In [1]:
```
import kraken
help(kraken)
```

```
Help on package kraken:

NAME
    kraken - entry point for kraken functionality

PACKAGE CONTENTS
    binarization
    ketos
    kraken
    lib (package)
    linegen
    pageseg
    repo
    rpred
    serialization
    transcribe

DATA
    absolute_import = _Feature((2, 5, 0, 'alpha', 1), (3, 0, 0, 'alpha', 0...
    division = _Feature((2, 2, 0, 'alpha', 2), (3, 0, 0, 'alpha', 0), 8192...
    print_function = _Feature((2, 6, 0, 'alpha', 2), (3, 0, 0, 'alpha', 0)...

FILE
    /opt/conda/lib/python3.7/site-packages/kraken/__init__.py
```

In [2]:
```
from kraken import pageseg
help(pageseg)
```

```
Help on module kraken.pageseg in kraken:

NAME
    kraken.pageseg

DESCRIPTION
    kraken.pageseg
    ~~~~~~~~~~~~~~

    Layout analysis and script detection methods.

FUNCTIONS
    detect_scripts(im, bounds, model='/opt/conda/lib/python3.7/site-packages/kr
aken/script.mlmodel', valid_scripts=None)
        Detects scripts in a segmented page.

        Classifies lines returned by the page segmenter into runs of scripts/wr
iting systems.

        Args:
            im (PIL.Image): A bi-level page of mode '1' or 'L'
            bounds (dict): A dictionary containing a 'boxes' entry with a list
of
                           coordinates (x0, y0, x1, y1) of a text line in the i
mage
                           and an entry 'text_direction' containing
                           'horizontal-lr/rl/vertical-lr/rl'.
            model (str): Location of the script classification model or None fo
r default.
            valid_scripts (list): List of valid scripts.

        Returns:
            {'script_detection': True, 'text_direction': '$dir', 'boxes':
            [[(script, (x1, y1, x2, y2)),...]]}: A dictionary containing the te
xt
            direction and a list of lists of reading order sorted bounding boxe
s
            under the key 'boxes' with each list containing the script segmenta
tion
            of a single line. Script is a ISO15924 4 character identifier.

        Raises:
            KrakenInvalidModelException if no clstm module is available.

    segment(im, text_direction='horizontal-lr', scale=None, maxcolseps=2, black
_colseps=False, no_hlines=True, pad=0, mask=None)
        Segments a page into text lines.

        Segments a page into text lines and returns the absolute coordinates of
        each line in reading order.

        Args:
            im (PIL.Image): A bi-level page of mode '1' or 'L'
```

```
            text_direction (str): Principal direction of the text
                                  (horizontal-lr/rl/vertical-lr/rl)
            scale (float): Scale of the image
            maxcolseps (int): Maximum number of whitespace column separators
            black_colseps (bool): Whether column separators are assumed to be
                                  vertical black lines or not
            no_hlines (bool): Switch for horizontal line removal
            pad (int or tuple): Padding to add to line bounding boxes. If int t
he
                                  same padding is used both left and right. If a
                                  2-tuple, uses (padding_left, padding_right).
            mask (PIL.Image): A bi-level mask image of the same size as `im` wh
ere
                                0-valued regions are ignored for segmentation
                                purposes. Disables column detection.

        Returns:
            {'text_direction': '$dir', 'boxes': [(x1, y1, x2, y2),...]}: A
            dictionary containing the text direction and a list of reading orde
r
            sorted bounding boxes under the key 'boxes'.

        Raises:
            KrakenInputException if the input image is not binarized or the tex
t
            direction is invalid.

DATA
    __all__ = ['segment', 'detect_scripts']

FILE
    /opt/conda/lib/python3.7/site-packages/kraken/pageseg.py
```

In [4]:
```
from PIL import Image
im=Image.open('readonly/two_col.png')
display(im)
bounding_boxes=pageseg.segment(im.convert('1'))['boxes']
print(bounding_boxes)
```

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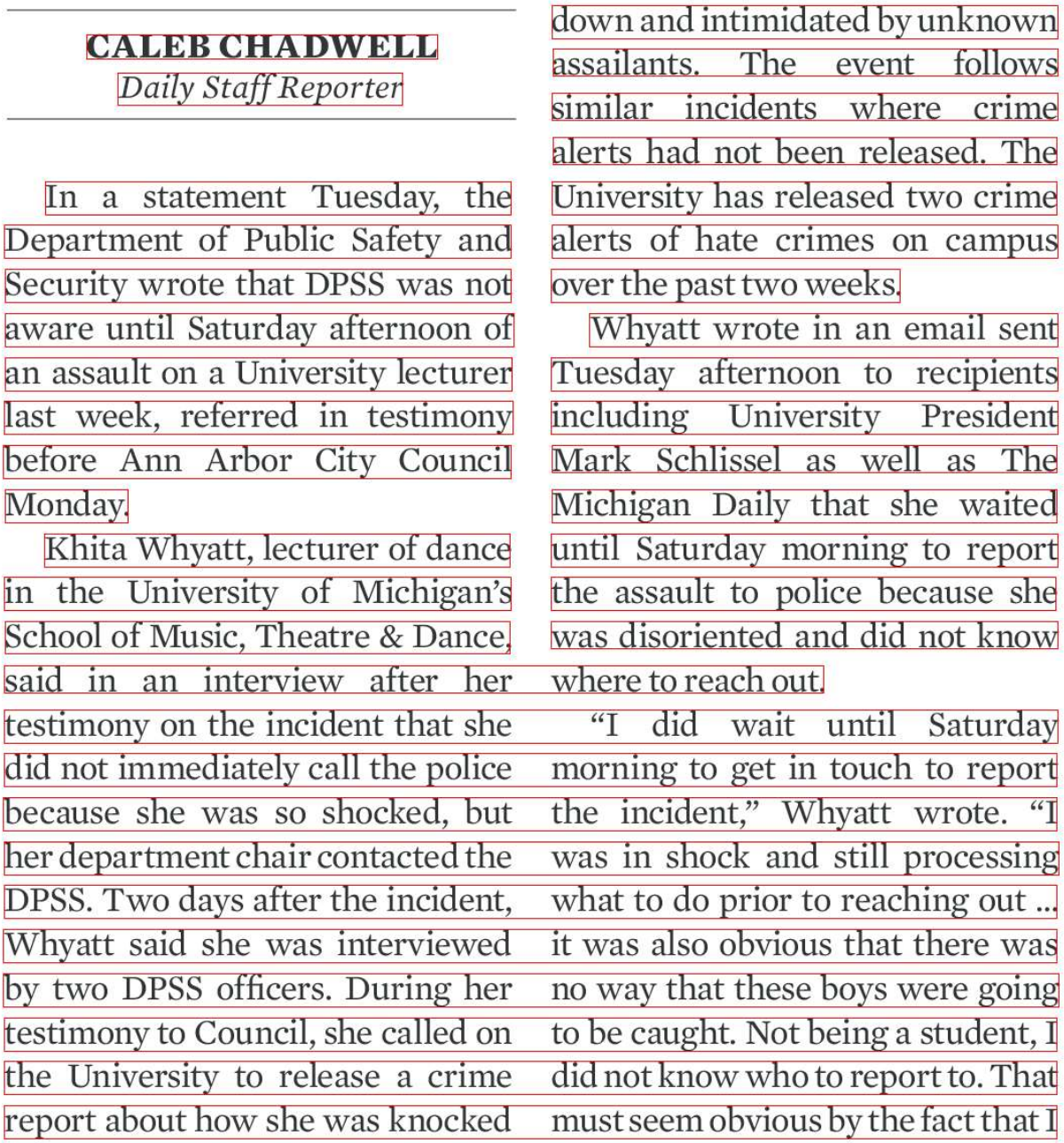
```
[[100, 50, 449, 74], [131, 88, 414, 120], [59, 196, 522, 229], [18, 239, 522, 2
72], [19, 283, 522, 316], [19, 327, 525, 360], [19, 371, 523, 404], [18, 414, 5
24, 447], [17, 458, 522, 491], [19, 502, 141, 535], [58, 546, 521, 579], [18, 5
89, 522, 622], [19, 633, 521, 665], [563, 21, 1066, 54], [564, 64, 1066, 91],
[563, 108, 1066, 135], [564, 152, 1065, 179], [563, 196, 1065, 229], [563, 239,
1066, 272], [562, 283, 909, 316], [600, 327, 1066, 360], [562, 371, 1066, 404],
[562, 414, 1066, 447], [563, 458, 1065, 485], [563, 502, 1065, 535], [562, 546,
1066, 579], [562, 589, 1064, 622], [562, 633, 1066, 660], [18, 677, 833, 704],
[18, 721, 1066, 754], [18, 764, 1065, 797], [17, 808, 1065, 841], [18, 852, 106
7, 885], [18, 895, 1065, 928], [17, 939, 1065, 972], [17, 983, 1067, 1016], [1
8, 1027, 1065, 1060], [18, 1070, 1065, 1103], [18, 1114, 1065, 1147]]
```

In [6]:
```
def show_boxes(img):
    '''Modifies the passed image to show a series of bounding boxes on an image a
    :param img: A PIL.Image object
    :return img:The modifies PIL.Image object
    '''
    from PIL import ImageDraw
    drawing_object=ImageDraw.Draw(img)
    bounding_boxes=pageseg.segment(img.convert('1'))['boxes']

    for box in bounding_boxes:
        drawing_object.rectangle(box, fill=None, outline='red')
    return img
display(show_boxes(Image.open('readonly/two_col.png')))
```



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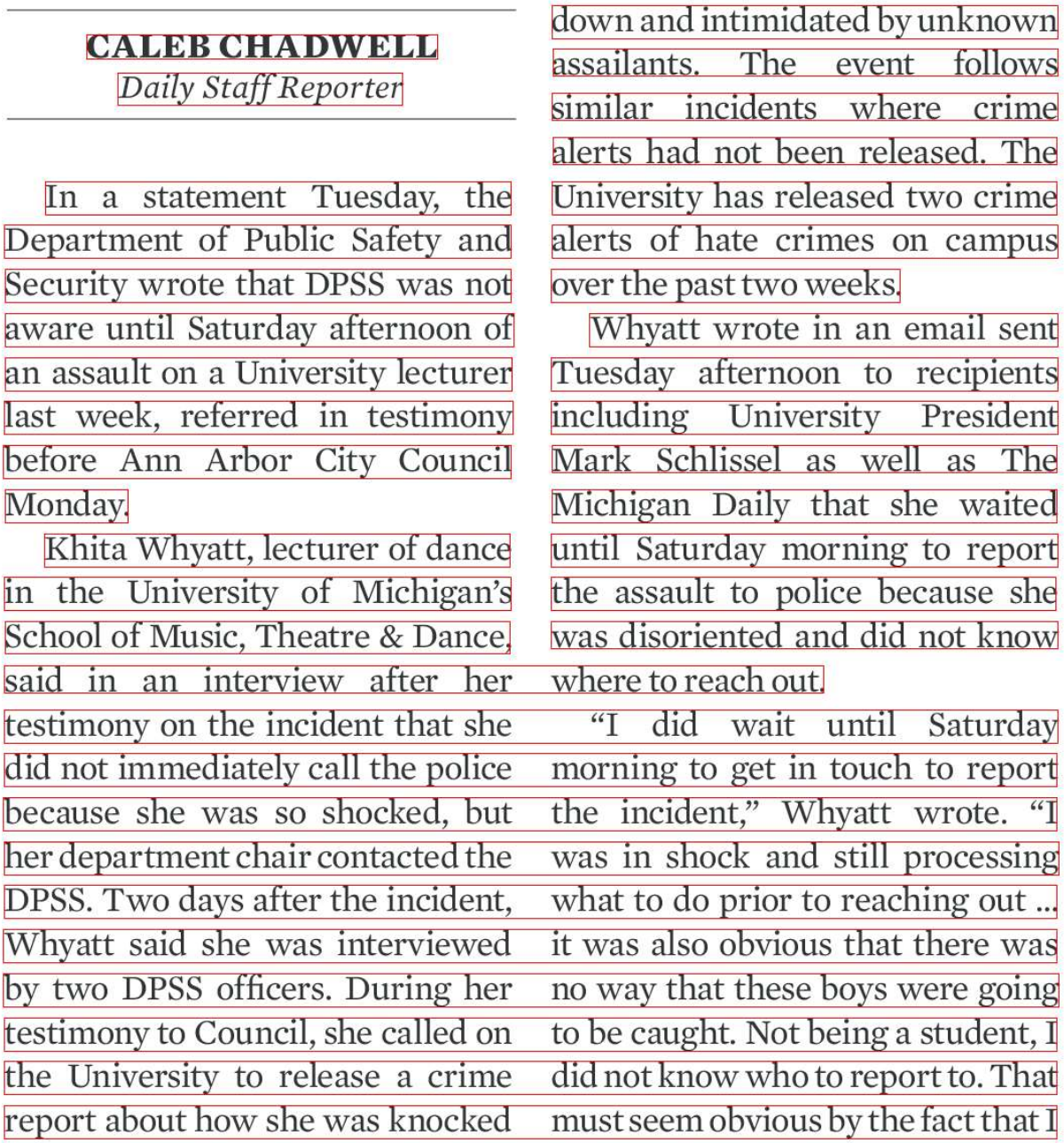
    :param img: A PIL.Image object
    :return img:The modifies PIL.Image object
    '''
    from PIL import ImageDraw
    drawing_object=ImageDraw.Draw(img)
    bounding_boxes=pageseg.segment(img.convert('1'),black_colseps=True)['boxes']

    for box in bounding_boxes:
        drawing_object.rectangle(box, fill=None, outline='red')
    return img
display(show_boxes(Image.open('readonly/two_col.png')))
```



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In [9]:
```
char_width=25
def calculate_line_height(img):
    '''calculate the average height of a line from a given image
    :param img:A PIL.Image object
    :return:The average height of line in pixels
    '''
    bounding_boxes=pageseg.segment(img.convert('1'))['boxes']
    height_accumulator=0
    for box in bounding_boxes:
        height_accumulator=height_accumulator+box[3]-box[1]
    return int((height_accumulator)/len(bounding_boxes))
line_height=calculate_line_height(Image.open('readonly/two_col.png'))
print(line_height)
```

```
31
```

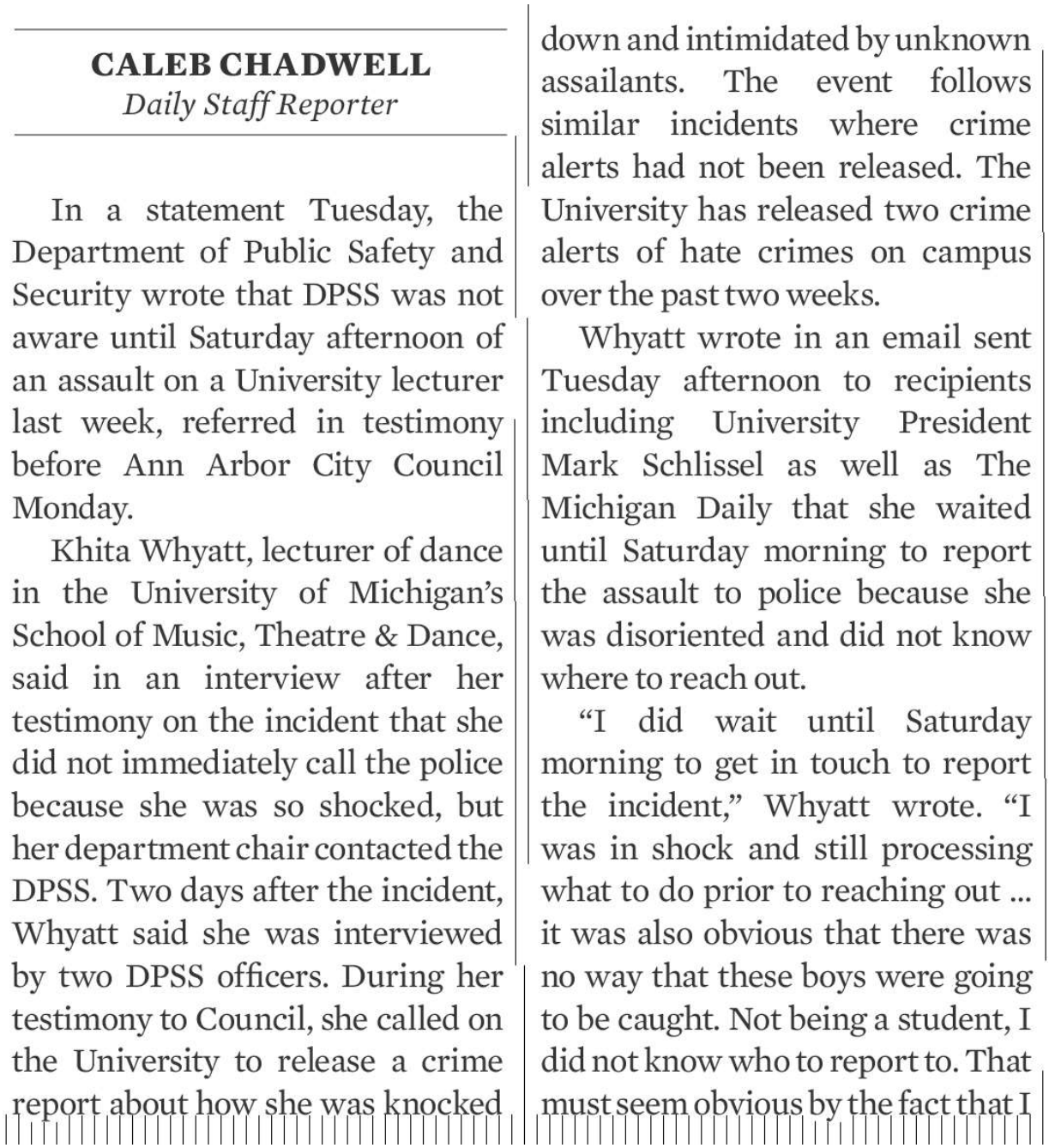
In [25]:
```
gap_box=(0,0,char_width,line_height*6)
gap_box
```

Out[25]:
```
(0, 0, 25, 186)
```

In [26]:
```
def gap_check(img, location):
    '''check a given image at a location(x,y) if it fits the description of a giv
    :param img: A PIL.Image file
    :param location:a tuple(x,y) which is a pixel location of that image
    :return:True if it fits the definition of a gap_box else false
    '''
    for x in range(location[0],location[0]+gap_box[2]):
        for y in range(location[1], location[1]+gap_box[3]):
            if x<img.width and y<img.height:
                if img.getpixel((x,y))!=255:
                    return False
    return True
```

In [27]:
```
def draw_sep(img, location):
    '''Draw a line at the middle of the gap discovered at the location
    :param img: A PIL.Image file
    :param location: A tuple (x,y) in pixel location
    '''
    from PIL import ImageDraw
    drawing_object=ImageDraw.Draw(img)
    x1=location[0]+int(gap_box[2]/2)
    x2=x1
    y1=location[1]
    y2=y1+gap_box[3]
    drawing_object.rectangle((x1,y1,x2,y2), fill='black', outline='black')
```

In [28]:
```
def process_img(img):
    '''Takes in an image of text and adds black vertical bars to break up columns
    :param img: A PIL.Image file
    :return: A modified PIL.Image file
    '''
    for x in range(img.width):
        for y in range(img.height):
            if (gap_check(img, (x,y))):
                draw_sep(img, (x,y))
    return img
i=Image.open('readonly/two_col.png').convert('L')
i=process_img(i)
display(i)
```



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In [30]:
```
display(show_boxes(i))
```

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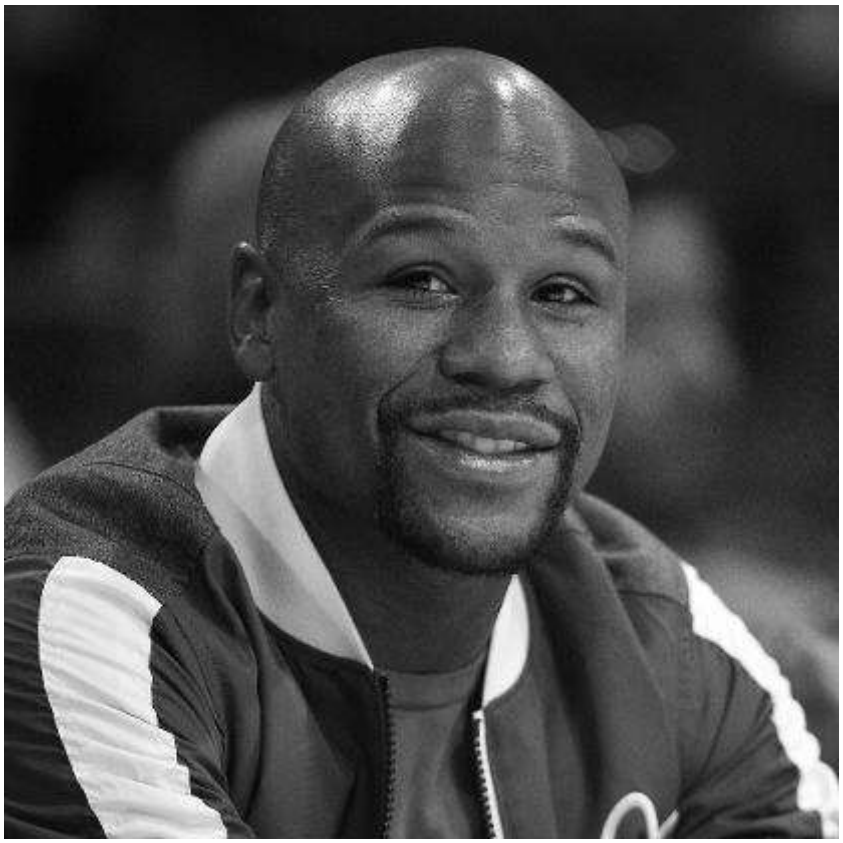
In [58]:
```
#Comparing data structures
import cv2 as cv
img=cv.imread('readonly/floyd.jpg')
gray=cv.cvtColor(img, cv.COLOR_BGR2GRAY)
import inspect
inspect.getmro(type(gray))
```

Out[58]:
```
(numpy.ndarray, object)
```

In [59]:
```
gray
```

Out[59]:
```
array([[ 40,  39,  39, ...,  77,  76,  75],
       [ 43,  42,  42, ...,  76,  75,  75],
       [ 39,  39,  39, ...,  76,  75,  74],
       ...,
       [ 21,  22,  24, ..., 219, 223, 209],
       [ 18,  20,  22, ..., 196, 206, 196],
       [ 16,  18,  20, ..., 168, 182, 176]], dtype=uint8)
```

In [60]:
```
from PIL import Image
image=Image.fromarray(gray,'L')
display(image)
```



In [61]:
```
import numpy as np
single_dim=np.array([25,50,25,10,10])
double_dim=np.array([single_dim])
double_dim
```

Out[61]:
```
array([[25, 50, 25, 10, 10]])
```

In [62]:
```
display(Image.fromarray(double_dim, 'L'))
```

-

In [63]:
```
double_dim.shape
```

Out[63]:
```
(1, 5)
```

In [64]:
```
img.shape
```

Out[64]:
```
(416, 416, 3)
```

In [65]:
```
first_pixel=img[0][0]
first_pixel
```

Out[65]:
```
array([33, 35, 53], dtype=uint8)
```

In [68]:
```
print('Original Image')
print(gray)
print('New Image')
image1d=np.reshape(gray,(1,gray.shape[0]*gray.shape[1]))
print(image1d)
```

```
Original Image
[[ 40  39  39 ...  77  76  75]
 [ 43  42  42 ...  76  75  75]
 [ 39  39  39 ...  76  75  74]
 ...
 [ 21  22  24 ... 219 223 209]
 [ 18  20  22 ... 196 206 196]
 [ 16  18  20 ... 168 182 176]]
New Image
[[ 40  39  39 ... 168 182 176]]
```

In [70]:
```
import cv2 as cv
img=cv.imread('readonly/two_col.png')
gray=cv.cvtColor(img, cv.COLOR_BGR2GRAY)
```

In [71]:
```
gray[2:4,1:3]
```

Out[71]:
```
array([[255, 255],
       [255, 255]], dtype=uint8)
```

In [72]:
```
np.count_nonzero(gray[2:4,1:3])
```

Out[72]:
```
4
```

In [73]:
```
white_matrix=np.full((12,12),255,dtype=np.uint8)
display(Image.fromarray(white_matrix,'L'))
white_matrix
```

Out[73]:
```
array([[255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255, 255]],
      dtype=uint8)
```

In [74]:
```
white_matrix[:,6]=np.full((1,12),0,dtype=np.uint8)
display(Image.fromarray(white_matrix,'L'))
white_matrix
```


Out[74]:
```
array([[255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255, 255,   0, 255, 255, 255, 255, 255]],
      dtype=uint8)
```

In [81]:
```
#OpenCV
import cv2 as cv
face_cascade=cv.CascadeClassifier('readonly/haarcascade_frontalface_default.xml'
eye_cascade=cv.CascadeClassifier('readonly/haarcascade_eye.xml')
```

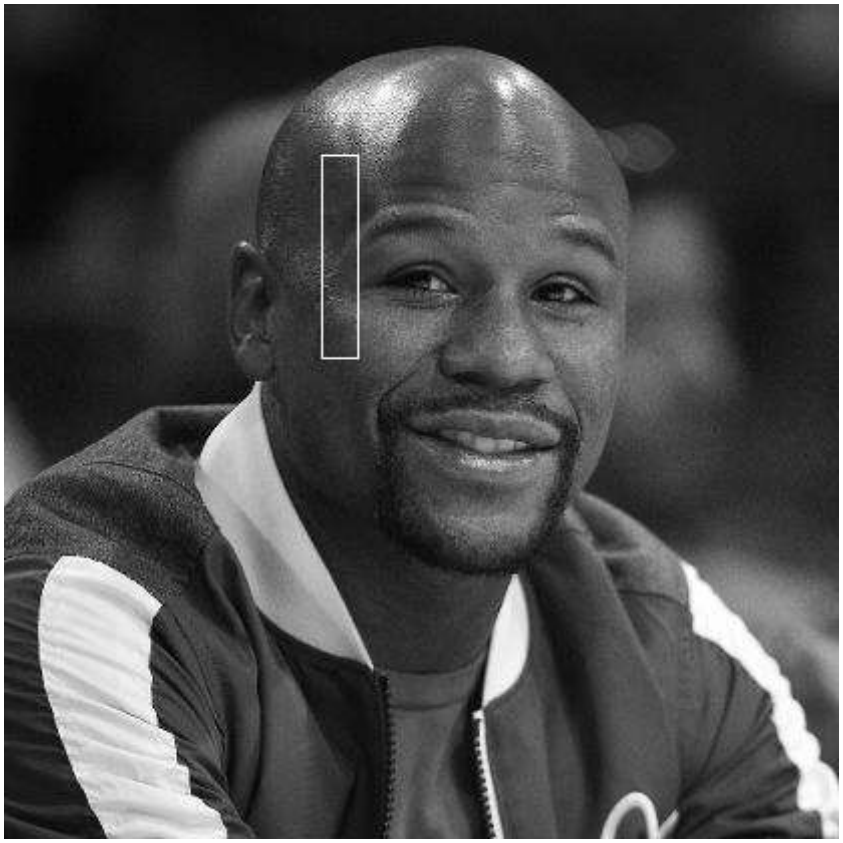
In [82]:
```
img=cv.imread('readonly/floyd.jpg')
gray=cv.cvtColor(img, cv.COLOR_BGR2GRAY)
faces=face_cascade.detectMultiScale(gray)
faces
```

Out[82]:
```
array([[158,  75, 176, 176]], dtype=int32)
```

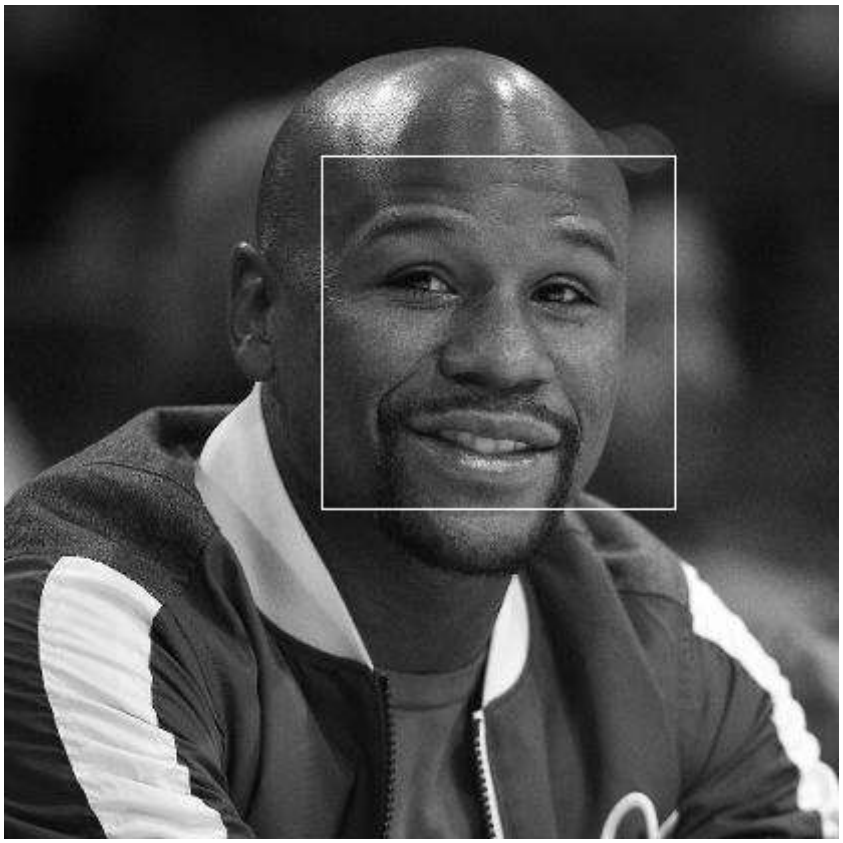
In [84]:
```
faces.tolist()[0]
```

Out[84]:
```
[158, 75, 176, 176]
```

In [85]:
```
from PIL import Image
pil_img=Image.fromarray(gray,mode='L')
from PIL import ImageDraw
drawing=ImageDraw.Draw(pil_img)
rec=faces.tolist()[0]
drawing.rectangle(rec, outline='white')
display(pil_img)
```



In [87]:
```
pil_img=Image.fromarray(gray, mode='L')
drawing=ImageDraw.Draw(pil_img)
drawing.rectangle((rec[0],rec[1],rec[0]+rec[2],rec[1]+rec[3]), outline='white')
display(pil_img)
```



In [89]:
```
img=cv.imread('readonly/msi_recruitment.gif')
display(Image.fromarray(img))
```

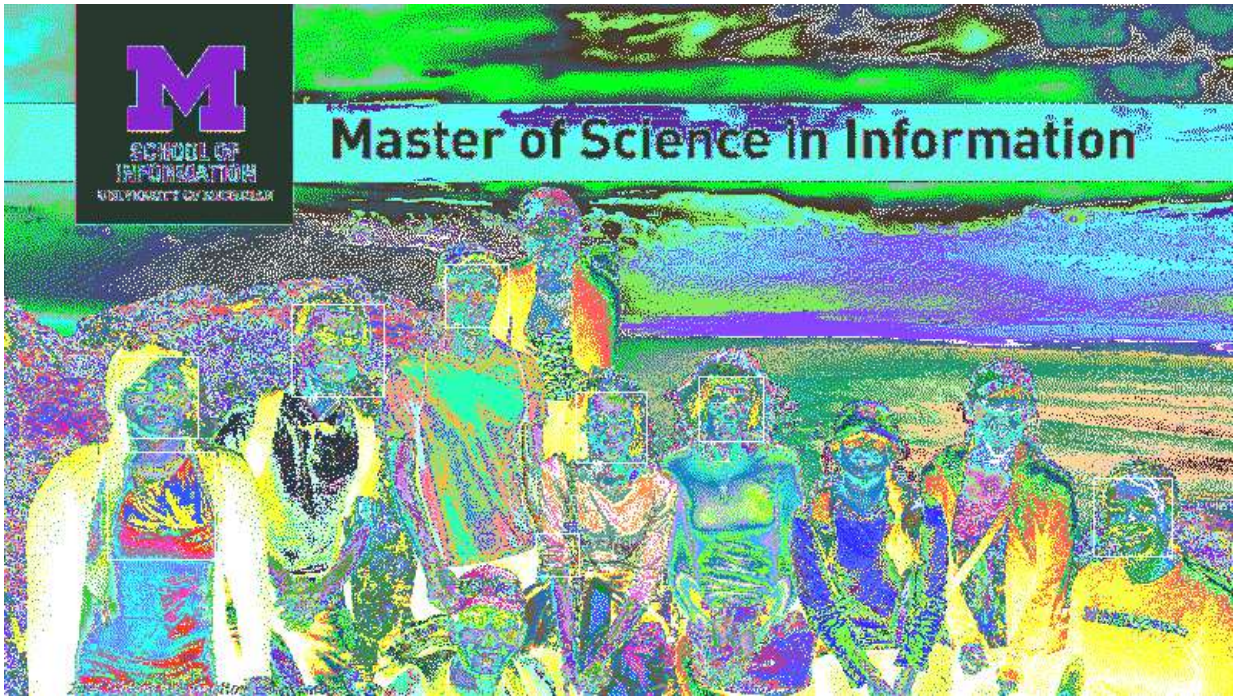
```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-89-92fac8edbb4b> in <module>
      1 img=cv.imread('readonly/msi_recruitment.gif')
----> 2 display(Image.fromarray(img))

/opt/conda/lib/python3.7/site-packages/PIL/Image.py in fromarray(obj, mode)
   2506     .. versionadded:: 1.1.6
   2507     """
-> 2508     arr = obj.__array_interface__
   2509     shape = arr['shape']
   2510     ndim = len(shape)

AttributeError: 'NoneType' object has no attribute '__array_interface__'
```

In [90]:
```
pil_img=Image.open('readonly/msi_recruitment.gif')
opencv_version=pil_img.convert('L')
opencv_version.save('msi_recruitment.png')
```

In [92]:
```
cv_img=cv.imread('msi_recruitment.png')
faces=face_cascade.detectMultiScale(cv_img)
pil_img=Image.open('readonly/msi_recruitment.gif')
drawing=ImageDraw.Draw(pil_img)
for x,y,w,h in faces:
    drawing.rectangle((x,y,x+w,y+h),outline='white')
display(pil_img)
```



In [93]:
```
pil_img.mode
```

Out[93]:
```
'P'
```

In [95]:
```
pil_img=Image.open('readonly/msi_recruitment.gif')
pil_img=pil_img.convert('RGB')
pil_img.mode
```

Out[95]:
```
'RGB'
```

In [96]:
```
drawing=ImageDraw.Draw(pil_img)
for x,y,w,h in faces:
    drawing.rectangle((x,y,x+w,y+h),outline='white')
display(pil_img)
```

In [ ]:
```
cv_img_bin=cv.threshold(img,120,255,cv.THRESH_BINARY)[1] # returns a list, we wa
# Now do the actual face detection
faces = face_cascade.detectMultiScale(cv_img_bin)
# Now lets see the results
show_rects(faces)
```

In [ ]:
```
faces = face_cascade.detectMultiScale(cv_img,1.05)
# Show those results
show_rects(faces)
# Now lets also try 1.15
faces = face_cascade.detectMultiScale(cv_img,1.15)
# Show those results
show_rects(faces)
# Finally lets also try 1.25
faces = face_cascade.detectMultiScale(cv_img,1.25)
# Show those results
show_rects(faces)
```

In [ ]:
```
%timeit face_cascade.detectMultiScale(cv_img,1.05)
```

In [ ]:
```
%timeit face_cascade.detectMultiScale(cv_img,1.15)
```

In [ ]:
```
#More jupyter widgets
from ipywebrtc import CameraStream, ImageRecorder
help(CameraStream)
```

In [ ]:
```
camera = CameraStream.facing_user(audio=False)
# The next object we want to look at is the ImageRecorder
help(ImageRecorder)
```

In [ ]:
```
image_recorder = ImageRecorder(stream=camera)
image_recorder.recording=True
# Now lets download the image
image_recorder.download()
# Then lets inspect the type of the image
type(image_recorder.image)
```

In [ ]:
```
import PIL.Image
# And lets import io
import io
# And now lets create a PIL image from the bytes
img = PIL.Image.open(io.BytesIO(image_recorder.image.value))
# And render it to the screen
display(img)
```