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.tiff. 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.tiff 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.tiff. 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
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.