

# Ali Yazdizadeh

Masters in Biotechnology (Bioinformatics Specialization)  
University of Tehran, Iran

Jan 2026 - UNIL PhD Fellowship -  
Thesis Director: Prof. Dessimoz

# My Background



MAX-PLANCK-GESELLSCHAFT



Remote Internship:  
Lead the computational work in  
AI for Optimization of Biosystems

Remote Internship:  
Use of AI in COVID 19 Vaccine Side Effect  
Prediction  
Supervised by Dr. Nahal Mansouri

Part Time Software  
Engineer  
in Netherlands



BSc Biotechnology  
at Uni Tehran



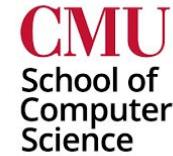
Summer Undergraduate Research: Contributed to  
Orthology inference at scale with FastOMA  
*Nature Methods*, 2025



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2019

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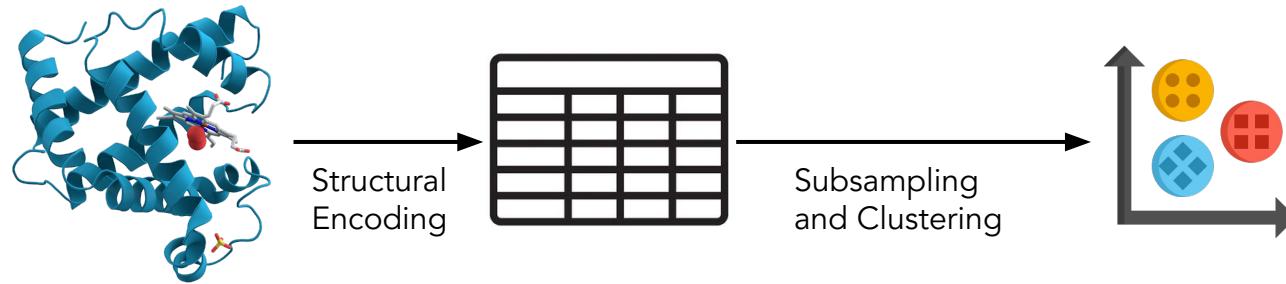


Summer Undergraduate Research: Contributed to  
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*Nature Methods*, 2025  
Writing Review Article on Genomic Minimizer

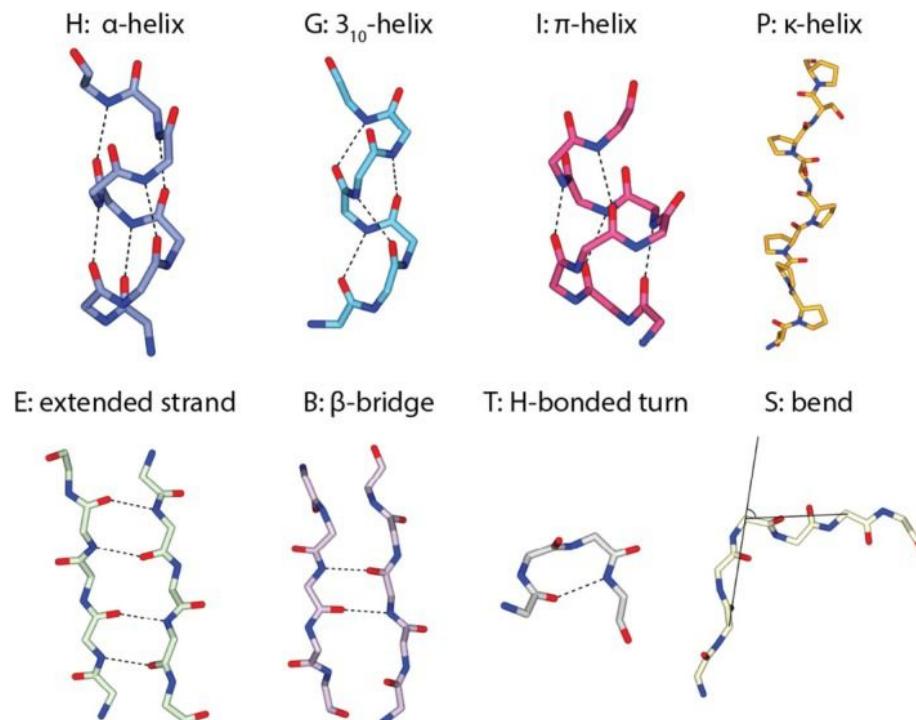
**DESSIMOZ LAB**  
Computational Evolutionary Biology

Masters Thesis (Supervised by Prof. Marashi)

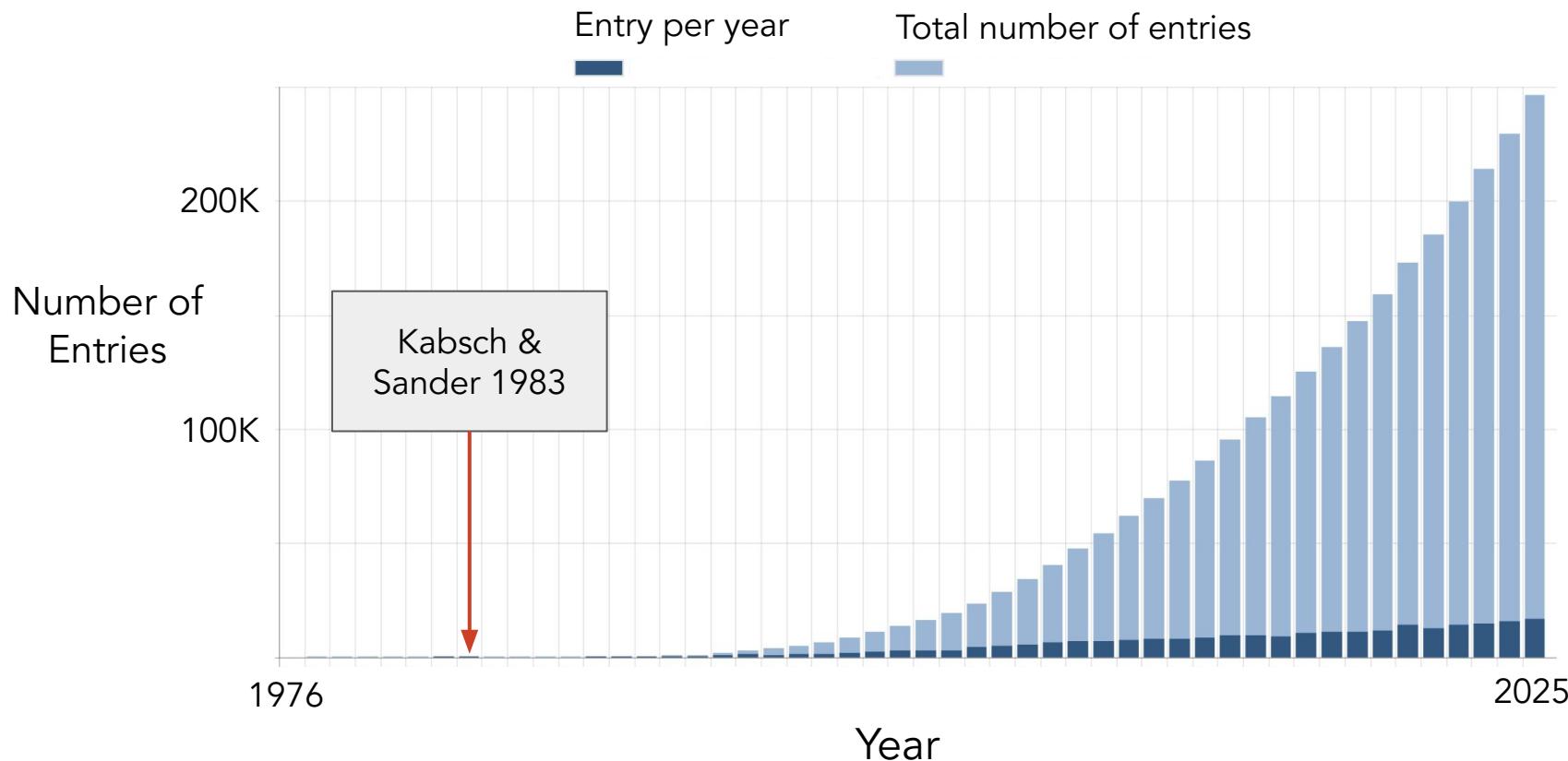
## Revisiting Protein Secondary Structures in the Age of Structural Data Abundance



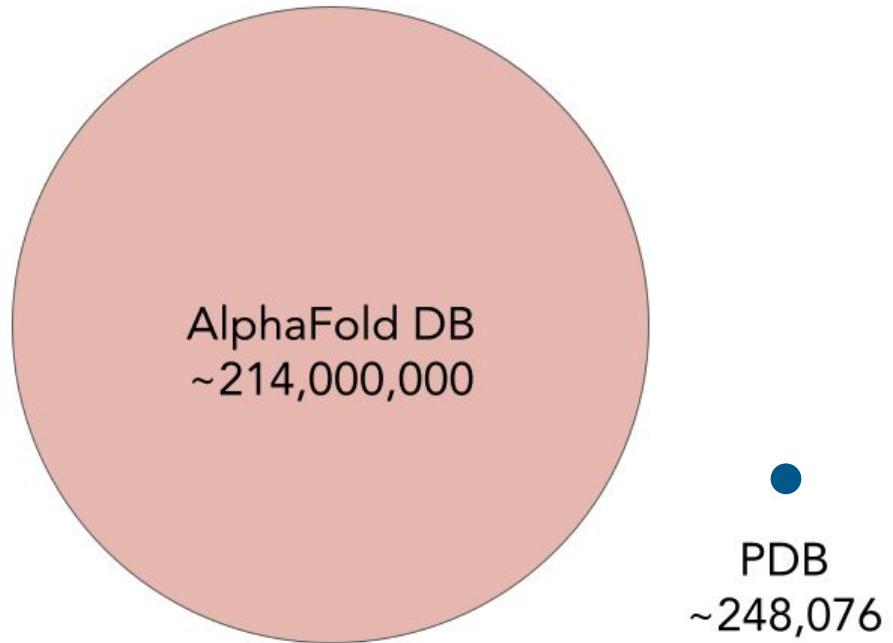
# Protein Secondary Structure Classes (Kabsch & Sander 1983)



# Protein Data Bank (PDB) Growth



# AlphaFold Revolution

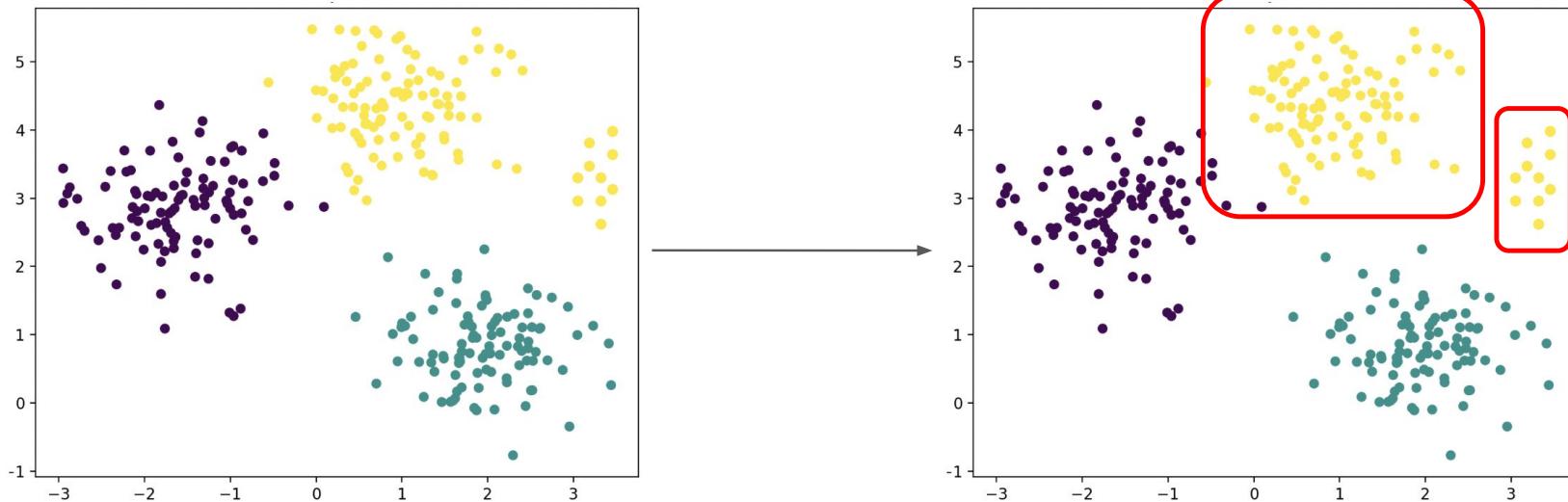


Based on December 2025 data

# Thesis idea: improving the secondary structure classification

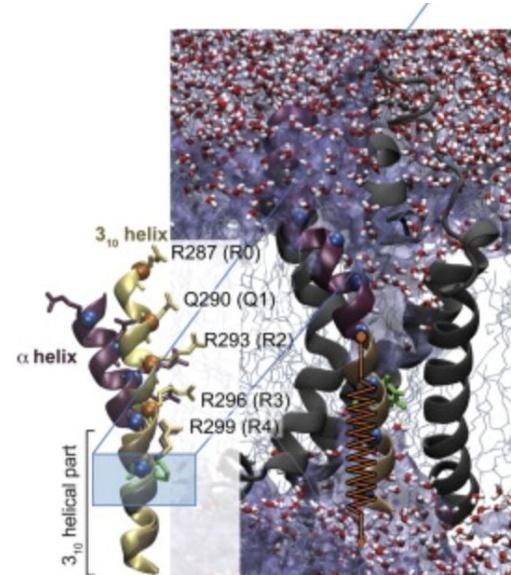
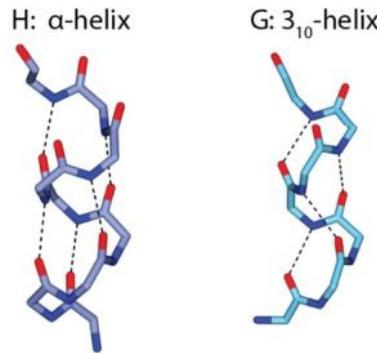
Main Questions:

1. Is there a better way to define the classical secondary structure groups?
2. Are there any undiscovered group, previously ignored due to small dataset size?



# Why this matters?

- Secondary Structure classes have functional implications
  - Switch between  $3_{10}$  helix and  $\alpha$  helix can regulate the potassium ion channels.

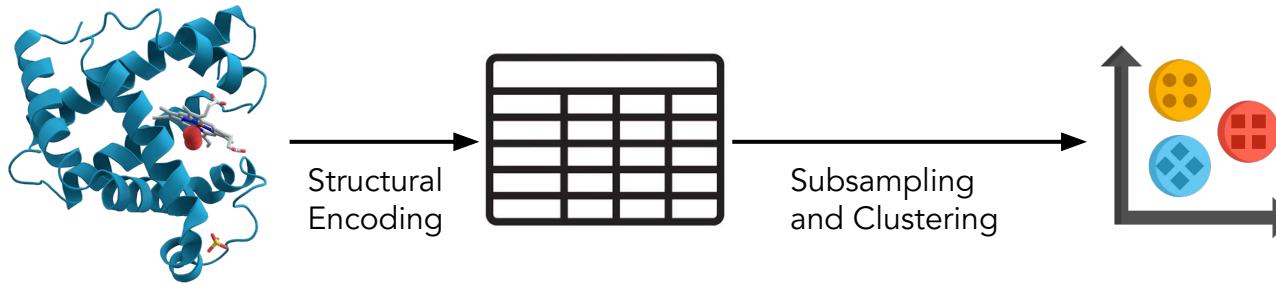


# Overview of the Workflow

~6000 Protein Chain

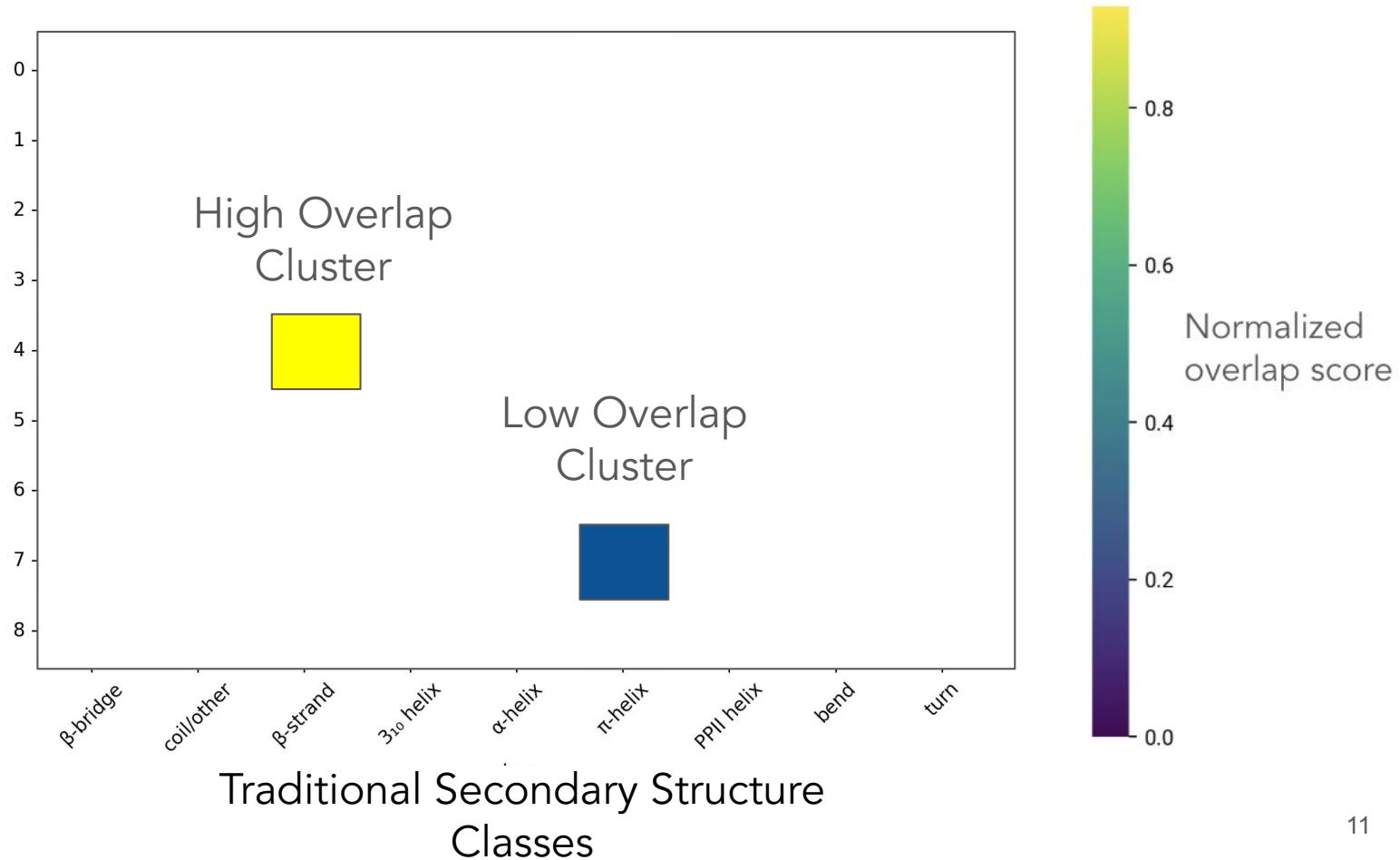
~1.5M Amino Acids

8 Clustering Methods Tested



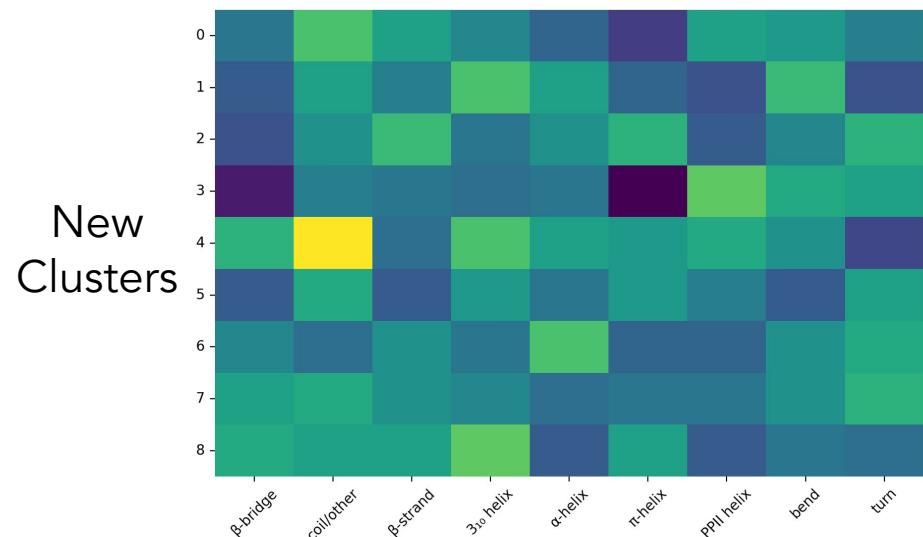
~500 CPU hours of computation were done on Amazon (AWS) servers funded by a grant I obtained.

Newly  
Computed  
Clusters  
(unsupervised)

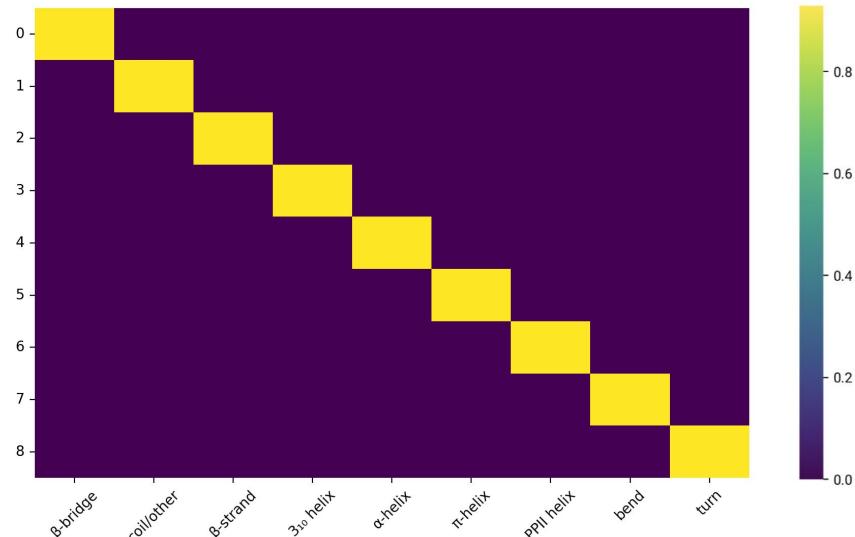


# Examples of Potential Outcomes

Low agreement



Complete agreement

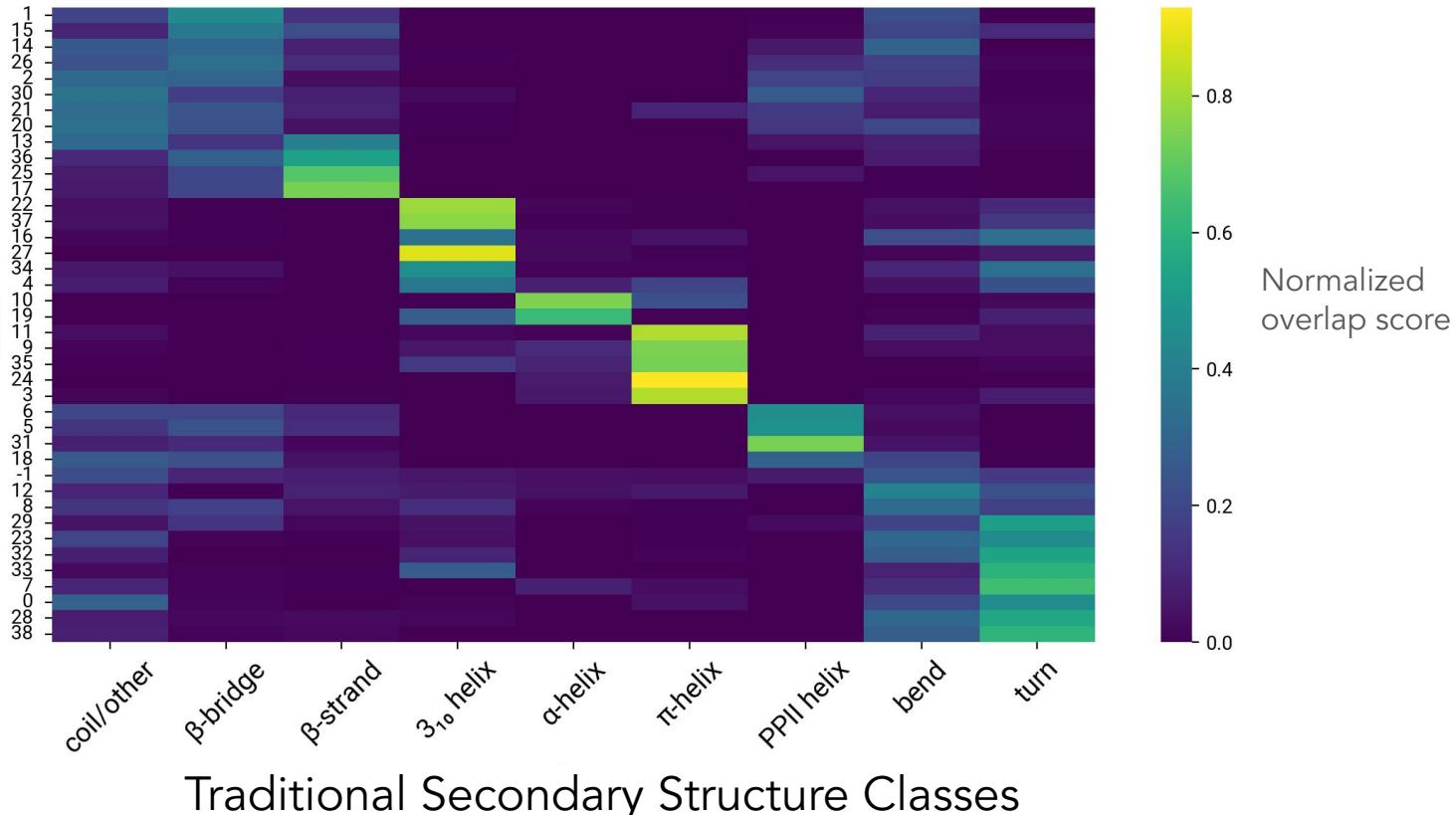


Traditional Secondary Structure  
Classes

# New Clustering Result

Substantial overlap with traditional classes, but also new insights

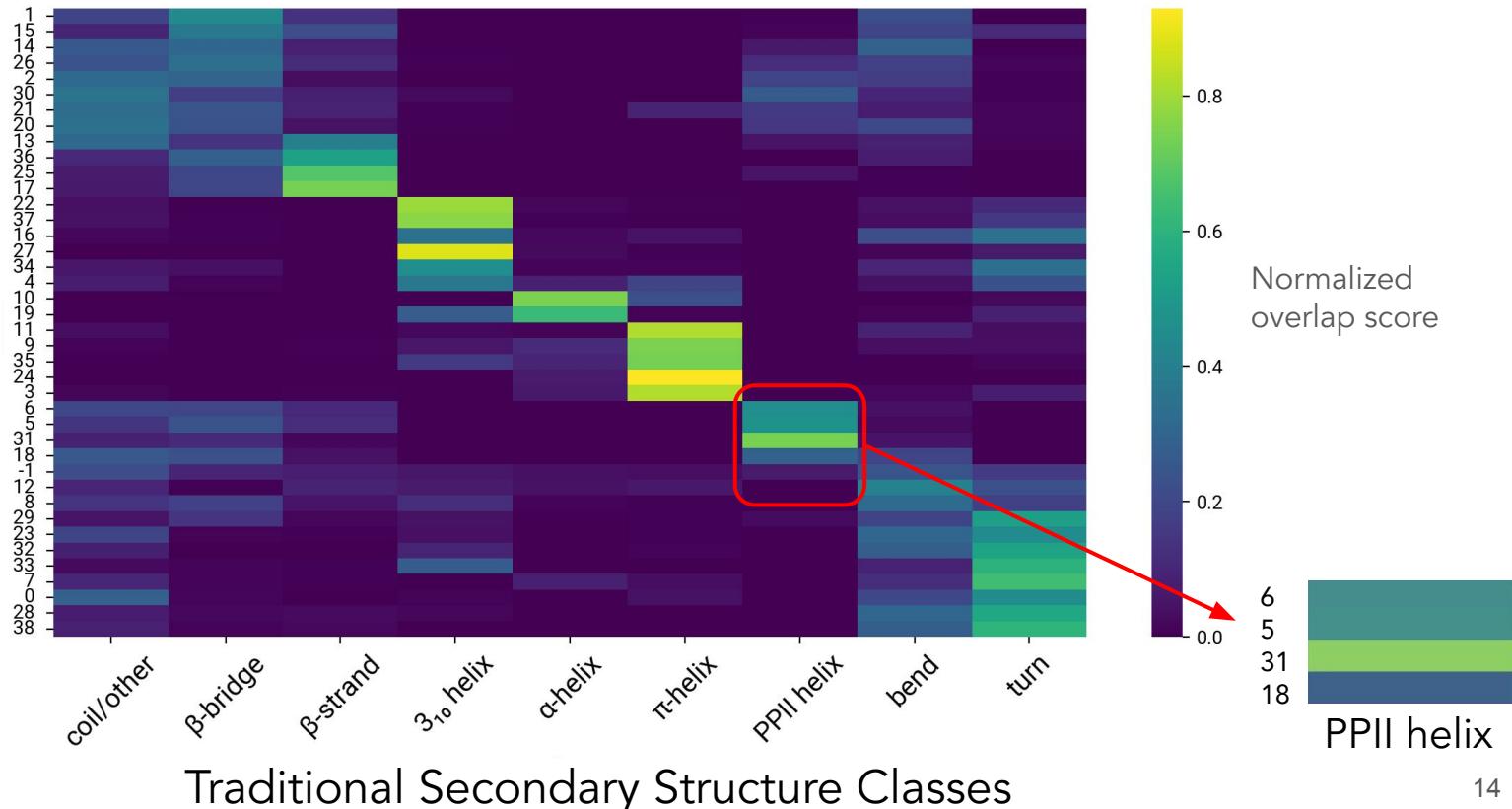
Our Computed Clusters



# New Clustering Result

Substantial overlap with traditional classes, but also new insights

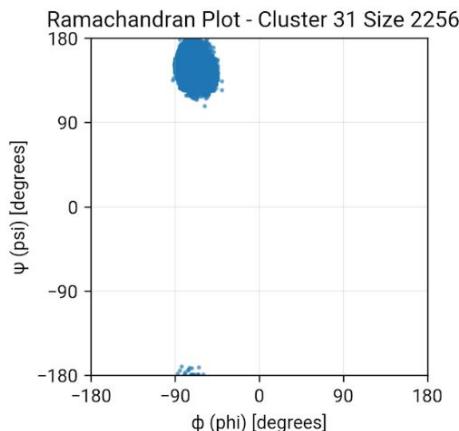
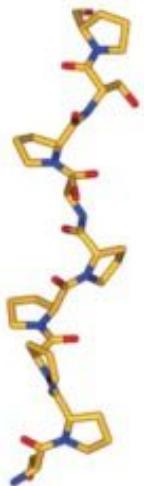
Our Computed  
Clusters



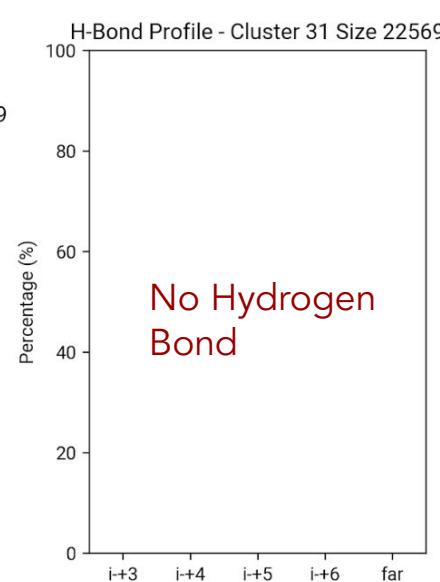
# Notable Founded Clusters: Redefining Known Groups

## A Better Defined Standard PPII Helix Group

P:  $\kappa$ -helix



Dihedral  
Angles



Hydrogen-Bond  
Pattern

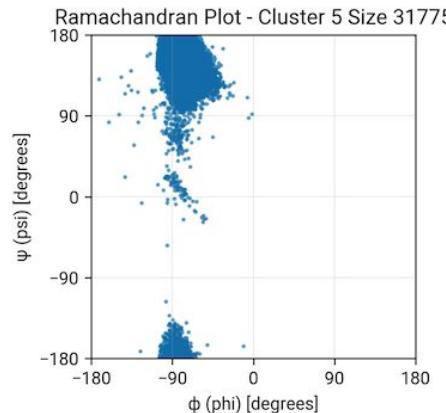


# Notable Founded Clusters: Potential New Groups

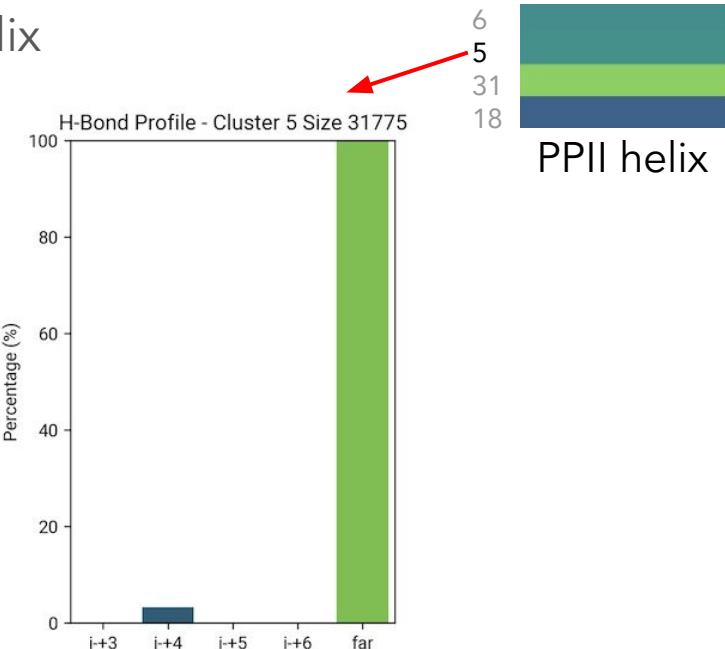


Snow Flea Antifreeze  
Protein (2pne)

## Hydrogen-Bonded PPII Helix



Dihedral  
Angles



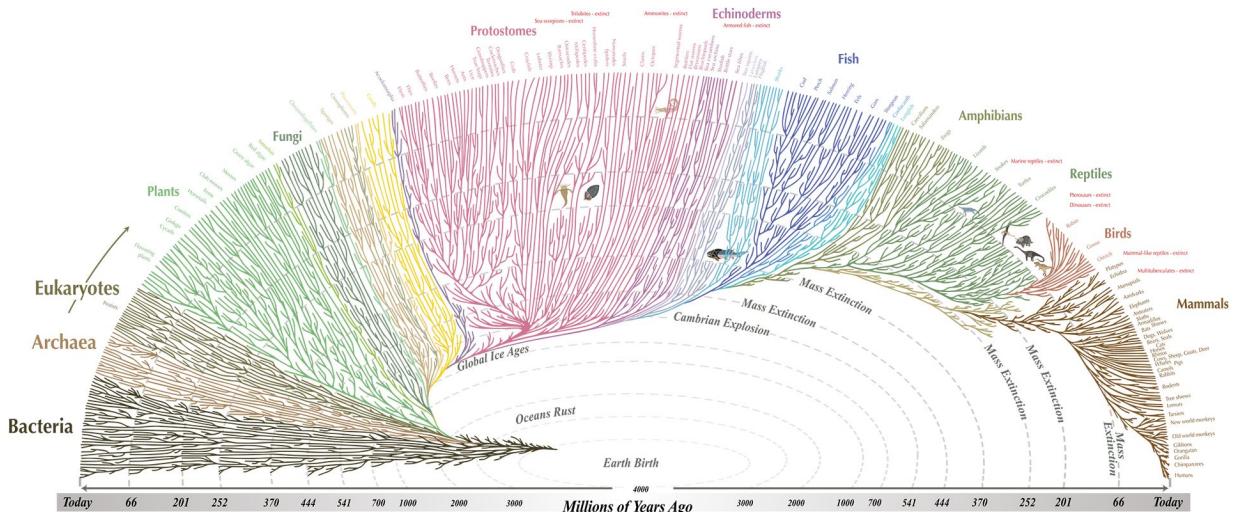
Hydrogen-Bond  
Pattern

# Conclusion

- There is a need to systematically reconsider traditional secondary structure classes, which can lead to discovery of new groups with functional implication.
- Our resulting clusters showed some traditional secondary structure groups can be defined with more resolution e.g. PPII helix and its hydrogen bonded subclass.
- Our result also suggests that some traditional secondary structure groups i.e. “bend” have poor geometrical homogeneity.

# PhD at Unil: Reconstructing a comprehensive Tree of Life integrating gene family evolution signals

- Many genomes are being sequenced
- Traditional methods can not handle this size of data
- Develop fast and scalable methods to reveal evolutionary history of all species



All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct

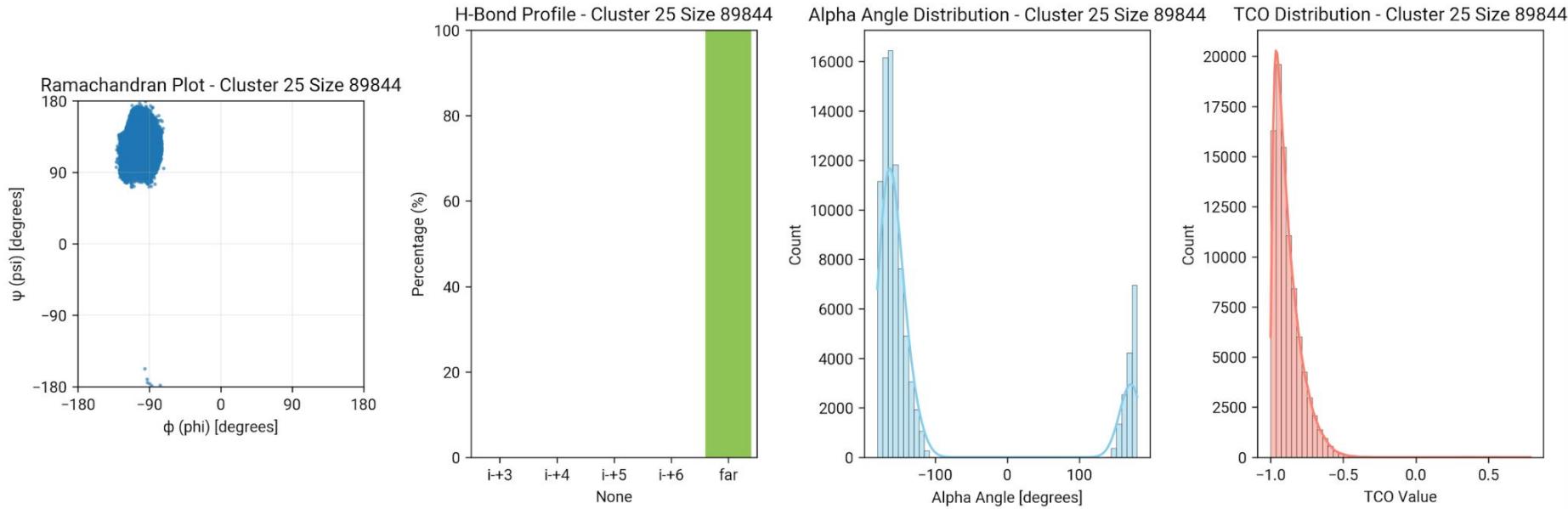
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## Appendix: In case needed to follow up questions

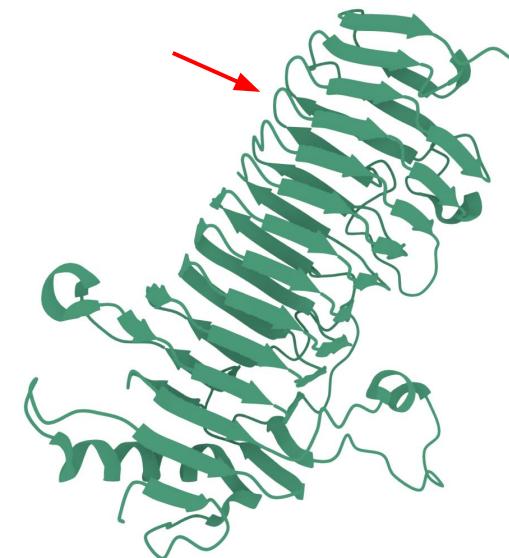
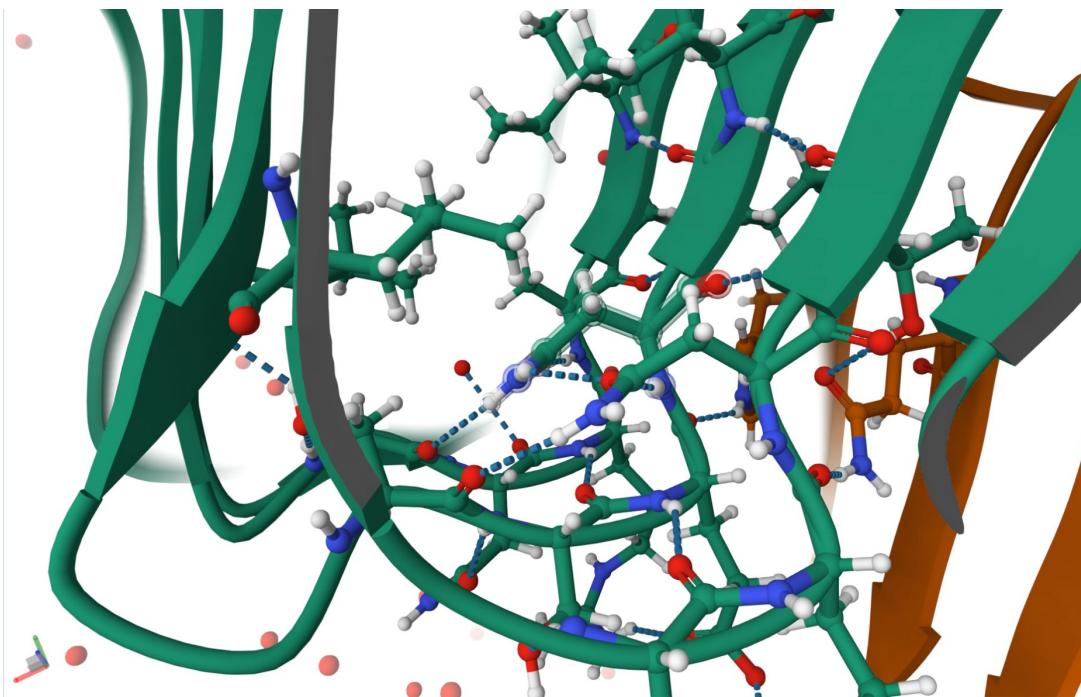
# Notable Founded Clusters: Potential New Groups

“Turn Stabled by Far H-Bond” or “Turned Beta Sheet”



# Notable Founded Clusters: Potential New Groups

"Turn Stabled by Far H-Bond" or "Turned Beta Sheet"



PDB ID: 8hui

# Clustering Result Showing Cluster Consensus with the Unseen DSSP Labels

