



## Denoise and Contrast for Category Agnostic Shape Completion

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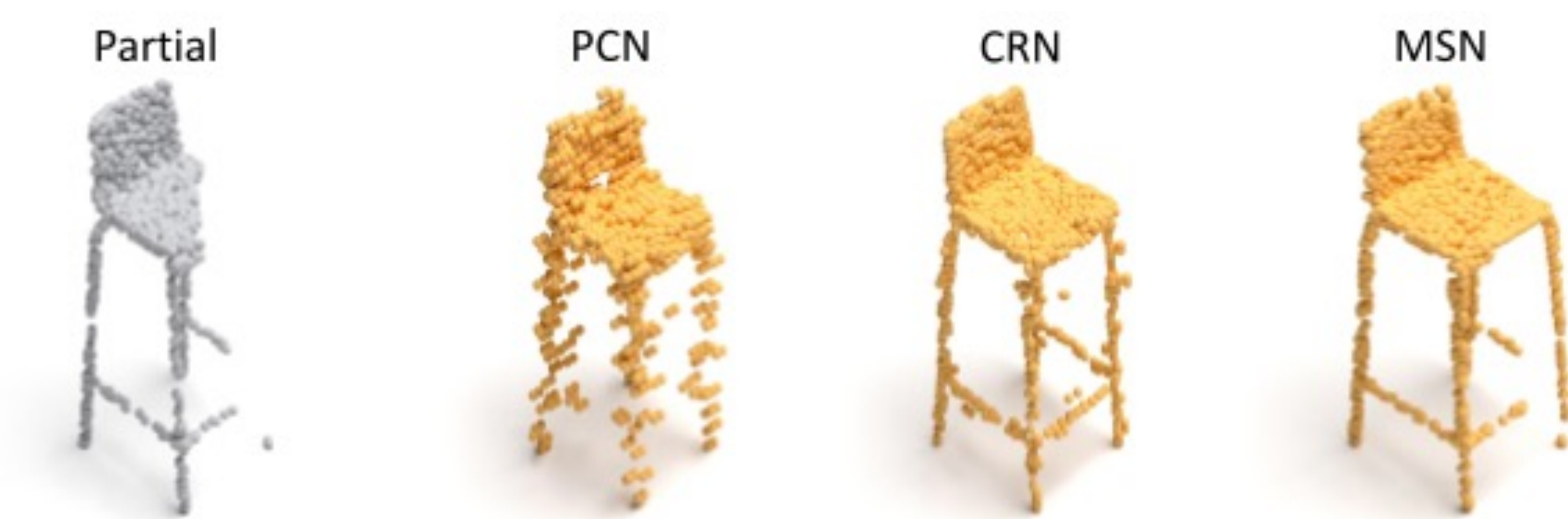
Project Page

### Motivation and background

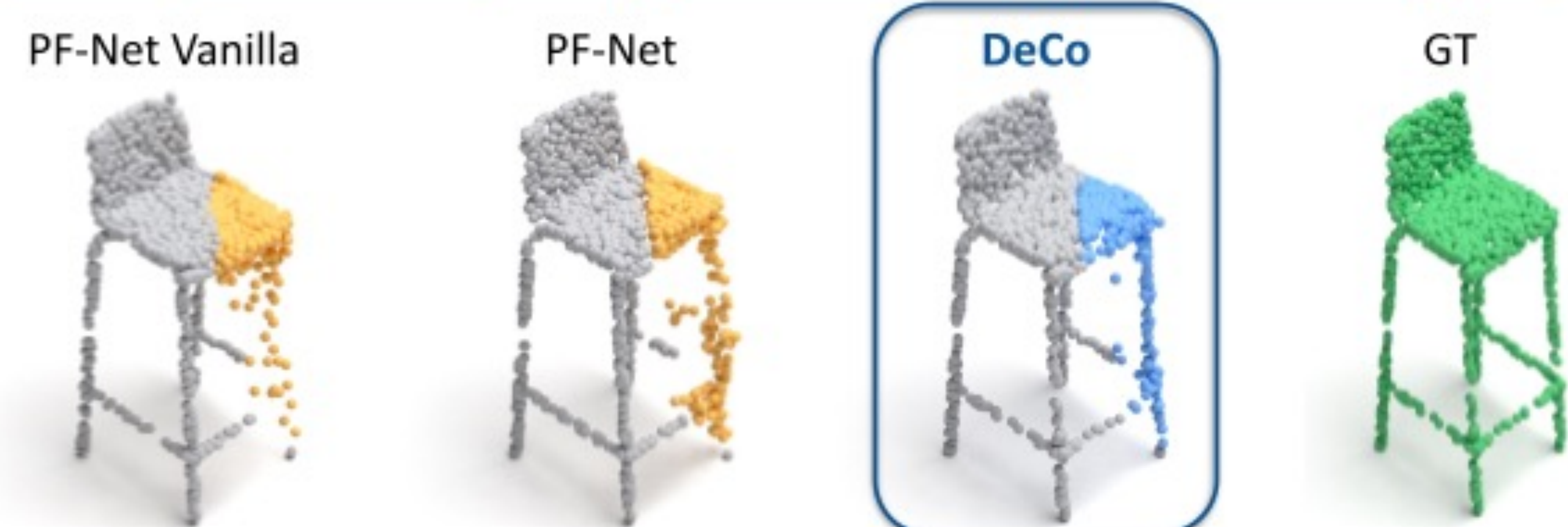
Point Cloud Completion aims to estimate the complete geometry of object from partial observation

- **Preserving details from the partial observation**
- **Modelling the missing part with realistic structure**

Existing models fail to meet both these requirements:

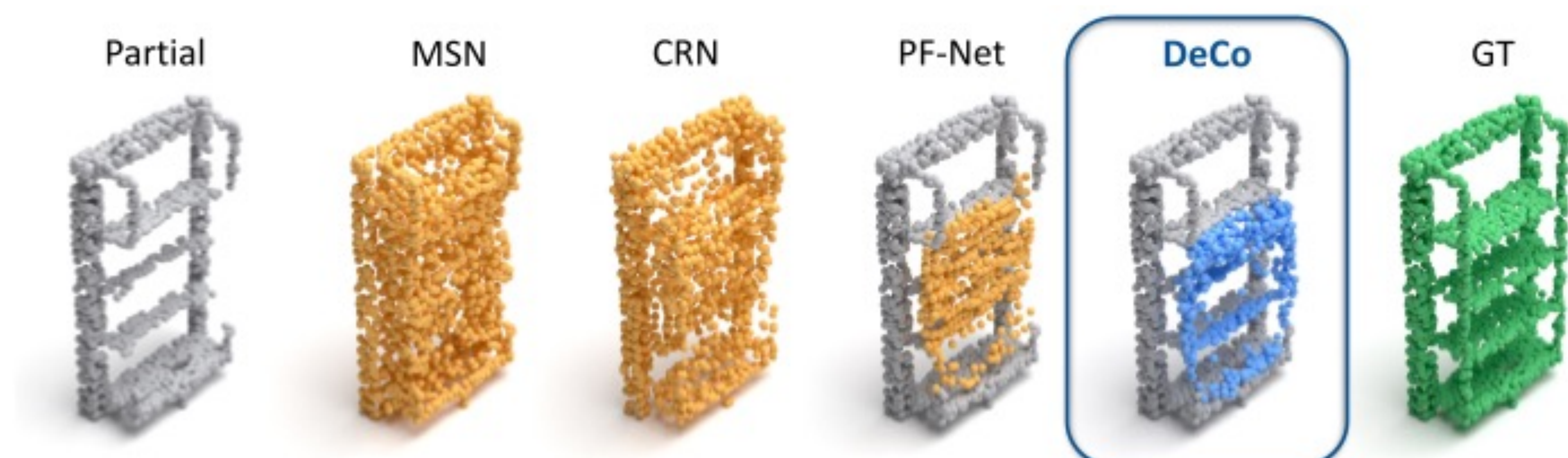


Partial preservation	✗	✗	✓
Missing part modelling	✗	✗	✗



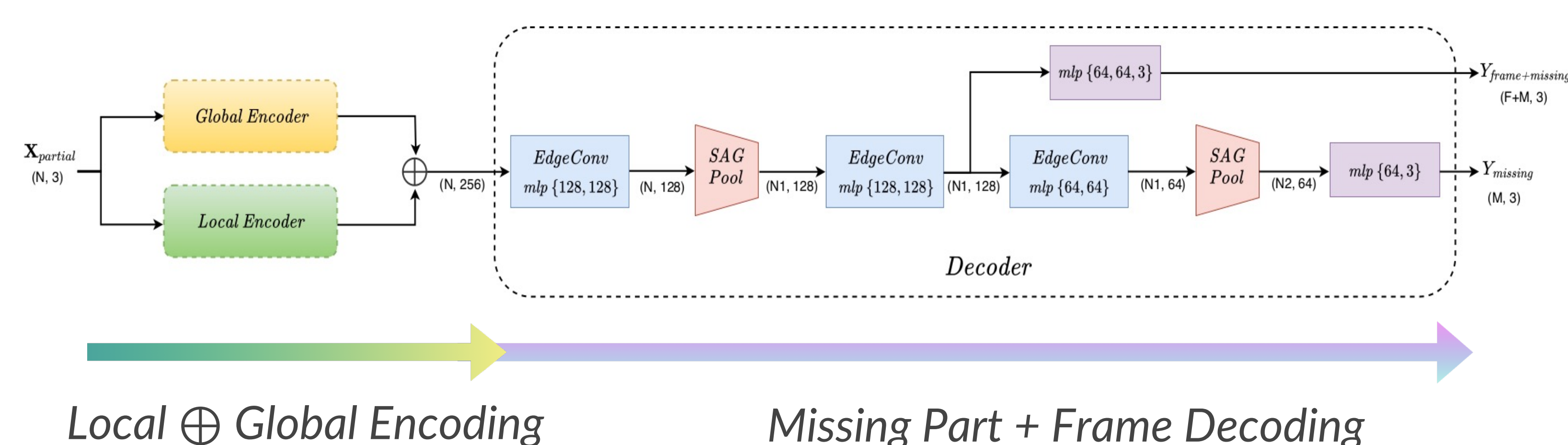
✓	✓	✓
✗	✗	✓

- **What about completion of Unknown Categories?**



Partial preservation	✗	✗	✓	✓
Missing part modelling	✗	✗	✗	✓

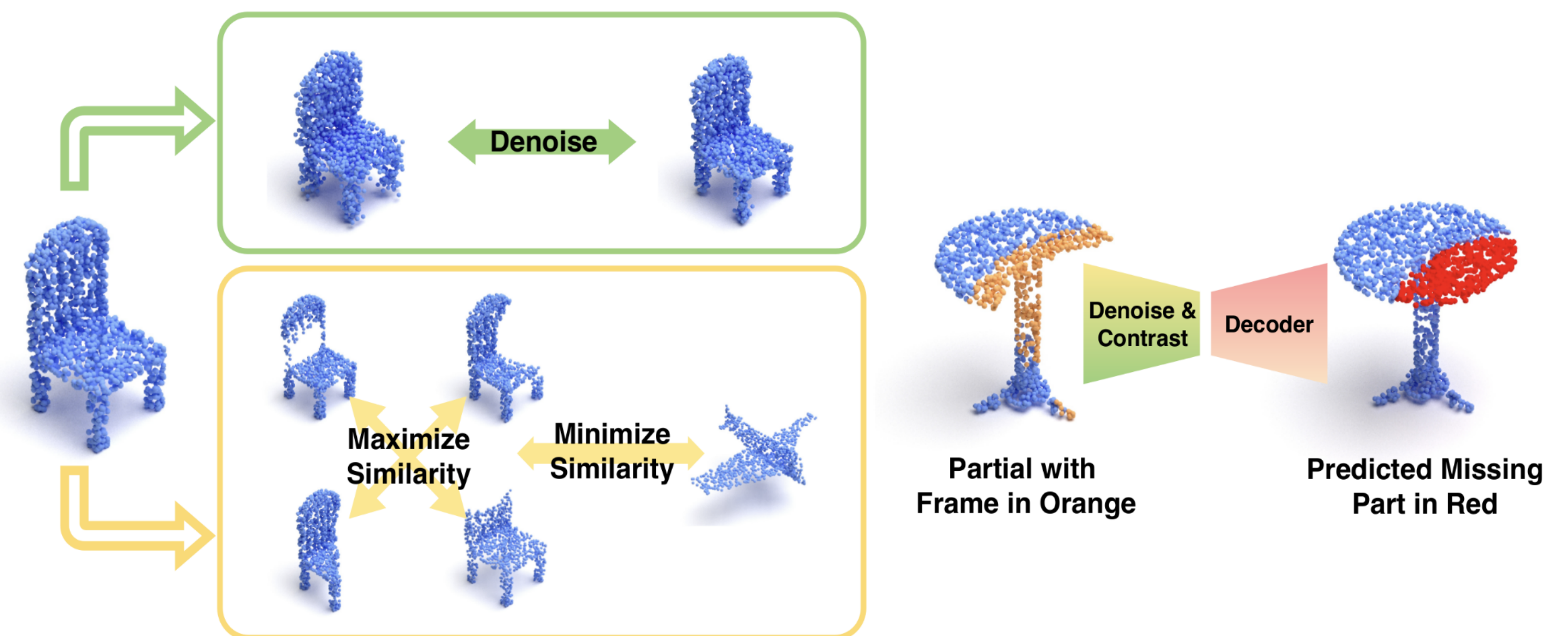
### Our Architecture



Local  $\oplus$  Global Encoding

Missing Part + Frame Decoding

### Method



- **Denoise Pretext**
  - Accounting for local structures in the shape topology
  - Local features better generalize to Unknown classes
- **Contrastive Pretext**
  - At a global level partial observations of the same shape should encode similar information (same semantic)
- **Frame Regularization**
  - Intermediate strategy between whole shape reconstruction and missing part prediction
  - Better blend the generated part with the partial observation

### Results

#### Known Categories

Category	PCN [39]	MSN [16]	CRN [30]	PF-Net vanilla [11]	PF-Net [11]	DeCo
Airplane	31.515	15.907	39.334	11.015	10.805	<b>10.003</b>
Bag	37.825	59.185	33.593	40.000	38.485	<b>28.508</b>
Cap	66.275	40.276	53.146	49.945	50.450	<b>36.436</b>
Car	24.320	24.176	39.537	21.925	<b>21.640</b>	22.963
Chair	31.265	20.751	28.688	19.130	19.490	<b>16.428</b>
Lamp	93.745	41.094	30.207	41.555	42.910	<b>24.150</b>
Laptop	22.460	11.718	26.393	11.520	<b>11.220</b>	12.706
Motorbike	34.420	21.276	41.292	20.525	19.905	<b>19.136</b>
Mug	35.905	57.007	41.153	32.800	<b>31.880</b>	34.239
Pistol	29.490	14.560	26.845	11.395	<b>10.885</b>	12.266
Skateboard	23.815	14.146	34.358	12.275	12.365	<b>9.861</b>
Table	24.775	22.103	23.953	20.560	20.845	<b>17.120</b>
Guitar	10.540	6.959	15.224	4.350	<b>4.425</b>	4.482
Overall	34.095	22.410	29.044	20.209	20.445	<b>16.517</b>

#### Unknown Categories

Categories	MSN [16]	CRN [30]	PF-Net vanilla [11]	PF-Net [11]	DeCo
<b>Similar</b>					
Bicycle	47.423	64.275	49.779	47.186	39.684
Basket	48.100	50.692	58.866	57.066	<b>34.613</b>
Helmet	71.161	57.851	63.742	69.849	<b>47.412</b>
Bowl	52.002	63.357	97.316	78.793	<b>35.209</b>
Rifle	34.712	47.239	25.438	28.684	<b>12.004</b>
Vessel	30.948	41.418	27.122	31.114	<b>18.836</b>
Overall	35.544	46.166	31.232	33.844	<b>17.680</b>
<b>Dissimilar</b>					
Piano	62.969	61.643	62.131	62.994	<b>49.429</b>
Bookshelf	48.397	44.738	58.920	55.123	<b>34.681</b>
Bottle	29.580	20.134	25.543	24.578	<b>20.002</b>
Clock	57.222	38.132	50.964	48.373	<b>32.826</b>
Microwave	53.354	56.259	61.702	56.152	<b>41.877</b>
Telephone	38.032	25.554	38.085	32.063	<b>20.106</b>
Overall	45.049	34.625	45.014	41.449	<b>28.403</b>

### Conclusions

We propose **DeCo** for point cloud completion in which:

- Local and global feature encoding is enforced by specific architectural choices and the use of tailored pretext tasks
- Framing strategy allows us to blend the generated output with the partial observation

Achieve **SOTA** for both Known and Unknown classes