Image blurring

In [1]:

```
import numpy as np
import matplotlib.pyplot as plt
```

Read in an image. PNG are easily supported, but the Python package PIL handles other formats.

Simply using `imread` and `imshow` will reveal that the image is in color (CMYK color space). This will be a $500 \times 500 \times 4$ double array. But let's collapse it by adding all of the colors.

In [2]:

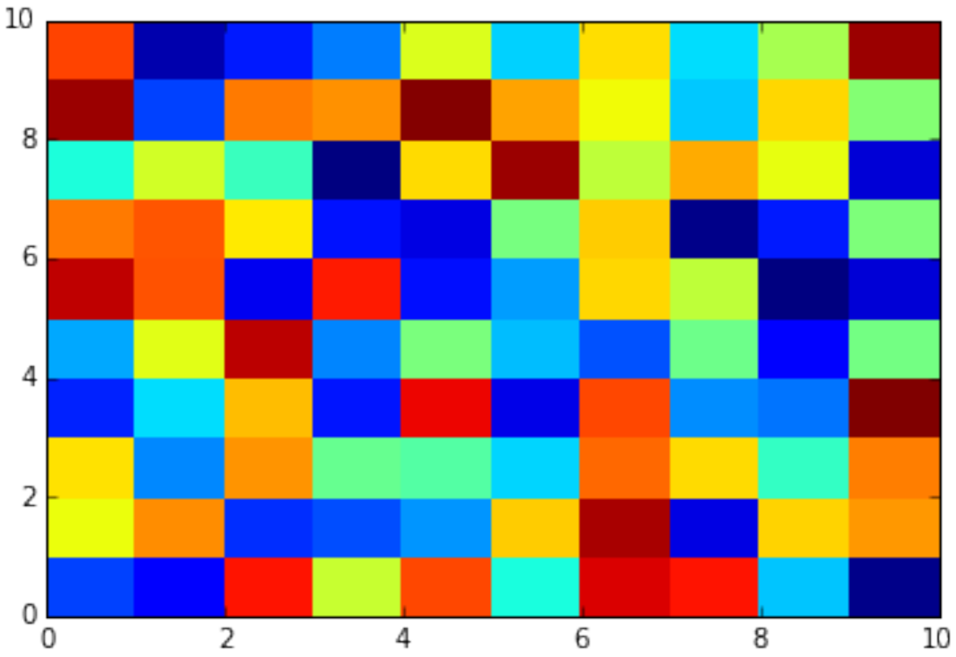
```
I = plt.imread('alma.png')
I = I.sum(axis=-1)
```

In [10]:

```
A = np.random.rand(10,10)
plt.pcolor(A)
```

Out[10]:

```
<matplotlib.collections.PolyCollection at 0x1092538d0>
```



In [8]:

```
plt.figure(figsize=(12,12))
plt.imshow(I, cmap="gray")
```

Out[8]:

```
<matplotlib.image.AxesImage at 0x107697710>
```

Let's try something. Let's go to every pixel in the image a rewrite the grayscale of that pixel as the weighted average of its neighbors:

$$pixel \leftarrow \frac{1}{8}(4pixel + pixel_{north} + pixel_{south} + pixel_{west} + pixel_{east})$$

In [11]:

```
def blur(I):
    for i in range(1,I.shape[0]-1):
        for j in range(1,I.shape[1]-1):
            I[i,j] = (4*I[i,j] + I[i-1,j] + I[i+1,j] + I[i,j-1] + I[i,j+1])/8.0
    return I
```

Now time it!

In [13]:

```
%timeit blur(I)
```

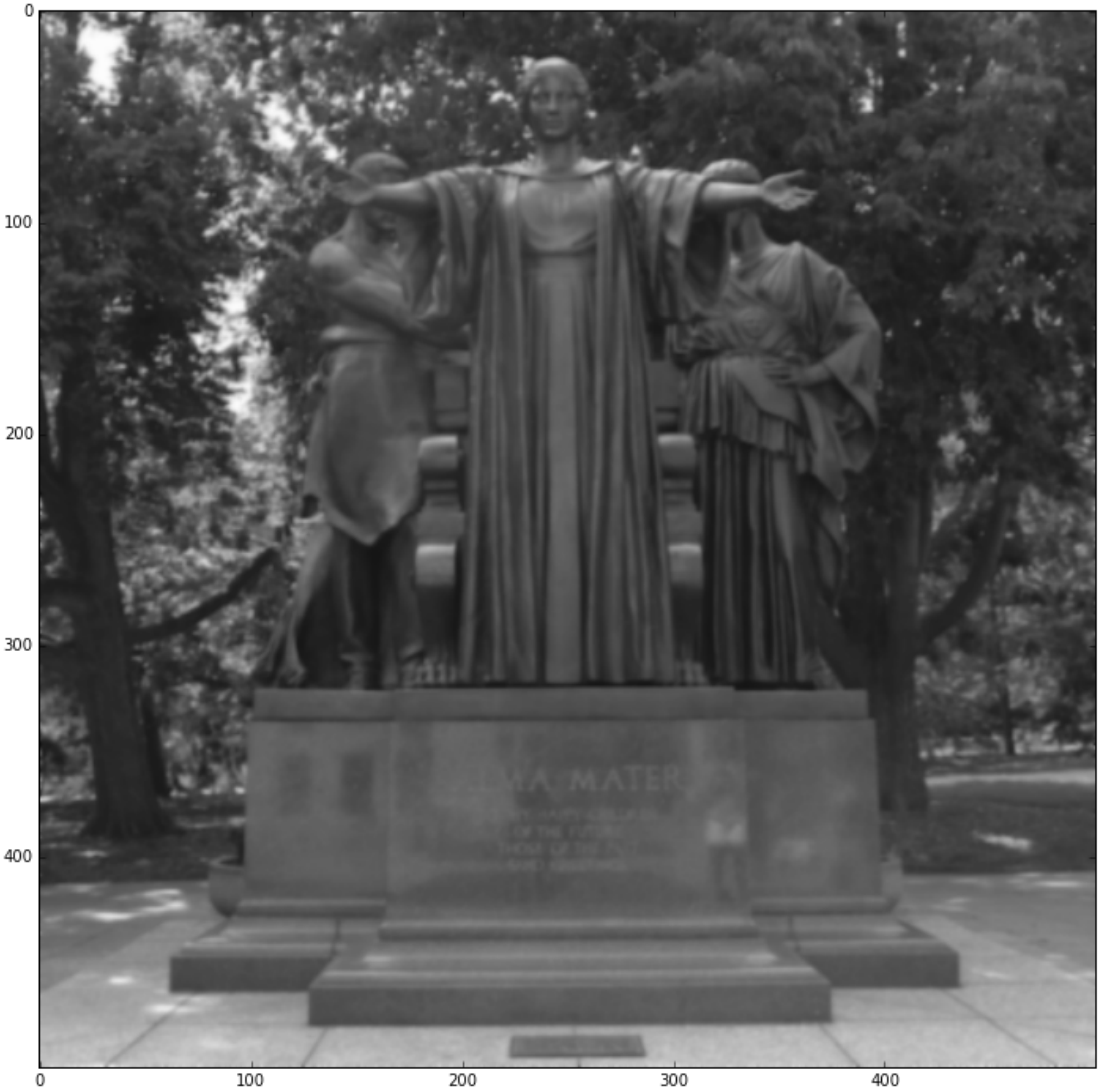
```
1 loops, best of 3: 1.38 s per loop
```

In [12]:

```
blur(I)
blur(I)
blur(I)
plt.figure(figsize=(12,12))
plt.imshow(I, cmap="gray")
```

Out[12]:

```
<matplotlib.image.AxesImage at 0x10930add0>
```



Ok, this is fine, but we can do it as an "array" operation instead of two loops. Check it out.

In [19]:

```
A = np.arange(0,25).reshape((5,5))
print(A)
idx = np.arange(1,4)
print(idx)
print(A[:,idx][idx,:])
```

```
[[ 0  1  2  3  4]
 [ 5  6  7  8  9]
 [10 11 12 13 14]
 [15 16 17 18 19]
 [20 21 22 23 24]]
[1 2 3]
[[ 6  7  8]
 [11 12 13]
 [16 17 18]]
```

In [20]:

```
def blur2(I):
    idx = np.arange(1,I.shape[1]-1,dtype=int)
    I[:,idx][idx,:] = (5*I[:,idx][idx,:] + I[:,idx-1][idx,:] + I[:,idx+1][idx,:]
+ I[:,idx][idx-1,:] + I[:,idx][idx+1,:])
    return I
```

In [21]:

```
%timeit blur2(I)
```

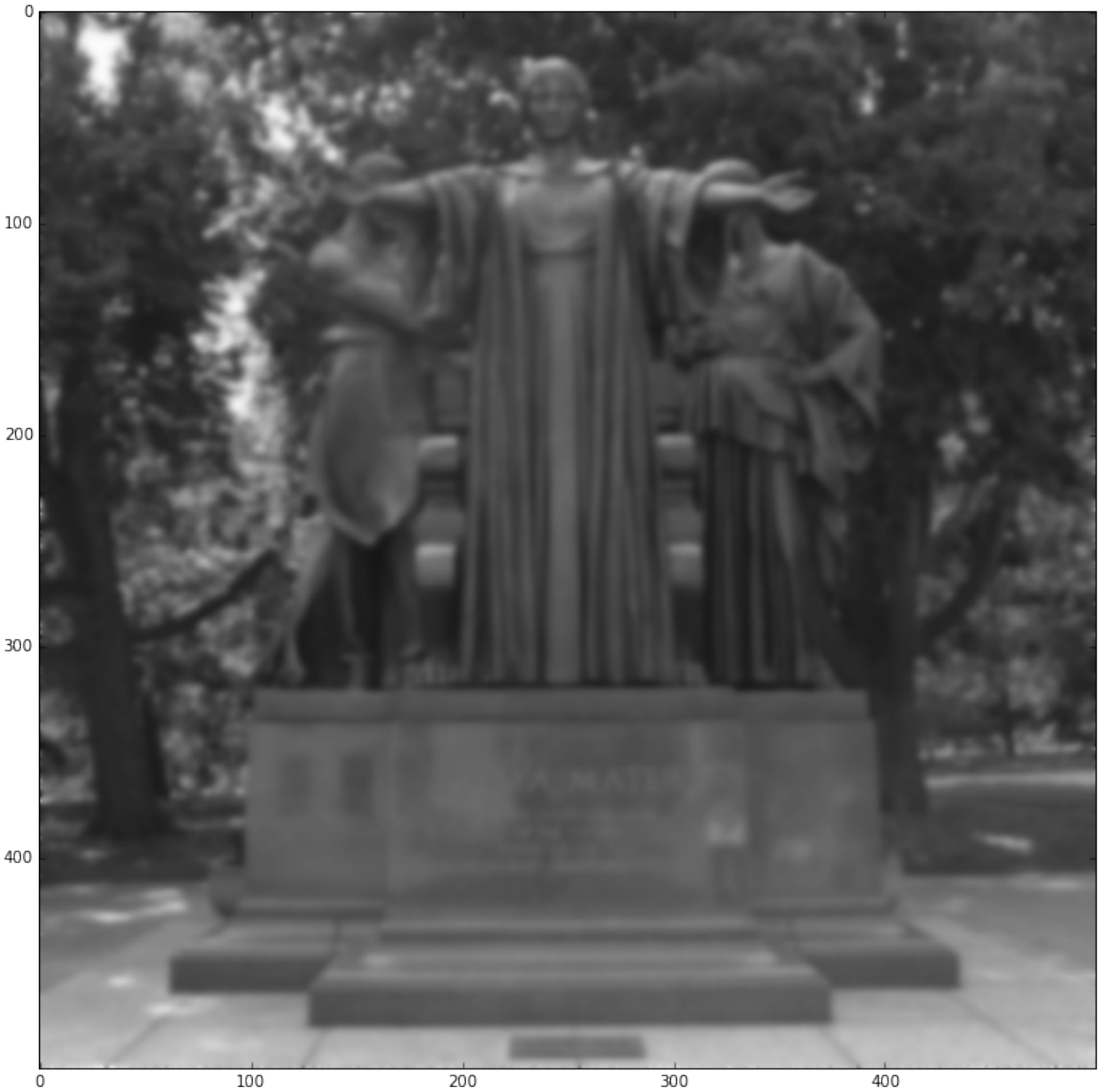
```
100 loops, best of 3: 7.1 ms per loop
```

In [22]:

```
blur(I)
blur(I)
blur(I)
plt.figure(figsize=(12,12))
plt.imshow(I, cmap="gray")
```

Out[22]:

```
<matplotlib.image.AxesImage at 0x1099baa50>
```



In [ ]: