

Computer Class 5

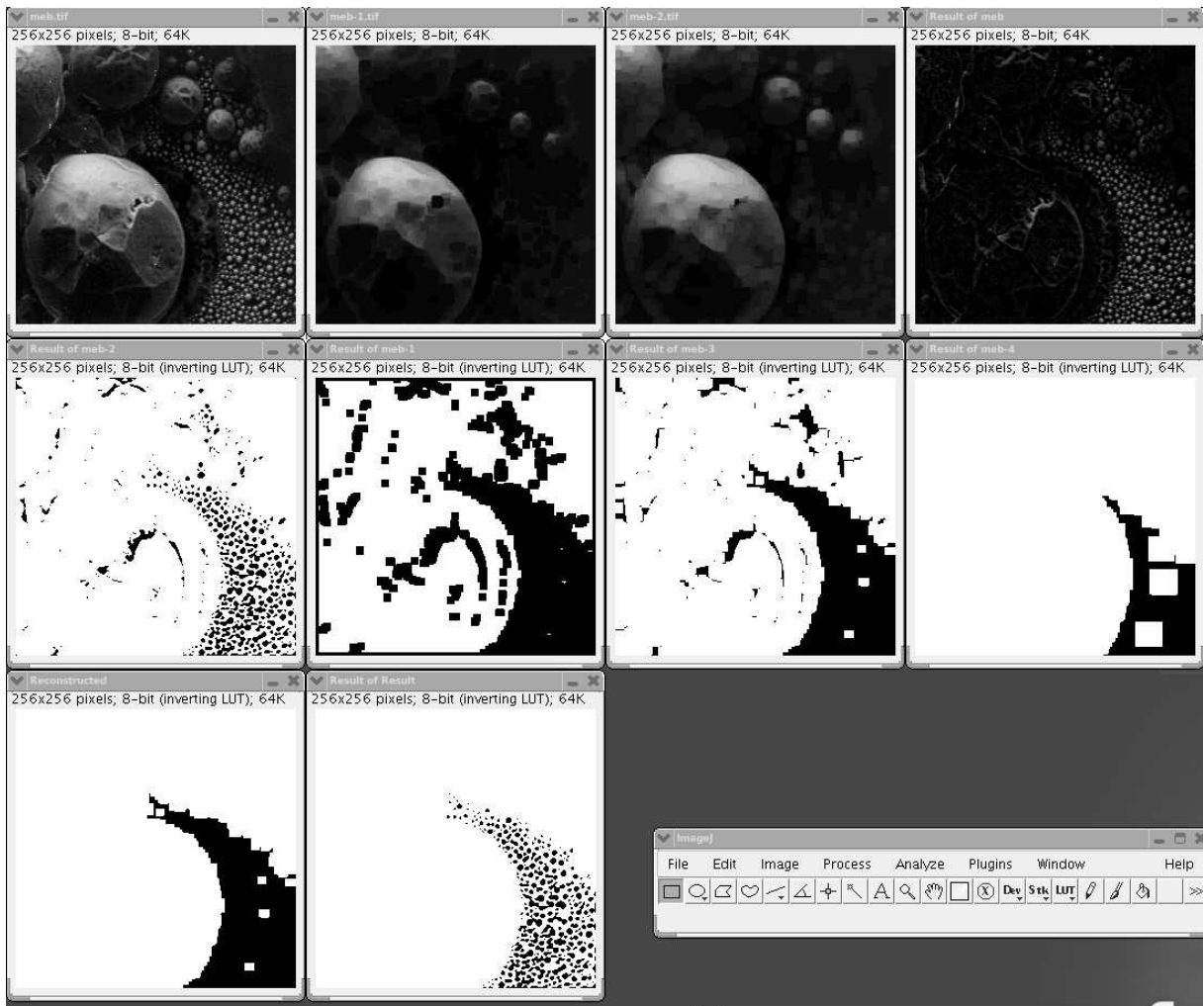
1. For the first question I would like you to repeat the demonstration that I did in class last week.

Read in the image meb.tif. We might ask how many small particles are in the region on the lower right of the image?

The analysis can be carried out by following the commands below. Remember to take duplicate images every now and then, so that intermediate images can be saved and used later. Also, the command Edit > Undo is useful for correcting a mistake!

Menu Commands	Resulting image
Open > meb.tif	[A]
Duplicate (use right mouse button)	
Plugins > Morphology > GreyscaleDilate (3 iterations)	
Plugins > Morphology > GreyscaleErode (3 iterations)	[B]
Process > Image Calculator	
[A] subtract [B]	
Image > Adjust > Threshold (apply)	[C]
Duplicate (use right mouse button)	
Plugins > Morphology > BinaryErode (3 iterations)	
Plugins > Morphology > BinaryDilate (3 iterations)	[D]
Duplicate (use right mouse button)	
Plugins > Morphology > BinaryDilate (8 iterations)	[E]
Plugins > Morphology > BinaryReconstruct	
mask [D] seed [E]	[F]
Process > Image Calculator	
[C] AND [F]	
Plugins > Morphology > Particles4	

Following through the commands the images below were obtained. How many particles are there in the last image?



2. Read in the image `cerm.tif` and provide a suitable thresholded binary image. How many particles are there of size at least 100 pixels which do not touch the border?
3. Read the file `scheme.tif`. Segment the image to extract the circuit from the background. Try to remove as much of the writing as possible.
You should list the commands that you use, with an explanation.
4. Choose one of the grayscale images in the image directory. Add some noise. Apply the mean, median, gray level opening and gray-level closing filters. Which method best removes the noise? Try other types of noise.

Some observations/solutions

Q1. Using the default threshold there are 367 particles.

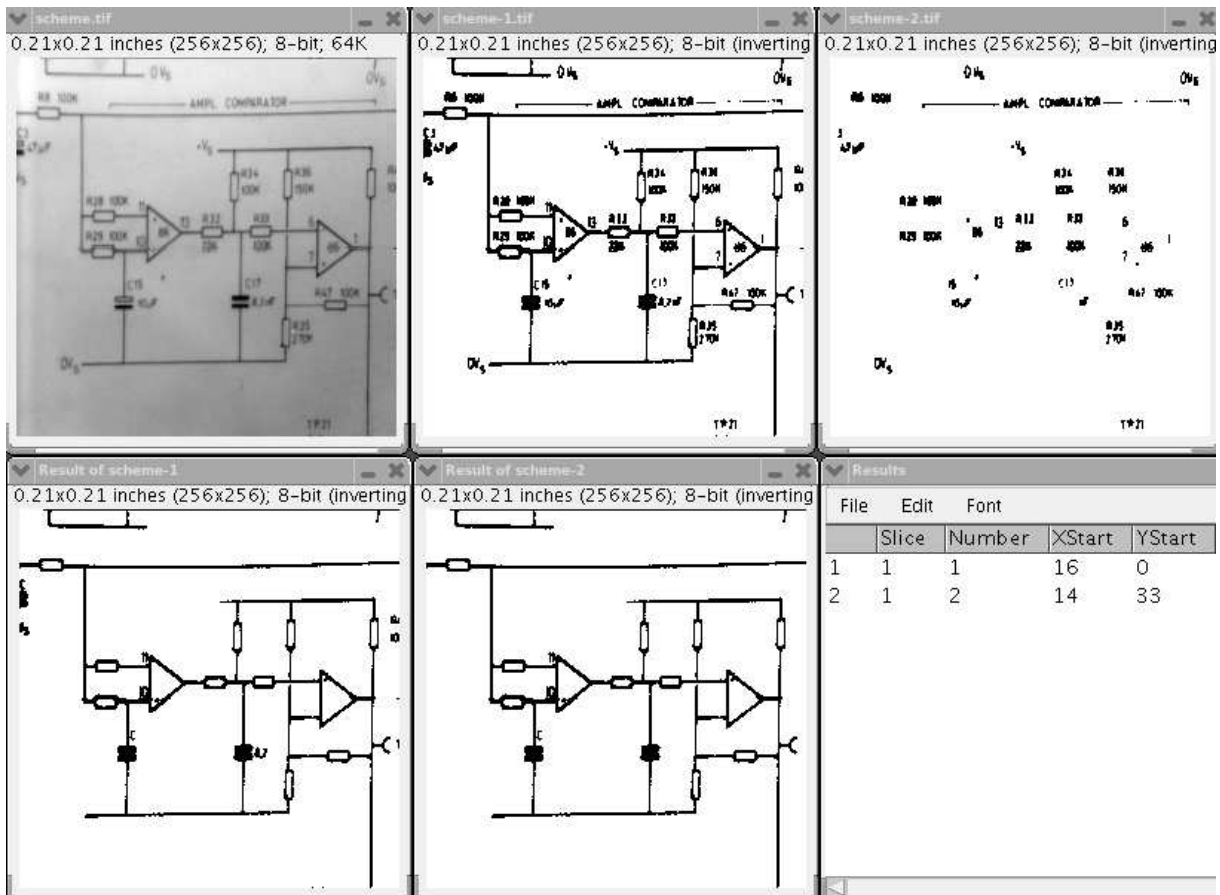
Q2. The threshold command is again used here, together with the Particles4 command in the morphology plug-in. There are 41 particles in the last image, which have size at least 100 pixels and do not touch the border, using the options in Plug-ins > Morphology > Particles4

The screenshot displays the ImageJ interface with the following components:

- Image Windows:**
 - carm-2.tif:** Original grayscale image of particles.
 - carm-1.tif:** Image after thresholding, showing particles in red.
 - carm-3.tif:** Inverted binary image (black particles on white background).
 - carm-4.tif:** Final image showing particles in red after applying the Particles4 command.
- Threshold Dialog:** Shows a histogram and a threshold slider set to 129. The 'Red' color is selected for the thresholded areas.
- Results Table:** A table listing the properties of 12 particles. The columns are Slice, Number, XStart, YStart, Perim, Area, Pixels, XM, and YM.

	Slice	Number	XStart	YStart	Perim	Area	Pixels	XM	YM
1	1	1	197	6	74	247	285	197.211	15
2	1	2	218	17	74	240	278	218.788	27
3	1	3	42	18	64	198	231	44.580	26
4	1	4	170	21	98	451	501	173.938	33
5	1	5	75	26	116	601	660	73.305	41
6	1	6	231	39	64	195	228	233.092	47
7	1	7	137	42	92	401	448	138.469	54
8	1	8	198	43	104	348	401	194.653	53
9	1	9	27	44	100	469	520	28.348	57
10	1	10	99	60	92	378	425	98.932	73
11	1	11	215	60	74	233	271	214.166	70
12	1	12	168	65	54	121	159	167.522	75

Q3. Obviously there is great flexibility in the use of commands, and you may well do better than I have.



The commands I used here are:

```

Process > Background Subtract
Image > Adjust > Threshold [A]
Plug-ins > Morphology > BinaryKillBorders [B]
Process > Image Calculator
[A] subtract [B]

```

```

Plug-ins > Morphology > Particles4 (remove particles of size > 100)

```

A thresholding of the original image does not work well, as there is a strong gradient in the background (dark in the bottom right, light in the top left). Hence, a local background subtraction works well here.

After applying a threshold the circuitry and writing remain in [A]. Note that the circuits intersect with the boundary, but the writing does not. Hence if we apply a Border Kill then we remove the circuitry, to give the writing only in [B]. Subtracting [B] from [A] gives us the desired circuit, without much writing. Small isolated parts of writing are then removed by applying the Particle4 command, removing items smaller than 100 pixels.