

Robust machine learning models for high dimensional data interpretation

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1. Introduction / Context

Deep neural networks (DNNs) have reached important milestones in the computer vision field. However, these models lack of transparency and interpretability, and inability to estimate the uncertainty associated to their predictions.

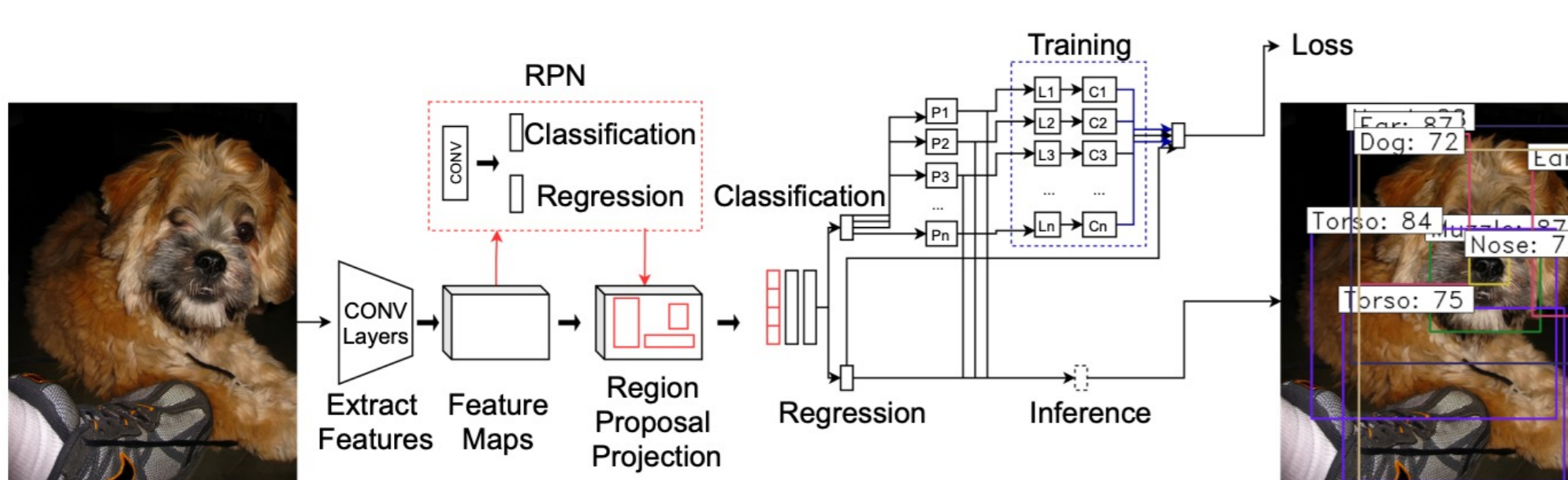
2. Goal / Objectives

My research involves the development of combined architectures composed of a convolutional model and a neuro-symbolic component. This approach allows to encode a prior information as a set of logical constraints to compensate for the lack of data in the training set through knowledge sharing between the two components.

3. Faster-LTN[1]

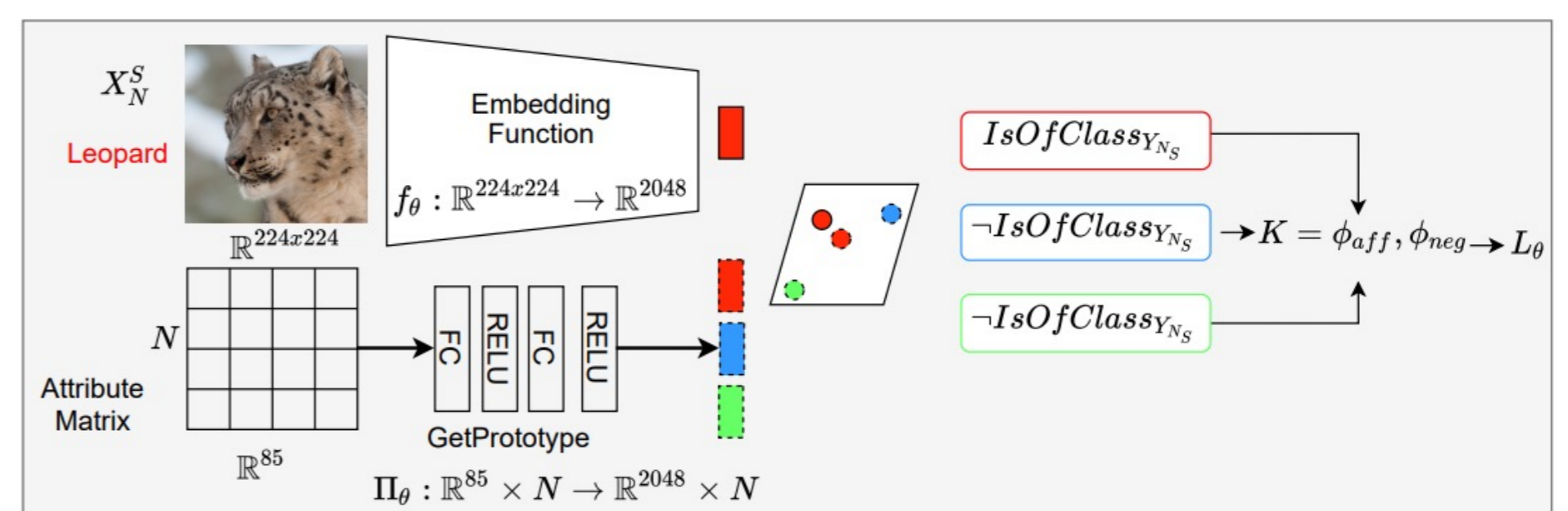
Faster – Logic Tensor Network (FasterLTN) is an object detector composed of a convolutional backbone and an LTN. We propose a novel approach consisting of the following steps:

1. Faster R-CNN: two-stage object detector
2. LTN - head: The logical constraints imposed by the LTN can thus shape the training of the convolutional layers, that are no longer purely data-driven.



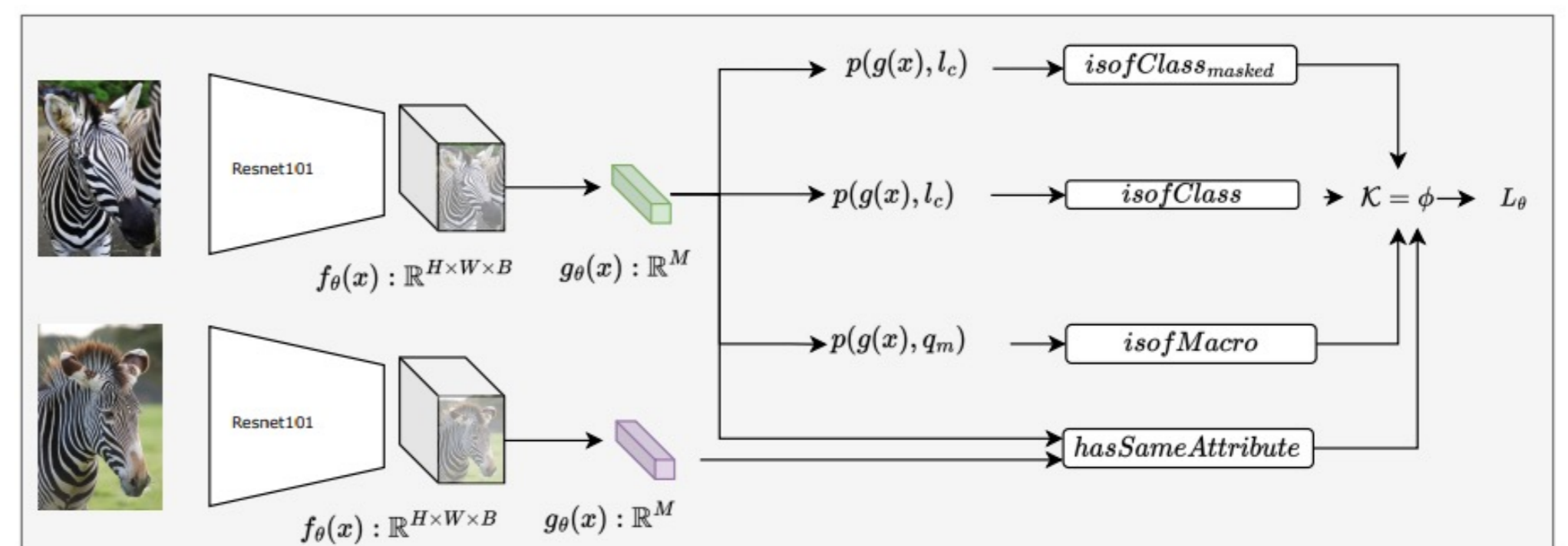
4. Proto-LTN[2]

A Logic Tensor Network for zero-shot learning task. Using a set of prototypes, it was possible to formulate “isofclass” predicates based on a measure of distance between images and prototype classes.



5. Fuzzy Logic Visual Network (FLVN)[3]:

FLVN is a NeSy architecture for Zero-Shot learning (ZSL) that learns to project visual features into a semantic attribute space by satisfying logical constraints.



Knowledge Base

1. Learning from labelled examples
2. Learning from image hierarchy
3. Learning better feature representation
4. Learning with refutation

6. References

1. Faster-LTN: a neuro-symbolic, end-to-end object detection architecture / Manigrasso, Francesco; Davide Miro, Filomeno; Morra, Lia; Lamberti, Fabrizio. 30th International Conference on Artificial Neural Networks (ICANN 2021).
2. PROTOtypical Logic Tensor Networks (PROTO-LTN) for Zero Shot Learning / Martone, Simone; Manigrasso, Francesco; Lamberti, Fabrizio; Morra, Lia (ICPR 2022) at Montreal nel 21-25 Agosto 2022.
3. Manigrasso, Francesco et al. “Fuzzy Logic Visual Network (FLVN): A neuro-symbolic approach for visual features matching.” International Conference on Image Analysis and Processing (2023).