System of linear equations

> Numerical methods used to solve such problem allow to introduce and experiment on Time_complexity, considering cubic time behavior of standard algorithms and *i.e.* quadratic time solutions using LU decomposition.

Theory

- System_of_linear_equations
- Gaussian_elimination, Gauss and Gauss-Jordan eliminations (diagonalization, triangularization)
- Pivot_element, pivoting
- LU_decomposition
  - Triangular_matrix#Forward_and_back_substitution
- Chapter 2 in the book “Numerical Recipes” :
  - 2.0 Introduction
  - 2.1 Gauss-Jordan Elimination
  - 2.2 Gaussian Elimination with Backsubstitution
  - 2.3 LU Decomposition and Its Application
- Time complexity analysis
  - Hint : in Python, use the timeit module

Exercices and applications

- Exercices :
  - write a python function for diagonalisation with partial pivoting
  - random numbers → linear systems
  - comparison with numpy standard library
  - measurements of execution time to check cubic complexity

1D problems with neigbours

- Thermal diffusion and chemical diffusion (transient or stationary) on a regular 1D space with equidistant steps. ODE equations can be writen such a given evolution equation for node # i only imlies nodes i+1 and i-1
- Using tridiagonal Thomas algorithm allows to save computational time thanks to n complexity
- ? Python library with Thomas algorithm

References :

- Numerical recipes, The Art of Scientific Computing 3rd Edition, William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, 2007, isbn: 9780521880688

- http://numerical.recipes/
  - in C : http://apps.nrbook.com/c/index.html
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