

HW #4 (Feb. 9, 2016): Computational Physics

deadline: Feb. 23, 2016 5pm

1. Solve the following linear algebraic equations by using the singular value decomposition (SVD) method. As you noticed, the equations are the same as those in HW3. This is a chance to solve the same problem with a different method. For diagonalization of a matrix, use the Jacobi method discussed in the class. At least, the following items must be discussed in the report: (i) the column-orthogonal matrix U , the square diagonal matrix W , and the orthogonal matrix V . (ii) Show that $\mathbf{A} = \mathbf{U}\mathbf{W}\mathbf{V}^T$. (iii) Write down the solution from your code. (iv) Confirm that your solution satisfies the original set of the equations. Is the solution of this problem the same as that in HW3? (v) The number of iterations used for the Jacobi transformation, where one iteration means after you go over all the off-diagonal elements once. (vi) The tolerance used in the Jacobi transformation. (vii) Confirm that the Jacobi transformation diagonalizes the given matrix which you would like to diagonalize. For both the SVD method and the Jacobi method, you need to mention how you tested your code.

$$2x + 3y + 10z - u = 1 \quad (1)$$

$$10x + 15y + 3z + 7u = 2 \quad (2)$$

$$-4x + y + 2z + 9u = 3 \quad (3)$$

$$15x - 3y + z + 3u = 4 \quad (4)$$

2. Solve the following linear algebraic equations by using the SVD method. For diagonalization of a matrix, use the Jacobi method discussed in the class. At least, the following items must be discussed in the report: (i) the column-orthogonal matrix U , the square diagonal matrix W , and the orthogonal matrix V . (ii) Show that $\mathbf{A} = \mathbf{U}\mathbf{W}\mathbf{V}^T$. (iii) Write down the solution from your code and the general solution for the equations. (iv) Confirm that your solution satisfies the original set of the equations. (v) The number of iterations used for the Jacobi transformation, where one iteration means after you go over all the off-diagonal elements once. (vi) The tolerance used in the Jacobi transformation. (vii) Confirm that the Jacobi transformation diagonalizes the given matrix which you would like to diagonalize. For both the SVD method and the Jacobi method, you need to mention how you tested your code.

$$2x + 3y + 10z - u = 1 \quad (5)$$

$$10x + 15y + 3z + 7u = 2 \quad (6)$$

$$-4x + y + 2z + 9u = 3 \quad (7)$$