



Scaling up instance annotation via label propagation

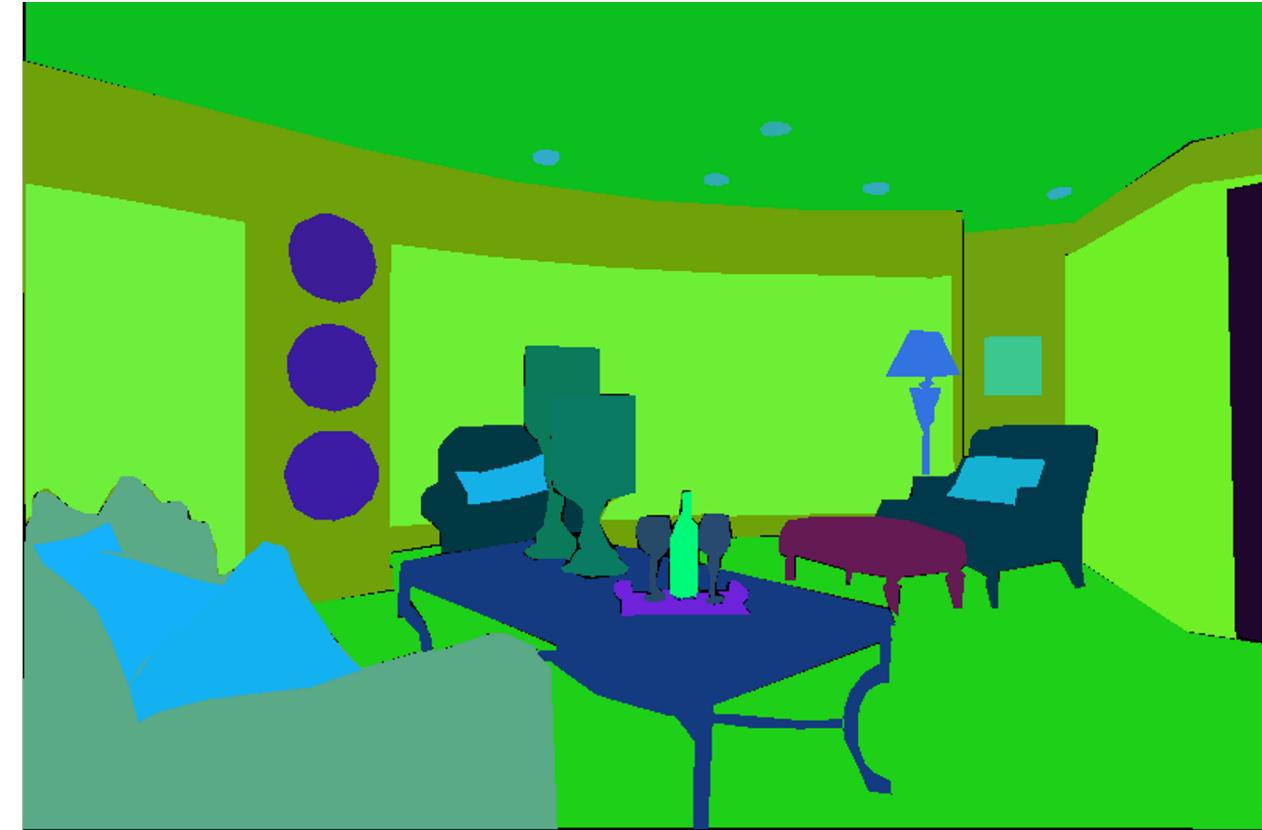
Dim P. Papadopoulos*, Ethan Weber*, Antonio Torralba

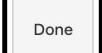
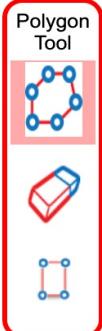
Instance Segmentation

Image



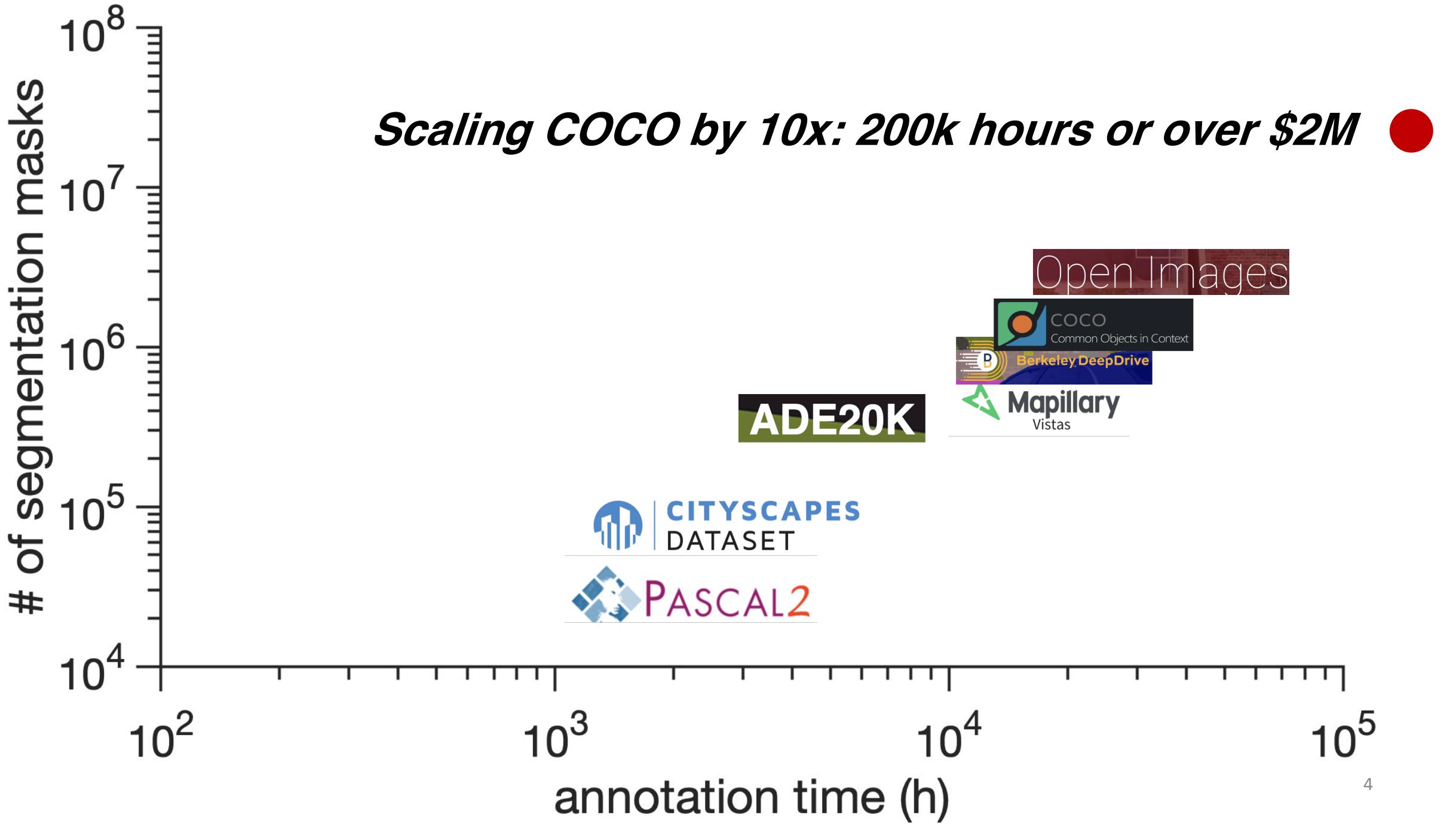
Prediction





coco:
80sec per object

CityScapes:
1.5 hours per image



Interactive Segmentation



[Xu CVPR 16, Li CVPR 18,
Chen CVPR 18, Benenson CVPR 19]

[Lin CVPR 16, Bearman ECCV 16,
Agustsson CVPR 19]

cheap

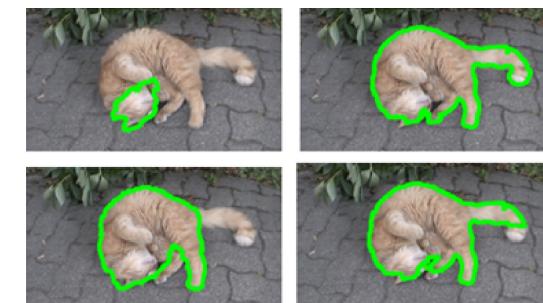
expensive



[Papadopoulos CVPR 16]



[Papadopoulos CVPR 16]



[Jain IJCV 19]



[Castreron CVPR 17, Acuna CVPR 18,
Ling CVPR 19]

Binary

Binary ++

Bounding box

Pick among N

Click/Scribble/ Edit polygon

+ Cut the unit cost of each annotation

- Cost is linear to the number of instances

Motivation

At large scale, instances with similar appearance and similar segmentation prediction



Motivation

Cluster



Motivation

Cluster, Annotate



Motivation

Cluster, Annotate and Propagate



Method Overview

Detection



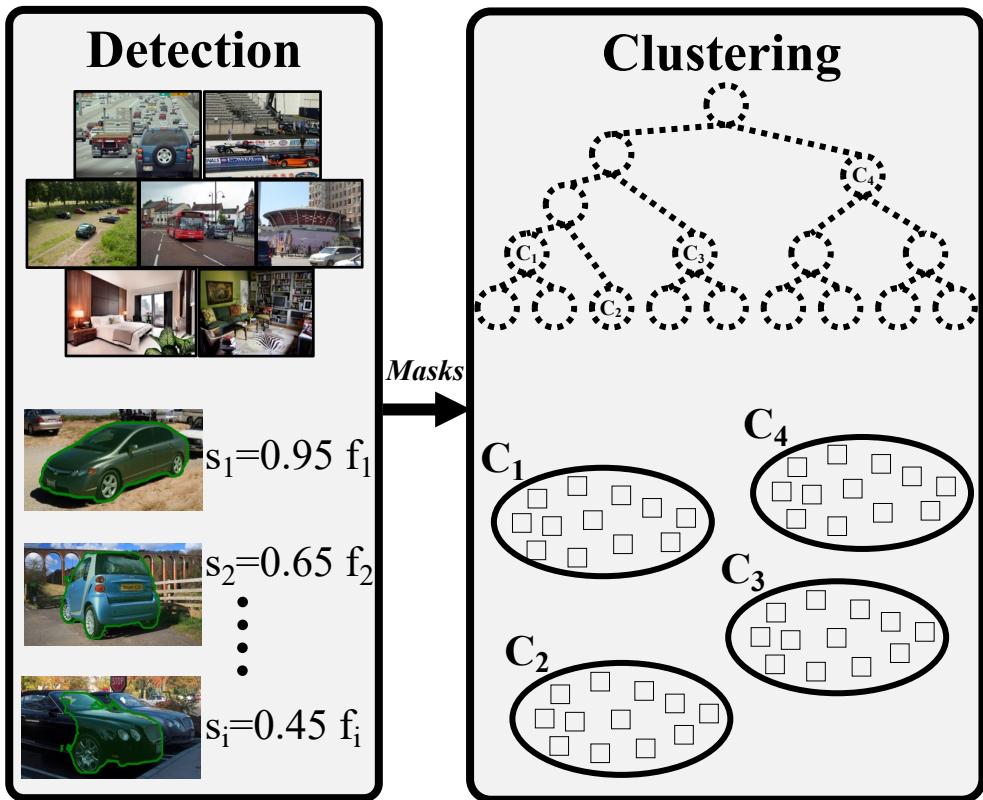
$s_1=0.95 f_1$

$s_2=0.65 f_2$

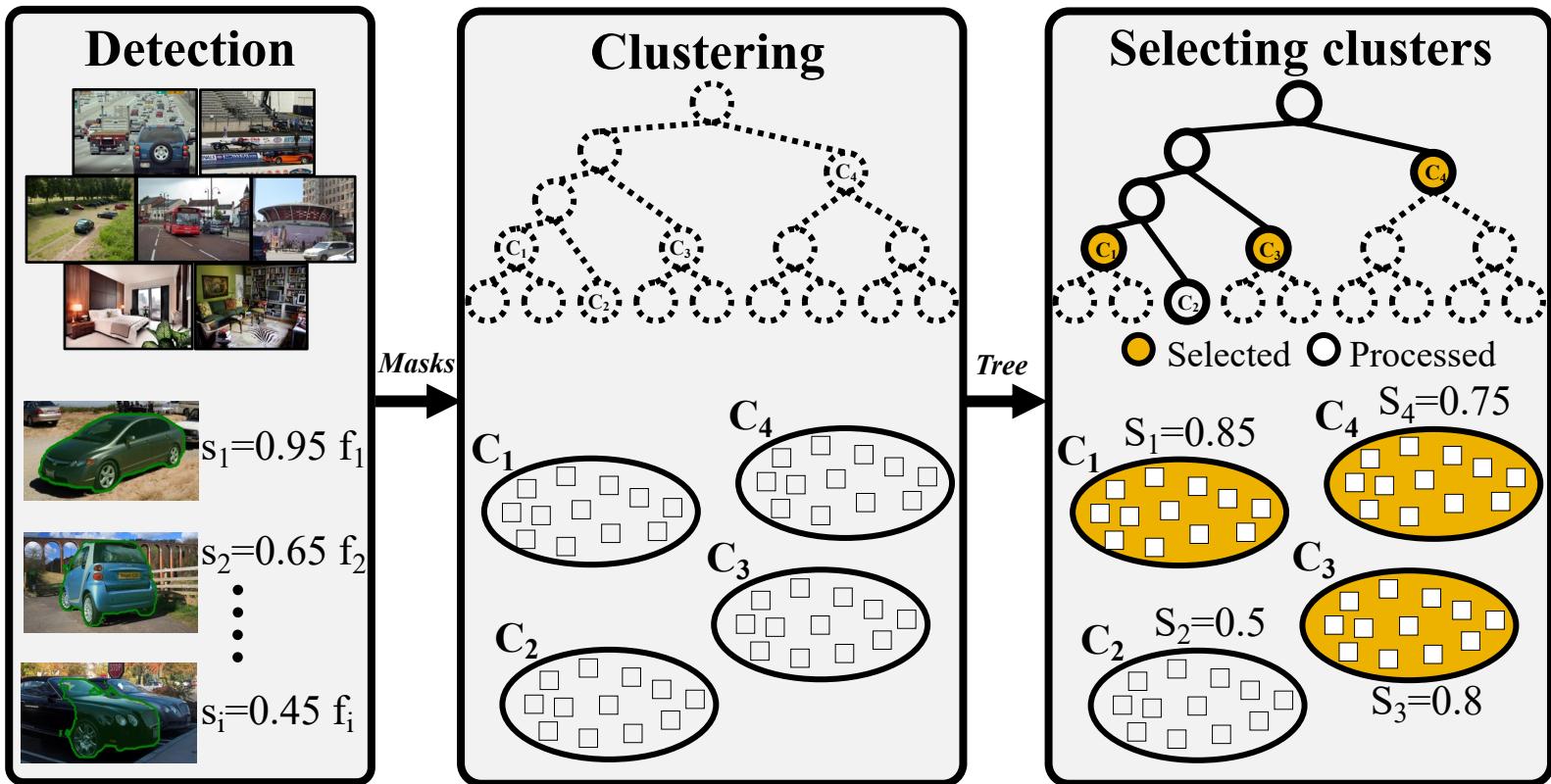
⋮

$s_i=0.45 f_i$

Method Overview

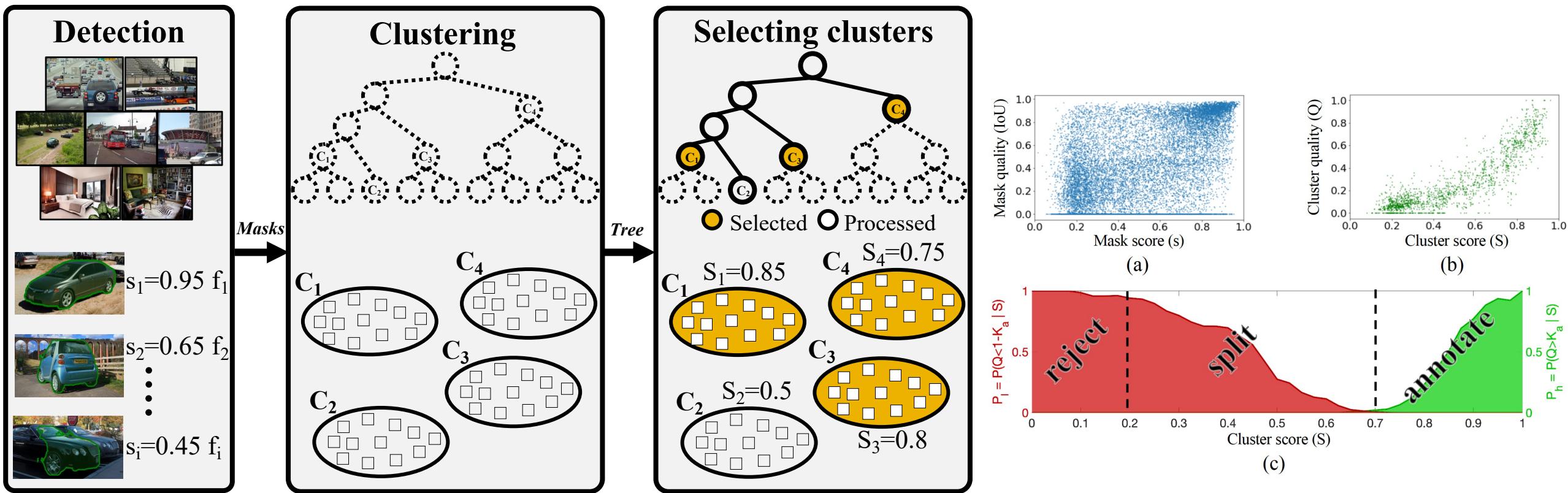


Method Overview

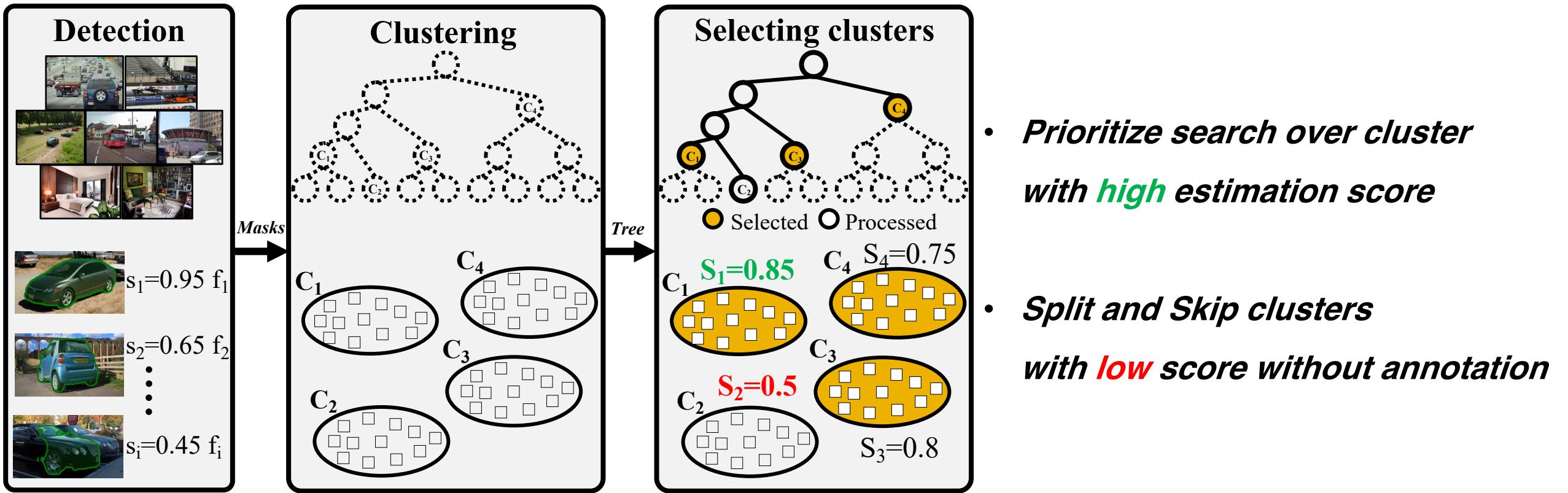


- **Minimize annotation time**
- **Select which clusters to annotate**

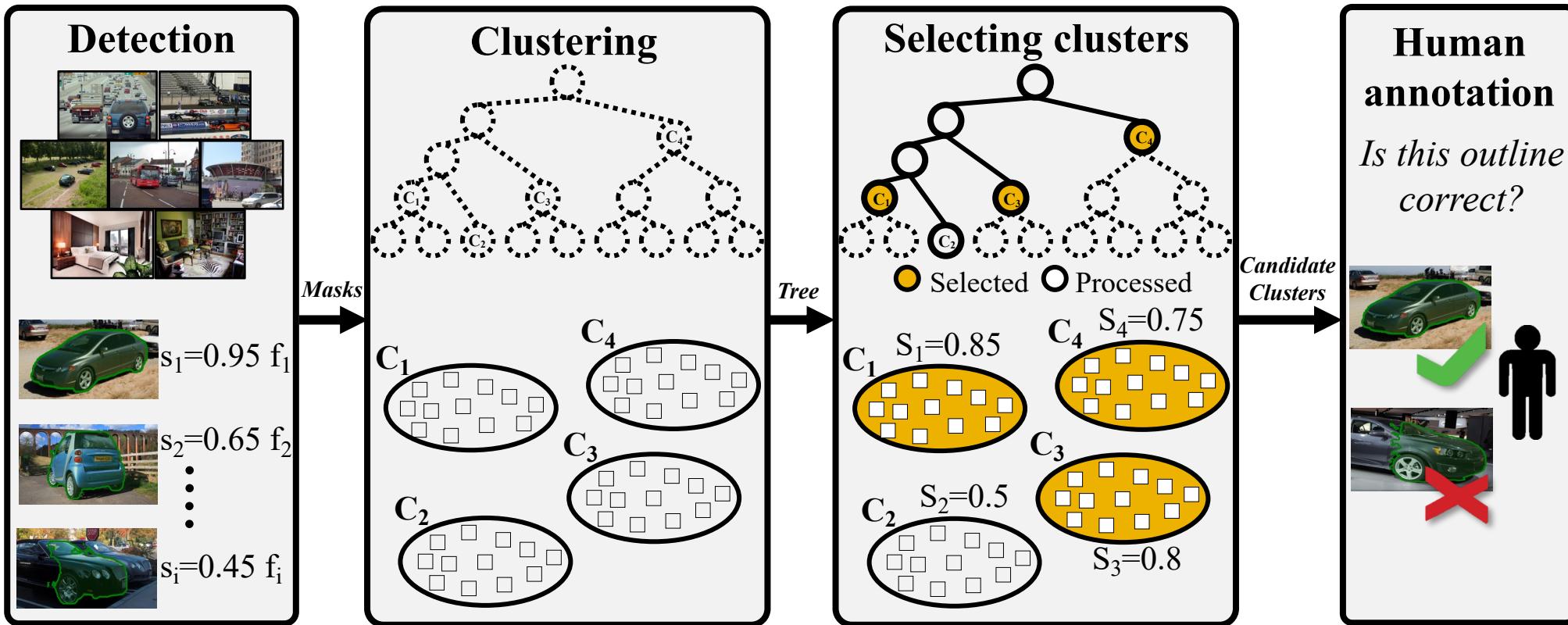
Method Overview



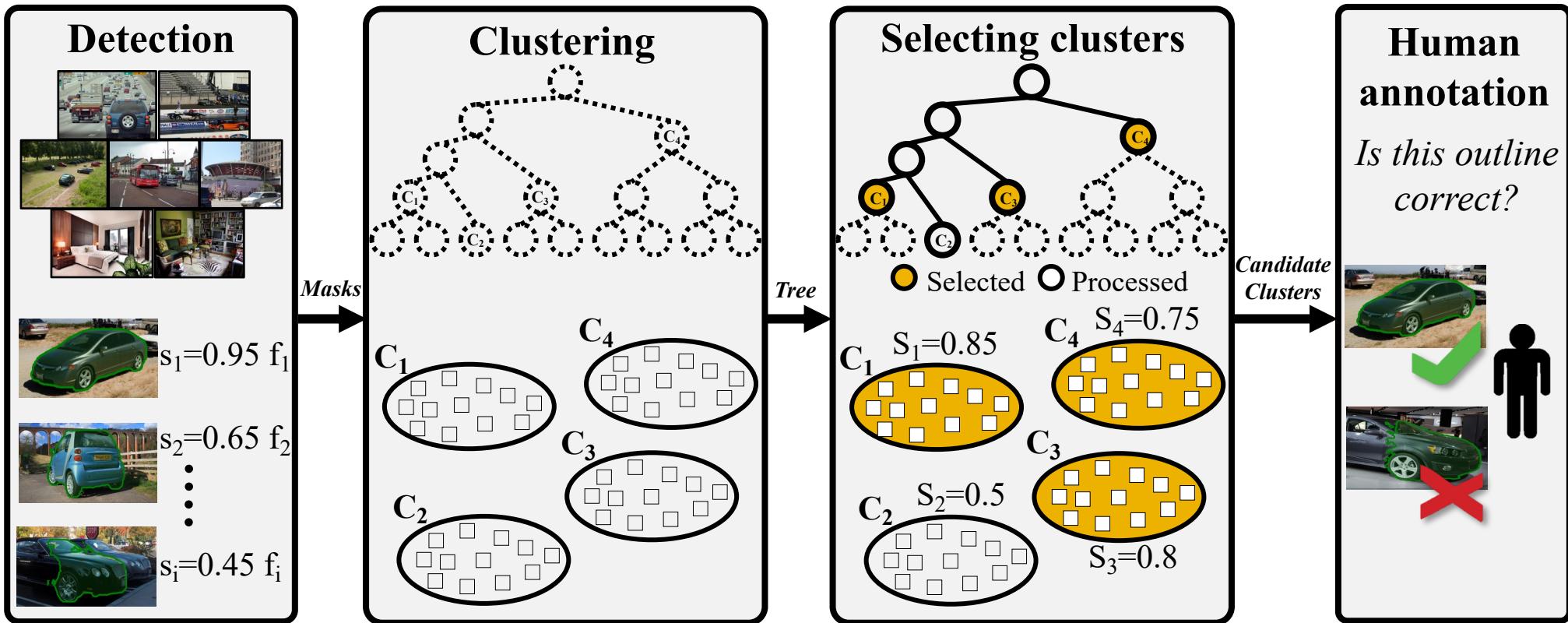
Method Overview



Method Overview

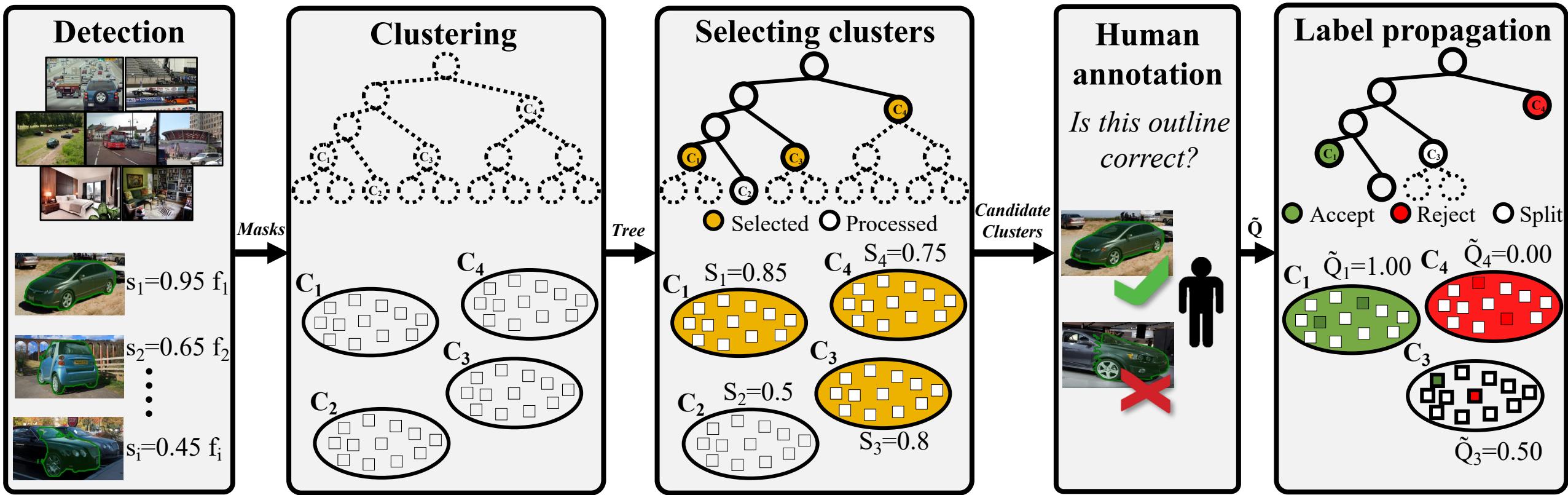


Method Overview

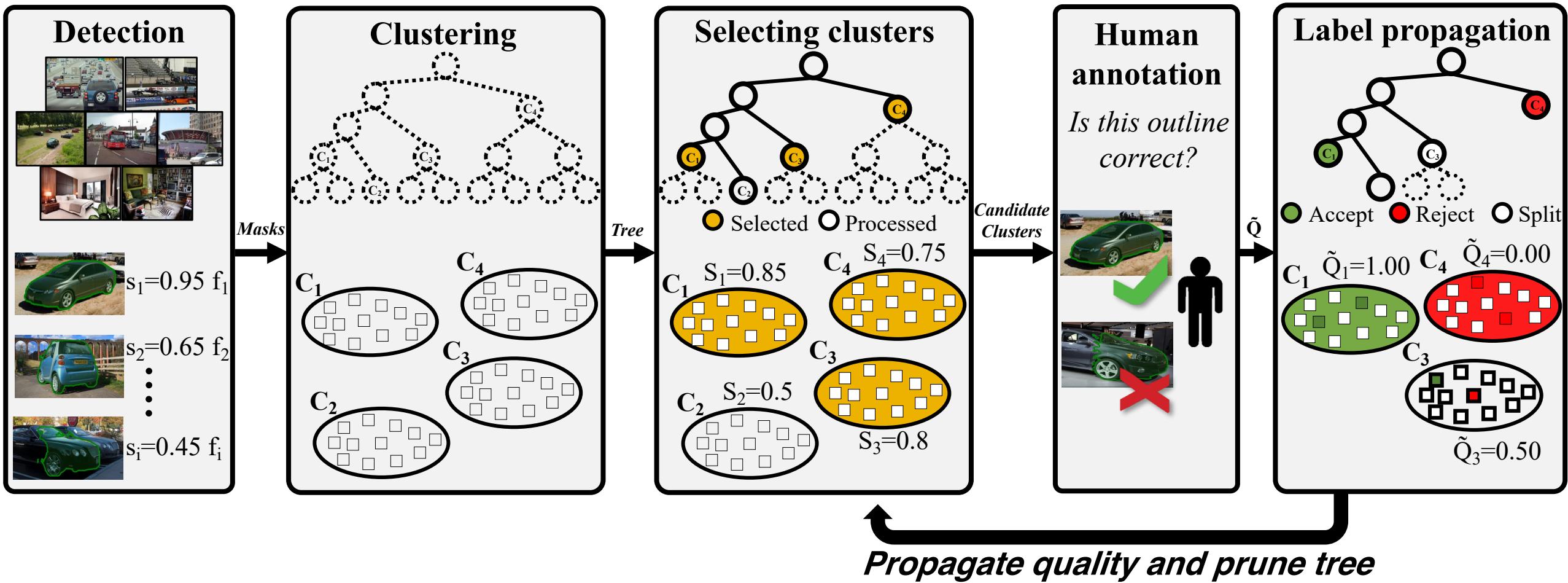


Minimum number of annotated masks per cluster

Method Overview



Method Overview



Simulated experiments on ADE20K, COCO, OpenImages



ADE20K

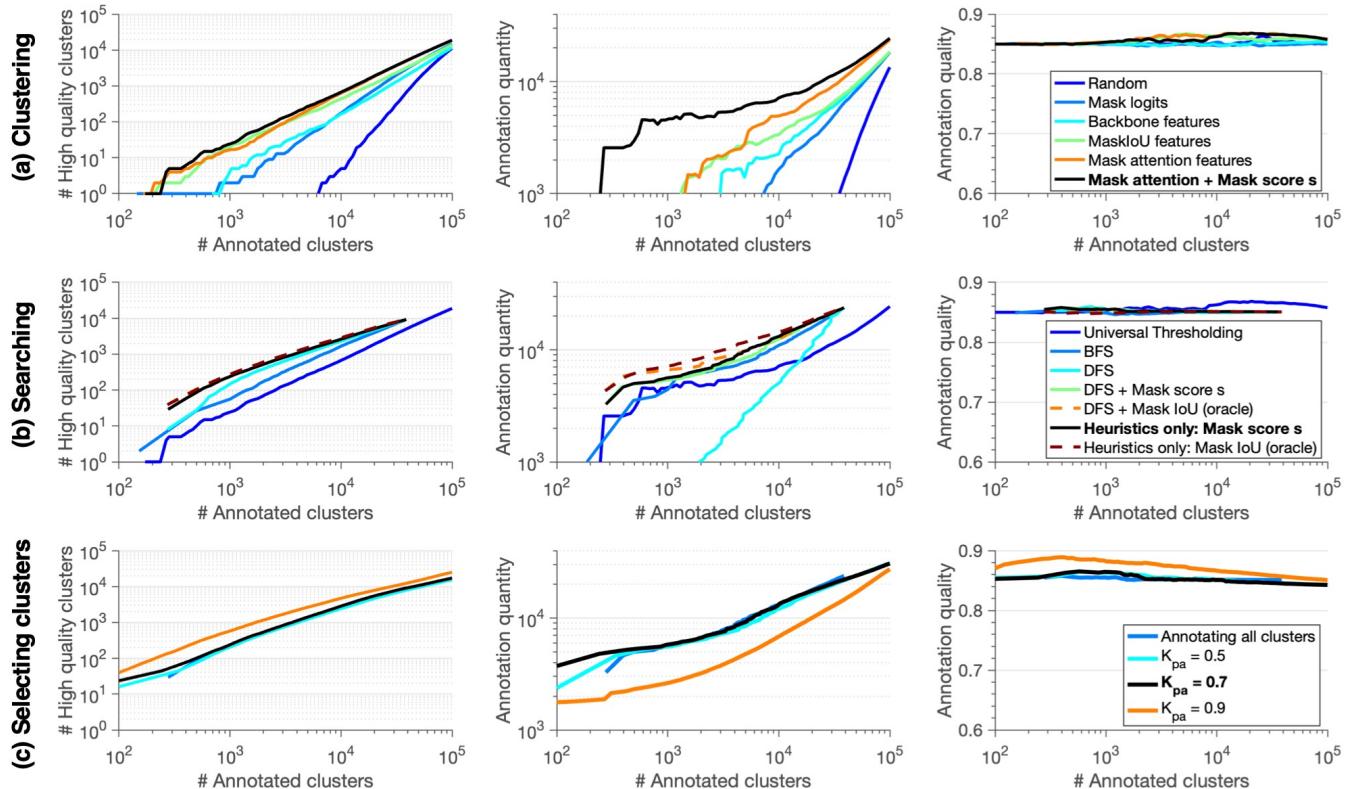


coco
Common Objects in Context

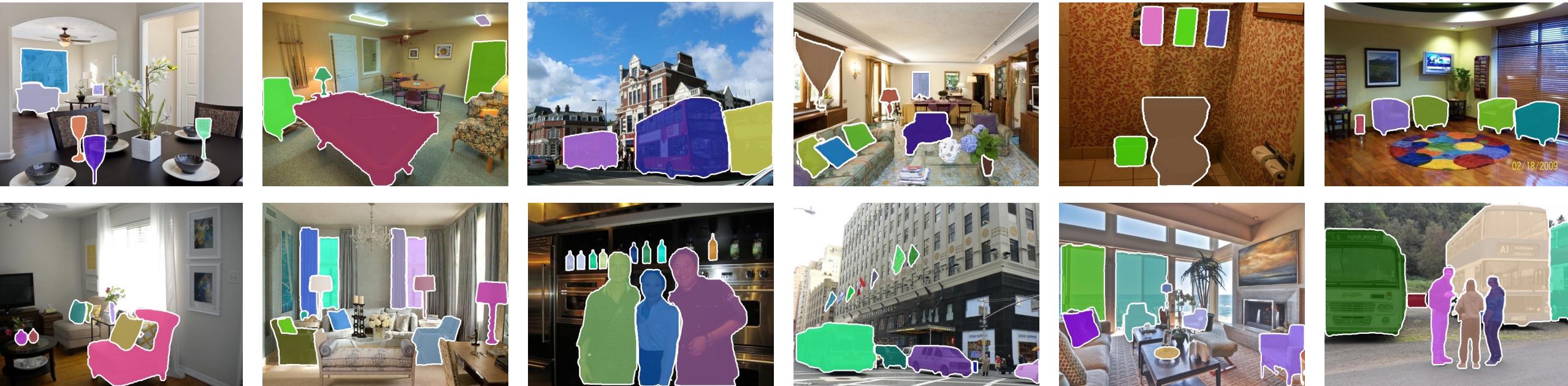


OpenImages

- Feature representation
- Searching the tree
- Selecting clusters
- Size of the initial training set
- Number of samples
- Quality of clusters
- IoU quality of masks

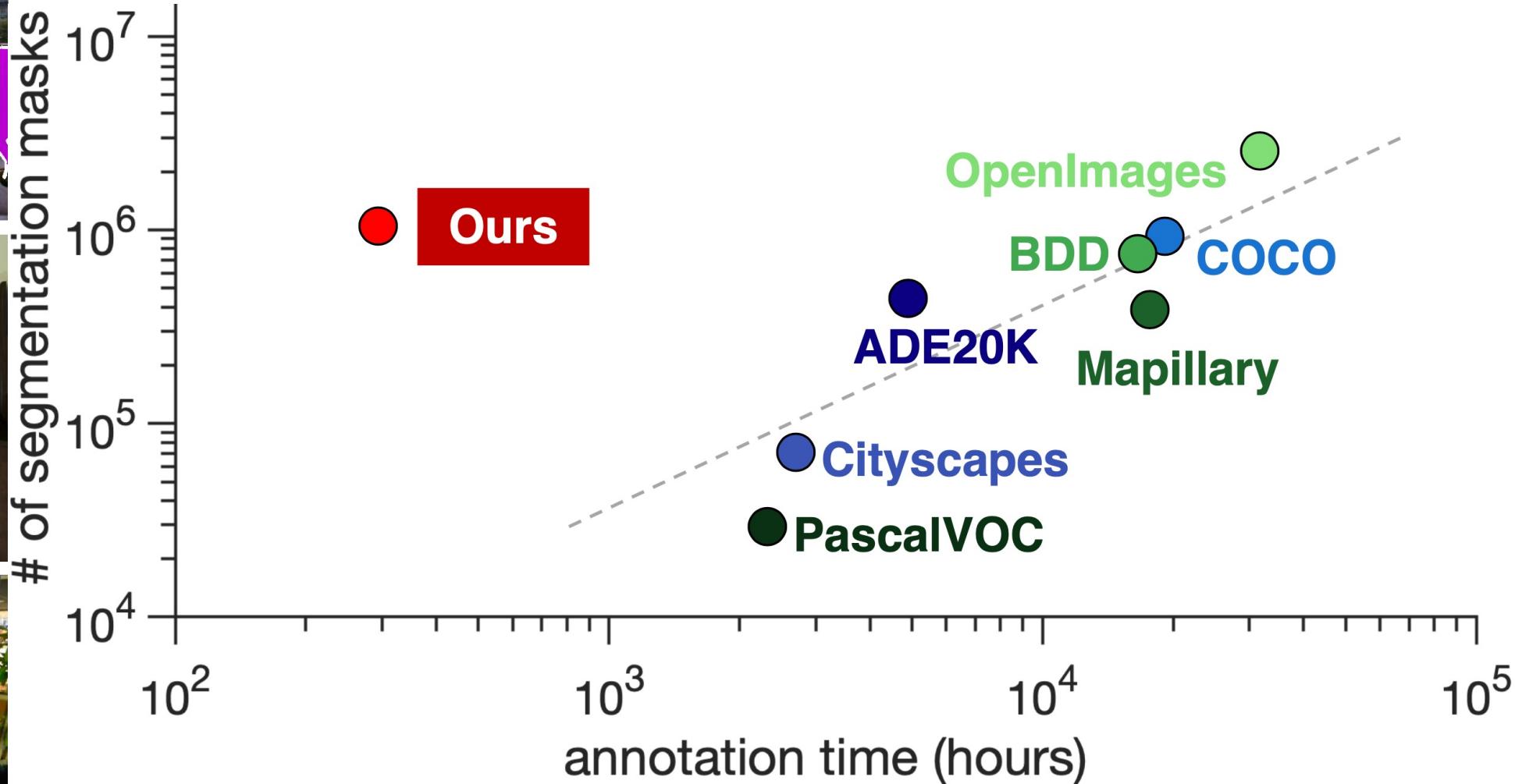


Places Annotations



1M annotation masks

Places Annotations: Quantity and cost



Annotation speed-up in perspective

Manual annotation: 1 car



Proposed method: 76 cars !!!



Places Annotations: Quality and usefulness

- **Quality**



Manually annotate 1,142 Places images:

mIoU=81.4%

- **Usefulness**

| Training set | Annotation | Time | mAP |
|------------------|-------------|-------------|-------------|
| ADE 1K | Manual | 217h | 8.1 |
| ADE 1.4K | Manual | 290h | 9.6 |
| Places 1M | Ours | 290h | 12.7 |

Code, models and data available online!!!

<http://scaling-anno.csail.mit.edu/>



Thank you !!!

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VIRTUAL