Department of Mathematics
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Exercise Class Numerical Linear Algebra

Direct Methods for Linear Systems

Exercise 1: Write a script which reads an upper triangular matrix $A \in \mathbb{R}^{n \times n}$ and a vector $b \in \mathbb{R}^n$ and solves the linear system $Ax = b$ with the backward substitution. Then compute the residual vector: $r = Ax - b$.

Exercise 2: Write a script which reads a lower triangular matrix $A \in \mathbb{R}^{n \times n}$ and a vector $b \in \mathbb{R}^n$ and solves the linear system $Ax = b$ with the forward substitution. Then compute the residual vector: $r = Ax - b$.

Exercise 3: Write a script that solves a linear system $Ax = b$ with the Gaussian elimination method (without pivoting). At the end print the solution $\bar{x}$ and the residual $r = Ax - b$

Exercise 4: Write a script which reads an upper triangular matrix $A \in \mathbb{R}^{n \times n}$ and compute its inverse A^{-1} .

Exercise 5: Write a script which reads a squadre matrix $A \in \mathbb{R}^{n \times n}$ and two number $1 \leq i, j \leq n$ and than swithes the $i - th$ row of A with the $j - th$ row.

Exercise 5: Write a script which reads a squadre matrix $A \in \mathbb{R}^{n \times n}$ and two numbers $1 \leq i, j \leq n$ and than swithes the $i - th$ column of A with the $j - th$ column.

Exercise 6: Write a script that solves a linear system $Ax = b$ with the Gaussian elimination method (with partial pivoting). At the end print the solution $\bar{x}$ and the residual $r = Ax - b$.

Exercise 7: Write a script that solves a linear system $Ax = b$ with the Gaussian elimination method (with total pivoting). At the end print the solution $\bar{x}$ and the residual $r = Ax - b$.

Exercise 8: Write a script that takes as input a symmetric and positive matrix A and solves a linear system $Ax = b$ using the Cholesky factorization. At the end print the solution $\bar{x}$ and the residual $r = Ax - b$.

Exercise 9: Write a script that takes as input a tridiagonal matrix A and solve a linear system $Ax = b$ using Thomas's algorithm. At the end print the solution $\bar{x}$ and the residual $r = Ax - b$.