

# Visual Domain Adaptation Challenge 2018: Openset Classification

Qing Lian, Yuming Jiang, Shengju Qian, Fengmao Lv,  
Changsheng Li, Lixin Duan

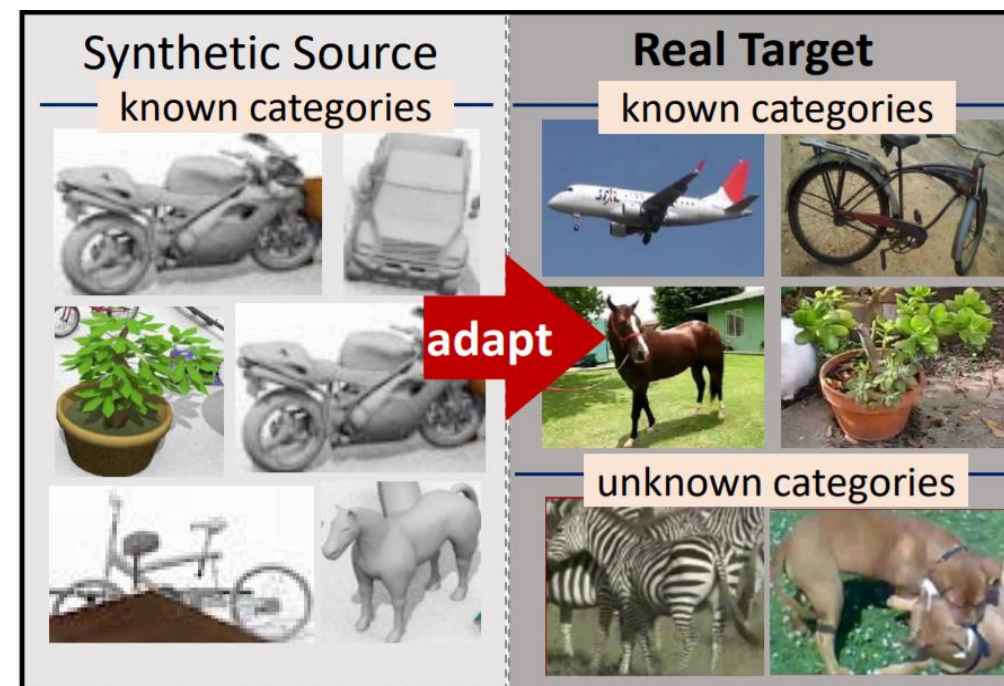
University of Electronic Science and Technology of China,  
Youedata Research



# VisDA 2018 Openset Classification

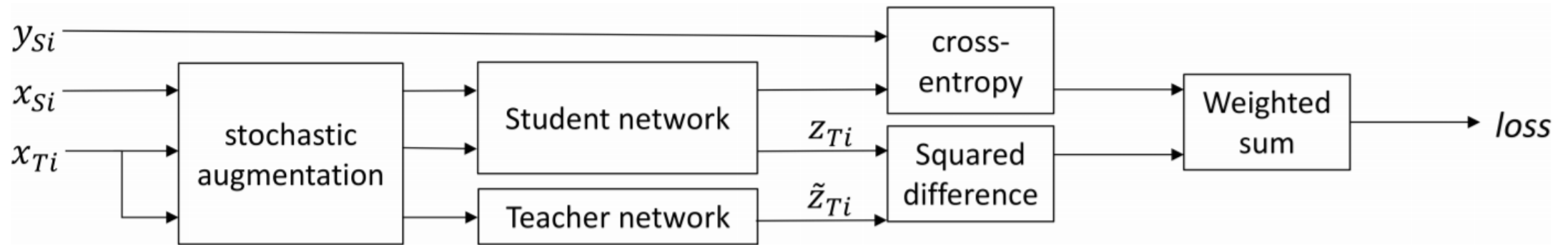
Num	Areo	Bike	Bus	Car	Horse	Knife	Mbike	Person	Plant	Skbord	Train	Truck	Other	Total
Training	6.0k	6.6k	6.1k	6.1k	7.2k	6.6k	6.5k	7.5k	7.1k	6.0k	6.2k	6.4k	64.5k	143k
Validation	3.6k	3.5k	4.6k	10.4k	4.7k	2.1k	5.8k	4.0k	4.5k	2.3k	4.2k	5.5k	49.7k	105k

- **Training unknown classes: 33**  
background categories from CAD images
- **Validation unknown classes: 69**  
COCO categories



# Preliminary: Self-ensemble

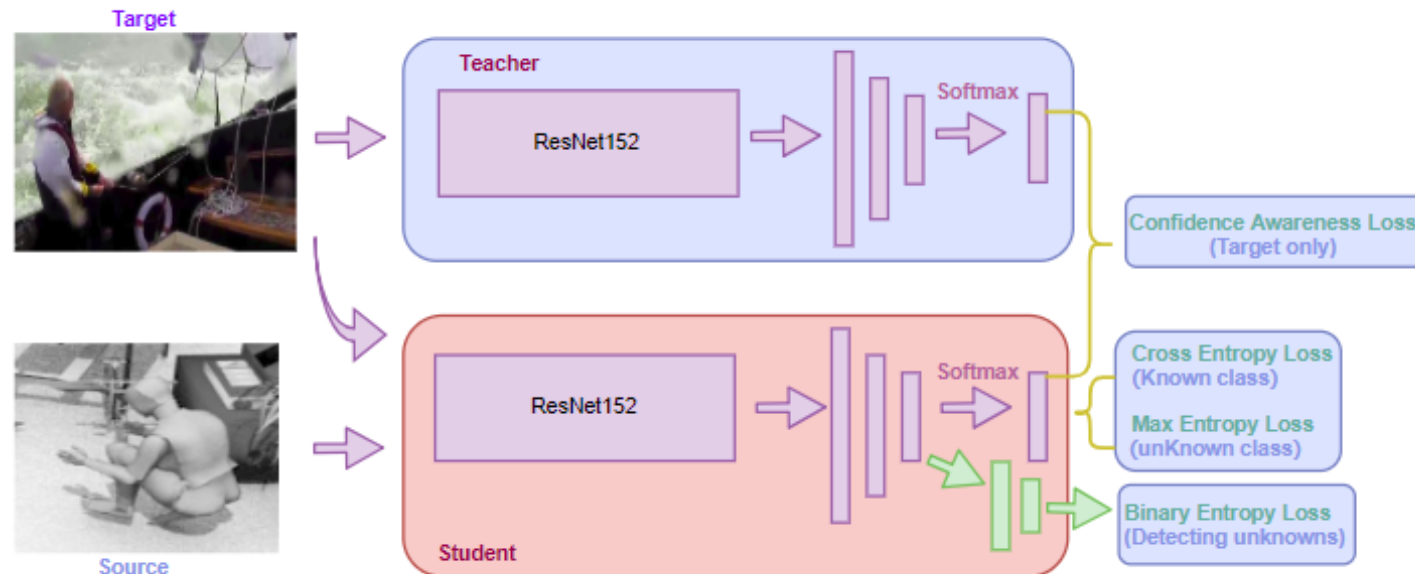
- Self-Ensemble For Visual Domain Adaptation<sub>[Geoffrey Frenchet al. ICLR'18]</sub>
- Last year's best method on closed set domain adaptation
- However, it's not clear on how to deal with unknown classes



$x_{Si}$ : source image,  $x_{Ti}$ : target image,  $y_{Si}$ : source label

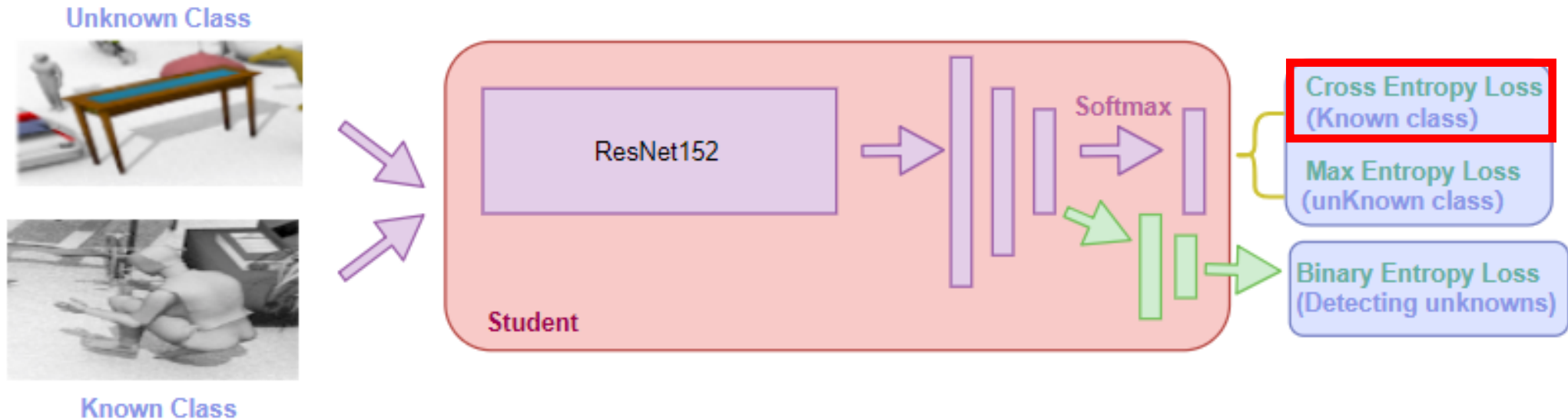
# Proposed Method

- Modified self-ensemble:
  - ✓ **Student:** *Training (source domain and target domain)*, **Teacher:** *Validation (target domain)*
- Known-class-biased feature learning:
  - ✓ Biased to learn features for the 12 known classes with full supervision



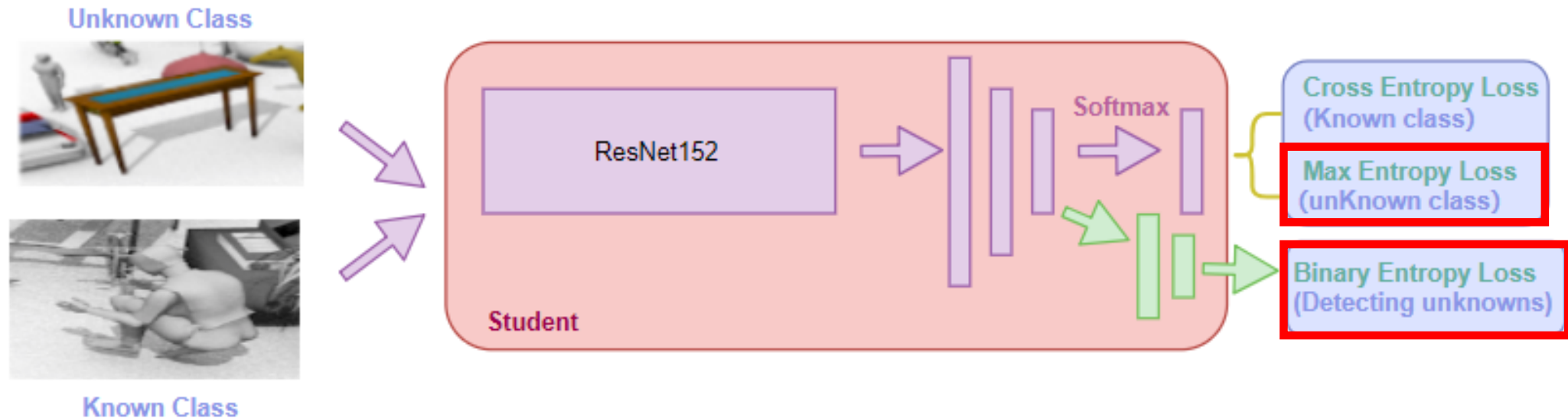
# Known-class-biased Feature Learning

- Biased to learn features for the 12 known classes with full supervision
  - ✓ Ensure good classification on the known classes
- Unknown class features are composed of known class ones
  - ✓ Categorization information from unknown classes is missing, directly learning against them may mess up the overall of feature learning



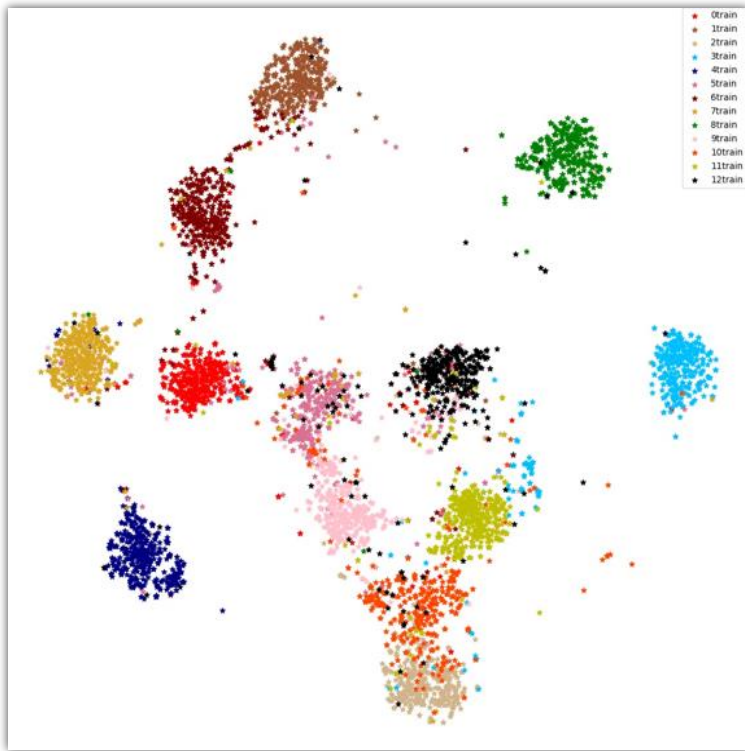
# Known-class-biased Feature Learning

- Entropy maximization over the unknown class samples
  - ✓ Enforce the samples from different unknown classes to gather together
- Unknown sample classification
  - ✓ Binary entropy loss: Known vs. unknown

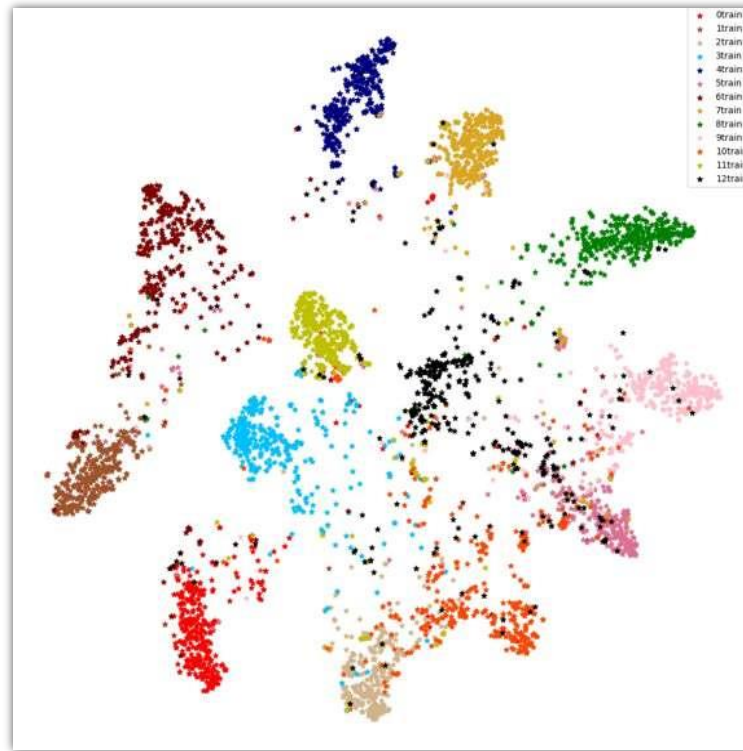


# Feature Visualization

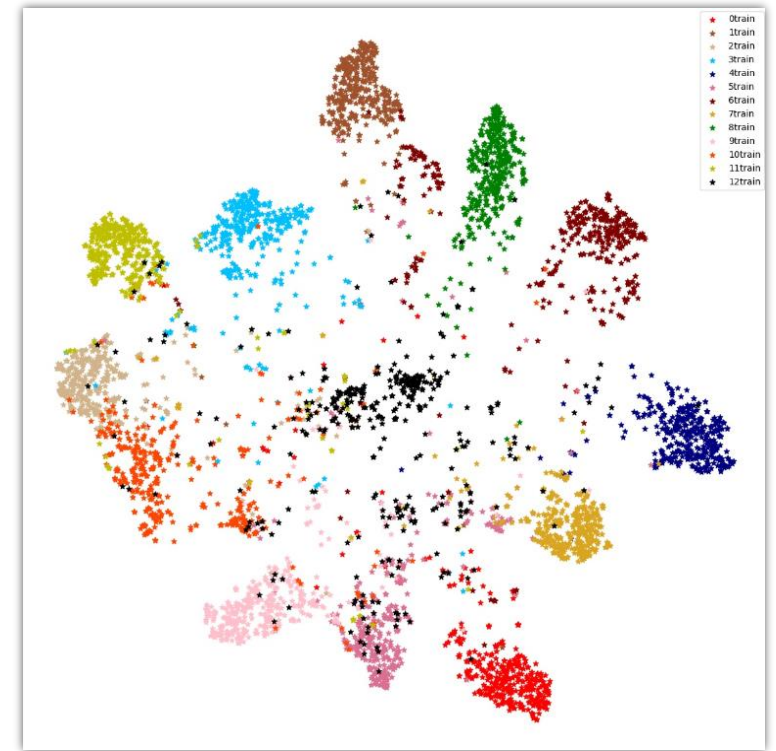
- T-SNE results (black dots are unknown class samples)



Directly learning against 13 classes  
(treating unknown as a single class)



Our proposed method *without*  
entropy maximization on the  
unknown classes



Our proposed method *with* entropy  
maximization on the unknown classes

# Use of Weighted Loss

- Student network:  $f_1$
- Teacher network:  $f_2$

$$(f_1 - f_2)^2$$

Squared loss

Confidence Awareness



$$e^{f_1} \cdot (f_1 - f_2)^2$$

Weighted loss



# Implementation Details

- ImageNet pretrained ResNet:
  - ✓ ResNet-101 [K. He et al. CVPR'16]
  - ✓ ResNet-152 [K. He et al. CVPR'16]
- Data Augmentation:
  - ✓ Random Resize, Random Crop, Random Rotation, Random Horizontal Flip
- Double softmax when calculating cross entropy loss
- Set the threshold as 0.6 for the unknown classifier (the reason why our unknown acc is much lower than other participants.)
- Ensemble:
  - ✓ Ensemble with independent training model

# Evaluation

Method	Mean Accuracy (%)
Source only	42.0
AdaBN	58.5
Self-ensemble	62.5
Ours without weighted loss	66.7
<b>Ours (single model)</b>	<b>68.4</b>
<b>Ours (ensemble)</b>	<b>69.0</b>

- **Effectiveness of Self-ensemble for DA: 62.5% vs. 58.5% (AdaBN)**
- **Effectiveness of weighted loss: 68.4% vs. 66.7%**
- **Average ensemble vs. single model: 69.0% vs. 68.4%**

# Thanks!

For futher question:  
[Jonathan.qinglian@gmail.com](mailto:Jonathan.qinglian@gmail.com)