**from** PIL **import** Image  
**from** pylab **import** \*  
  
*##image manipulation*im = Image.open(**'uw.png'**)  
  
crop = (75,100,180,150)  
im\_crop = im.crop(crop)  
im\_rs = im.resize((100,100))  
im\_rotate = im.rotate(180)  
  
print(im)  
print(im\_crop)  
print(im\_rs)  
print(im\_rotate)  
  
imshow(im)  
imshow(im\_crop)  
imshow(im\_rs)  
imshow(im\_rotate)

*##math representation*im\_m = array(im)  
im\_grey\_m = array(im.convert(**'L'**))  
im\_v = im\_m.flatten()  
  
print(im\_m)  
print(im\_grey\_m)  
print(im\_v)  
  
im\_m.shape  
im\_v.shape  
im\_grey\_m.shape

im\_4 = im\_m[:,:,3]  
imshow(im\_4)  
  
im\_s = im\_m[20:60,:,:]  
imshow(im\_s)  
  
im\_i = 255 - im\_m[:,:,:-1]  
imshow(im\_i)  
  
im\_3d = im\_m[:,:,:-1]  
imshow(im\_3d)  
  
figure()  
hist(im\_v,256)

*##normalization*imhist,bins = histogram(im\_grey\_m.flatten(), 256, density=**True**)  
cdf = imhist.cumsum()cdf = 255 \* cdf / cdf[-1]im2 = interp(im\_grey\_m.flatten(), bins[:-1], cdf)  
im\_norm = im2.reshape(im\_grey\_m.shape)

*##display*  
imshow(im\_norm)  
imshow(im\_grey\_m)

figure()  
hist(im\_grey\_m.flatten(),256)  
hist(im2.flatten(),256)