CPSC 425: Assignment 3: Face Detection in a Scaled Representation

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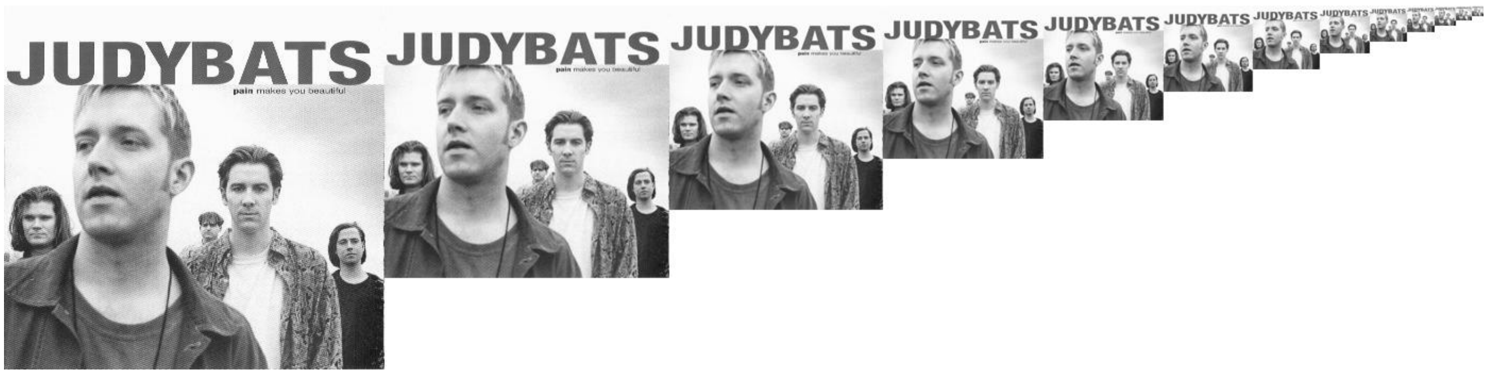
3. ShowPyramid



5. Finding Even Matches

Threshold	False Negatives	False Positives	Best
0.6	11	8	
0.55	9	15	
0.58	10	10	picked

6. Recall

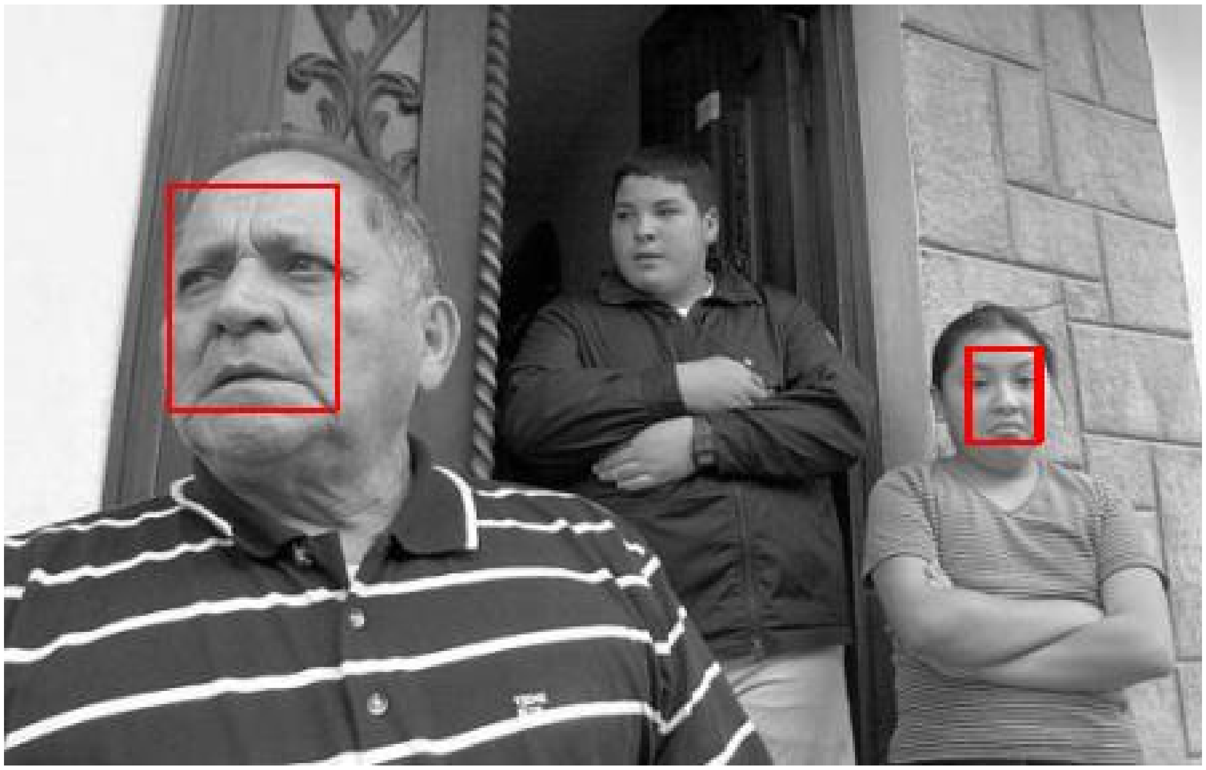
File	Recall
family.jpg	2/3
fans.jpg	0/3
judybats.jpg	4/5
sports.jpg	0/1
students.jpg	23/27
tree.jpg	0/0

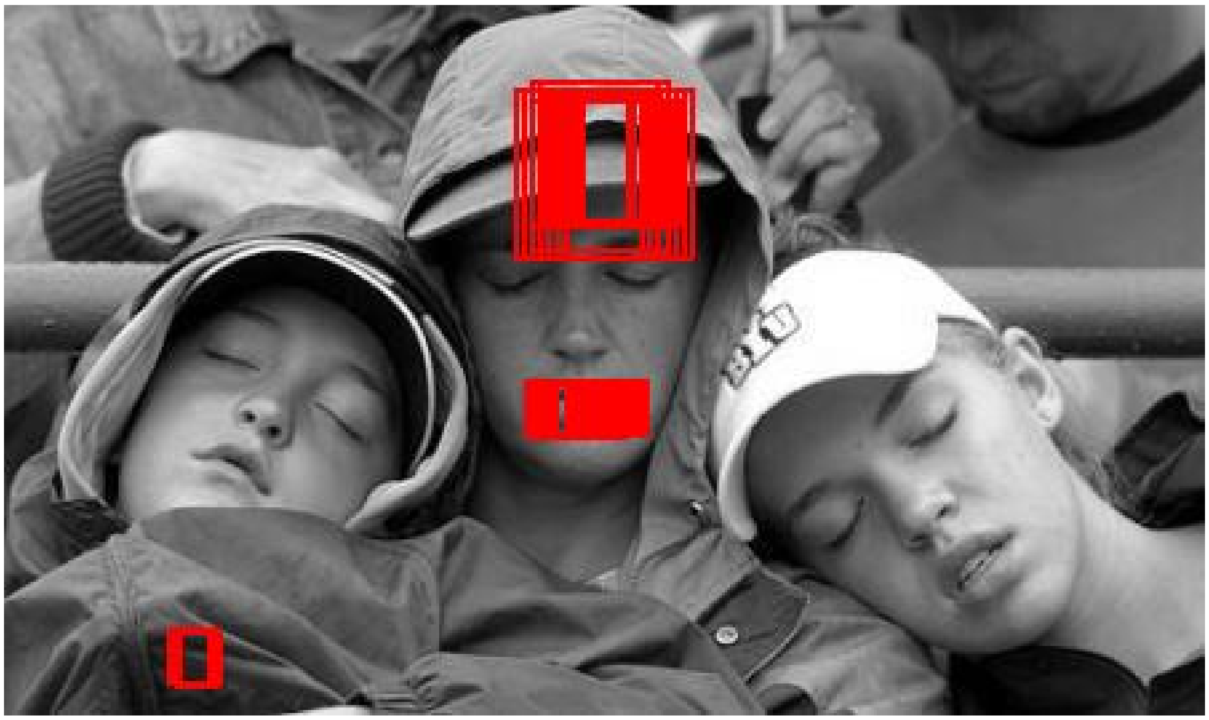
The recall using NCC is sometimes very low on certain images due to differing lighting conditions, face rotation, or other factors that cause the face to be significantly different from the template.

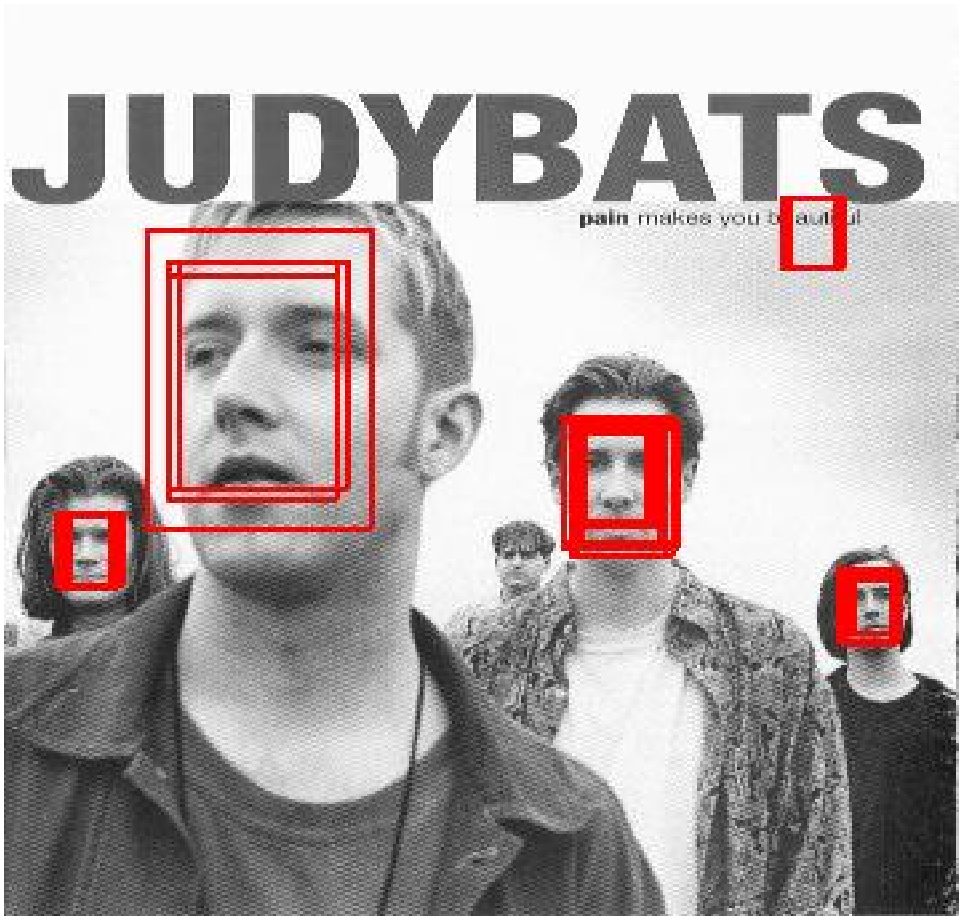
Code

```
from PIL import Image, ImageDraw
import numpy as np
import math
from scipy import signal
import ncc


def MakePyramid(image, minsize):
    images = []
    scale = 1
    while(min(image.size)*scale > minsize):
        x, y = image.size
        img = image.resize((int(x*scale), int(y*scale)), Image.BICUBIC)
        img.scale = scale
        images.append(img)
        scale *= 0.75

    return images

def ShowPyramid(pyramid, save=False):
    height = max([img.size[1] for img in pyramid])
    width = sum([img.size[0] for img in pyramid])
    image = Image.new("L", (width, height), color=(255))
    offset_x = 0
    offset_y = 0
    for img in pyramid:
        image.paste(img, (offset_x, offset_y))
        offset_x += img.size[0]
    image.show()
    if save:
        image.save('output/pyramid.jpg')

def DrawBox(im, x, y, width, height):
    x -= width/2
    y -= height/2
    draw = ImageDraw.Draw(im)
    draw.line((x,y,x,y+height), fill="red", width=2)
    draw.line((x,y+height,x+width, y+height), fill="red", width=2)
    draw.line((x+width,y,x+width, y+height), fill="red", width=2)
    draw.line((x,y,x+width, y), fill="red", width=2)
    del draw

def FindTemplate(pyramid, template, threshold, show=True, save=False):
    template_width = 15
    x, y = template.size
    template = template.resize((int(template_width), int(y*template_width/x)), Image.BICUBIC)

    faces = []
    for img in pyramid:
        corr = ncc.normxcorr2D(img, template)
        rows = len(corr)
        columns = len(corr[0])
        for y in range(rows):
            for x in range(columns):
                if corr[y][x] < threshold:
                    continue
                scale = 1/img.scale
                w, h = template.size
                face = (x*scale, y*scale, w*scale, h*scale)
                faces.append(face)

    if show or save:
        output = pyramid[0].convert('RGB')
        for face in faces:
            DrawBox(output, *face);
        if show:
            output.show()
        if save:
            output.save(save)

    return faces

def RegionOverlap(a, b):
    ax, ay, aw, ah = a
    bx, by, bw, bh = b
    return ax < (bx + bw) and (ax + aw) > bx and ay < (by + bh) and (ay + ah) > by

def RegionOverlapsArea(regions, region):
    for r in regions:
        if RegionOverlap(r, region):
            return True
    return False

def UniqRegions(regions):
    count = 0
    visited = []
    for region in regions:
        if len(visited) == 0 or not RegionOverlapsArea(visited, region):
            count += 1
        visited.append(region)
    return count

pics = [
    ('judybats.jpg', 5),
    ('family.jpg', 3),
    ('fans.jpg', 3),
    ('sports.jpg', 1),
    ('students.jpg',27),
    ('tree.jpg', 0),
]

pics = [(path, faces, Image.open('faces/'+path)) for path, faces in pics]

template = Image.open("faces/template.jpg")
threshold = 0.58
for path, faces, im in pics:
    pyramid = MakePyramid(im, 10)
    #ShowPyramid(pyramid,save=True)
    found = FindTemplate(pyramid, template, threshold) #, show=False, save='output/'+path)
    count = UniqRegions(found)
    print(path, faces, count, len(found))
```

Photos






JUDYBATS
pain makes you beautiful

BONDS
SAN
FRANCISCO
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FILA