SEMI-SUPERVISED CO-ANALYSIS OF 3D SHAPE STYLES FROM PROJECTED LINES

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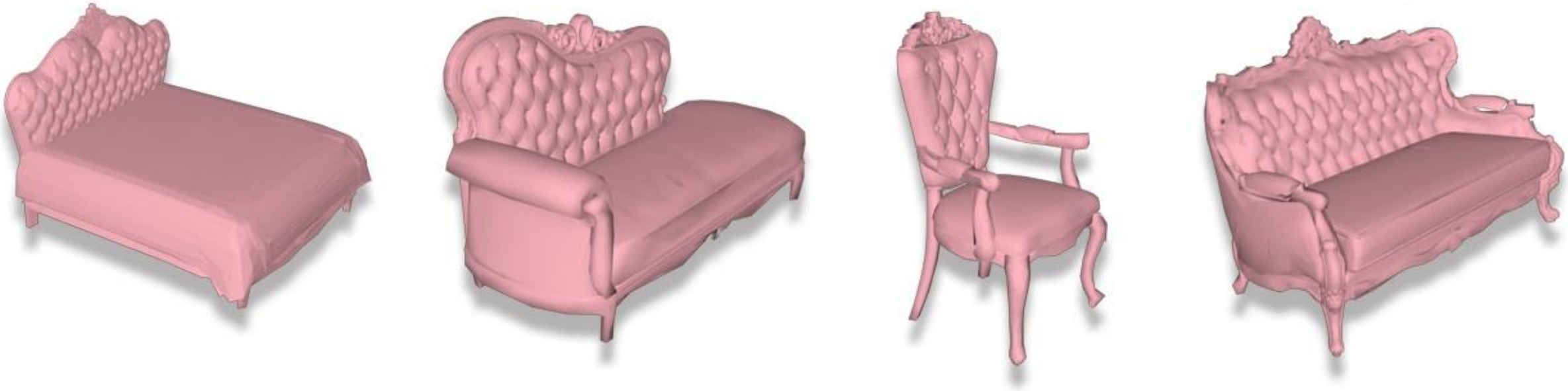
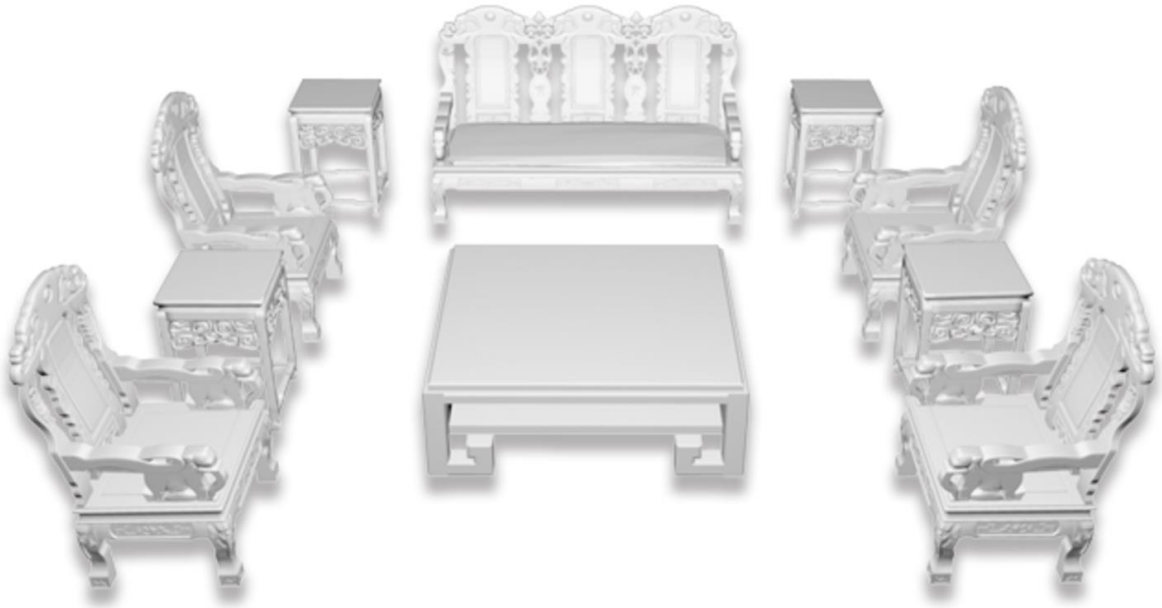
Style



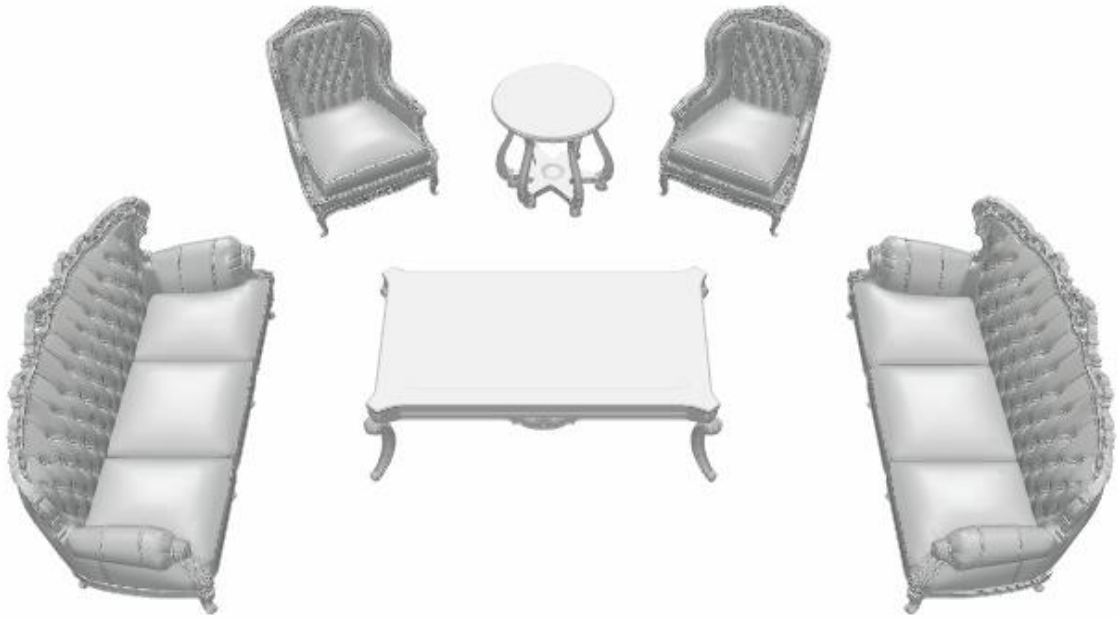
Distinctive features which permit the grouping of objects into related categories

Eric Fernie. Art History and its Methods: A critical anthology

Style

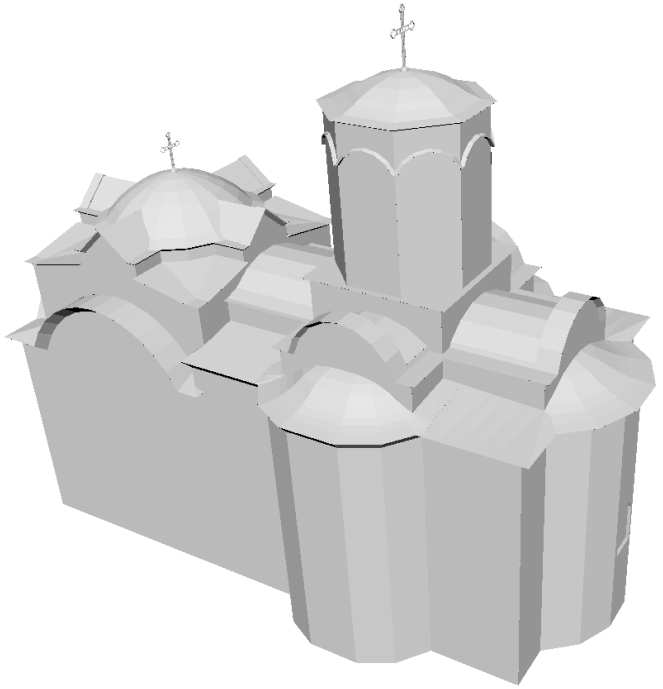


Chinese Style

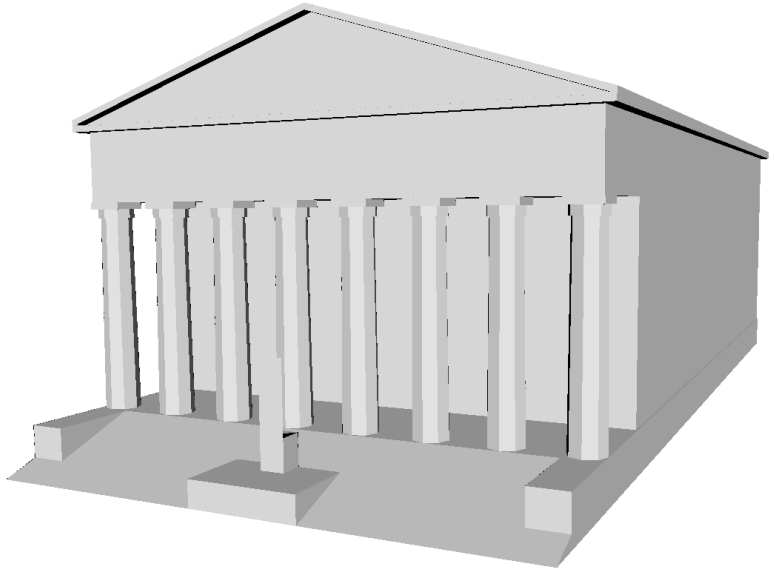


European Style

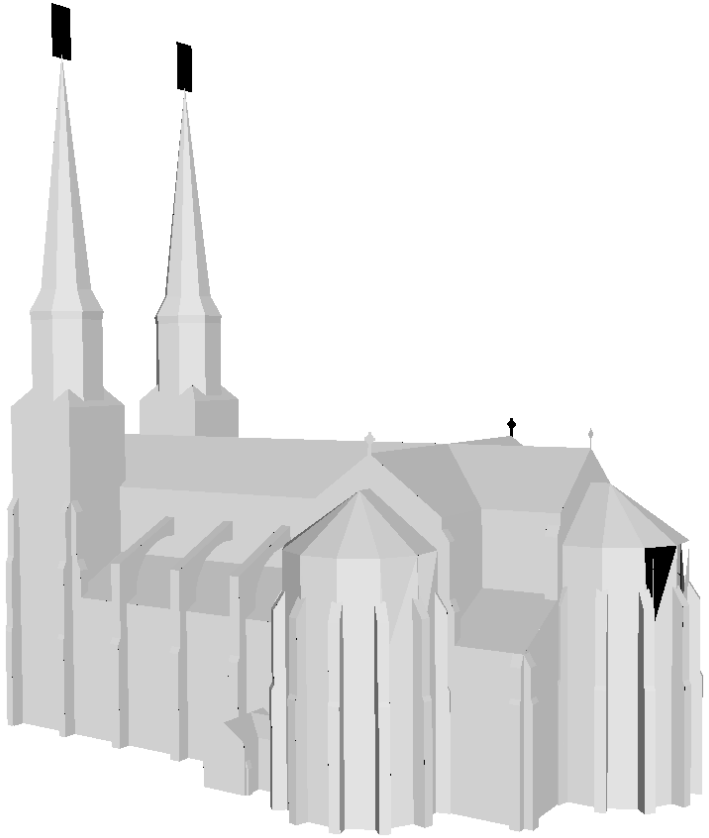
Style



Byzantine

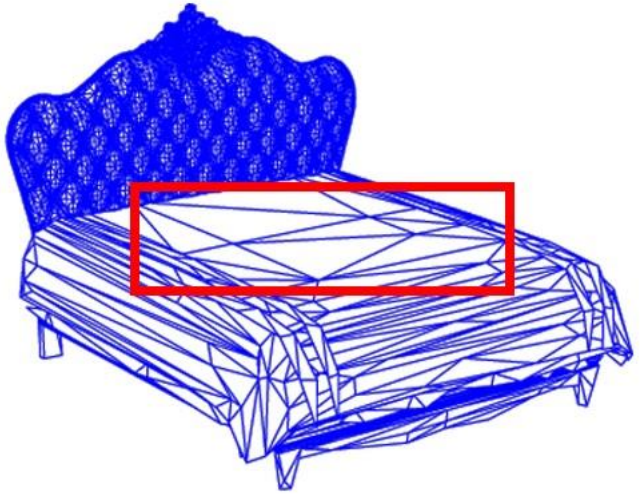


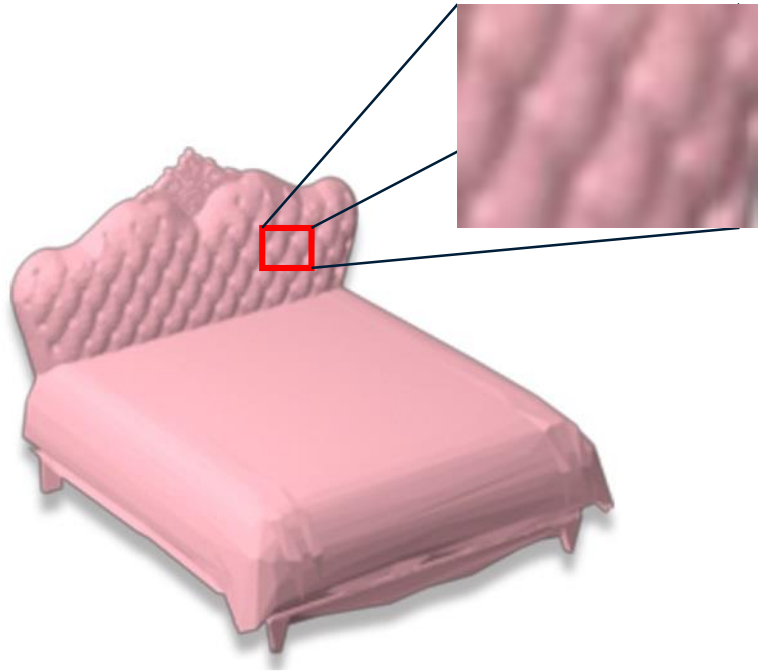
Greek



Gothic

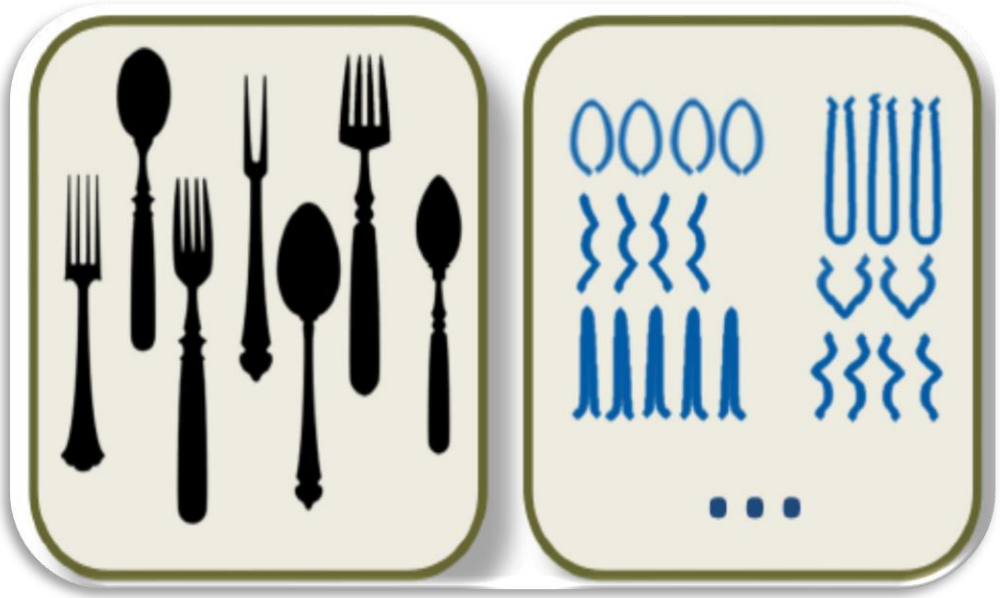
Style-Aware Mesh Simplification





Style-Aware Shape Clustering

Related Work

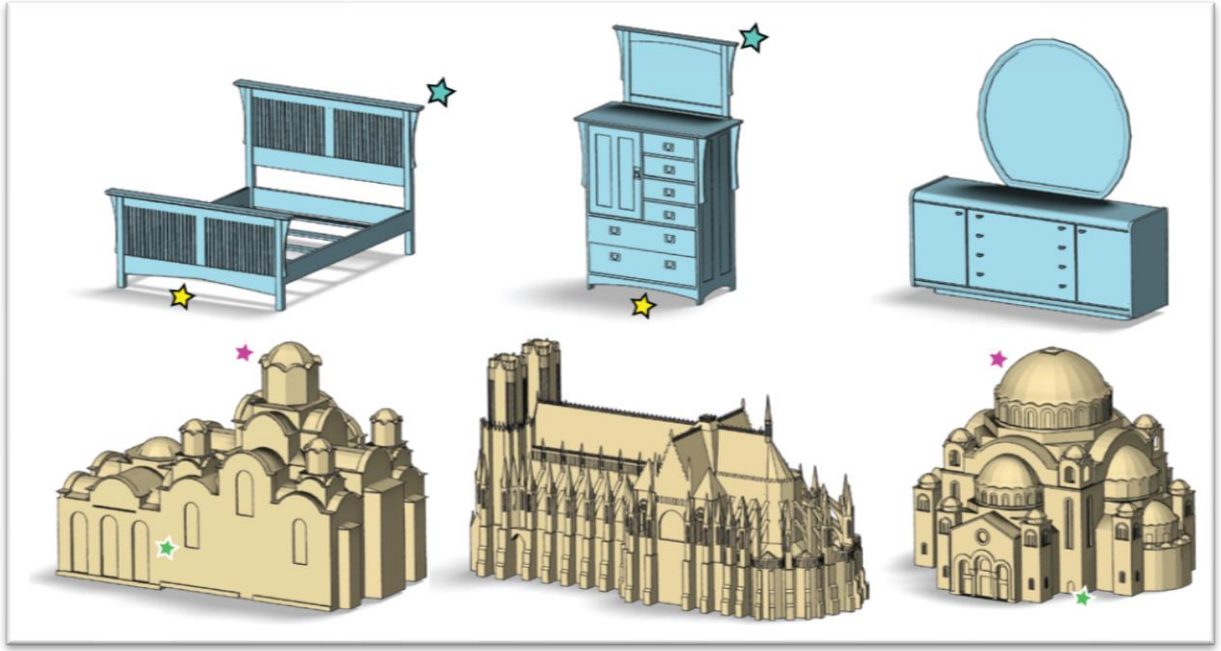


[Li et.al., 2012]

[Xu et.al., 2010]

Hand Crafted Rules

Related Work

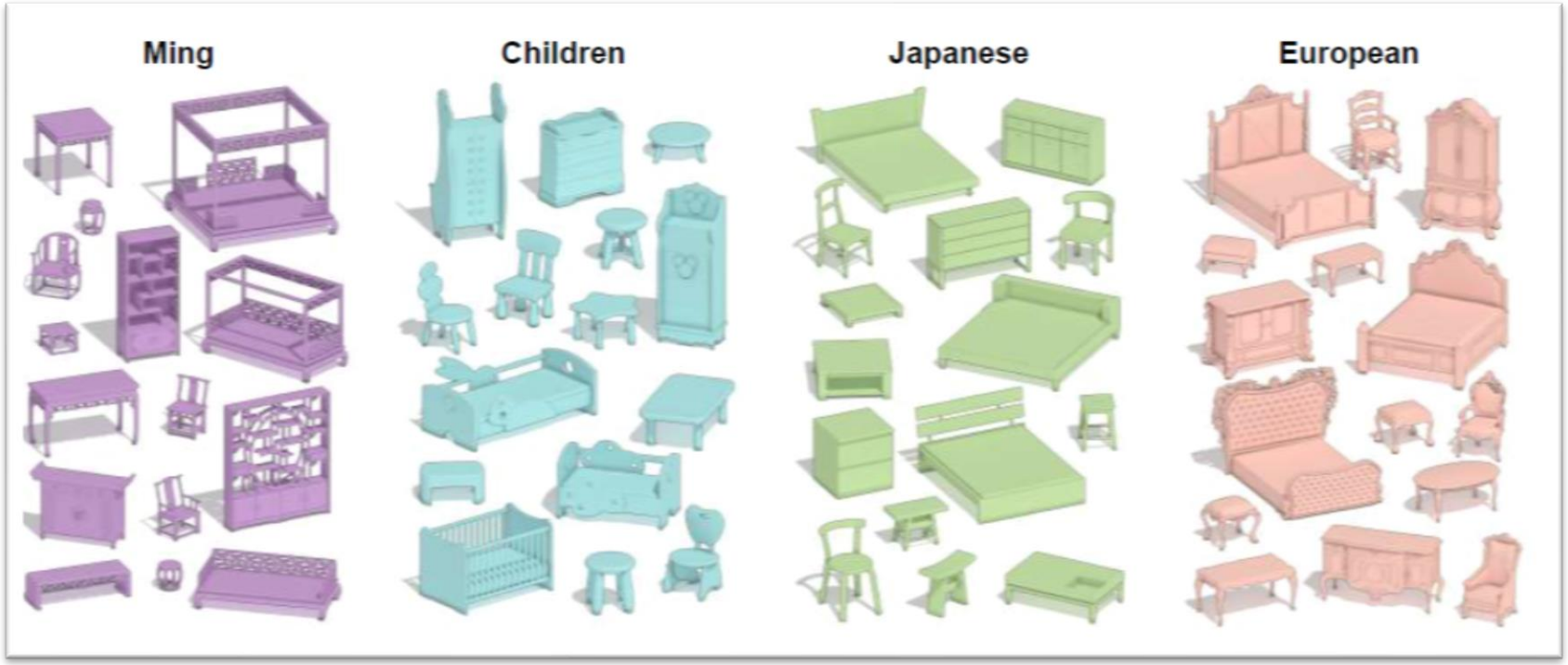


[Lun et.al., 2015]

[Liu et.al., 2015]

Supervised Style Ranking

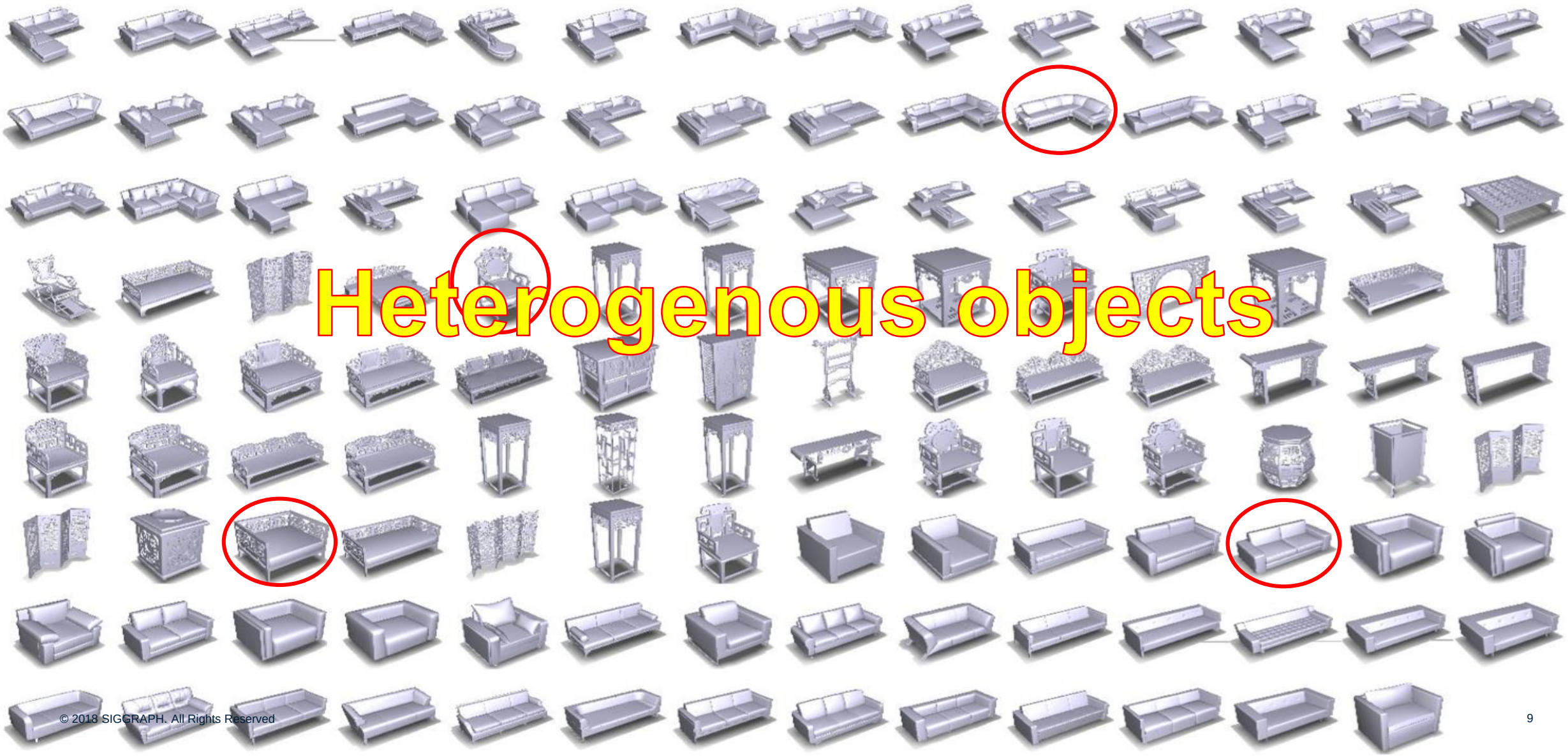
Related Work



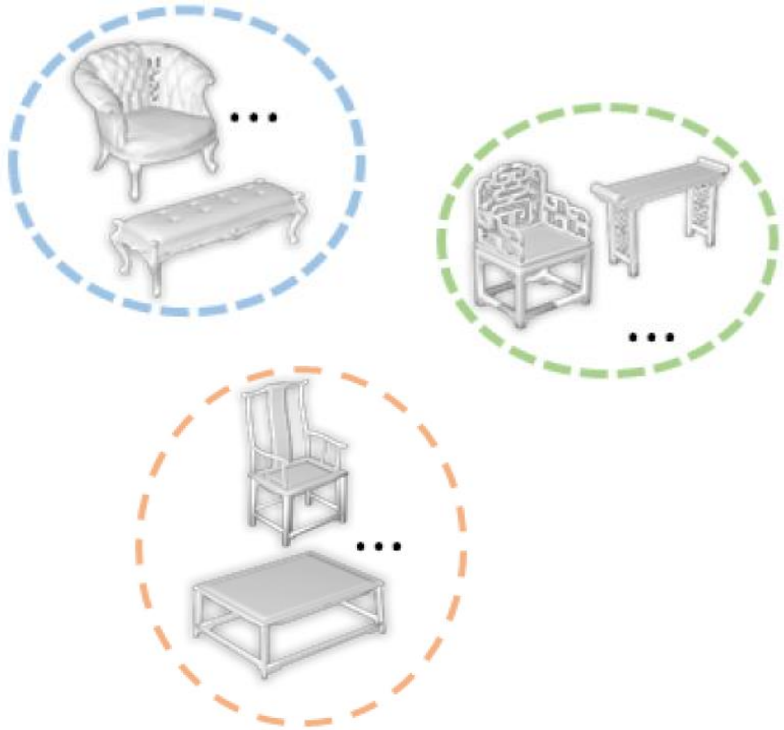
[Hu et.al., 2017]

Expert Annotated Dataset

Semi-Supervised Method



Main Operations



Shape Clustering

Patches Identification

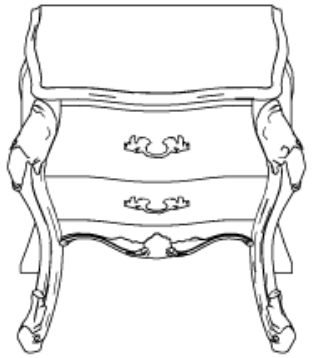
Line Drawing

3D shape

Feature Line Images

Line Drawing Advantages

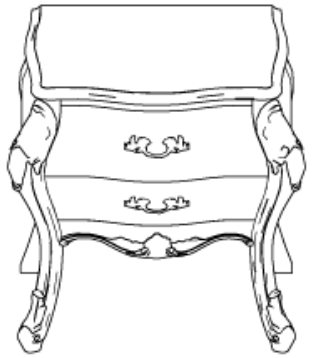
Reduces visual clutter



Line Drawing Advantages

Reduces visual clutter

Not affected by poor illumination

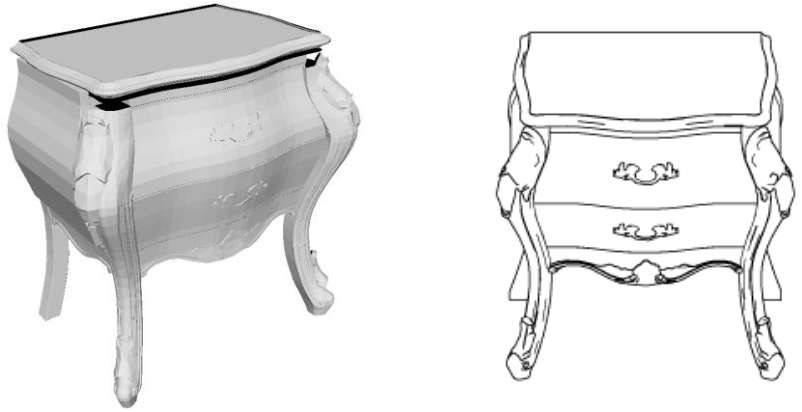


Line Drawing Advantages

Reduces visual clutter

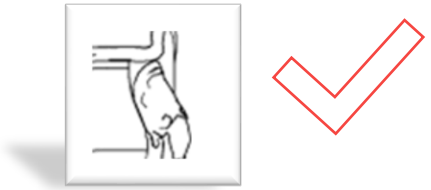
Not affected by poor illumination

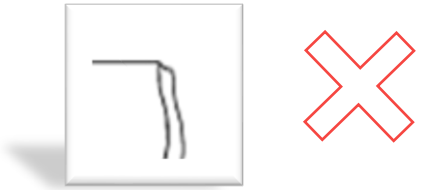
Robust under shape imperfection



Challenges

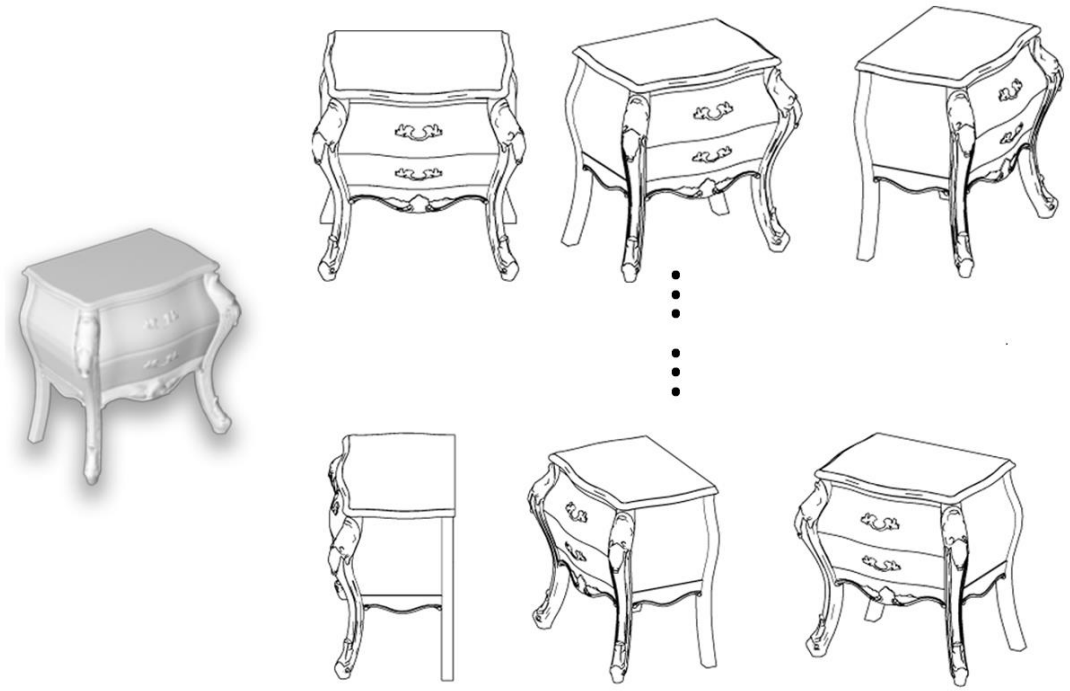
How to distinguish stylistic patches?





Challenges

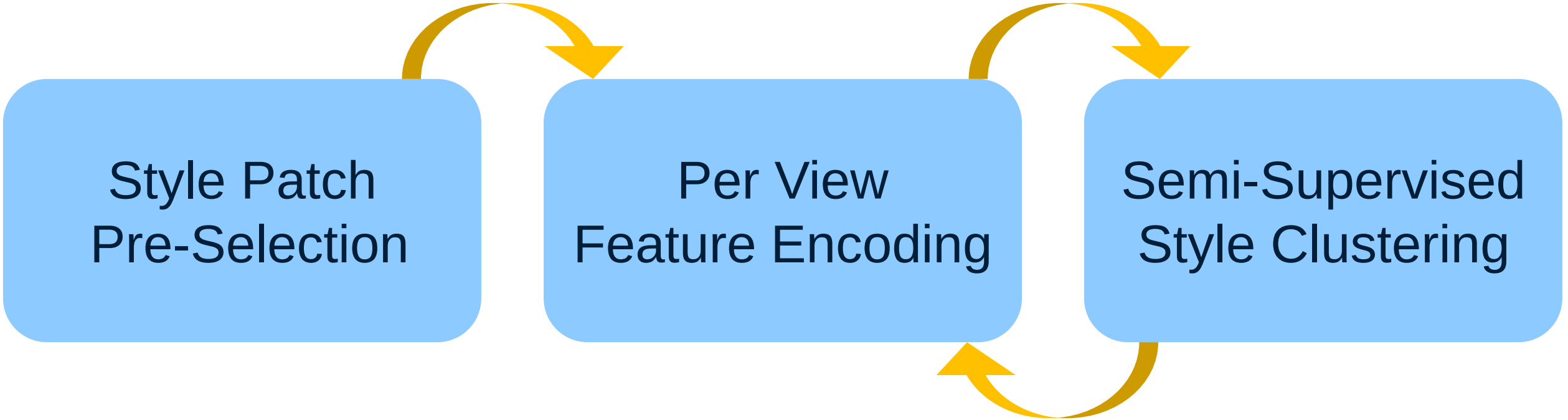
How to combine features at multiple views?



Challenges

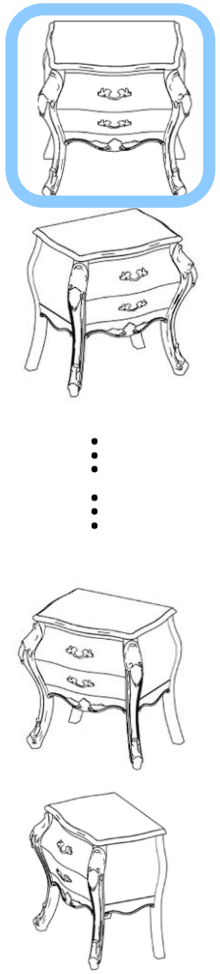
How to bring human in the loop to have semi-supervised learning?

Pipe-Line

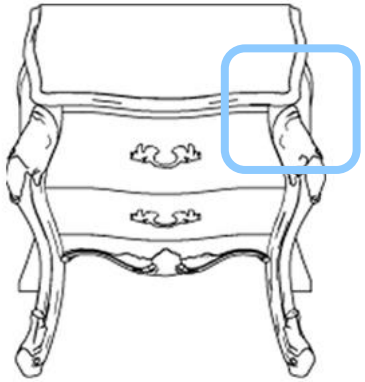


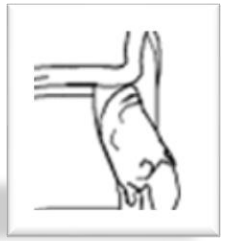
Style Patch Pre-Selection

Input 3D shape



Feature Line Images

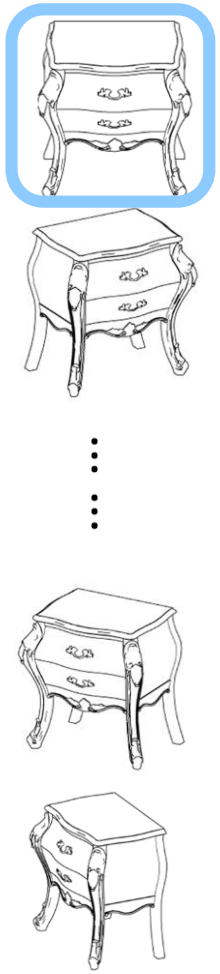




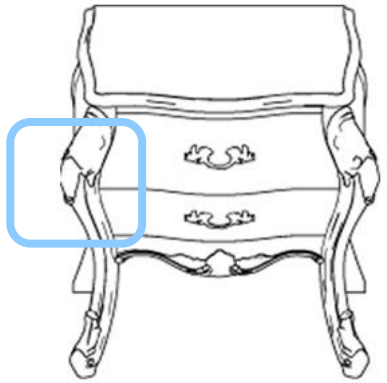
Mid-level Patches

Style Patch Pre-Selection

Input 3D shape



Feature Line Images



Mid-level Patches

Style Patch Pre-Selection

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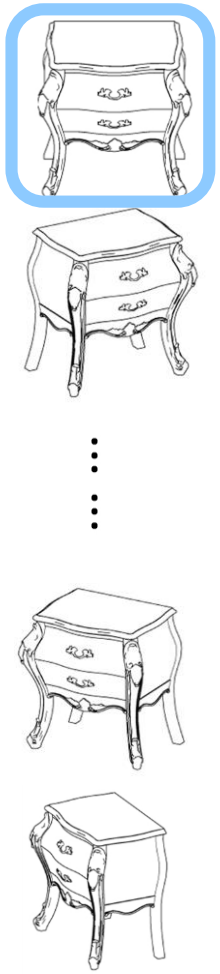
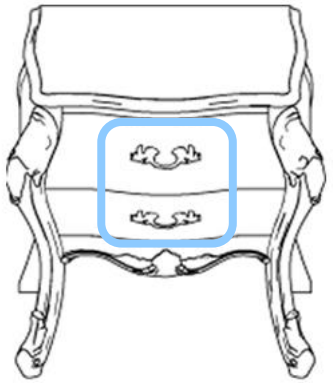
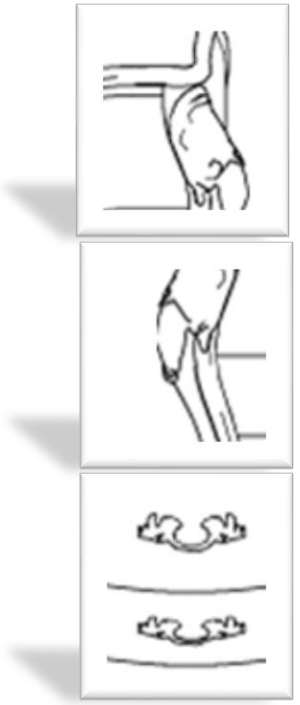


Feature Line Images

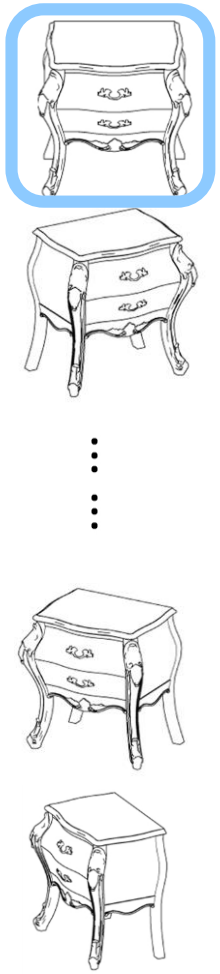




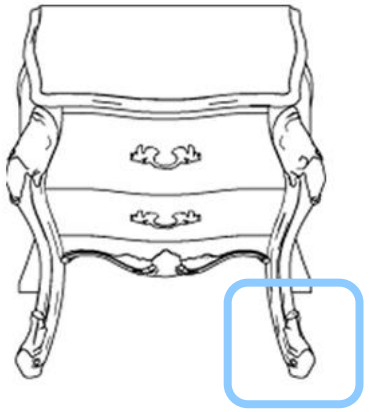
Mid-level Patches

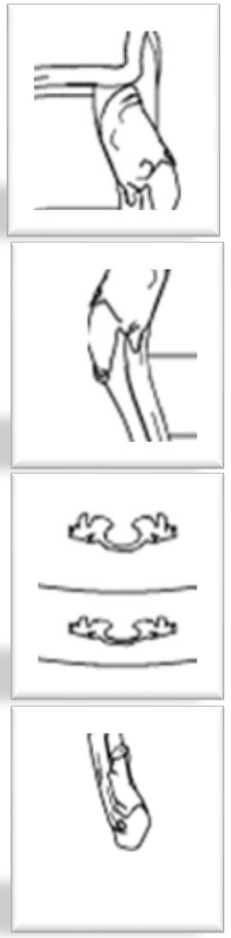
Style Patch Pre-Selection

Input 3D shape



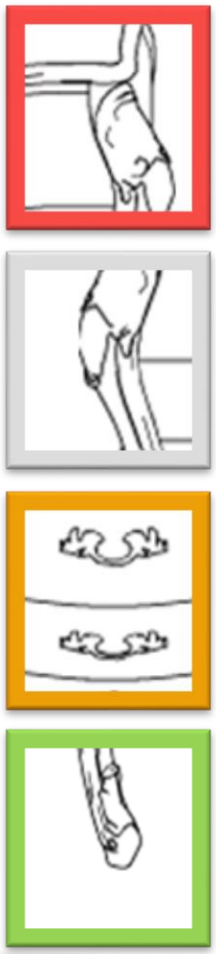
Feature Line Images

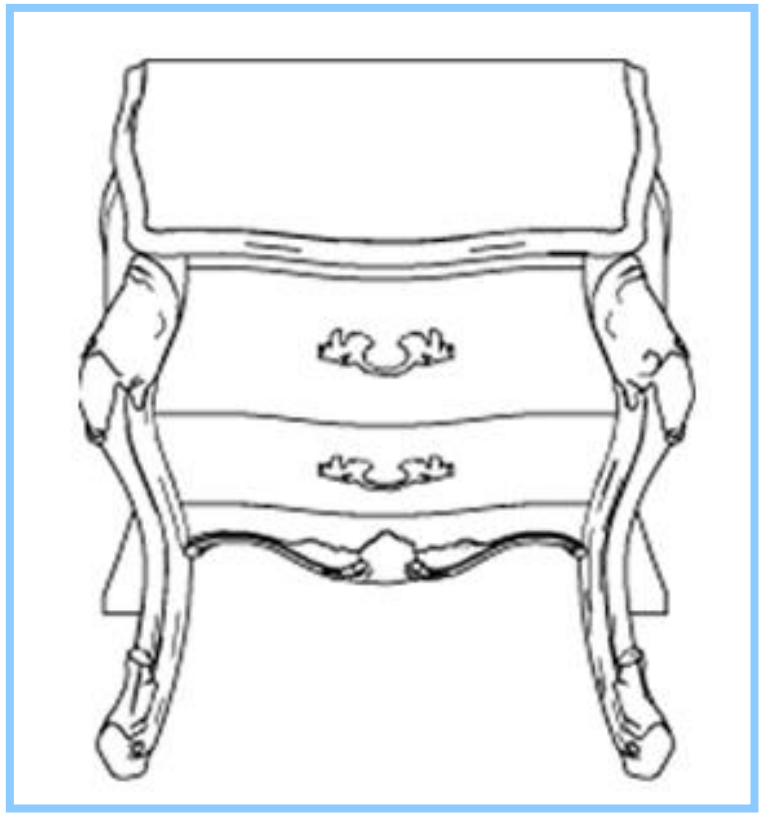




Mid-level Patches

Per-View Feature Encoding

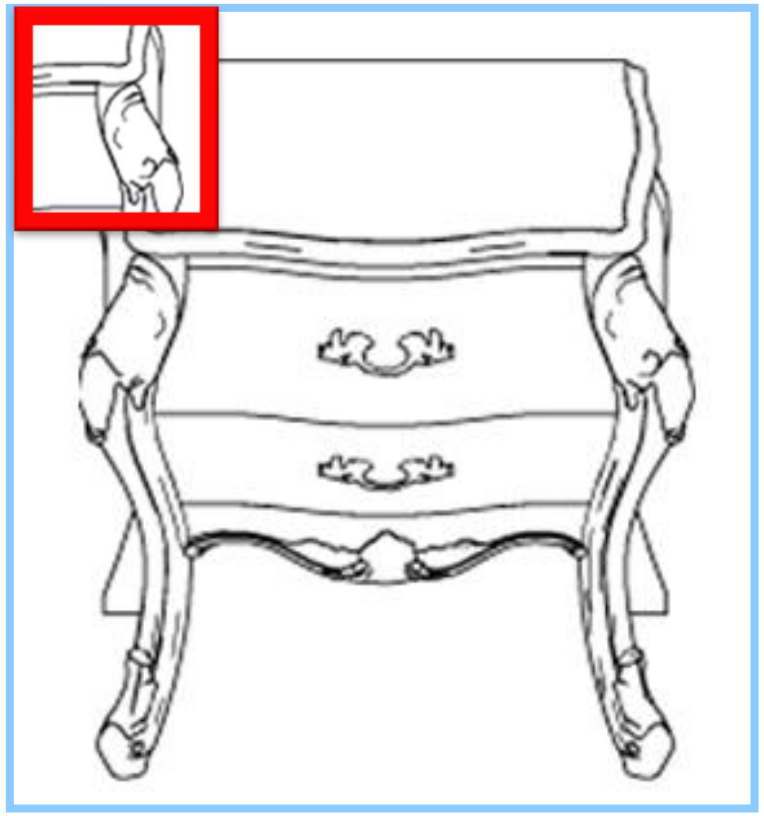


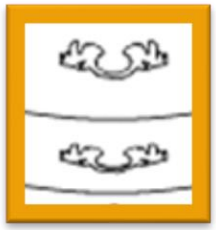


Patches as convolution Kernel

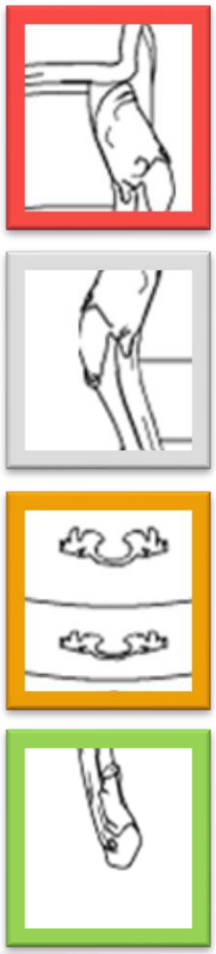
Per-View Feature Encoding

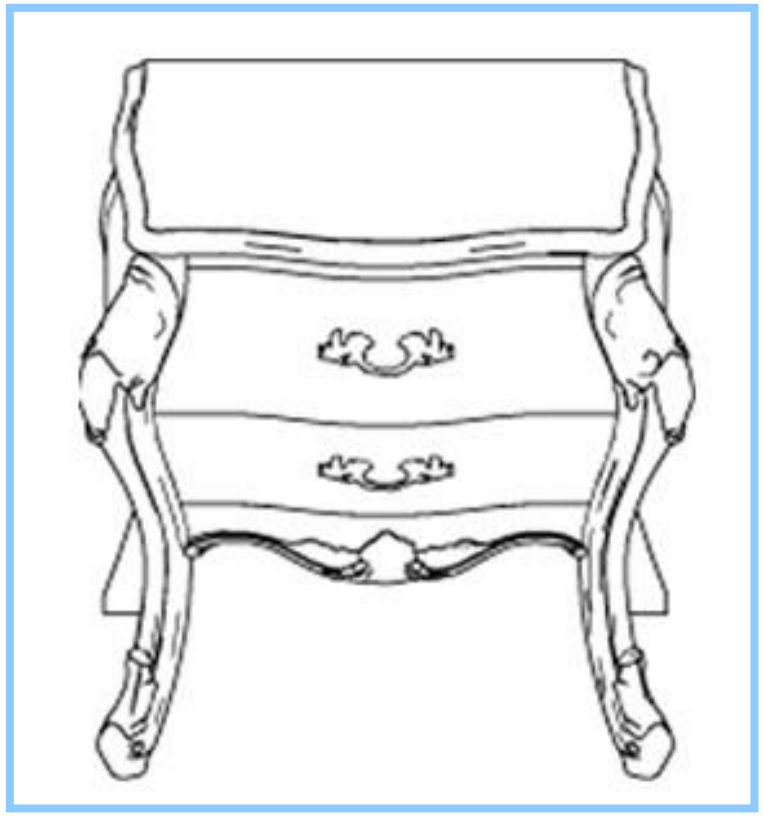
Feature Per Patch





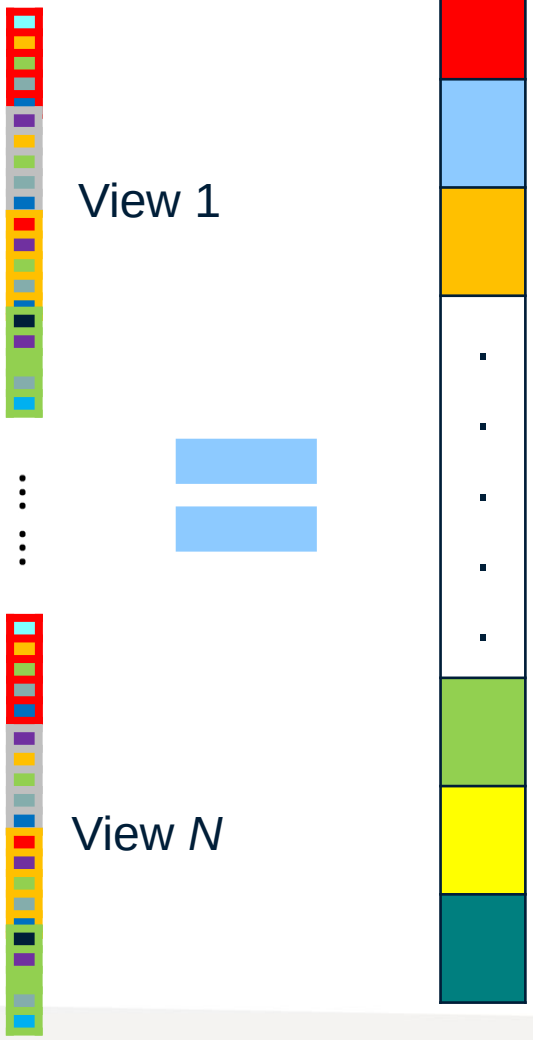
Per-View Feature Encoding





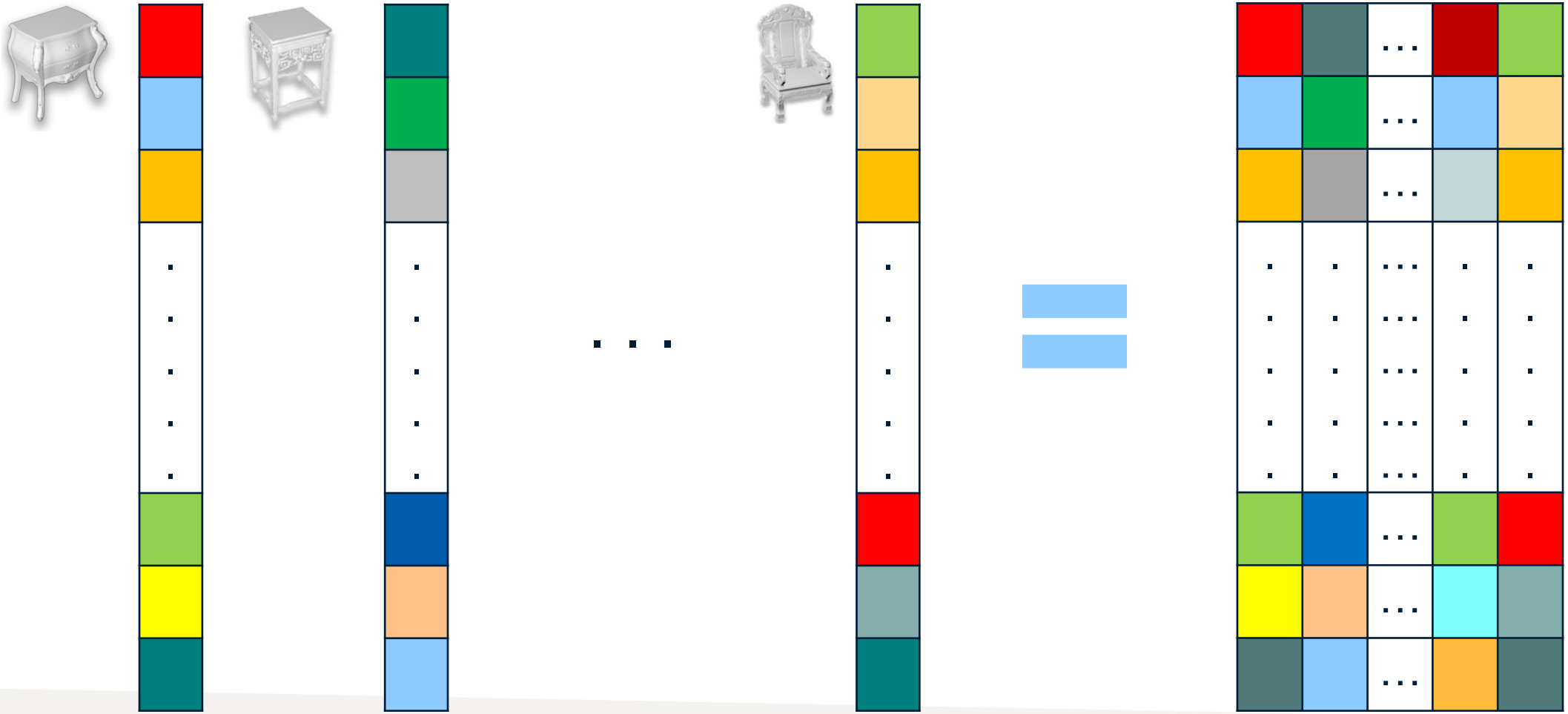
Feature Per View

Per-View Feature Encoding

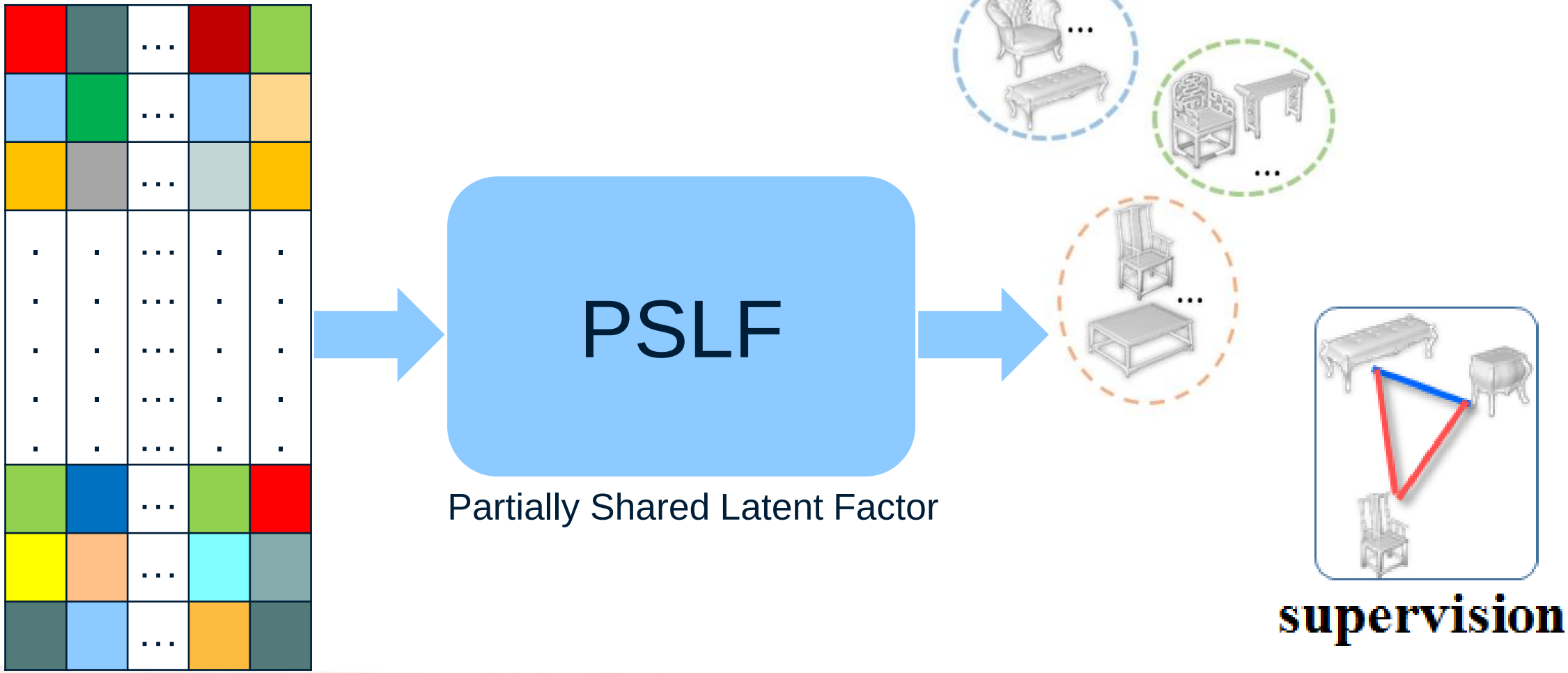


Feature for Shape

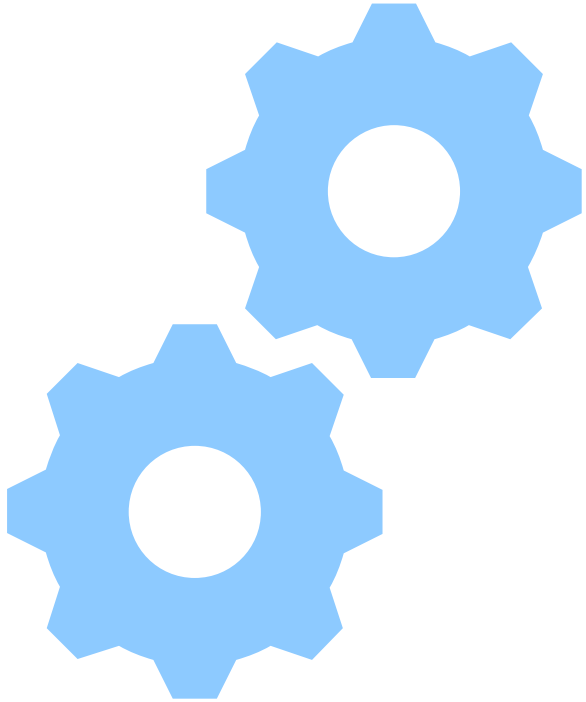
Semi-Supervised Style Clustering



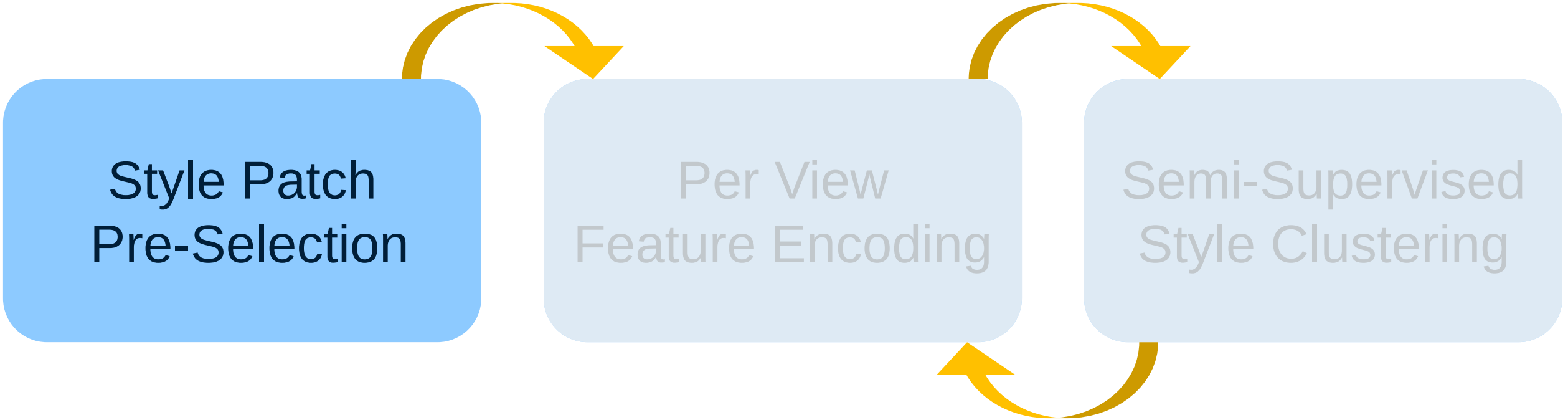
Semi-Supervised Style Clustering



Technical Details



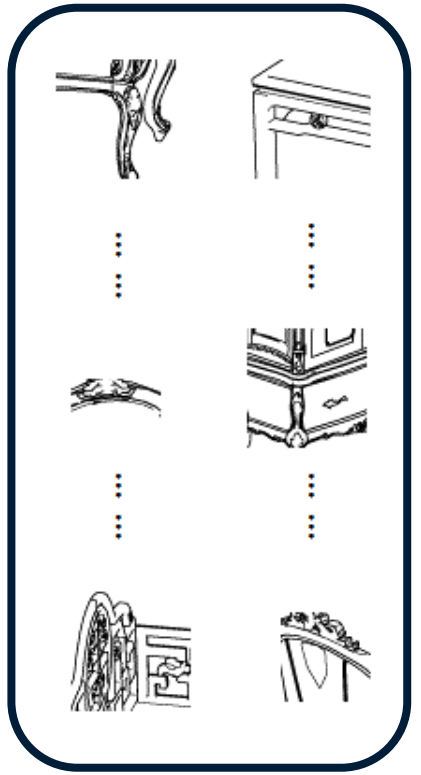
Pipe-Line



Patch Sampling

Patch Pre-Selection

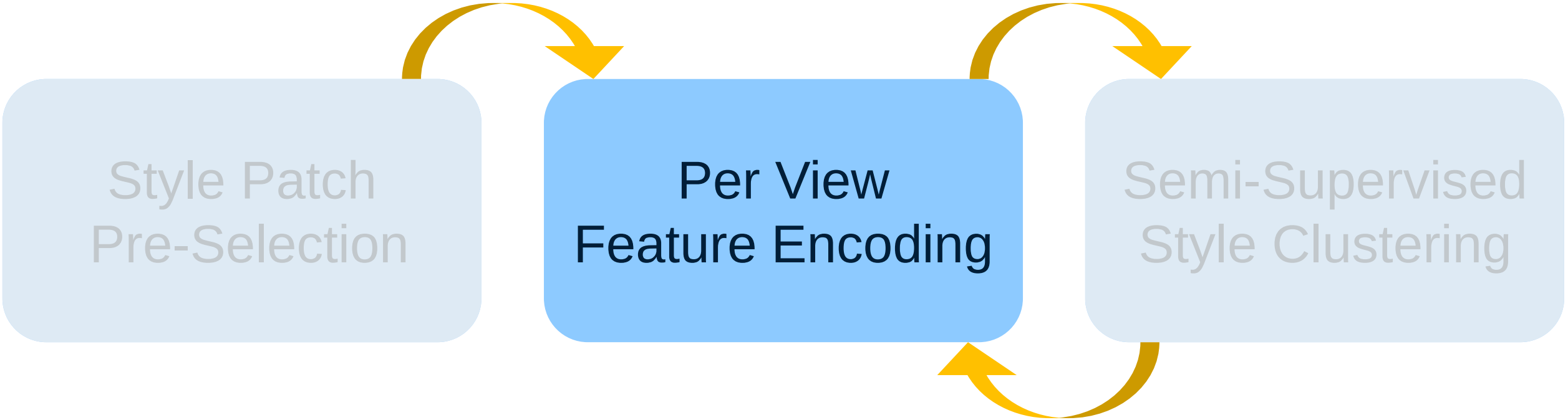
k-means



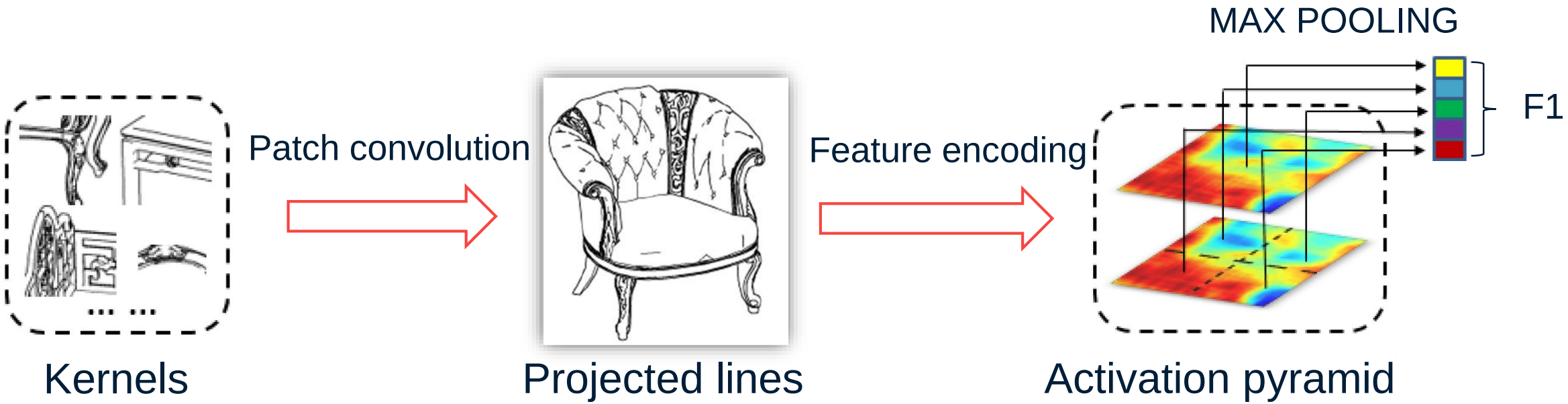
Sampled patches

Candidate style patches

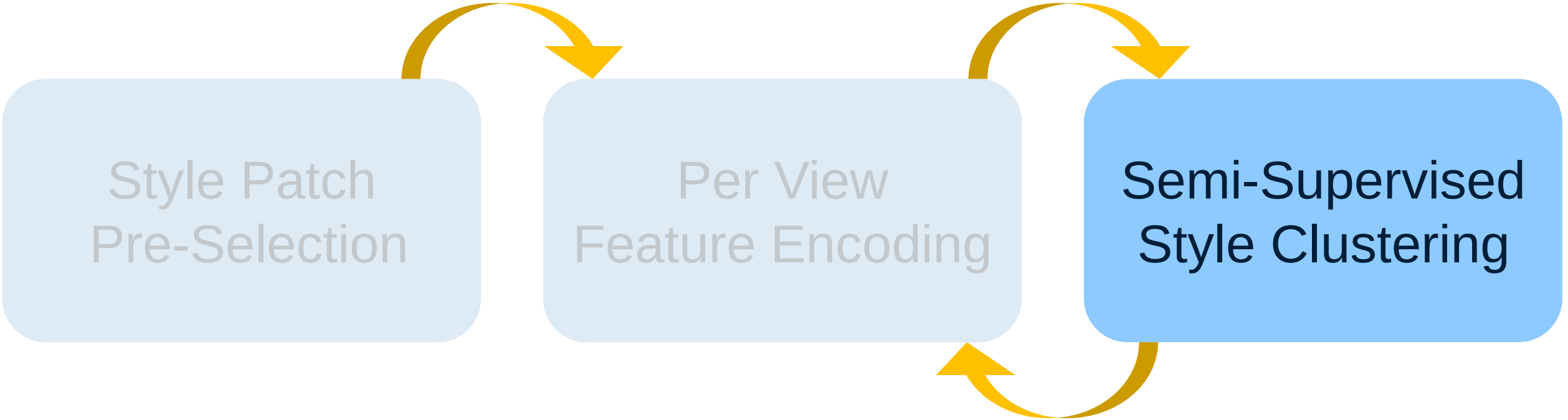
Pipe-Line



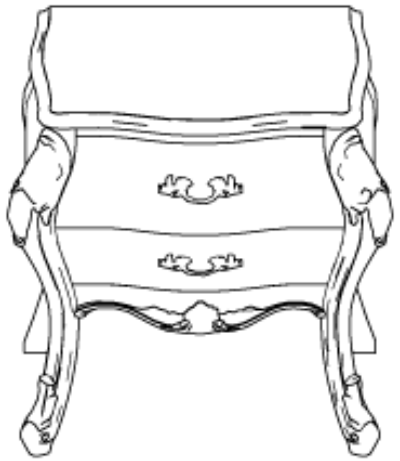
Patch Convolution

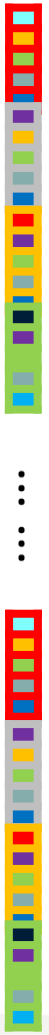


Pipe-Line



Motivation of PSLF





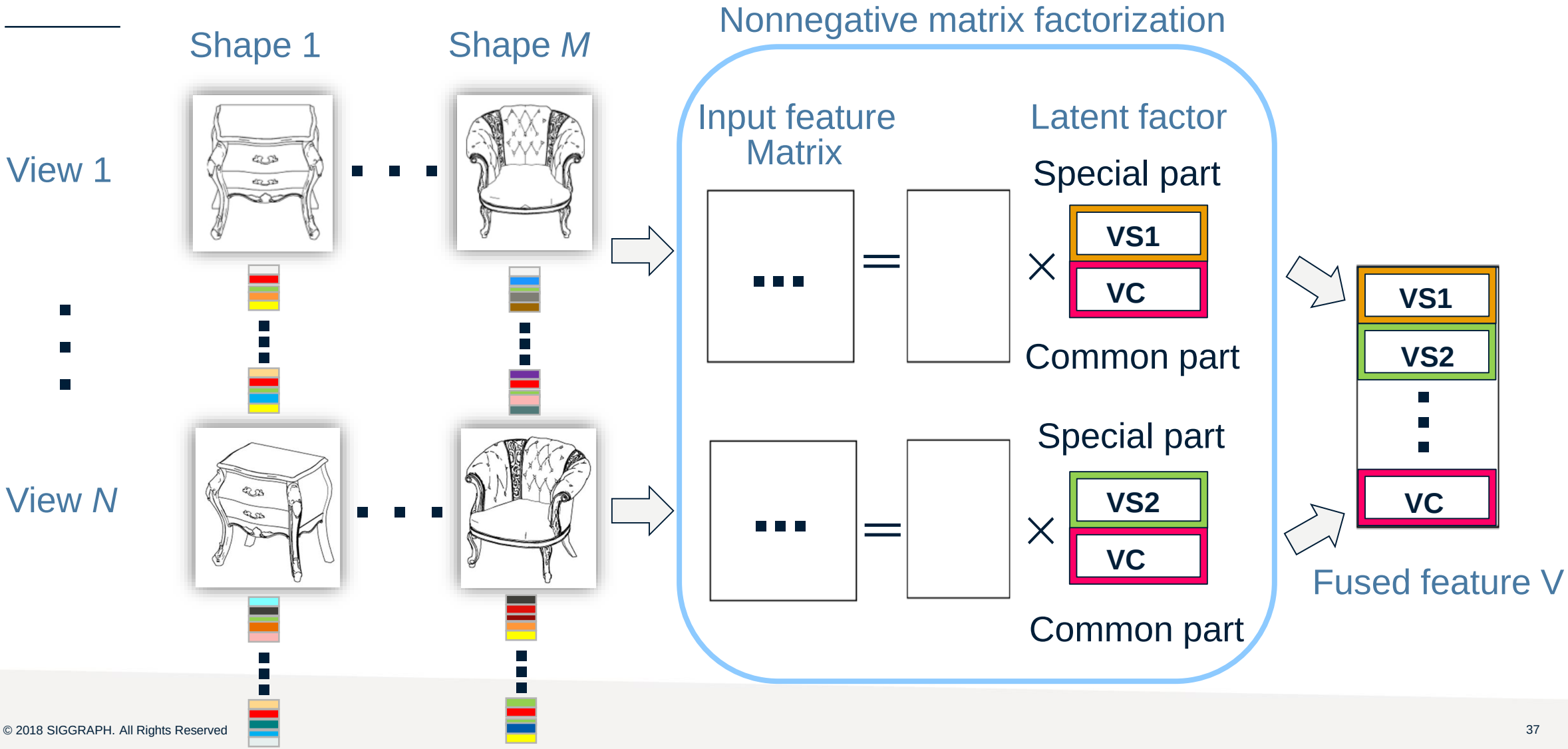
View 1

View *N*

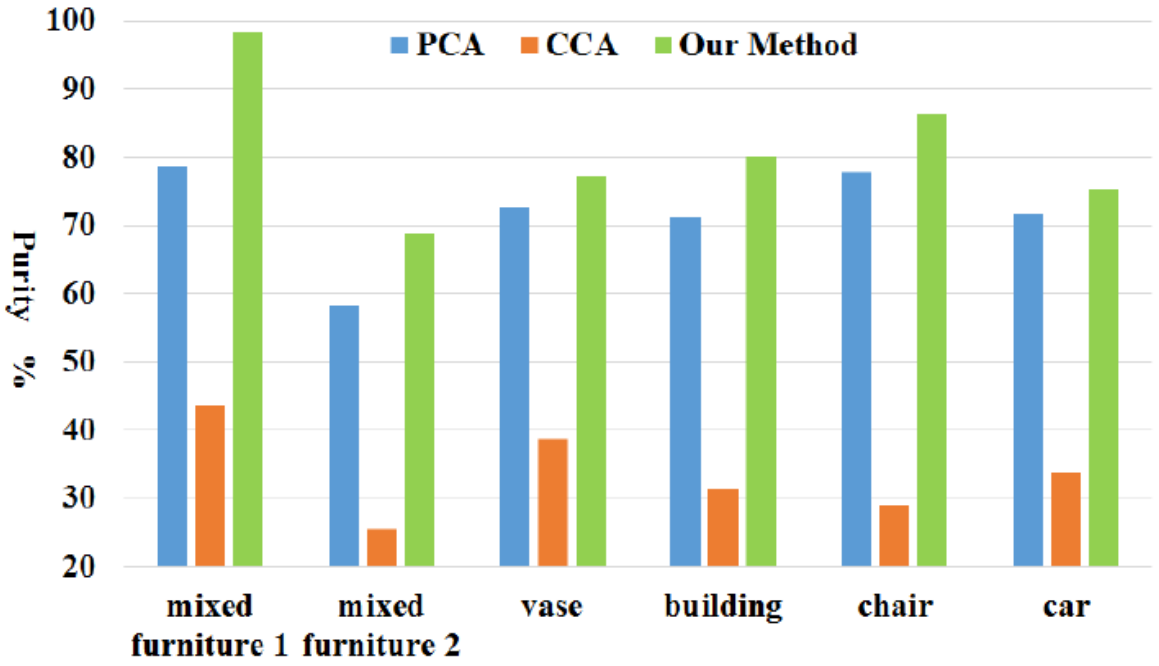
Consistent: decorative style are generally shared over all views

Complementary: distinctive stylistic features in each view

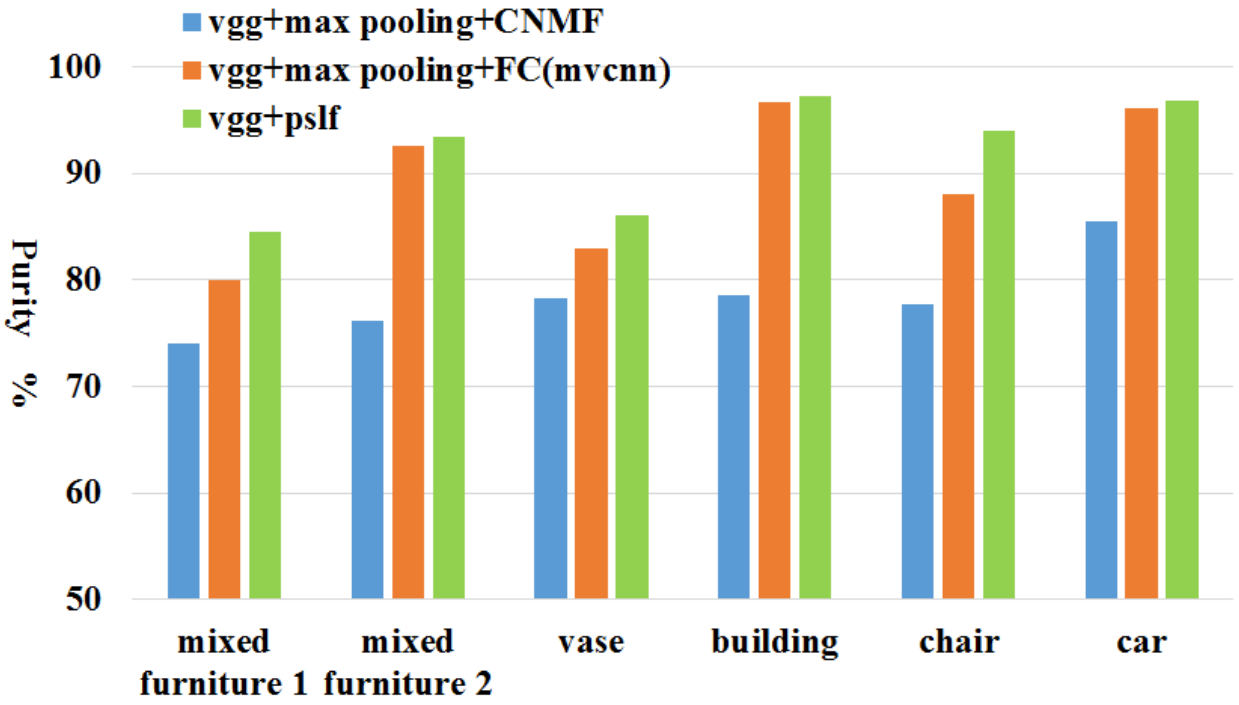
Feature Fusion by PSLF



PSLF VS Other Methods

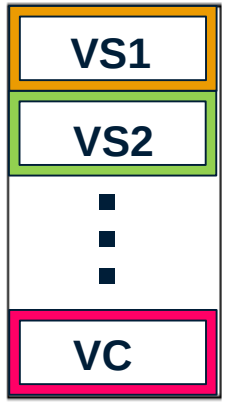


Fuse feature from our method



Fuse feature from VGGNET16

Style Clustering

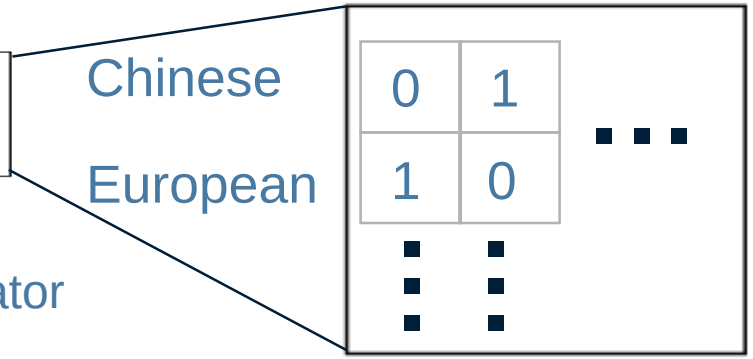


Fused feature V

Extraction

$$\mathbf{V}_l = \mathbf{W} \times \mathbf{Y}_l$$

Labeled feature | Cluster centers | Label indicator

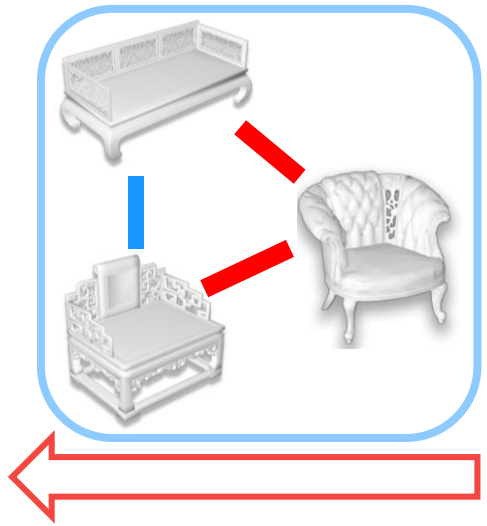


$$\mathbf{W}^T \times \mathbf{V}_u = \mathbf{Y}_u$$

Cluster centers | Unlabeled feature | Cluster indicator

Clustering with label constraints

Style Clustering



A'

Similarity with constraints

A

Similarity

$$A' = Y^T \times S \times Y$$

Similarity with constraints

Cluster centers

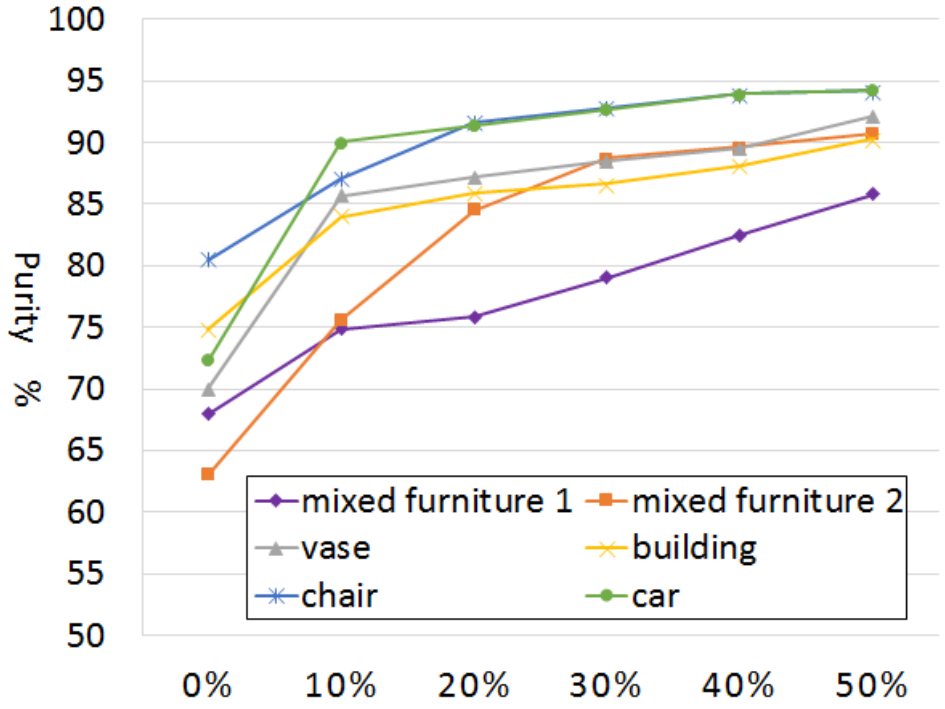
Cluster indicator

Clustering with style-rankings constraints

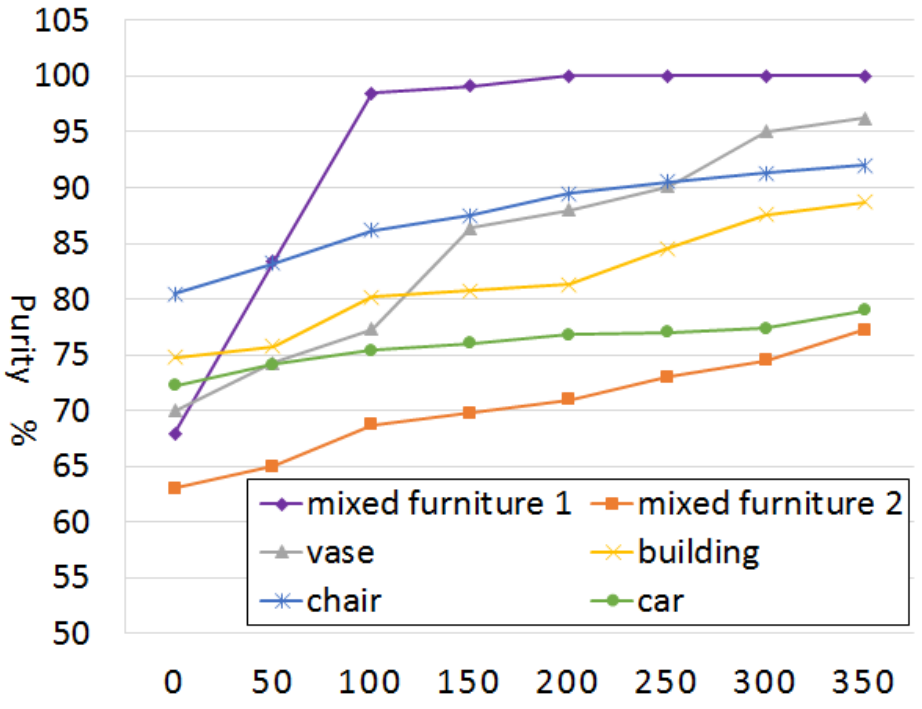
Datasets

Object Collection	Numb Shapes	Numb Style Classes
Mixed Furniture 1	120	4
Mixed Furniture 2	400	5
Building	329	4
Chair	516	9
Car	1050	6
Vase	194	5

Style Clustering

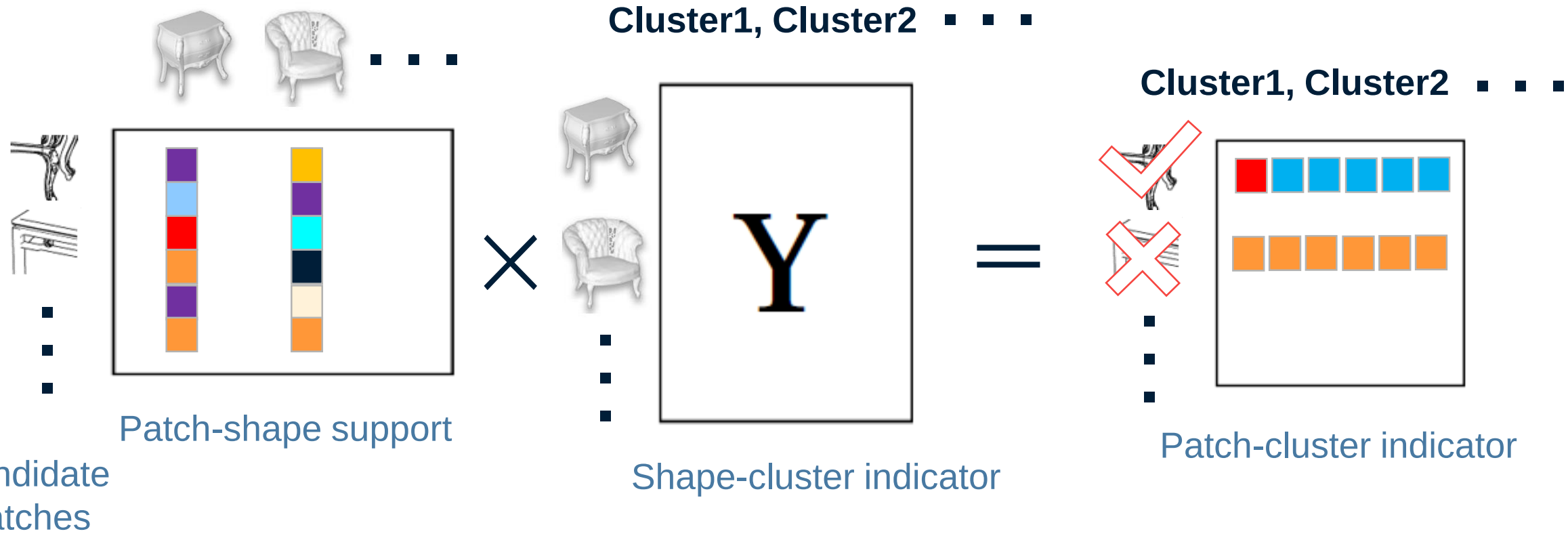


Proportion of user style labels

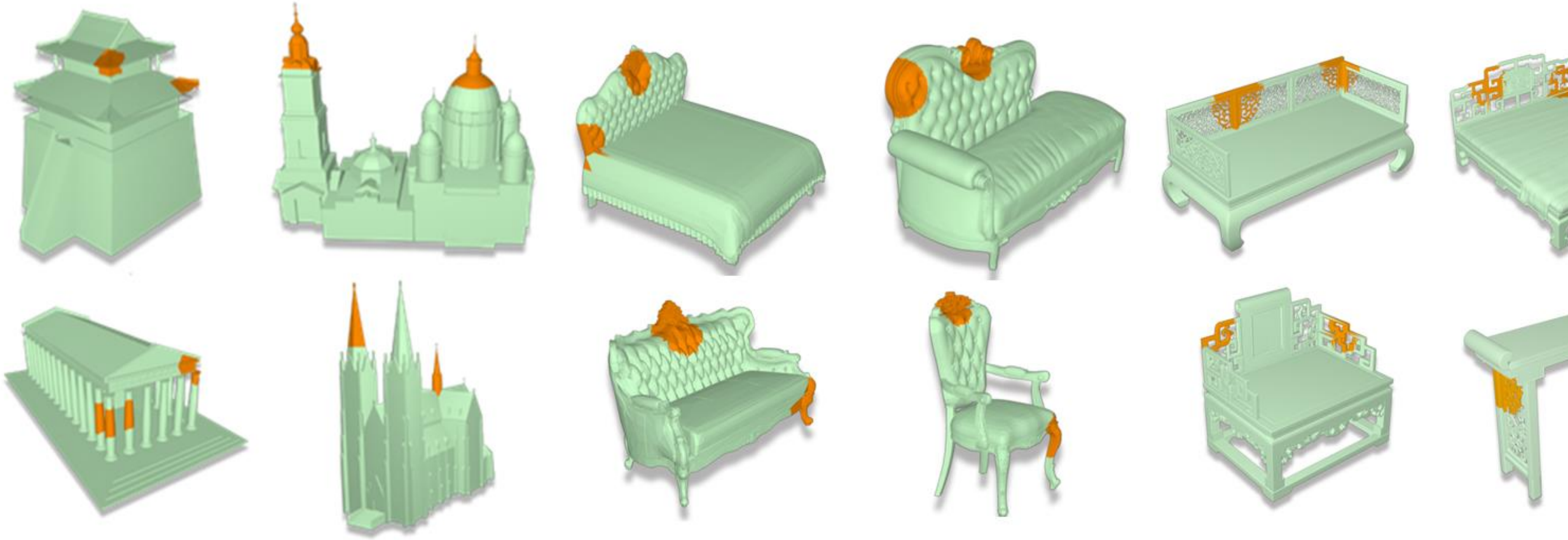


Number of style ranking triplets

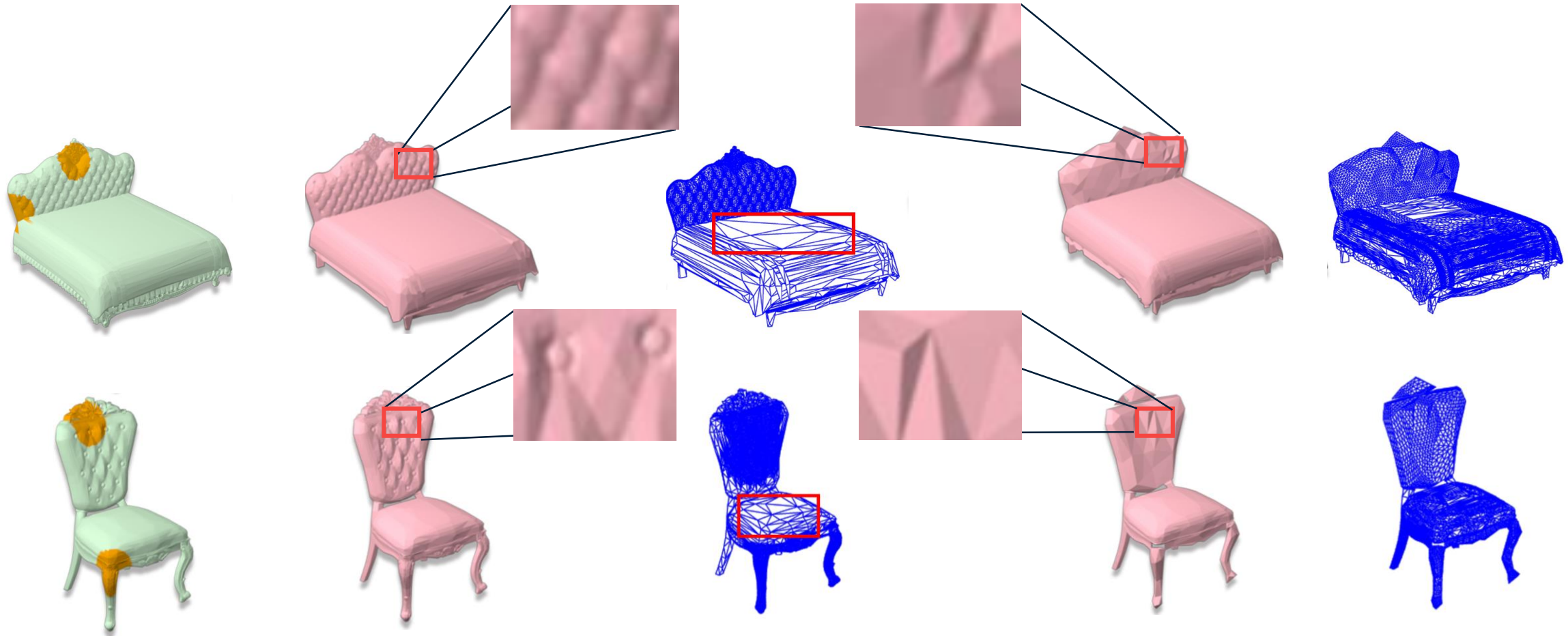
Patch Selection



Style Patch Localization



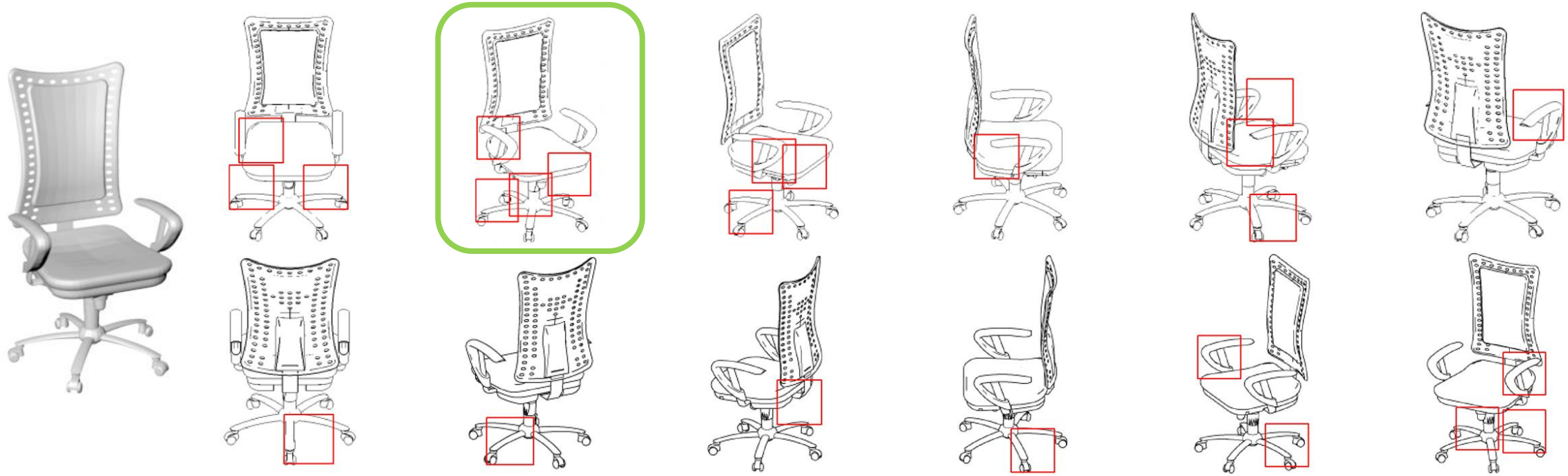
Style Aware Simplification



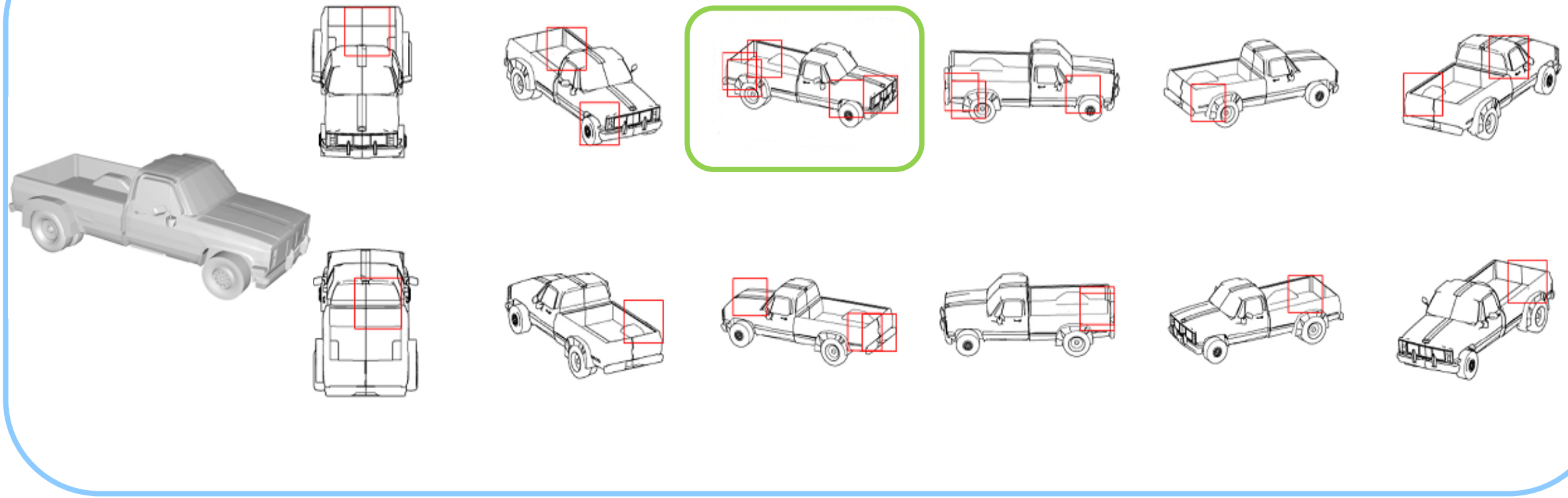
Style preserved

Without Style preserved

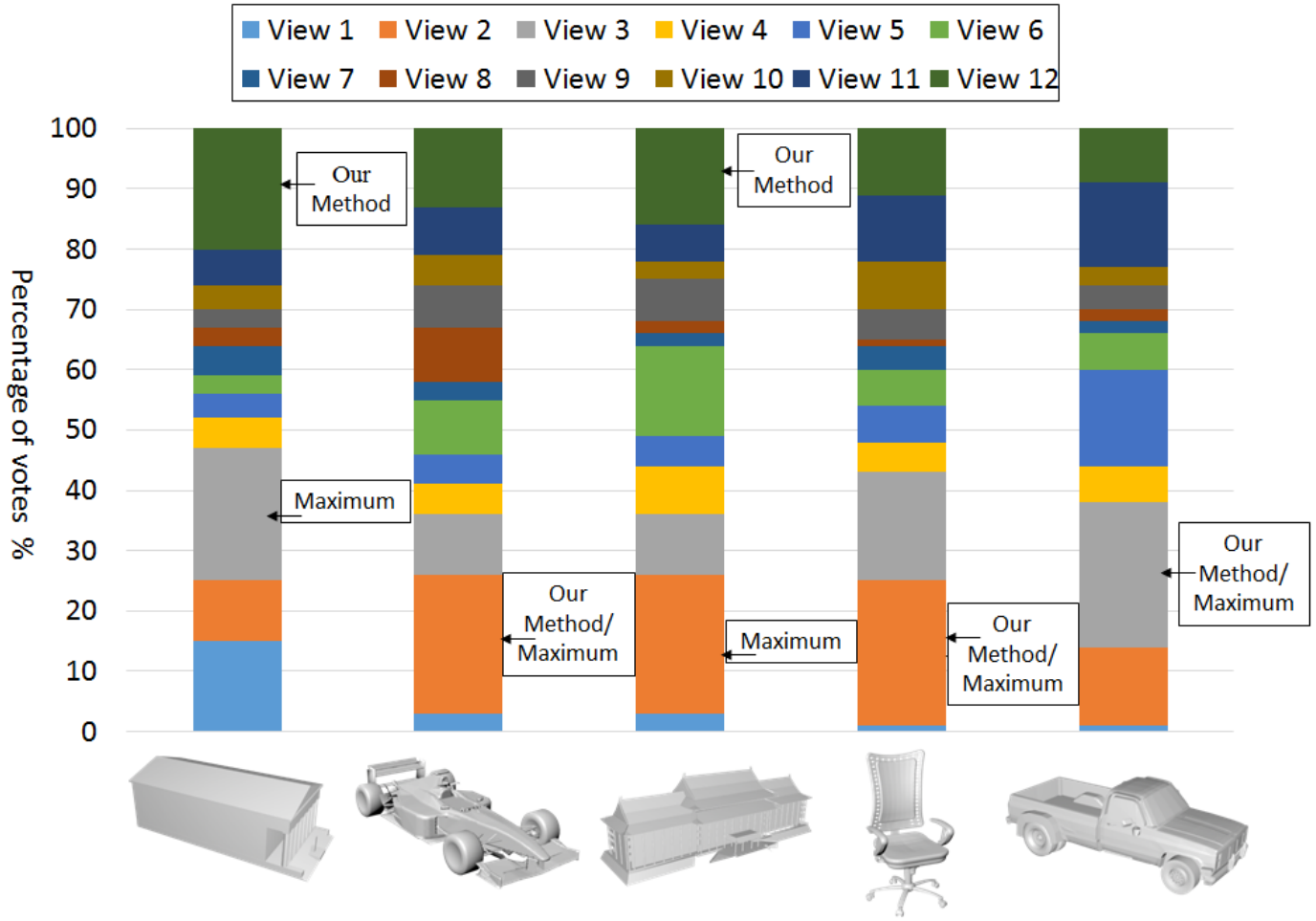
Style Aware View Selection



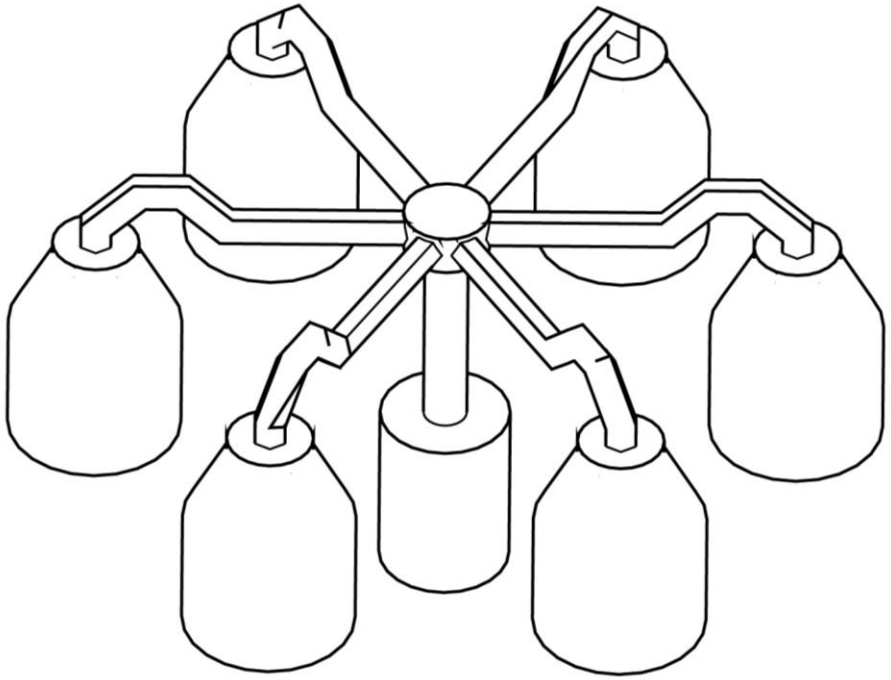
Style Aware View Selection



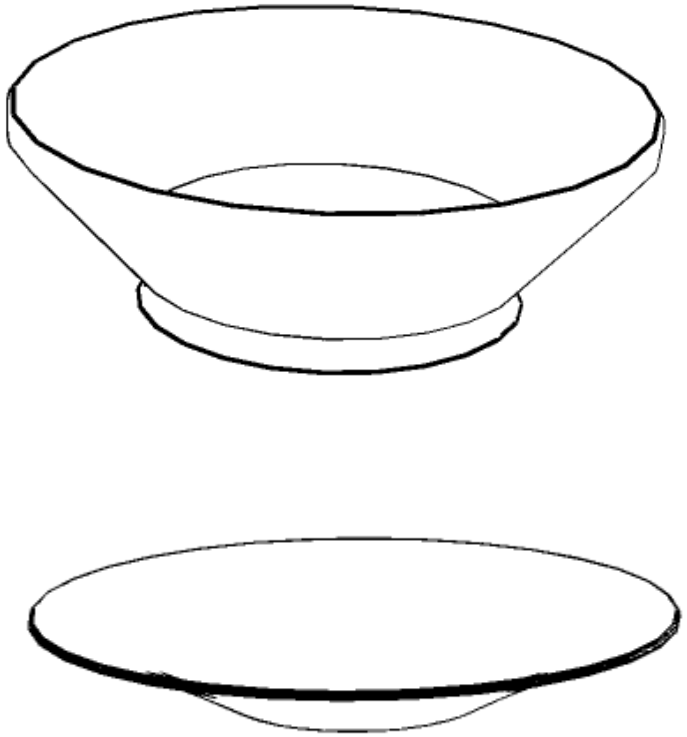
Style Aware View Selection



Limitation



symmetries and repetition style



insufficient stylistic elements

Conclusion

- The first semi-supervised co-analysis of 3D shape styles
- We focus on projective feature lines, and achieve improvements on previous works.
- Our method combines local feature learning and global discriminative style extraction.
- We can locate stylistic shape elements without user involvement to mark any style patches.

THANK YOU!

Web App: http://180.209.64.32:8080/Style_analysis/style_web.jsp

Code & Data: https://github.com/FoggYu/proj_style

The Graphics Replicability Stamp Initiative(GRSI)

http://www.replicabilitystamp.org/

Acknowledgement

NSFC

Adobe