DETR for fire detection

Evaluation using a transformer model

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Fire detection project

- DETR transformer: https://doi.org/10.48550/arXiv.2005.12872
- Dataset: COCO format for DETR for default
- Useful Reference for DETR object detection: https://huggingface.co/docs/transformers/model_doc/detr

DETR transformer model

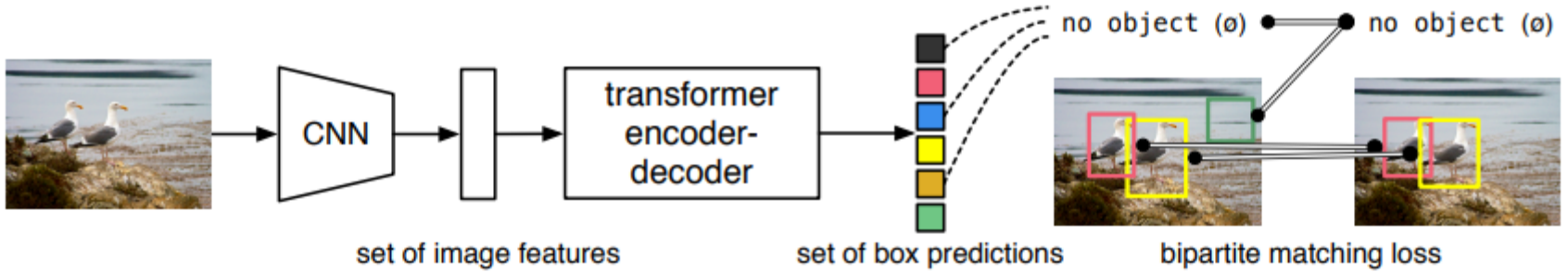
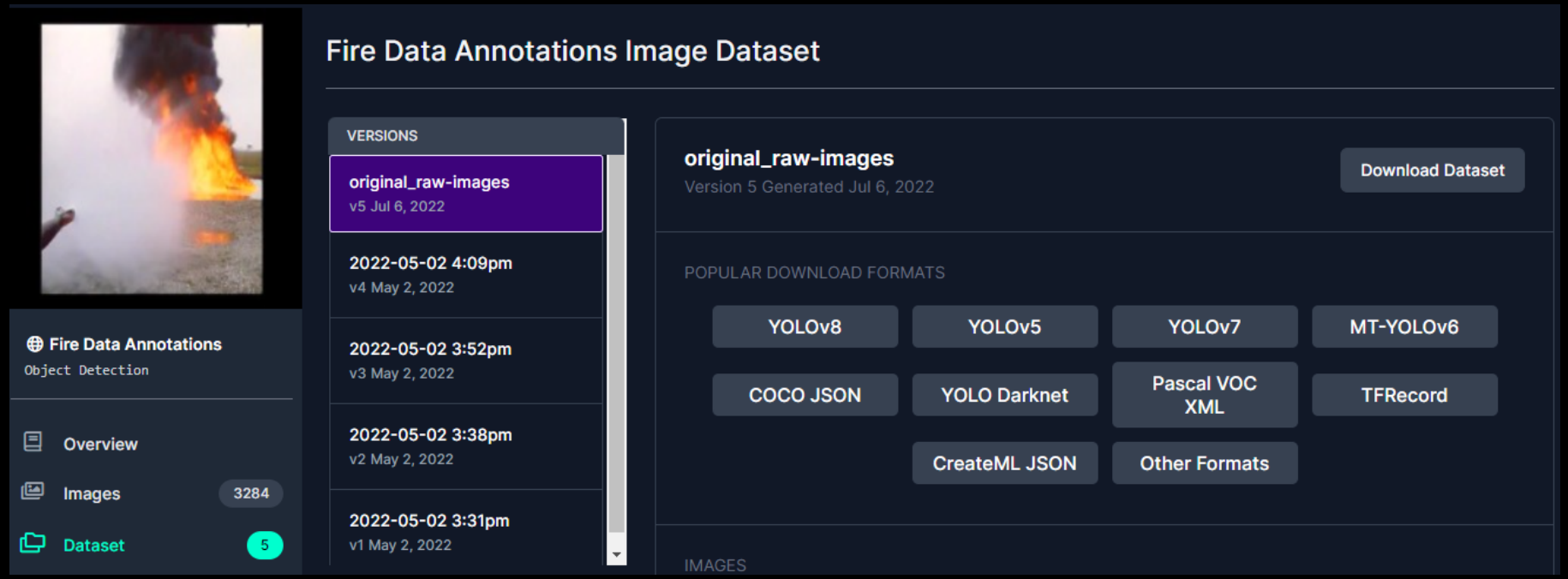


Fig. 1: DETR directly predicts (in parallel) the final set of detections by combining a common CNN with a transformer architecture. During training, bipartite matching uniquely assigns predictions with ground truth boxes. Prediction with no match should yield a "`no object`" ($\varnothing$) class prediction.

Carion, N., Massa, F., Synnaeve, G., Usunier, N., Kirillov, A., & Zagoruyko, S. (2020). End-to-End Object Detection with Transformers. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *12346 LNCS*, 213–229. https://doi.org/10.1007/978-3-030-58452-8_13

COCO dataset from Roboflow

- https://universe.roboflow.com/fire-detection/fire-data-annotations/dataset/5



Training phase

- Google Colab needed for memory resources needed in GPU

```
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 525.85.12    Driver Version: 525.85.12    CUDA Version: 12.0     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla T4            Off  | 00000000:00:04.0 Off |                    0 |
| N/A   50C    P8    10W /  70W |      0MiB / 15360MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+
```

- 50 epochs ≈ 4 hours
- 41.5M params

```
   | Name  | Type                      | Params
-------------------------------------------------
0 | model | DetrForObjectDetection | 41.5 M
-------------------------------------------------
41.3 M    Trainable params
222 K     Non-trainable params
41.5 M    Total params
166.038   Total estimated model params size (MB)
```

Inference: aerial images, so good!

Inference: clean indoor images, so good!

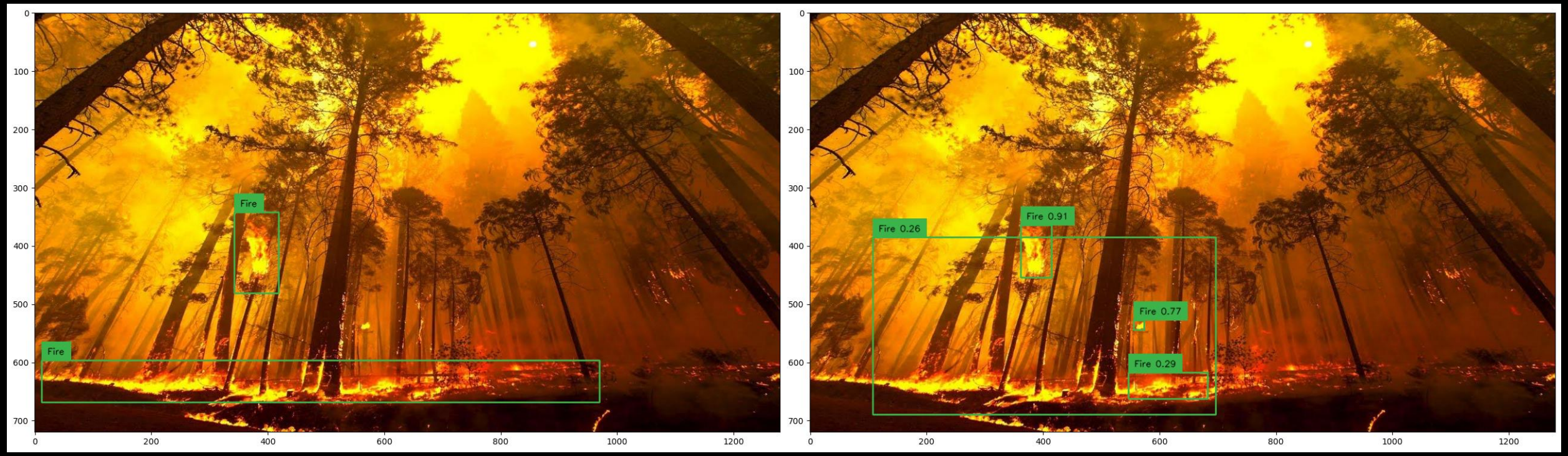
Inference: Several sources, not bad!

Inference: Several sources, not bad!

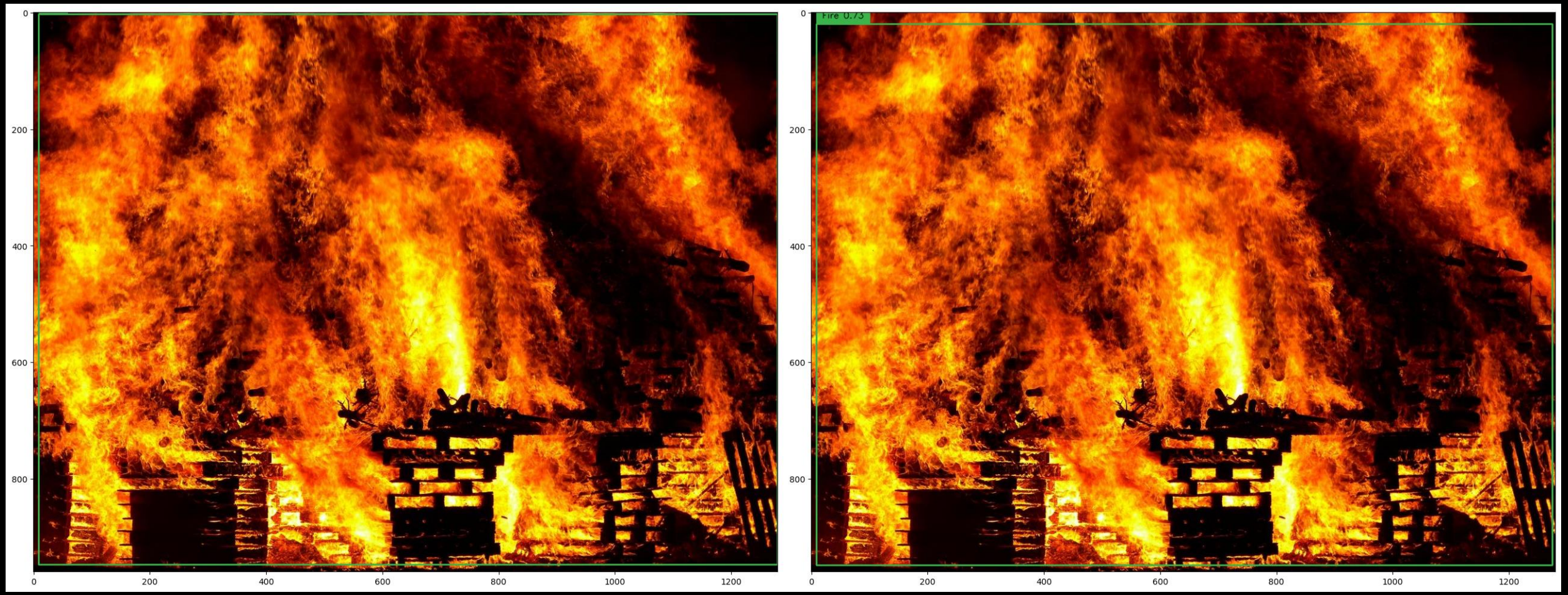
Inference: Several sources, not bad!

Inference: Several sources, not bad!

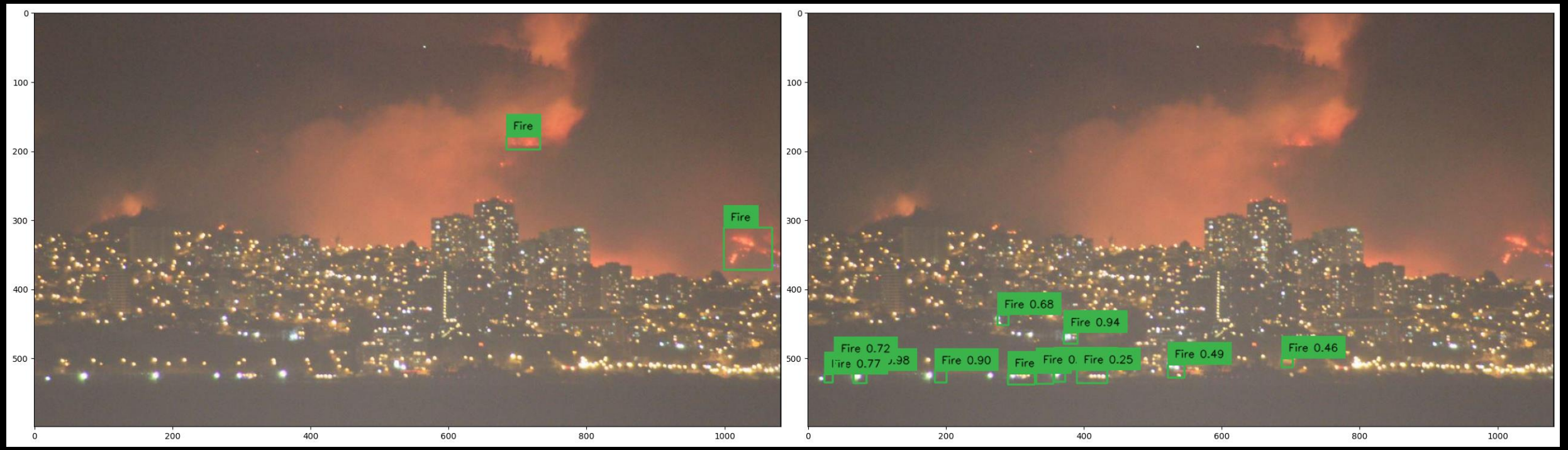
Inference: Into a wildfire, fire vs smoke and brightness

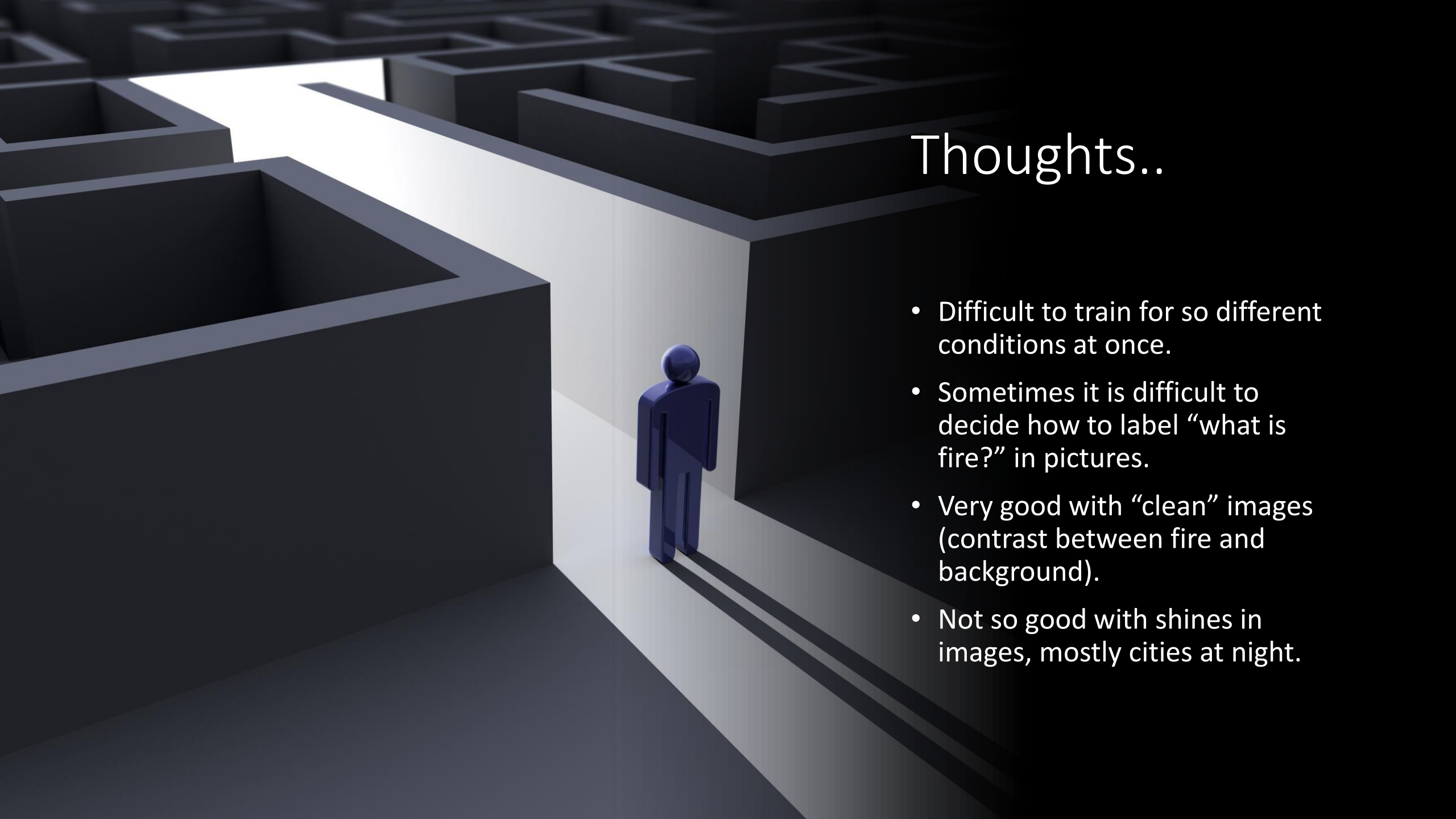


Inference: Close to the fire, not bad!



Inference: cities at night. lights! -> worst results ☹





Thoughts..

- Difficult to train for so different conditions at once.
- Sometimes it is difficult to decide how to label “what is fire?” in pictures.
- Very good with “clean” images (contrast between fire and background).
- Not so good with shines in images, mostly cities at night.

Possible improvements

More training?

Better labeled images?

Focus on a specific type of environment, like aerial images?

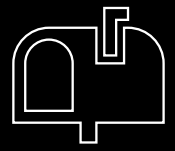
Better hyperparameter configuration?

The fire nature is difficult to define by photos

Conclusions… for now

- Give a try if needed -> there is a lot of information about transformers
- There are heavy models with many parameters. Prepare it well before training (resources and time).
- Dataset could be the cause of better or worse results.
- NMS trial and error determination.

Appreciable any comment or suggestion



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