

CSE 494/598, Fall 2007 Homework 6
Due on Monday, November 12

1. We apply tensor factorization to a three-dimensional image (data in MATLAB format: Brain_img.mat). You can load the data into MATLAB by `load Brain_img.mat`. The matrix A is of size 181-by-271-by-181. To visualize a slice of the image, you can use `imshow(A(:,:,100))`. Hand in an electronic (blackboard) copy of the solution by providing:
 - (i) The source code for unfolding along the i -th mode to get the matrix $A_{(i)}$. **(10 points)**
 - (ii) The source code for computing the orthogonal matrices $U^{(i)}$ along the i -th mode through the SVD of $A_{(i)}$. **(10 points)**
 - (iii) The source code for computing the core tensor S . **(10 points)**
 - (iv) The source code for computing the reduced rank tensor by keeping the top $R1$ slices of S along the first mode, the top $R2$ slices of S along the second mode, and the top $R3$ slices of S along the third mode. **(10 points)**
 - (v) The source code for computing the reconstructed tensor. **(5 points)**
 - (vi) Report the information loss and the compression ratio for the following three cases (Summarized the result in a table): **(5 points)**
 - * $(R1, R2, R3) = (40, 40, 40)$
 - * $(R1, R2, R3) = (30, 30, 30)$
 - * $(R1, R2, R3) = (20, 20, 20)$

Download the tensor toolbox at <http://csmr.ca.sandia.gov/~tgkolda/TensorToolbox/>.

The function, `tenmat`, may be useful for this homework: `A1 = tenmat(A, mode)`. You need to use `A1.data` to get the matrix. Use the help function to learn more about a specific function, e.g., `help tenmat`.

The information loss is defined as $\frac{\text{norm}(Z - A)}{\text{norm}(A)}$, if Z is the reconstruction. The compression ratio is defined as the ratio between the size of A and the size of the reduced core tensor $(R1 * R2 * R3)$.