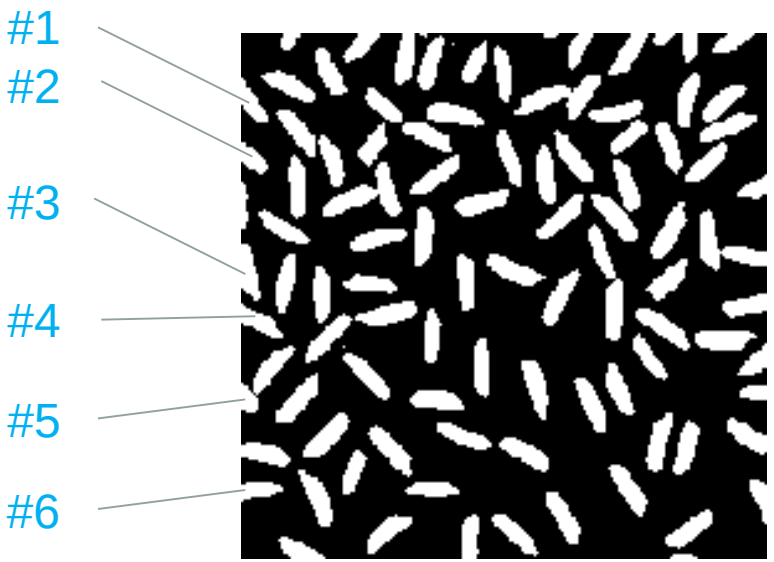
Now What?

- Want to identify how many grains are there in the image
- How?



Connected-component Labeling

- A procedure for assigning a unique label to each object

Binary image

0	0	0	0	0	0	0
0	1	1	0	0	0	0
0	1	0	1	1	1	0
0	1	0	0	1	0	0
0	0	0	0	0	0	0

Label matrix

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Step 1:

Binary image

0	0	0	0	0	0	0
0	1	1	0	0	0	0
0	1	0	1	1	1	0
0	1	0	0	1	0	0
0	0	0	0	0	0	0

Label matrix

0	0	0	0	0	0	0
0	1	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Connected-component Labeling (Cont'd)

- Finish labeling of a component

Step 2:

Binary image

0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	1	1	1	0
0	1	0	0	1	0	0
0	0	0	0	0	0	0

Label matrix

0	0	0	0	0	0	0
0	1	1	0	0	0	0
0	1	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Step 3:

Binary image

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	1	1	1	0
0	1	0	0	1	0	0
0	0	0	0	0	0	0

Label matrix

0	0	0	0	0	0	0
0	1	1	0	0	0	0
0	1	0	0	0	0	0
0	1	0	0	0	0	0
0	0	0	0	0	0	0

Connected-component Labeling (Cont'd)

- Iterative process until all the pixels are checked

Step 4:

Binary image

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	1	1	0
0	0	0	0	1	0	0
0	0	0	0	0	0	0

Label matrix

0	0	0	0	0	0	0
0	1	1	0	0	0	0
0	1	0	2	2	0	0
0	1	0	0	0	0	0
0	0	0	0	0	0	0

Step 5:

Binary image

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Label matrix

0	0	0	0	0	0	0
0	1	1	0	0	0	0
0	1	0	2	2	2	0
0	1	0	0	2	0	0
0	0	0	0	0	0	0

Connected-component Labeling: `bwlabel()`

- Built-in connected-component labeling algorithm

```
I=imread('rice.png');
BG=imopen(I, strel('disk', 15));
I2=imsubtract(I, BG); level=graythresh(I2);
BW=im2bw(I2, level);
[labeled, numObjects]=bwlabel(BW, 8);
```

- Check the matrix `labeled`
- What is the size of the largest grain?
- What is the mean size of the grains?

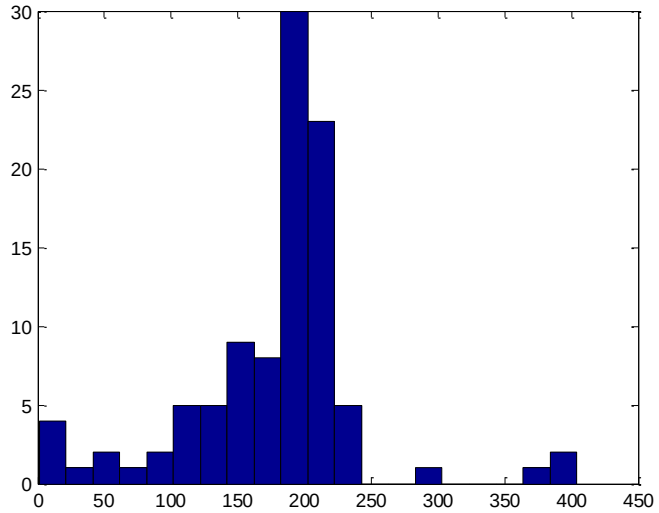
Color-coding Objects: `label2rgb()`

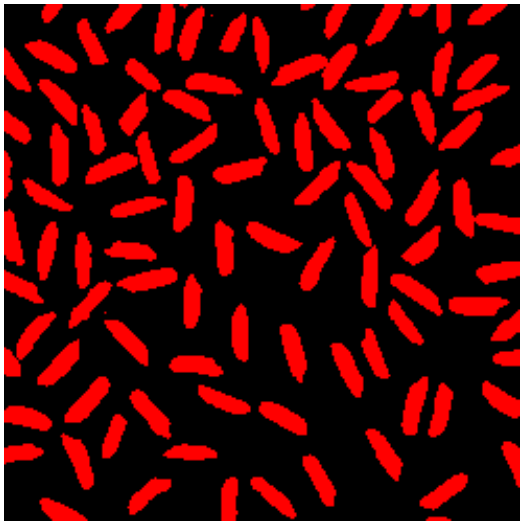
- Converts a label matrix into an RGB color image
- Visualize the labeled regions

```
I=imread('rice.png');
BG=imopen(I, strel('disk', 15));
I2=imsubtract(I, BG); level=graythresh(I2);
BW=im2bw(I2, level);
[labeled, numObjects]=bwlabel(BW, 8);
RGB_label=label2rgb(labeled); imshow(RGB_label);
```

Practice

- Plot the histogram of grain size
- Identify all the grains in the image by painting them in red





- Wait, is it perfect?