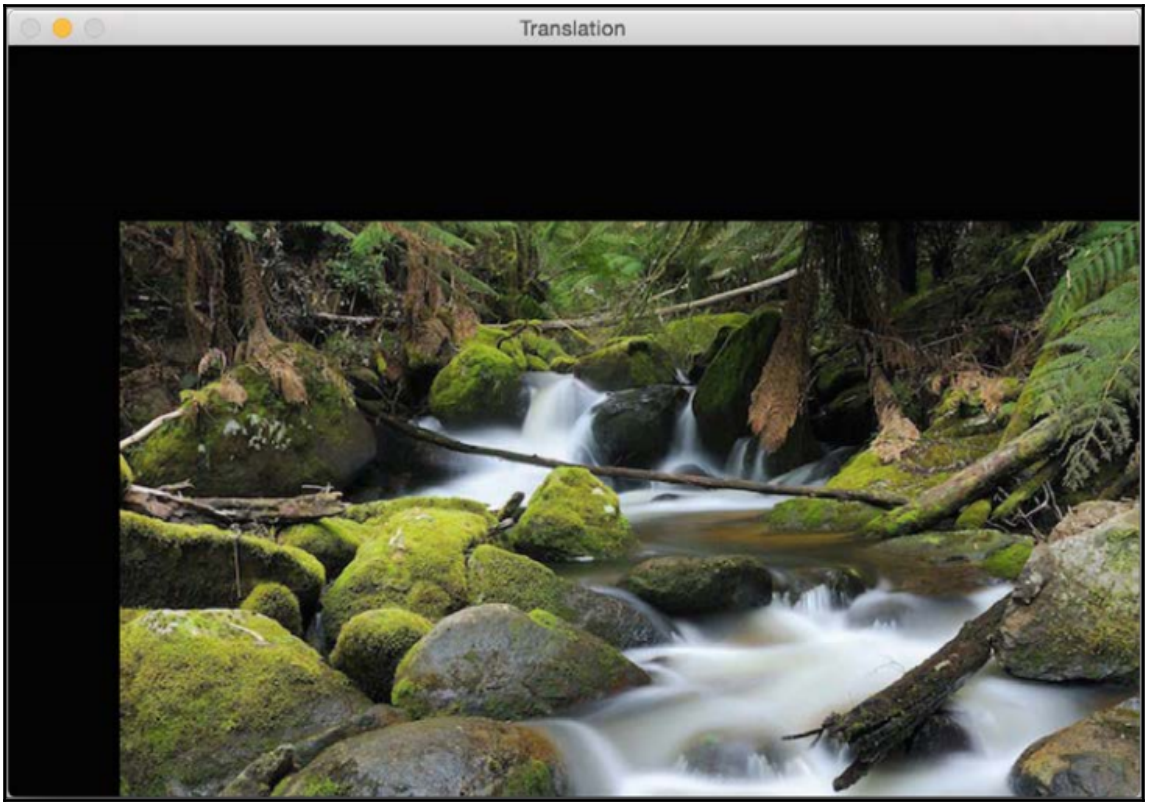

V channel

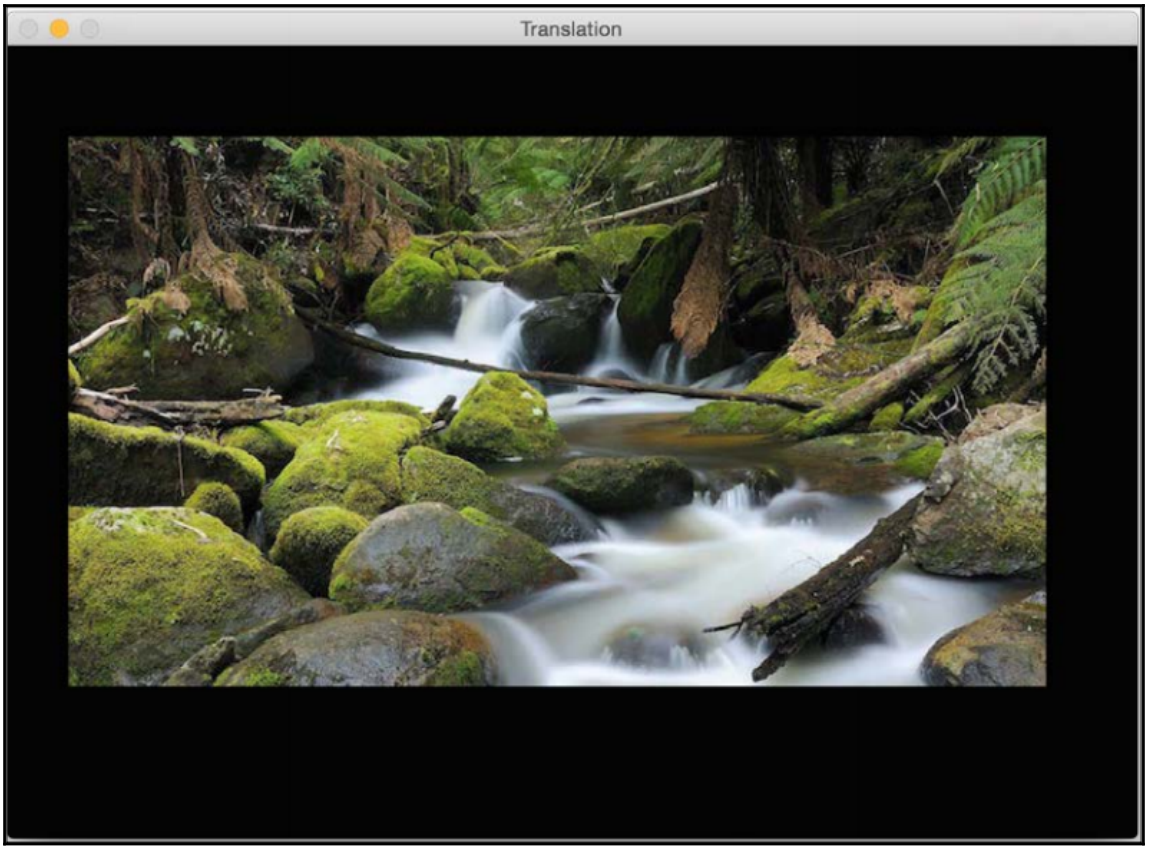
RBG

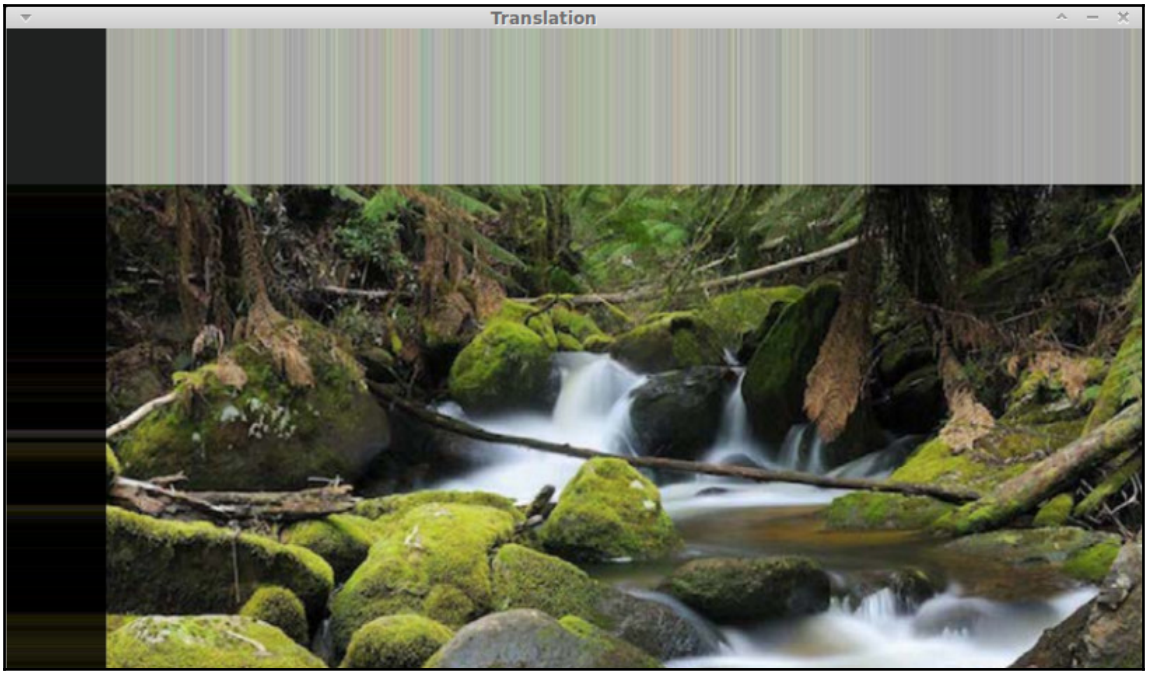

RBR



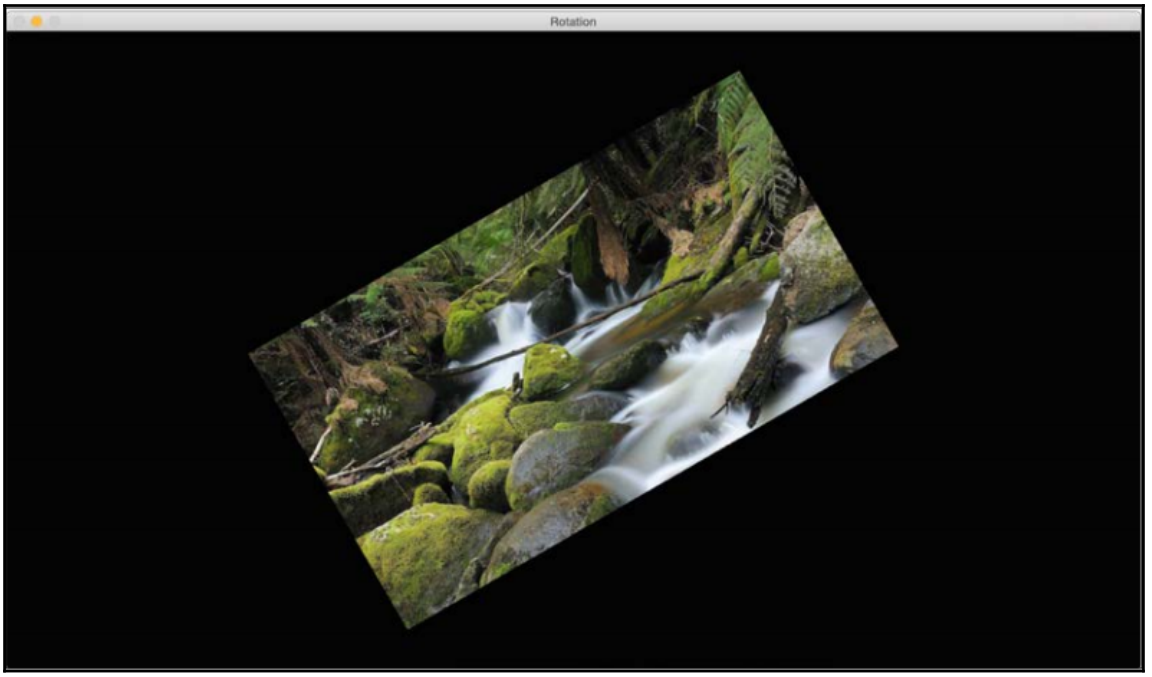
$$T = \begin{bmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \end{bmatrix}$$

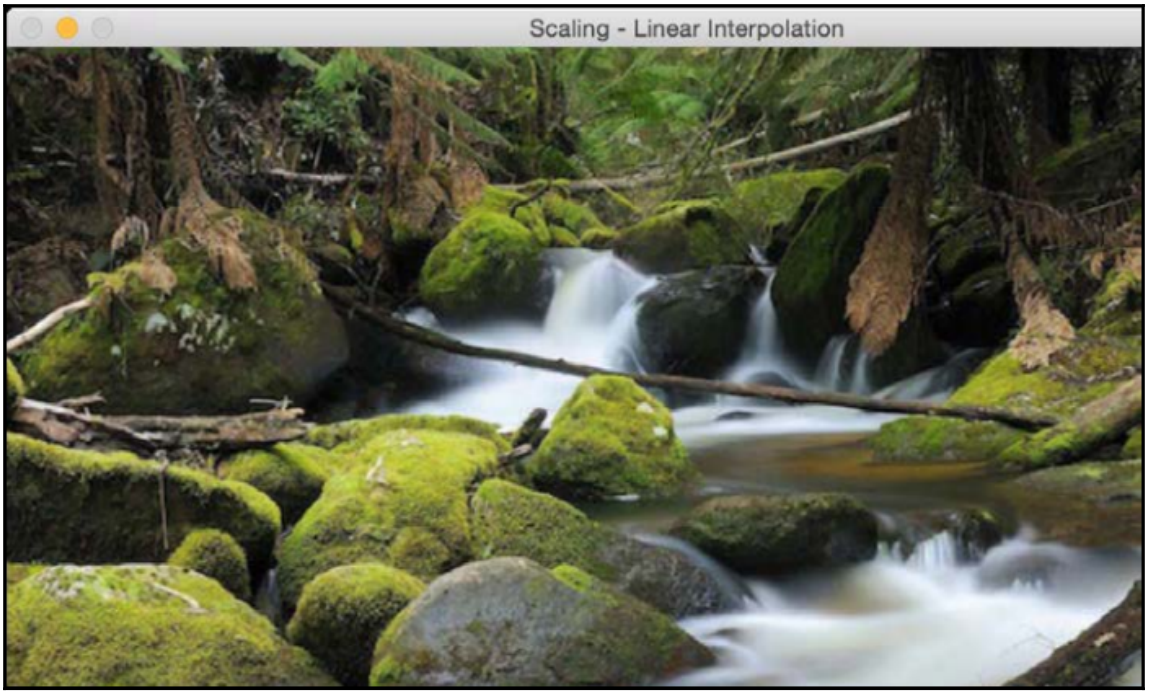

Translation

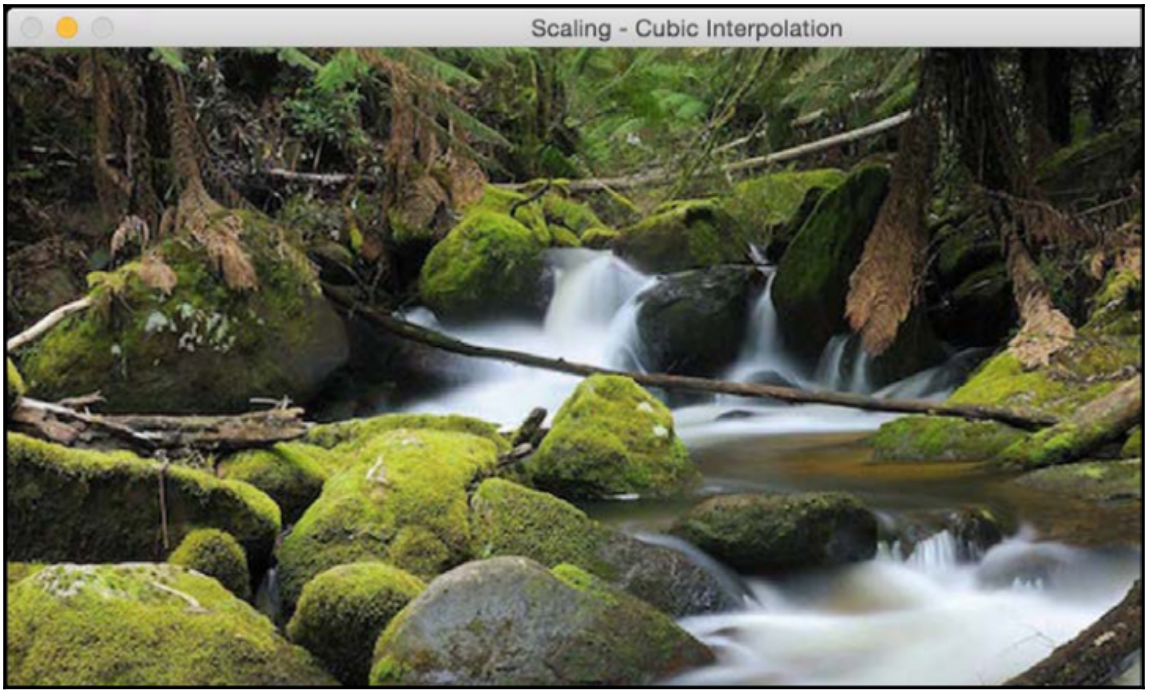

Translation


Translation

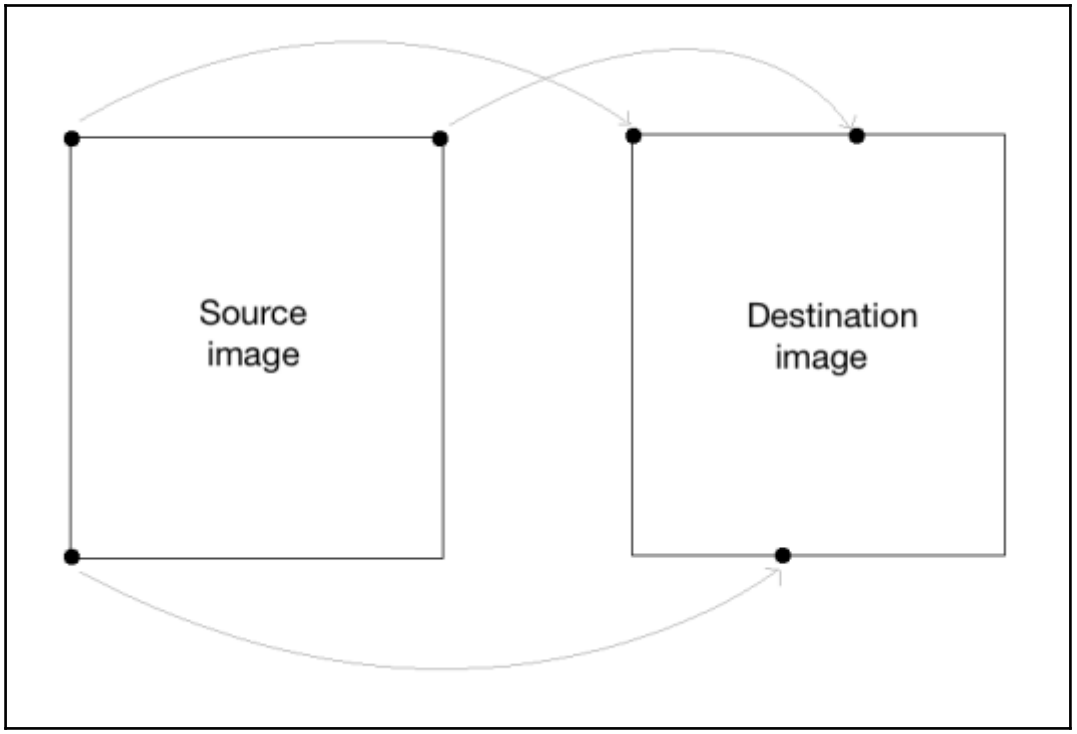
$$R = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$


Rotation


Scaling - Linear Interpolation

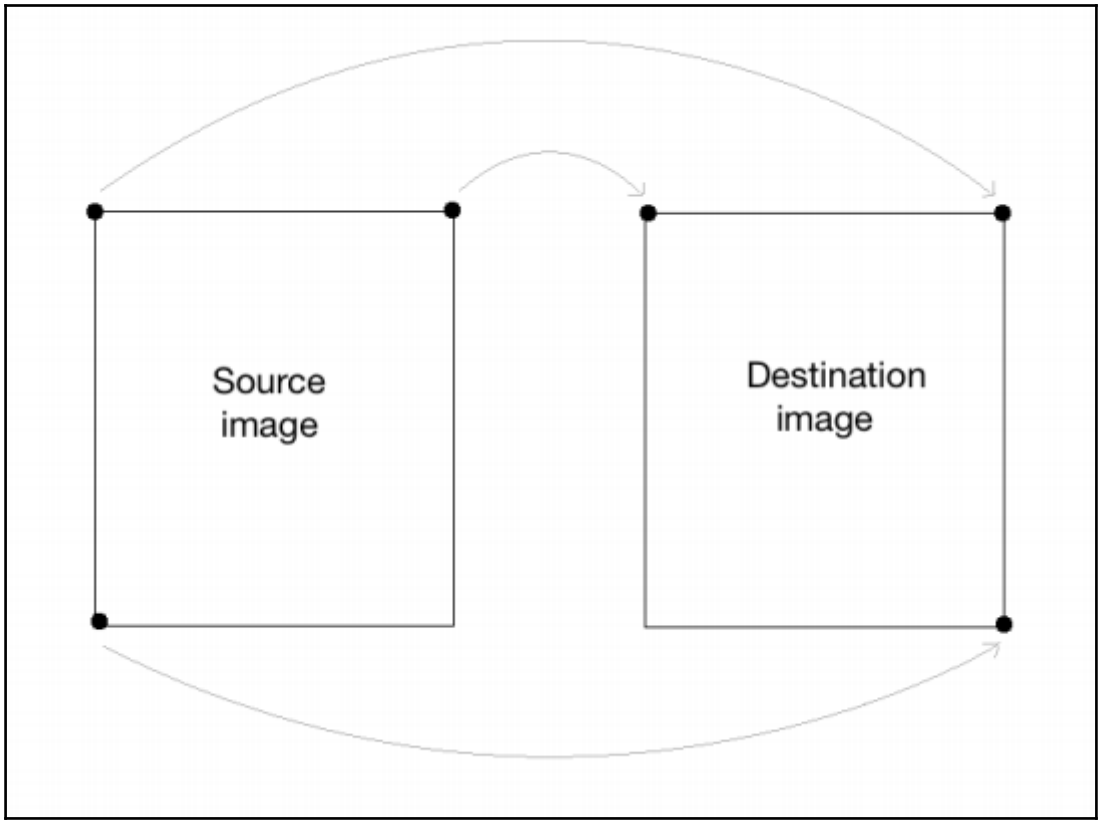

Scaling - Cubic Interpolation

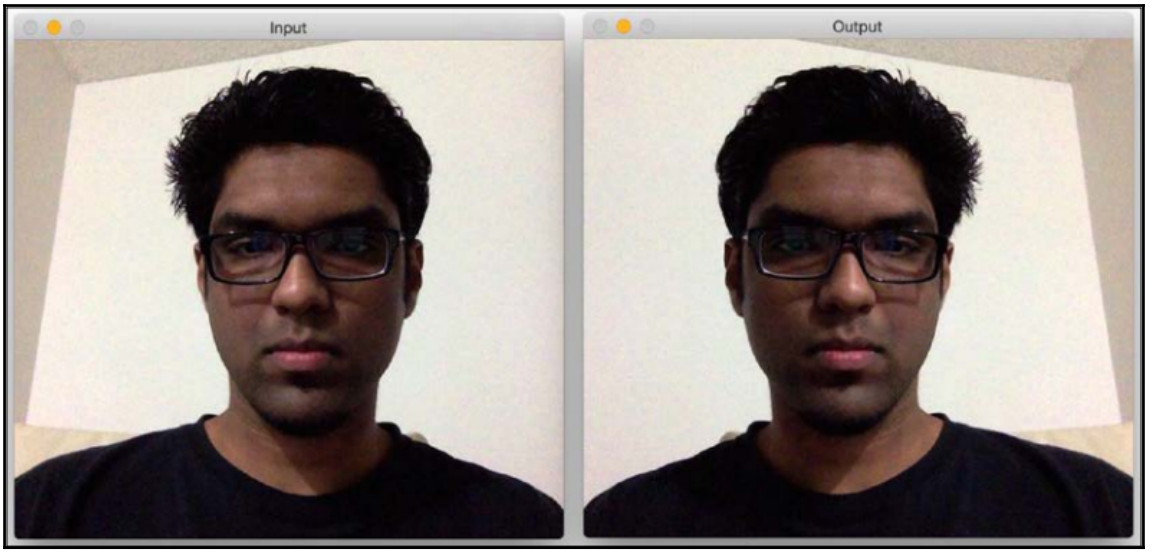
Scaling - Skewed Size


Source
image
Destination
image

Input

Output


Source
image
Destination
image

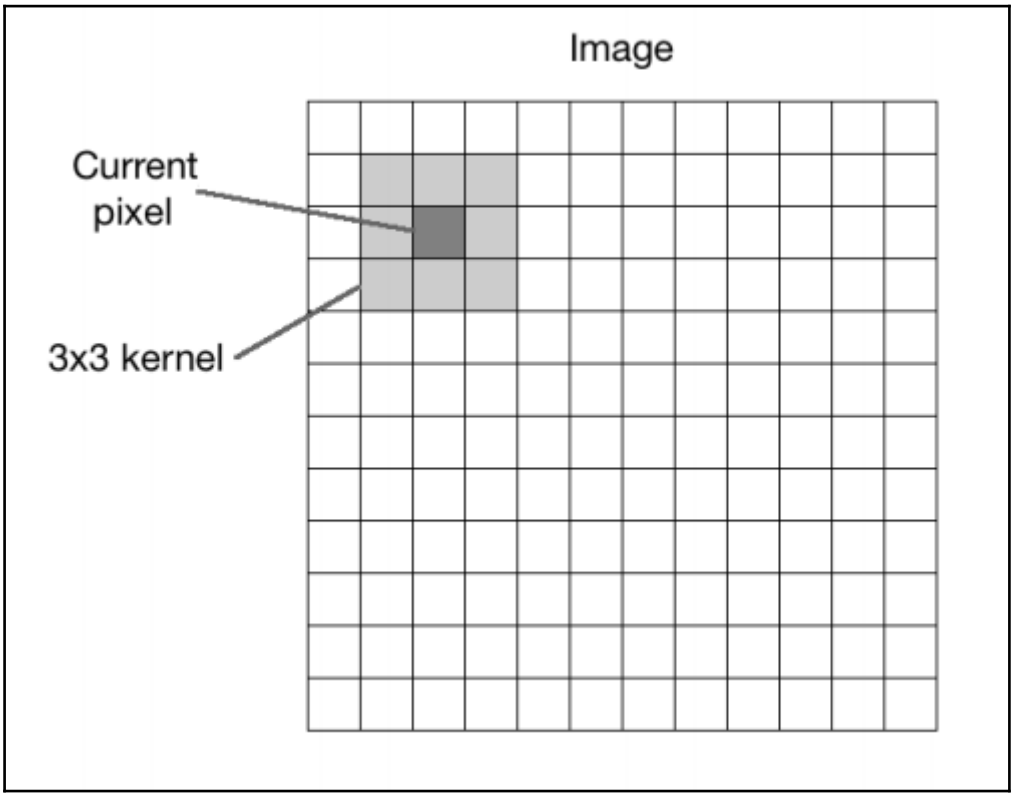

Input
Output

Output

Output

Vertical wave
Horizontal wave
Multidirectional wave
Concave

Chapter 2 - Detecting Edges and Applying Image Filters



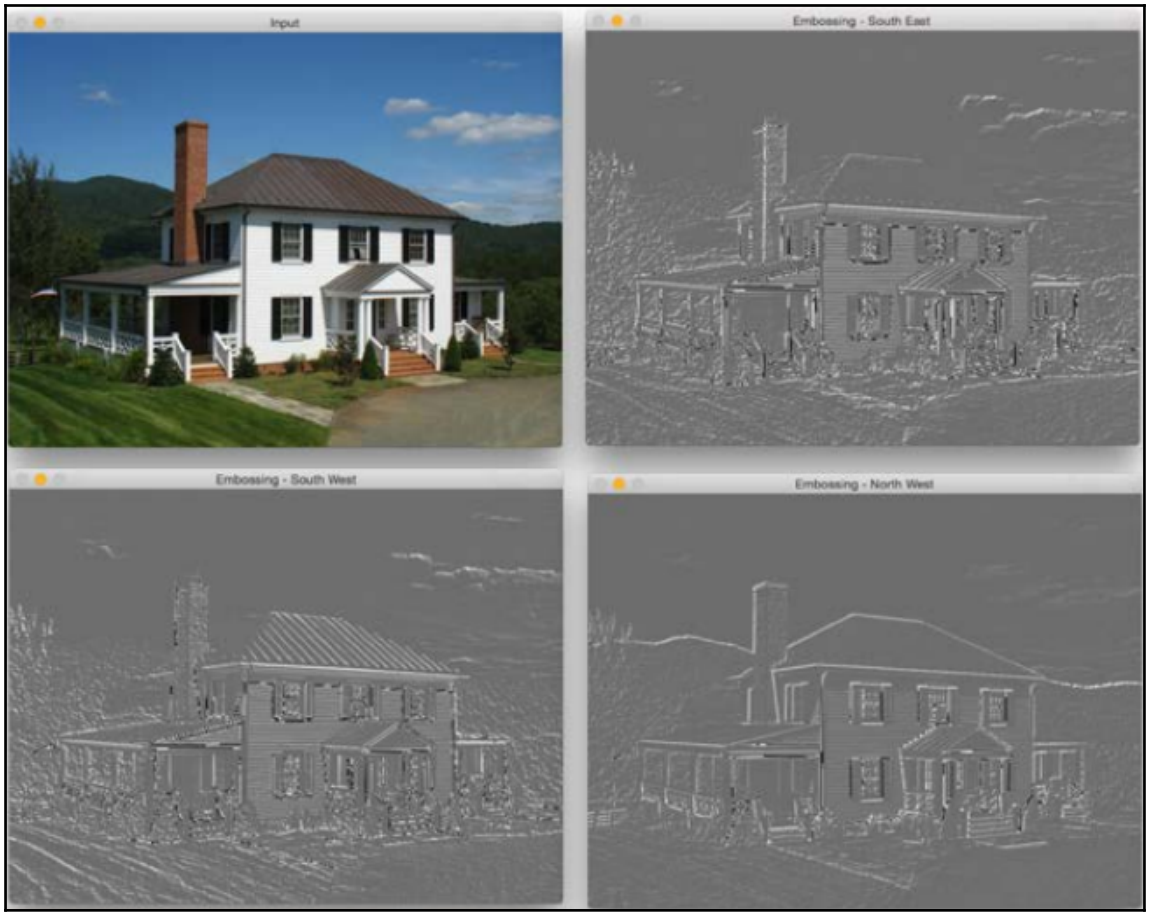
$$I = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$L = \frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

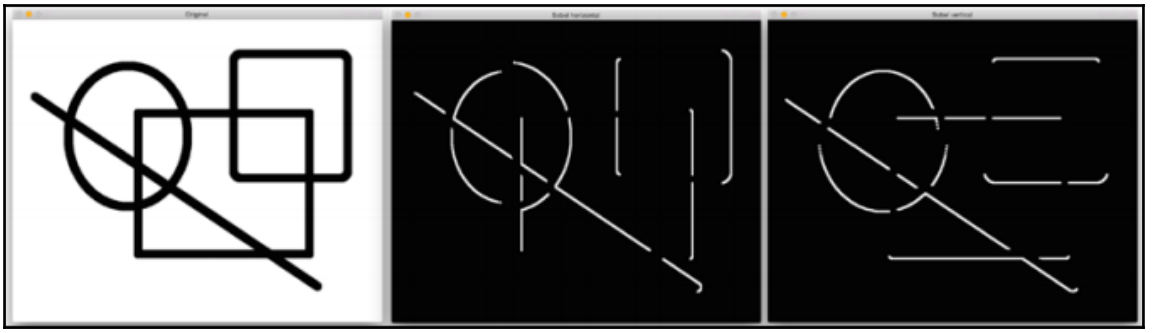
$$M = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

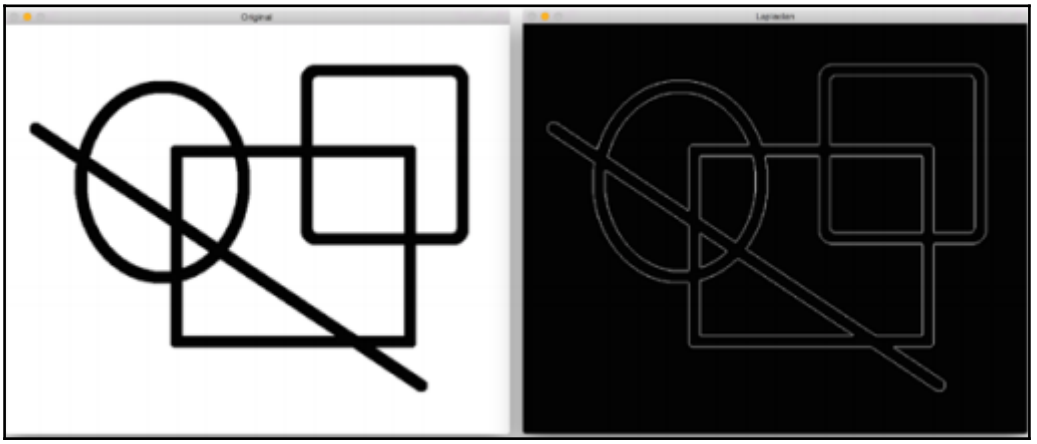
$$M = \begin{bmatrix} -1 & -1 & -1 \\ -1 & 9 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

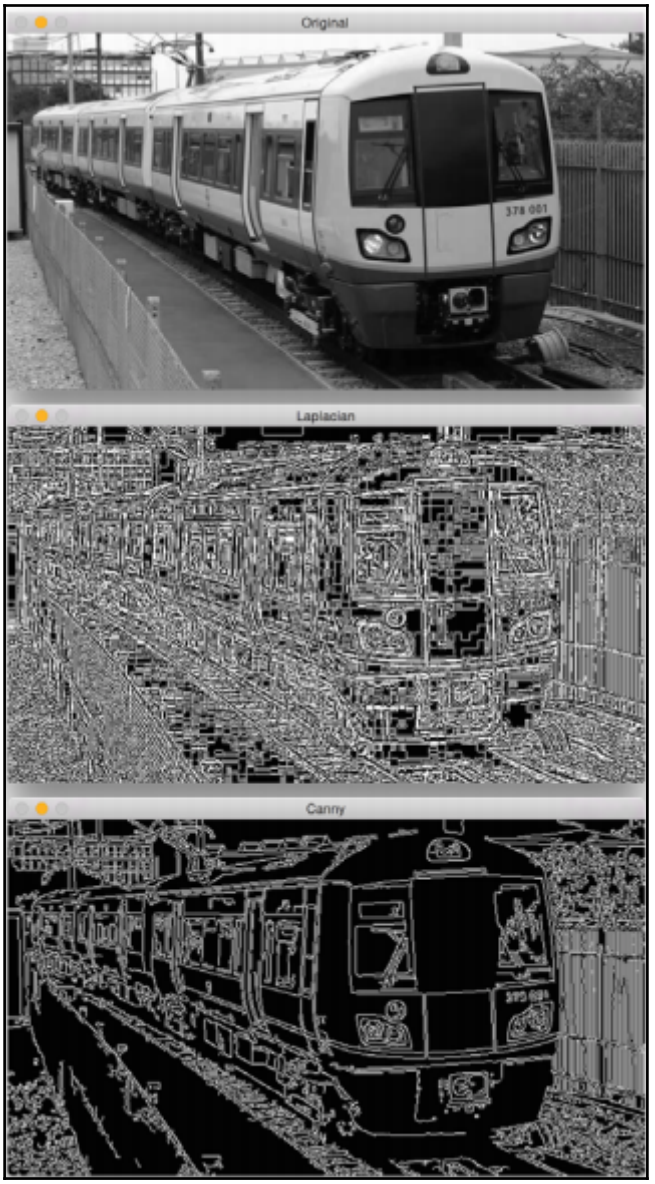
$$M = \begin{bmatrix} 1 & 1 & 1 \\ 1 & -7 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$



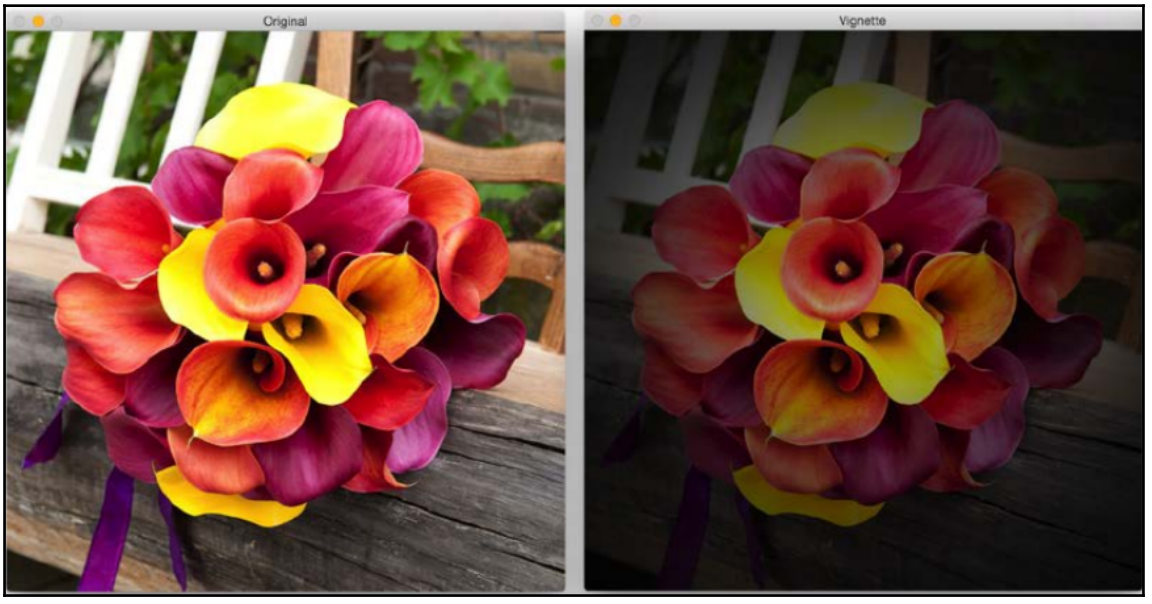
$$S_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \qquad S_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

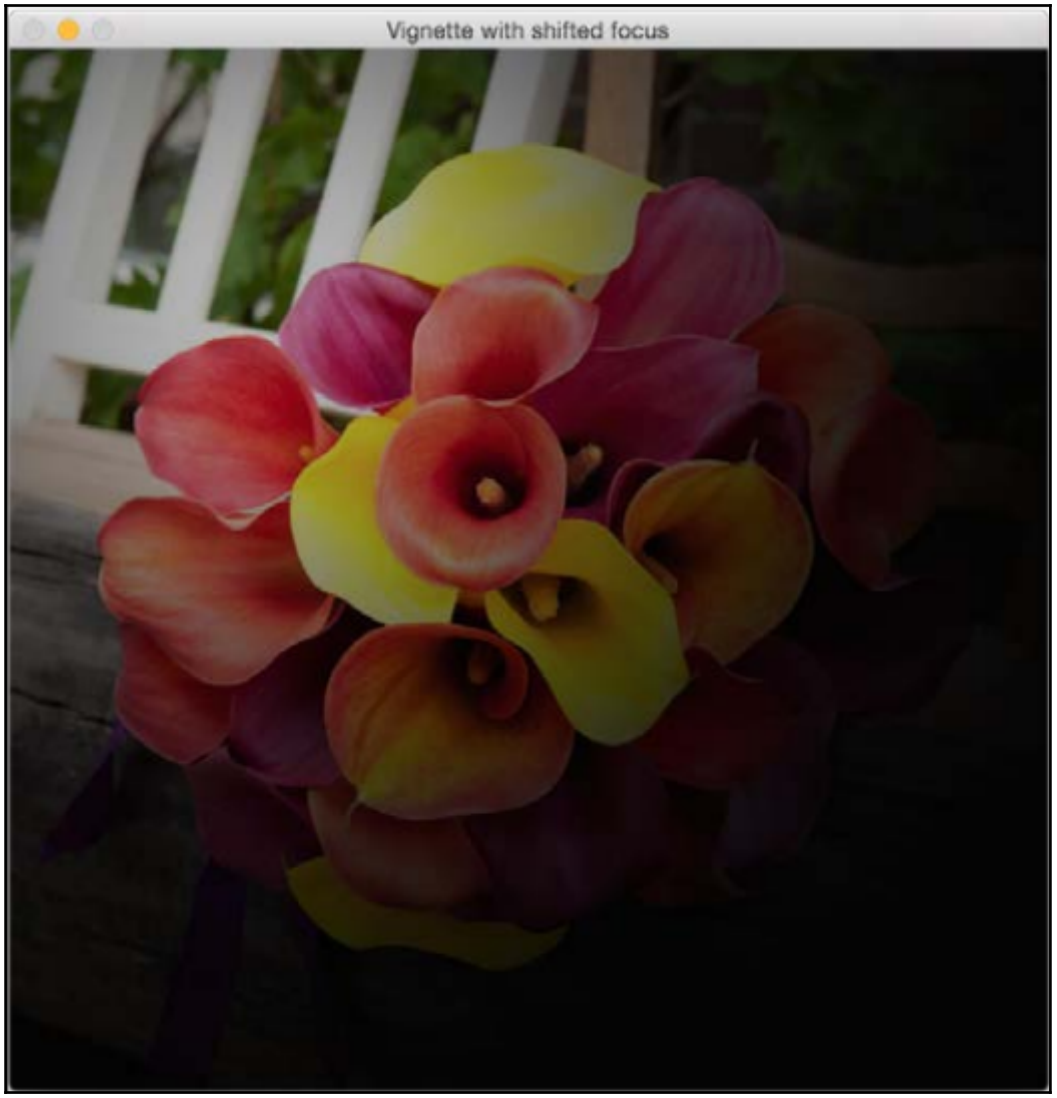





Original
Laplacian
Canny

Input
Morphology
Erosion
Morphology
Dilation
Morphology

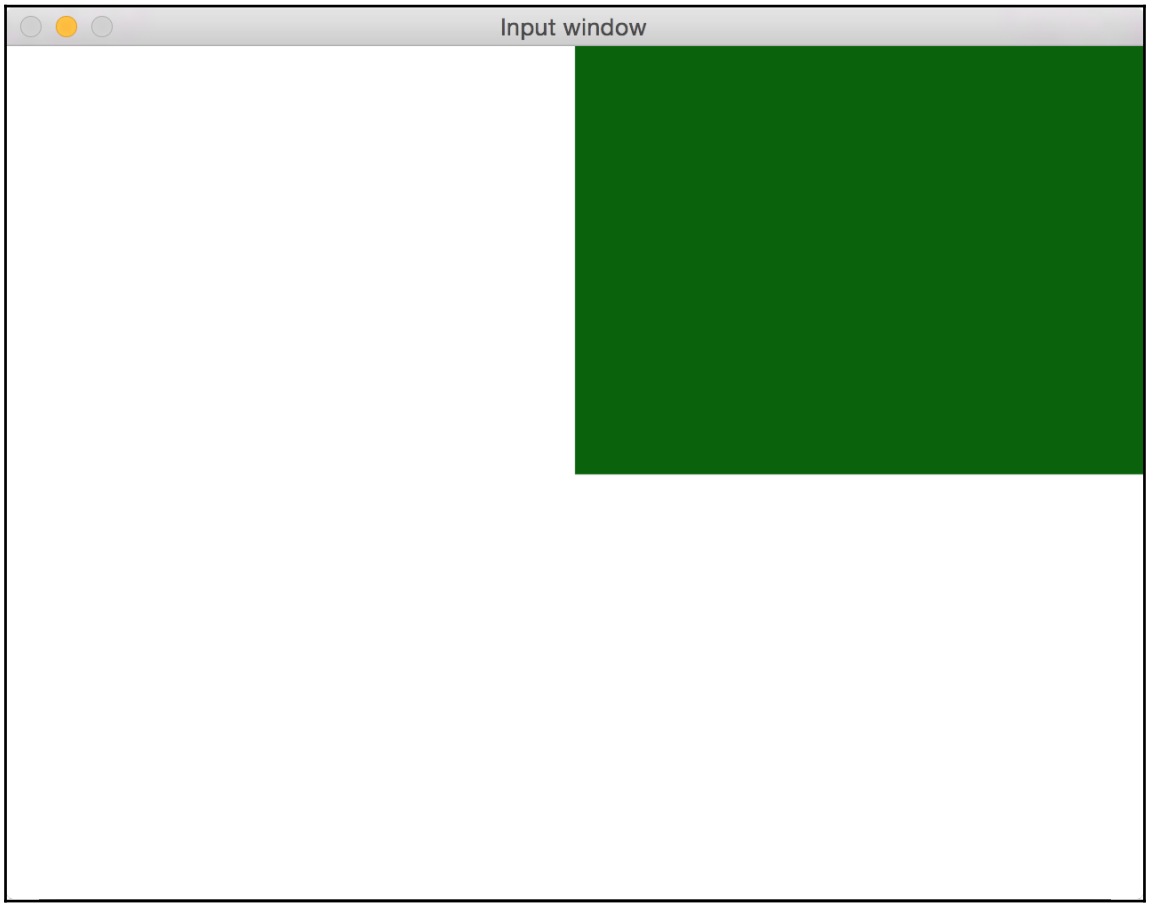

Original
Vignette

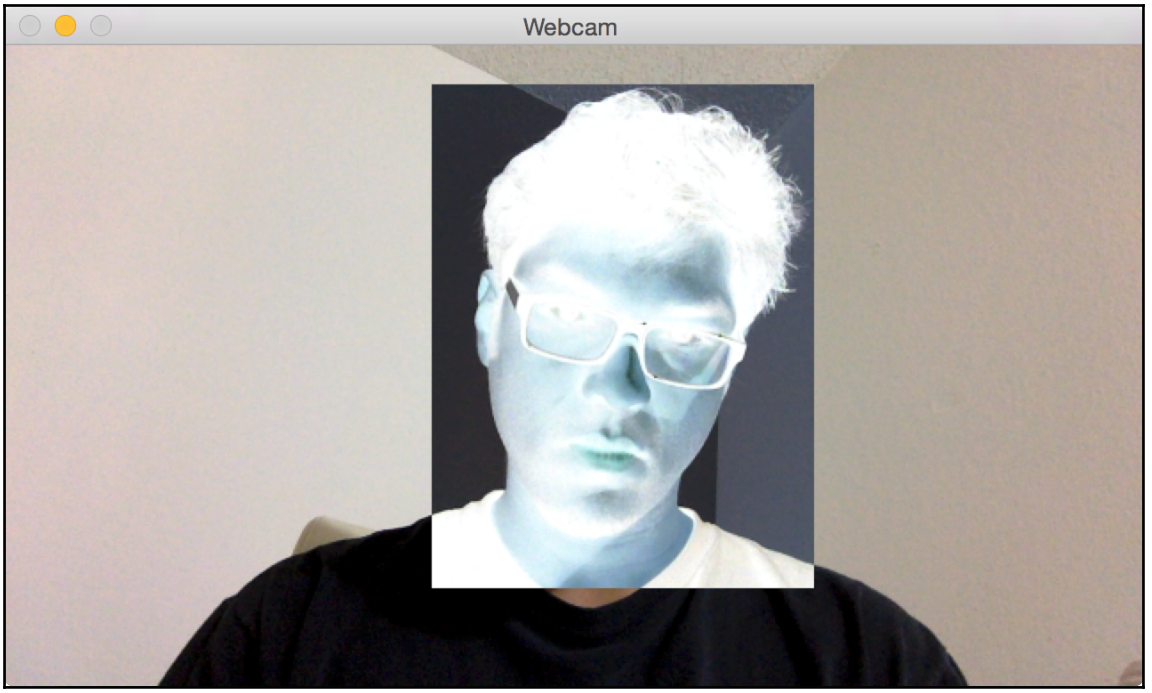

Vignette with shifted focus

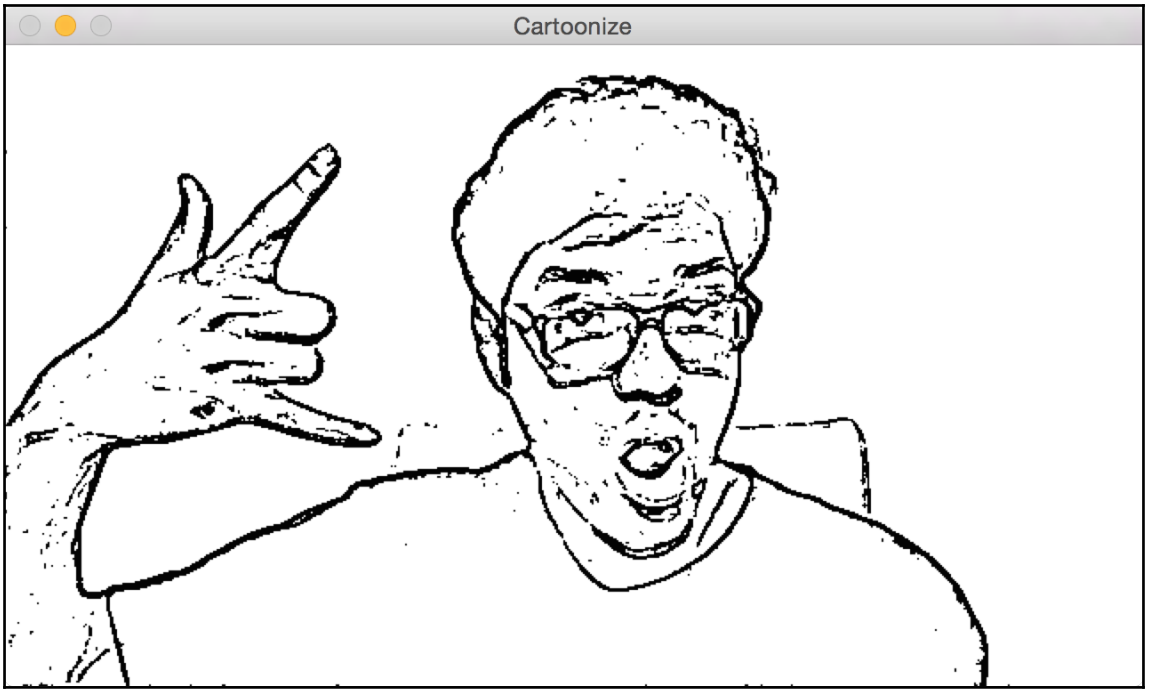
Input
Histogram equalized

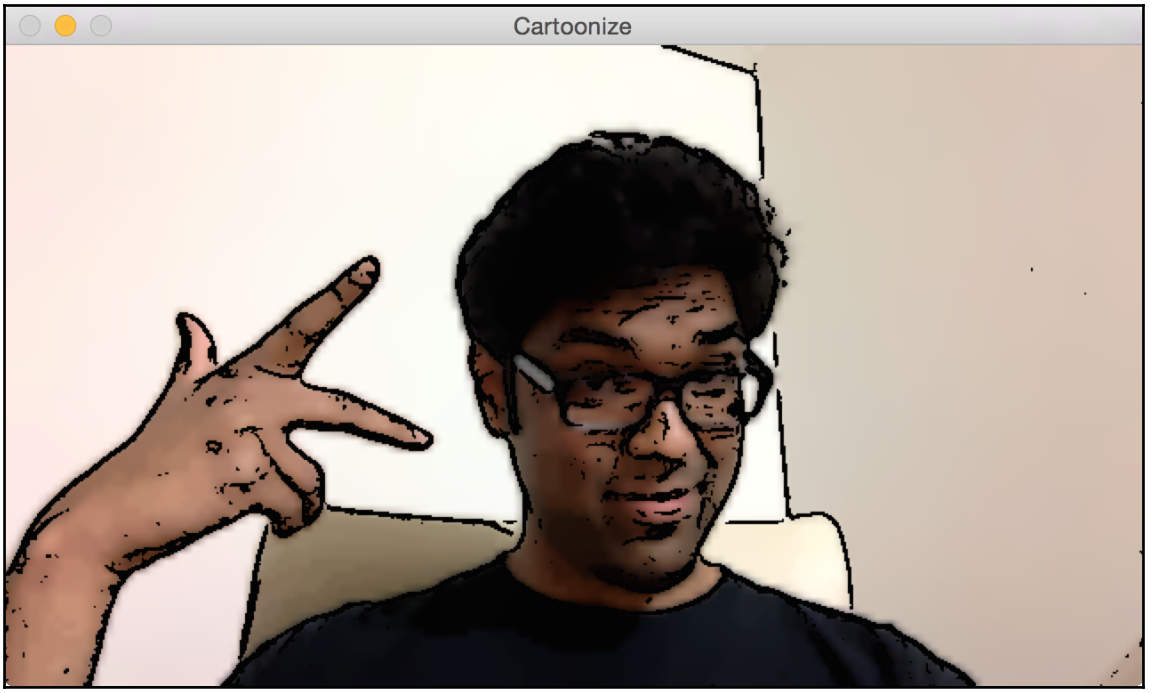
Color input image
Histogram equalized

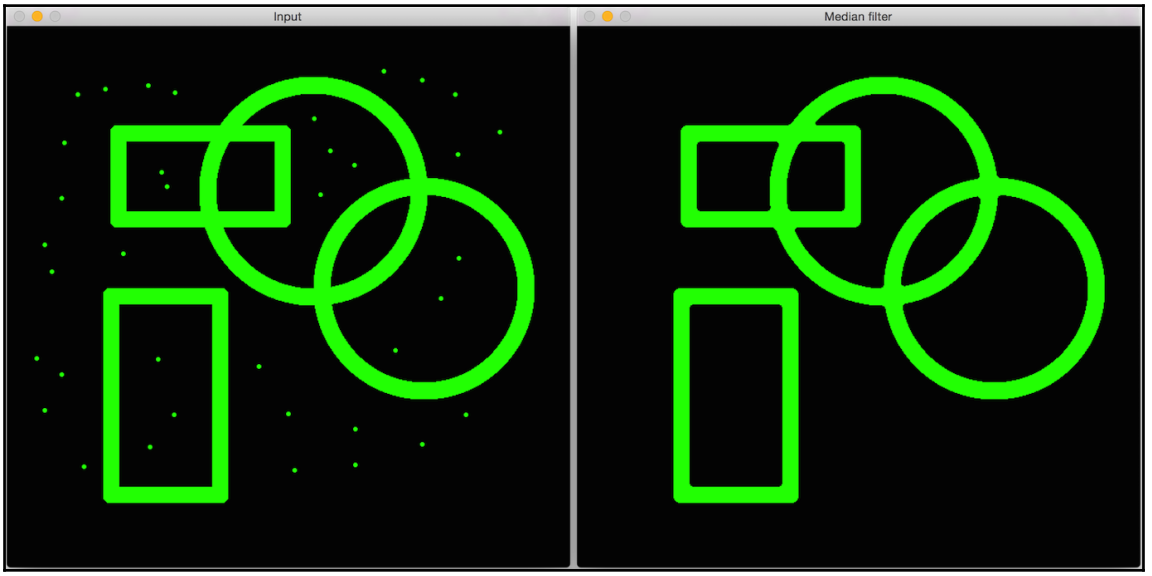
Chapter 3 - Cartoonizing an Image

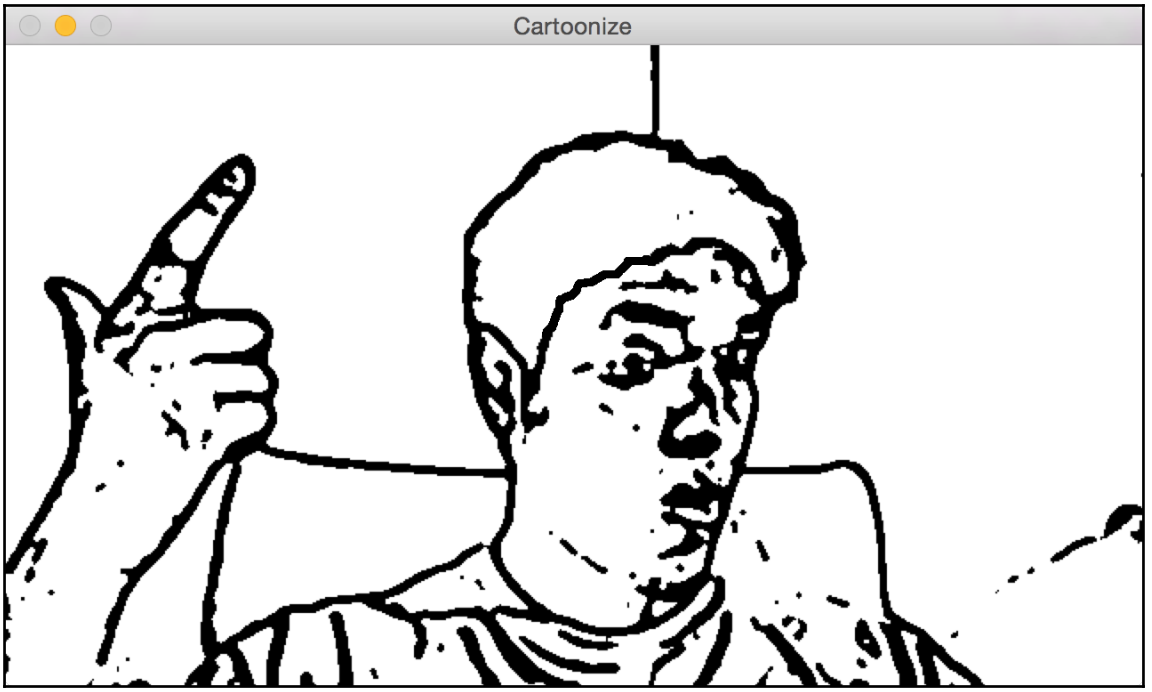



Webcam


Cartoonize

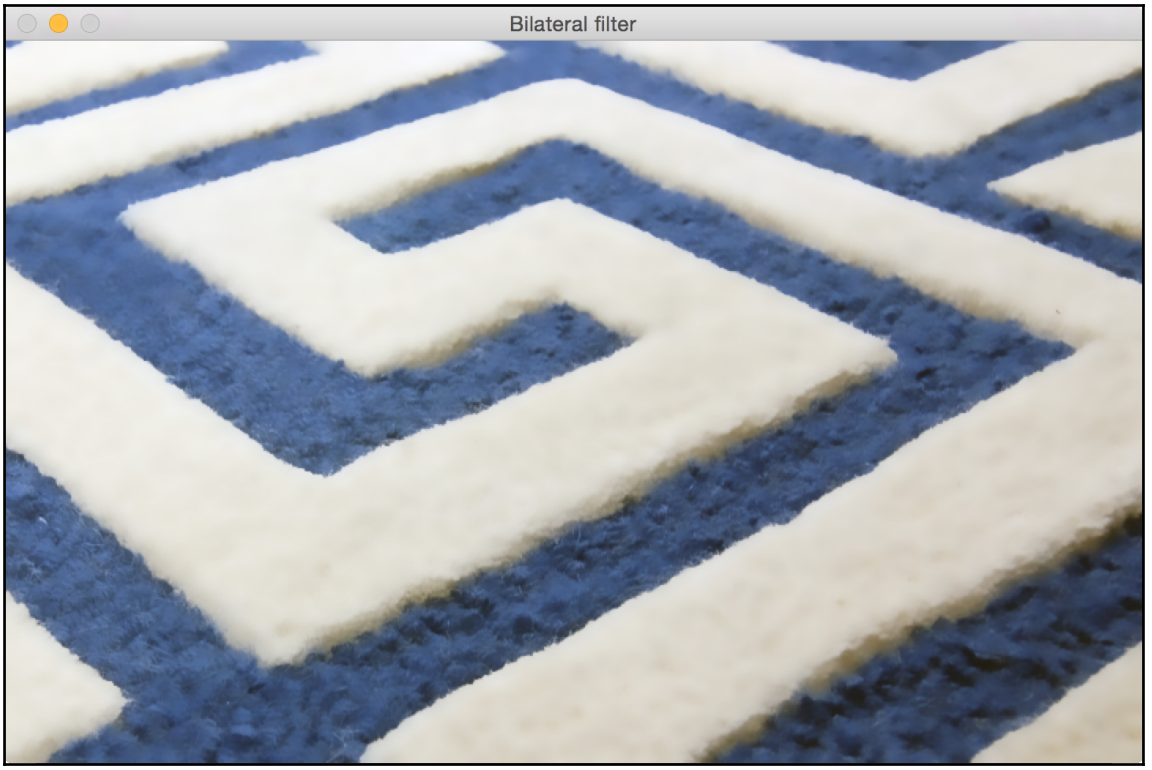

Cartoonize


Input
Median filter

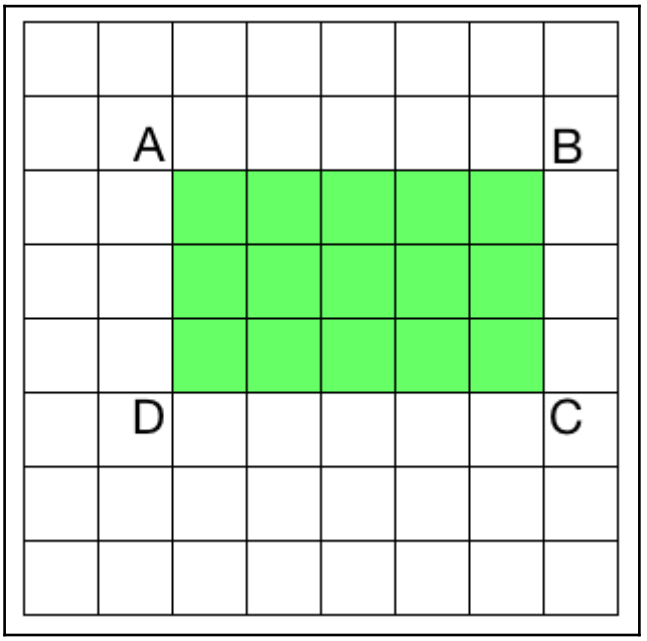

Cartoonize

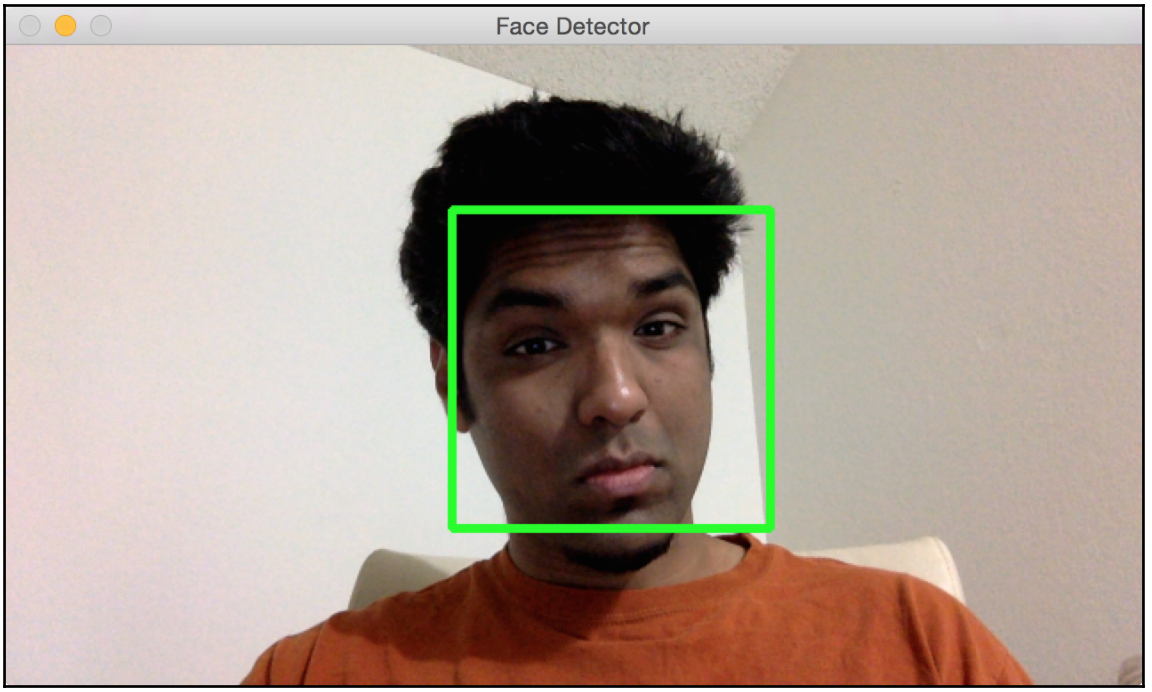
Input

Gaussian filter


Bilateral filter

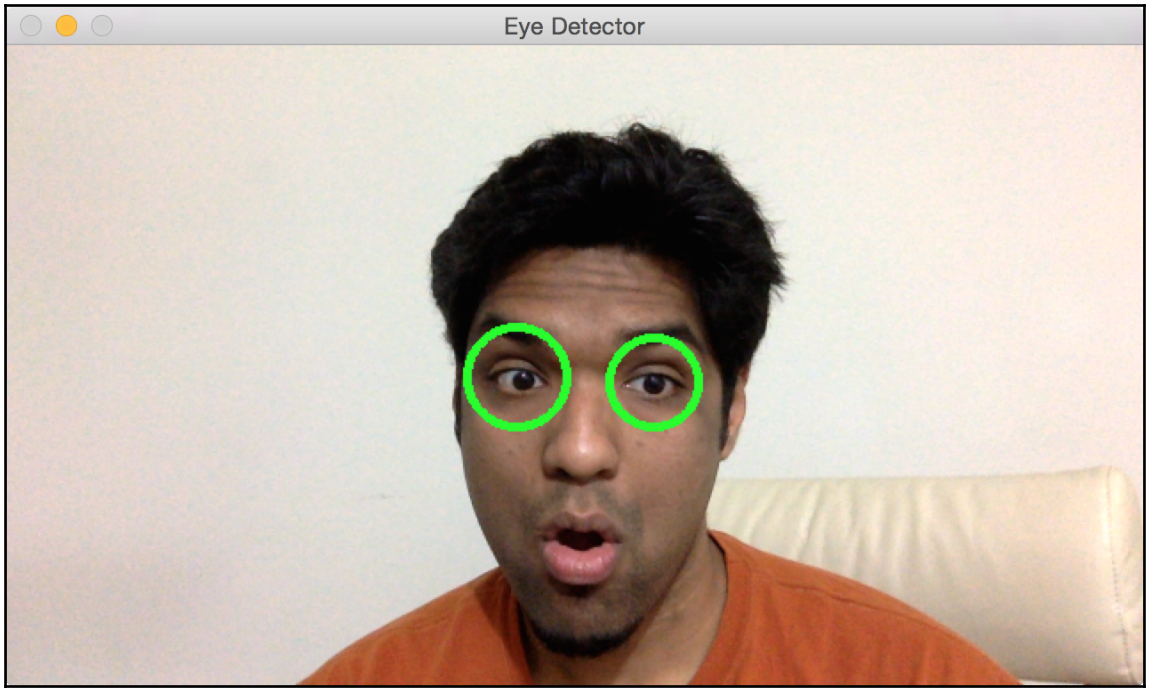
Chapter 4 - Detecting and Tracking Different Body Parts

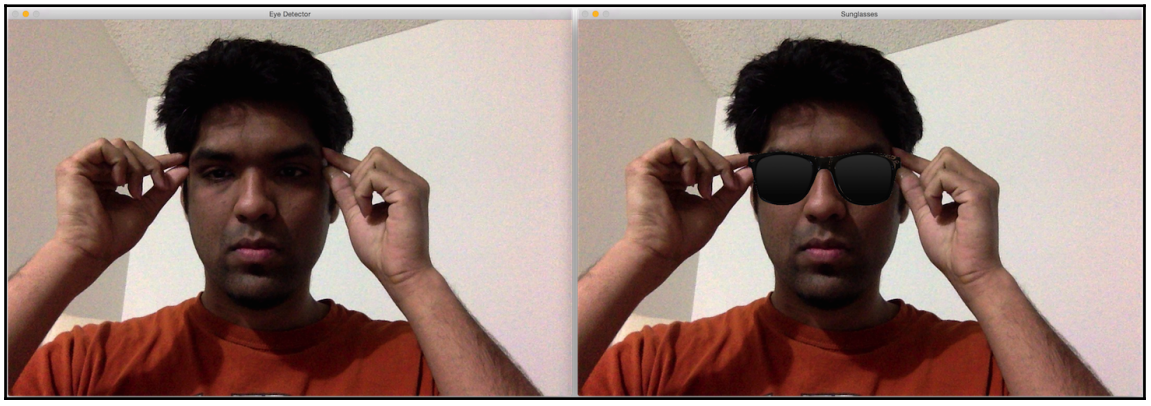


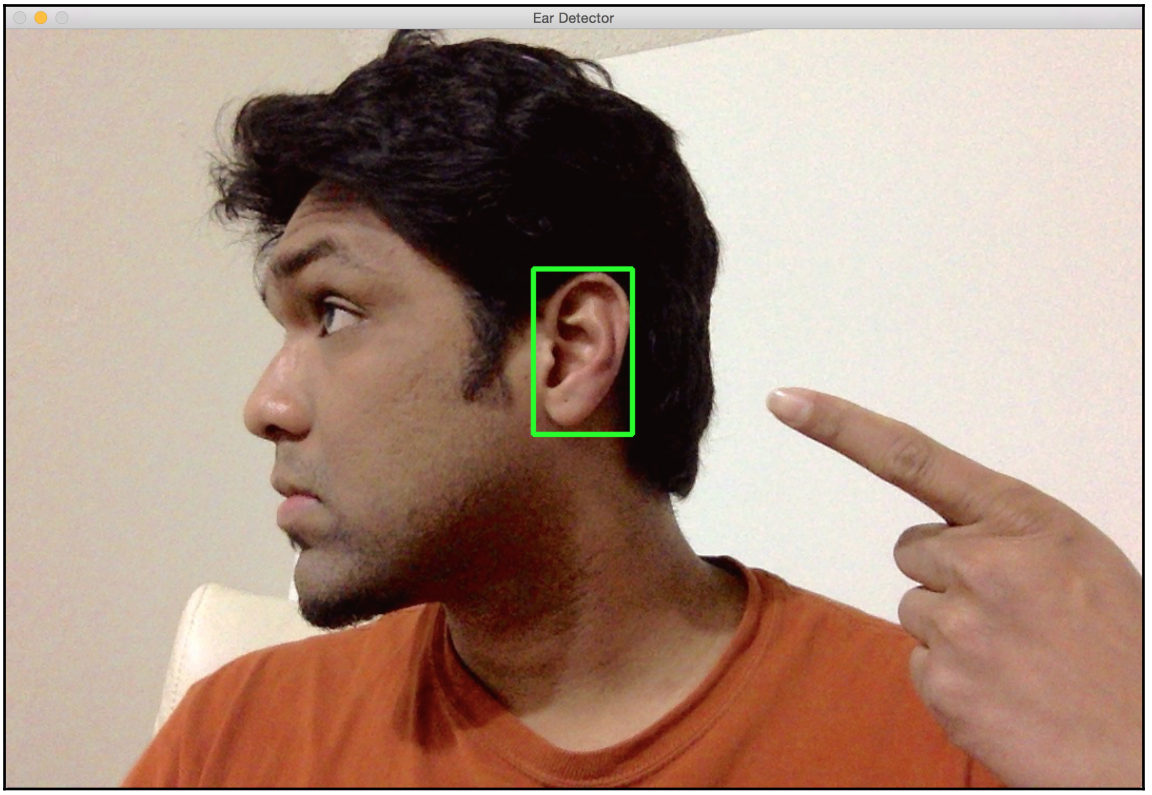

Face Detector

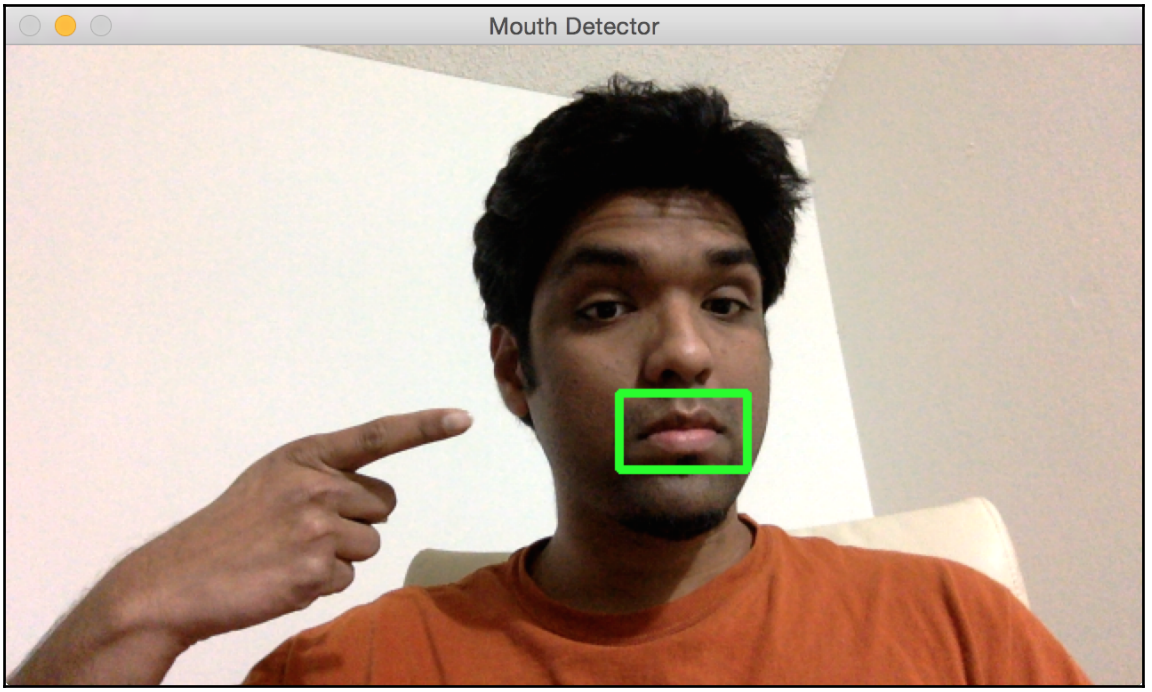
Face Detector

Face Detector


Eye Detector


Eye Detector
Sunglasses

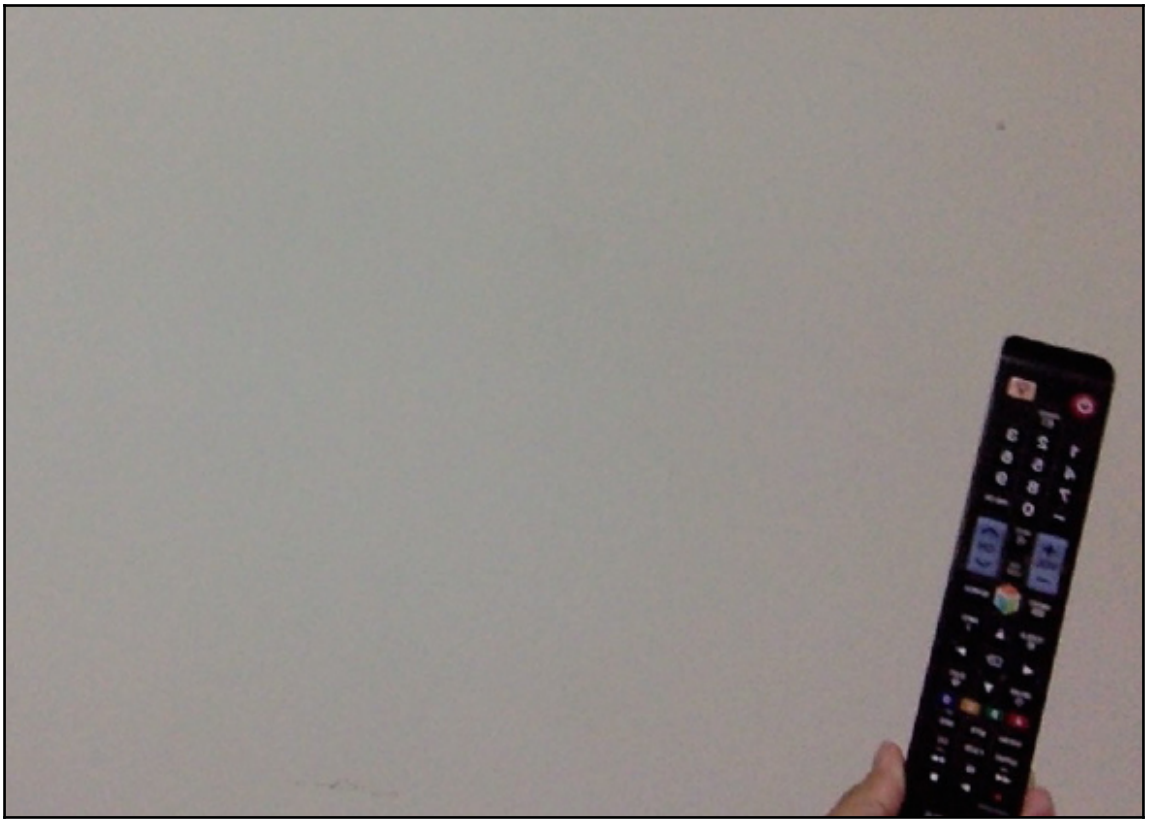

Ear Detector

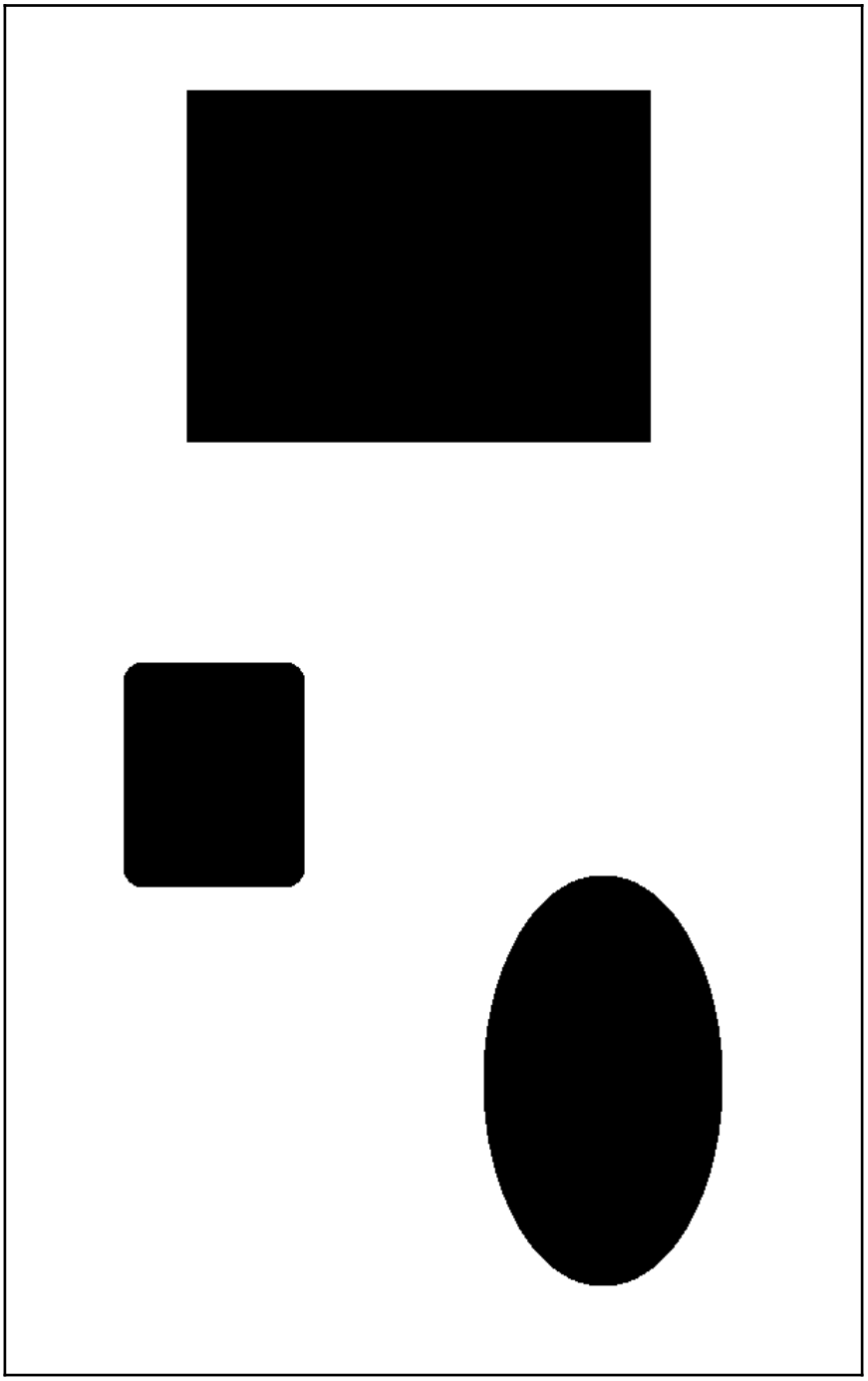

Mouth Detector

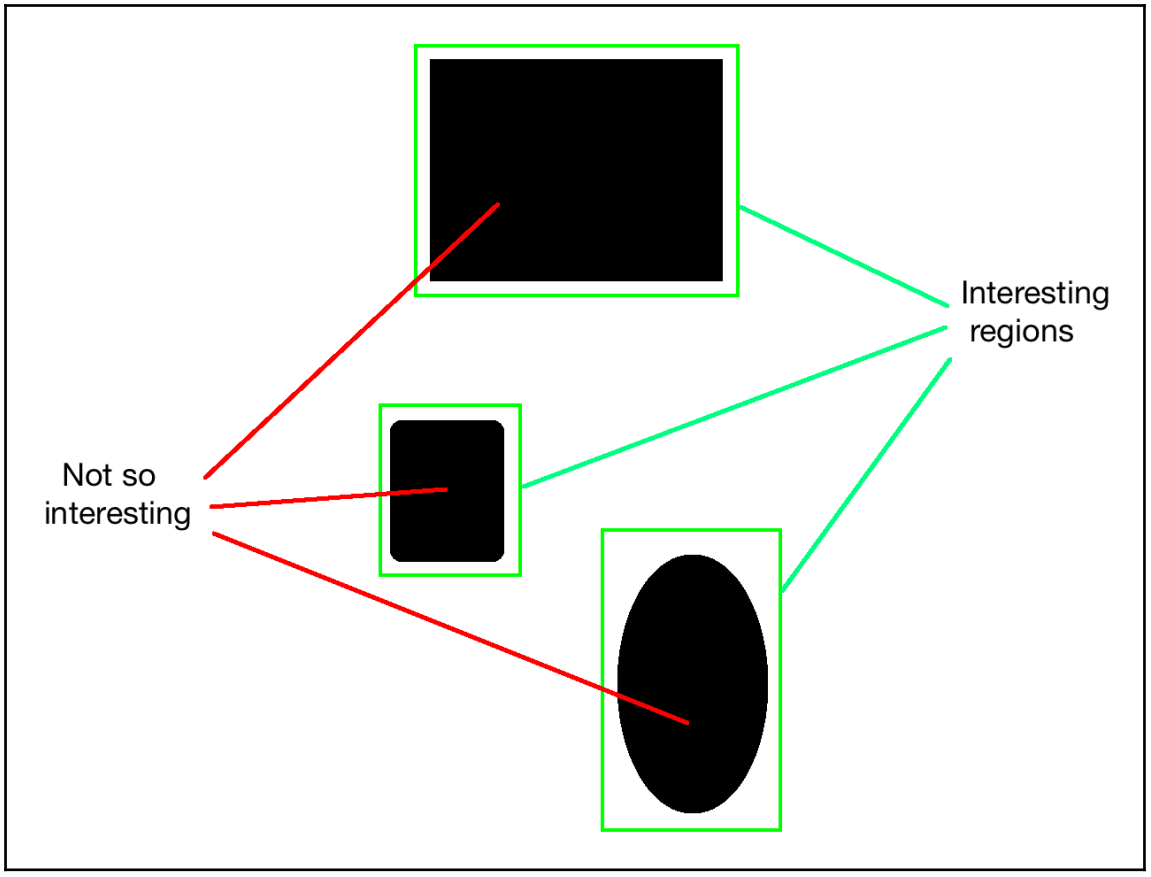
Moustache

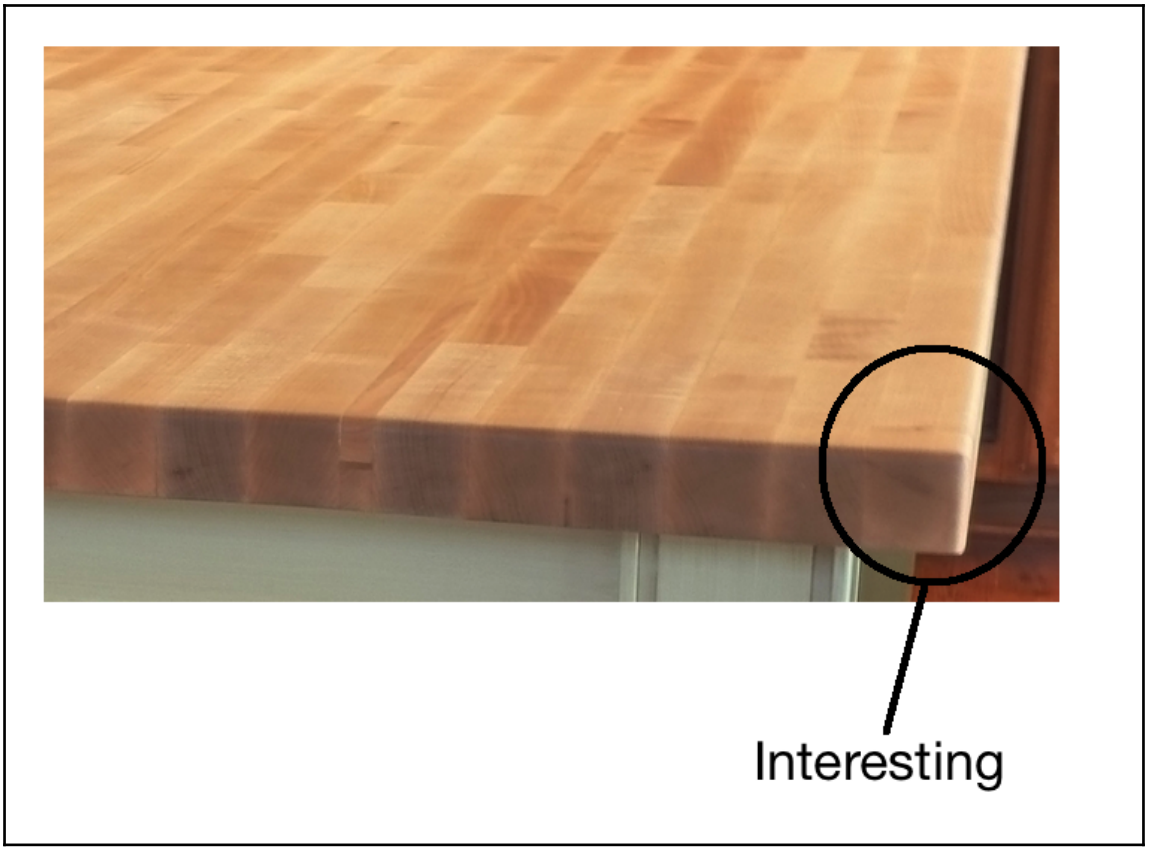
Pupil Detector

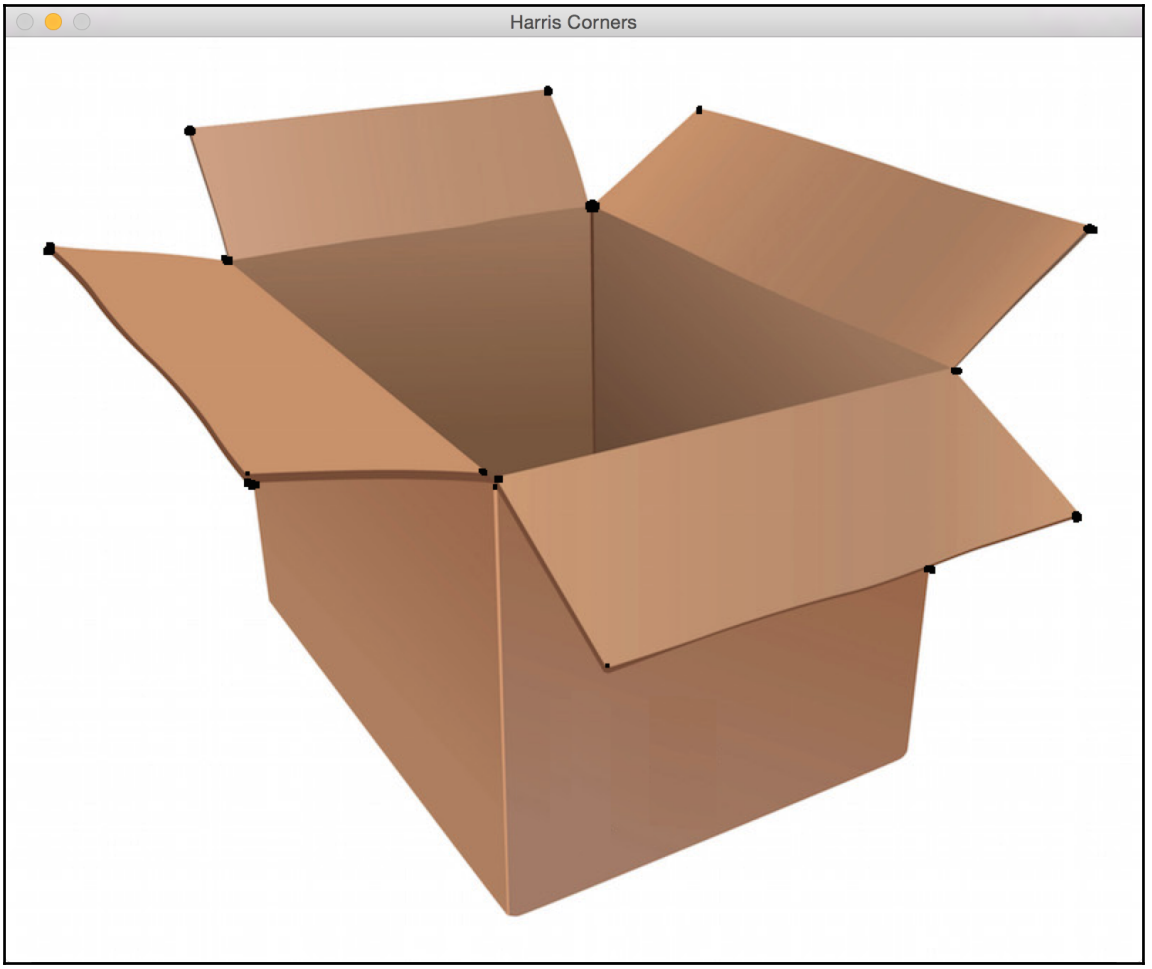
Chapter 5 - Extracting Features from an Image

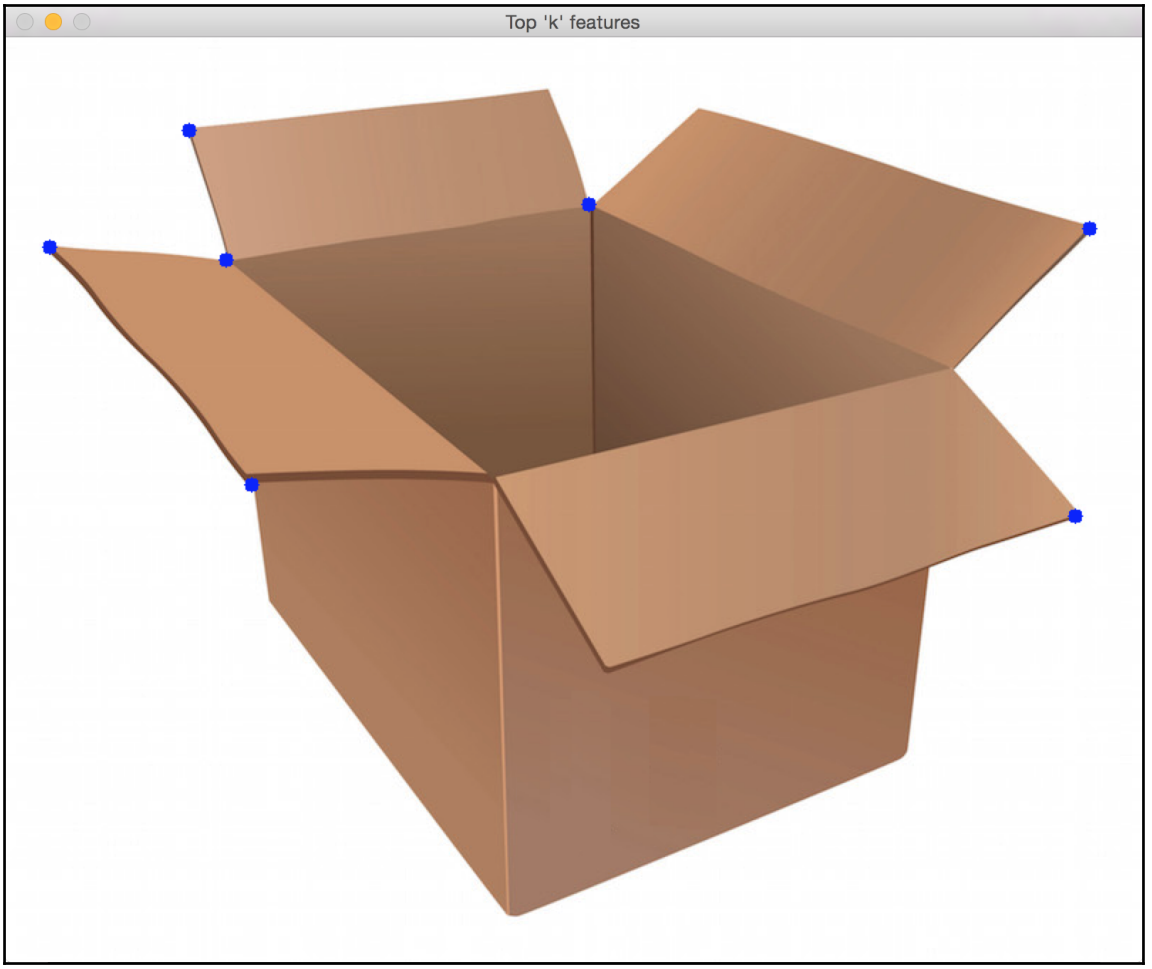


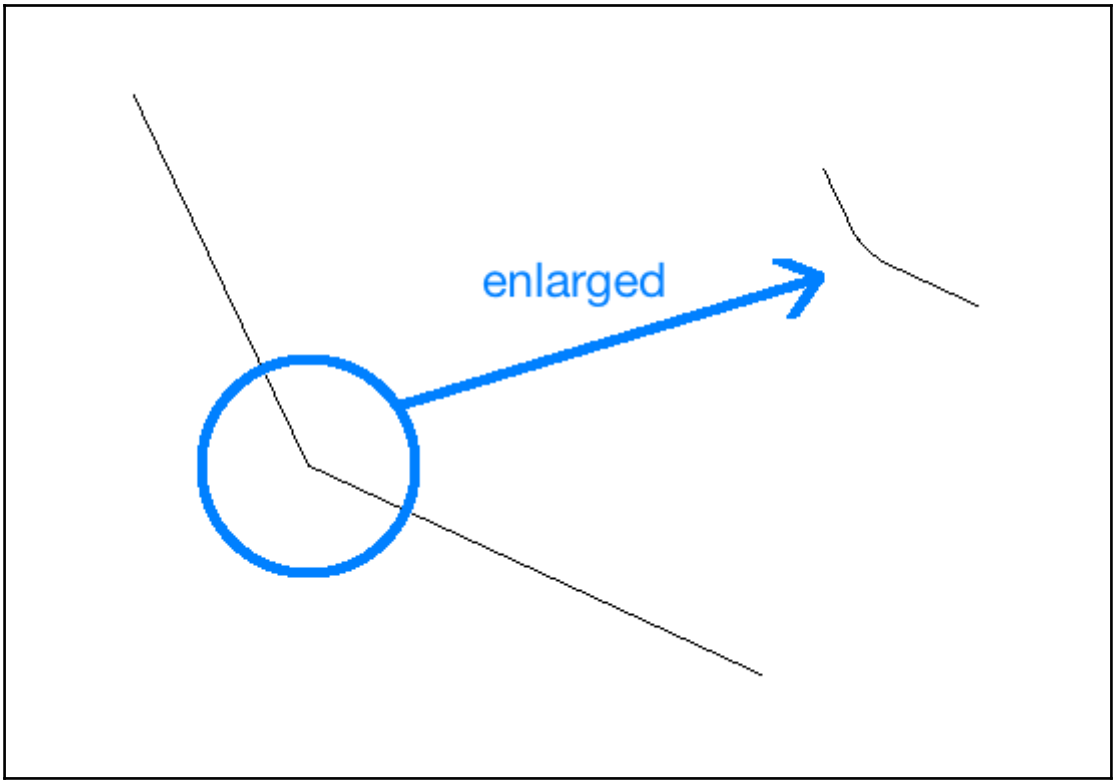



Interesting
regions
Not so
interesting


Interesting

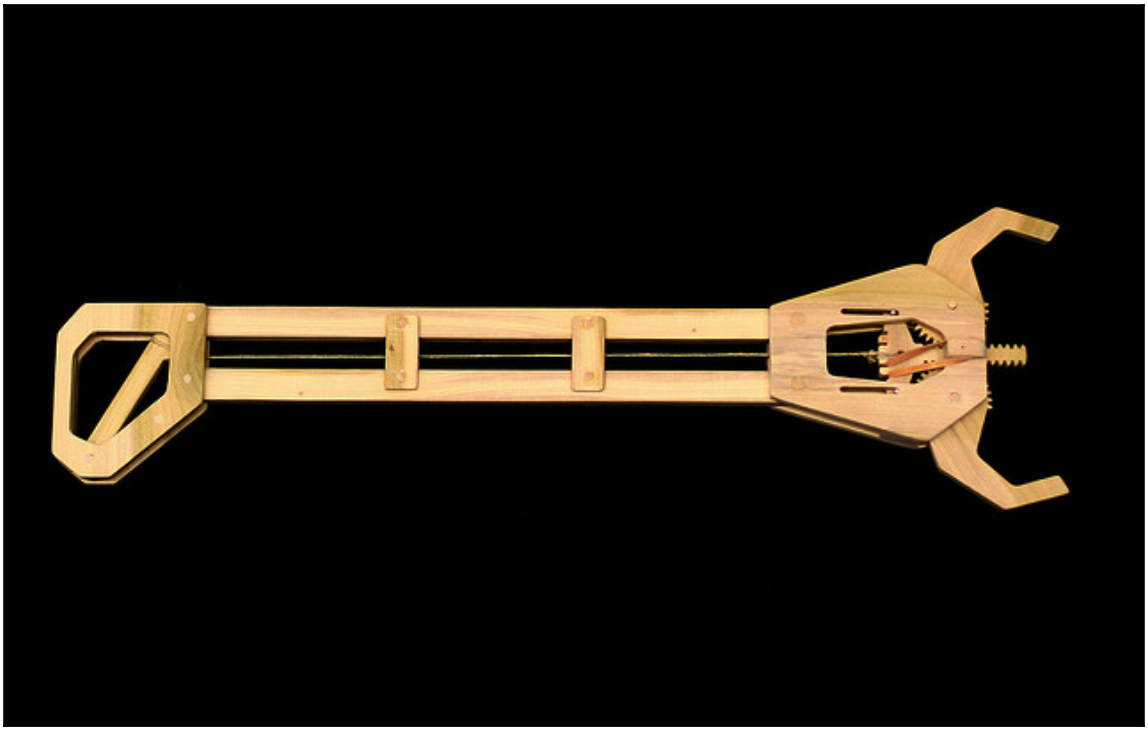

Harris Corners

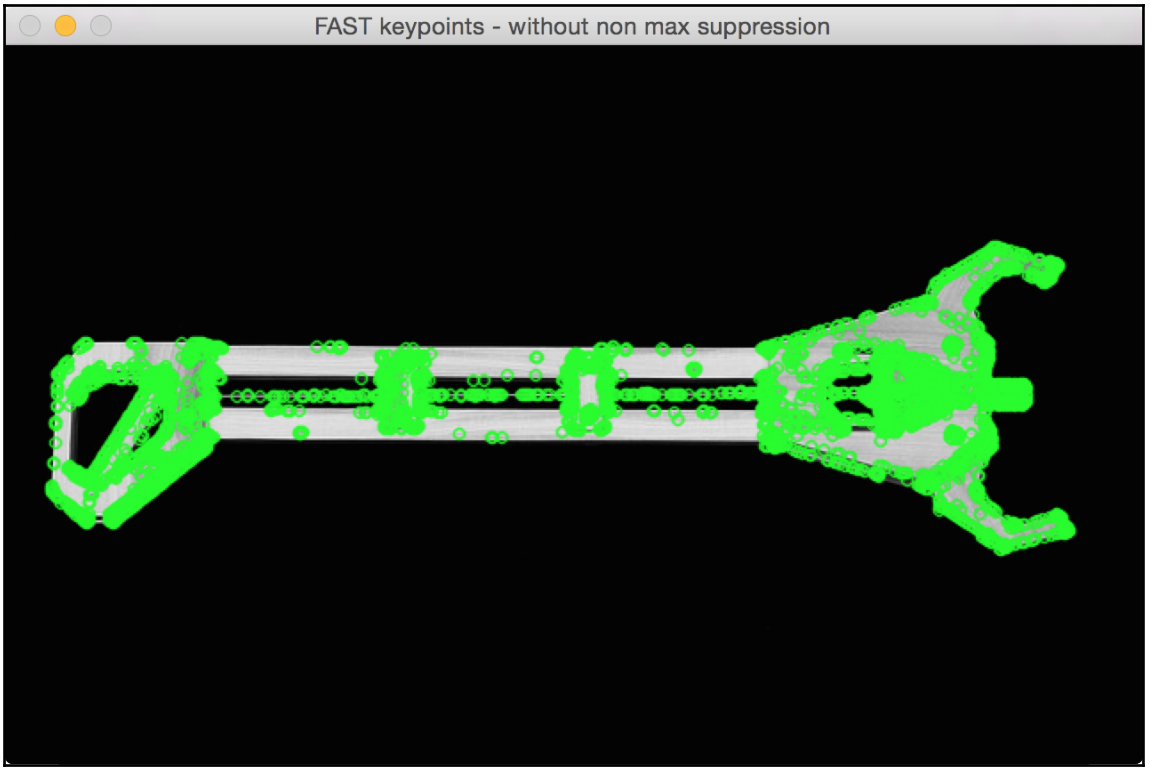

Top 'k' features

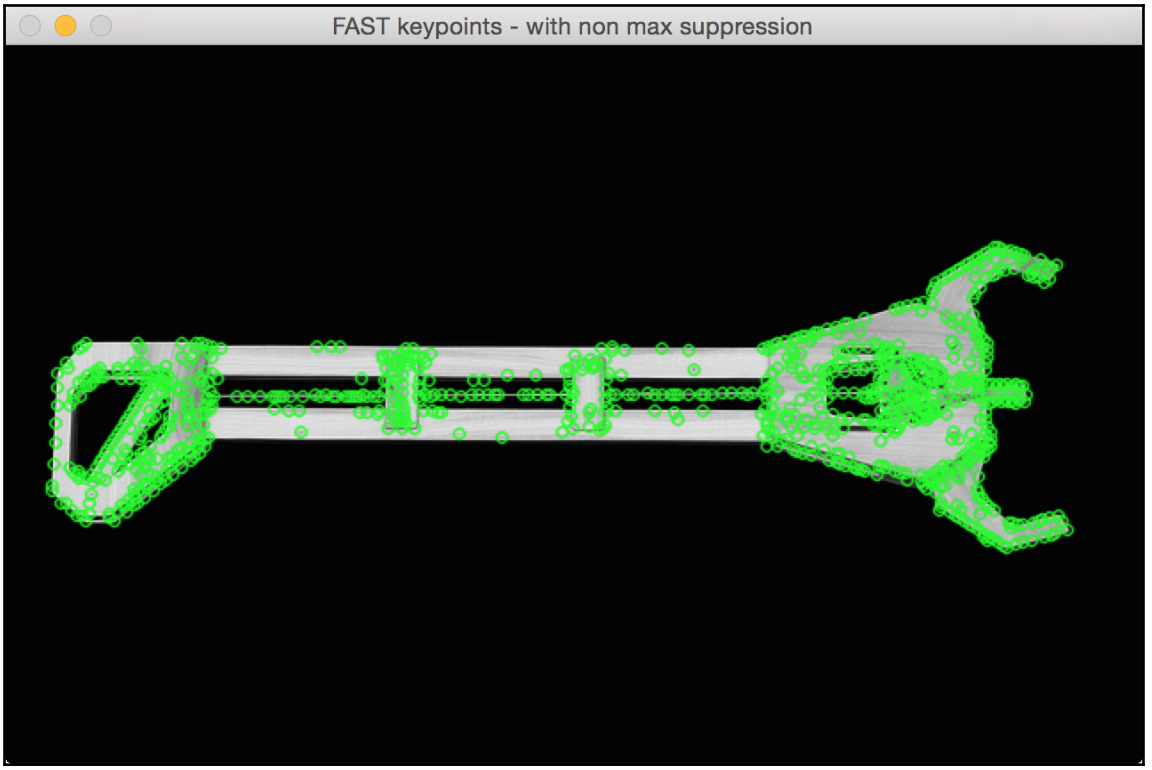

enlarged

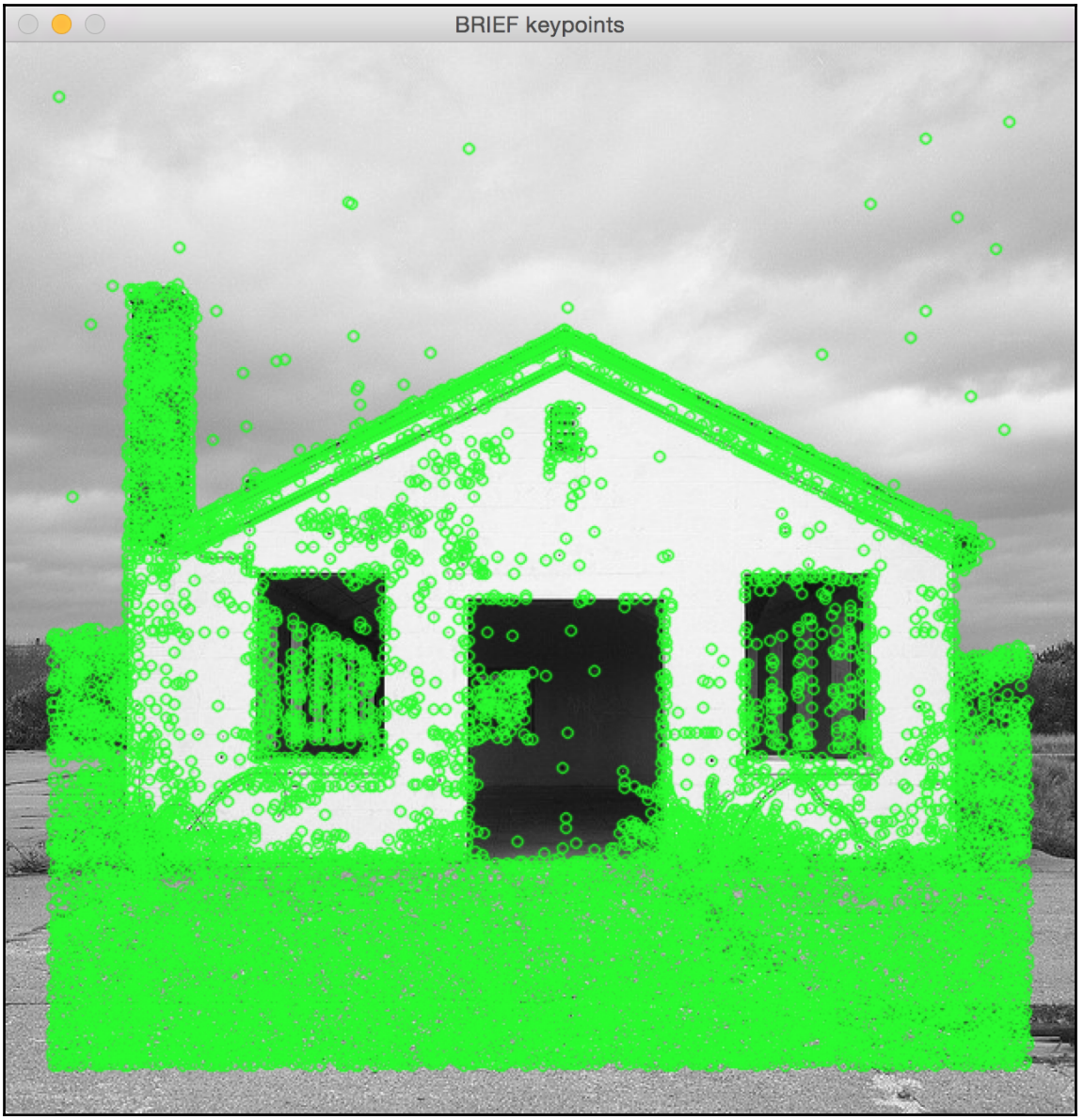
SIFT features

SURF features



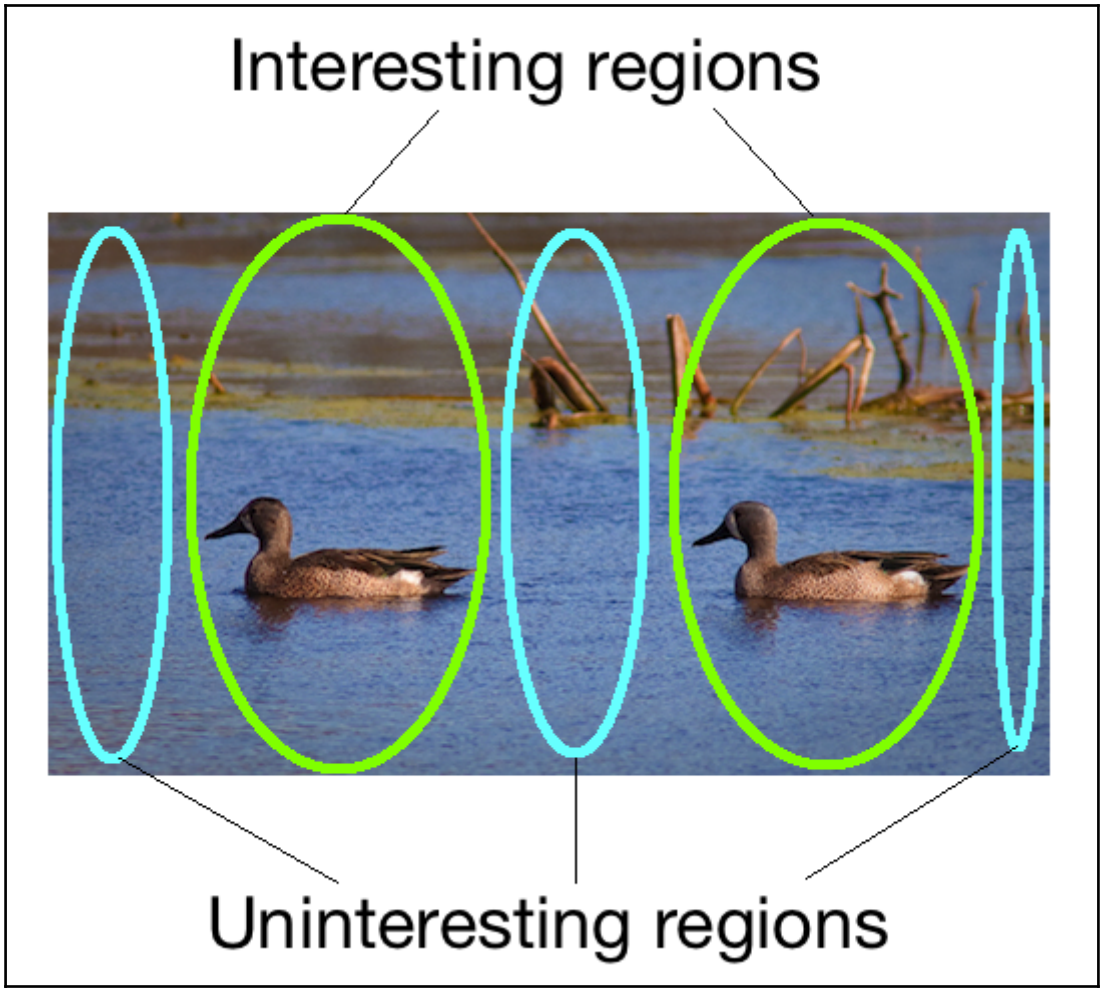

FAST keypoints - without non max suppression

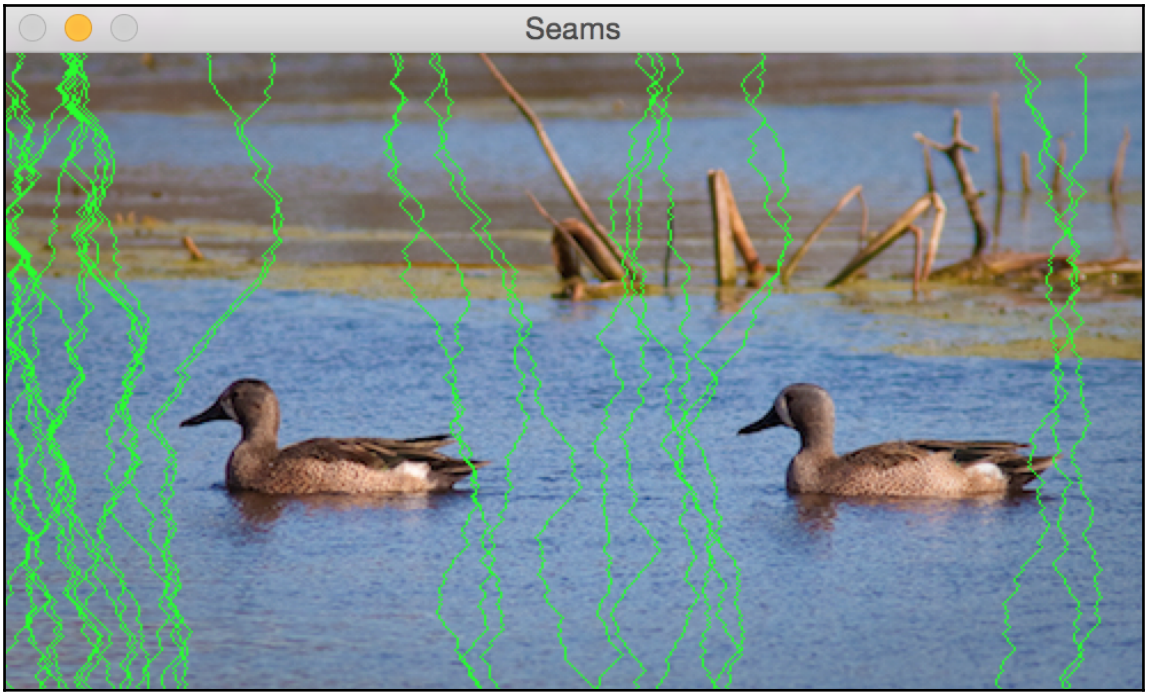

FAST keypoints - with non max suppression


BRIEF keypoints

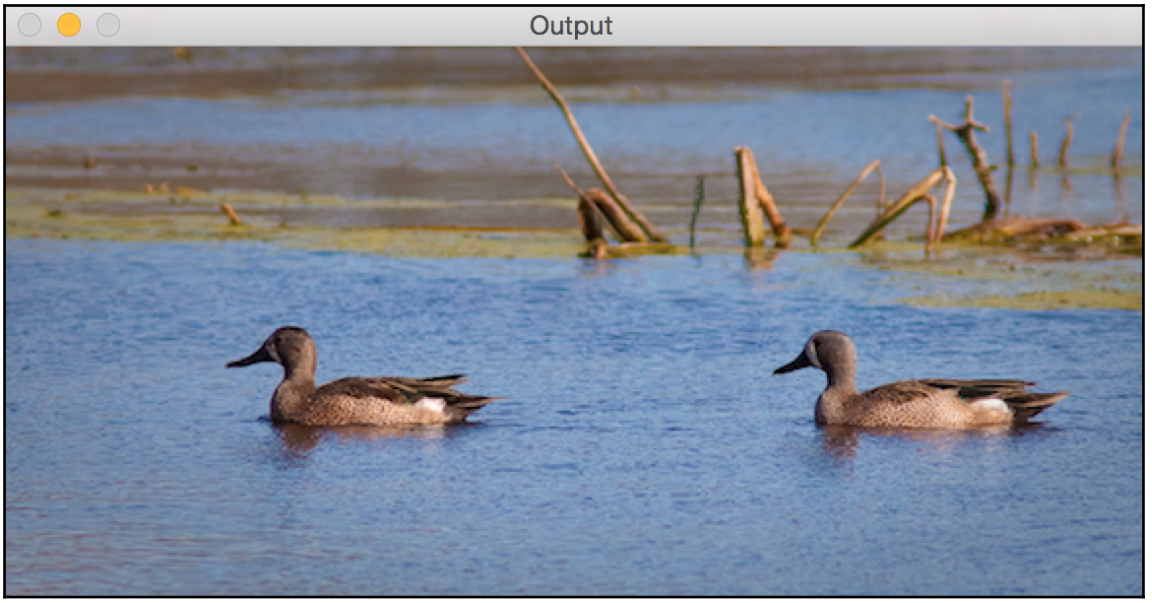
ORB keypoints

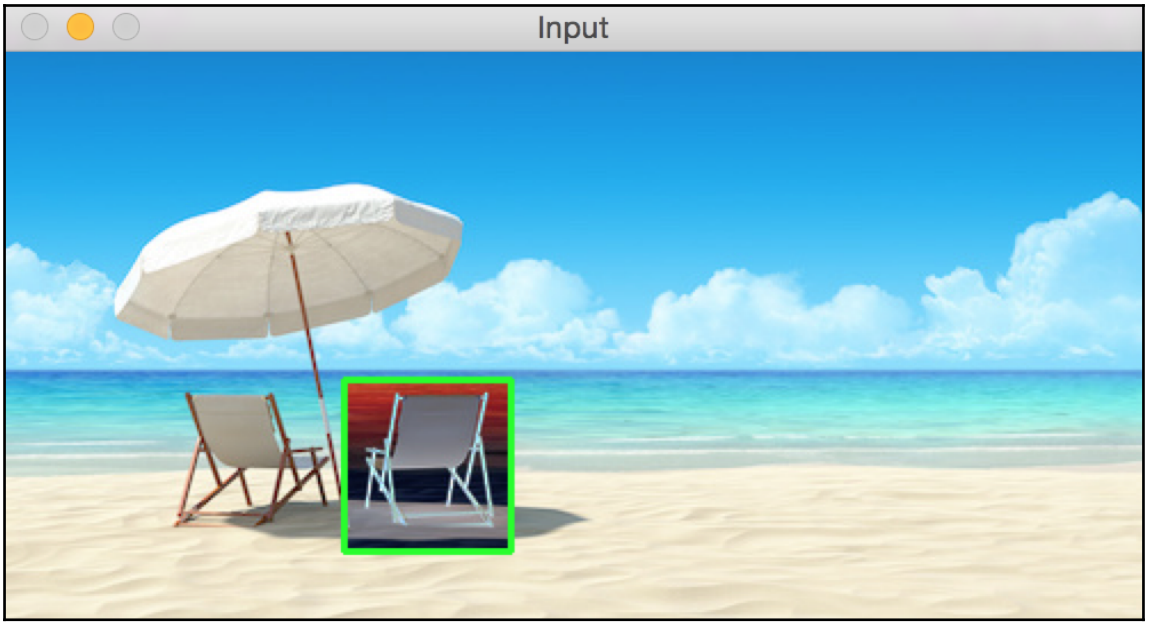
Chapter 6 - Seam Carving

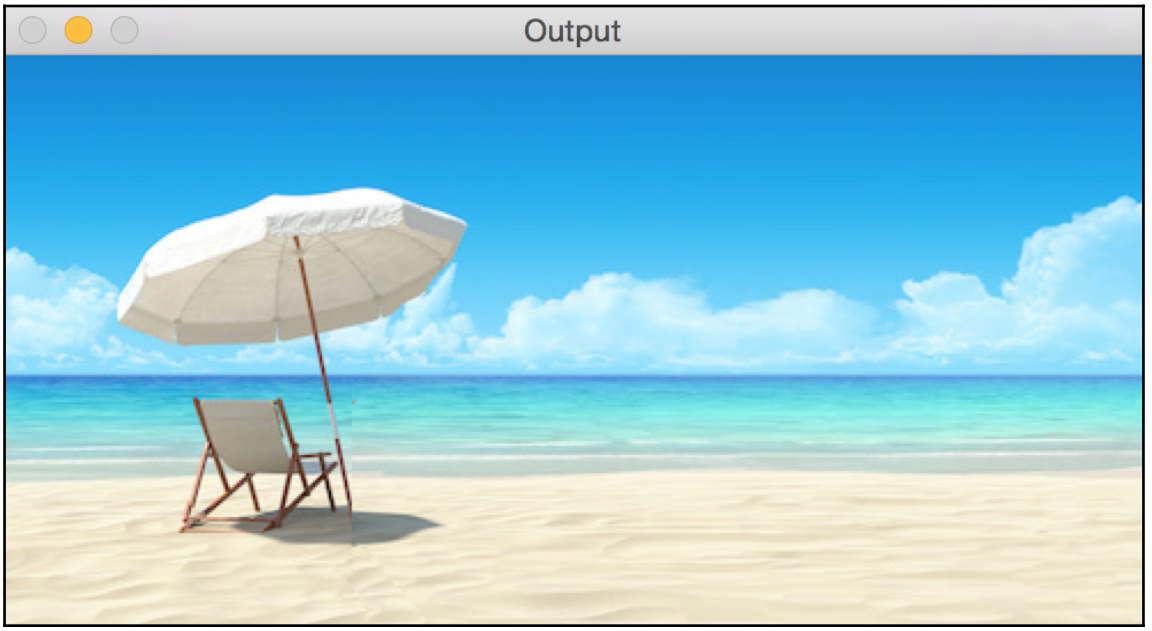

Interesting regions
Uninteresting regions


Seams

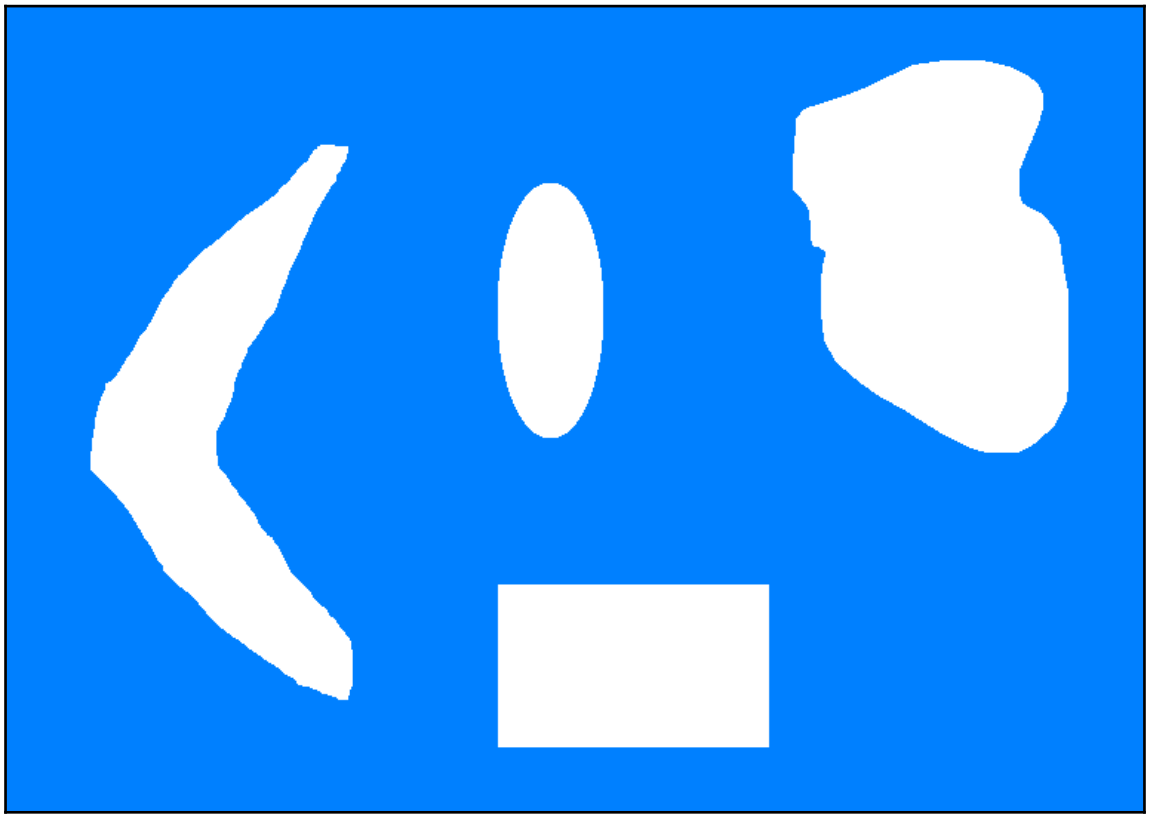
Output

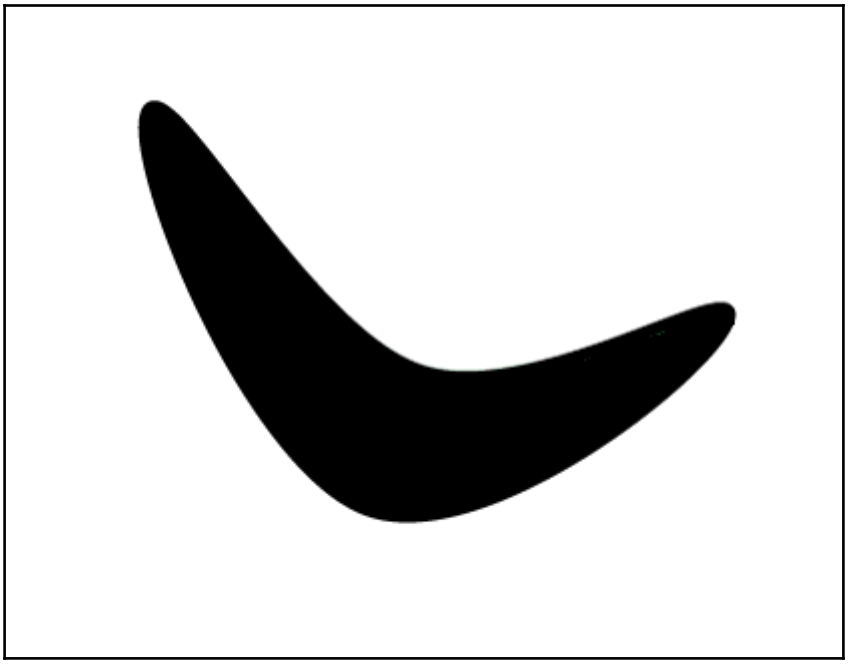

Output


Input

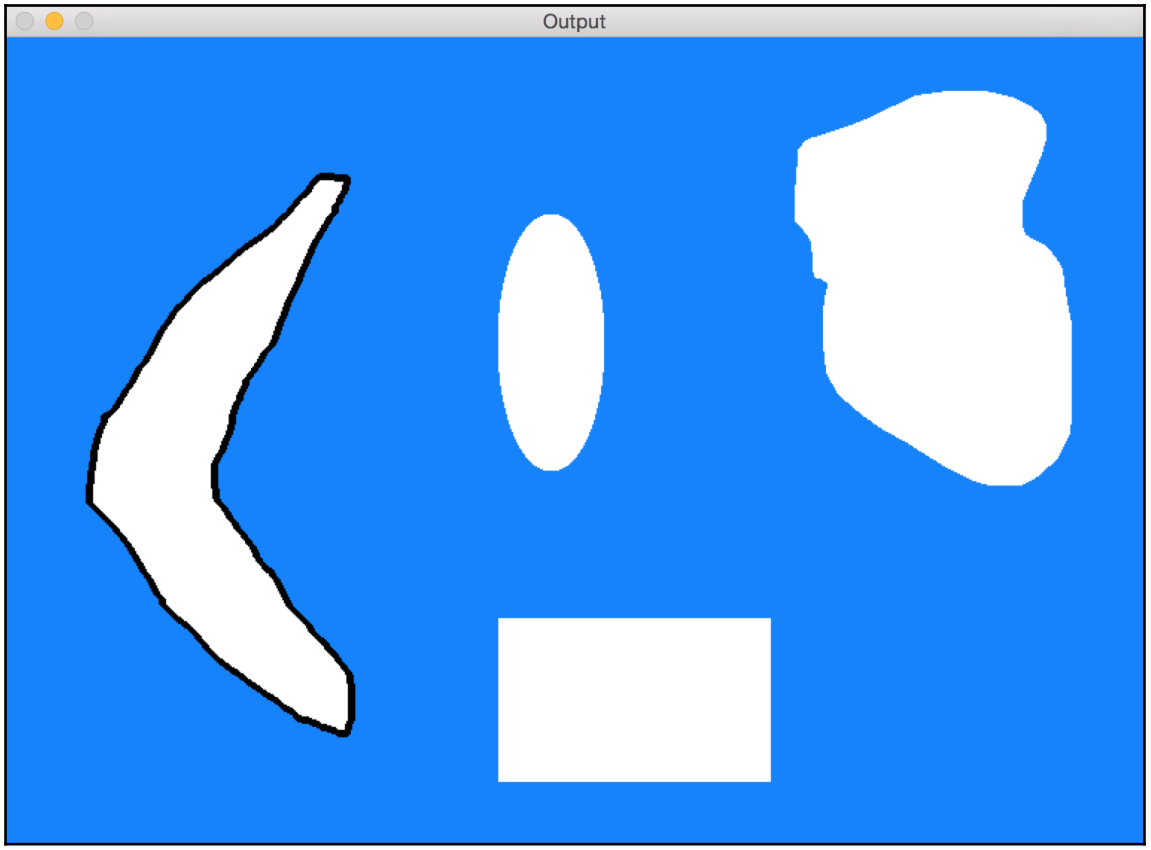

Output

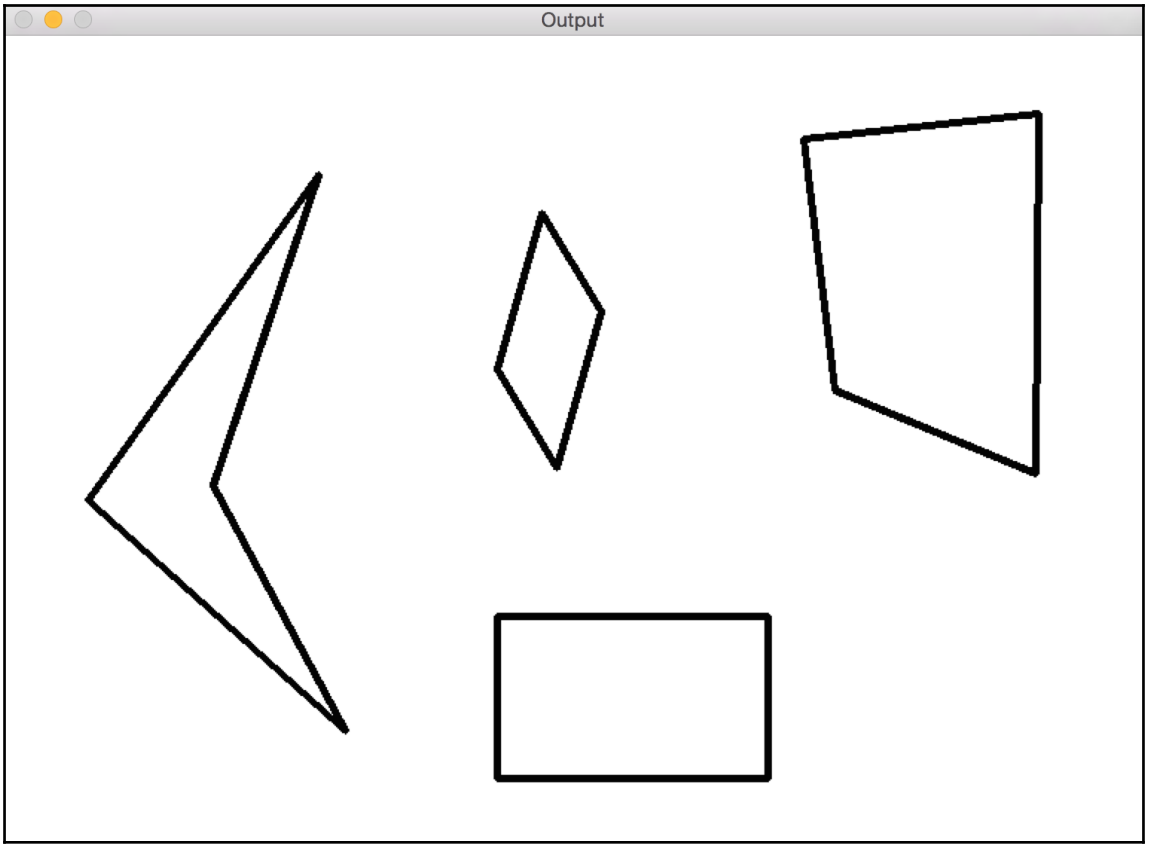
Chapter 7 - Detecting Shapes and Segmenting an Image





$$I = \sum_{i=0}^{N} w_i p_i^k$$


Output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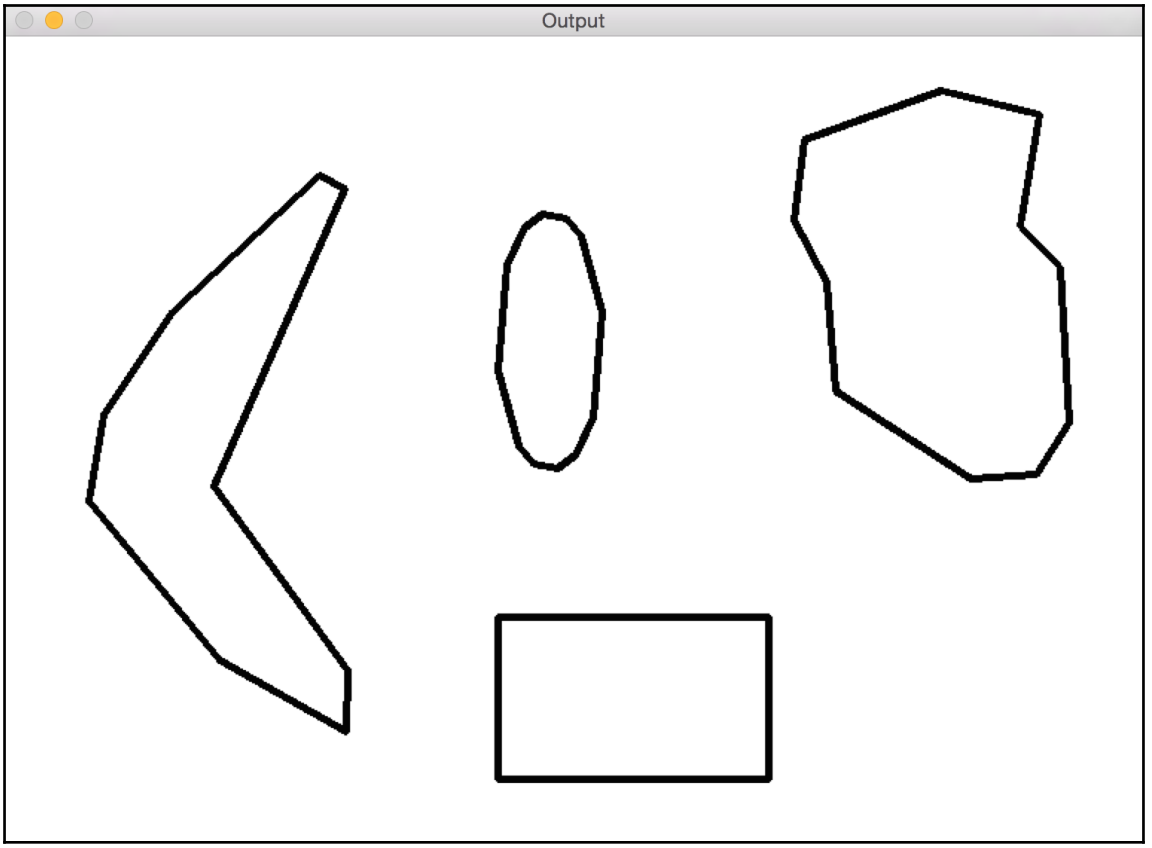
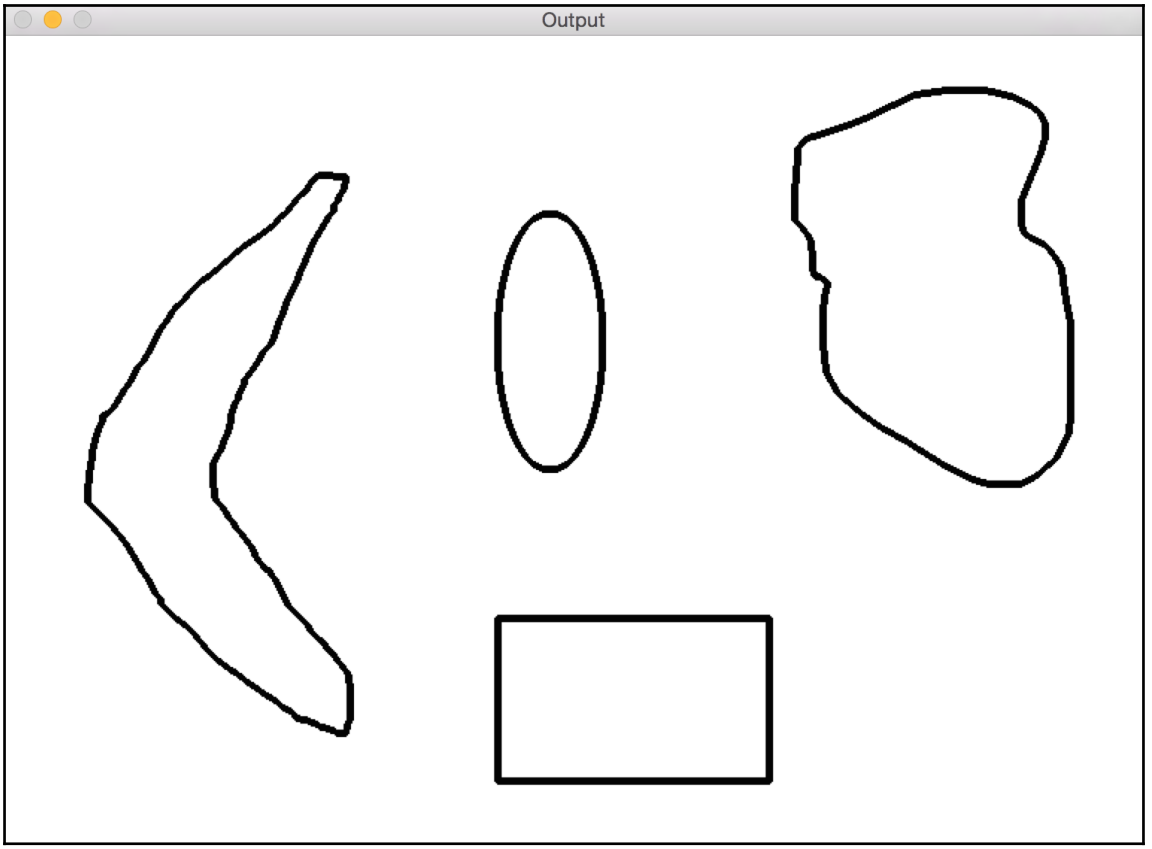
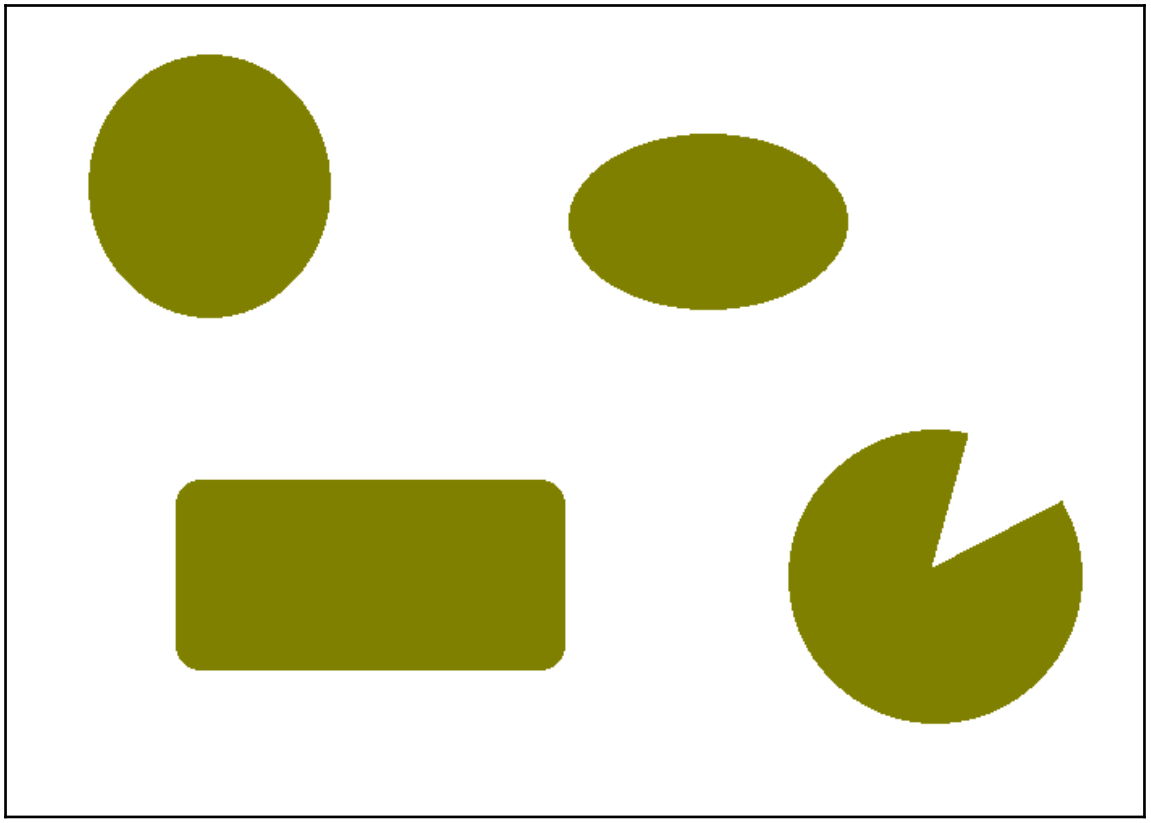
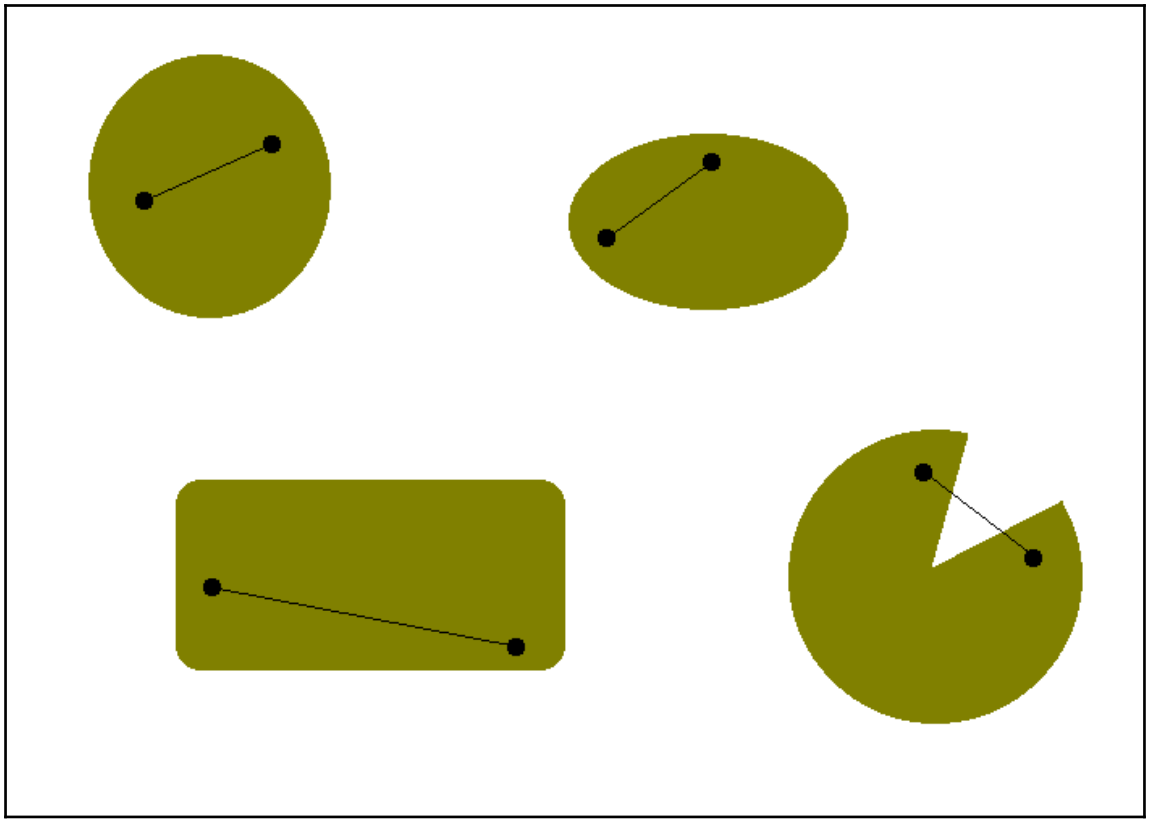
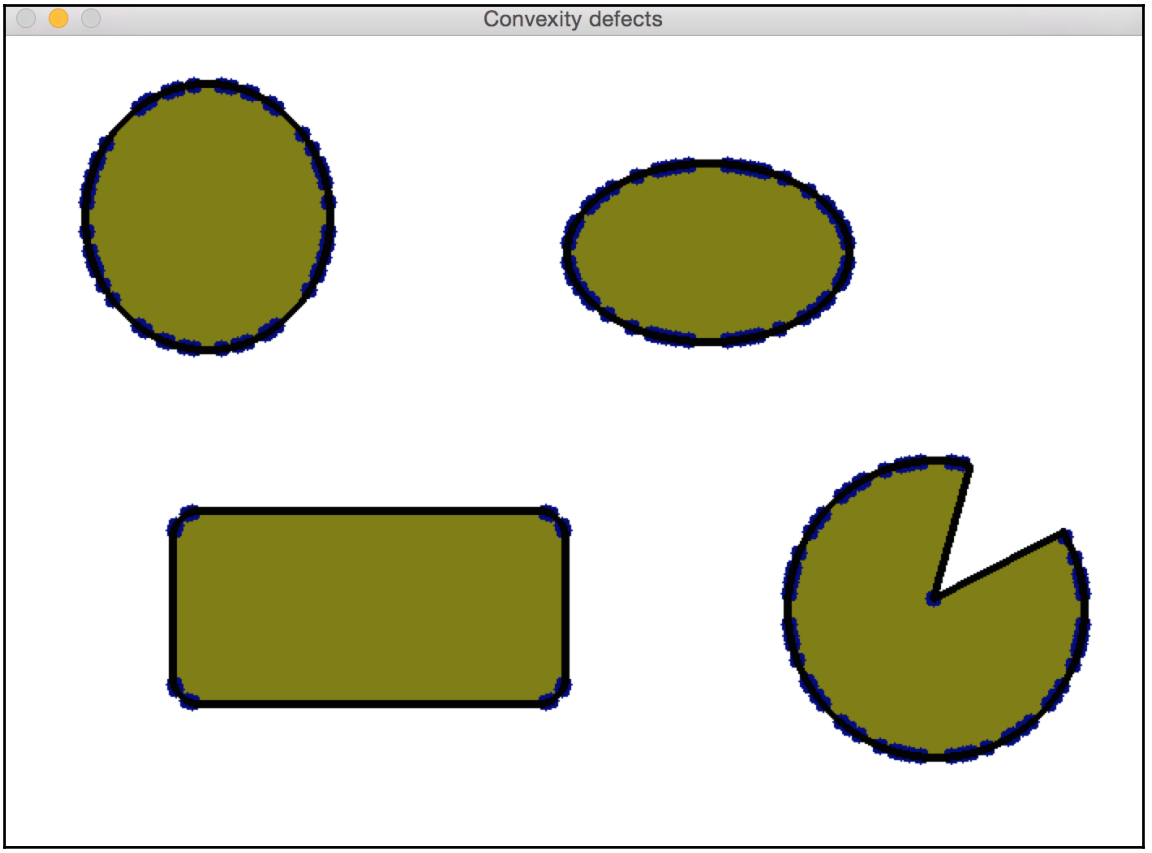
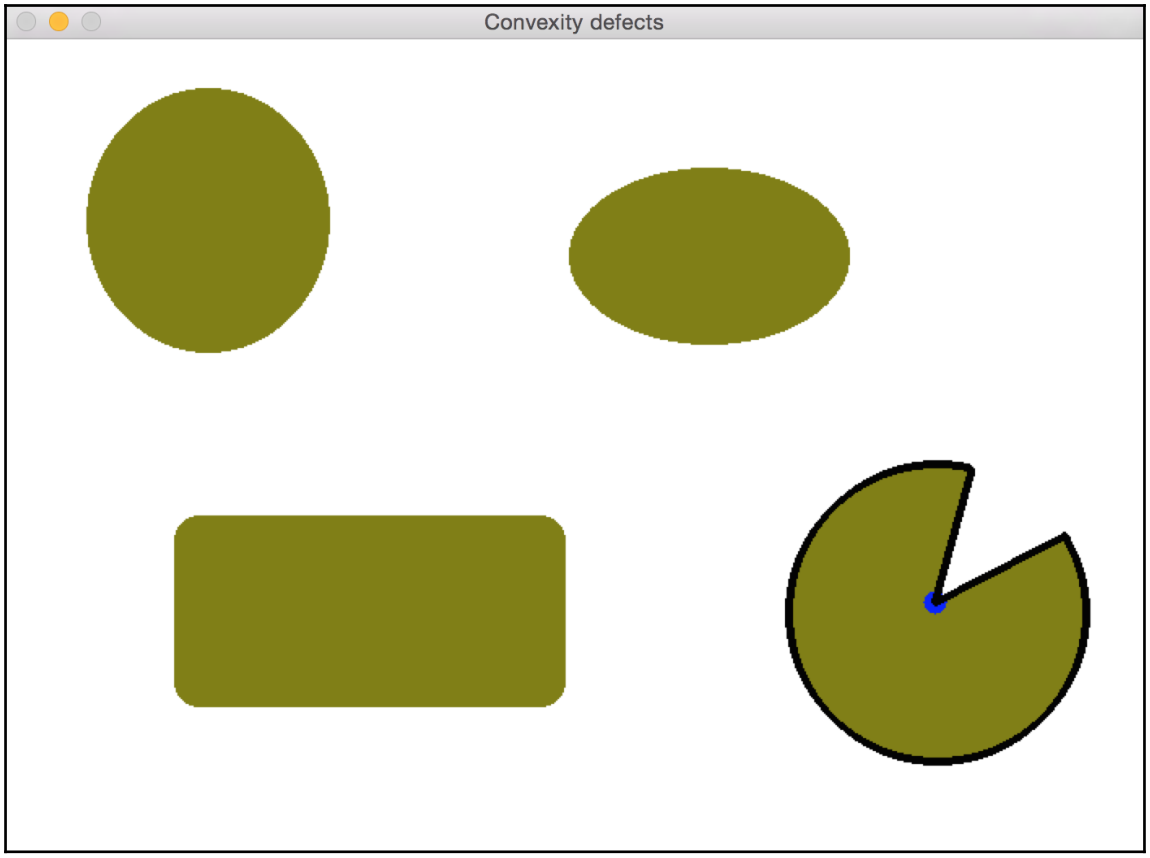

Output

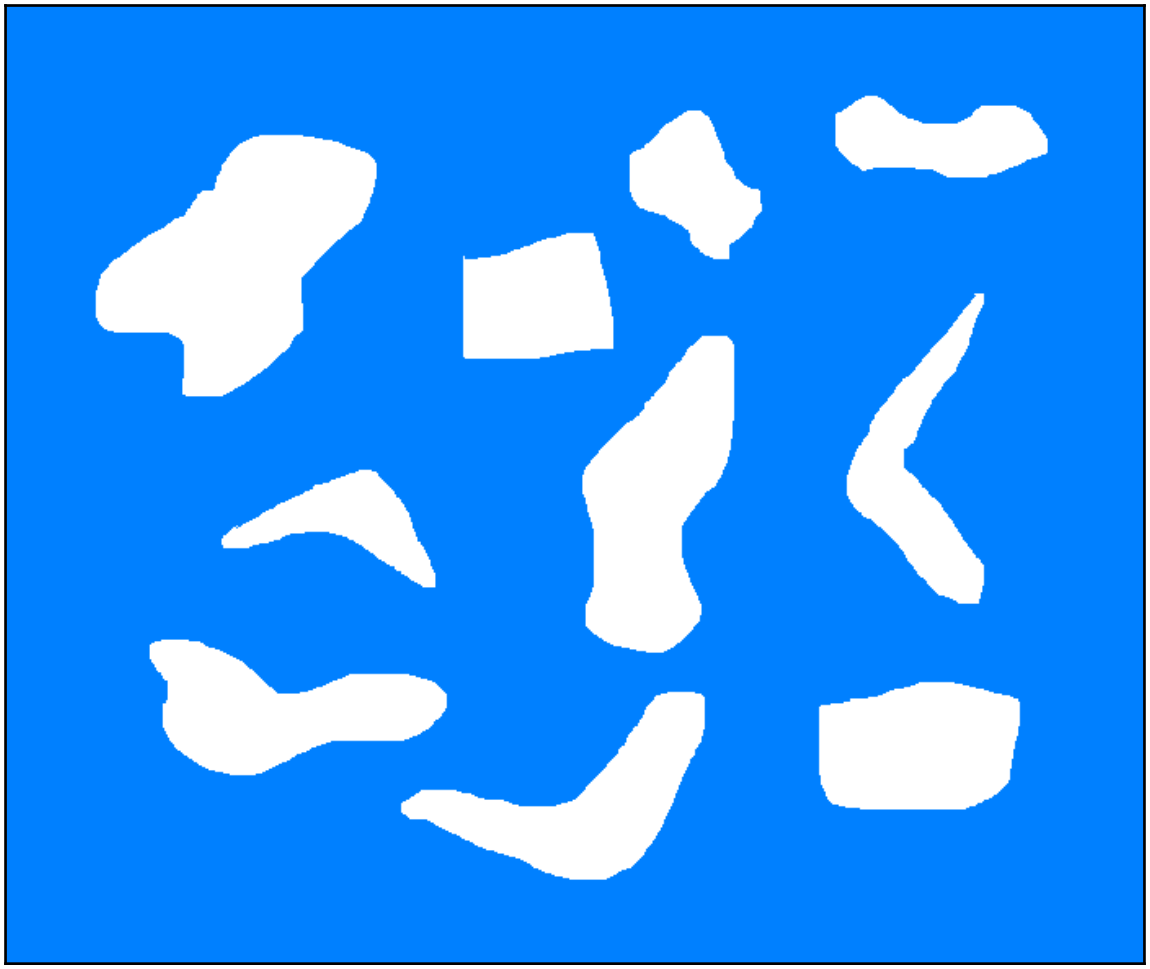

Output

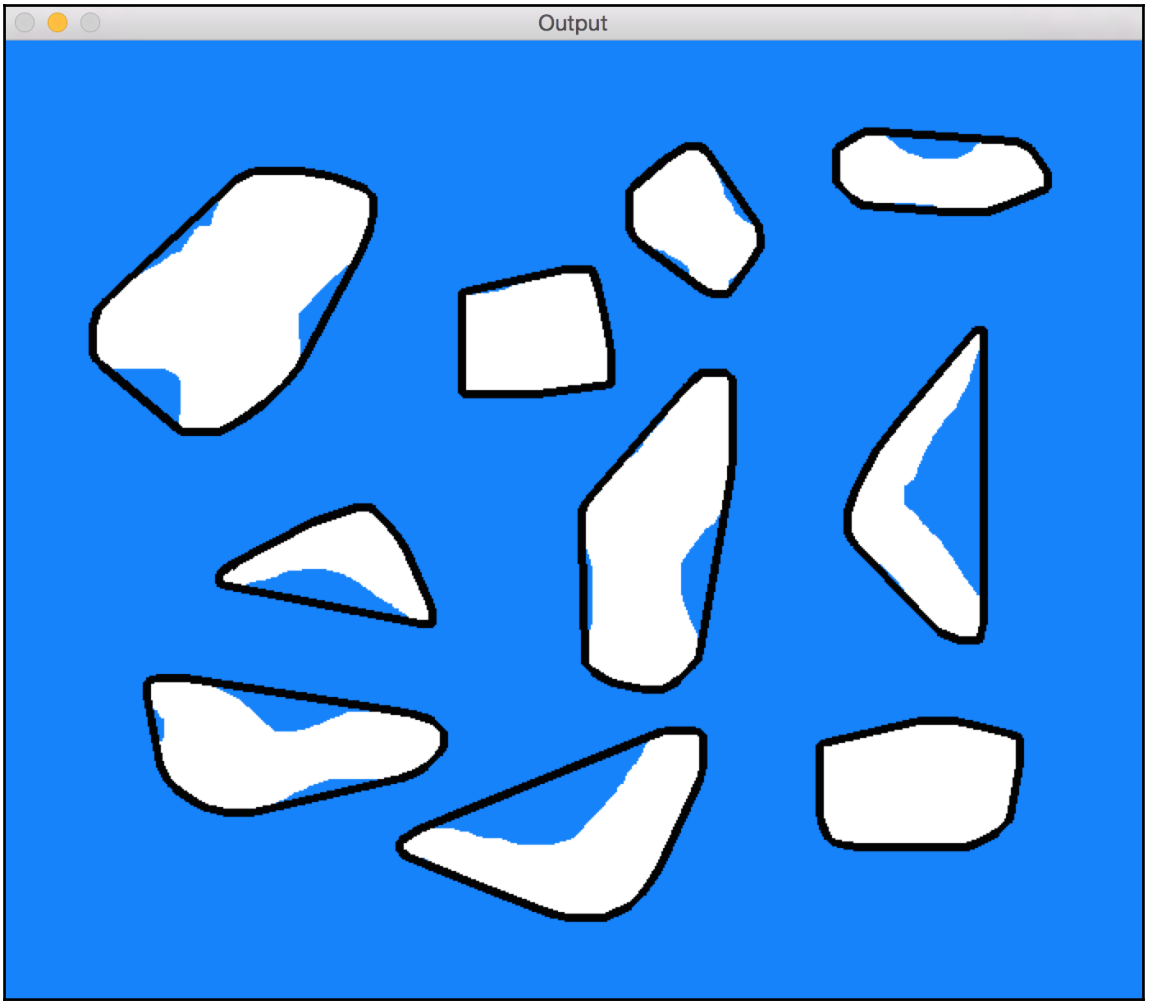


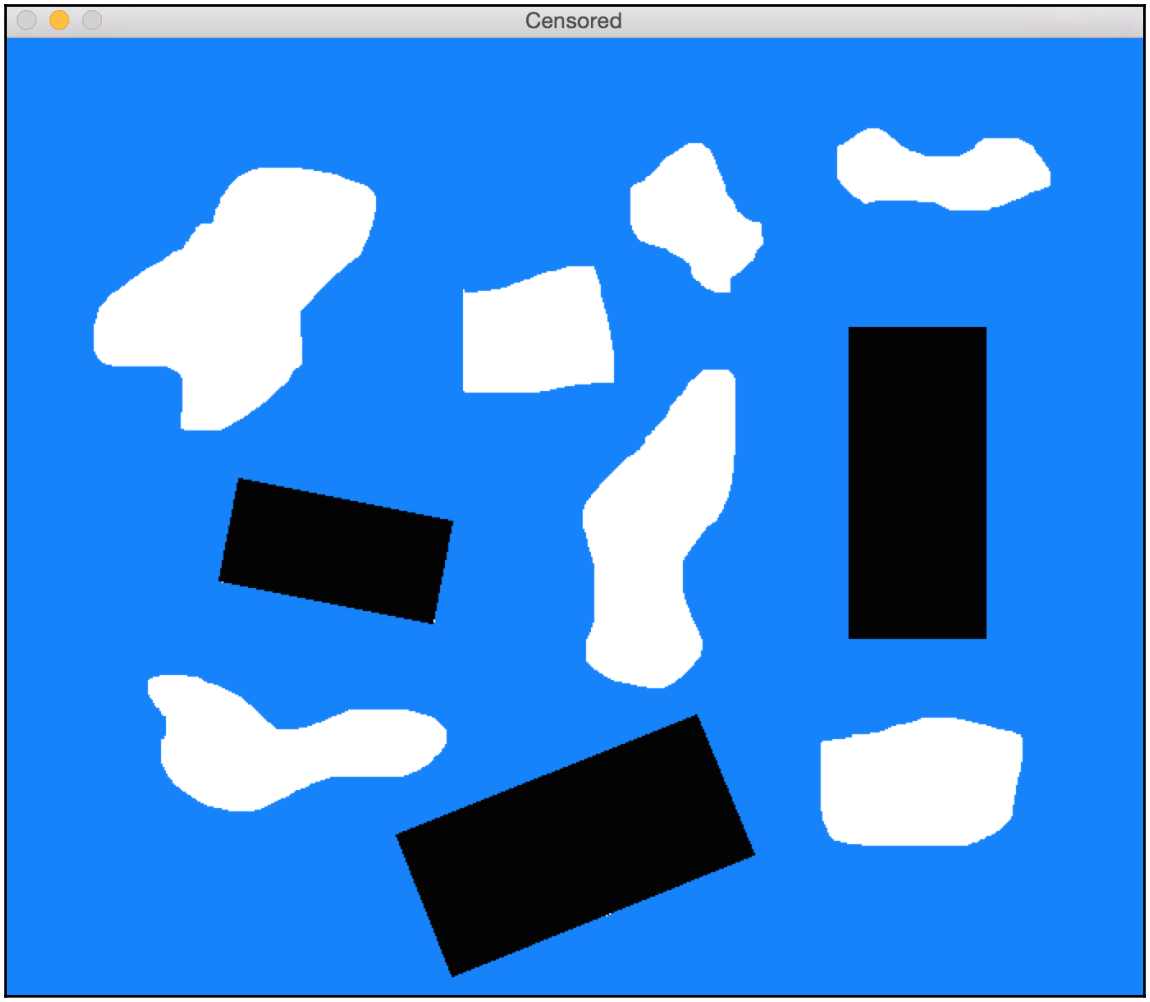


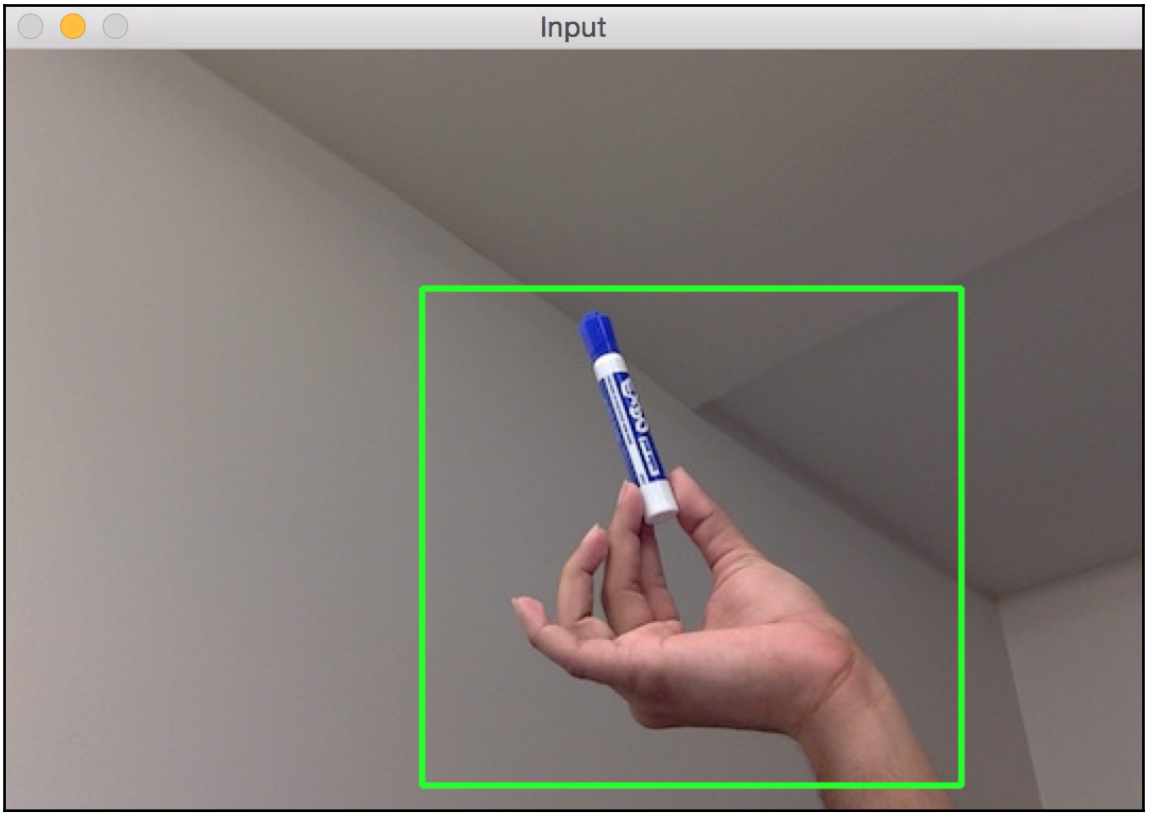

Convexity defects

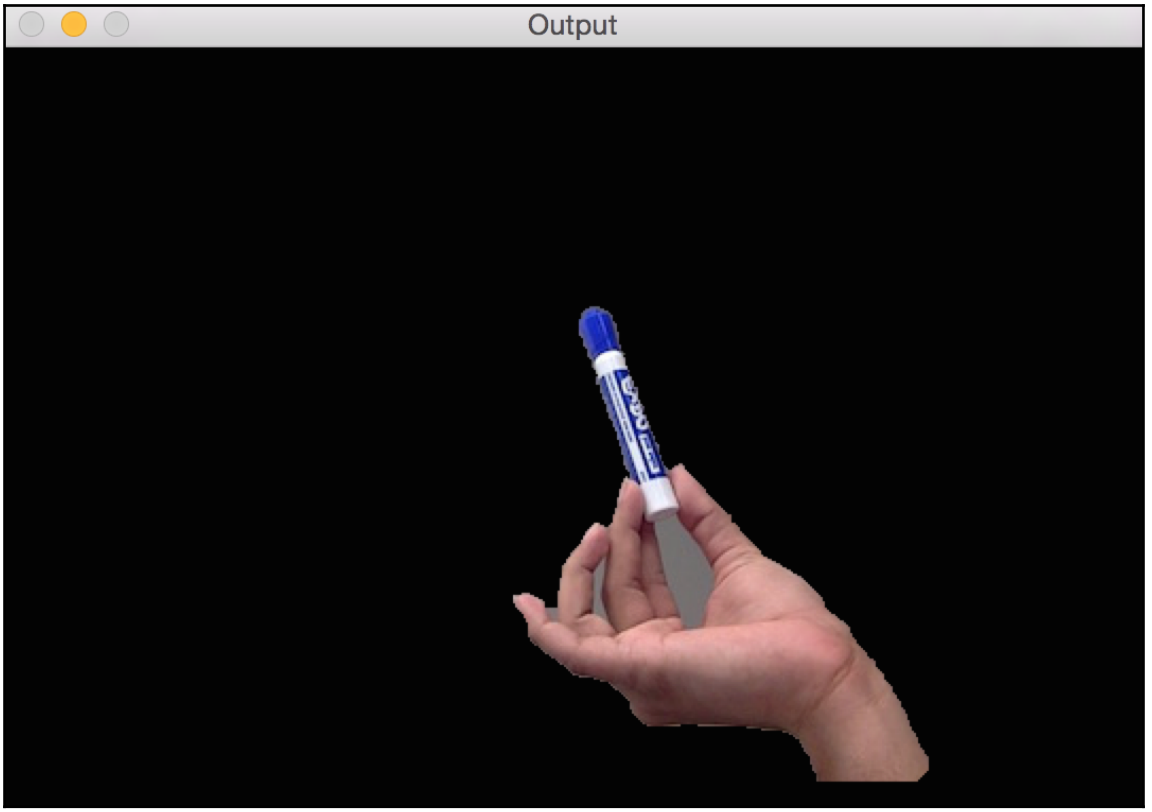

Convexity defects

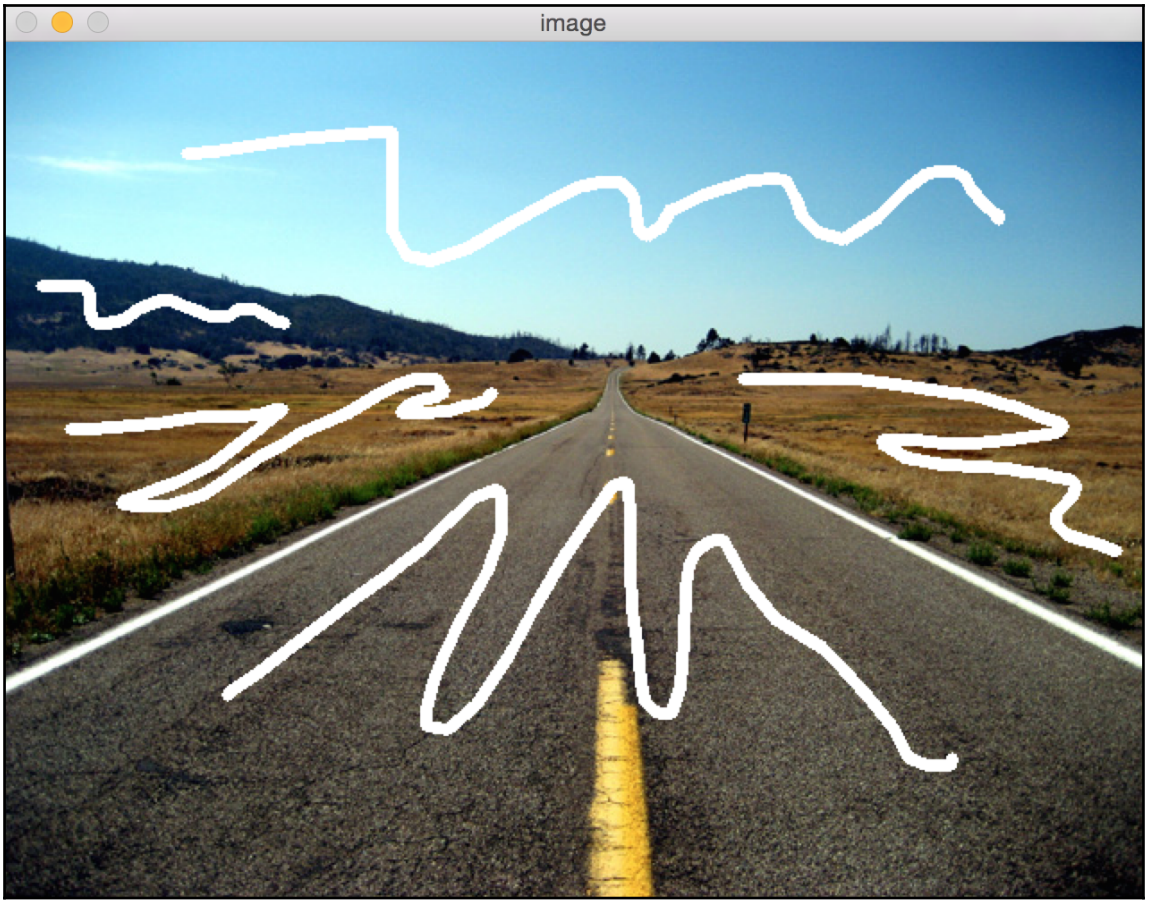



Output

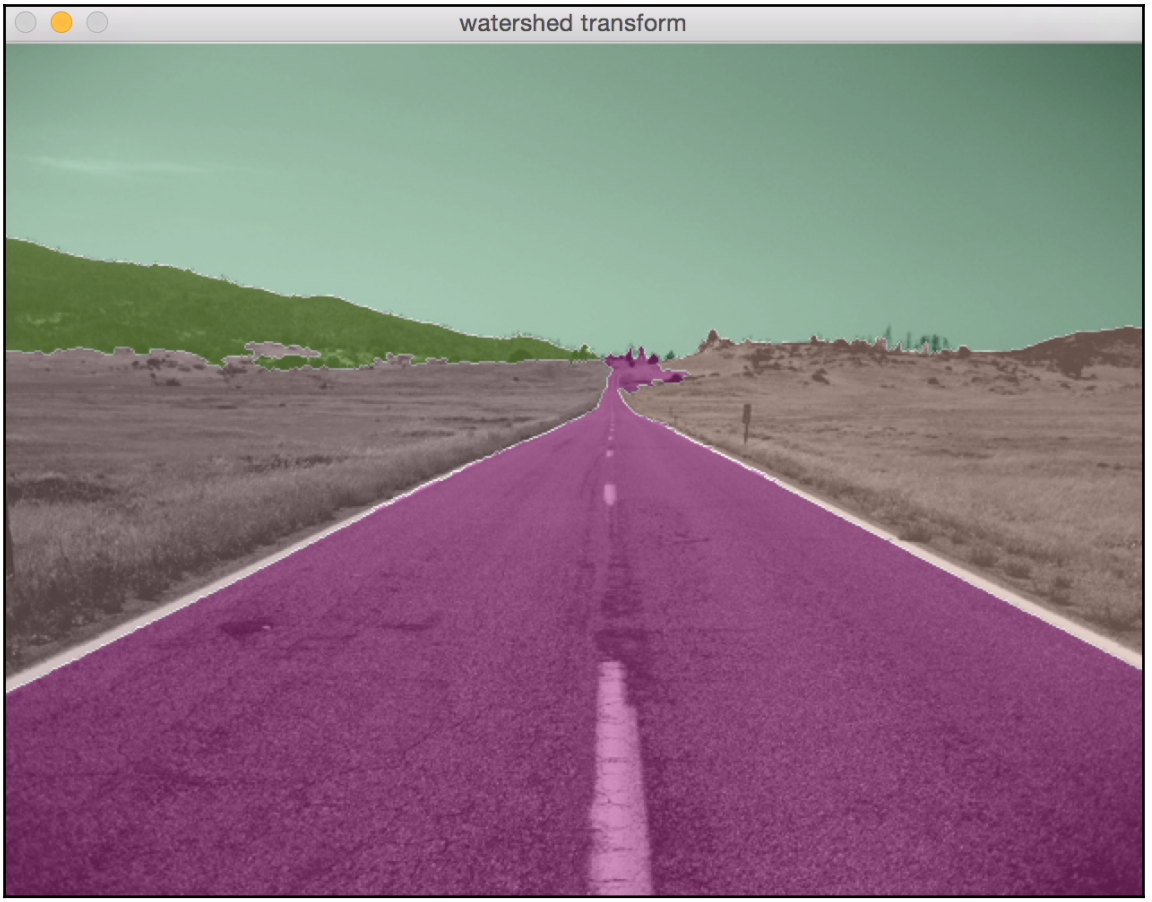

Censored


Input

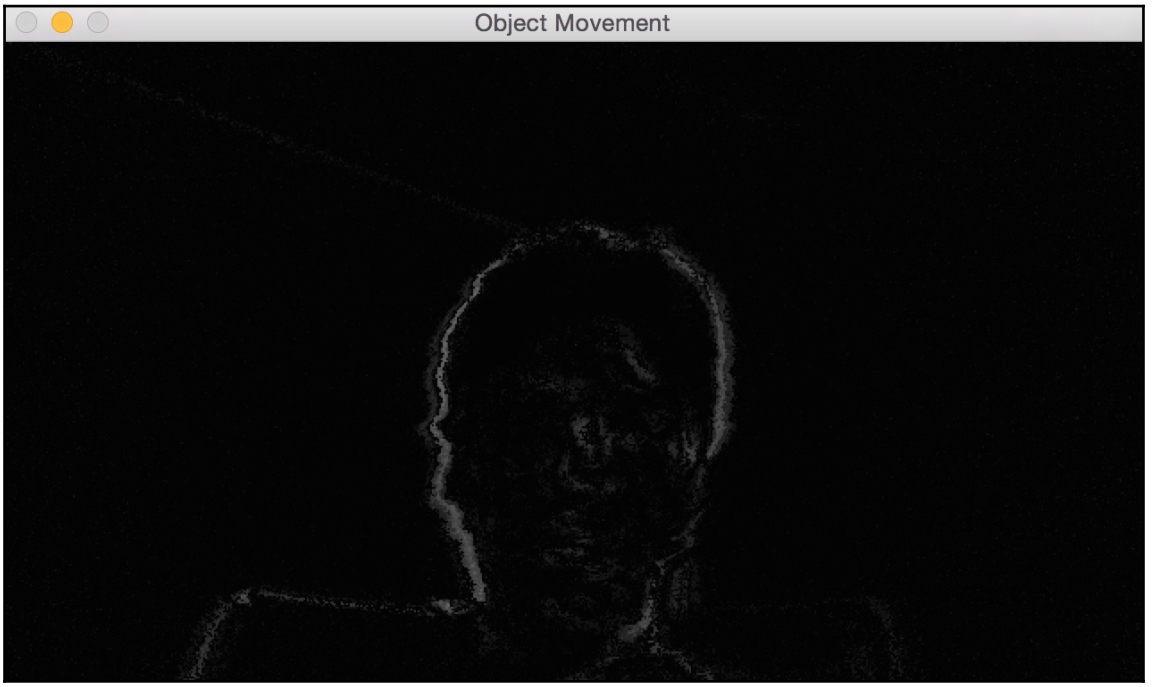

Output



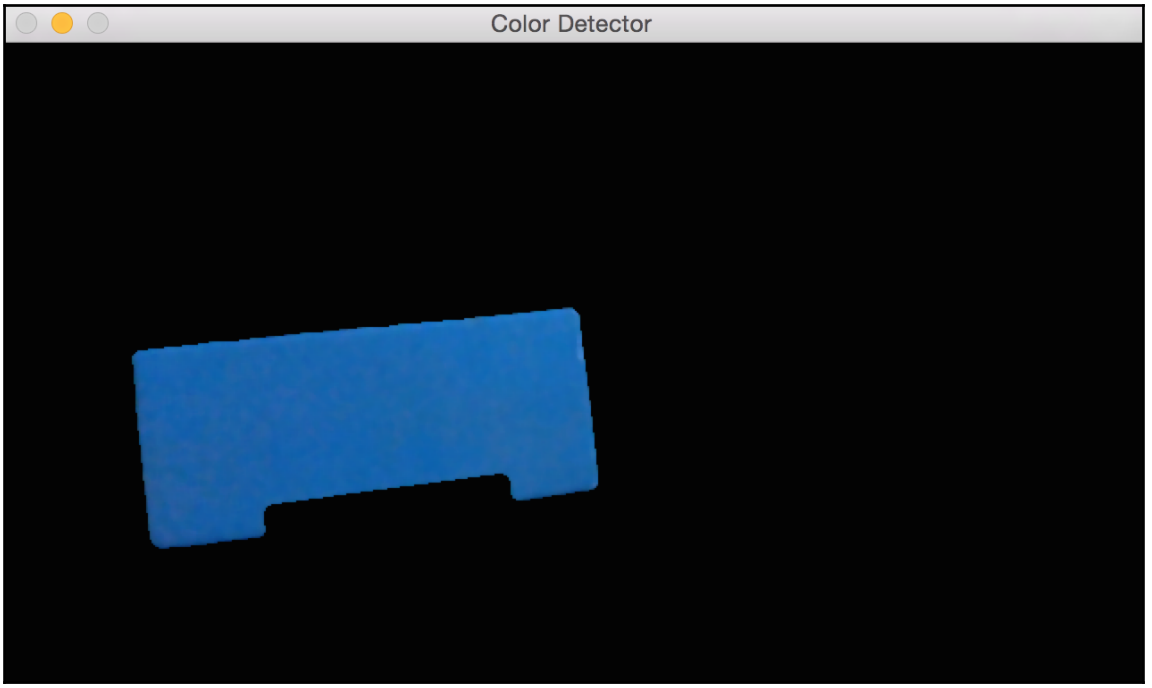
image

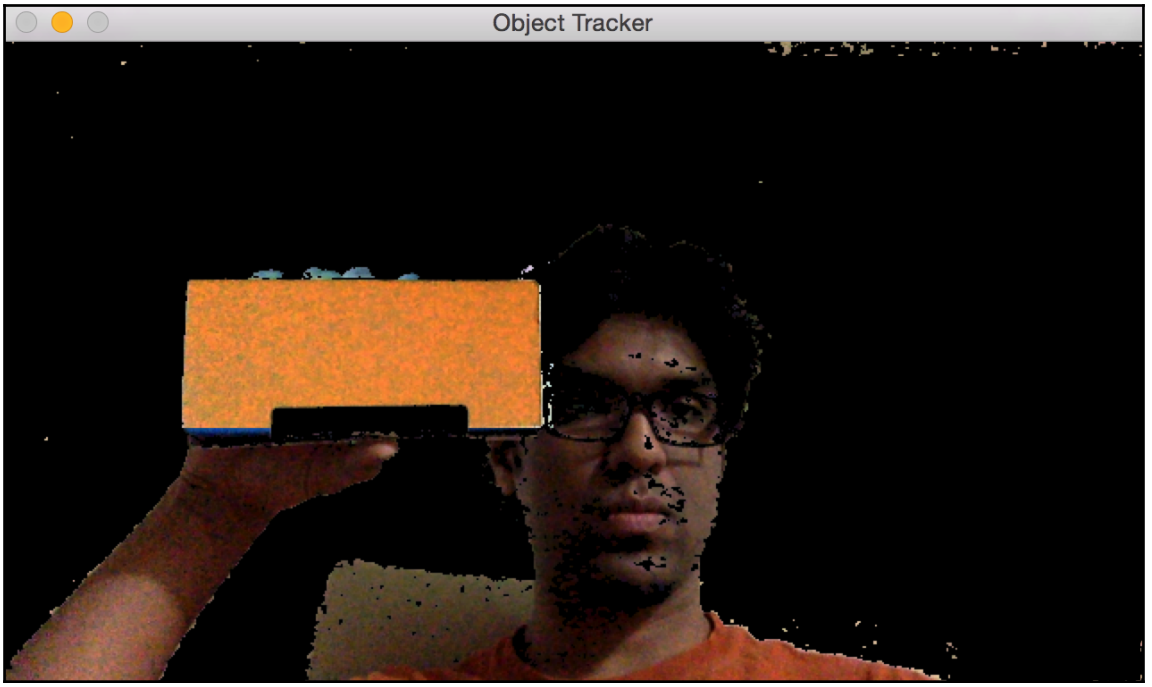

watershed transform

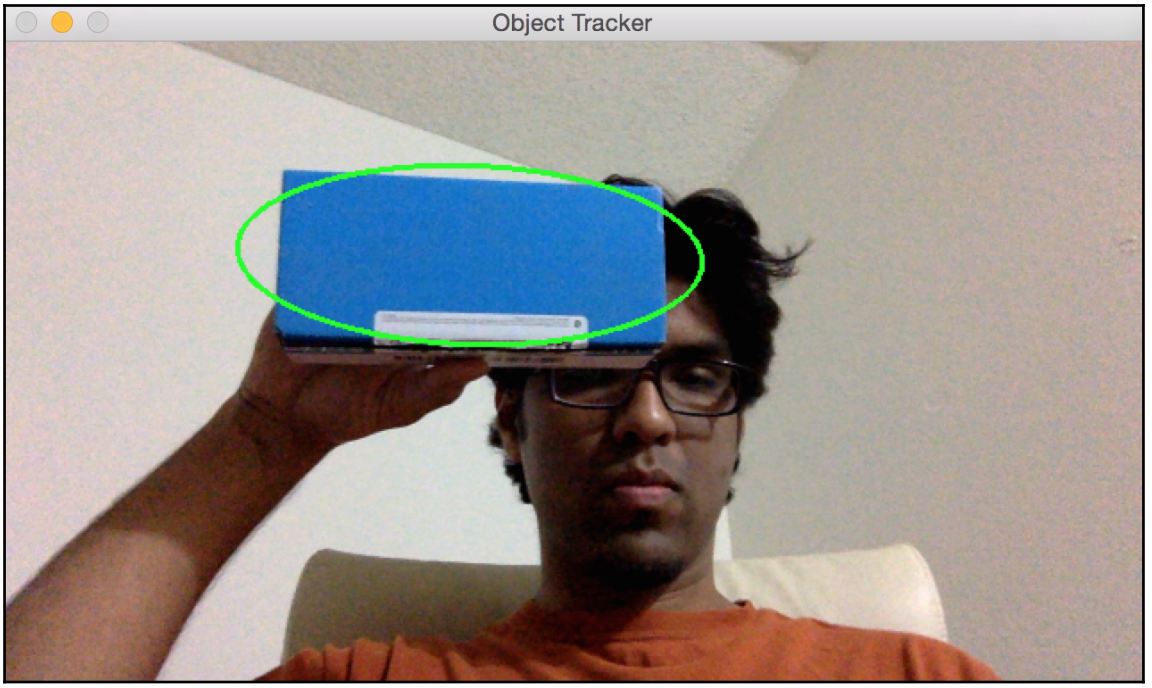
Chapter 8 - Object Tracking

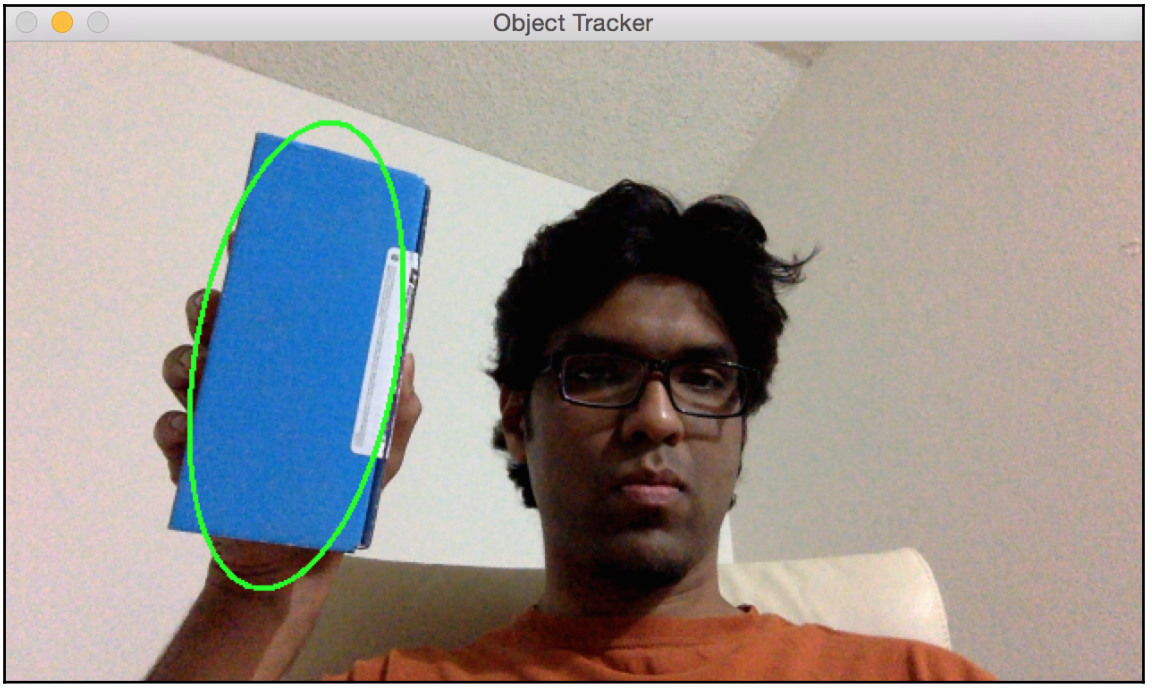


Original image

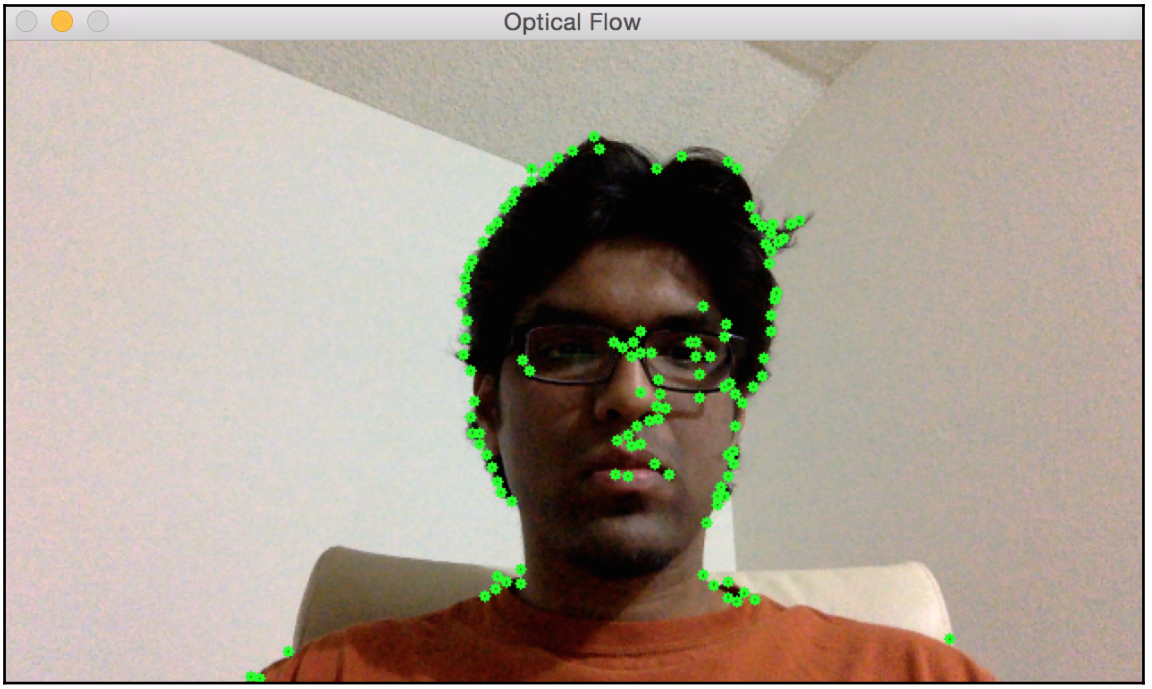

Color Detector

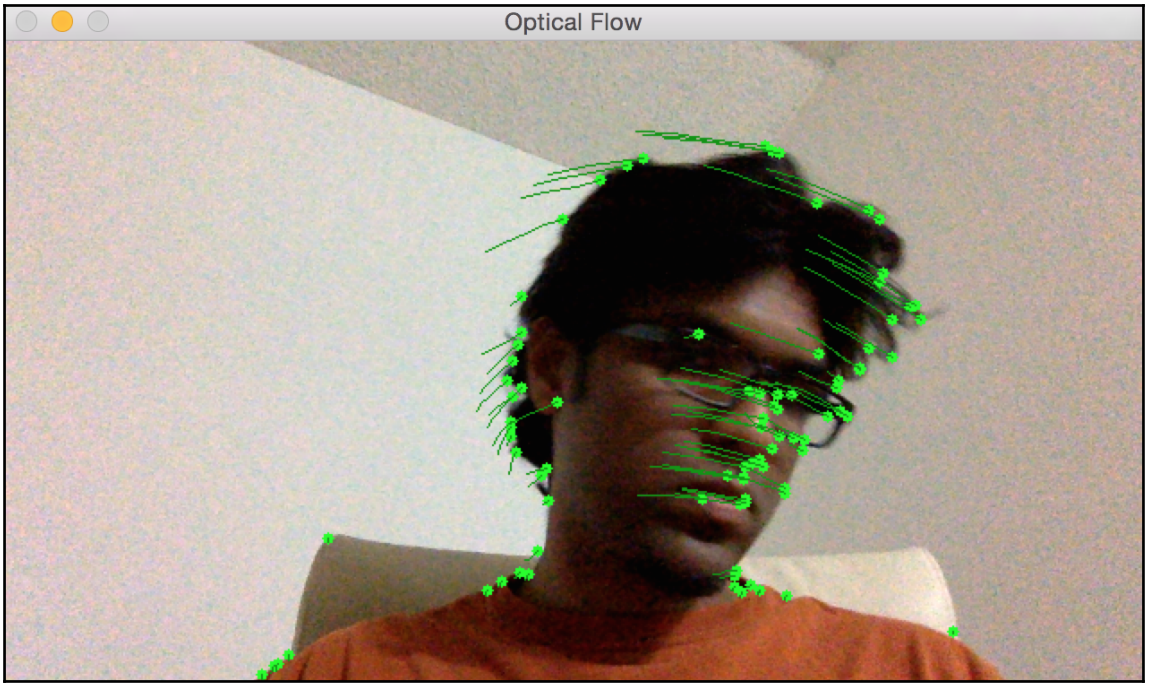

Object Tracker

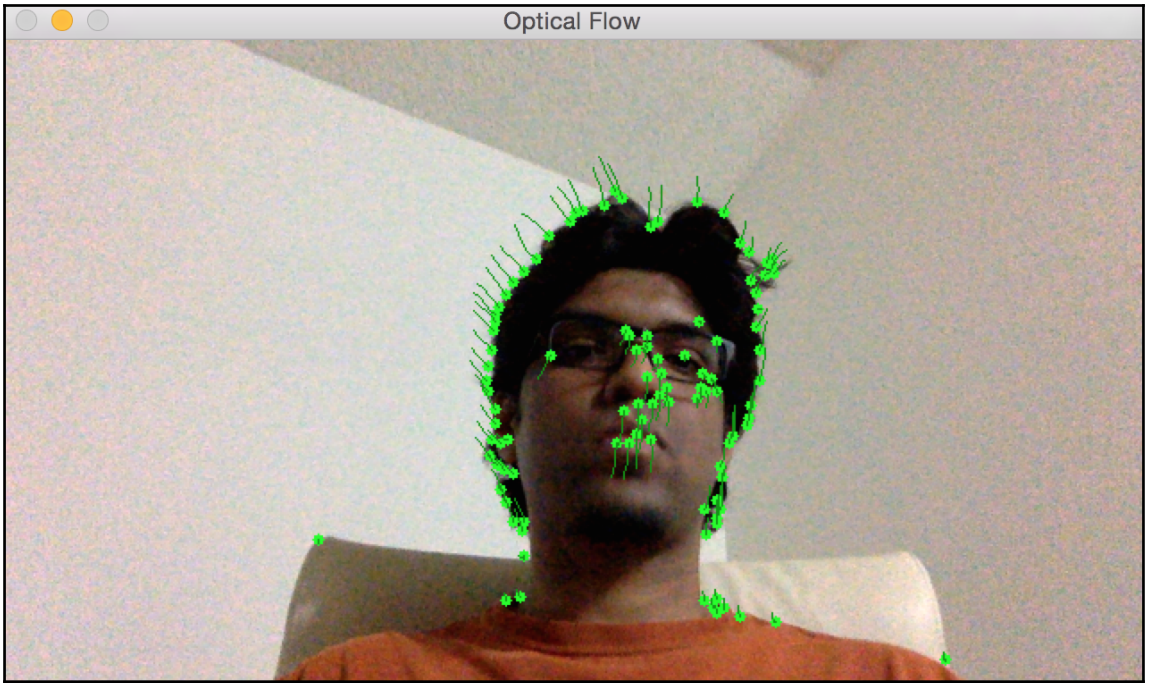

Object Tracker


Object Tracker

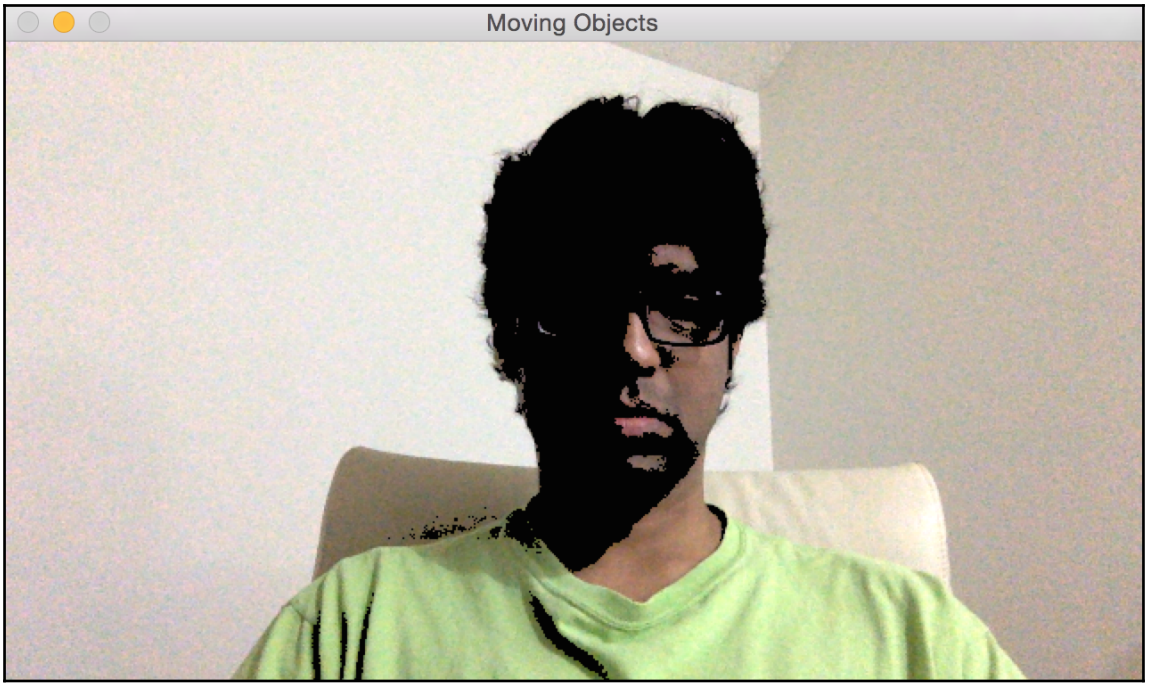
Object Tracker

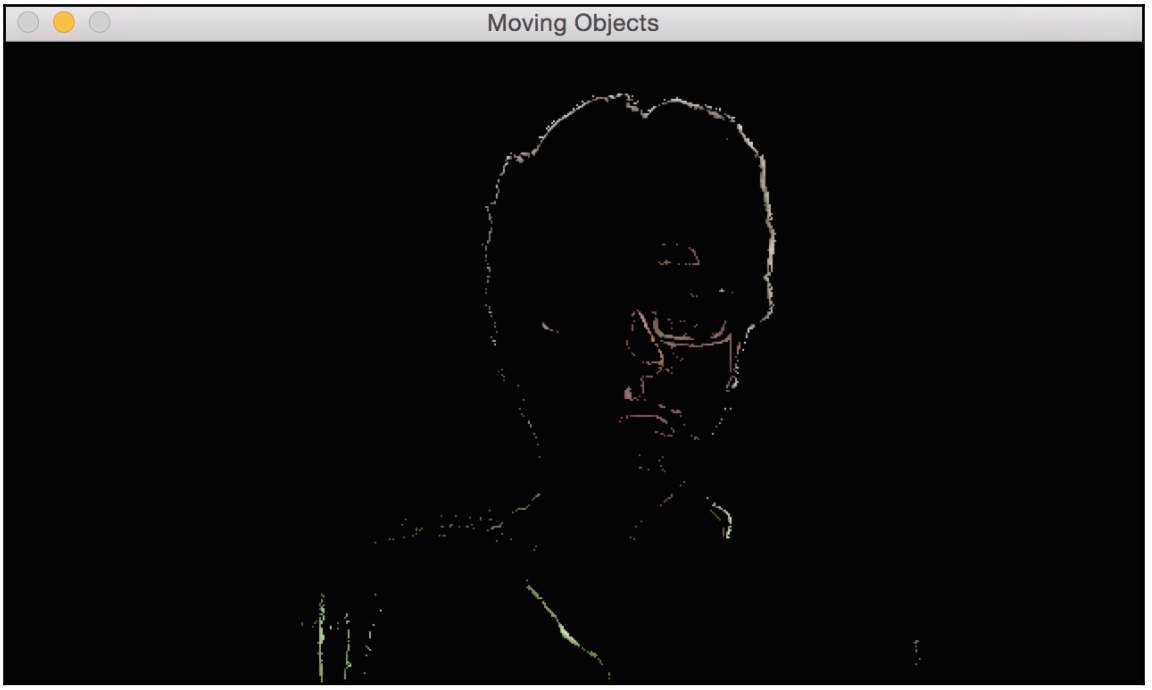

Optical Flow

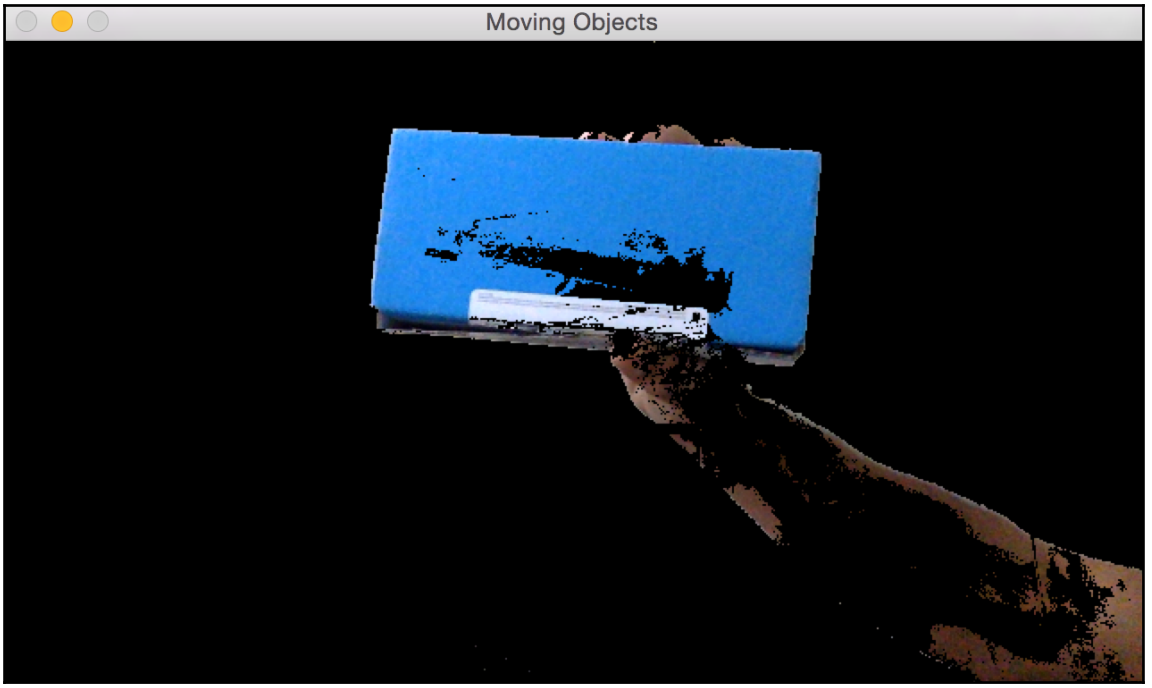

Optical Flow


Optical Flow

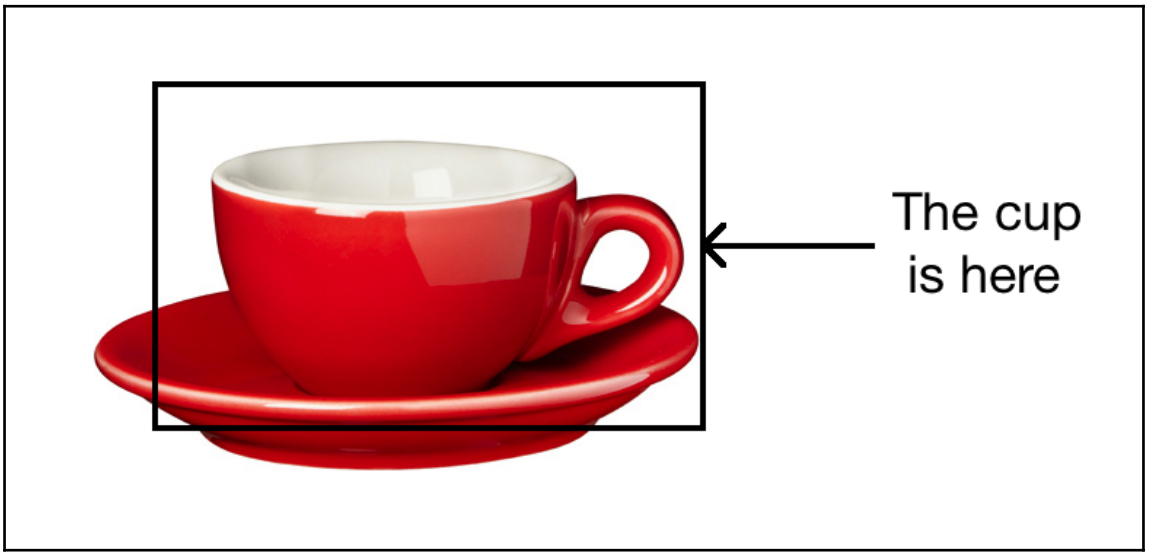
Input frame

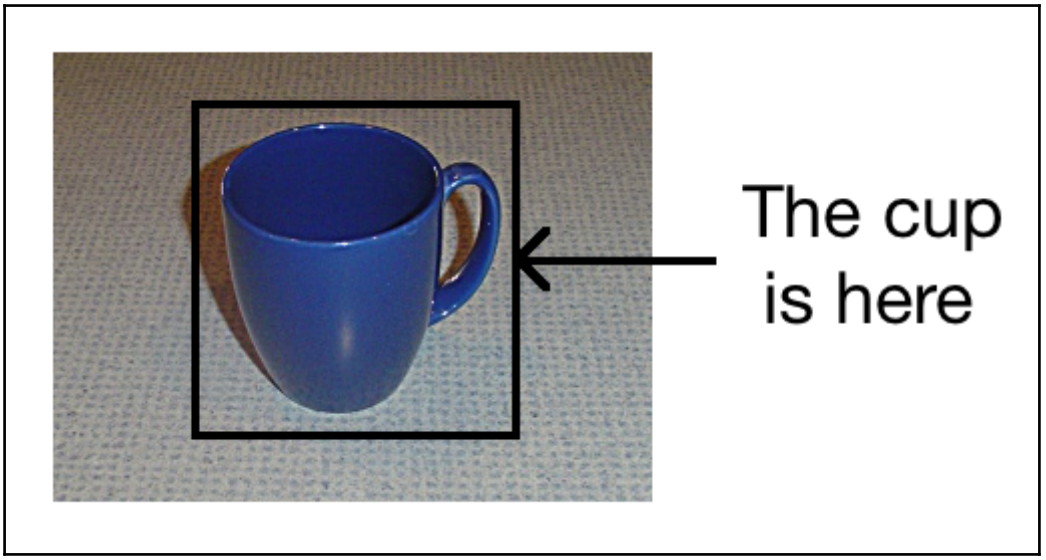

Moving Objects

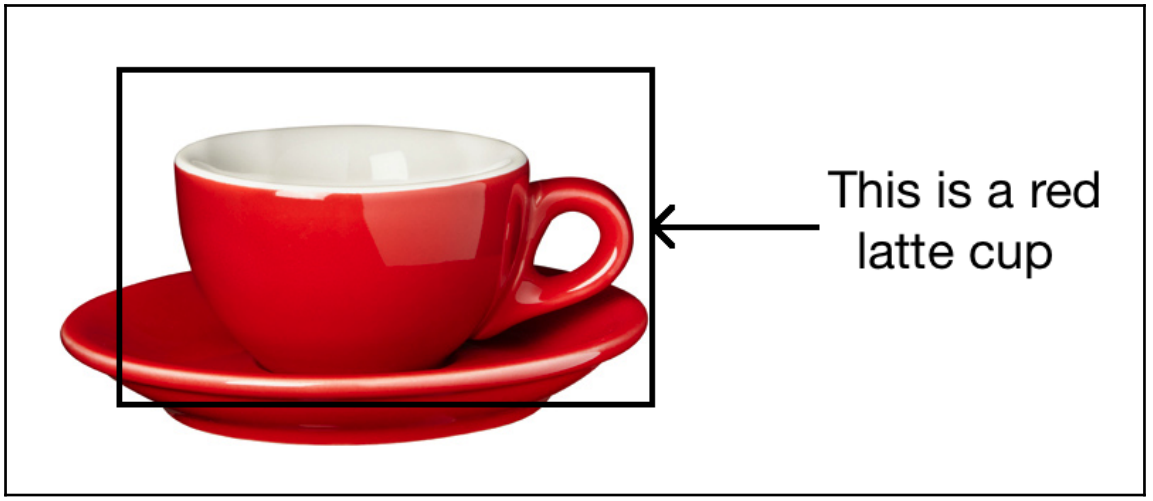

Moving Objects

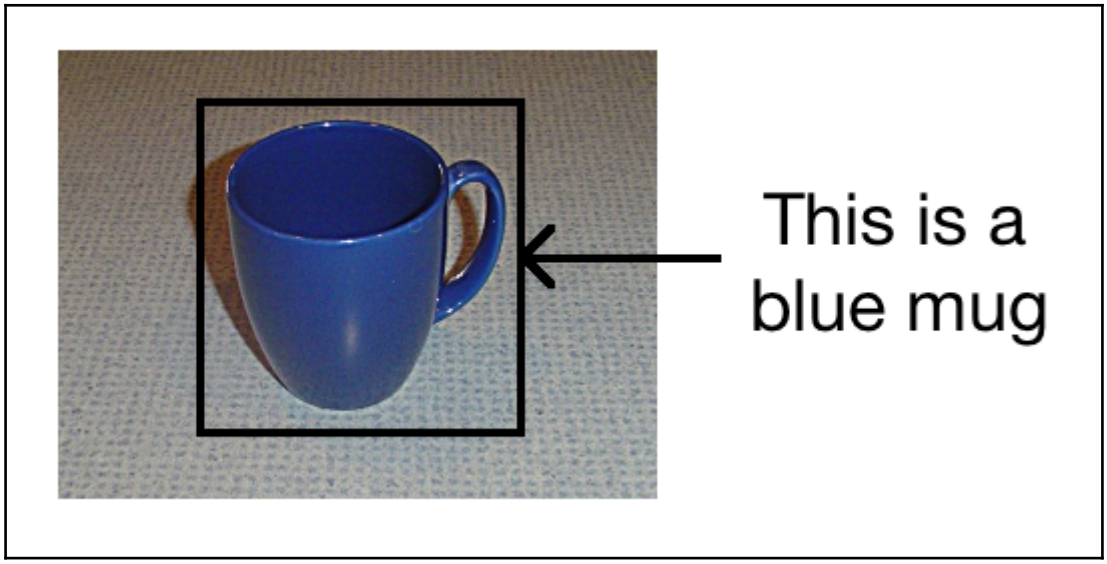

Moving Objects

Chapter 9 - Object Recognition




The cup
is here


This is a red
latte cup


This is a
blue mug

SIFT detector

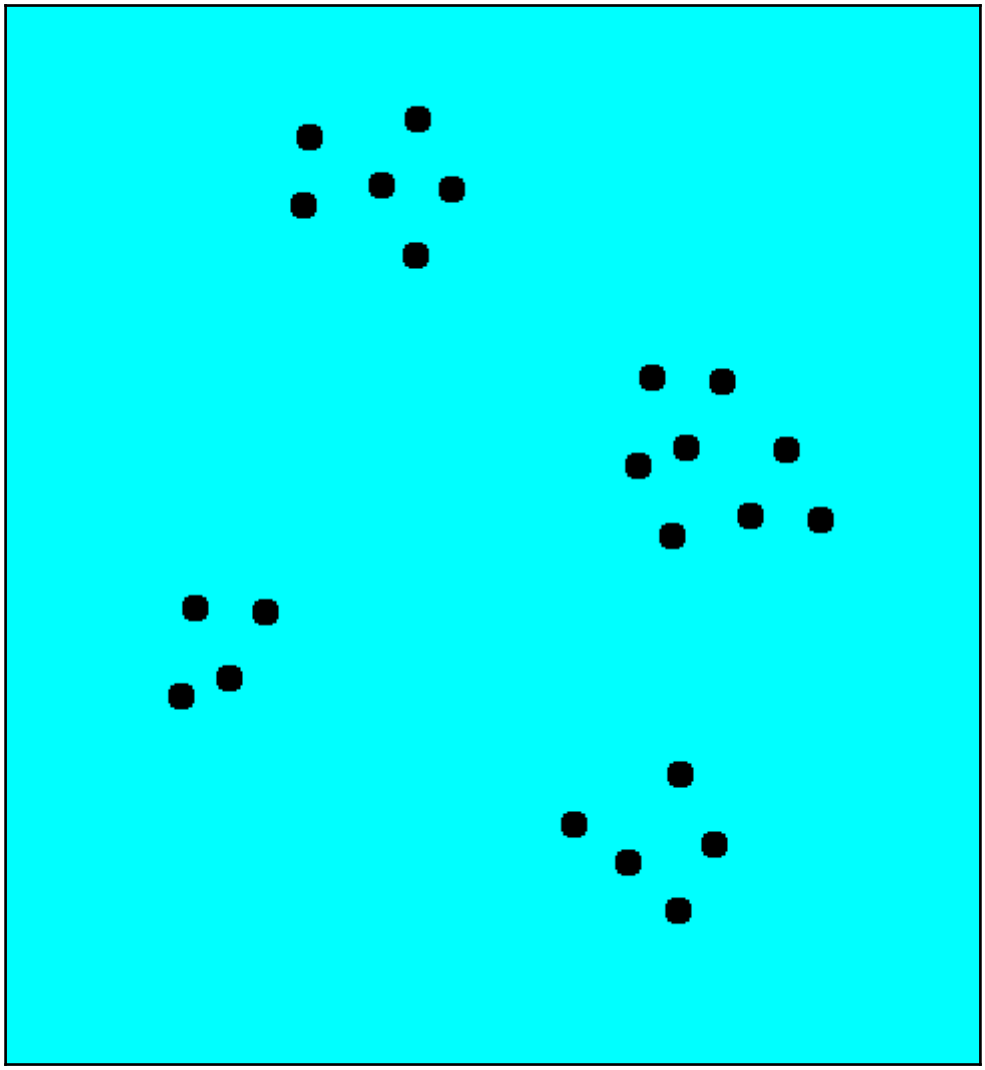
Dense feature detector

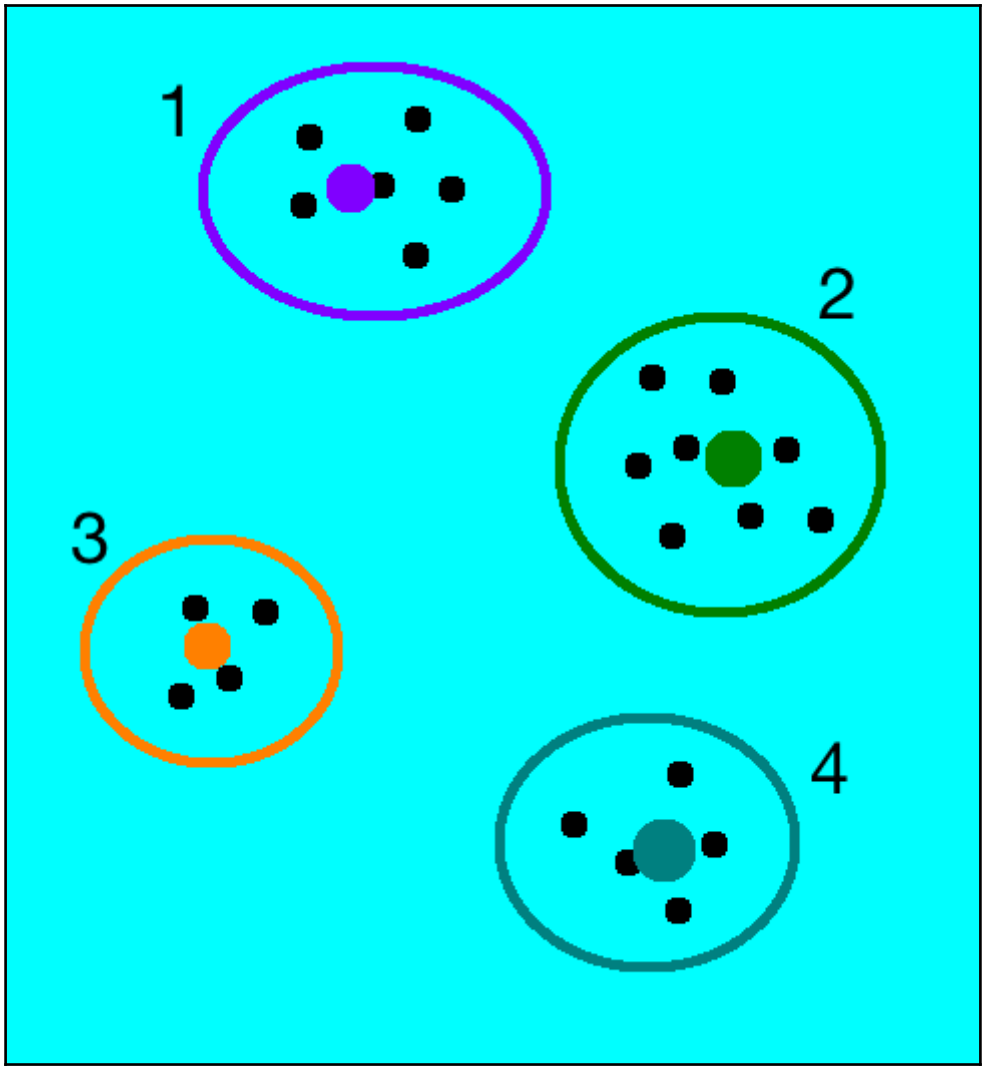
Dense feature detector

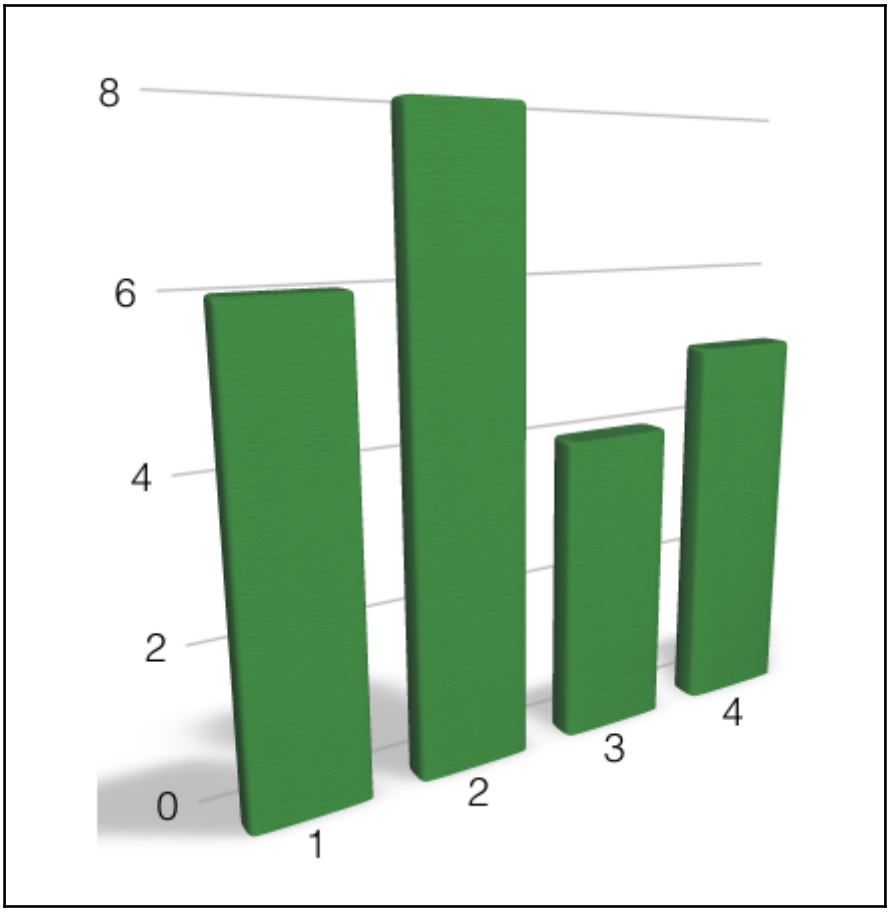
Input image

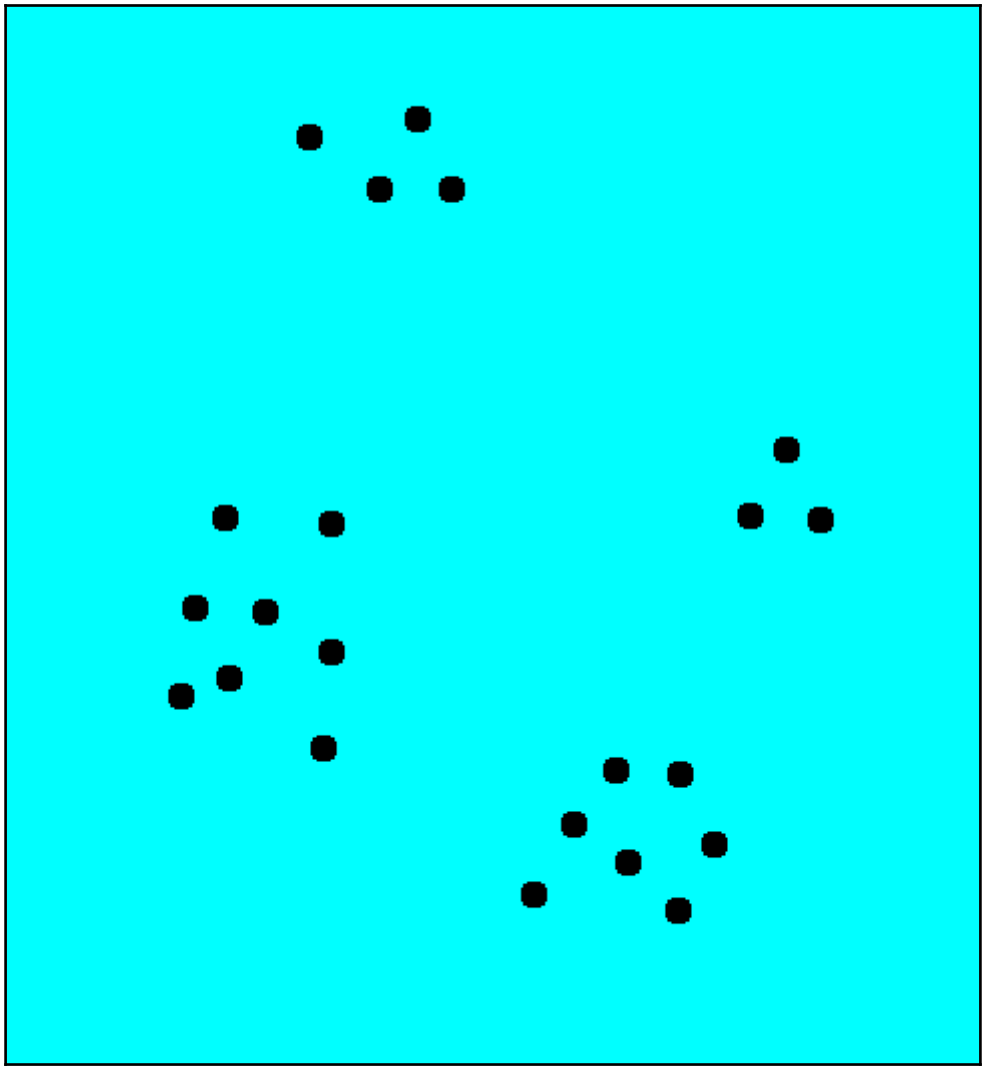
Visual
Dictionary

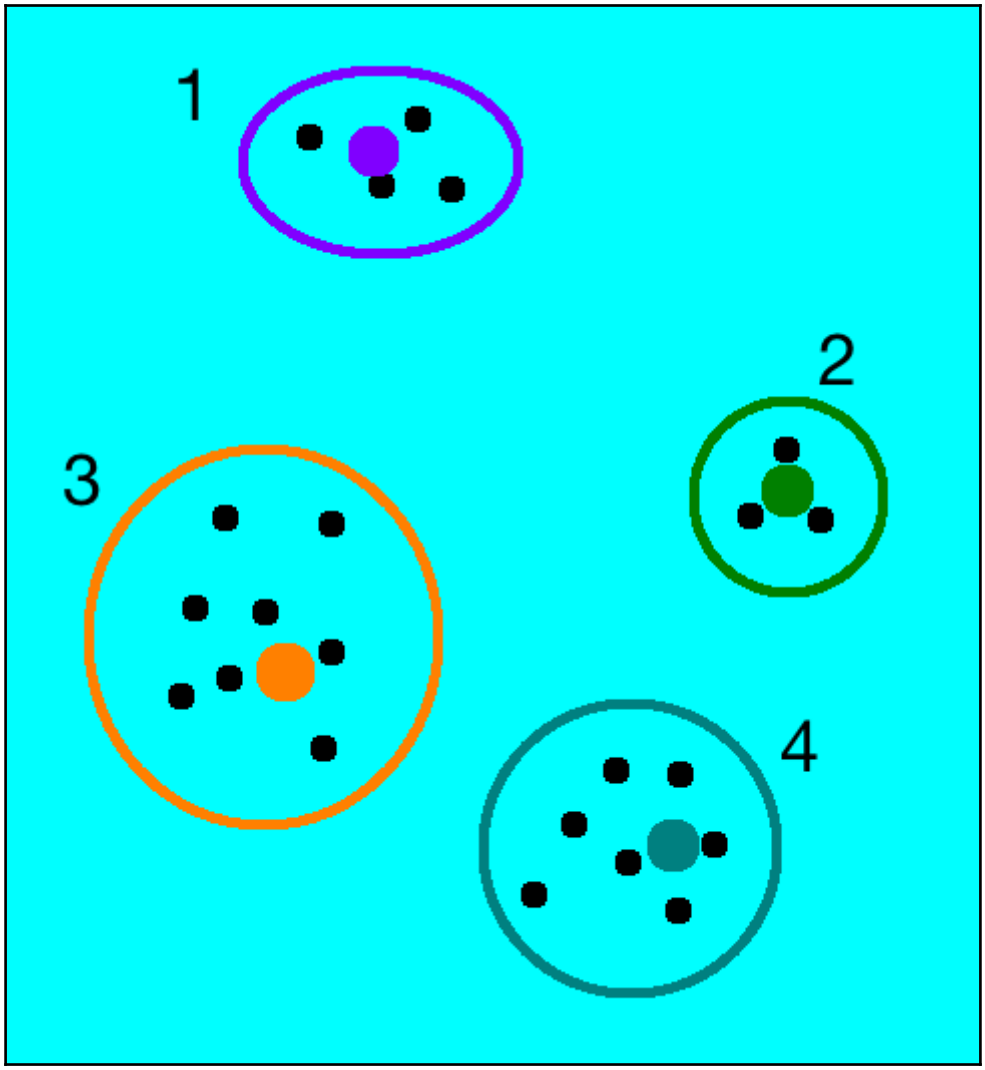
Bag of
visual words

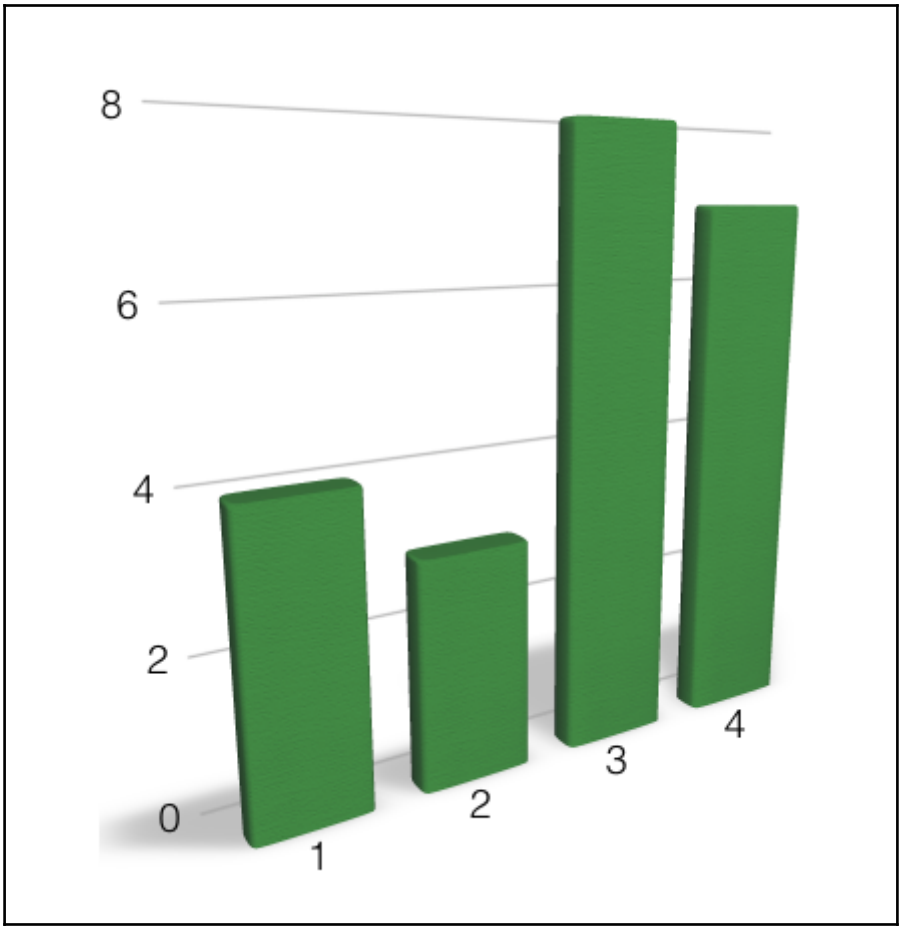


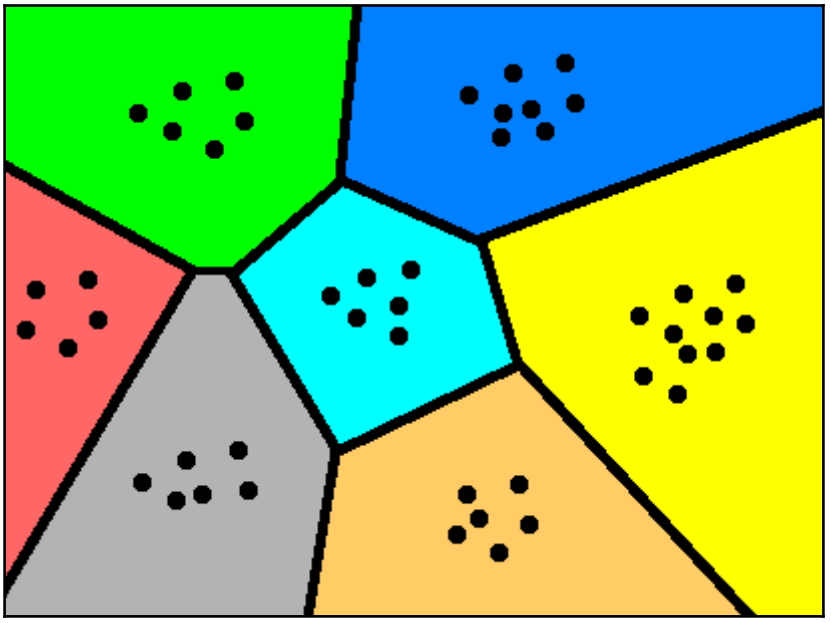

1
2
3
4

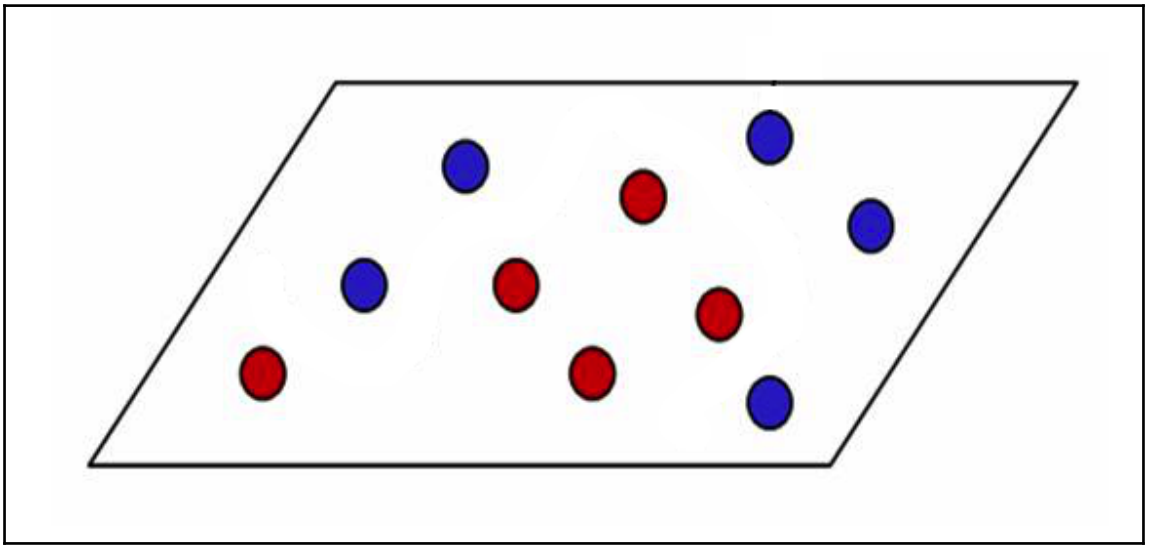

8
6
4
2
0
1
2
3
4

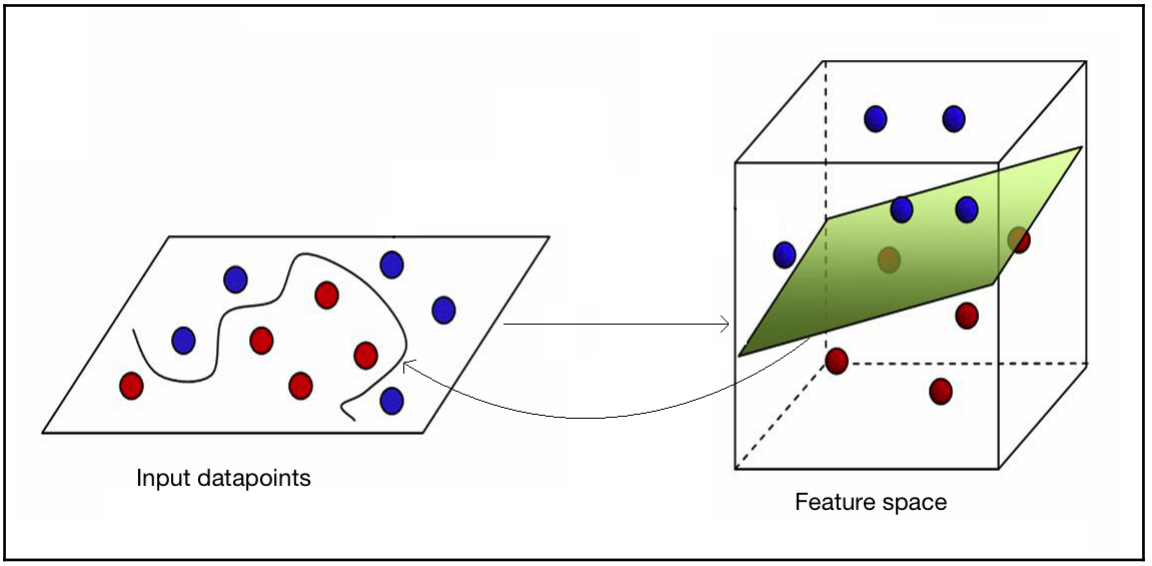



1
2
3
4

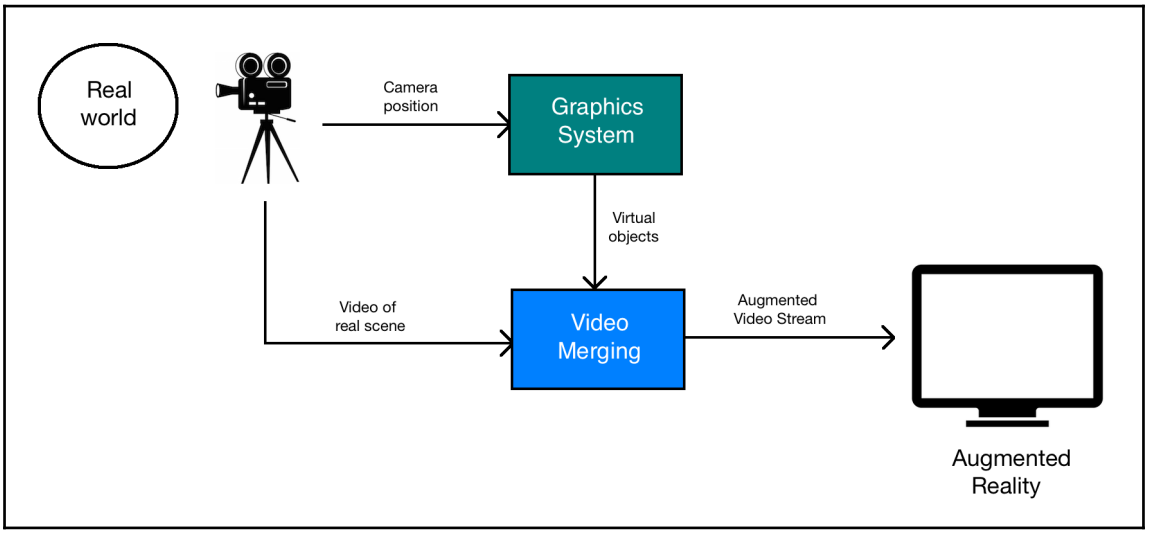

8
6
4
2
0
1
2
3
4

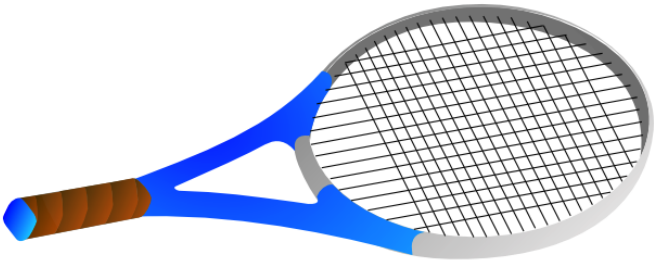


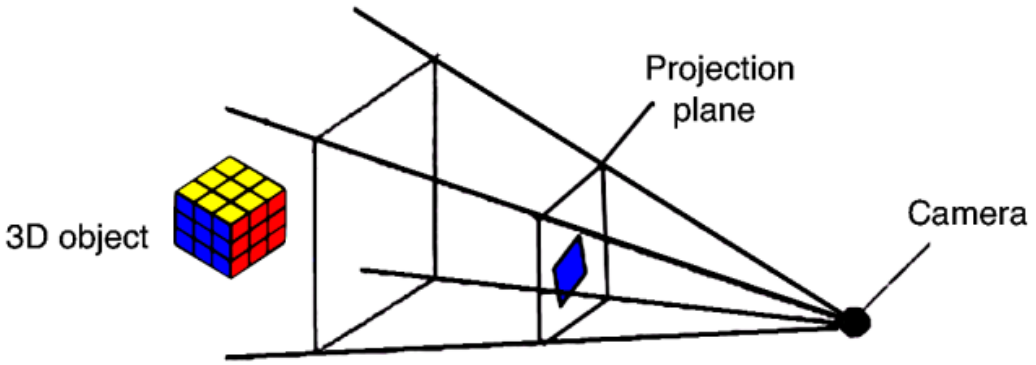


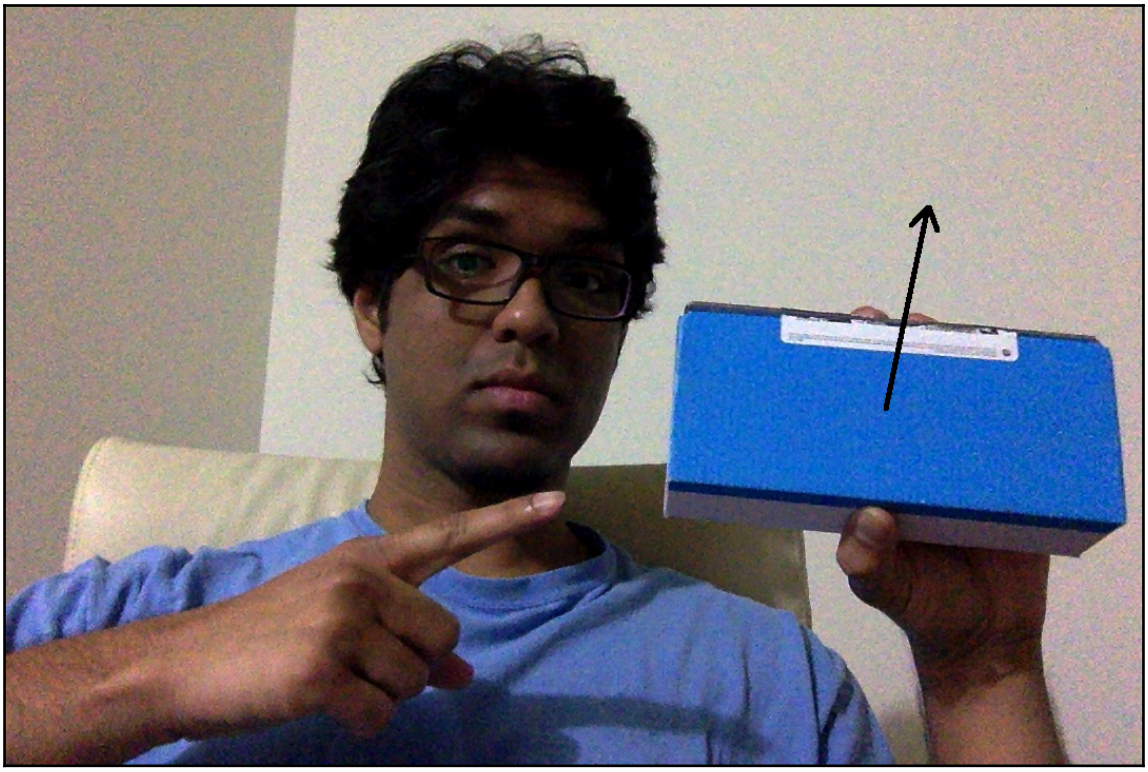

Input datapoints
Feature space

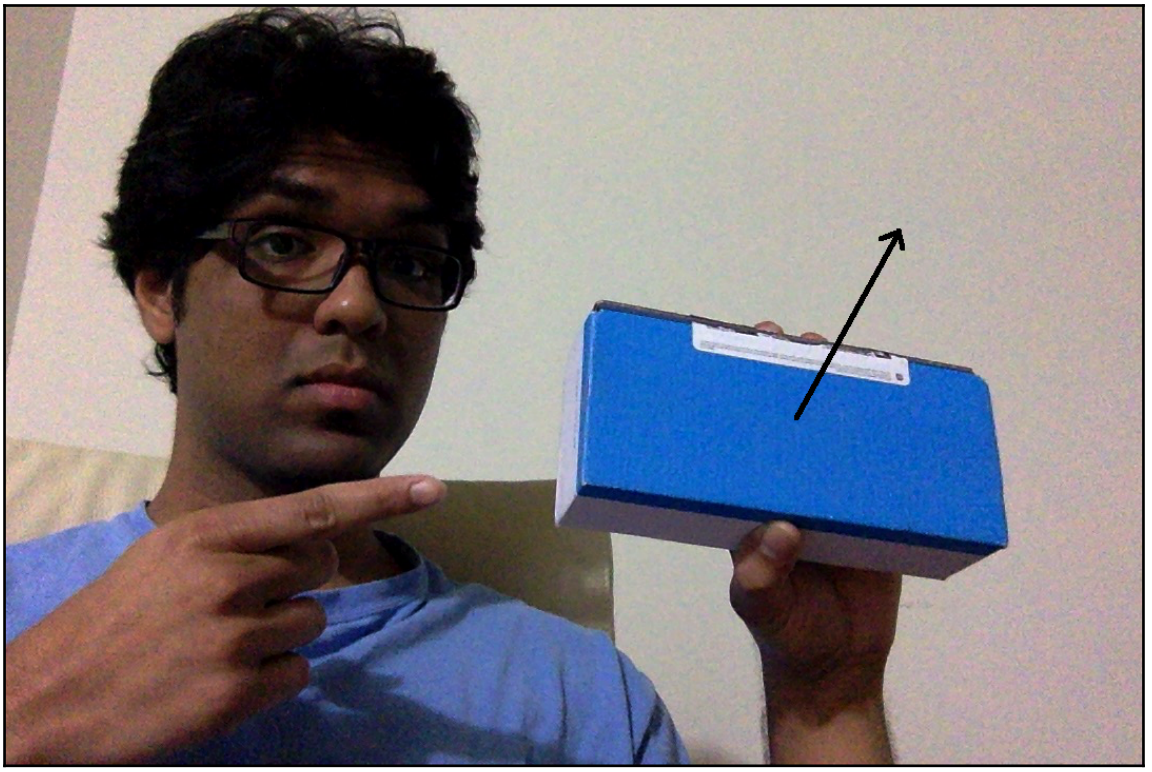
Chapter 10 - Augmented Reality



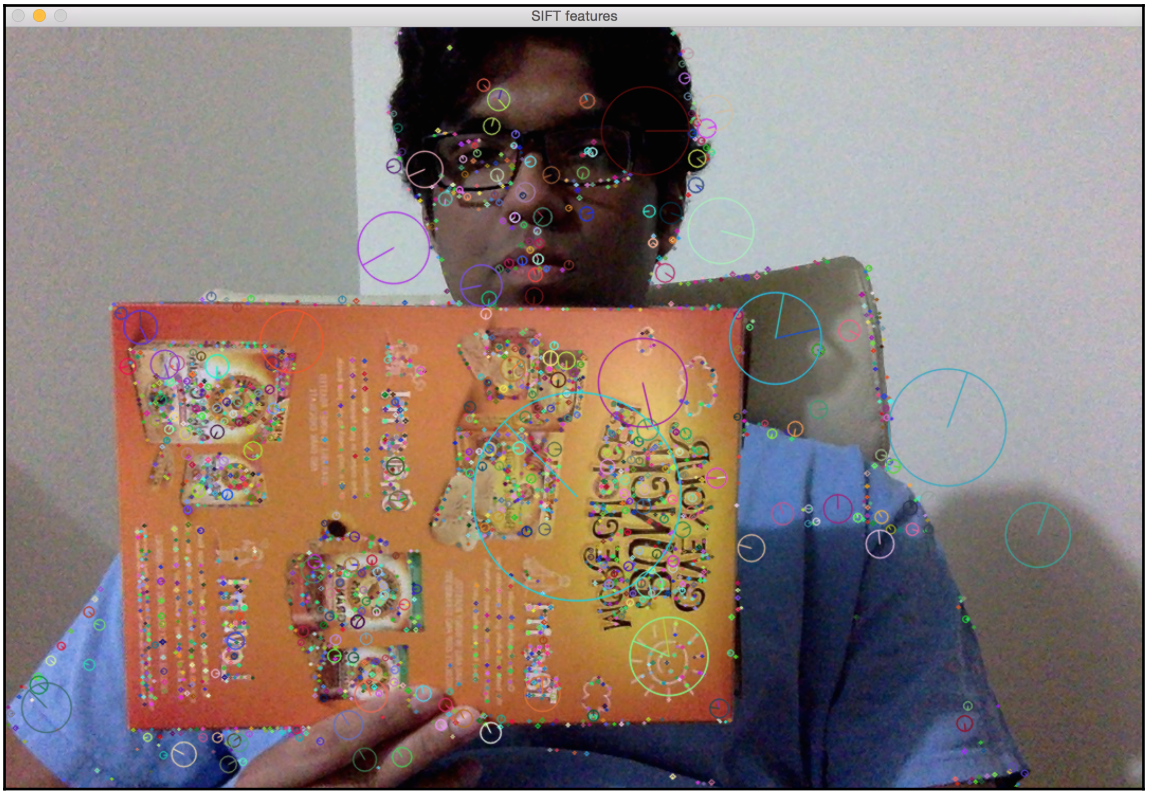


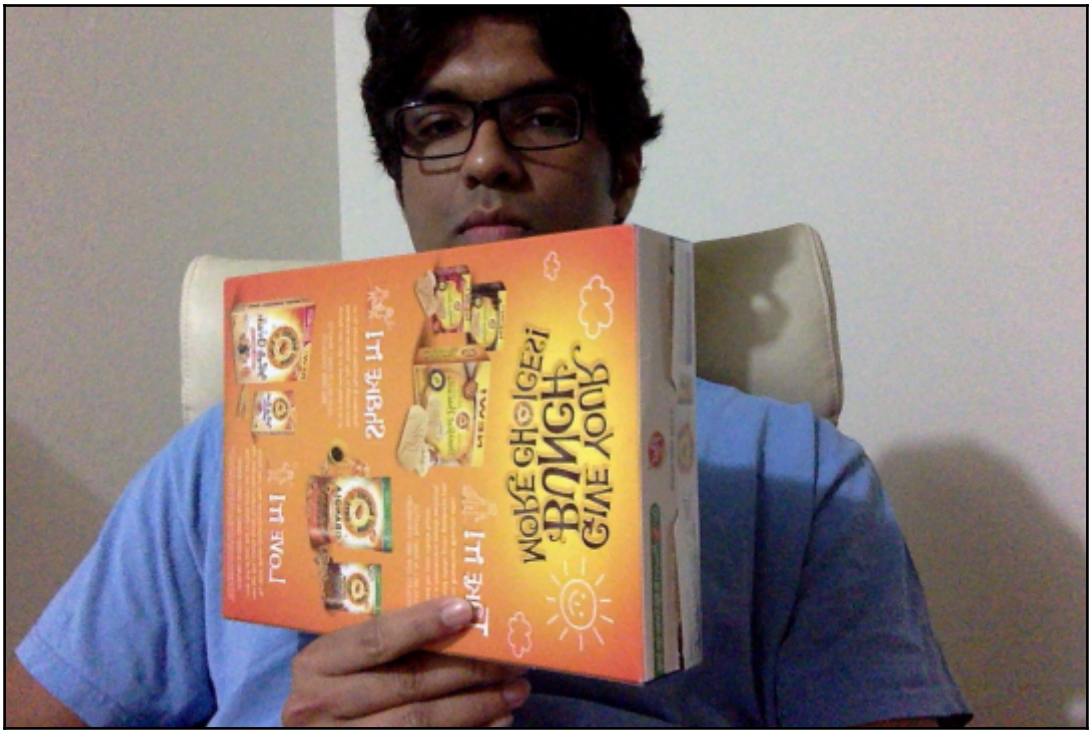

Projection
plane
3D object
Camera

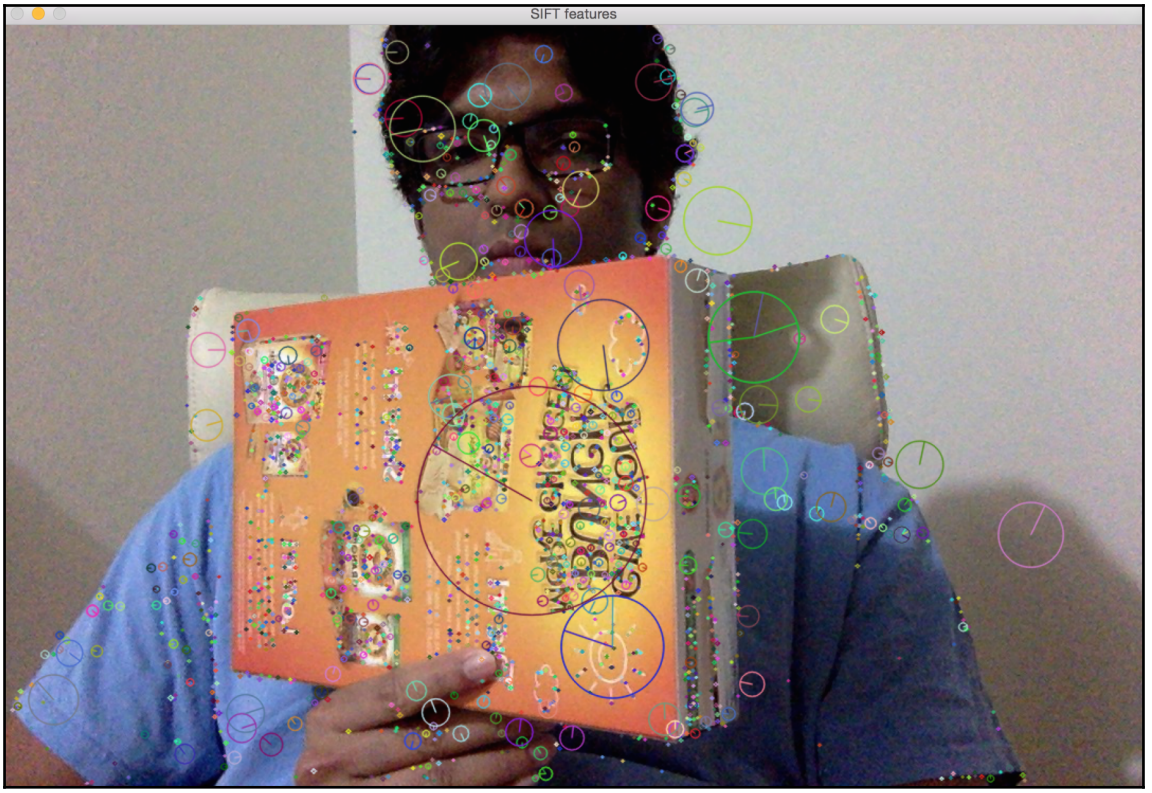




WORK CHOICES!
BUNCH
GIVE YOUR
LOVE IN
SPARE IN
TAKE IN


SIFT features


WORK CHOICES
BUNCH
GIVE YOUR

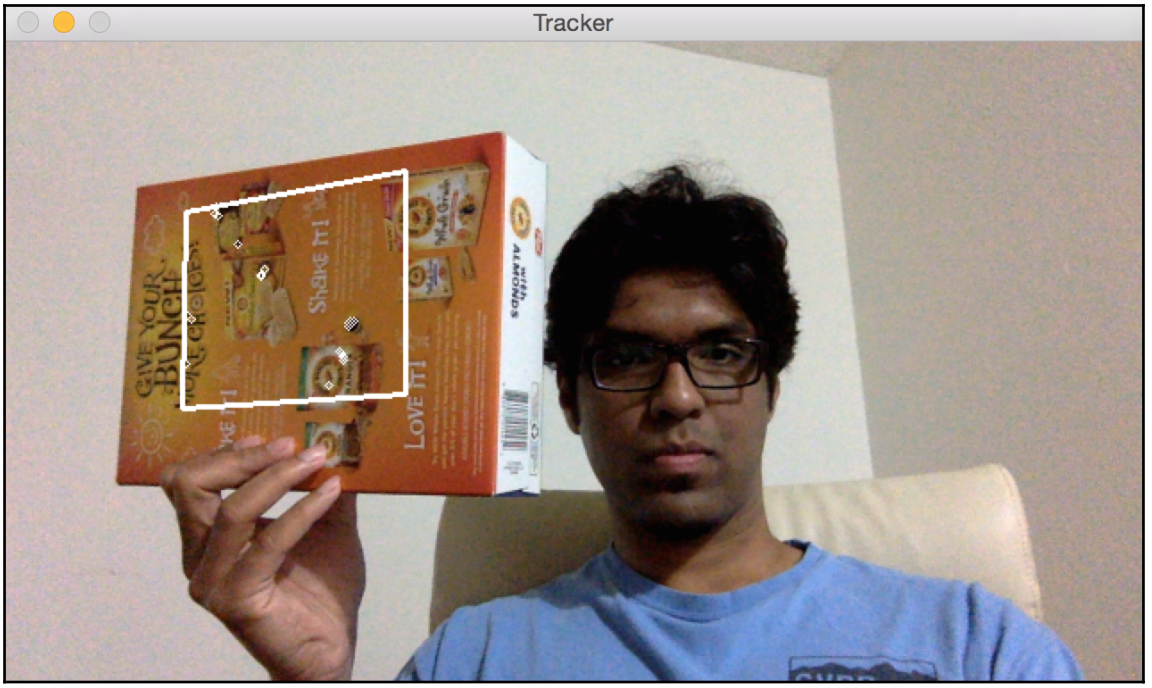

SIFT features

SIFT features
Feature points are closer to each other
Feature points are relatively far apart

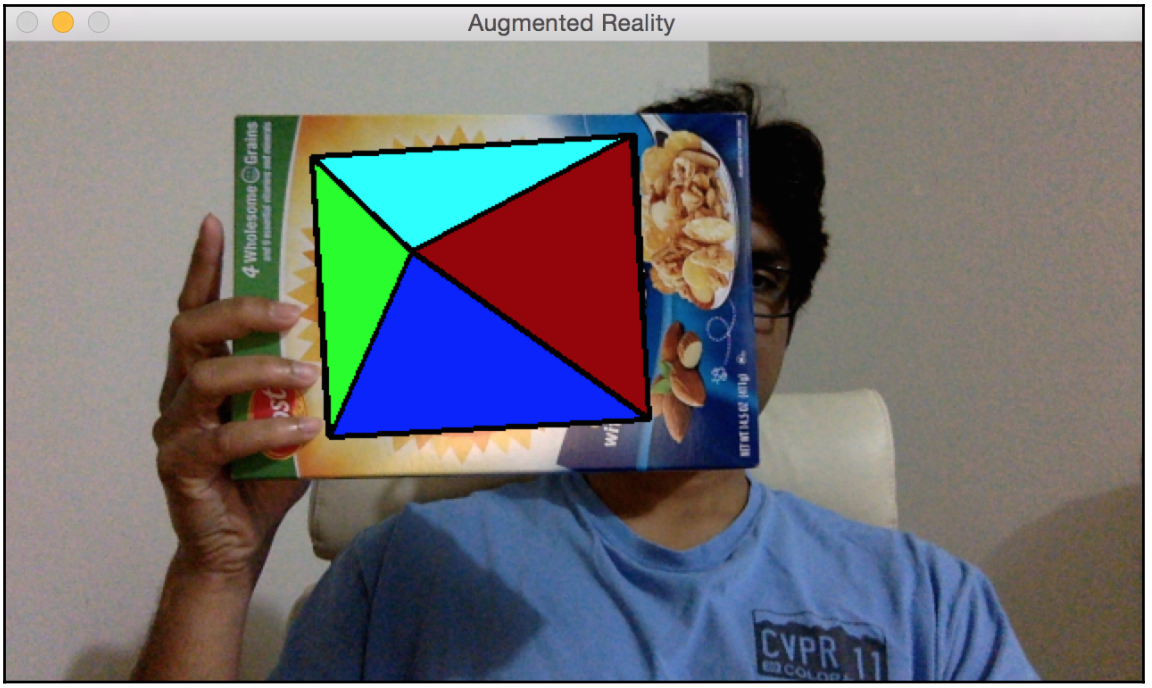
Object of interest

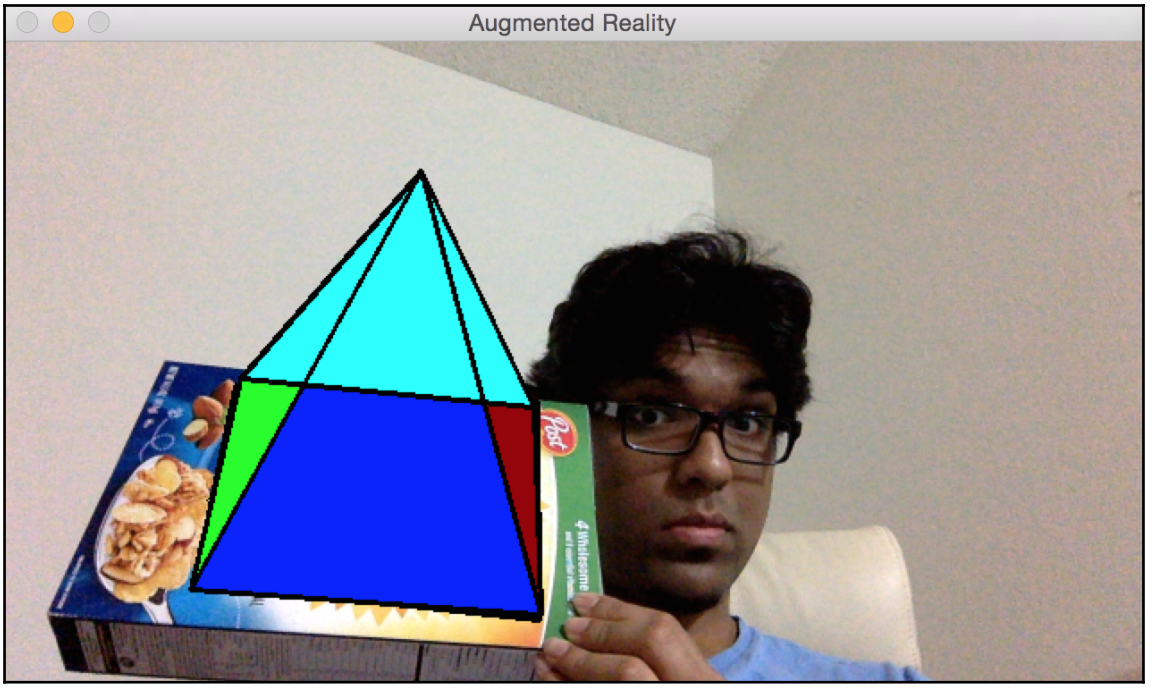
Tracker
GIVE YOUR BUNCH
LOVE IT!

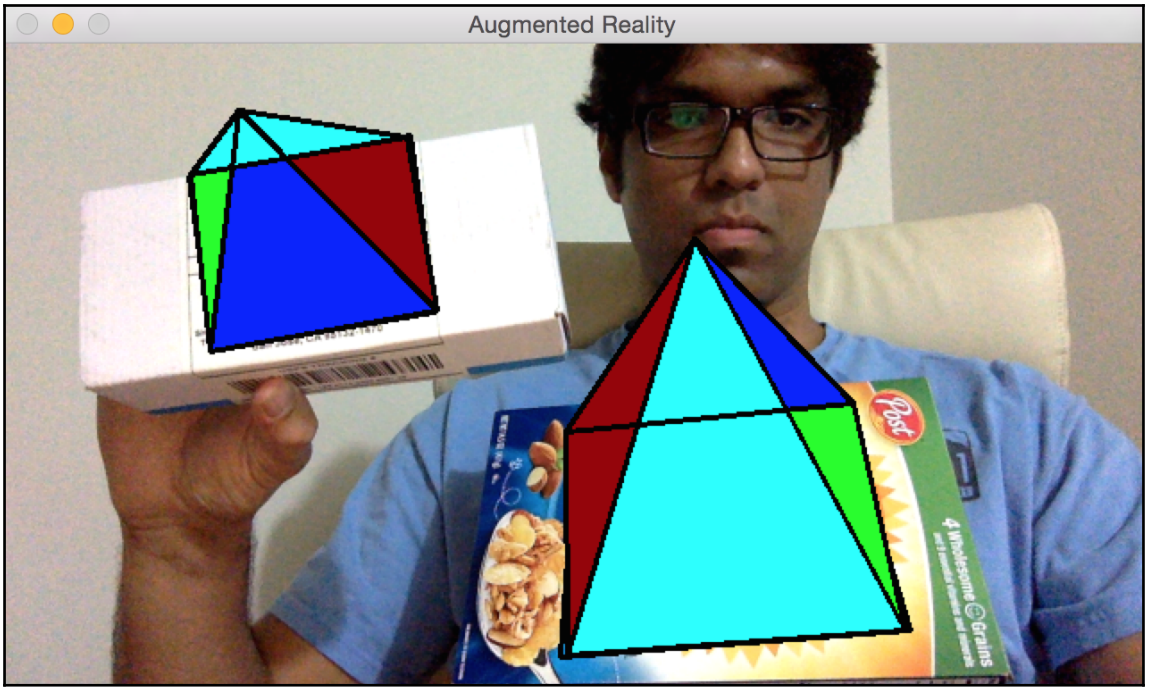
Tracker
GIVE YOUR BUNCH
SHARE IT!
LOVE IT!

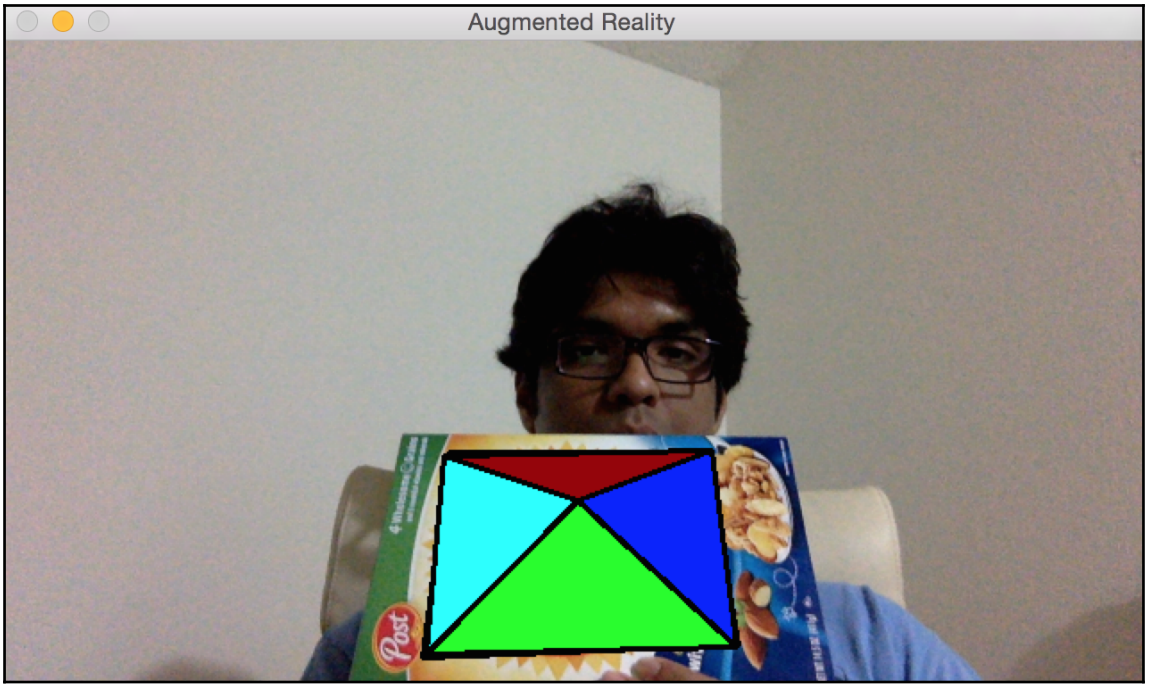

Tracker
GIVE YOUR BUNCH
Shake it!
Love it!
with ALMONDS

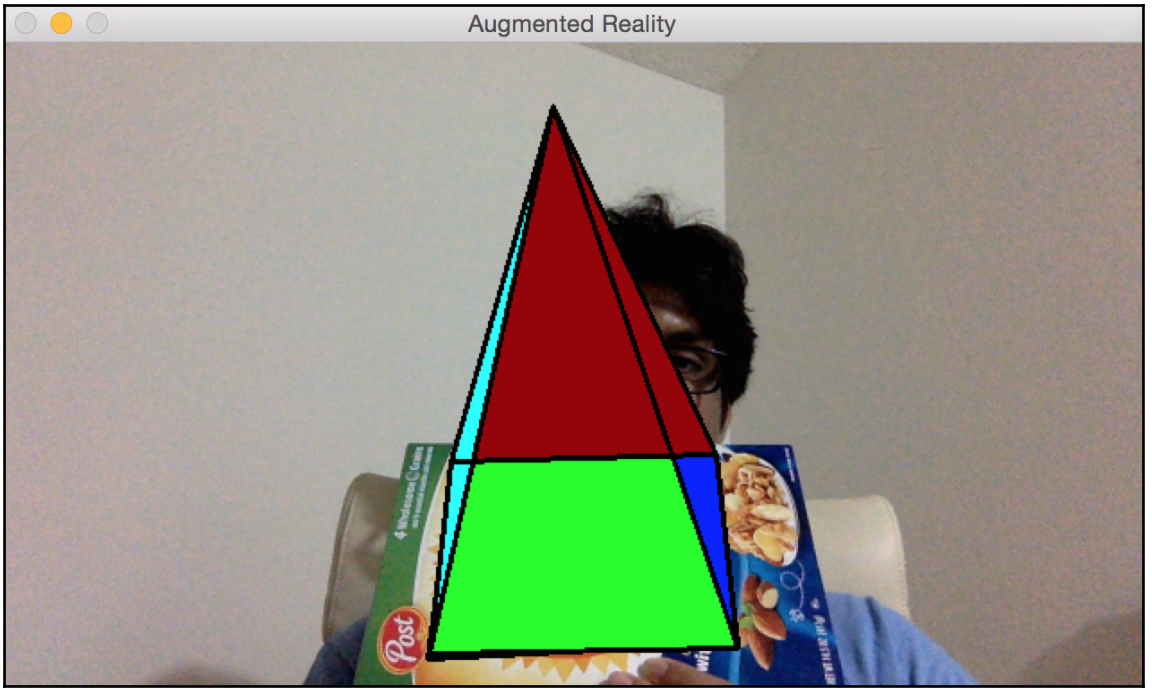
SAMSUNG

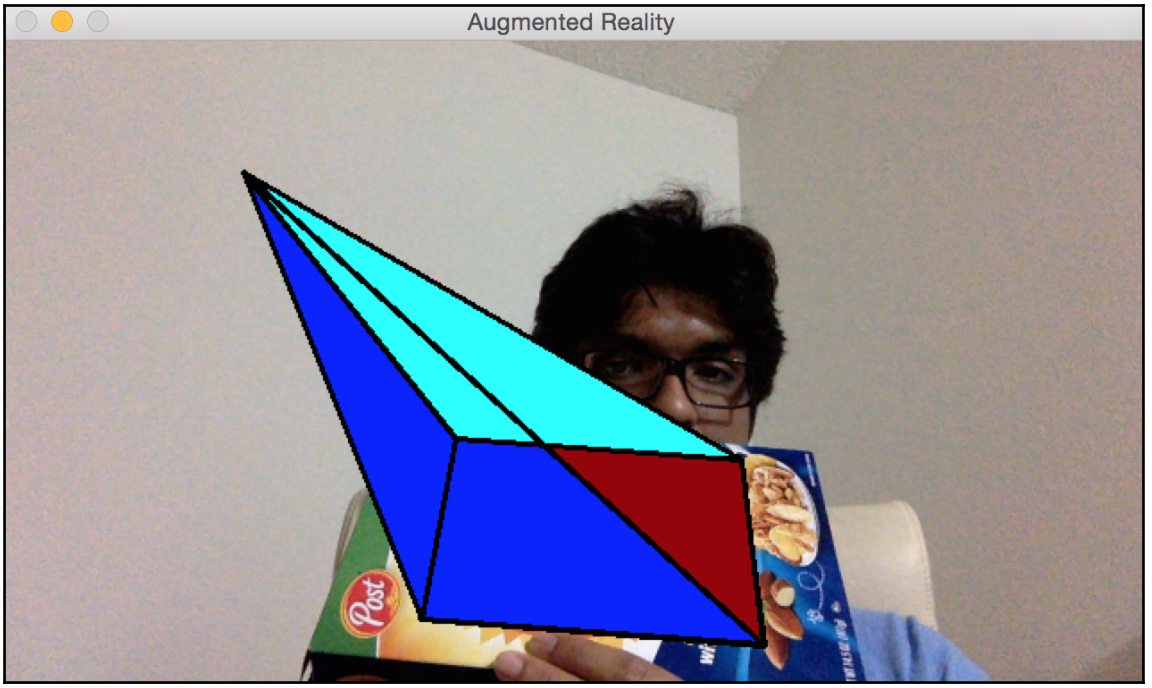

Augmented Reality
Wholesome Grains
CVPR 11

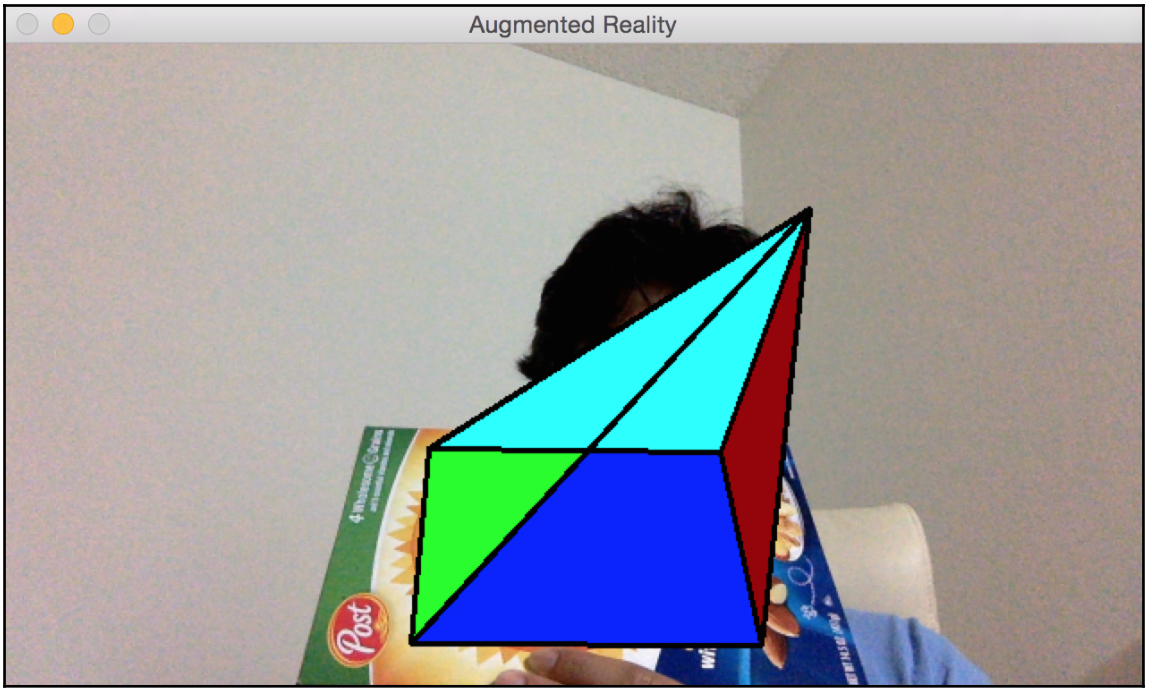

Augmented Reality

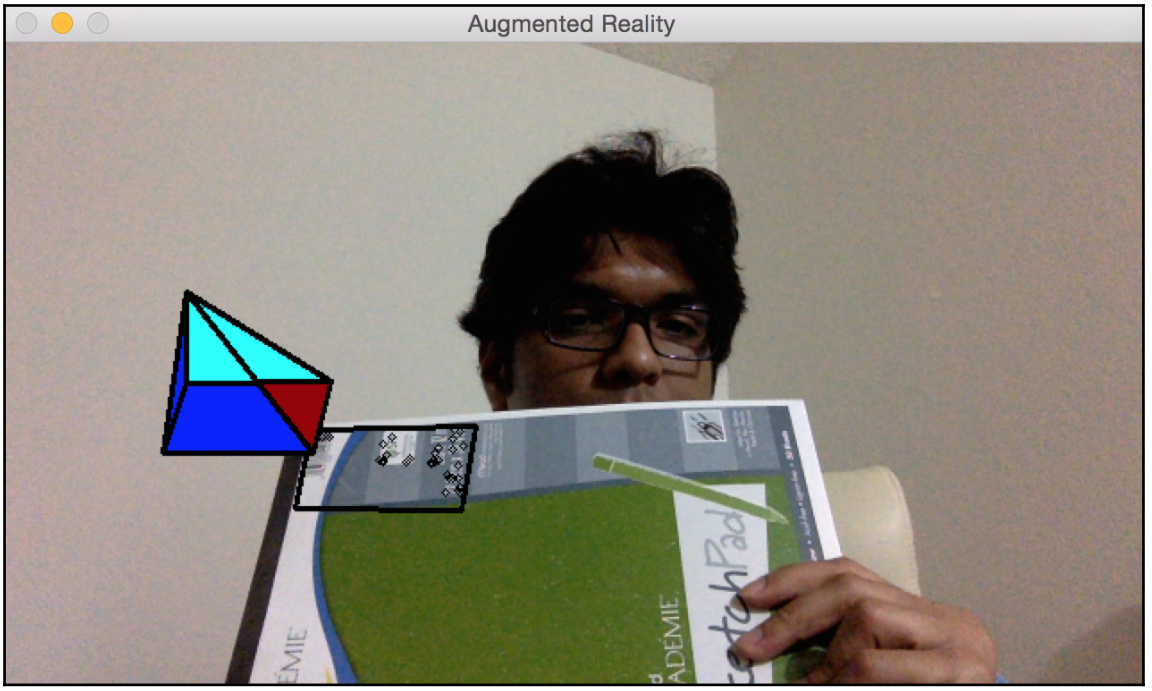

Augmented Reality
Post
4 Wholesome Grains

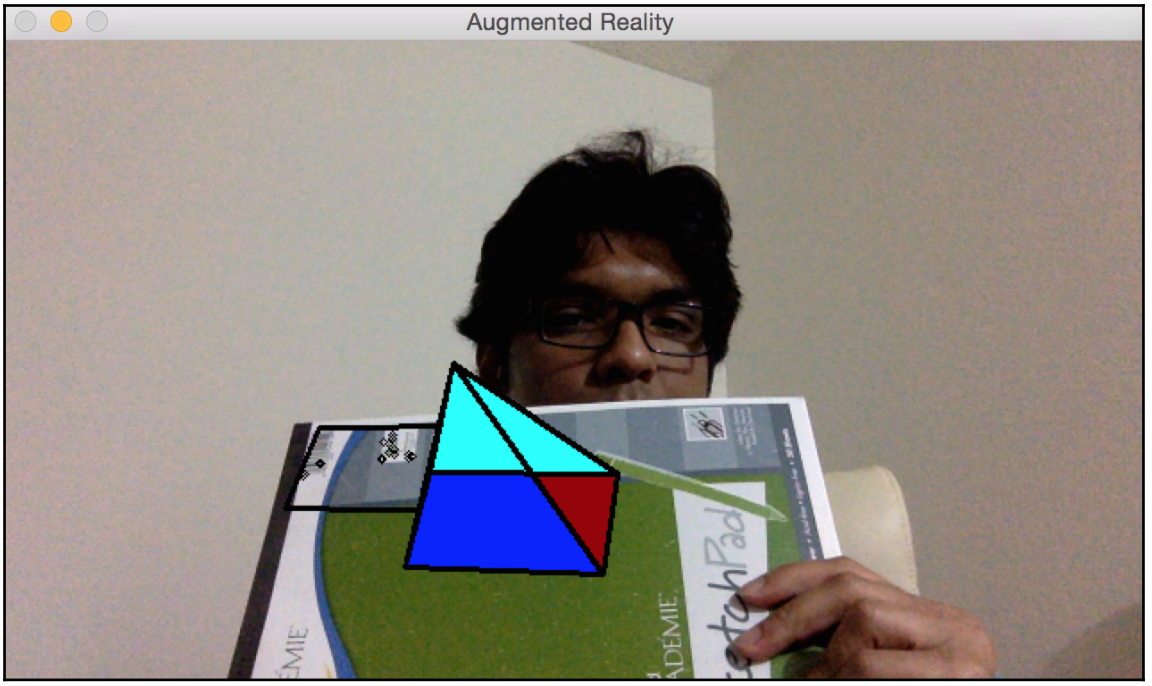

Augmented Reality
Post

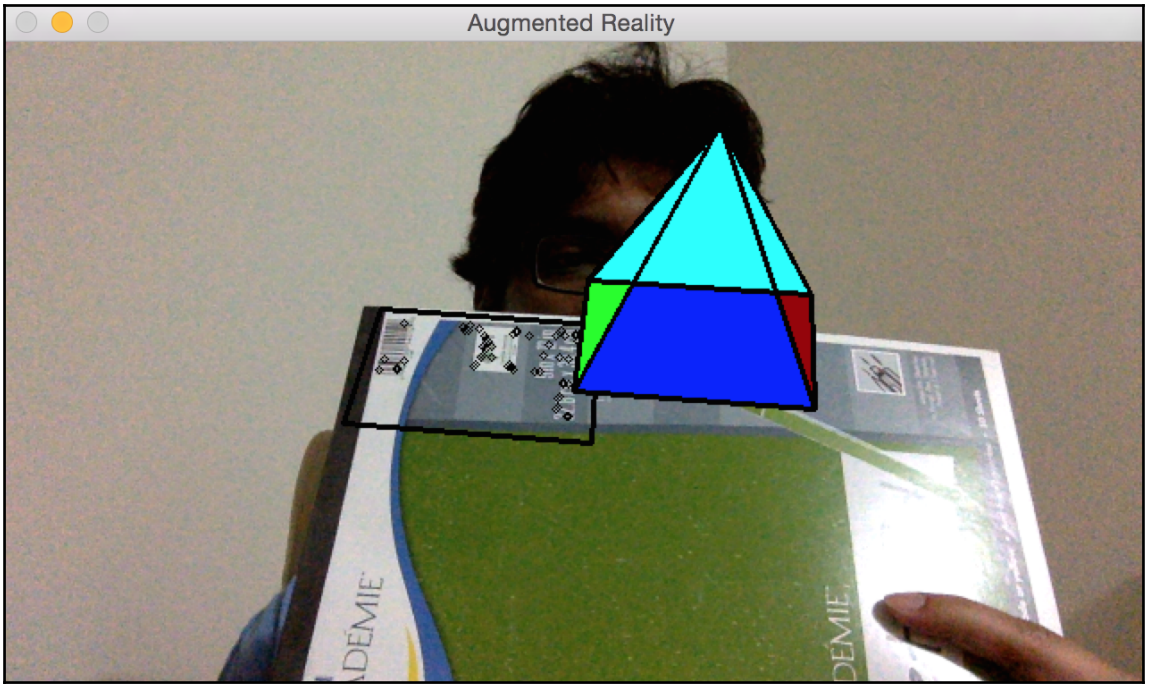

Augmented Reality
Post

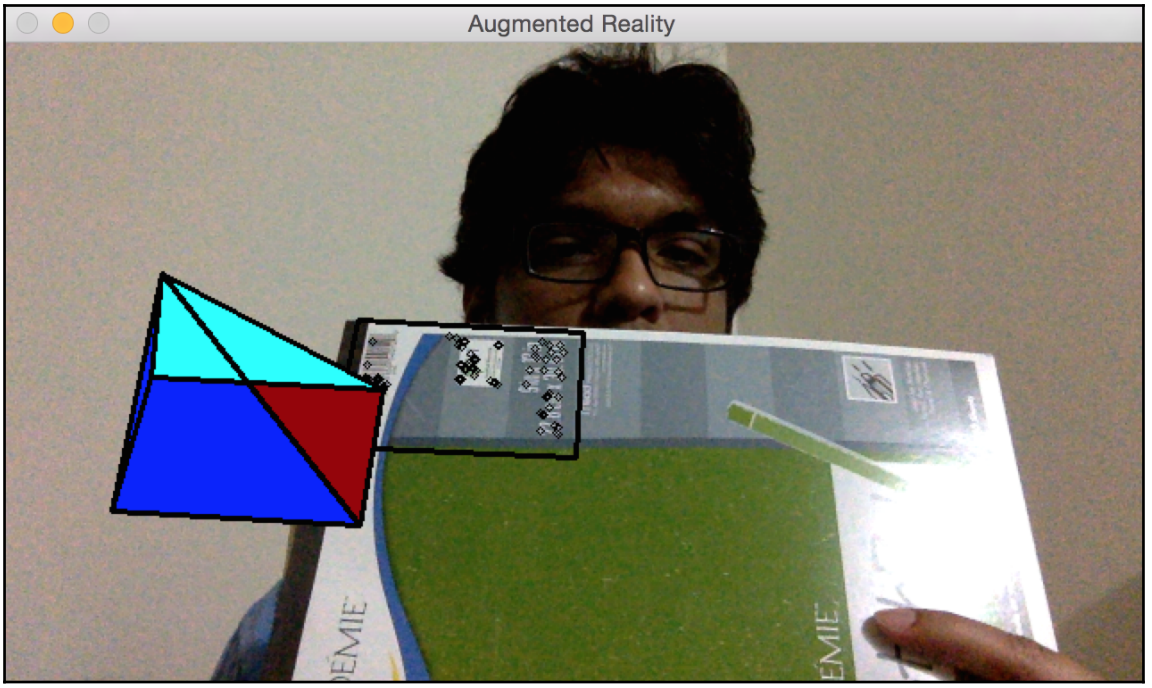

Augmented Reality
Post


Augmented Reality
Post

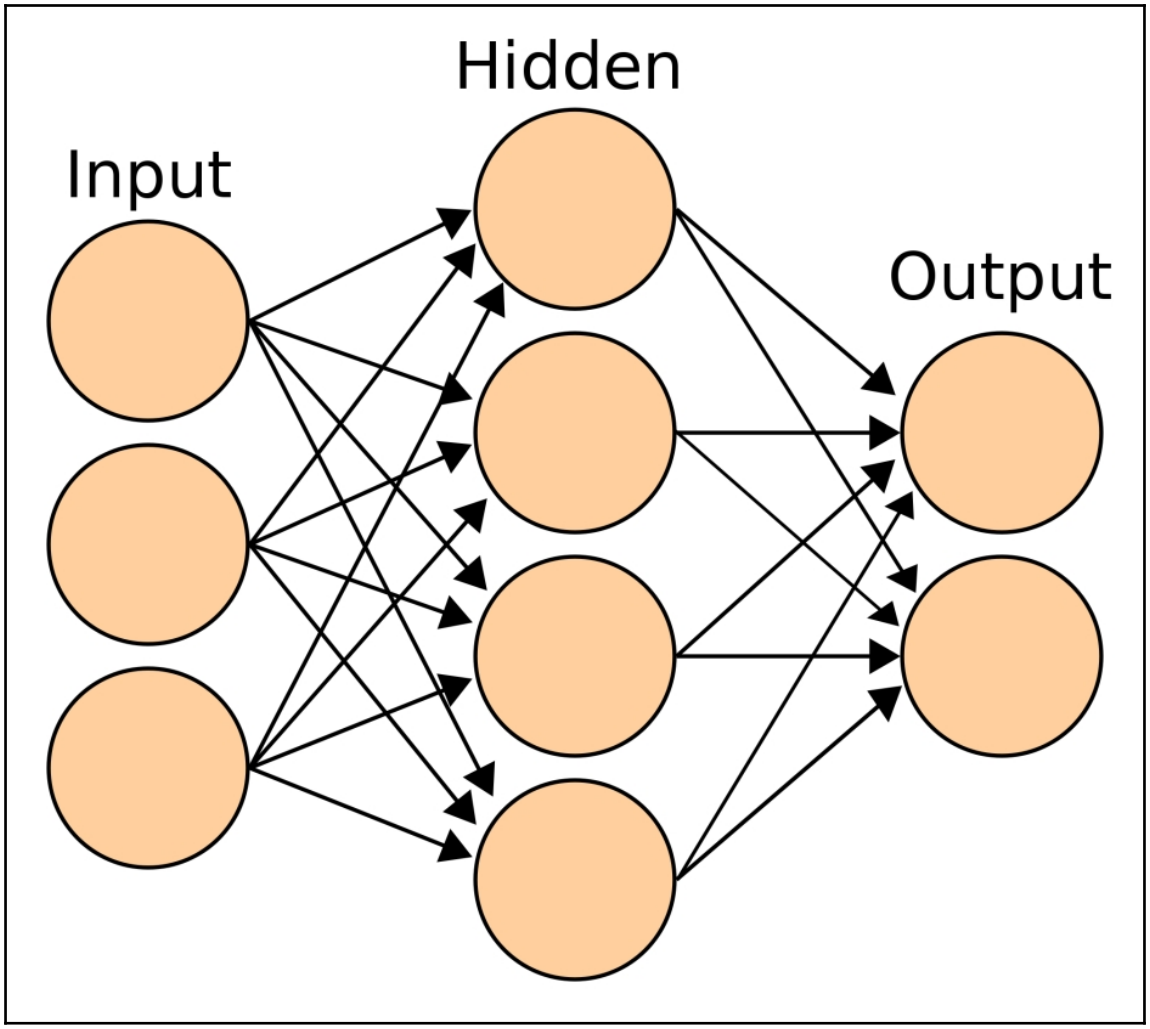

Augmented Reality

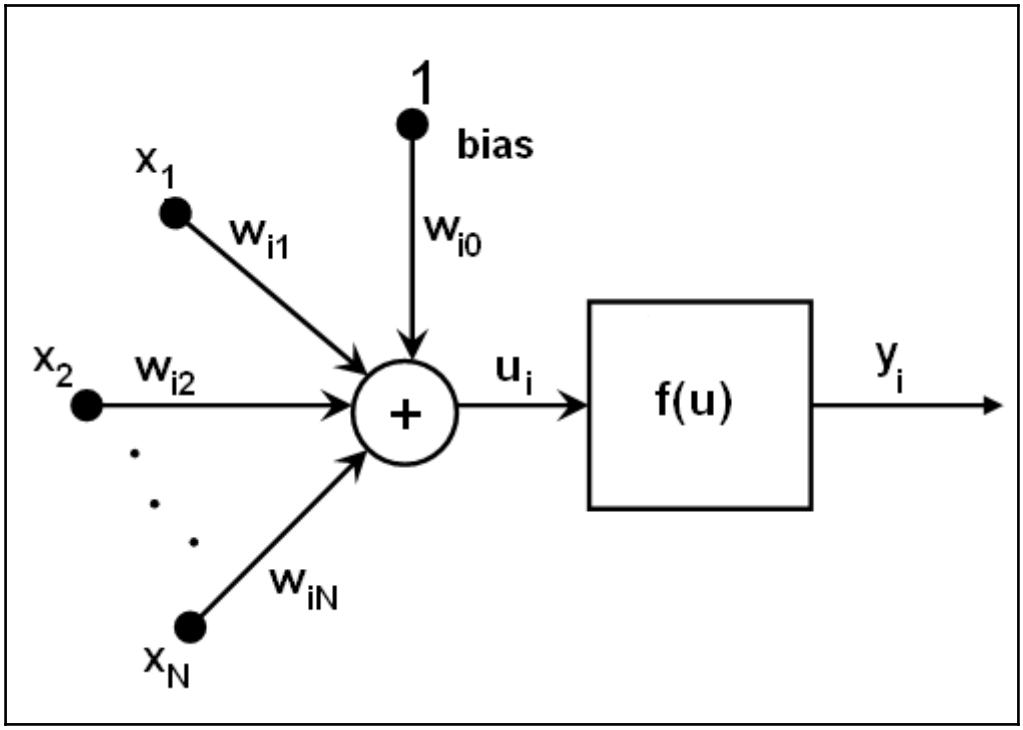

Augmented Reality

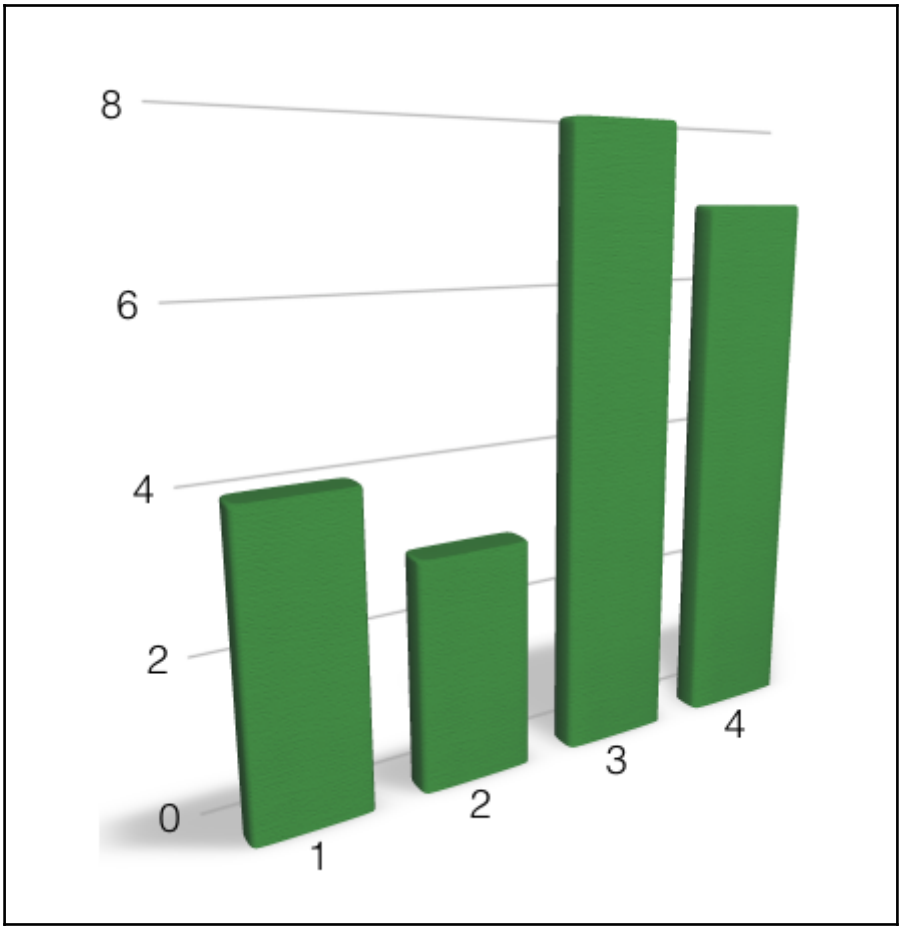

Augmented Reality

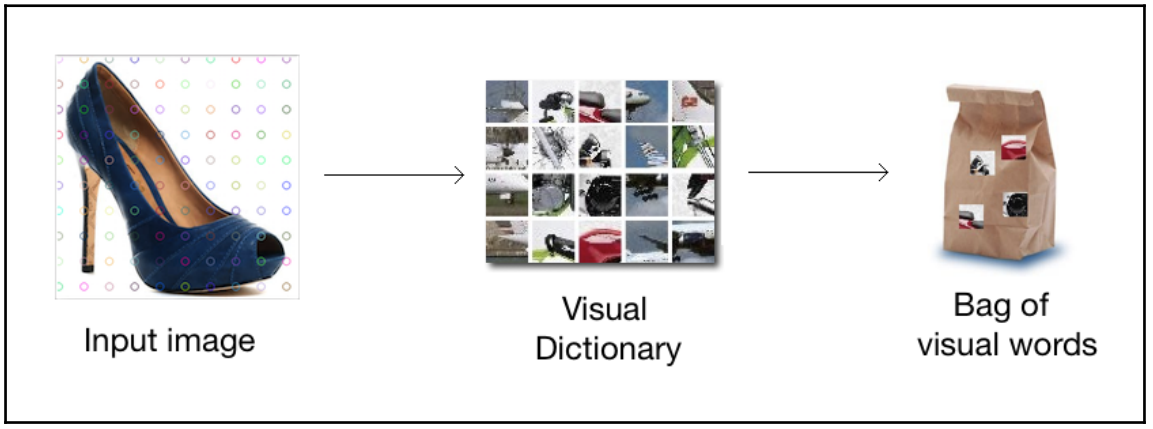

Augmented Reality

Chapter 11 - Machine Learning by an Artificial Neural Network


Hidden
Input
Output


1
bias
x1
wi1
wi0
x2
wi2
+
ui
f(u)
yi
wiN
xN


8
6
4
2
0
1
2
3
4


Input image
Visual
Dictionary
Bag of
visual words

$$ACC = \frac{TP + TN}{TP + TN + FP + FN}$$

$$\frac{8 + 16}{8 + 16 + 4 + 2} = 0.8$$

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