



Generative Zero-Shot Learning for Semantic Segmentation of 3D Point Clouds

Poster presentation - 3DV 2021

Bjoern Michele, Alexandre Boulch, Gilles Puy, Maxime Bucher, Renaud Marlet



Zero-Shot learning

Training



Seen Unseen



Test-Time

Zero-Shot learning (ZSL)



Zero-Shot learning

Training



Seen Unseen



Test-Time

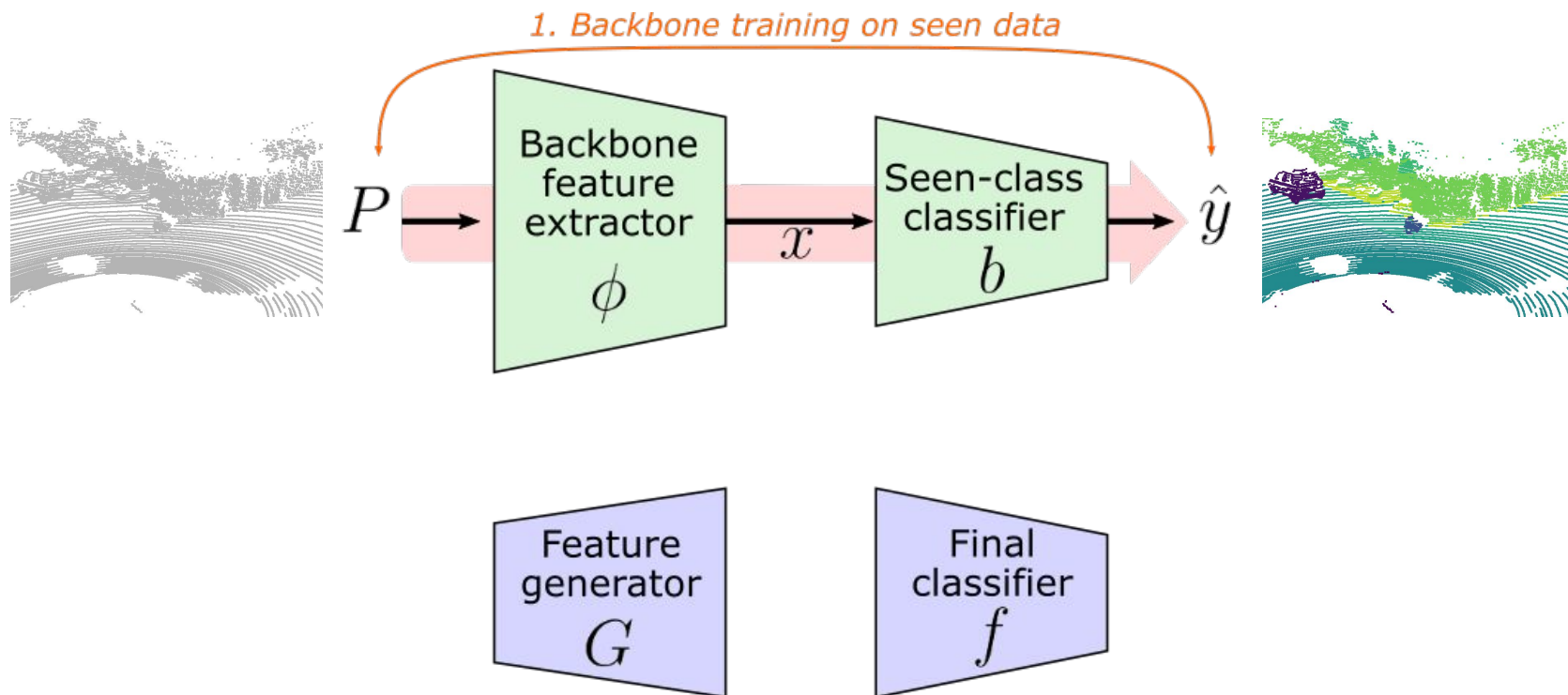
Zero-Shot learning (ZSL)



Generalized Zero-Shot learning (GZSL)

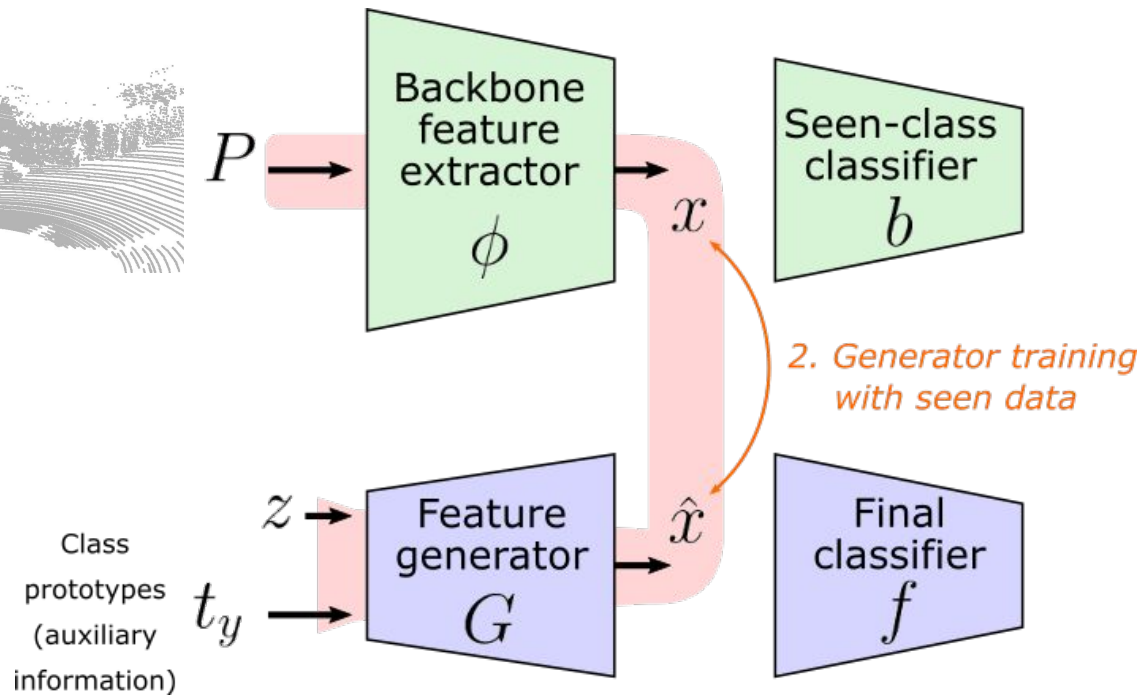
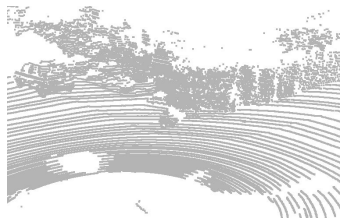


Method¹⁾

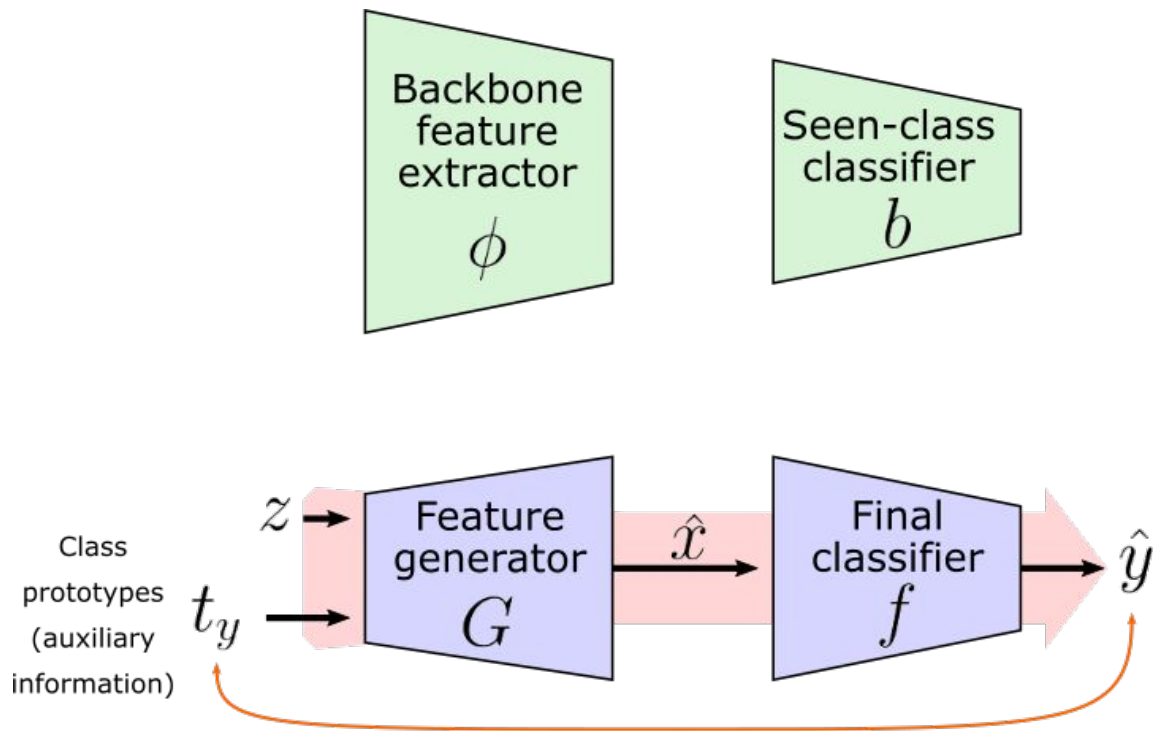


¹⁾ Adapted from:
Bucher et al. Generating visual representations for zero-shot classification. ICCV, 2017.
Bucher et al. Zero-shot semantic segmentation. NeurIPS, 2019.

Method

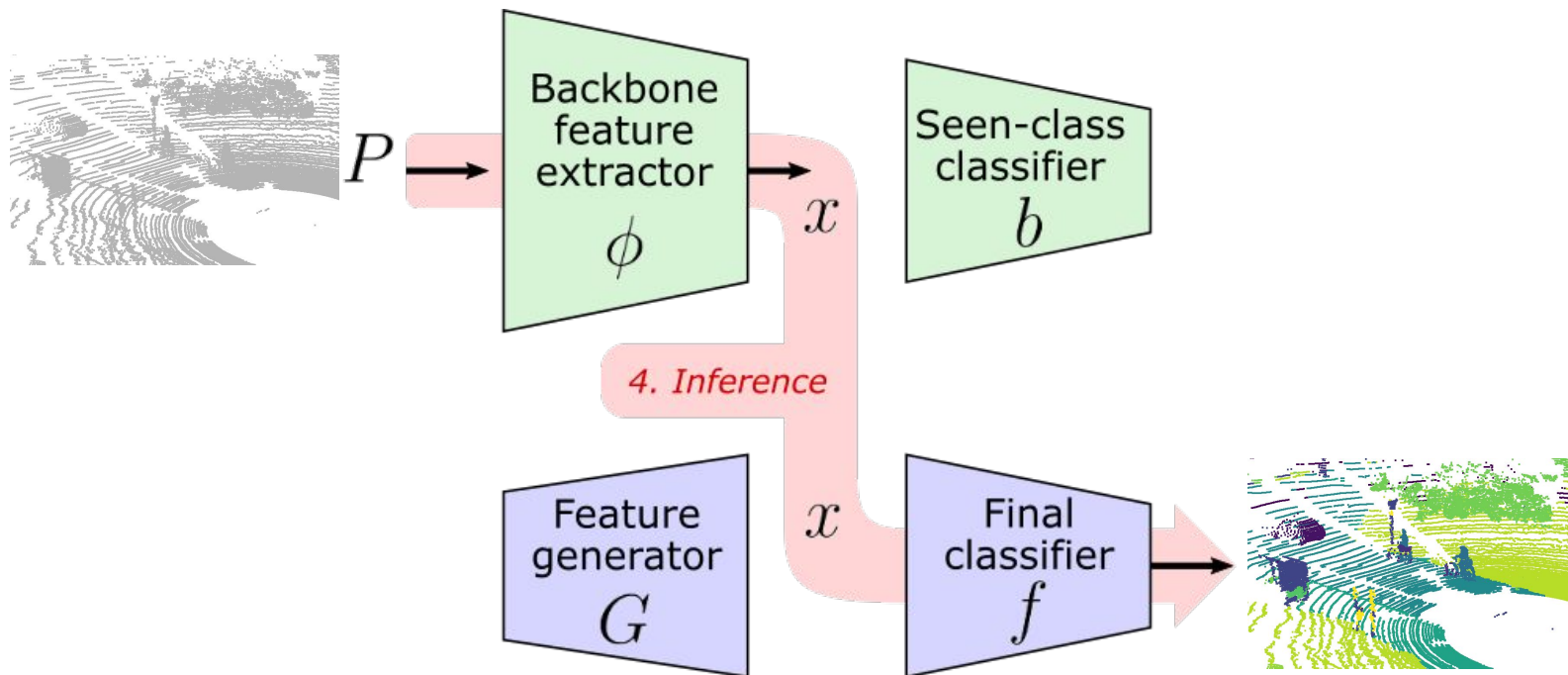


Method



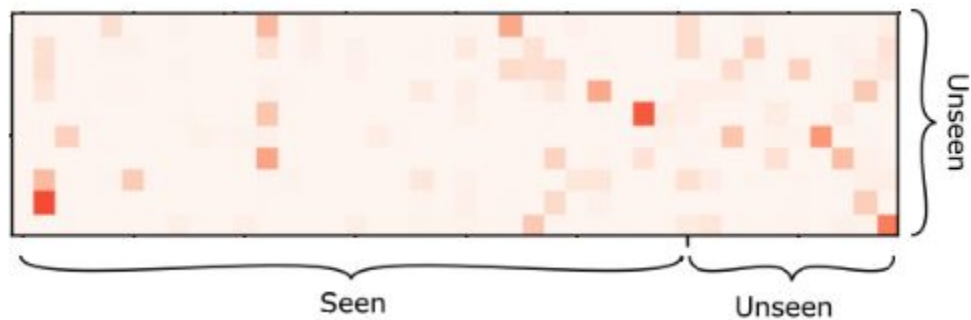
*3. Classifier training on generated unseen data
(+ seen for GZSL)*

Method



Bias problem GZSL

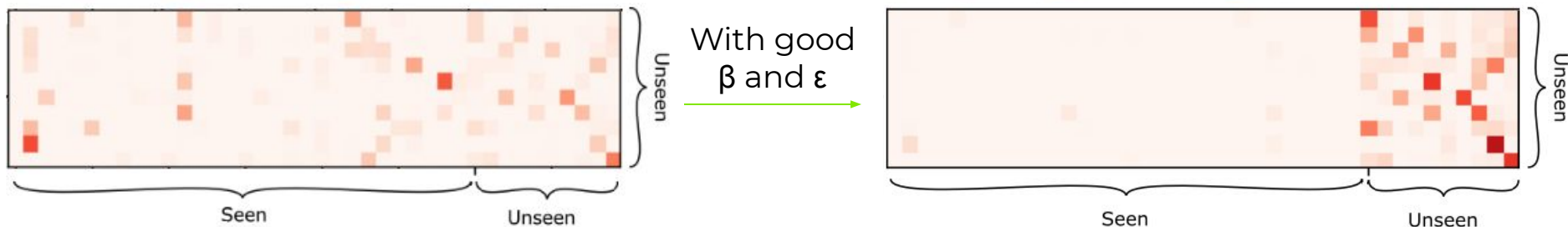
Confusion matrix for unseen classes (GZSL on Modelnet40)



Bias problem and reduction

Additional bias reduction techniques

- **Class-dependant weighting:** Loss for unseen classes is weighted (factor $\beta > 1$) in classifier training.
- **Calibrated Stacking¹⁾:** Subtracting a small value ϵ from the seen-class score (after softmax) at test time.

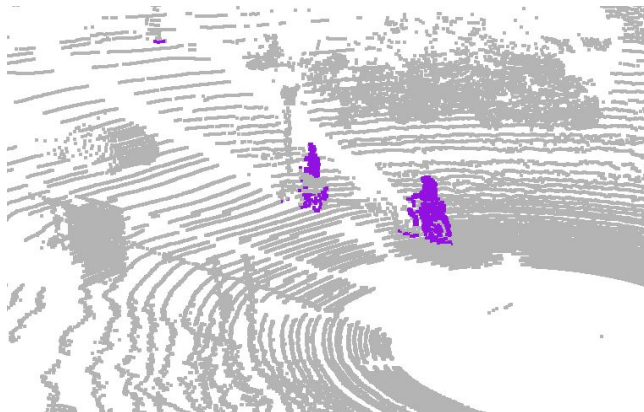


1) Chao et al. An empirical study and analysis of generalized zero-shot learning for object recognition in the wild. ECCV, 2016.

Visualisations SemanticKITTI

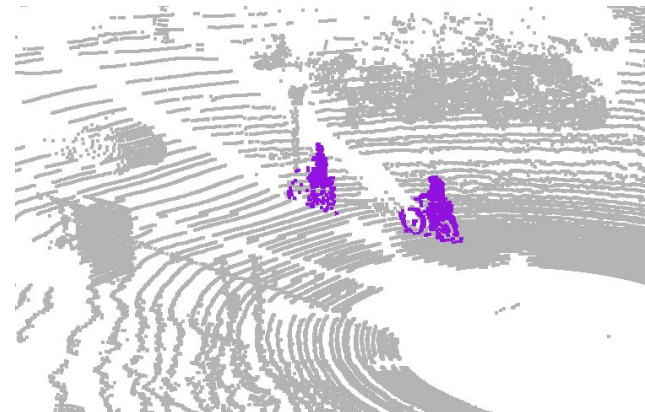
4 unseen, 15 seen classes

Predicted



Unseen Class
Bicyclist

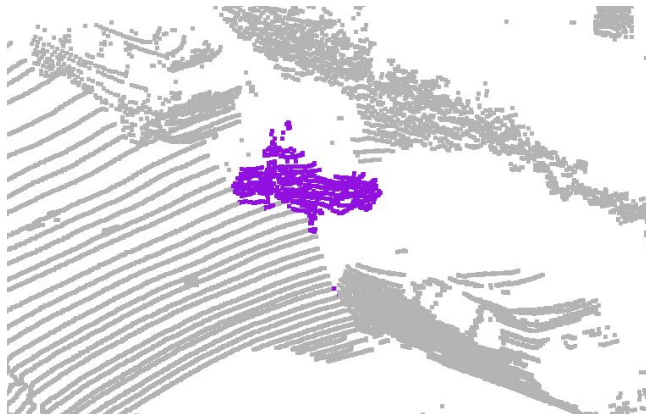
Ground-Truth



Visualisations SemanticKITTI

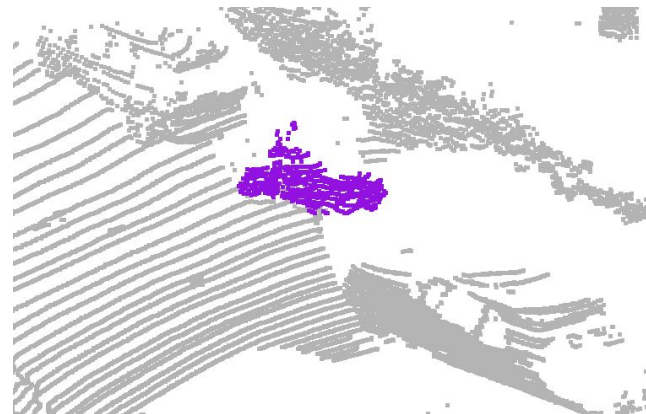
4 unseen, 15 seen classes

Predicted



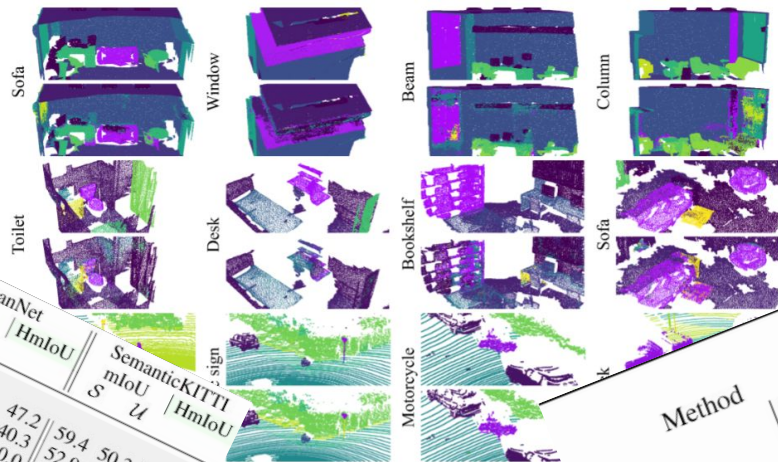
Unseen Class
Motorcycle

Ground-Truth



Interested ?

- Zero shot learning for 3D point clouds with generative approach:
 - GZSL in **Classification** with additional bias reduction
 - GZSL for **Semantic Segmentation** with 3D PCs on 3 datasets (SemantickITTI, S3DIS, ScanNet)
- Usage of **image-based class prototypes information**



Training set	Backbone	Classifier	S3DIS			ScanNet			SemanticKITTI		
			mIoU	U	HmIoU	mIoU	U	HmIoU	mIoU	U	HmIoU
Supervised methods with different levels of supervision											
S	SU	U	74.0	50.0	59.6	43.3	51.9	47.2	59.4	50.3	54.5
			60.9	21.5	31.8	41.5	39.2	40.3	52.9	13.2	21.2
			70.2	0.0	0.0	39.2	0.0	0.0	55.8	0.0	0.0
Zero-shot learning methods											
S	S	U	65.5	0.0	0.0	28.2	0.0	0.0	49.1	0.0	0.0
			70.2	0.0	0.0	20.0	0.0	0.0	49.7	0.0	0.0
			5.2	1.3	0.0	16.4	4.2	6.7	26.4	10.2	0.0
S	S	U	3.6	1.4	2.0	12.8	3.0	4.8	42.9	4.4	0.0
			53.1	7.3	12.9	32.8	7.7	12.5	47.4	4.4	0.0
			70.2	0.0	0.0	39.2	0.0	0.0	55.8	0.0	0.0

Sofa

Window

Toilet

Desk

z-sign

VALEO RESERVED

Method	Generative	Full supervision Acc.	ZSL		Bias reduct.	GZSL		GloVe	
			W2V Acc.	GloVe Acc.		W2V Acc.	HM Acc.	W2V Acc.	HM Acc.
PointNet	✓	89.2	20.7	-	-	76.3	3.7	7.0	-
f-CLSWGAN* [5]	✓	23.0	20.9	-	-	84.7	1.3	2.6	-
ADA-VAE* [5]	✓	28.0	28.7	✓	✓	40.1	22.5	28.8	49.2
		33.9	29.3	✓	✓	53.8	26.2	35.2	53.8
		28.6	29.3	✓	✓	48.8	29.3	36.6	44.4



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