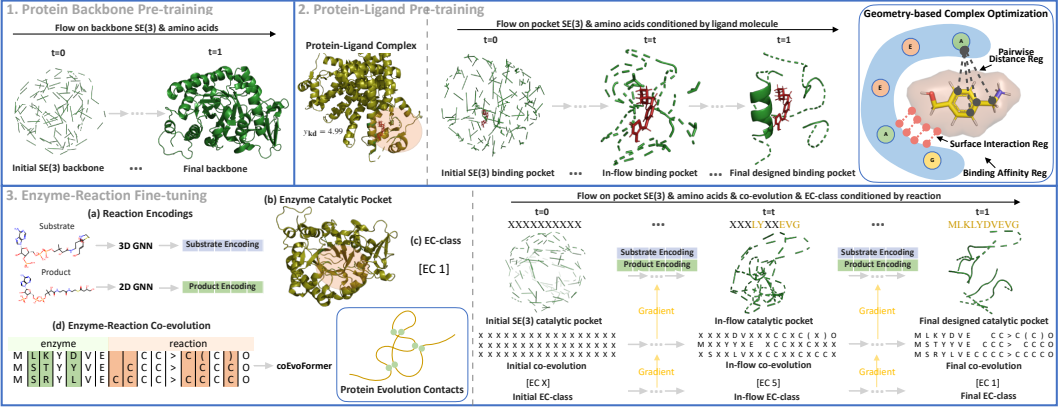
1. Protein Backbone Pre-training
Flow on backbone SE(3) & amino acids
t=0
t=1
Initial SE(3) backbone
Final backbone
2. Protein-Ligand Pre-training
Flow on pocket SE(3) & amino acids conditioned by ligand molecule
Protein-Ligand Complex
$y_{kd} = 4.99$
t=0
t=t
t=1
Initial SE(3) binding pocket
In-flow binding pocket
Final designed binding pocket
Geometry-based Complex Optimization
Pairwise Distance Reg
Surface Interaction Reg
Binding Affinity Reg
3. Enzyme-Reaction Fine-tuning
(a) Reaction Encodings
Substrate
Product
3D GNN
2D GNN
Substrate Encoding
Product Encoding
(b) Enzyme Catalytic Pocket
(c) EC-class
[EC 1]
(d) Enzyme-Reaction Co-evolution
enzyme
reaction
coEvoFormer
Protein Evolution Contacts
Flow on pocket SE(3) & amino acids & co-evolution & EC-class conditioned by reaction
t=0
t=t
t=1
XXXXXXXXXX
XXXIYXXEVG
MLKLYDVEVG
Substrate Encoding
Product Encoding
Gradient
Initial SE(3) catalytic pocket
In-flow catalytic pocket
Final designed catalytic pocket
Initial co-evolution
In-flow co-evolution
Final co-evolution
[EC X]
[EC 5]
[EC 1]
Initial EC-class
In-flow EC-class
Final EC-class