

# Exam

Pick one of the following articles, which are applications of geometric and topological data analysis to biology.

- Cámara, Levine, Rabadán, Inference of ancestral recombination graphs through topological data analysis, PLOS Computational Biology, 2016.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4988722/pdf/pcbi.1005071.pdf>
- Kuchroo et al., Single-cell analysis reveals inflammatory interactions driving macular degeneration, Nature Communications, 2023.  
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10162998/pdf/41467\\_2023\\_Article\\_37025.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10162998/pdf/41467_2023_Article_37025.pdf)
- Hoekzema et al., Multiscale methods for signal selection in single-cell data, Entropy, 2022.  
<https://www.mdpi.com/1099-4300/24/8/1116/pdf?version=1661340602>
- A. Roth et al, Hybridizing rapidly growing random trees and basin hopping yields an improved exploration of energy landscapes, J. Comp. Chem., 37 (8), 2016.  
<https://inria.hal.science/hal-01191028>
- T. O'Donnell and F. Cazals, Enhanced conformational exploration of protein loops using a global parameterization of the backbone geometry, J. Comp. Chem., 44 (11), 2023.  
<https://www.biorxiv.org/content/10.1101/2022.06.21.497022v2>

Then, follow these steps and write a corresponding report (10 pages maximum).

1. Read the article carefully. Don't hesitate to look at the bibliography or any other resources if there is a definition or method that you find difficult.
2. Summarize the article – 3 pages maximum. Explain what problem is being solved by the authors, what new theoretical and/or experimental contributions they bring to the state-of-the-art, and what biological discovery has been achieved.
3. Discuss the strong and weak points of the methods proposed in the article (such as efficiency, complexity, running time, etc). If applicable, implement the methods and provide some examples to illustrate your point.
4. Suggest potential improvements: what would you do to solve the weaknesses identified in the previous question?