# **Cross-Domain Object Detection with YOLO**

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**Abstract**

*There are some papers about cross-domain classification, but only few of them are about object detection. In this paper, we present the results obtained and the methodologies adopted for cross-domain supervised object detection, basing ourselves on the paper by Inoue, Furuta, Yamasaki, Aizawa. For this paper, we have access to images with instance-level annotations in multiple source domains and images with only image-level annotations in a target domain. The classes to be detected in the target domain are all or a subset of those in the source domains. We start from a YOLO implementation using a pre-trained Darknet, and then we apply a two-step progressive domain adaptation technique by fine-tuning the Darknet on two types of artificially and automatically generated samples. Finally, we test our YOLO network on a subset of the Comic dataset, achieving… (and achieve an improvement of approximately 5 to 20 percentage points in terms of mean average precision (mAP) compared to the best-performing baselines.)*

# Introduction

The idea behind this paper is to train a network implementing the YOLO algorithm to detect objects in real-time in a target domain, which has only information about objects in the images, but no information about where they are placed. So, our goal is to use instance-level annotations of other domains and try to generate them on the target one. To make this possible, we have used the Darknet as implemented by [reference to pjreedie] with no pre-trained weights applied. Object detection is the process of autonomously recognizing objects (e.g. people, animals, cars etc.) in an image or video not only classifying those objects correctly deciding what they are, but also recognizing their positions and sizes in the input image. In fact, object detection is about assigning the right label (i.e. the class) and the right bounding box (i.e. a rectangular shaped frame) to an object. So, we define as image-level annotation of an image the set of classes coupled with the objects contained in that image, without knowing where objects are. The knowledge of the class and the position of objects in an image defines the instance-level annotation of the image. The position of an object is defined with a bounding box **b**, defined as *(x, y, width, height)*, where *x* and *y* are the coordinates in pixel of the upper left vertex of the box.

Right now, most object detection networks and researches focus on images from the real world­­­­­­­ obtaining great results, but object detection can be very useful also in other domains than just real-world one. The methods explained in this paper aim for detect objects in domains covered by few datasets with lack of annotations, i.e. painting or comic, and this is very useful to improve performances on them and transfer knowledge from a well-known domain. For example, an automated museum guide will exploit the knowledge obtained from these techniques to recognize objects in form of statues, paintings, etc.

We start from a Darknet pretrained on images with instance-level annotations from a source domain, then we fine-tune it in the target domain. This approach seems the best one, but there are no instance-level annotations available in the target domain. To generate this information, we use the same methods applied in the paper made by Inoue, that are *Domain Transfer* and *Pseudo Labeling*, that will be explained later. Once the annotations are automatically created, we fine-tune the Darknet on them. The results obtained by the original paper applying this task achieve an improvement of 5 to 20 percentage points in terms of mean average precision, but the domain adaptation was made starting from a single source domain to a target one. The source was always Pascal VOC, which contains real-world images, and three networks were created to transfer instance-level knowledge to three different domains, that are Clipart, Comic and Watercolor. In our implementation, we want to know how much the results change if we use several sources and transfer all their information to the target one. All the sources have instance-level annotations, meanwhile the target one has only information about the objects in the images, so image-level annotations. The domains we take as source domains are Pascal VOC 2007 and 2012, Watercolor and Clipart. Comic, instead, is used as target domain.

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...

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FAQ

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# References

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4. Actual Author Name. The frobnicatable foo filter, 2014. Face and Gesture (to appear ID 324).
5. Actual Author Name. Frobnication tutorial, 2014. Some URL al tr.pdf.

1. This is what a footnote looks like. It often distracts the reader from the main flow of the argument. [↑](#footnote-ref-1)