RECOGNIZING MATERIAL OF COVERED OBJECT: A CASE STUDY WITH GRAFFITI

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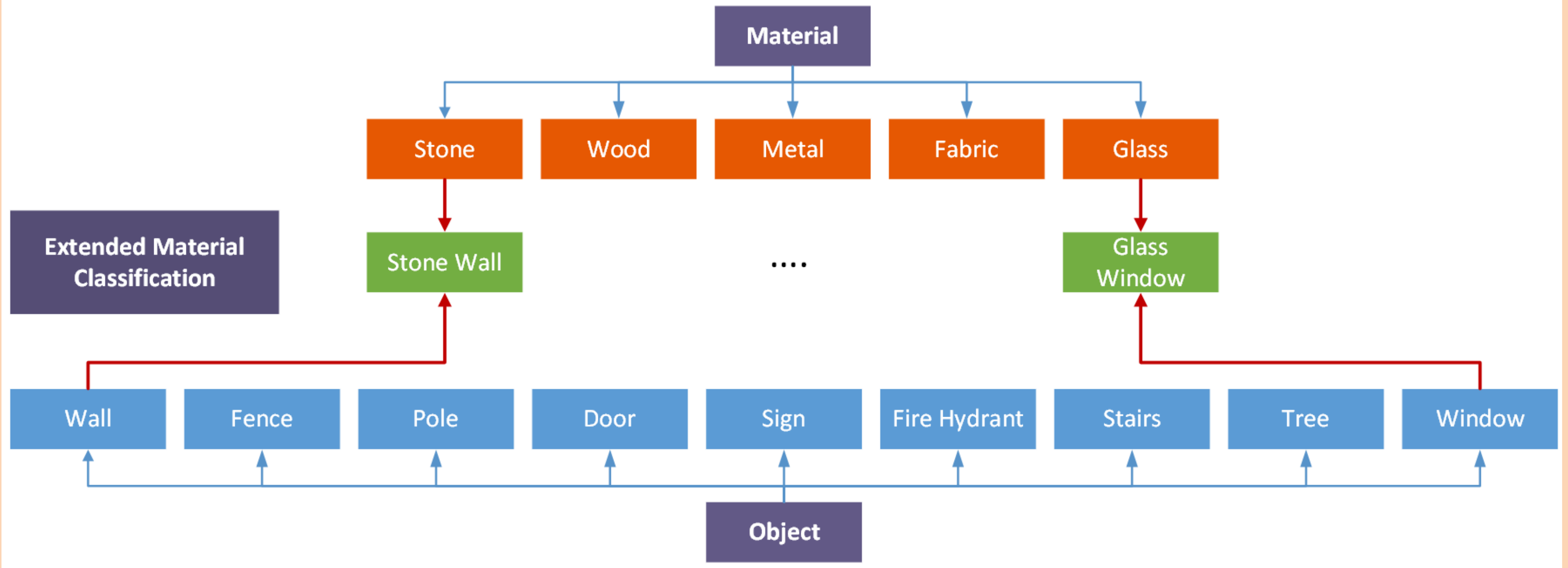
INTRODUCTION

- **Recognizing surface material** of an object is important for developing various **smart city** solutions.
- Sometimes, materials of objects in an image are obstructed by incidental "covers" (referred to as **covered materials**). Examples of such covers include graffiti drawn by people or property damages caused by natural disasters.

- **<u>Challenge:</u>** Visual characteristics are distorted so surface material identification and classification is hard.

MATERIAL CLASSIFICATION

As a case study, we studied recognizing covered materials by graffiti using 19K labeled images provided by City of Los Angeles.



- Given **t** types of materials (i.e., $\mathbf{M = \{m_1, m_2, \ldots, m_t\}}$) and **n** types of objects (i.e., $\mathbf{O = \{o_1, o_2, \ldots, o_n\}}$), the extended material classification includes at maximum **t*n** materials.

LEARNING APPROACHES

One-Phase Learning Approach (OLA)

- This approach is to consider a cover (e.g., graffiti) with its corresponding material as one unified object.

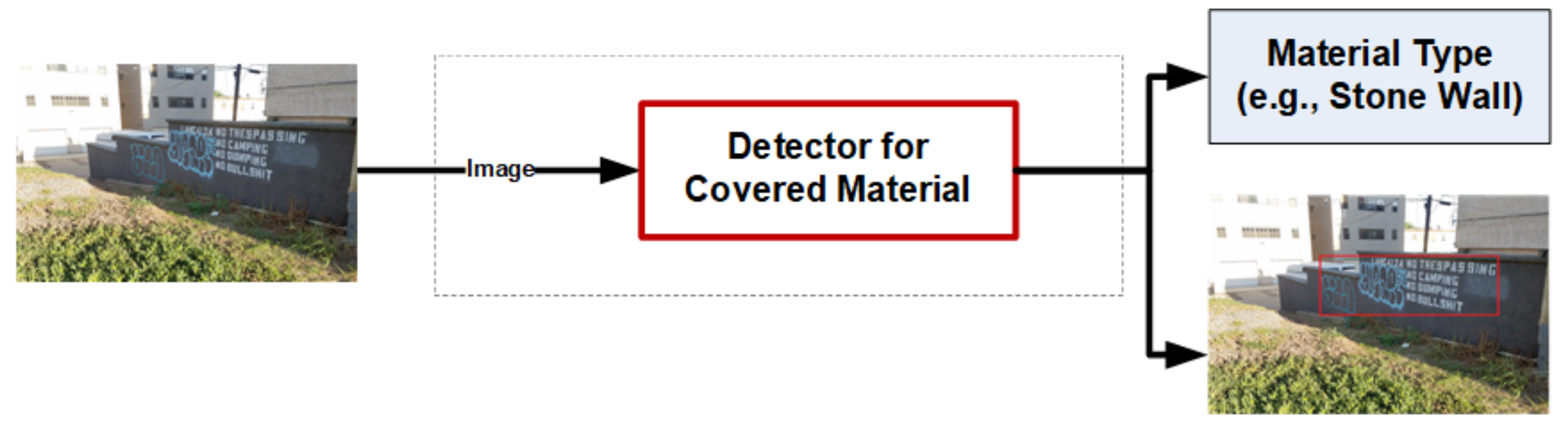


Image
Detector for Covered Material
Material Type (e.g., Stone Wall)

Two-Phase Learning Approach (TLA)

- First detect a cover and then classify the material covered by the detected cover.

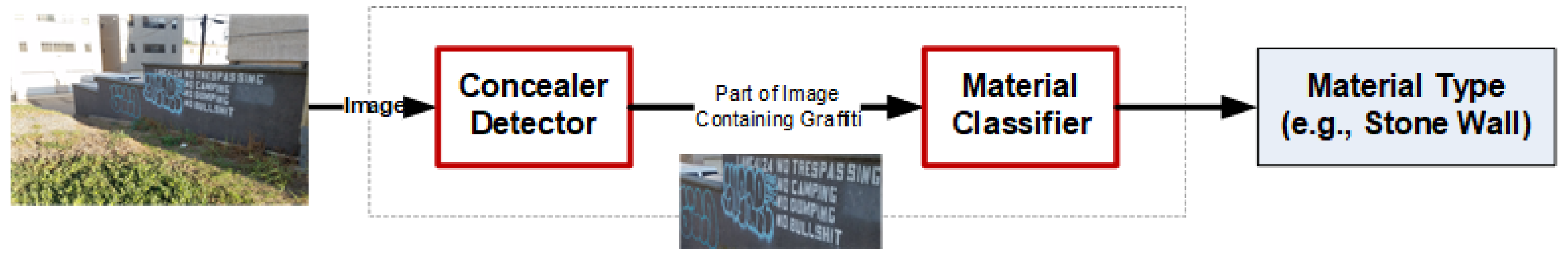
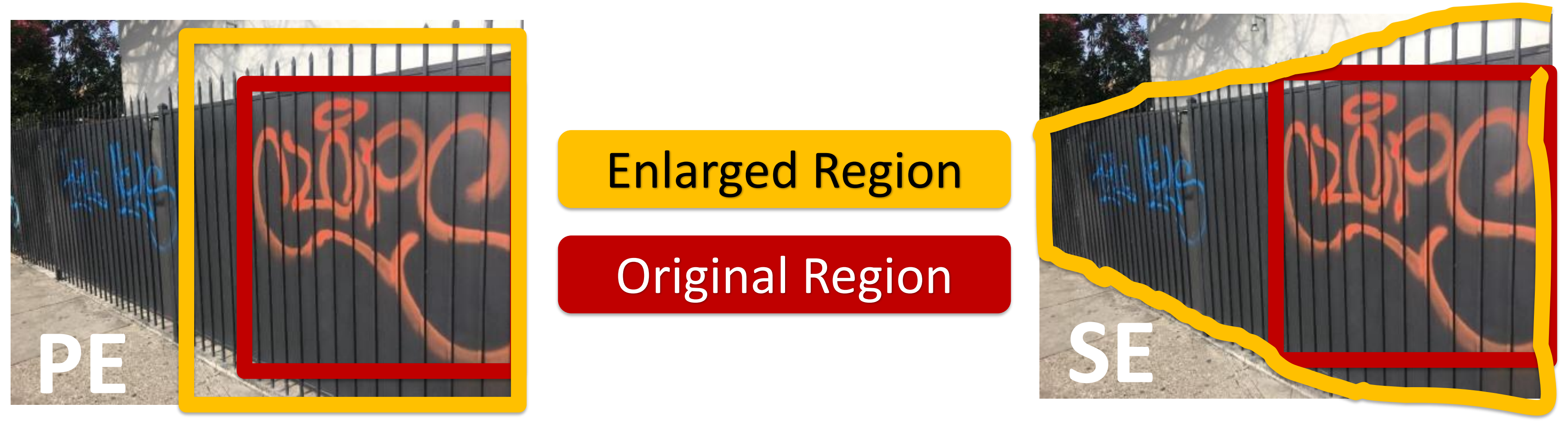


Image
Concealer Detector
Part of Image Containing Graffiti
Material Classifier
Material Type (e.g., Stone Wall)

APPROACHES W/ HEURISTIC EXPANSION

Proportional Expansion (PE)

- enlarge the learning region (which contains a covered material) by a factor (e.g., 1.3x.).



Semantic Expansion (SE)

- Use a segmentation algorithm to enlarge a learning region to the segment containing the covered material.

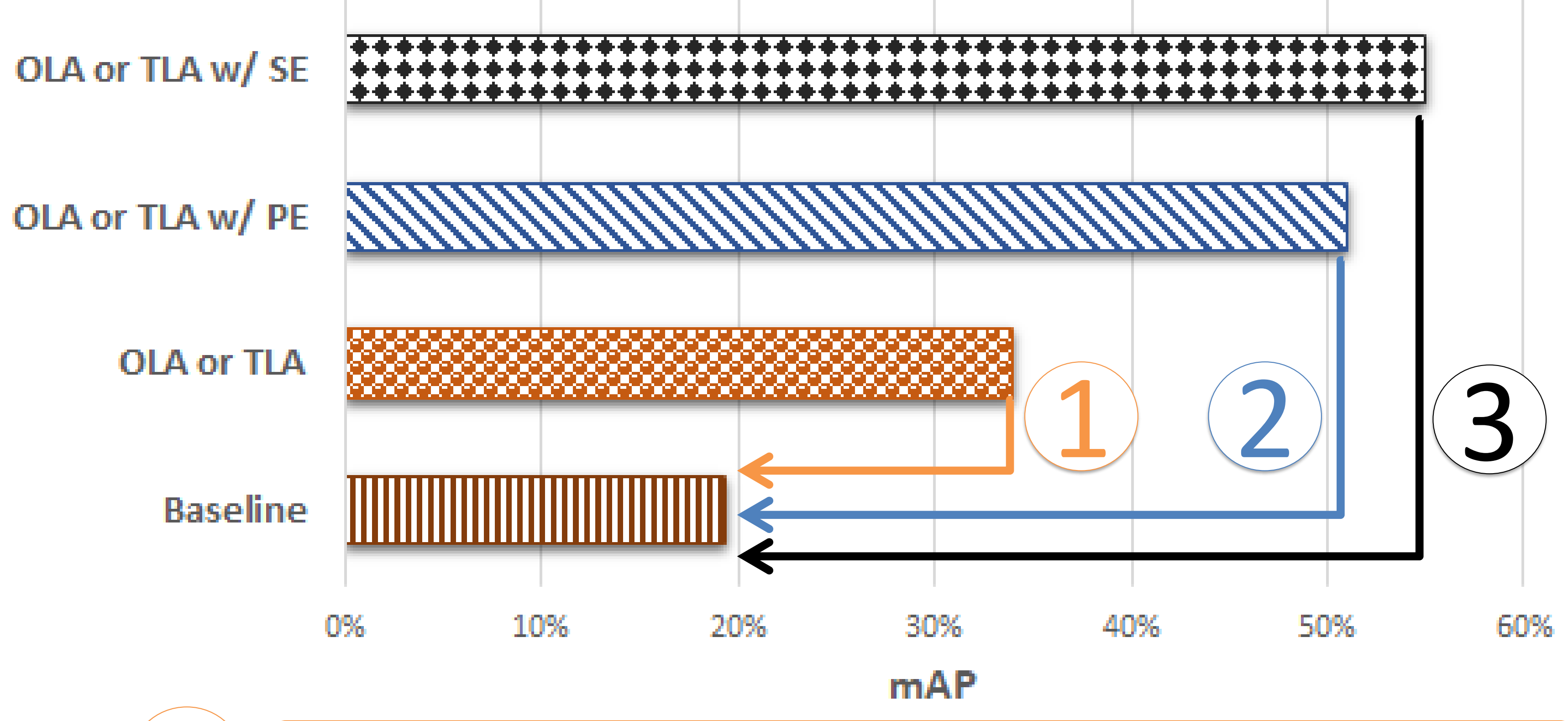
BASELINE APPROACH

- A material recognition model (adapted version from Bell et al. [CVPR'15]). The model is trained on image segments that display plain materials.

Image Segments of "Plain material" = Blue Box – Black Bok

BASELINE VS. PROPOSED APPROACHES

- Our approaches are superior to the baseline in recognizing surface materials in images with graffiti.



1 OLA and TLA improved mAP by a factor of **0.75x**

2 PE enabled mproving mAP by a factor of **1.6x**

3 EE enabled mproving mAP by a factor of **1.8x**