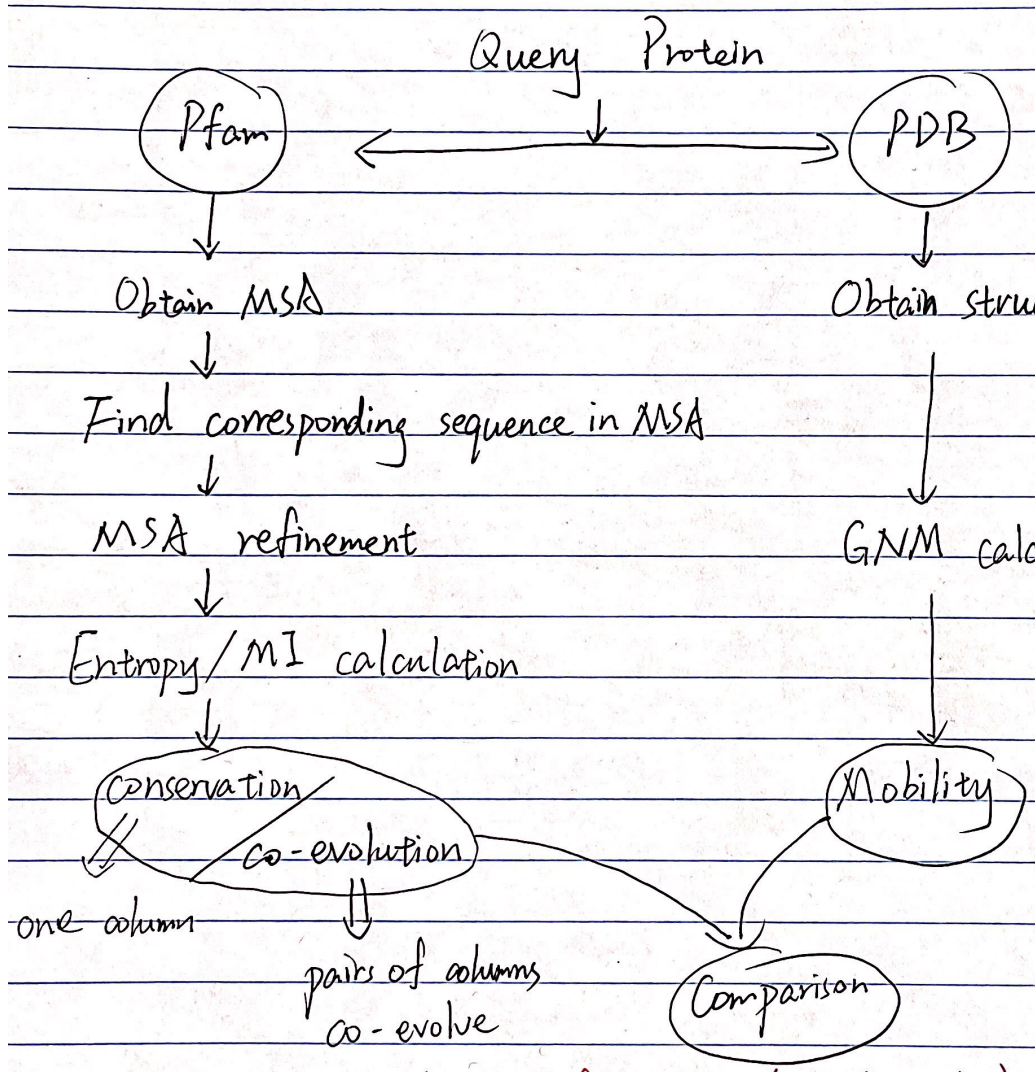
# Bridging Sequence Evolution and Structural Dynamics - Evol

sequence ⟷ structure ⟷ dynamics ⟷ function

1/ Sequence encodes structure
2/ Each structure has a unique dynamics
3/ Dynamics is functional

? Did sequences evolve to enable functional dynamics




MSF: Mean Square Fluctuations

low frequency modes (soft modes/global modes) ⇒ dominant role in defining the most cooperative events

Less conserved ⟷ more flexible

co-evolving residues : not conserved ; change in regulated way ⇒ maintain function

Sequence Entropy : less ⟷ conserved residue

co-evolution patterns → predict structures

why? ⇒ co-evolving residues are interacting

Information entropy (Shannon, 1951)

$$S(i) = \sum_{x_i=1}^{20} P(x_i) \log \frac{1}{P(x_i)}$$

for correlated mutations analysis (CMA)

Mutual Information (MI)

$$I(i,j) = \sum_{x_i=1}^{20} \sum_{y_j=1}^{20} P(x_i, y_j) \log \frac{P(x_i, y_j)}{P(x_i) P(y_i)}$$

Mobility increases with sequence entropy

Hinge sites are evolutionarily conserved
(despite their moderate-to-high exposure to environment)

AA involved in intermolecular recognition are distinguished by
co-evolution propensities
high global mobility

Types of functional sites ×4

| Functional site | Mobility in global modes | Sequence evolution | Dominant Feature |
|---|---|---|---|
| Chemical | Min | Conserved | high fidelity; precision |
| Core | Min | Conserved | high stability |
| Hinge sites | Min | Conserved | rotational flexibility |
| Substrate recognition | High | High co-evolution propensity | adaptability |

⇒ PPI