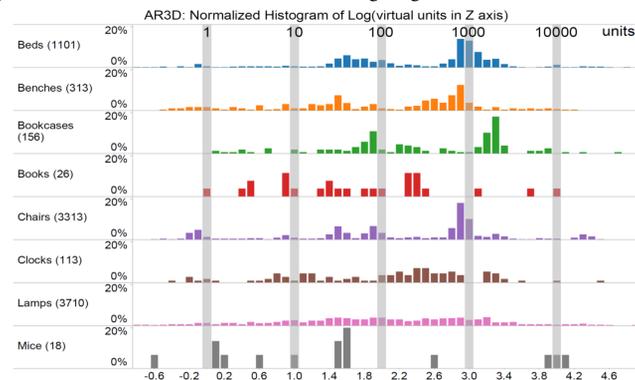


## Introduction

3D model repositories are *rapidly* growing and enabling new ways of 3D content creation.



But there's a big problem: 3D models have *inconsistent virtual unit scales*. Below is a plot of various categories of models from Archive3D showing large variations in virtual size:



What to do? *Insight*: Integrate 3D models with external information about physical sizes.

## Information Sources

### 3D Scenes

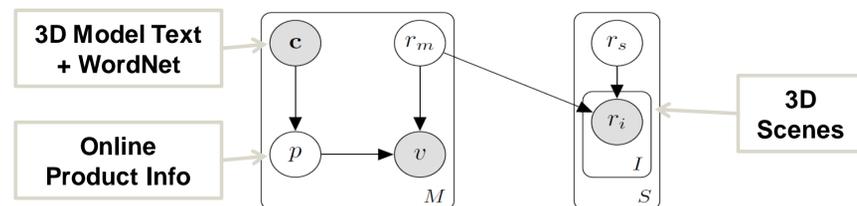


### Online Product Info

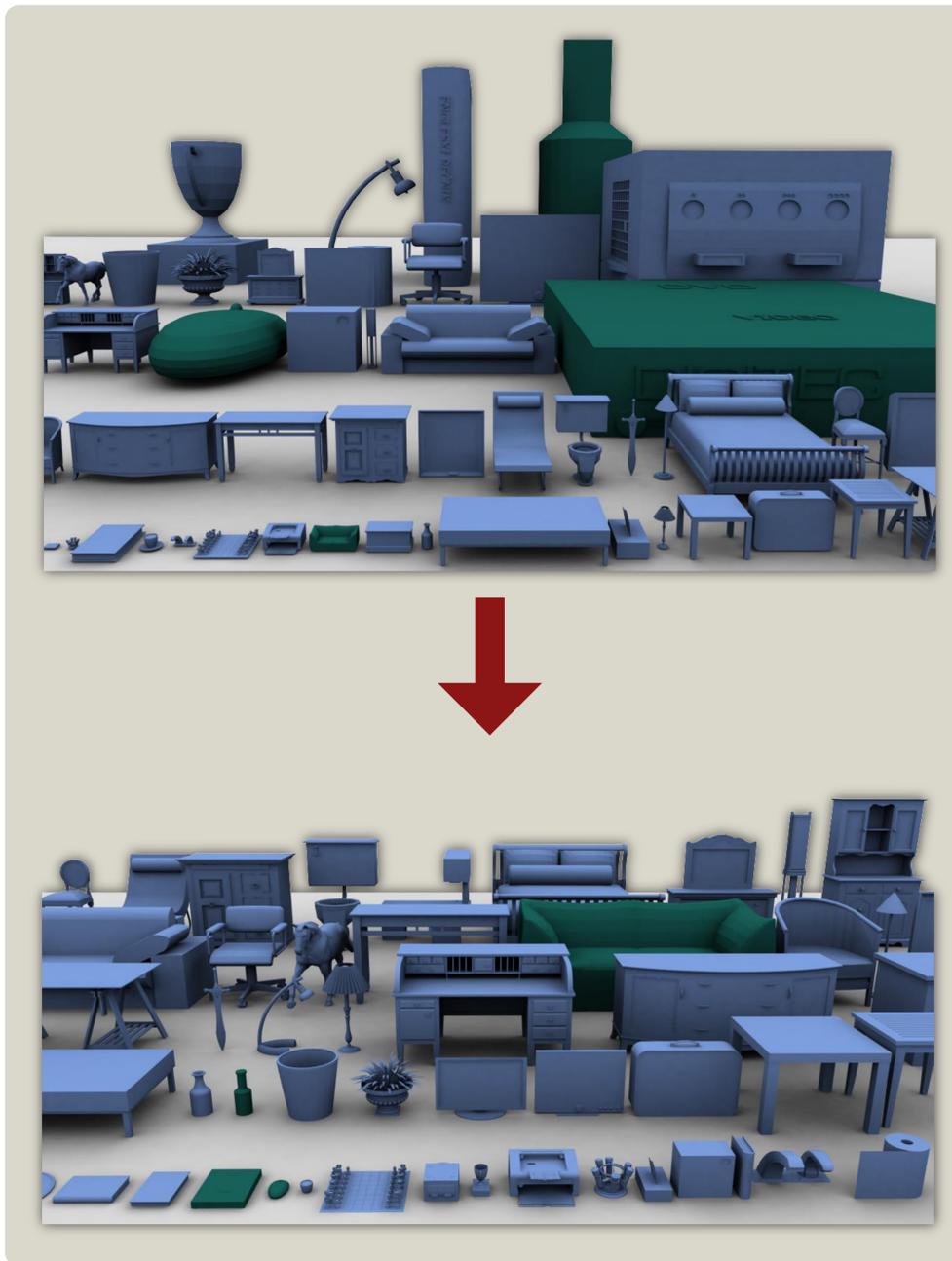


## Approach

We formulate a probabilistic graphical model for 3D model sizes to predict scales resulting in physically plausible sizes:



| Notation               | Interpretation                    |
|------------------------|-----------------------------------|
| $c \in 1 \dots K$      | Category label                    |
| $v \in \mathbb{R}^+$   | Virtual units                     |
| $p \in \mathbb{R}^+$   | Physical units                    |
| $r_m \in \mathbb{R}^+$ | Model scale ( $p = v \cdot r_m$ ) |
| $r_s \in \mathbb{R}^+$ | Scene scale                       |
| $r_i \in \mathbb{R}^+$ | Model instance scale              |



## Acknowledgments

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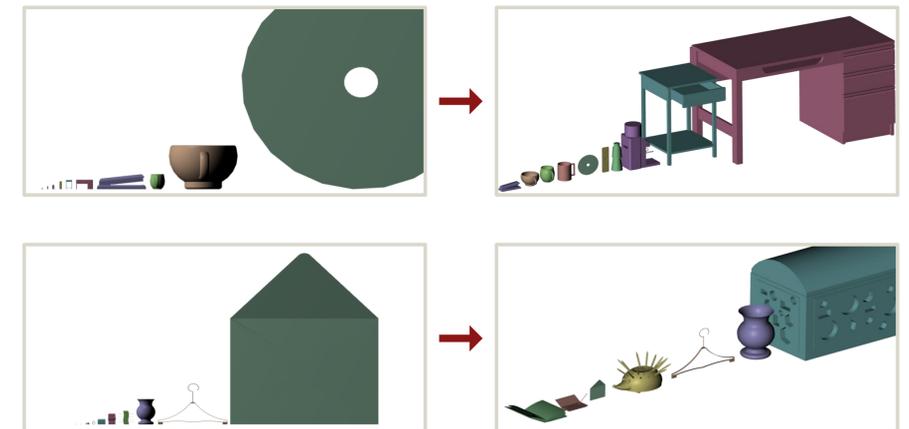
## Contact

This is an ongoing research project. More details and relevant information available by contacting the primary author through email: [msavva@stanford.edu](mailto:msavva@stanford.edu)



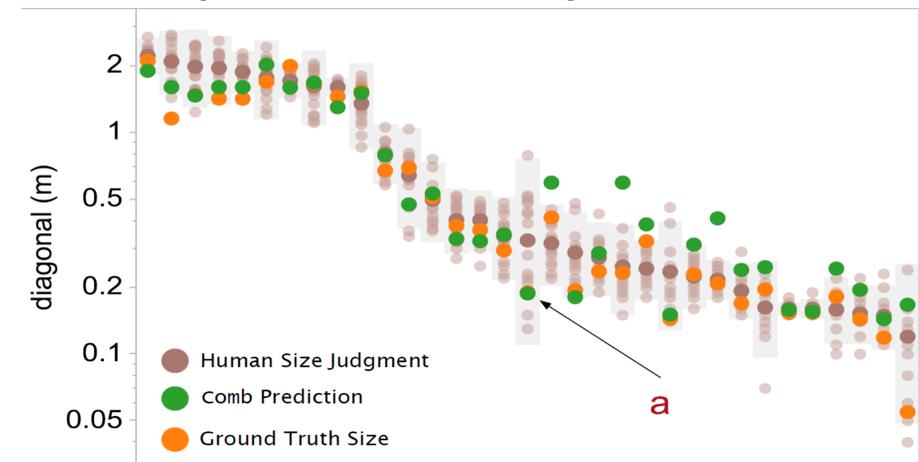
## Results

Sets of 10 randomly selected 3D models sorted by increasing original virtual unit height (left) rescaled to physically plausible sizes using our approach (right):



We performed a study to evaluate our algorithmic predictions against human size judgments and ground truth values. Each column plotted below represents size predictions for one 3D model instance and columns are sorted by average human size judgment:

Human Judgments, Ground Truth and Algorithmic Size Prediction



## Conclusions

Integrating size knowledge from online product catalogues and from 3D scenes allows us to predict physical sizes of large collections of 3D models.

An evaluation against human size judgments shows that our algorithmic approach matches ground truth sizes at least as accurately as people.

Our approach can be used to provide size information for online repositories of 3D models and to improve high level 3D scene synthesis algorithms and interactive systems.