Numerical Methods for Visual Computing
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Weekly Exercises 7

To be discussed on Friday, 29.11.2019, 10:15-11:45, in room H-C 6336
Submission deadline: Wednesday, 27.11.2019

Programming

Exercise 1 (4 points)**.** Consider the matrix

$$A = \begin{pmatrix} 2 & 0 & -1 \\ 3 & -1 & 2 \\ -6 & 0 & 3 \end{pmatrix}.$$

Implement the power method for finding the eigenvalue of largest magnitude of a matrix. Test your program using the matrix A, and plot the decay of $\|(A-\lambda^k I)u^k\|$ and $|\lambda^k - \lambda_1|$, where λ^k and u^k are your current estimates of the eigenvalue with largest magnitude and a corresponding eigenvector.

Now initialize your power method with a vector $\alpha_2 u_2 + \alpha_3 u_3$ with random weights α_2 and α_3. How does the power method behave now?

Exercise 2 (4 points)**.** In this exercise, we consider finding the dominant principal component of given data points. Download the point cloud given in *data.zip*. You will find a 2D point cloud data in *points.mat* and *points.csv*. Normalize the data in each column $x_n = \dfrac{x - \mu_x}{\sigma_x}$, and $y_n = \dfrac{y - \mu_y}{\sigma_y}$, and stack these columns to form a normalized data matrix X. Form a covariance matrix $X^T X$. Find the dominant eigen value and eigen vector of this matrix using the power method implemented in Exercise 1. Plot together the normalized point cloud and the dominant eigen vector. What do you observe?