General Task

Implement and document a software package for Approximate Joint Diagonalization of matrices in Julia, including the following subtasks:

- implement the algorithm JDiag from [1] and FFDiag from [2], for orthogonal and non-orthogonal AJD, respectively.
- create some test cases with fully diagonalizable matrices and approx. diagonalizable time-delayed correlation matrices.
- visualize the convergence behavior, i.e. by plotting the diagonalization error as a function of the number of iteration
- You should setup a GitHub repository for AJD as part of this project.

Please do not copy/clone existing packages such as *Diagonalizations.jl*, but you can use anything from *LinearAlgebra.jl* and *MatrixDepot.jl*, etc. and existing implementations in Matlab, Python and C can be used for inspirations.

Resources

[1] Cardoso JDiag

Jean-François Cardoso and Antoine Souloumiac. "Jacobi angles for simultaneous diagonalization." SIAM journal on matrix analysis and applications 17.1 (1996): 161-164.

related packages: https://marco-congedo.github.io/Diagonalizations.jl/dev/

python code: https://github.com/gabrieldernbach/approximate_joint_diagonalization

https://github.com/edouardpineau/Time-Series-ICA-with-SOBI-Jacobi

[2] Ziehe FFDiag

Andreas Ziehe, Pavel Laskov, Guido Nolte, and Klaus-Robert Müller. “A fast algorithm for joint diagonalization with non-orthogonal transformations and its application to blind source separation”. The Journal of Machine Learning Research, 5:777– 800, 2004.

— Paper URL: https://www.jmlr.org/papers/volume5/ziehe04a/ziehe04a.pdf
— Matlab code: https://user.tu-berlin.de/aziehe/code/ffdiag_pack.zip
— Python code: https://github.com/lisatostrams/joint_diagonalization/blob/master/joint_diagonalizer.py

Further References

- Florent Bouchard, Jérôme Malick, Marco Congedo. Riemannian Optimization and Approximate Joint Diagonalization for Blind Source Separation. IEEE Transactions on Signal Processing, 2018, 66 (8), pp.2041-2054.
- Haoze He, Daniel Kressner, Randomized Joint Diagonalization of Symmetric Matrices. https://arxiv.org/abs/2212.07248
- P. Ablin, J.F. Cardoso and A. Gramfort. Beyond Pham’s algorithm for joint diagonalization. Proc. ESANN 2019. https://arxiv.org/abs/1811.11433

Requirements for milestone in session 1

- Basic project structure available on GitHub (or equivalent)
- Some reviewable basic functionality implemented, e.g. one algorithm and generation of test data
- Minimal documentation, including a basic "Getting Started"