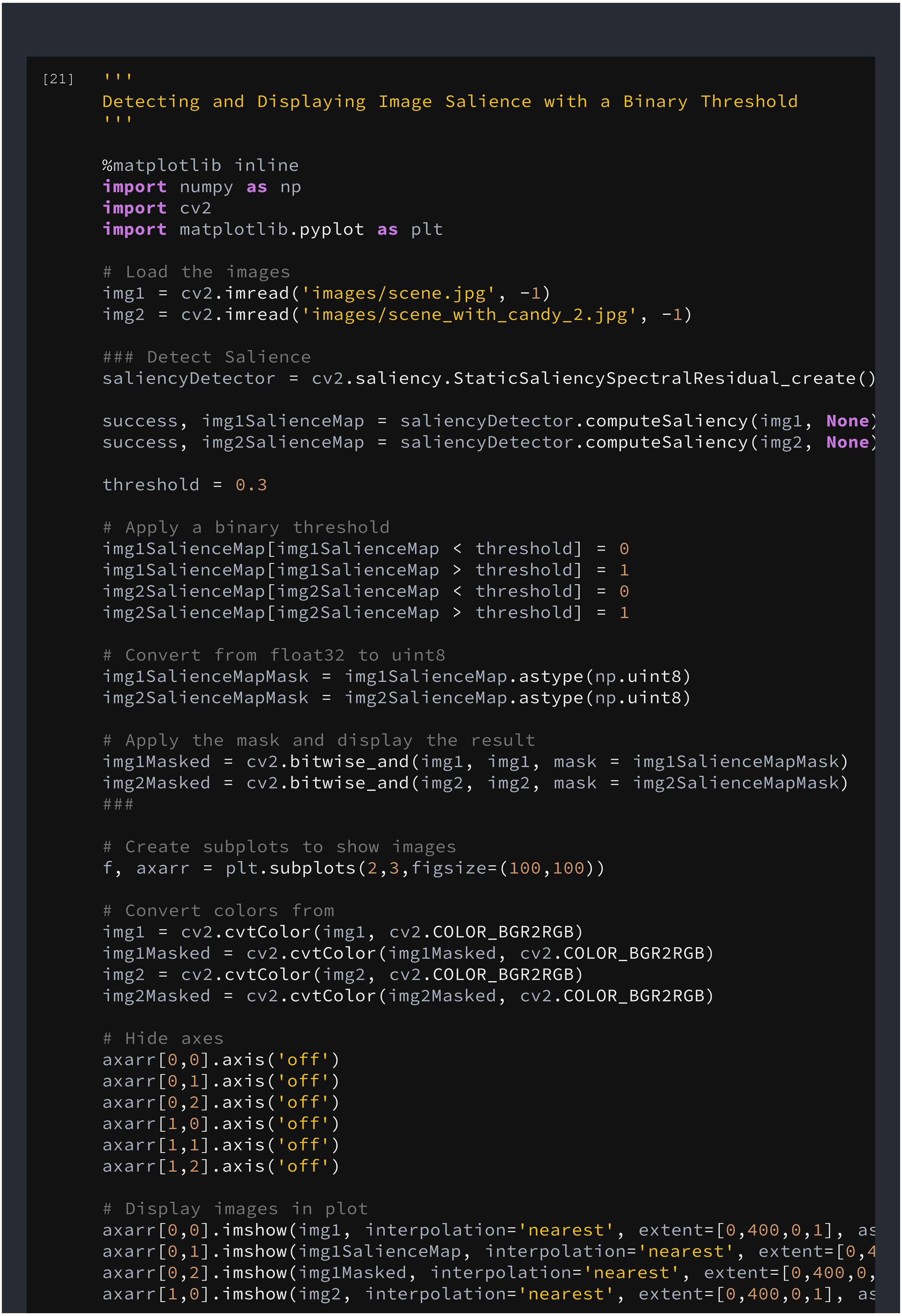


```
[21]  '''
      Detecting and Displaying Image Salience with a Binary Threshold
      '''

      %matplotlib inline
      import numpy as np
      import cv2
      import matplotlib.pyplot as plt

      # Load the images
      img1 = cv2.imread('images/scene.jpg', -1)
      img2 = cv2.imread('images/scene_with_candy_2.jpg', -1)

      ### Detect Salience
      saliencyDetector = cv2.saliency.StaticSaliencySpectralResidual_create()

      success, img1SalienceMap = saliencyDetector.computeSaliency(img1, None)
      success, img2SalienceMap = saliencyDetector.computeSaliency(img2, None)

      threshold = 0.3

      # Apply a binary threshold
      img1SalienceMap[img1SalienceMap < threshold] = 0
      img1SalienceMap[img1SalienceMap > threshold] = 1
      img2SalienceMap[img2SalienceMap < threshold] = 0
      img2SalienceMap[img2SalienceMap > threshold] = 1

      # Convert from float32 to uint8
      img1SalienceMapMask = img1SalienceMap.astype(np.uint8)
      img2SalienceMapMask = img2SalienceMap.astype(np.uint8)

      # Apply the mask and display the result
      img1Masked = cv2.bitwise_and(img1, img1, mask = img1SalienceMapMask)
      img2Masked = cv2.bitwise_and(img2, img2, mask = img2SalienceMapMask)
      ###

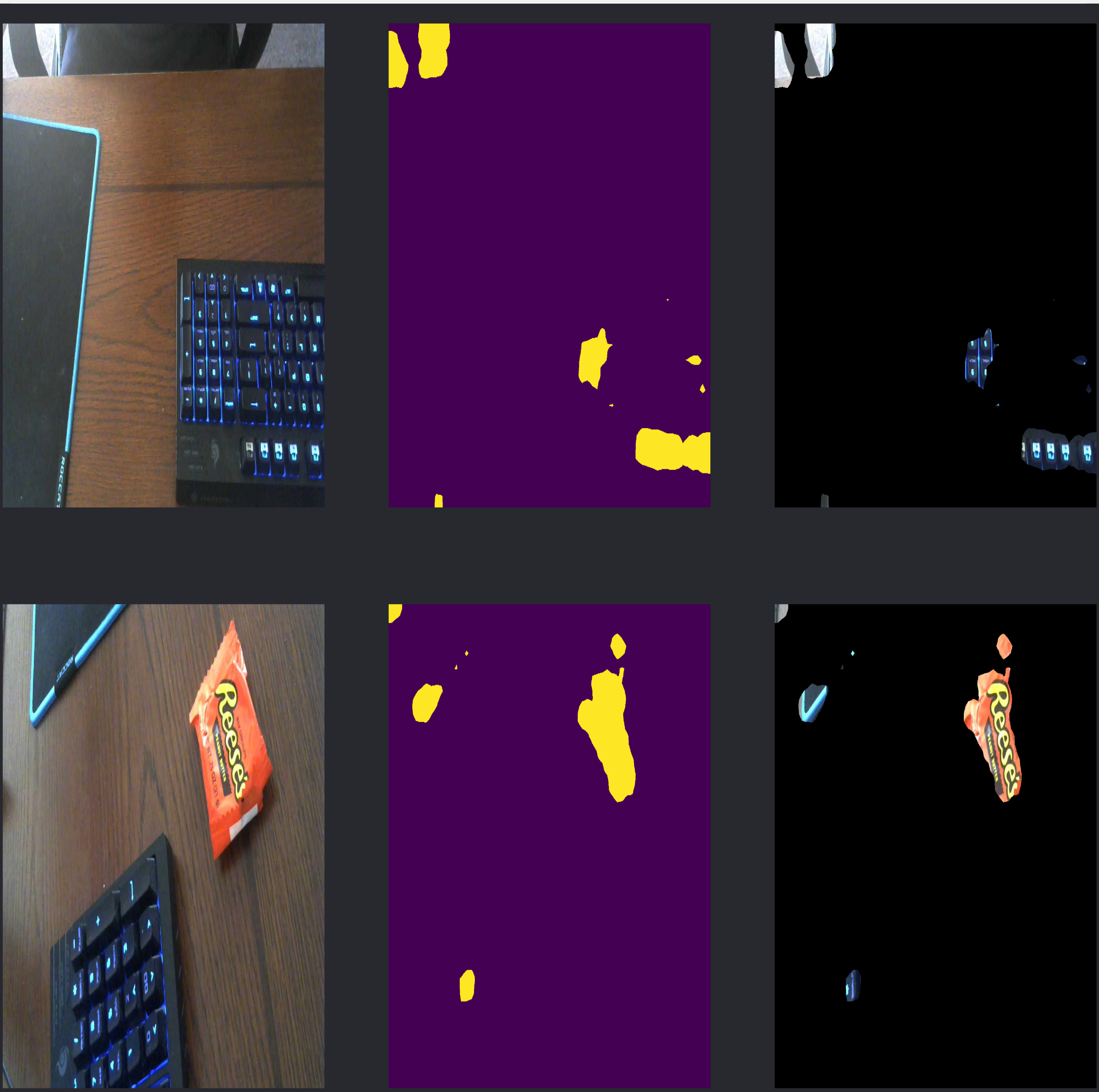
      # Create subplots to show images
      f, axarr = plt.subplots(2,3,figsize=(100,100))

      # Convert colors from
      img1 = cv2.cvtColor(img1, cv2.COLOR_BGR2RGB)
      img1Masked = cv2.cvtColor(img1Masked, cv2.COLOR_BGR2RGB)
      img2 = cv2.cvtColor(img2, cv2.COLOR_BGR2RGB)
      img2Masked = cv2.cvtColor(img2Masked, cv2.COLOR_BGR2RGB)

      # Hide axes
      axarr[0,0].axis('off')
      axarr[0,1].axis('off')
      axarr[0,2].axis('off')
      axarr[1,0].axis('off')
      axarr[1,1].axis('off')
      axarr[1,2].axis('off')

      # Display images in plot
      axarr[0,0].imshow(img1, interpolation='nearest', extent=[0,400,0,1], as
      axarr[0,1].imshow(img1SalienceMap, interpolation='nearest', extent=[0,4
      axarr[0,2].imshow(img1Masked, interpolation='nearest', extent=[0,400,0,
      axarr[1,0].imshow(img2, interpolation='nearest', extent=[0,400,0,1], as
      axarr[1,1].imshow(img2SalienceMap, interpolation='nearest', extent=[0,4
      axarr[1,2].imshow(img2Masked, interpolation='nearest', extent=[0,400,0,

      plt.show()
```



```
[2]  '''
     Feature Matching using ORB Feature Detector and Binary Descriptor

     ORB feature detection using an oriented FAST detection method and rota
     '''

     %matplotlib inline
     import numpy as np
     import cv2
     import matplotlib.pyplot as plt
     from PIL import Image

     # Load the images in gray scale
     img1 = cv2.imread('images/scene_with_candy.jpg', 0)
     img2 = cv2.imread('images/scene_with_candy_2.jpg', 0)

     ### Detect Salience
```

```
saliencyDetector = cv2.saliency.StaticSaliencySpectralResidual_create()

success, img1SalienceMap = saliencyDetector.computeSaliency(img1, None)
success, img2SalienceMap = saliencyDetector.computeSaliency(img2, None)

threshold = 0.3

# Apply a binary threshold
img1SalienceMap[img1SalienceMap < threshold] = 0
img1SalienceMap[img1SalienceMap > threshold] = 1
img2SalienceMap[img2SalienceMap < threshold] = 0
img2SalienceMap[img2SalienceMap > threshold] = 1

# Convert from float32 to uint8
img1SalienceMapMask = img1SalienceMap.astype(np.uint8)
img2SalienceMapMask = img2SalienceMap.astype(np.uint8)

# Apply the mask and display the result
img1Masked = cv2.bitwise_and(img1, img1, mask = img1SalienceMapMask)
img2Masked = cv2.bitwise_and(img2, img2, mask = img2SalienceMapMask)
###

# Detect the SIFT key points and compute the descriptors for the two
sift = cv2.xfeatures2d.SIFT_create()
keyPoints1, descriptors1 = sift.detectAndCompute(img1Masked, None)
keyPoints2, descriptors2 = sift.detectAndCompute(img2Masked, None)

# Create brute-force matcher object
bf = cv2.BFMatcher()

# Match the descriptors
matches = bf.knnMatch(descriptors1, descriptors2, k=2)

# Select the good matches using the ratio test
goodMatches = []

for m, n in matches:
    if m.distance < 0.7 * n.distance:
        goodMatches.append(m)

# Apply the homography transformation if we have enough good matches
MIN_MATCH_COUNT = 10

if len(goodMatches) > MIN_MATCH_COUNT:
    # Get the good key points positions
    sourcePoints = np.float32([ keyPoints1[m.queryIdx].pt for m in goo
    destinationPoints = np.float32([ keyPoints2[m.trainIdx].pt for m i

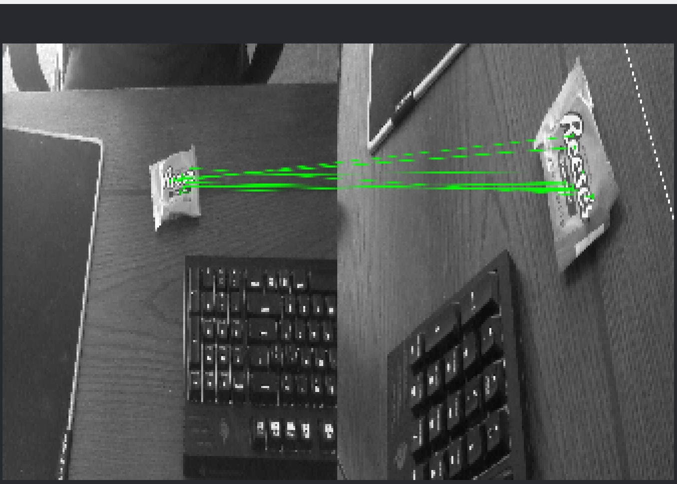
    # Obtain the homography matrix
    M, mask = cv2.findHomography(sourcePoints, destinationPoints, meth
    matchesMask = mask.ravel().tolist()

    # Apply the perspective transformation to the source image corners
    h, w = img1.shape
    corners = np.float32([ [0, 0], [0, h - 1], [w - 1, h - 1], [w - 1
    transformedCorners = cv2.perspectiveTransform(corners, M)

    # Draw a polygon on the second image joining the transformed corne
    img2 = cv2.polylines(img2, [np.int32(transformedCorners)], True, (
else:
    print("Not enough matches are found - %d/%d" % (len(goodMatches),
    matchesMask = None

# Draw the matches
drawParameters = dict(matchColor=(0, 255, 0), singlePointColor=None, ma
result = cv2.drawMatches(img1, keyPoints1, img2, keyPoints2, goodMatche

# Display the results
plt.axis("off")
plt.imshow(result, extent=[0,400,0,1], aspect='auto')
plt.show()
```



[3]

```
'''
Change Detection based on
Feature Matching using ORB Feature Detector and Binary Descriptor
ORB feature detection using an oriented FAST detection method and rota
'''

%matplotlib inline
import numpy as np
import cv2
import matplotlib.pyplot as plt
from PIL import Image

# Load the images in gray scale
img1 = cv2.imread('images/scene.jpg', 0)
img2 = cv2.imread('images/scene_with_candy_2.jpg', 0)

### Detect Salience
saliencyDetector = cv2.saliency.StaticSaliencySpectralResidual_create()

success, img1SalienceMap = saliencyDetector.computeSaliency(img1, None)
success, img2SalienceMap = saliencyDetector.computeSaliency(img2, None)

threshold = 0.3

# Apply a binary threshold
img1SalienceMap[img1SalienceMap < threshold] = 0
img1SalienceMap[img1SalienceMap > threshold] = 1
img2SalienceMap[img2SalienceMap < threshold] = 0
img2SalienceMap[img2SalienceMap > threshold] = 1

# Convert from float32 to uint8
```

```
img1SalienceMapMask = img1SalienceMap.astype(np.uint8)
img2SalienceMapMask = img2SalienceMap.astype(np.uint8)

# Apply the mask and display the result
img1Masked = cv2.bitwise_and(img1, img1, mask = img1SalienceMapMask)
img2Masked = cv2.bitwise_and(img2, img2, mask = img2SalienceMapMask)
###

# Detect the SIFT key points and compute the descriptors for the two 
sift = cv2.xfeatures2d.SIFT_create()
keyPoints1, descriptors1 = sift.detectAndCompute(img1Masked, None)
keyPoints2, descriptors2 = sift.detectAndCompute(img2Masked, None)

# Create brute-force matcher object
bf = cv2.BFMatcher()

# Match the descriptors
matches = bf.knnMatch(descriptors1, descriptors2, k=2)

# Select the bad matches using the ratio test
badMatches = []

for m, n in matches:
    if m.distance > 0.7 * n.distance:
        badMatches.append(m)

# Get the bad key points positions
changePoints = np.float32([ keyPoints1[m.queryIdx].pt for m in badMatc

# This contains the coordinates of points in the region of a salient 
# found in the second image and not found (or very poorly matched) in 
print(changePoints)

# TODO: Find a way to represent this visually
```

```
[[[ 229.53855896    7.375844  ]]

 [[ 230.5677948    19.32374191]]

 [[ 211.94612122   22.69588852]]

 [[ 230.76502991   25.47104836]]

 [[ 205.4480896    34.30665207]]

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 [[ 171.69572449   64.88794708]]

 [[ 211.47601318   74.22544098]]

 [[ 144.74691772   77.30522156]]

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 [[  809.42150879   469.54943848]]

 [[  809.42150879   469.54943848]]

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 [[  231.35072327    31.8449173 ]]

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 [[ 1028.6809082    634.31994629]]

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 [[  208.8500824     24.48658371]]

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[[ 1112.55712891   640.71820068]]

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        [[   49.78216934    91.8459549 ]]

        [[  815.49755859   465.34283447]]

        [[  841.52935791   468.16195679]]

        [[  837.98120117   475.99157715]]

        [[  837.98120117   475.99157715]]

        [[  837.98120117   475.99157715]]

        [[  835.80529785   509.09332275]]

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        [[  838.94732666   518.62652588]]

        [[  190.358078     704.49346924]]

        [[  208.84550476    33.8540802 ]]

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[[ 1049.3918457    630.64154053]]

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[[ 1106.41552734   631.43395996]]

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