Homework 5

Due date: April 1, 2016, 11:55PM.

Bibliography: Course lecture notes Lessons 21-23. Textbook pp. 395-424, Sections 8.2-8.4.

1. (1 course point) Textbook p.400, Exercise 8.2.1
2. (1 course point) Textbook p.401, Exercise 8.2.7
3. (1 course point) Textbook p.404, Exercises 8.2.19-22
4. (1 course point) Textbook p.404, Exercises 8.2.23-26
5. (Computer application 4 course points) We illustrate practical applications of eigenvalue and eigenvector computation by an investigation of systems of masses and springs.

   Task 1. (1 course point *ex oficio*). Read Section 6.1 of textbook, pp. 293-301.

   Task 2. (1 course point). Consider a one-dimensional lattice of n point masses with mass m_j at position j, $1 \leqslant j, k \leqslant n$, connected by $n-1$ springs of stiffness c_j and undeformed length $l=1$ between point masses $j, j+1$. Let $\boldsymbol{u}$ denote the vector of displacements of the point masseses from their equilibrium positions. Write an Octave/Matlab script to construct the stiffness matrix $\boldsymbol{K}$ of the system (cf. formula 6.12, p.296 of textbook).

   Task 3. (2 course points). Choose $n = \text{ord(FirstName)} + \text{ord(LastName)}$, with ord the ordinal of the letter in the alphabet. Compute the eigenvalues and eigenvectors of $\boldsymbol{K}$ for:

   a) $c_j = 1, 1 \leqslant j \leqslant n-1$

   b) $c_j = 1 + (j-1)(n-1-j)$

   In both cases, plot the first 5 eigenvectors. What aspect of the motion of the mass-spring system is represented by each eigenvector.