EQUIBIND: Geometric Deep Learning for Drug Binding Structure Prediction

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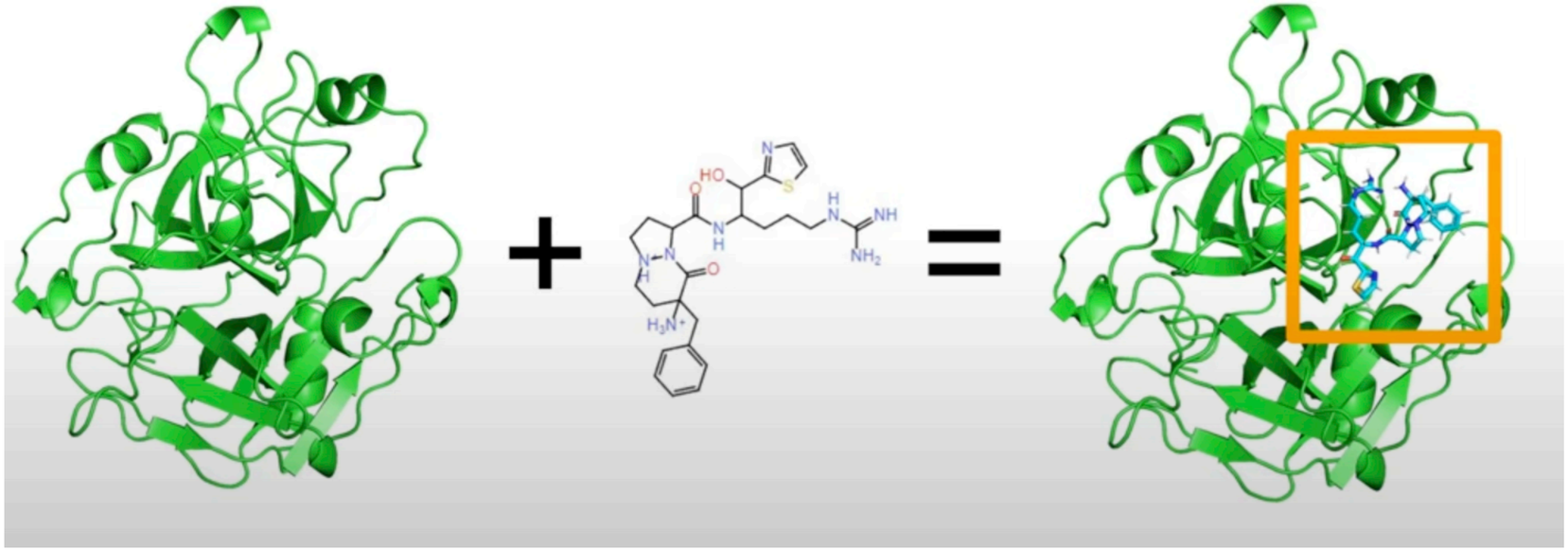
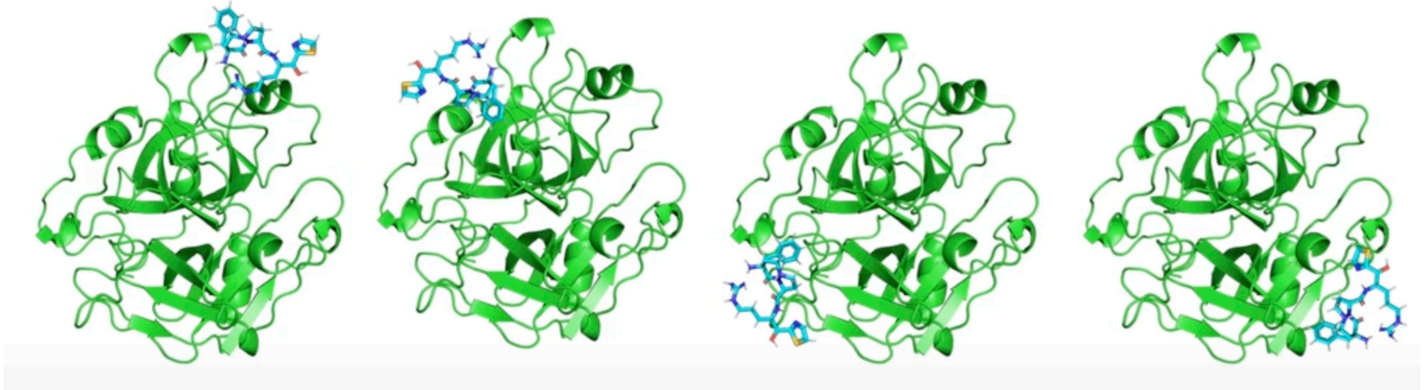
Aditya Bantwal

Introduction



Introduction

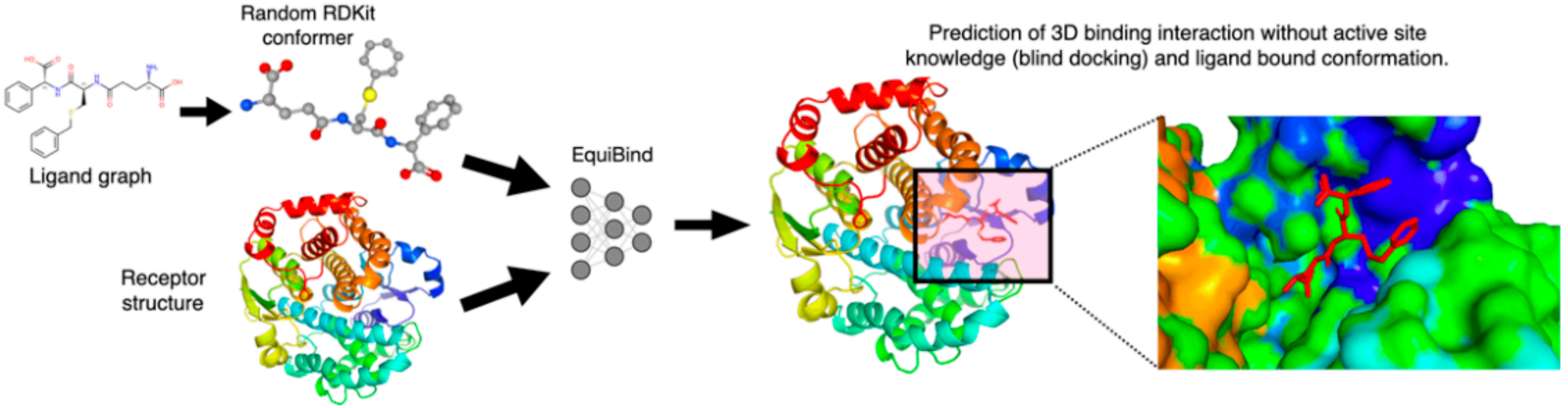
- Existing methods are slow
- Try many different ligand structures and score them



Equibind

- Direct Single forward pass

Equibind


Random RDKit
conformer
Ligand graph
Receptor
structure
EquiBind
Prediction of 3D binding interaction without active site
knowledge (blind docking) and ligand bound conformation.

Equibind:Flexible Drug Prediction

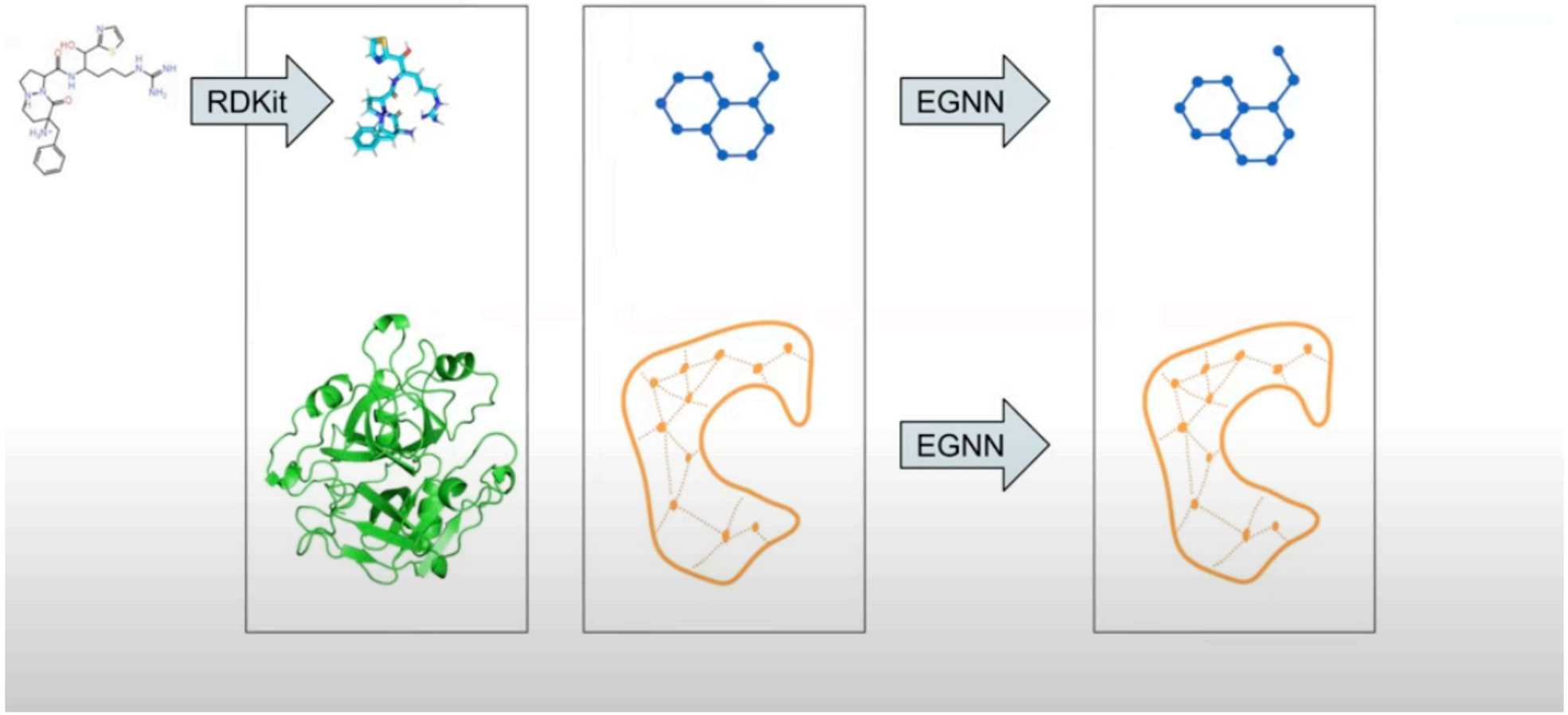
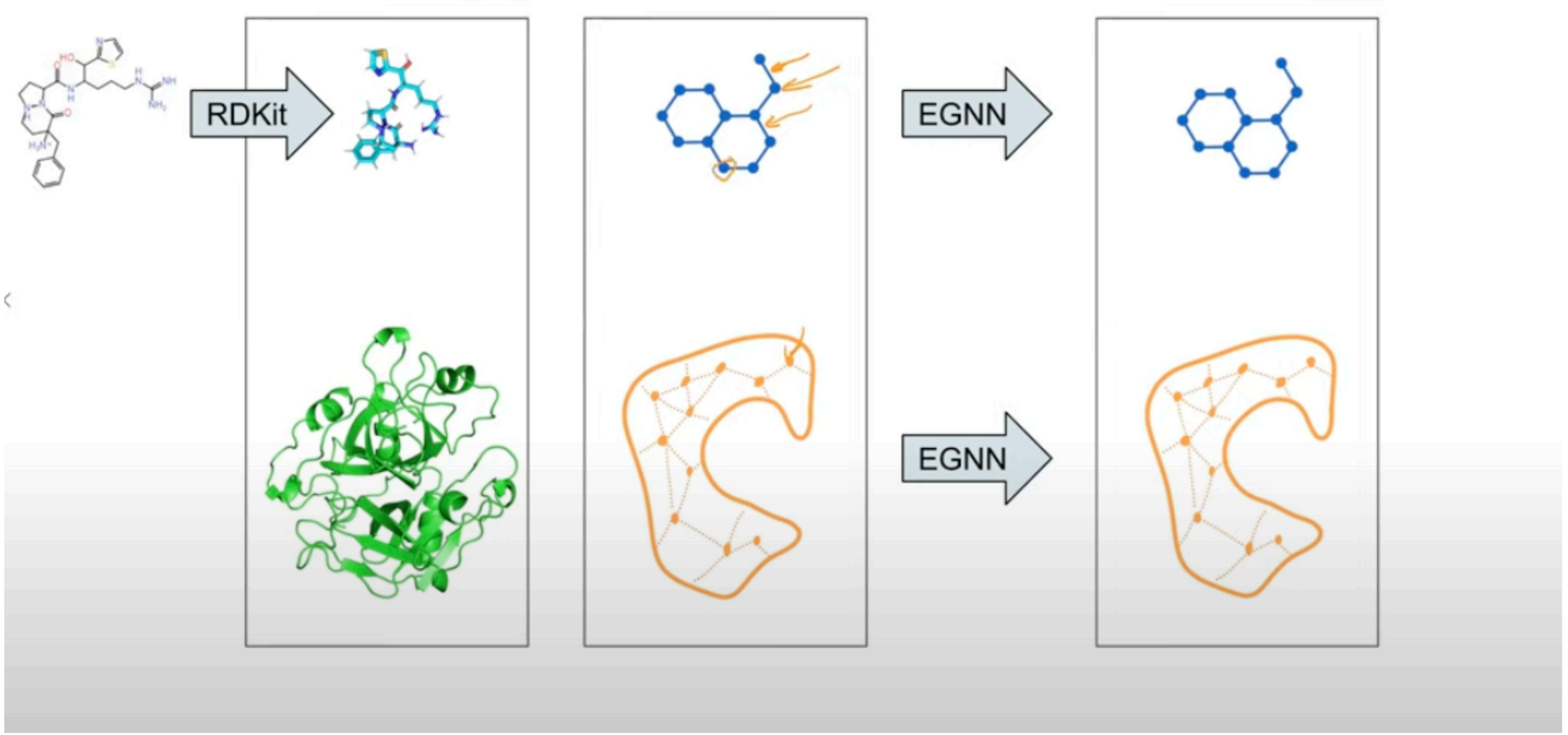


Figure : Equibind Architecture overview. Screenshot from 'Absci Invites: Seminar Series YouTube: https://www.youtube.com/watch?v=JAvh9e6XEGM&t=2360s.

Equibind:Flexible Drug Prediction



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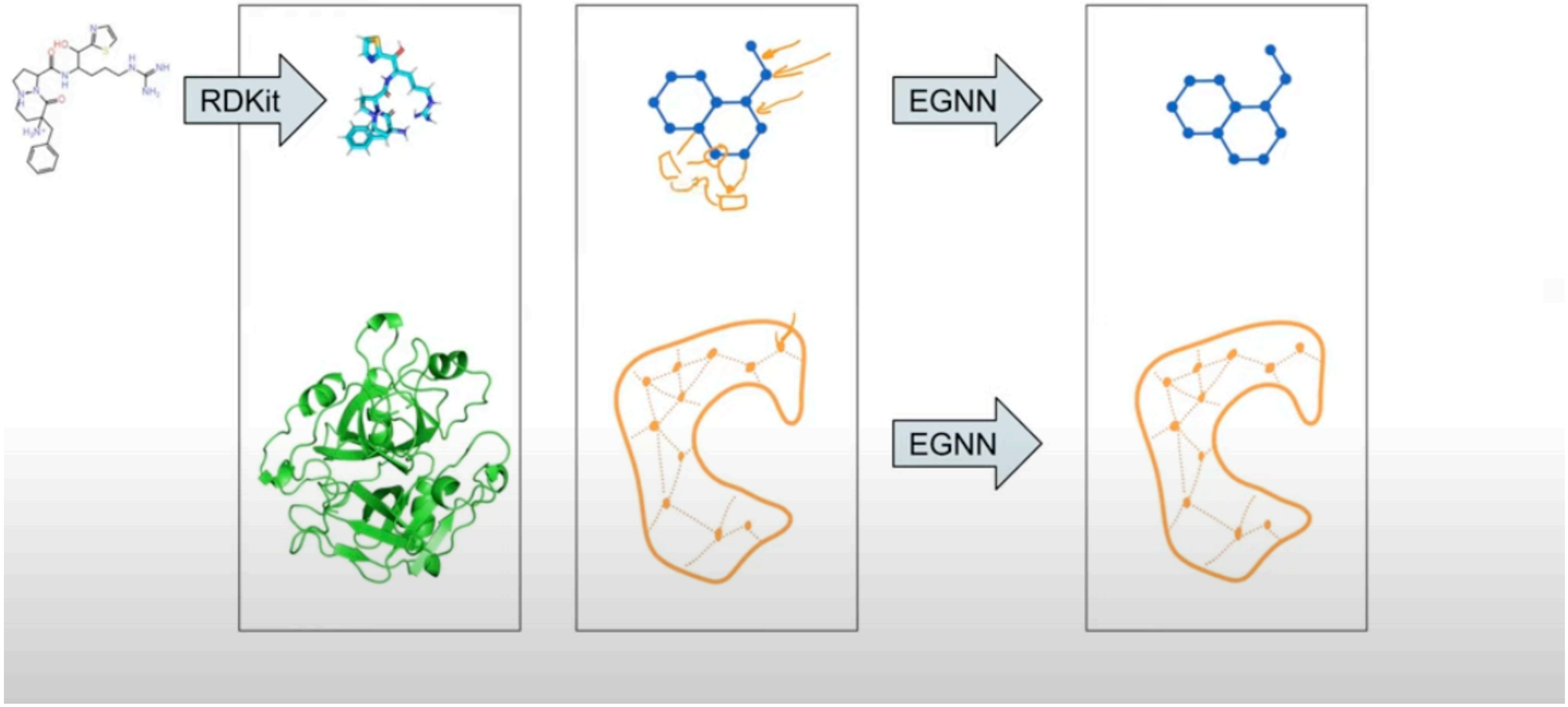

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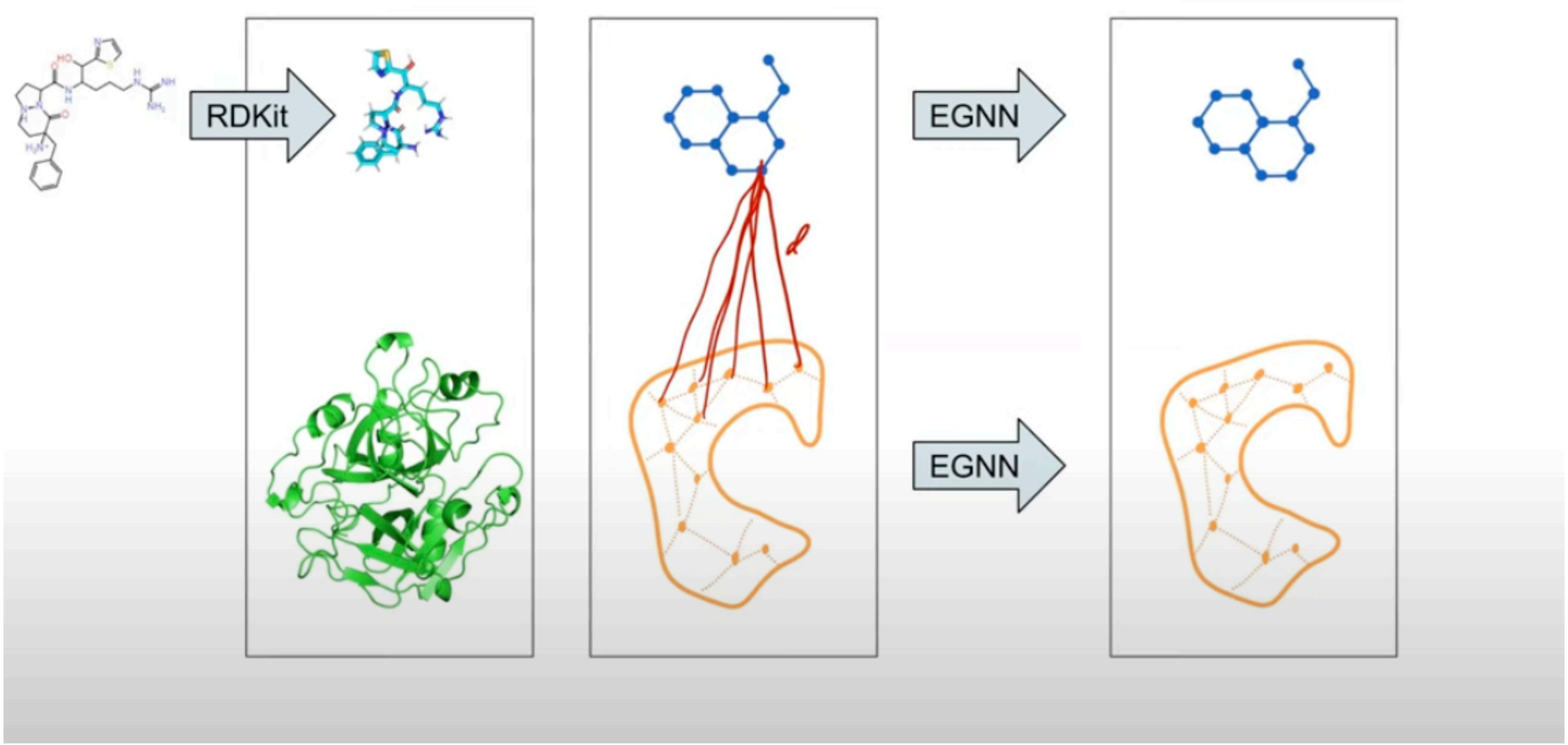

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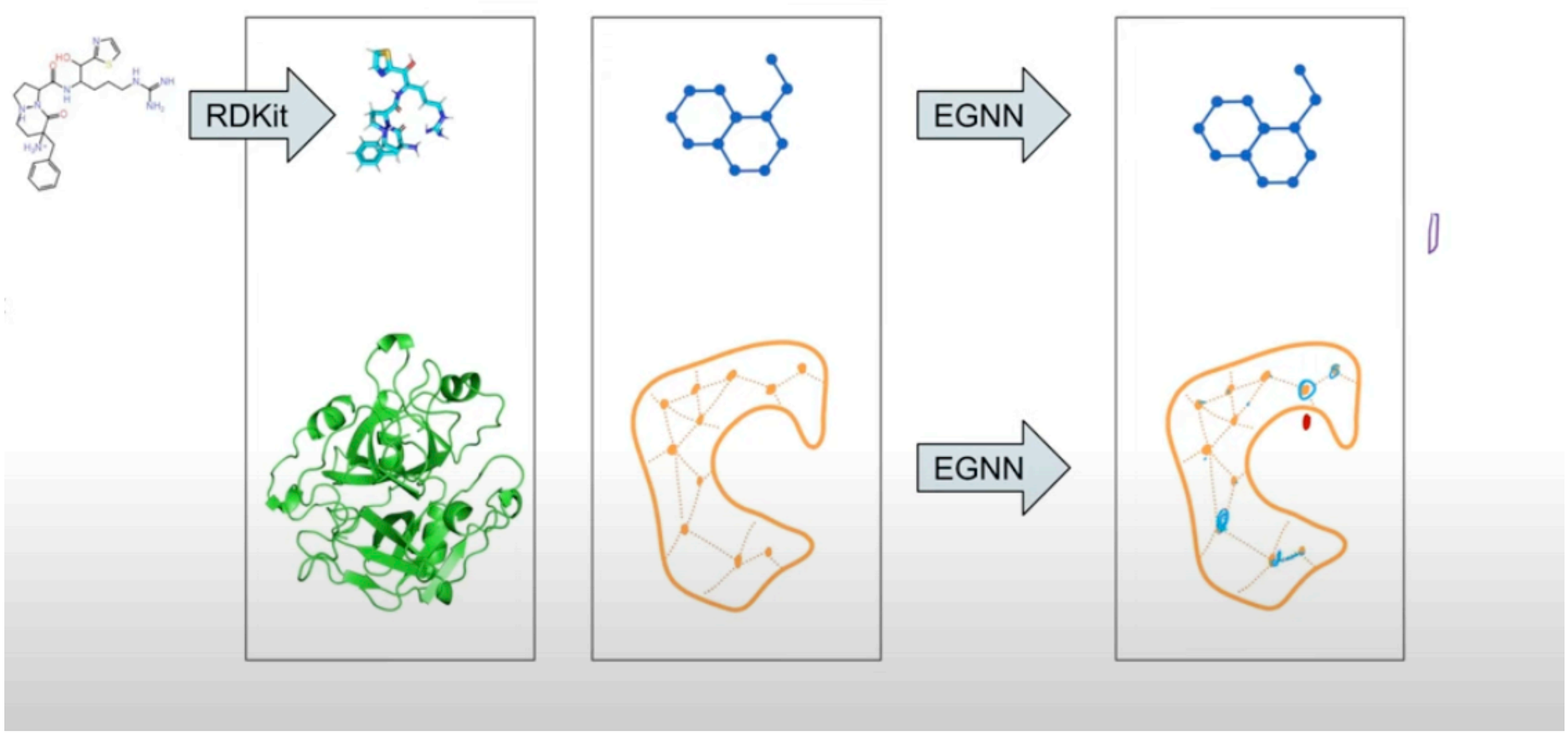

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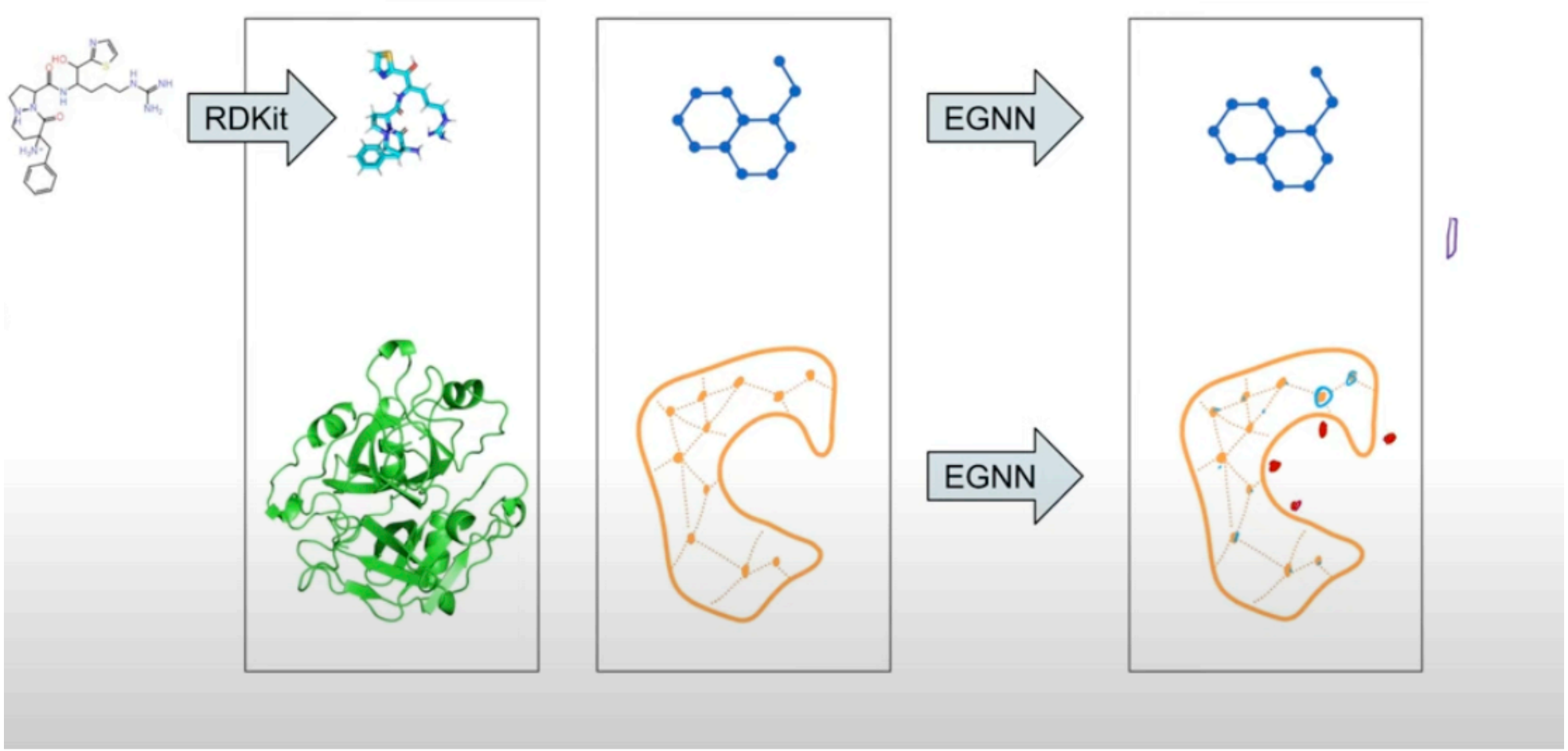

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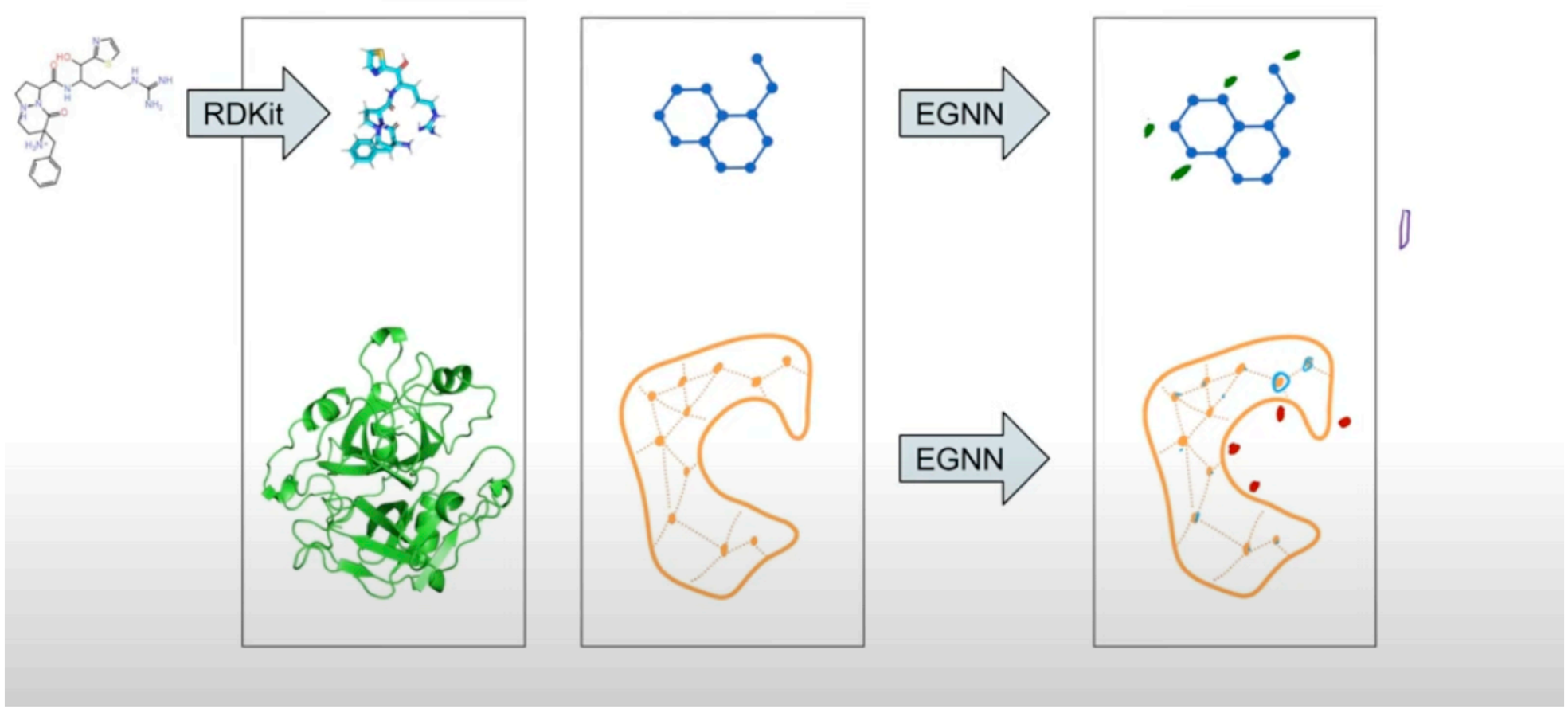

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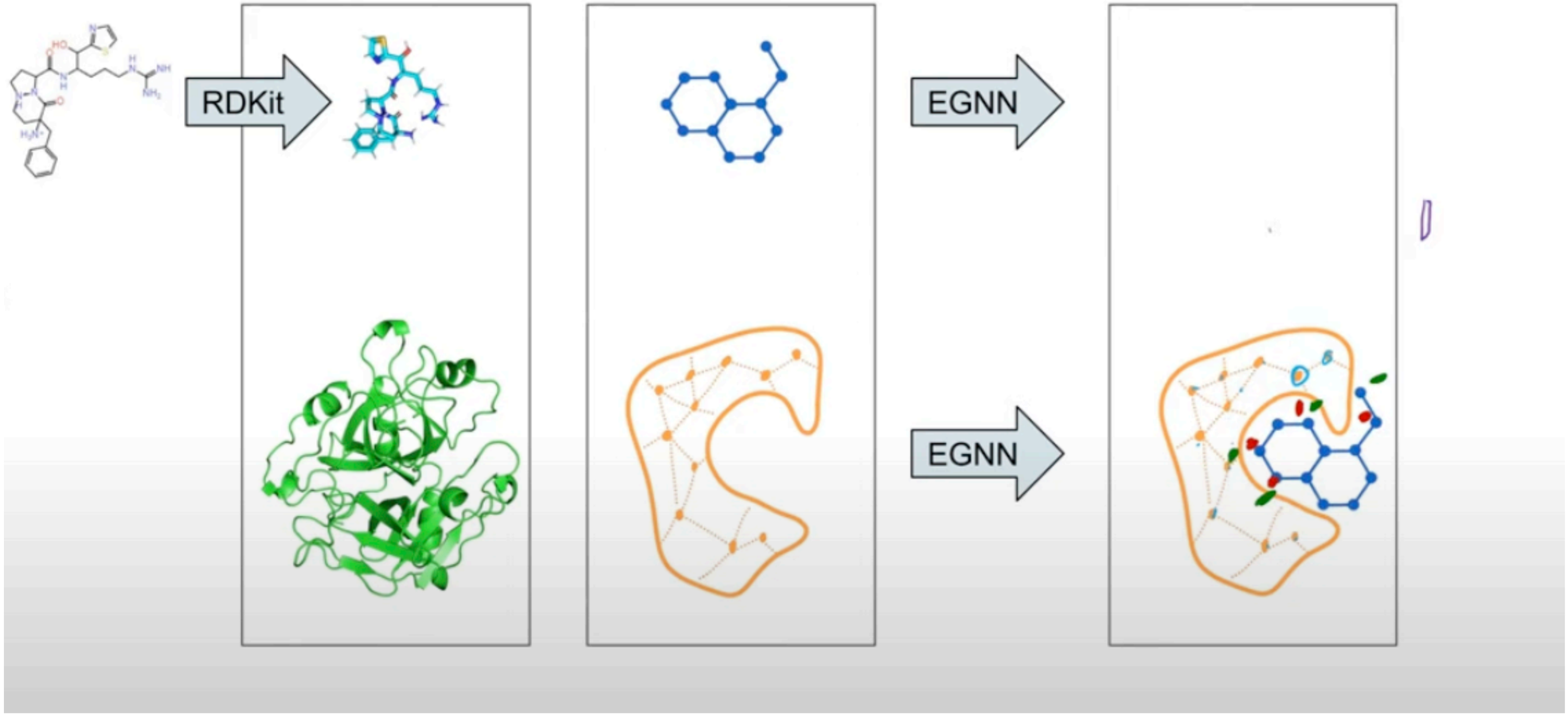

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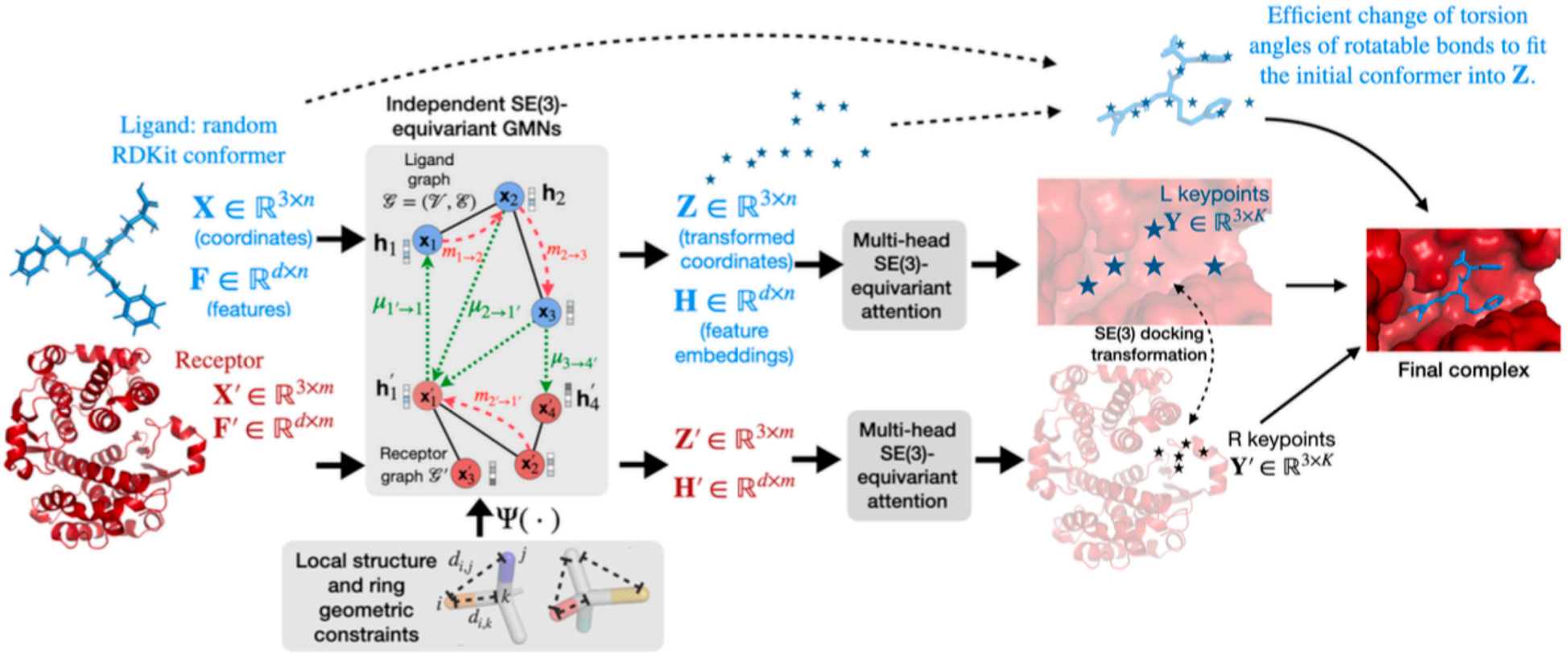

Efficient Point Cloud Intersection Loss

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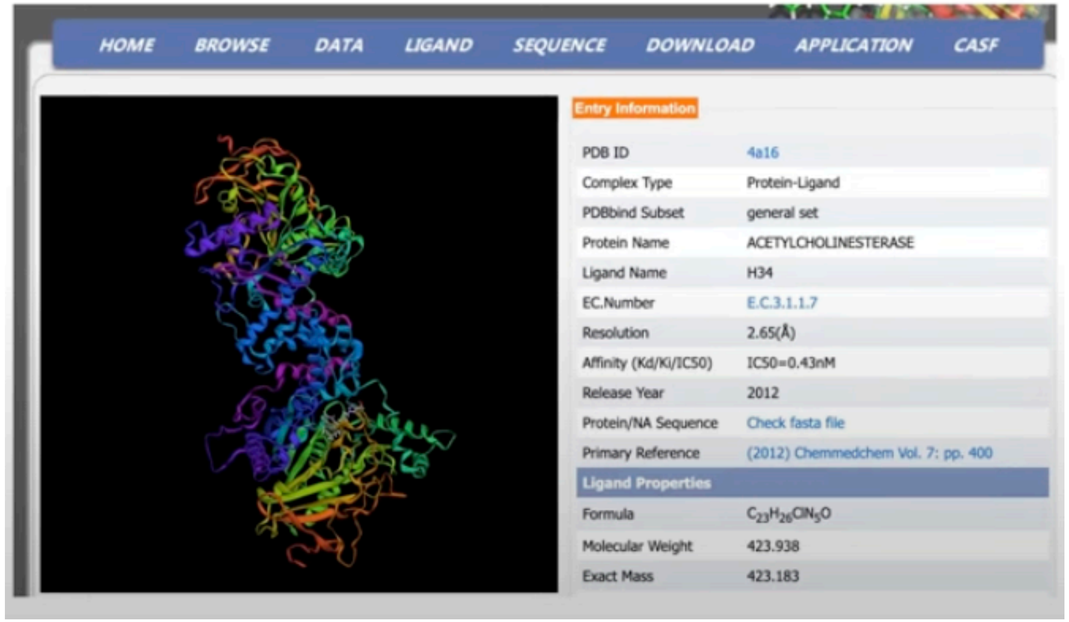
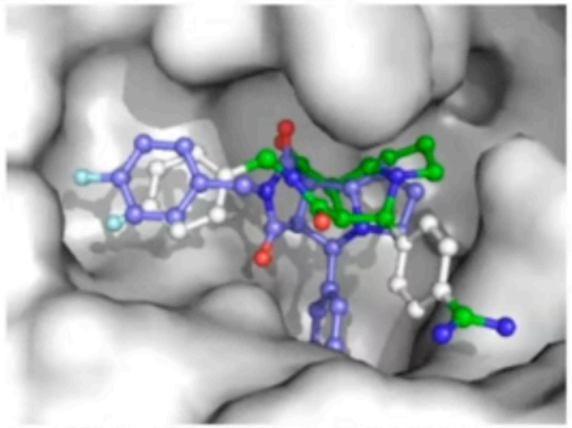
Datasets

- PDBBind experimental data- expensive X-ray crystallography techniques.
- Size:~ 19k complexes
- Test set:2020 released structures, Train set: <=2019 structures, no shared ligands



Baselines

SMINA



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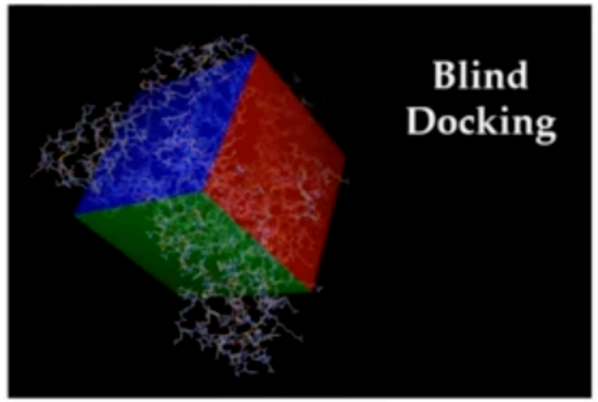
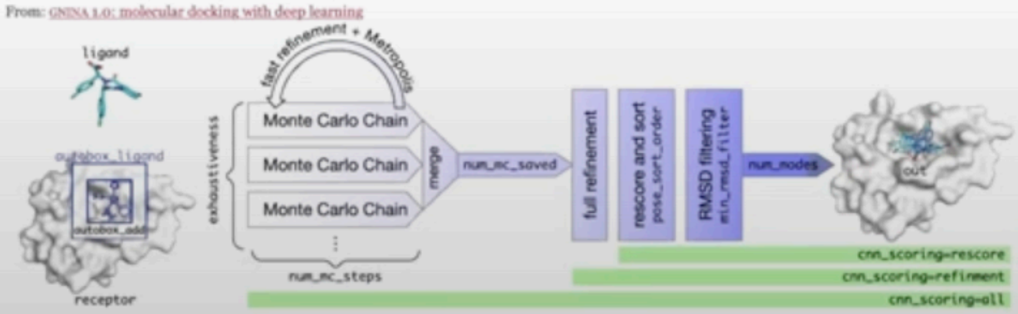
// QuickVina-W

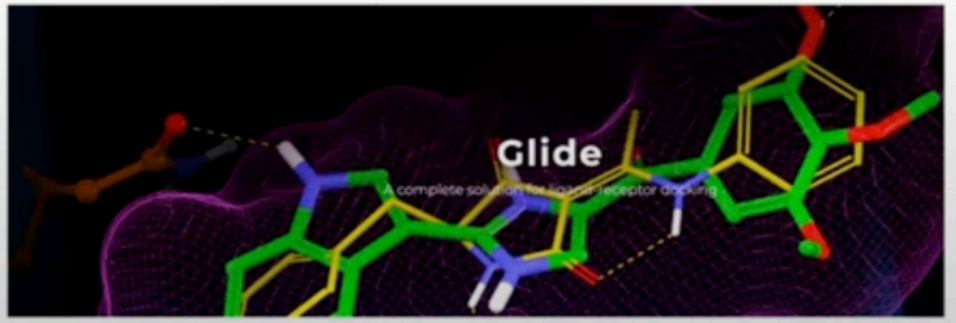


GNINA (2021) - deep learning based scoring



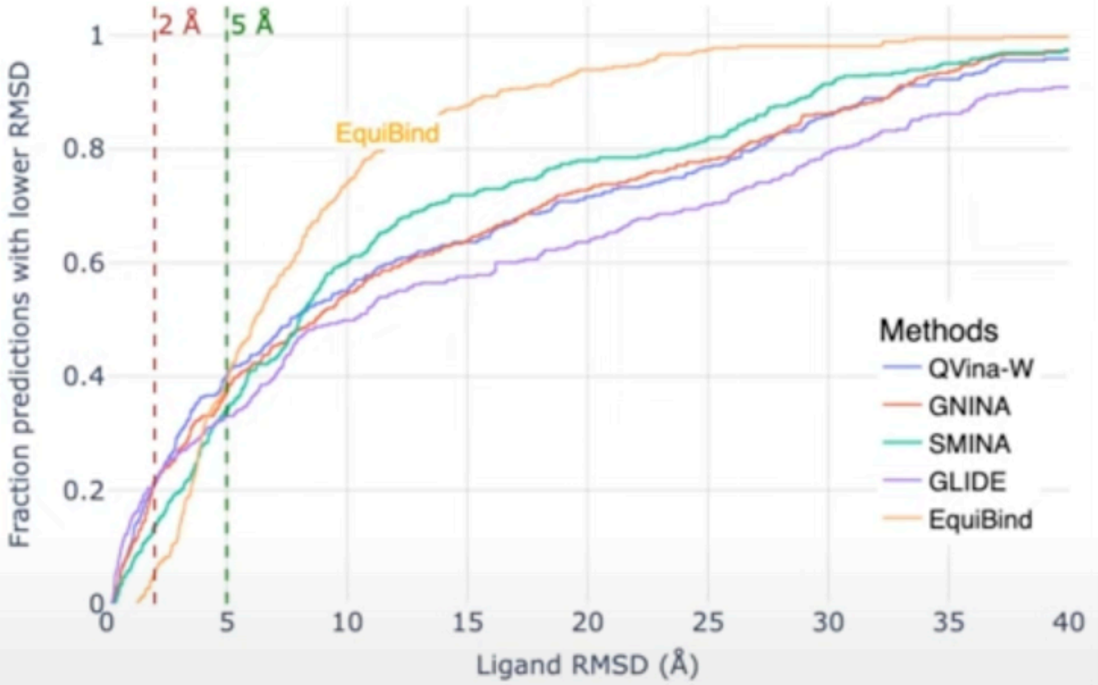
Glide (commercial)

Schrödinger



Equibind:Results

Methods	Avg. sec. 16-CPU	Avg. sec. GPU	Ligand RMSD ↓ Percentiles ↓ Mean	25th	50th	75th	% below threshold ↑ 5 Å	2 Å
QVina-W	49	-	13.6	2.5	7.7	23.7	40.2	20.9
GNINA	247	146	13.3	2.8	8.7	22.1	37.1	21.2
SMINA	146	-	12.1	3.8	8.1	17.9	33.9	13.5
GLIDE (c.)	1405*	-	16.2	2.6	9.3	28.1	33.6	21.8
EquiBind	**0.16**	**0.04**	**8.2**	3.8	6.2	**10.3**	39.1	5.5



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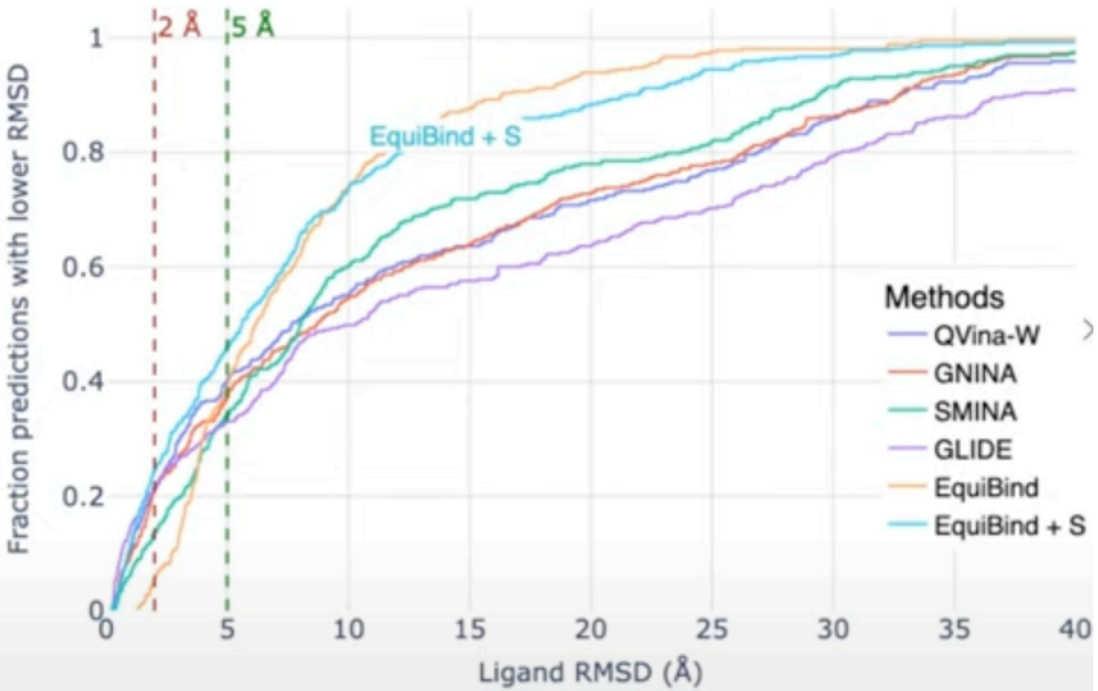
EquiBind	**0.16**	**0.04**	**8.2**	3.8	6.2	**10.3**	39.1	5.5
EquiBind+Q	8	8	8.4	2.6	6.6	11.1	38.0	18.7
EquiBind+Q2	15	15	8.7	2.6	6.8	11.1	40.7	21.6
EquiBind+S	146	146	8.3	**2.1**	**5.6**	10.5	**46.4**	**24.6**



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Limitations and Future Work

Current Limitation

- Only implicitly models side chain atom positions
- Uses local frame encoding features
- Applied to α-carbon graph of receptor

Thank You!