Advanced Topics in Machine Learning (600.692)
Homework 2: Manifold Learning and Subspace Clustering

Instructor: René Vidal

Due Date: 04/18/2016, 11:59AM Eastern Time

READING MATERIAL: Chapters 4, 6, 7, 8 of GPCA book.

1. **Spectral Clustering** (25 points)

   (a) Exercise 4.13

2. **LLE and LLMC** (20 points)

   (a) Exercise 7.2

3. **SSC and LRSC** (10 + 5 = 15 points)

   (a) Exercise 8.1

   (b) Exercise 8.3

4. **Face Clustering** (30 + 10 = 40 points)

   (a) Implement the K-Subspaces Algorithm (Algorithm 6.1), the LRSC algorithm with noisy data (Algorithm 8.1 with C matrix as per Theorem 8.10) and the SSC algorithm with noisy data (Algorithm 8.5 and 8.6).

   (b) Apply the algorithms in part (a) to the face images from three individuals of the YaleB dataset available here. Report the clustering error for different choices of the parameters τ for LRSC and λ for SSC.

Submission instructions. Please send an email to the TA (click here) with subject 600.692:HW2 and attachment `firstname-lastname-hw2-learning16.zip` or `firstname-lastname-hw2-learning16.tar.gz`. The attachment should have the following content:

1. For analytical questions, please submit a file called `hw2.pdf` containing your answers to each one of the analytical questions. If at all possible, you should generate this file using the latex template hw1-learning14.tex. If not possible, you may use another editor, or scan your handwritten solutions. But note that you must submit a single PDF file with all your answers.

2. For coding questions, please submit a file called `README`, which contains instructions on how to run your code. Please use separate directories for each coding problem, each one containing all the functions and scripts you are asked to write in separate files. For example, for HW1 the structure of your submission could look like

   (a) `README`

   (b) `hw1.pdf`

   (c) `hw1q3: hw1q3c.m, hw1q3e.m`

   The TA will run your scripts to generate the results. Thus, your script should include all needed plotting commands so that figures pop up automatically. Please make sure that the figure numbers match those you describe in `hw1.pdf`. You do not need to submit input or output images. The output images should be automatically generated by your scripts so that the TA can see the results by just running the scripts. In writing your code, you should assume that the TA will place the input images in the directory that is relevant to the question solved by your script. Also, make sure to comment your code properly.