# BME 51:186 — Homework 4

**DUE: October 18, 2004 at start of class**
**No late homework accepted!**

In this assignment you will create and test image processing functions for binary mathematical morphology. You will find the images for this assignment in the `homework4` directory. For each of the parts described below, handle common error conditions such as no image loaded, wrong image type loaded, and bad input parameter value by detecting these conditions and displaying an error dialog.

Because these problems require that you devise an algorithm to solve a problem, part of your grade will be based on how well you comment the source code that describes the algorithm. If we can't understand your source code and comments, you will not receive full credit, even if the algorithm works.

**How to turn in your assignment:** All problems must be completed using the MILP framework discussed in class. To submit the homework, use the same procedure you used for homework one. For this assignment, you might find it best to organize all of the morphology functions into a source file by themselves.

1. See the image file `balls.tif`. Using morphological operations, write a function to process the image and retain only the disk-shaped regions. Make your function run as operation `O1` in the MILP framework.

2. The size characteristics of image regions can be measured using *granulometry*. To measure the region size at homothetic size $k$, we compute the quantity $a(k)$:

$$a(k) = (I \circ (k-1)B) \setminus (I \circ kB),$$

   where $k = 1, 2, \ldots N$, $I$ is the image under consideration, $\circ$ represents the morphological opening, $kB$ is the $k^{\text{th}}$ homothetic of a structuring element $B$, $N$ is the largest integer such that the opening of the image with $NB$ is non-empty, and "\" is the set difference operation. By measuring the area of $a(k)$ for various $k$, we can make a size histogram for the regions in an image.

   Develop an algorithm to compute the size histogram for an image. Your function should create a file `shist.txt` that contains two columns of numbers: the first column lists $k$ and the second column lists $a(k)$.

   **Note: in an ideal setting, we would use a disk structuring element for $B$. In this case, use the approximation that $B$ is a single point at the origin for $k = 0$, $B = B_4$ for $k = 1$, $B = B_4 \oplus B_8$ for $k = 2$, $B = B_4 \oplus B_8 \oplus B_4$ for $k = 3$, etc.**

   Make your size histogram function run as operation `O2` in the MILP framework. Test your program by applying it to the files `disks1`, `disk2`, `disks3`, and `disks4`.

3. Plot the size histogram for `disks1, disks2, disks3` and `disks4` in the `morphology` directory. Plot and compare the size histograms for these four different images. One image should be "different" from the others. Which image is different and why?