Numerical Implementation Assignments

I strongly recommend to all enrolled students to choose one numerical assignment, and to work on that problem with my help. You can also work in teams of 2-3 students on the same project. Students already working on related subjects, can choose a short project part of their current thesis research, instead of the following proposed projects.

Students who are more interested in reading a paper in details (not among those already discussed), and maybe giving a short presentation in class, instead of working on a numerical project, can do so.

The steps should be (using the paper devoted to the model of your choice):

- write down the model (variational model or PDE's)
- write down the numerical scheme to be used
- implement in the language of your choice that numerical scheme and perform a test, including the choice of parameters, on a particular image.

Projects:

1. Classical edge detection: comparison between gradient-edge detector, zero-crossings of the Laplacian and the Canny's edge detector.
2. Blurring images by convolution with different types of blurs (point-spread-functions).
3. Osher-Rudin image enhancement filter.
4. Total variation minimization for image denoising (the unconstrained case).
5. Total variation minimization for image denoising (the constrained case and adaptive Lagrange multiplier, when the standard deviation of the noise is known).
6. Perona-Malik equation for anisotropic diffusion.
7. Multi-scale analysis by motion by mean curvature.
8. Multi-scale analysis by affine motion with mean curvature.
9. Ambrosio-Tortorelli approximations for Mumford-Shah segmentation.
10. Geodesic active contours by level sets for object detection (Caselles, Kimmel, Sapiro).
11. Active contours without edges by level sets for object detection (Chan-Vese).
12. More projects can be proposed.