CPSC 425 - HW7

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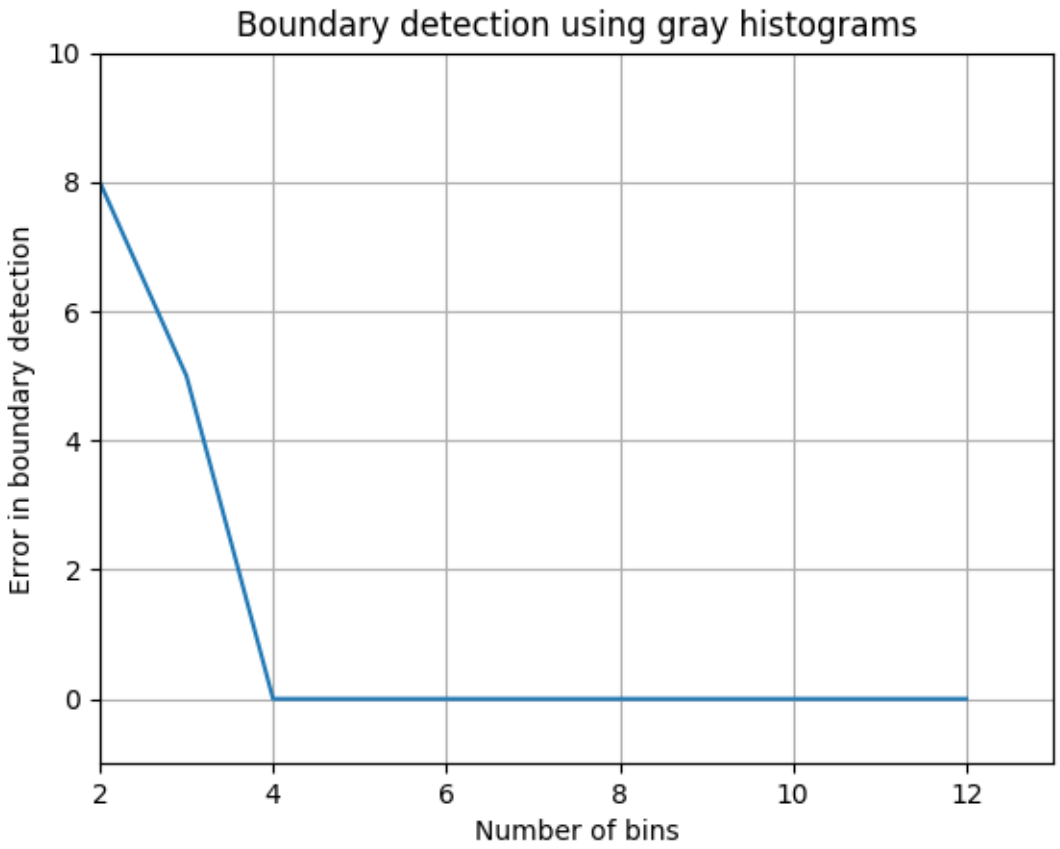
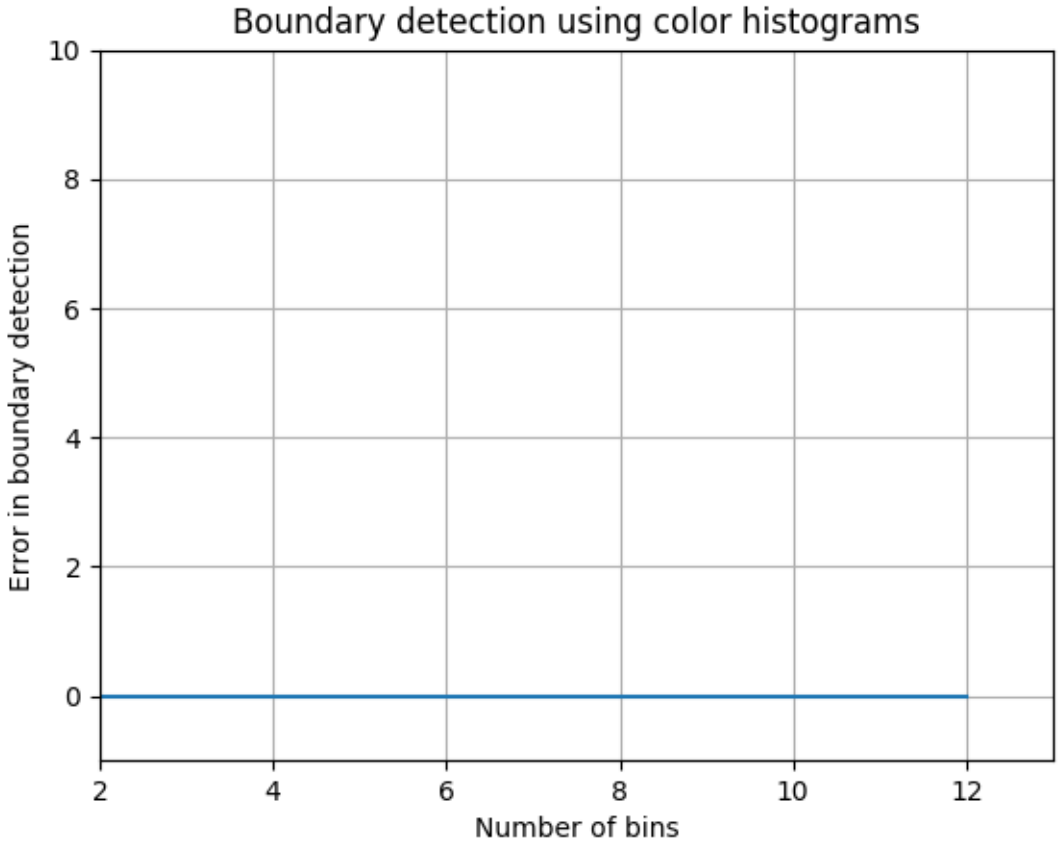
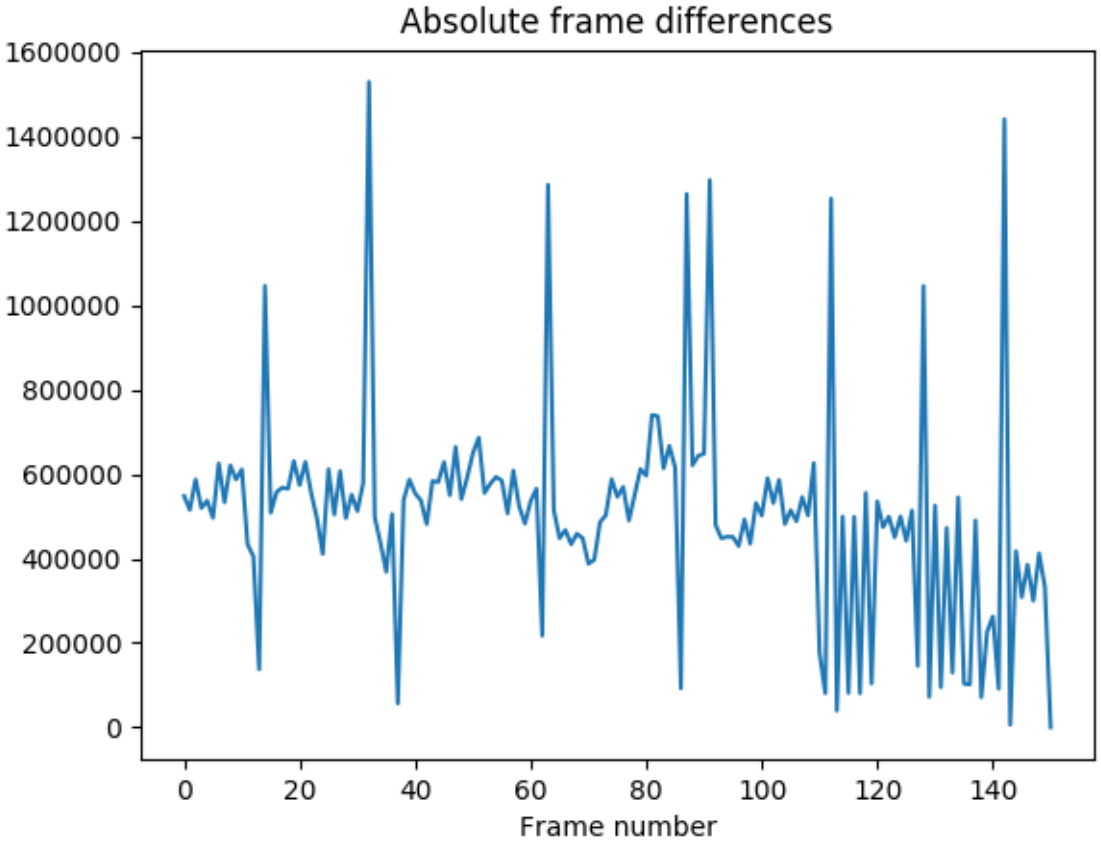
2.



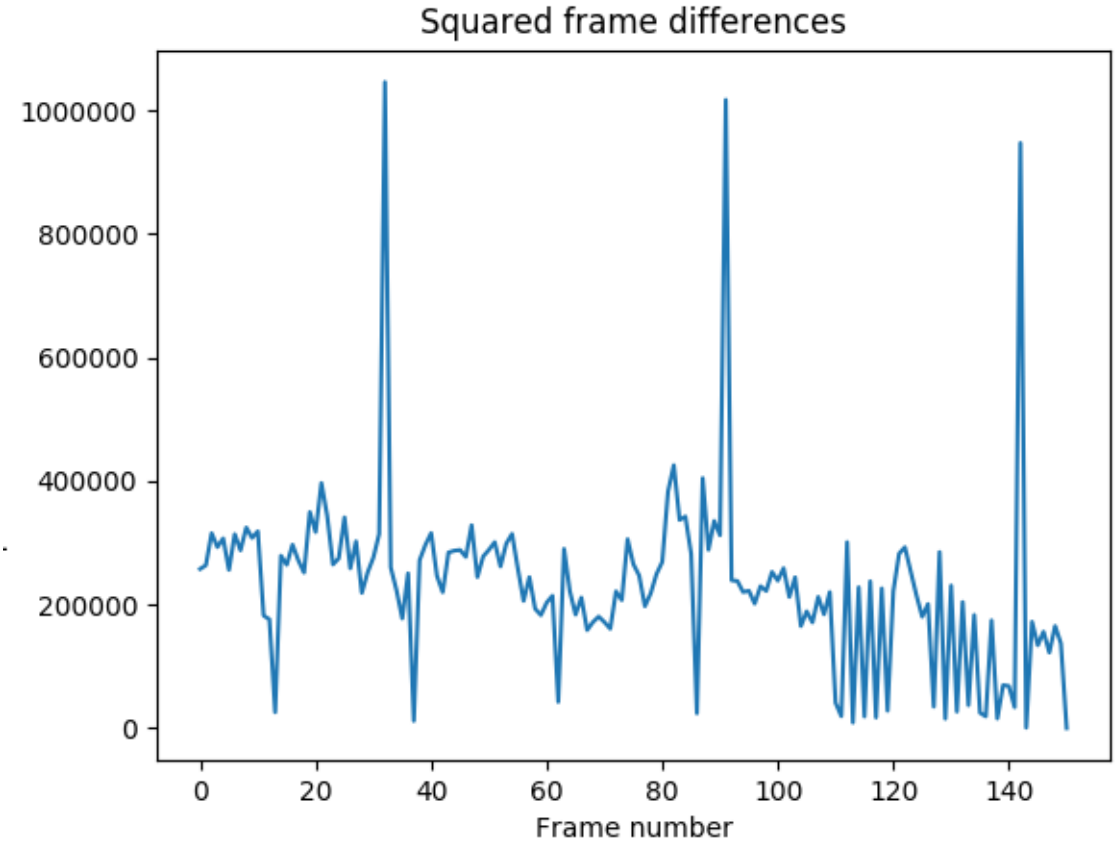
4.


Boundary detection using color histograms
Error in boundary detection
Number of bins
0
2
4
6
8
10
2
4
6
8
10
12

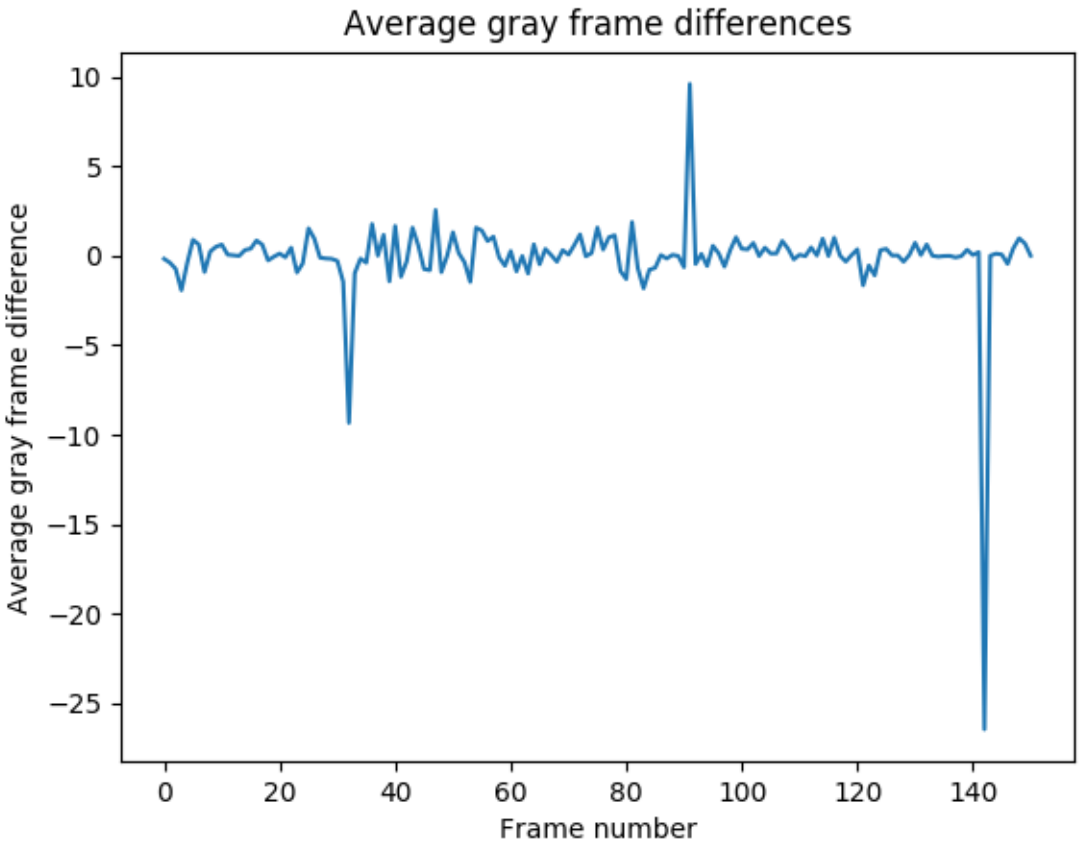
5.


Absolute frame differences
Frame number
0
200000
400000
600000
800000
1000000
1200000
1400000
1600000
0
20
40
60
80
100
120
140

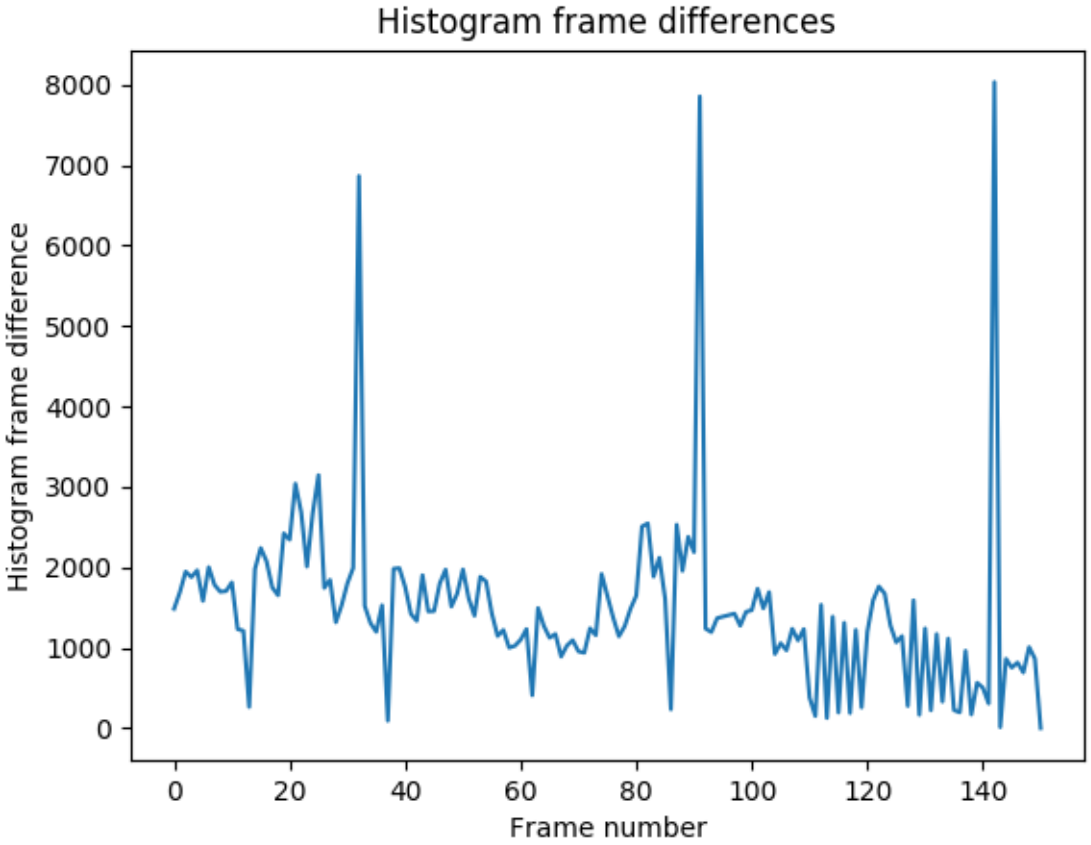
6.


Squared frame differences
1000000
800000
600000
400000
200000
0
0
20
40
60
80
100
120
140
Frame number

7.


Average gray frame differences
Average gray frame difference
10
5
0
−5
−10
−15
−20
−25
0
20
40
60
80
100
120
140
Frame number

8.



9. Which frame difference method is better? Why?

TODO

10. We worked with shots without camera movement. Which of our six methods do you think would work best if the camera were slowly moving instead of static? Why?

TODO

Code

Shot.py

```
from PIL import Image, ImageDraw
import numpy as np
from scipy.cluster.vq import vq, kmeans
from scipy.spatial.distance import cdist
import matplotlib.pyplot as plt

# Computes the cost of given boundaries. Good boundaries have zero cost.
def get_boundaries_cost( boundaries, good_boundaries ):
    return np.sum( boundaries != good_boundaries );

# Finds the indices of color_histograms given a series of cluster centres.
def cluster2boundaries(histograms, centres):

    # Find the cluster assignment of each histogram
    distances = cdist( histograms, centres )
    idx       = np.argmin( distances, 1 )

    # Find the points where the index changes
```

```
    boundaries = np.zeros( len(idx)+1, dtype = np.bool )

    for i in range( len(idx)-1 ):
        boundaries[i+1] = idx[i] != idx[i+1];

    return boundaries

# Computes histograms from gray images
def compute_gray_histograms( grays, nbins ):
    gray_hs = np.zeros(( nframes, nbins ), dtype = np.uint16 );

    for i in range( len(grays) ):
        gray_im = grays[i]
        v1 = np.histogram(gray_im.flatten(),bins=nbins, range=(0,255))
        gray_hs[i] = v1[0]

    return gray_hs;


def compute_color_histograms( colors, nbins ):
    colours_hs = np.zeros(( nframes, nbins * 3 ), dtype = np.uint16 );

    for i in range( len(colors) ):
        color_im = colors[i]
        for channel in range(3):
            im = color_im[:,:,channel]
            v1 = np.histogram(im.flatten(),bins=nbins, range=(0,255))
            colours_hs[i,(channel*nbins):((channel+1)*nbins)] = v1[0]

    return colours_hs;


# === Main code starts here ===
fname     = 'colours' # folder name
nframes   = 151       # number of frames
im_height = 90        # image height
im_width  = 120       # image width

# define the list of (manually determined) shot boundaries here
good_boundaries = [33,92,143];

# convert good_boundaries list to a binary array
gb_bool = np.zeros( nframes+1, dtype = np.bool )
gb_bool[ good_boundaries ] = True

# Create some space to load the images into memory
colors = np.zeros(( nframes, im_height, im_width, 3), dtype = np.uint8);
grays  = np.zeros(( nframes, im_height, im_width   ), dtype = np.uint8);

# Read the images and store them in color and grayscale formats
for i in range( nframes ):
    imname    = '%s/dwc%03d.png' % ( fname, i+1 )
    im        = Image.open( imname ).convert( 'RGB' )
    colors[i] = np.asarray(im, dtype = np.uint8)
    grays[i]  = np.asarray(im.convert( 'L' ))

# Initialize color histogram
nclusters   = 4;
nbins       = range(2,13)
gray_costs  = np.zeros( len(nbins) );
color_costs = np.zeros( len(nbins) );
```

```
# === GRAY HISTOGRAMS ===
for i, n in enumerate(nbins):
    print("====== Gray", n, "======")
    # Compute the gray histograms.
    # Needs to be converted to np.double to use kmeans.
    hist = compute_gray_histograms(grays, n).astype(np.double)
    # Cluster the histograms using k-means
    clusters, average = kmeans(hist, nclusters)
    # Compute the frame boundaries
    boundaries = cluster2boundaries(hist, clusters)
    # Compute the cost function for the found boundaries and save it.
    gray_costs[i] = get_boundaries_cost(boundaries, gb_bool)

# === END GRAY HISTOGRAM CODE ===

plt.figure(1);
plt.xlabel('Number of bins')
plt.ylabel('Error in boundary detection')
plt.title('Boundary detection using gray histograms')
plt.plot(nbins, gray_costs)
plt.axis([2, 13, -1, 10])
plt.grid(True)
plt.savefig("gray_histogram.png")
plt.show()

# === COLOR HISTOGRAMS ===
for n in nbins:
    # Compute the gray histograms.
    # Needs to be converted to np.double to use kmeans.
    hist = compute_color_histograms(colors, n).astype(np.double)
    # Cluster the histograms using k-means
    clusters, average = kmeans(hist, nclusters)
    # Compute the frame boundaries
    boundaries = cluster2boundaries(hist, clusters)
    # Compute the cost function for the found boundaries and save it.
    color_costs[i] = get_boundaries_cost(boundaries, gb_bool)
# === END COLOR HISTOGRAM CODE ===

plt.figure(2);
plt.xlabel('Number of bins')
plt.ylabel('Error in boundary detection')
plt.title('Boundary detection using color histograms')
plt.plot(nbins, color_costs)
plt.axis([2, 13, -1, 10])
plt.grid(True)
plt.savefig("colour_histogram.png")
plt.show()

fdiffs = np.zeros( nframes )
# === ABSOLUTE FRAME DIFFERENCES ===

# For each frame from 0 to nframes-1, compute the sum of the pairwise
# differences between the next frame and current frame.
for i in range(nframes-1):
    fdiffs[i] = np.sum(grays[i+1]-grays[i])

plt.figure(4)
plt.xlabel('Frame number')
plt.ylabel('Absolute frame difference')
plt.title('Absolute frame differences')
```

```
plt.plot(fdiffs)
plt.savefig("absolute_frame_diff.png")
plt.show()

sqdiffs = np.zeros( nframes )
# === SQUARED FRAME DIFFERENCES ===

# For each frame from 0 to nframes-1, compute the sum of the squared pairwise
# differences between the next frame and current frame.
for i in range(nframes-1):
    sqdiffs[i] = np.sum((grays[i+1]-grays[i])**2)

plt.figure(5)
plt.xlabel('Frame number')
plt.ylabel('Squared frame difference')
plt.title('Squared frame differences')
plt.plot(sqdiffs)
plt.savefig("squared_frame_diff.png")
plt.show()

avgdiffs = np.zeros( nframes )
# === AVERAGE GRAY DIFFERENCES ===

# For each frame from 0 to nframes-1, compute the difference in mean pixel value
# between the next frame and current frame.
for i in range(nframes-1):
    avgdiffs[i] = np.mean(grays[i+1])-np.mean(grays[i])

plt.figure(6)
plt.xlabel('Frame number')
plt.ylabel('Average gray frame difference')
plt.title('Average gray frame differences')
plt.plot(avgdiffs)
plt.savefig("average_frame_diff.png")
plt.show()

histdiffs = np.zeros( nframes )
# === HISTOGRAM DIFFERENCES ===

# For each frame from 0 to nframes-1, compute the euclidean difference of the
# histograms between the next frame and current frame.
for i in range(nframes-1):
    histdiffs[i] = np.sum(((compute_gray_histograms(grays[i+1],10)
                            -compute_gray_histograms(grays[i],10))**2)**(1/2))

plt.figure(7)
plt.xlabel('Frame number')
plt.ylabel('Histogram frame difference')
plt.title('Histogram frame differences')
plt.plot(histdiffs)
plt.savefig("histogram_frame_diff.png")
plt.show()
```