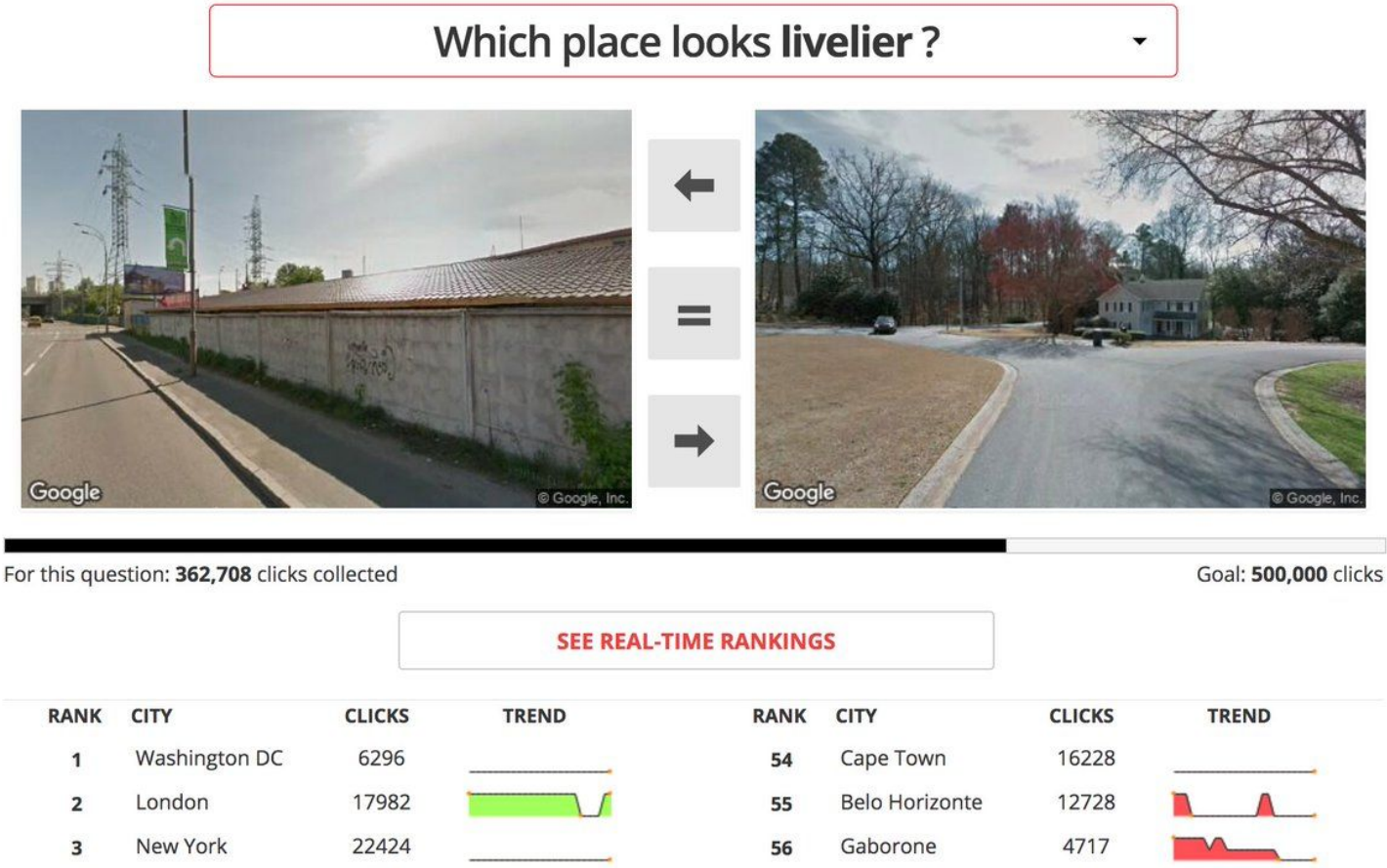
Urban Perception: Can we understand why a street is safe?

Felipe A. Moreno-Vera, Bahram Lavi, and Jorge Poco

Place Pulse



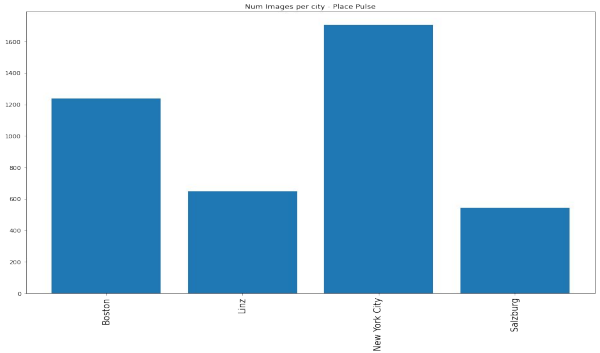
http://pulse.media.mit.edu/

* Comparisons were made using two random images from random cities.

Place Pulse Dataset

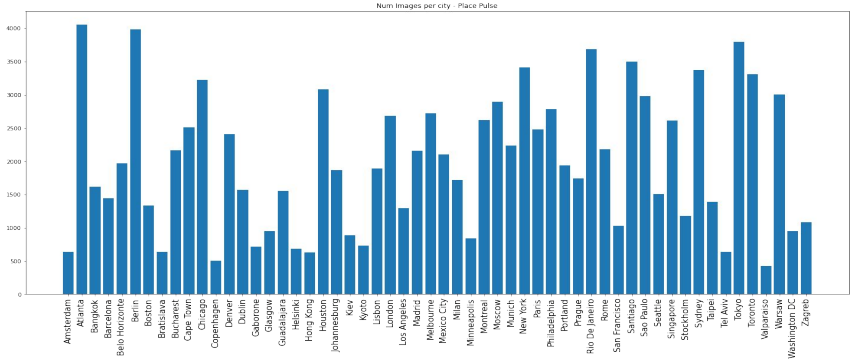
Place Pulse 1.0:

- 73 806 Comparisons, 4 136 images
- 2 Countries (US y Austria)
- 4 cities: New York City, Boston, Linz and Salzburg
- 3 categories: Safe, Wealth and Unique



Place Pulse 2.0:

- 1 223 649 Comparisons, 111 390 images
- 32 countries
- 56 cities
- 6 categories: Safe, Wealth, Depress, Beautiful, Boring, and Lively



* **Remember:** We will focus in **Place Pulse 2.0** only.

Dataset sample: Set of comparisons*

left_id	right_id	winner	left_lat	left_long	right_lat	right_long	category
513d7e23fdc9f	513d7ac3fdc9f	equal	40.744156	-73.93557	-33.52638	-70.591309	depressing
513f320cfdc9f	513cc3acfdc9f	left	52.551685	13.416548	29.76381	-95.394621	safety
513e5dc3fdc9f	5140d960fdc9f	right	48.878382	2.403116	53.32932	-6.231007	lively

* **Remember:** Comparisons were made using two random images from random cities.

Processed sample: Images from Rio de Janeiro - Place Pulse 2.0

Image	ID	Safety	Lively	Wealthy	Beauty	Boring	Depressive
	513d7e23fdc9f	7.42	8.58	6.5	7.3	2.64	1.23
	513f320cfdc9f	6.07	4.97	7.13	8.61	1.67	0.86

* **Note:** We perform the calculation in all categories, but we will focus in safety only.

Dataset Statistics: summary

Place Pulse 1.0				
City	# images	*safe mean*	*wealth mean*	*unique mean*
Linz	650	4.85	5.01	4.83
Boston	1237	4.93	4.97	4.76
New York	1705	4.47	4.31	4.46
Salzburg	544	4.75	4.89	5.04
Total	4136			

Place Pulse 2.0			
Continent	#countries	#cities	#images
Europe	19	22	38,747
North America	3	17	37504
South America	2	5	12,524
Asia	5	7	11,417
Oceania	1	2	6,097
Africa	2	3	5,101
Total	32	56	111,390

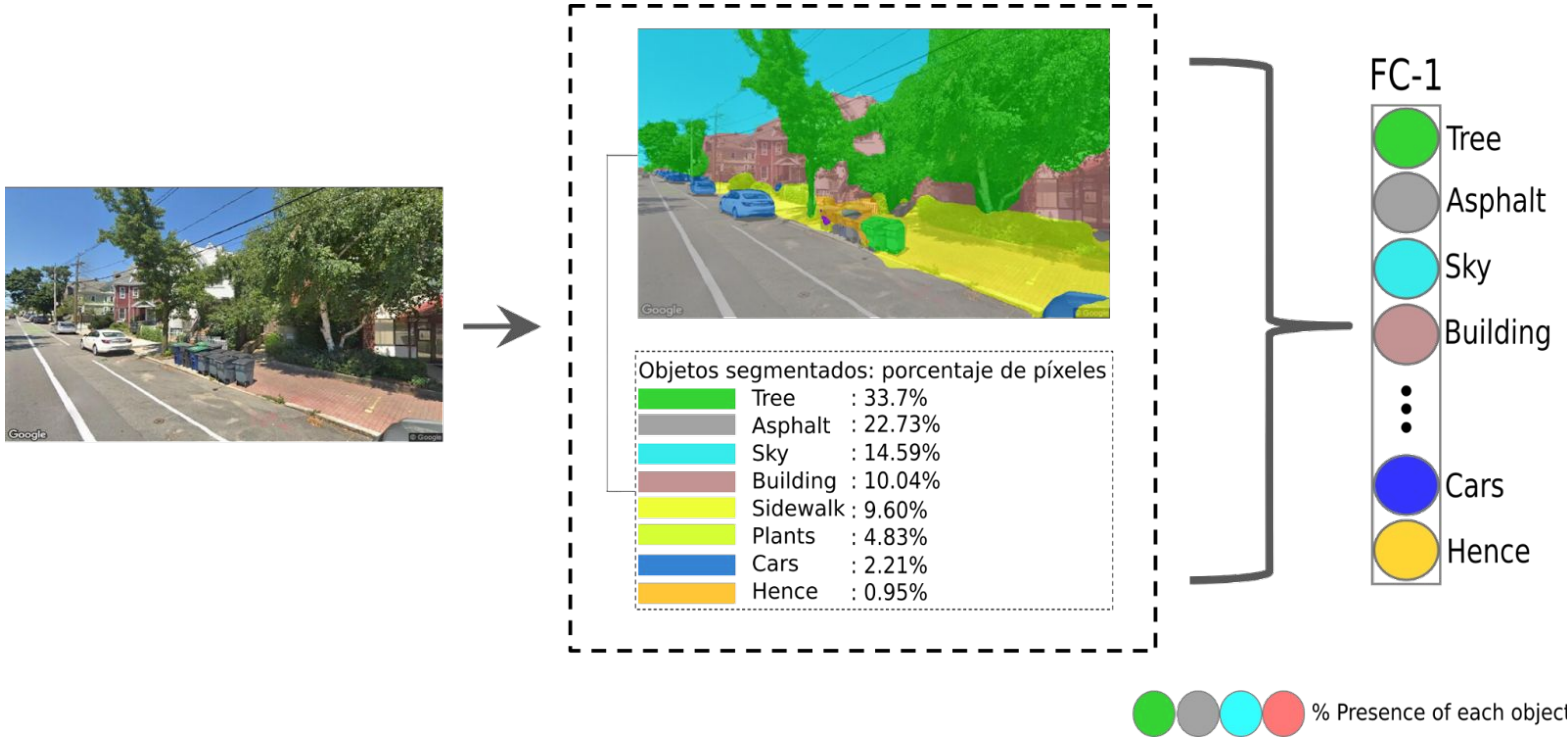
Place Pulse 2.0			
Category	# comparisons	# images	*mean*
Safety	368,926	111,389	5.188
Lively	267,292	111,348	5.085
Beautiful	175,361	110,766	4.920
Wealthy	152,241	107,795	4.890
Depressing	132,467	105,495	4.816
Boring	127,362	106,363	4.810
Total	1,223,649		

Urban Safety Perception

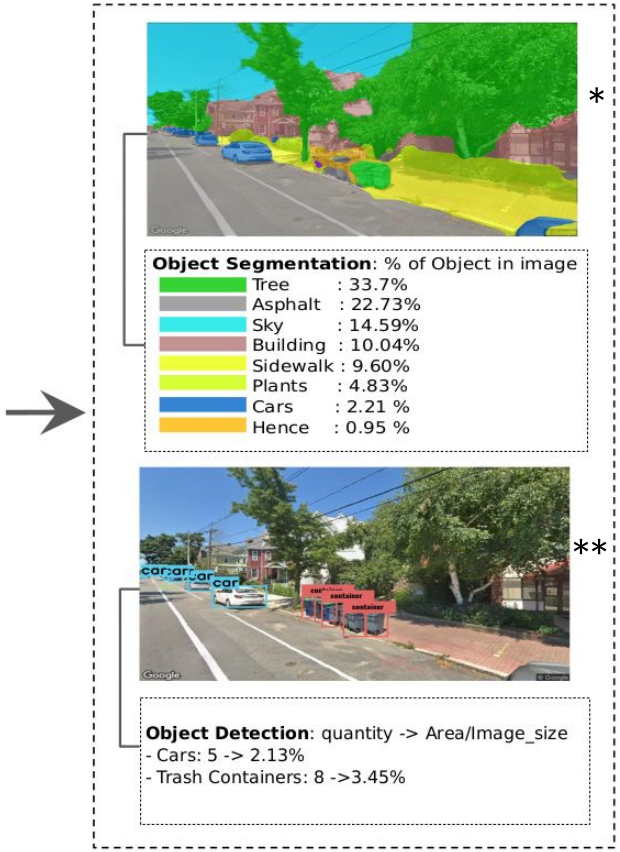
Object Presence

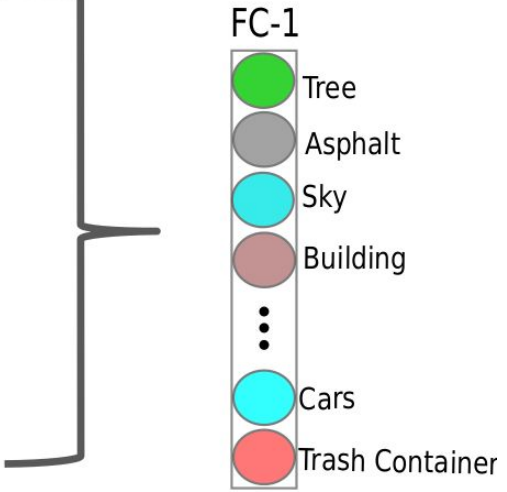
Objects Presence Features (OPF)

DeepLabV3+ specialize on ADE20K



Objects Presence



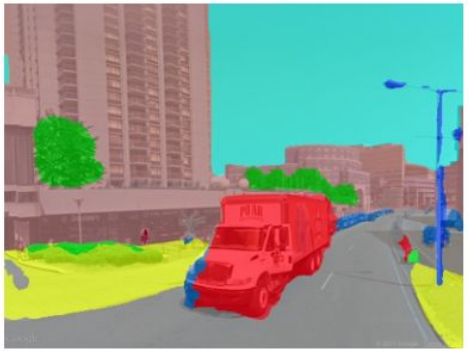


*ADE20k -> DeepLabV3+
**MRCNN/YOLO

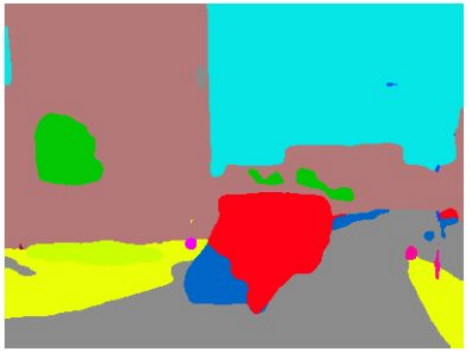
Objects Presence Features (OPF)

(b) PoV 1

(c) PoV 2



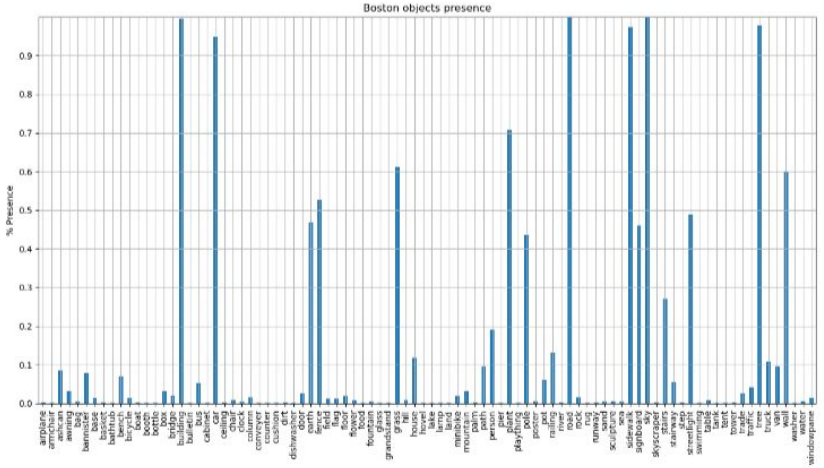
(d) DeepLabV3+



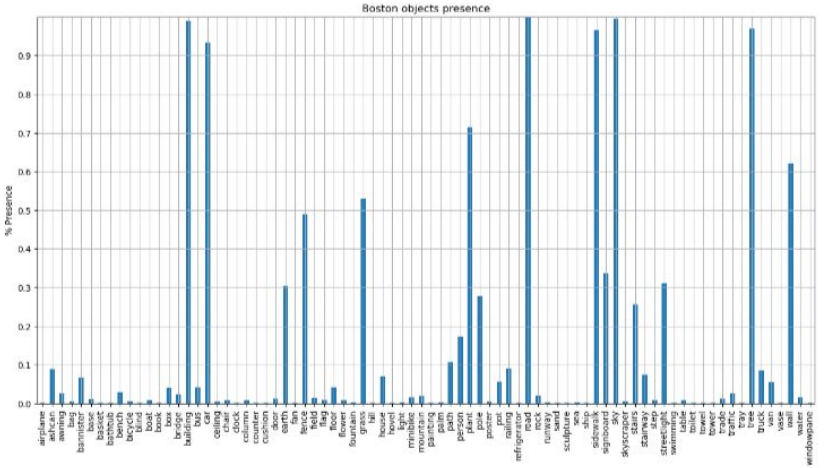
(e) PSPNet

OPF Statistics

$$X_{i,k} = \begin{cases} 1 & \text{if object } (k) \text{is present in image } X_i \\ 0 & \text{if object } (k) \text{is not present in image } X_i \end{cases}$$



(a) DeepLabV3+



(b) PSPNet

Experiments & Results

Processed data: Perceptual scores

left	right	winner
		draw
		left
		right
. . .	. . .	. . .
		right
		left

$$\hat{y}_{i,k} = q_{i,k}$$

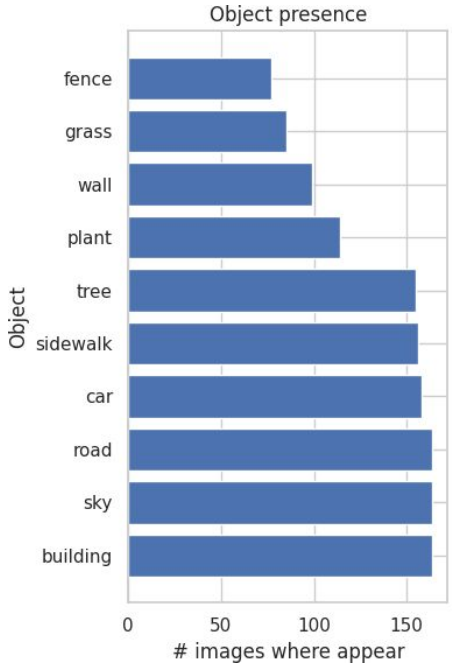
I:
(X,Y)

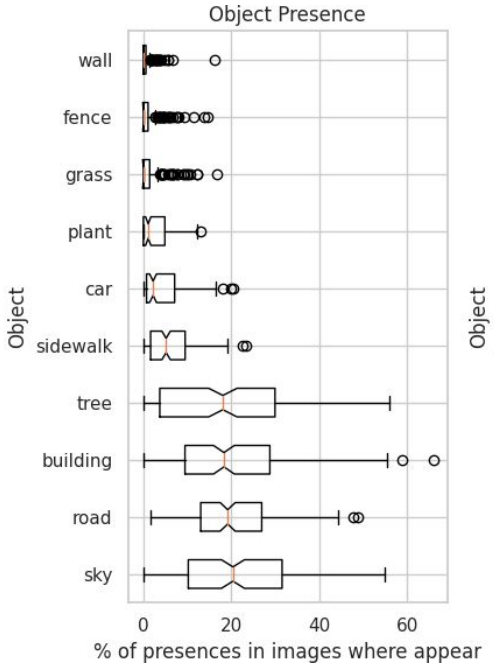
Image	Perceptual Scores
	8.35
	7.16
. . .	
	5.01
. . .	
	1.29
	0.55

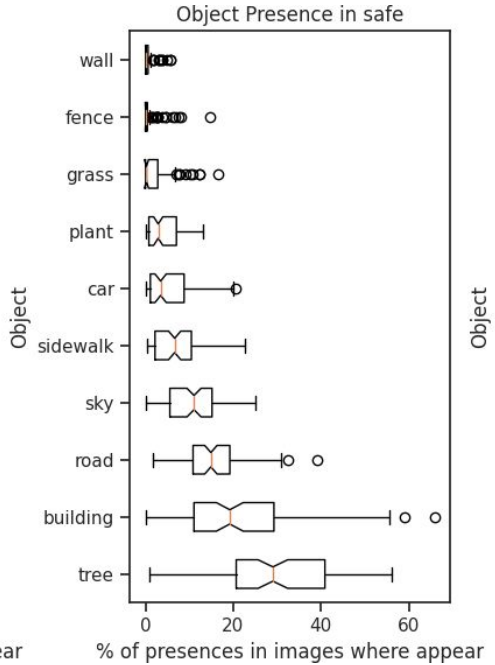
OPF Performance

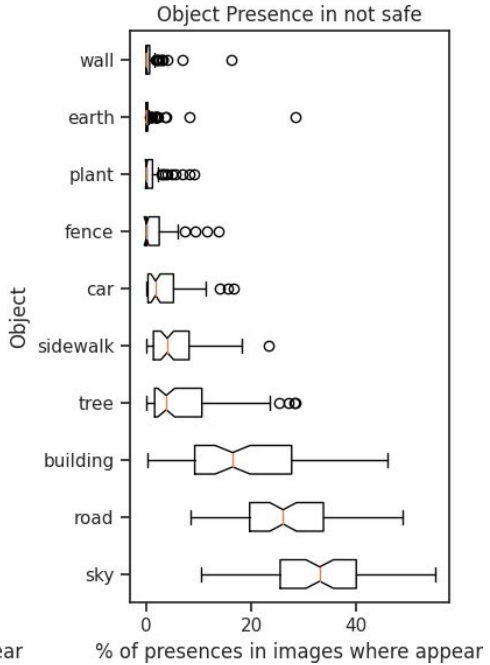
Feature Extractor	Metrics\Methods	**Linear SVC**	**Logistic Regressor**	**Ridge Classifier**
PSPNet	AUC	0.47036	0.465	0.48551
	ACC	0.48065	0.47097	0.48387
	F1	0.5752	0.50602	0.47712
DeepLabV3+	AUC	0.51255	0.51895	0.56066
	ACC	0.50323	**0.52258**	0.51935
	F1	**0.59043**	0.53459	0.52396

Object Presence



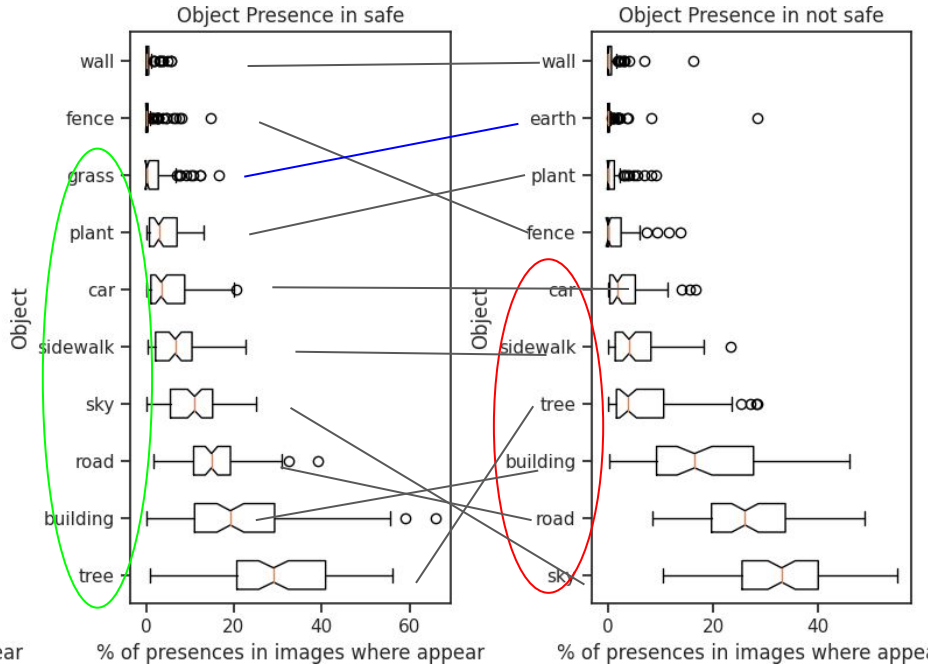




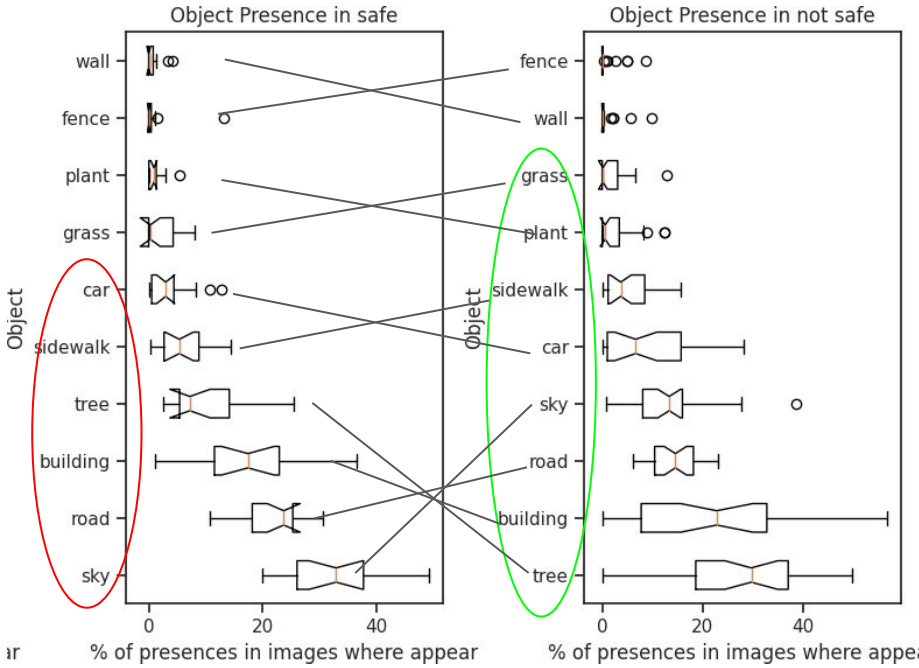


Object Presence - correct/miss classified samples

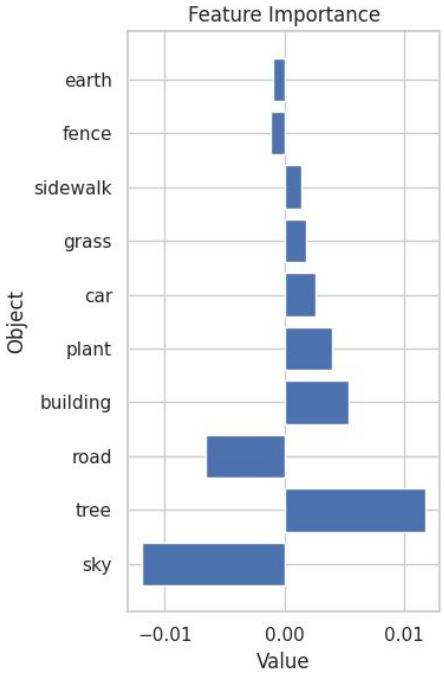
correct classified samples

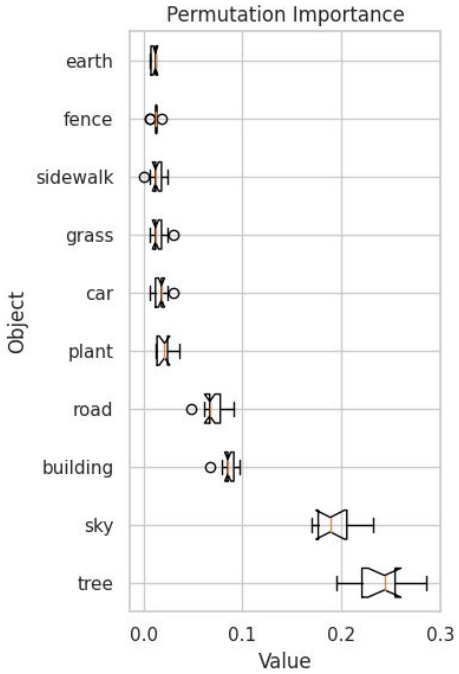


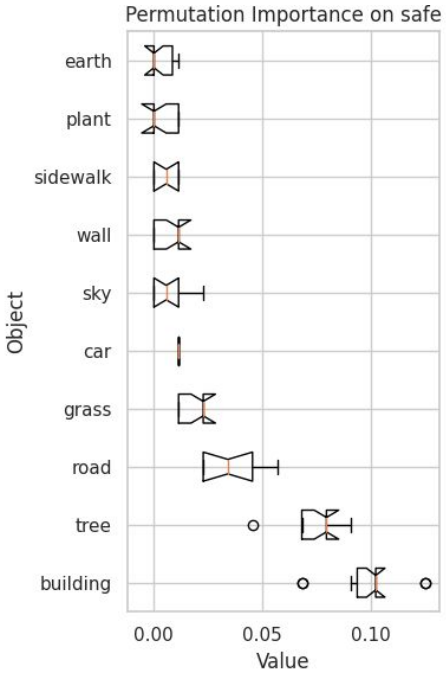
miss classified samples

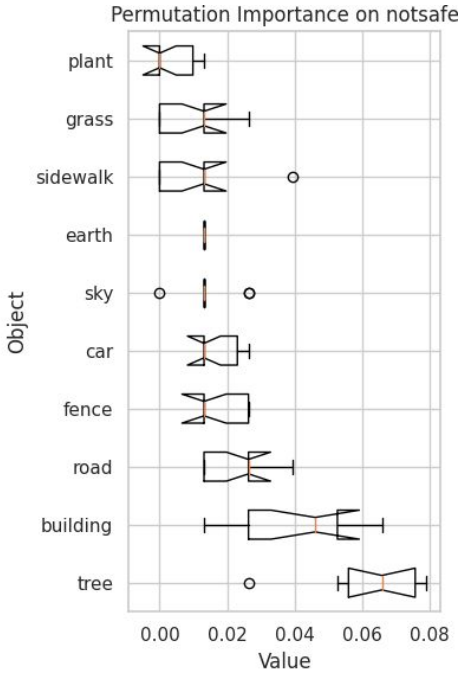


Object Importance



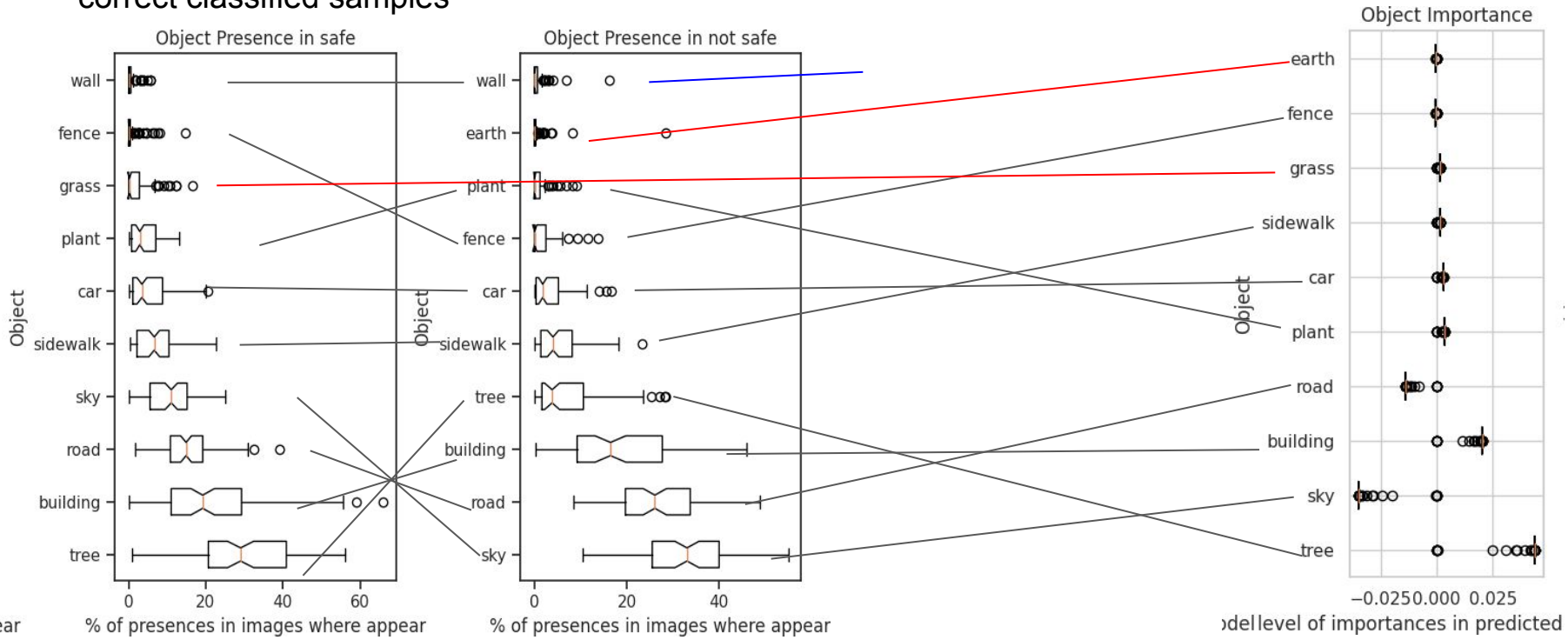






Object Importance - Presence - Mean

correct classified samples



Conclusions

Main Contributions

- We analyze Place Pulse 2.0 dataset and identify the limitations
- We show high correlation between object presence and the urban safety perception.
- Misclassified samples have similar distribution with other category distribution

Questions?