Randomized Numerical Linear Algebra

TD 2

Augustin Parret-Fréaud

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Safran SA | DSTI | Safran Tech | Digital Sciences and Technologies
augustin.parret-freaud@safrangroup.com

Objectives

The objectives of this TD is to investigate interpolative decomposition (ID) and single pass algorithms.

Regarding the numerical experiments, you can work with the same types of operator as in the fist TD, to helps comparison between approaches. The type of studies are roughly the same, with a specific interest on storage size for ID.

As in the previous TD, you will need Python with NumPy, SciPy and Matplotlib.

Exercise 1: ID decomposition

Implement the basic column ID decomposition algorithm.

1. Preliminary: implement a k-step partial CPQR factorisation with a flag to also return the value of its approximation error for a given input matrix (you can do a ”naive” truncated-based version if you want).
2. Implement the deterministic column ID decomposition, and verify on numerical examples that the approximation error is the same as for the partial CPQR.
3. Implement a randomized column ID RSVD algorithm taking an oversampling parameter p and iteration parameter q as arguments.
4. Compare the error approximation and storage requirements with respect to RSVD factorization.

Exercise 2: streaming RSVD algorithm

1. Implement the streaming RSVD algorithm taking an oversampling input parameter p.
2. Investigate the error bounds of your approximation on the matrices studied during TD1 and compare it with classical two-pass RSVD.