anisotropic_diffusion

February 2, 2018

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In [85]: from matplotlib import cm, pyplot as plt
         from scipy.misc import imread, imsave
         import numpy as np
         from numpy.random import randint
```

1 Antisotropic Diffusion

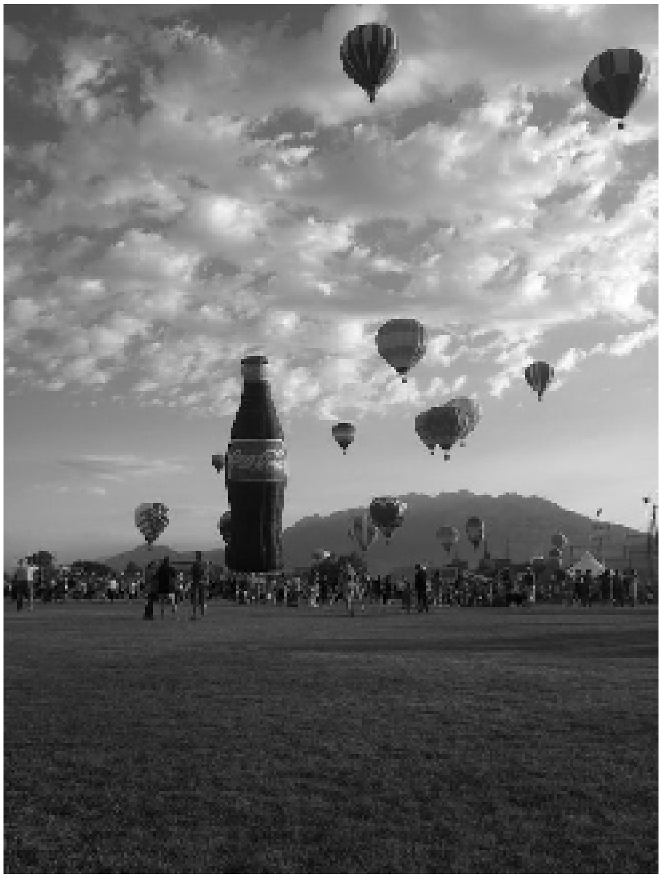
Code utilizing antisotropic diffusion equation to edit photographs.

```
In [38]: def anisdiff_bw(U, N, lambda_, g):
             m,n=np.shape(U)
             A=np.zeros(shape=(m+2,n+2))
             A[1:-1,1:-1]=U
             A[0]=A[1]
             A[1]=A[-2]
             A[:,0]=A[:,1]
             A[:,-1]=A[:,-2]
             U=A
             #print(A)
             for i in range(N):
                 U[1:-1,1:-1]=U[1:-1,1:-1]+lambda_*(g(abs(U[0:-2,1:-1]-U[1:-1,1:-1]))*(U[0:-2,1:
                 +g(abs(U[2:,1:-1]-U[1:-1,1:-1]))*(U[2:,1:-1]-U[1:-1,1:-1])\
                 +g(abs(U[1:-1,2:]-U[1:-1,1:-1]))*(U[1:-1,2:]-U[1:-1,1:-1])\
                 +g(abs(U[1:-1,:-2]-U[1:-1,1:-1]))*(U[1:-1,:-2]-U[1:-1,1:-1]))
             plt.figure(figsize=(6,6))
             plt.imshow(U[1:-1,1:-1], cmap=cm.gray)
             plt.title("N="+str(N))
             plt.axis("off")
             plt.show()

         print("PROBLEM 1")
         picture=imread('balloon.png', flatten=True)*1/255
         plt.figure(figsize=(6,6))
         plt.imshow(picture, cmap=cm.gray)
         plt.axis("off")
         plt.show()
         sigma=.1
```

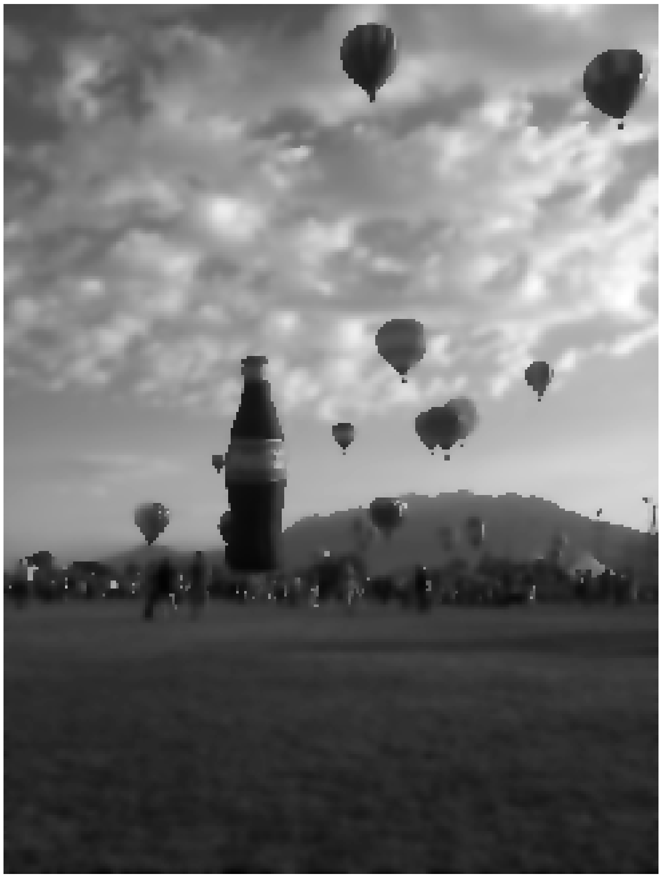
```
        g=lambda x: np.e**(-1*(x/sigma)**2)
        anisdiff_bw(picture, 5,.25,g)
        anisdiff_bw(picture, 20,.25,g)
        anisdiff_bw(picture, 100, .25, g)
```

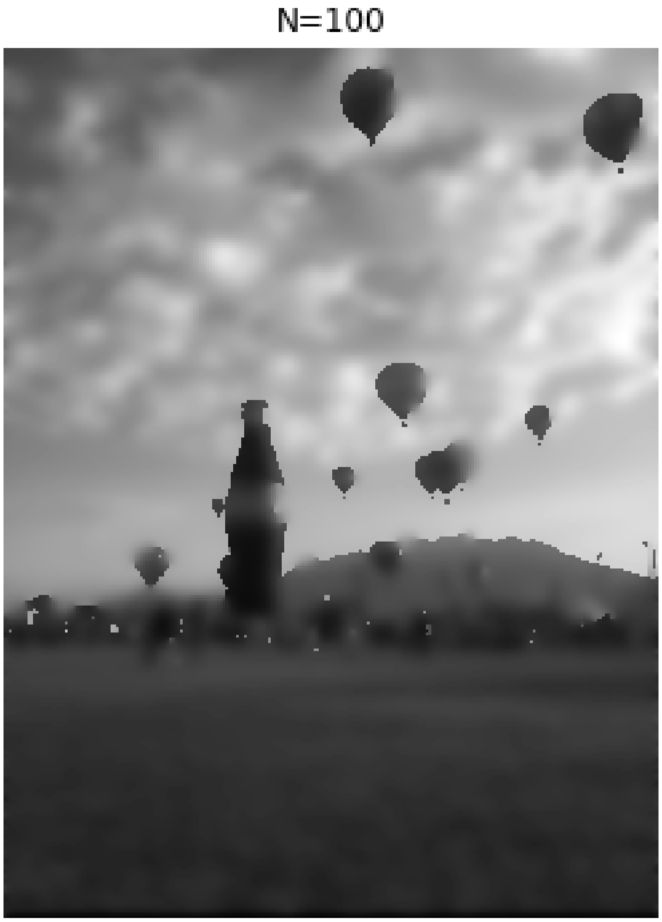
PROBLEM 1



N=5

N=20





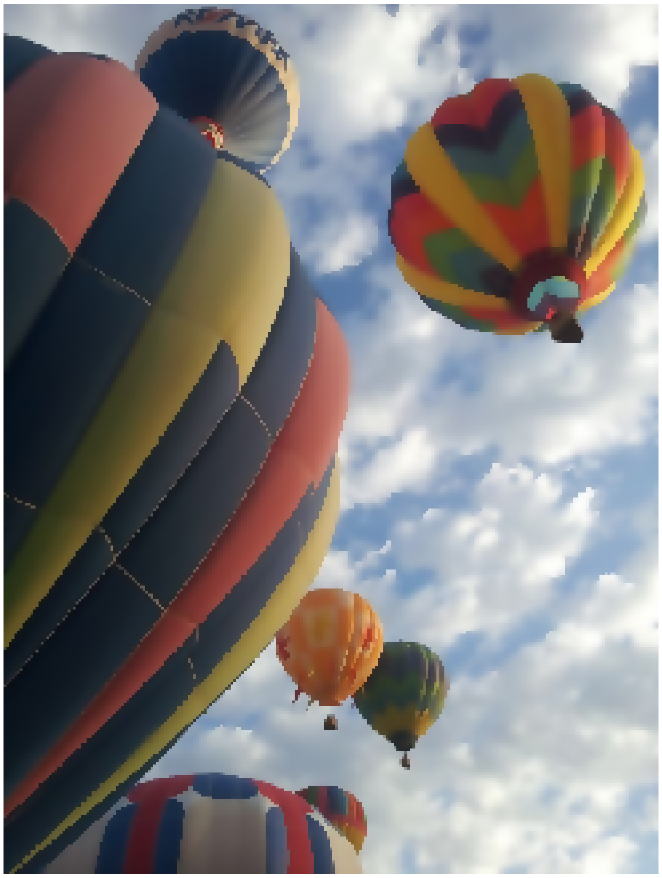
```
In [96]: def anisdiff_color(U,N,lambda_,sigma):
             x,y,z=U.shape
             A=np.zeros(shape=(x+2,y+2,z))
             norm=lambda u: np.sqrt(np.sum(u**2,axis=2,keepdims=True))
             A[1:-1,1:-1,:]=U
             A[0]=A[1]
             A[1]=A[-2]
             A[:,0]=A[:,1]
             A[:,-1]=A[:,-2]
             U=A
             for i in range(N):
                 U[1:-1,1:-1]=U[1:-1,1:-1]+lambda_*\
                 (g(norm(U[0:-2,1:-1]-U[1:-1,1:-1]))*(U[0:-2,1:-1]-U[1:-1,1:-1])\
                 +g(norm(U[2:,1:-1]-U[1:-1,1:-1]))*(U[2:,1:-1]-U[1:-1,1:-1])\
                 +g(norm(U[1:-1,0:-2]-U[1:-1,1:-1]))*(U[1:-1,0:-2]-U[1:-1,1:-1])\
                 +g(norm(U[1:-1,2:]-U[1:-1,1:-1]))*(U[1:-1,2:]-U[1:-1,1:-1]))
             plt.figure(figsize=(6,6))
```

```
    plt.imshow(U[1:-1,1:-1])
    plt.title("N="+str(N))
    plt.axis("off")
    plt.show()

print("PROBLEM 2")
picture=imread('balloons_color.png')*1./255
plt.figure(figsize=(6,6))
plt.imshow(picture)
plt.axis("off")
plt.show()
anisdiff_color(picture,5,.25,.1)
anisdiff_color(picture, 20,.25,.1)
anisdiff_color(picture,100,.25,.1)
```

```
PROBLEM 2
```

N=5



N=20

N=100

```
In [106]: image=imread('balloon.png',flatten=True)
          plt.figure(figsize=(6,6))
          plt.imshow(image, cmap=cm.gray)
          plt.show()
          x,y=image.shape
          for i in range(x*y//100):
              image[randint(x),randint(y)]=127+randint(127)
          plt.figure(figsize=(6,6))
          plt.title("Image with Noise")
          plt.imshow(image, cmap=cm.gray)
          plt.axis("off")
          plt.show()
          sigma=.1
          g=lambda x: np.e**(-1*(x/sigma)**2)
          anisdiff_bw(image, 20,.25,g)
          print("The contrast between the noise and the original image is sharp enough \
          that it is being recognized as part of the image.")
```

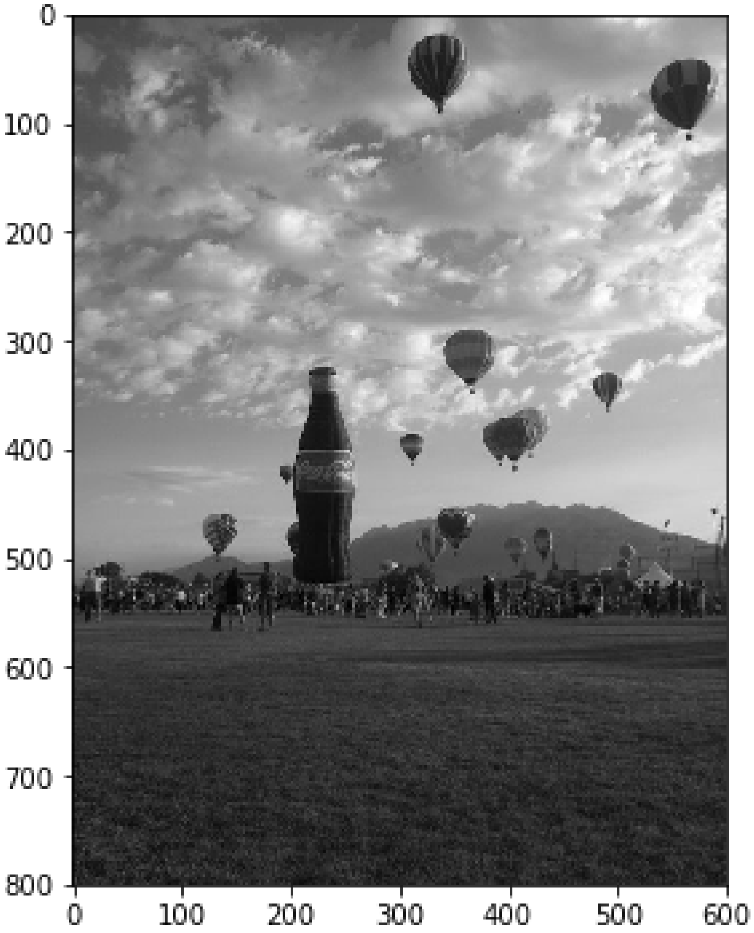
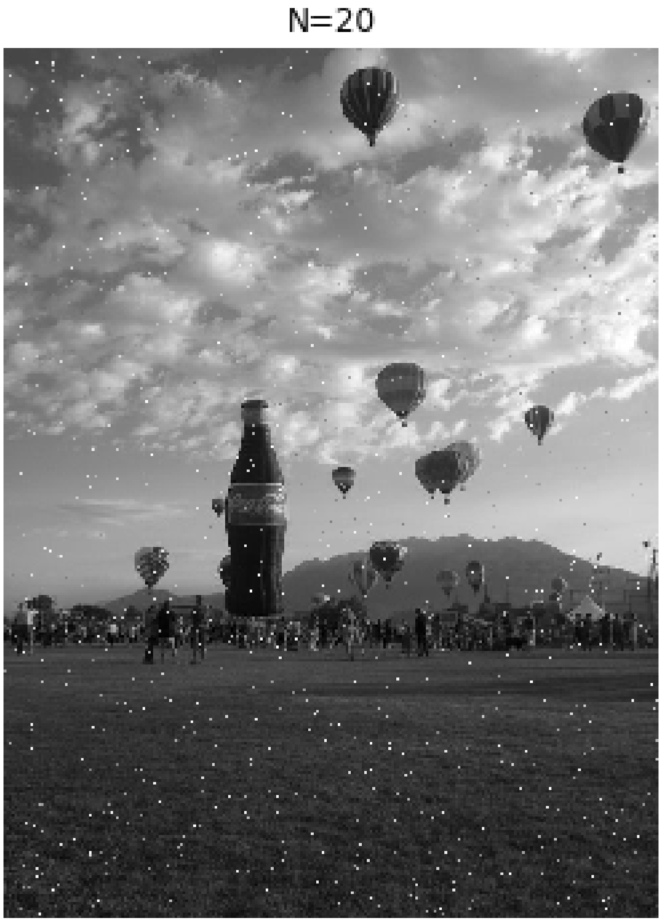

0
100
200
300
400
500
600
700
800
0
100
200
300
400
500
600

Image with Noise



```
The contrast between the noise and the original image is sharp enough that it is being recognize
```

In [ ]: