

Towards Corner Case Detection by Modeling the Uncertainty of Instance Segmentation Networks

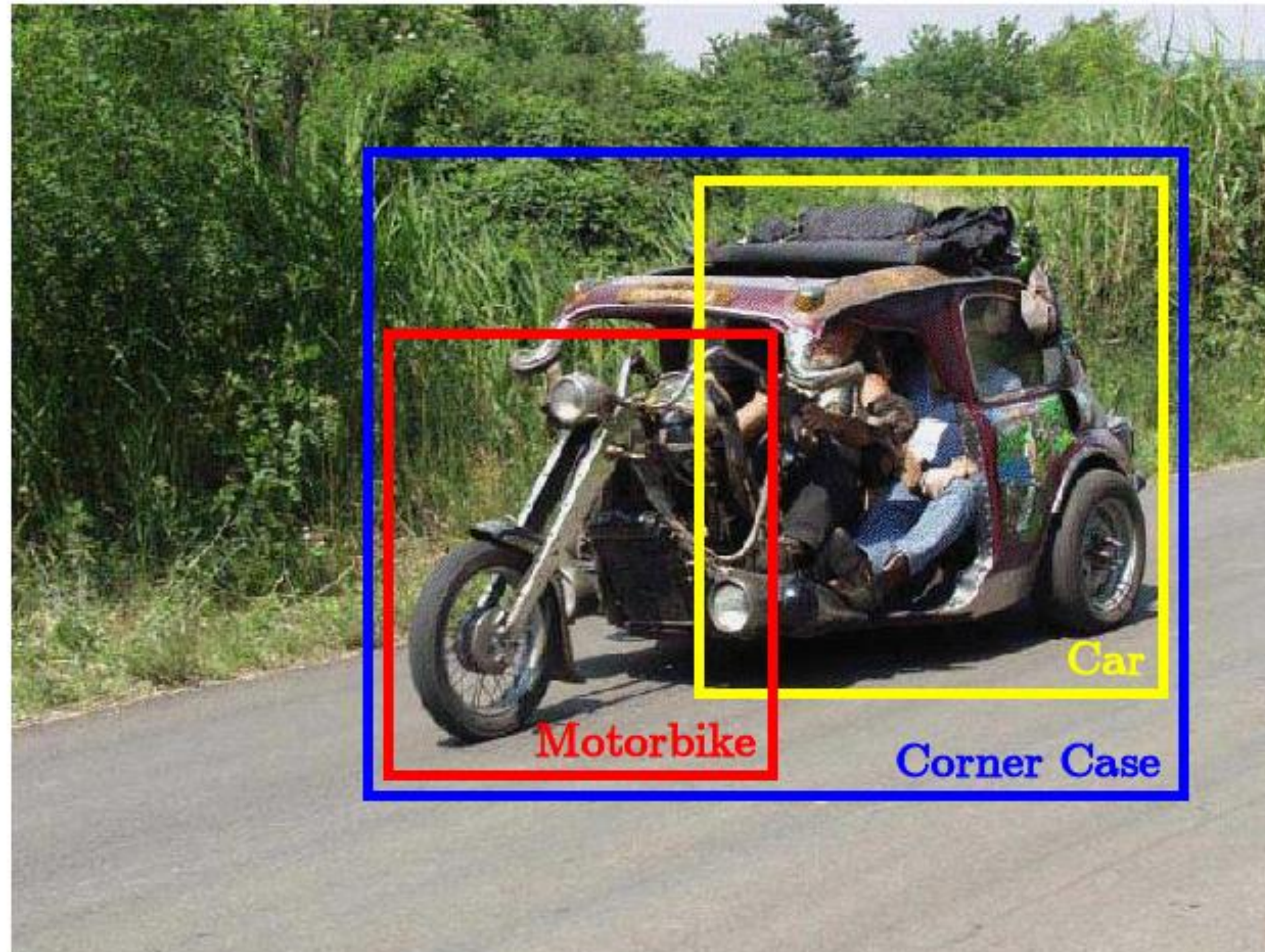
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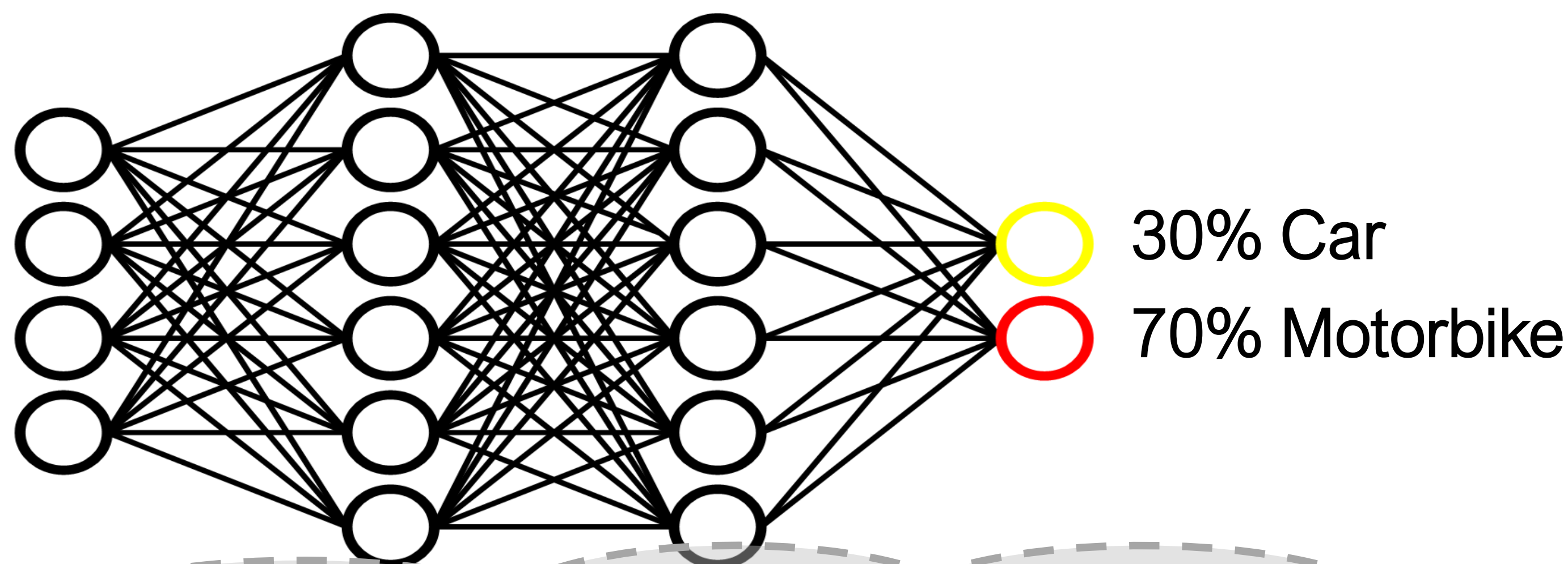
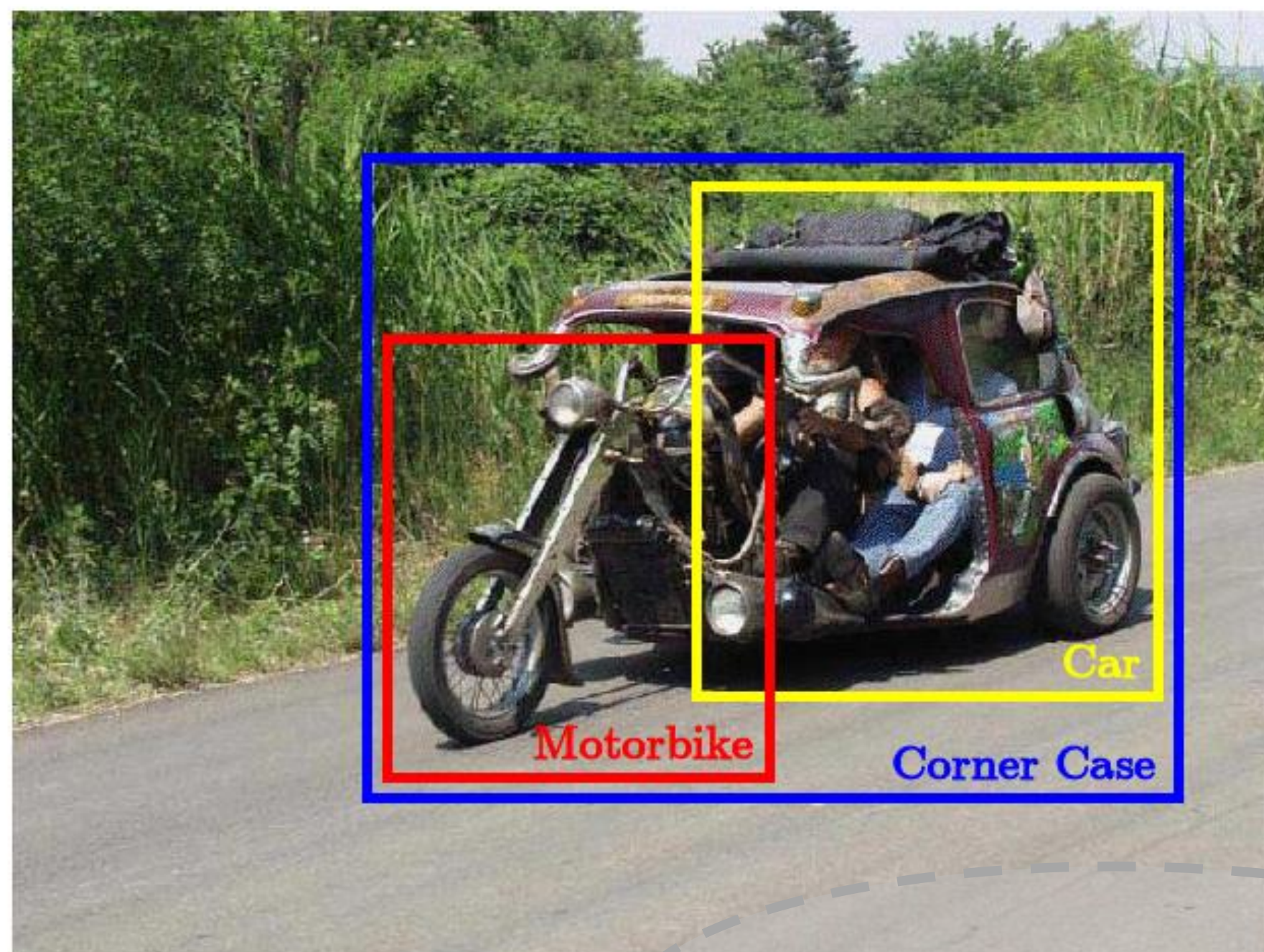
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Corner Case

Object Detection in Images



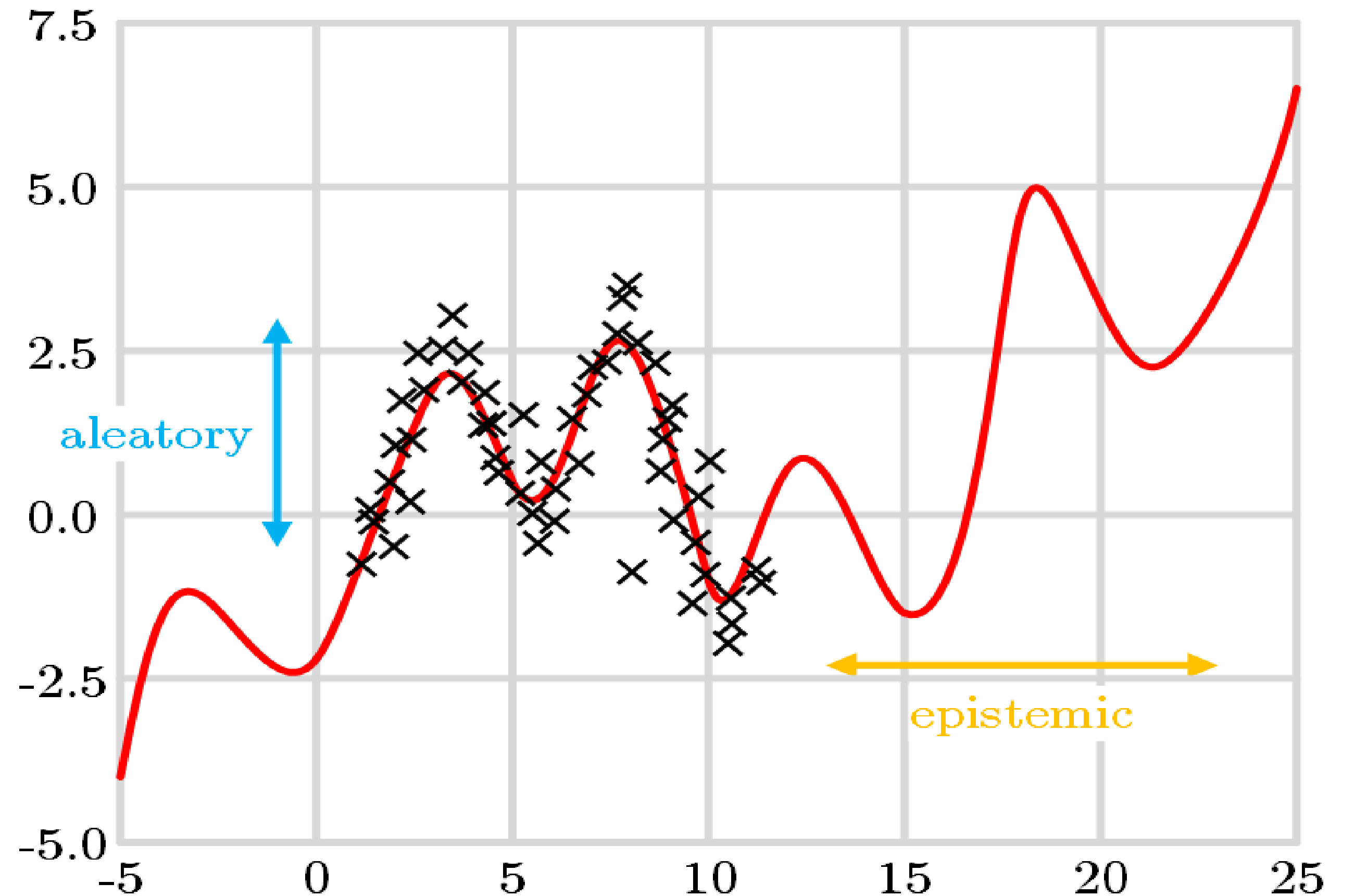
Uncertainty in Neural Networks



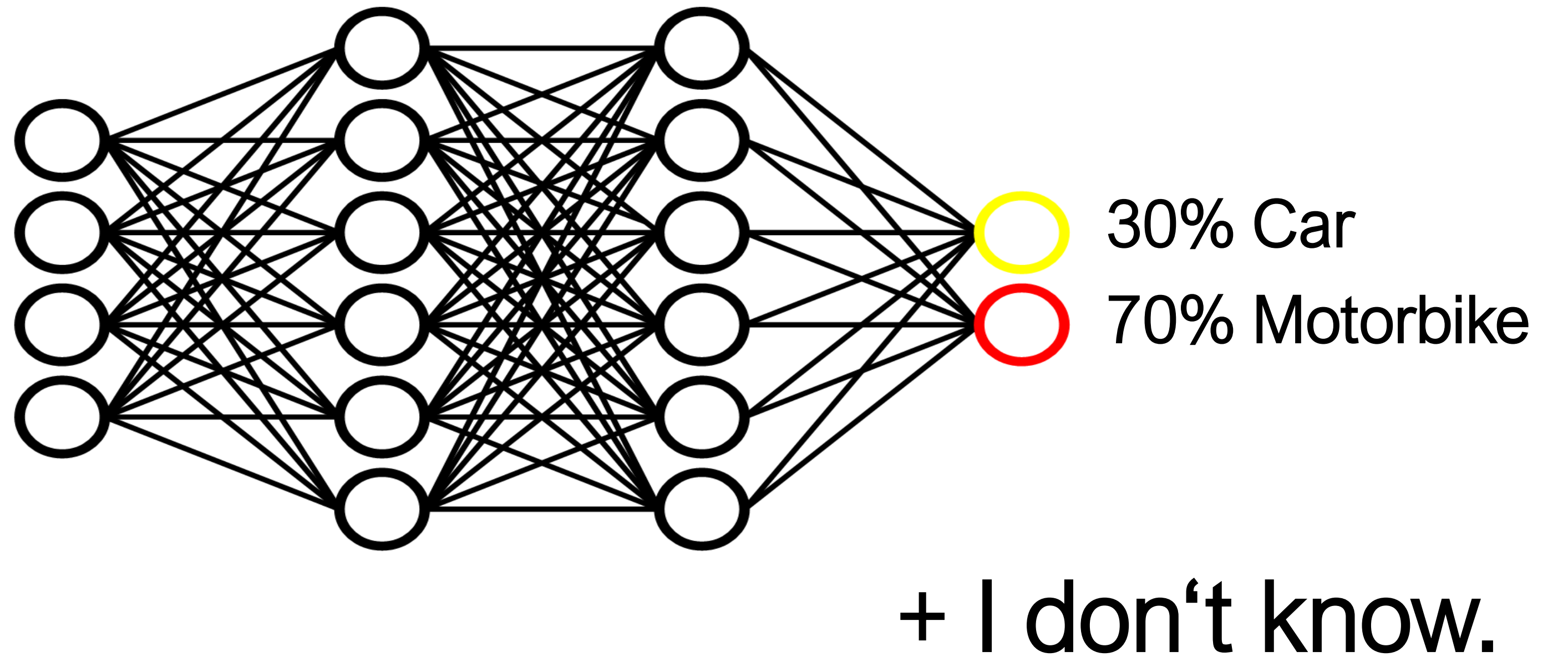
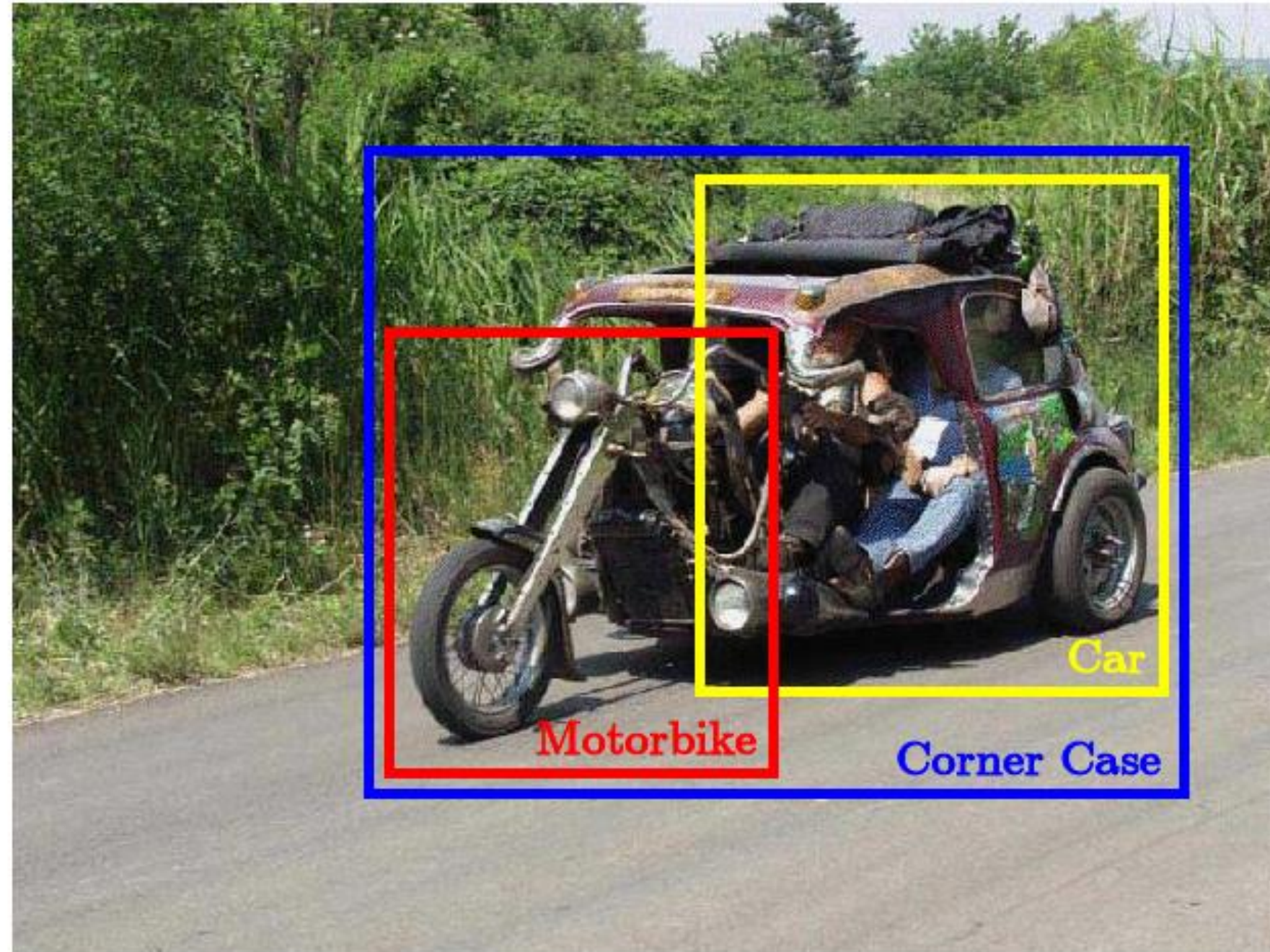
Is this really what we want ?

Aleatory vs. Epistemic Uncertainty

- **Aleatory uncertainty** refers to the natural variability of the physical world
- **Epistemic uncertainty** refers to the lack of human or model knowledge.
 - **Note:** also influence by inductive bias

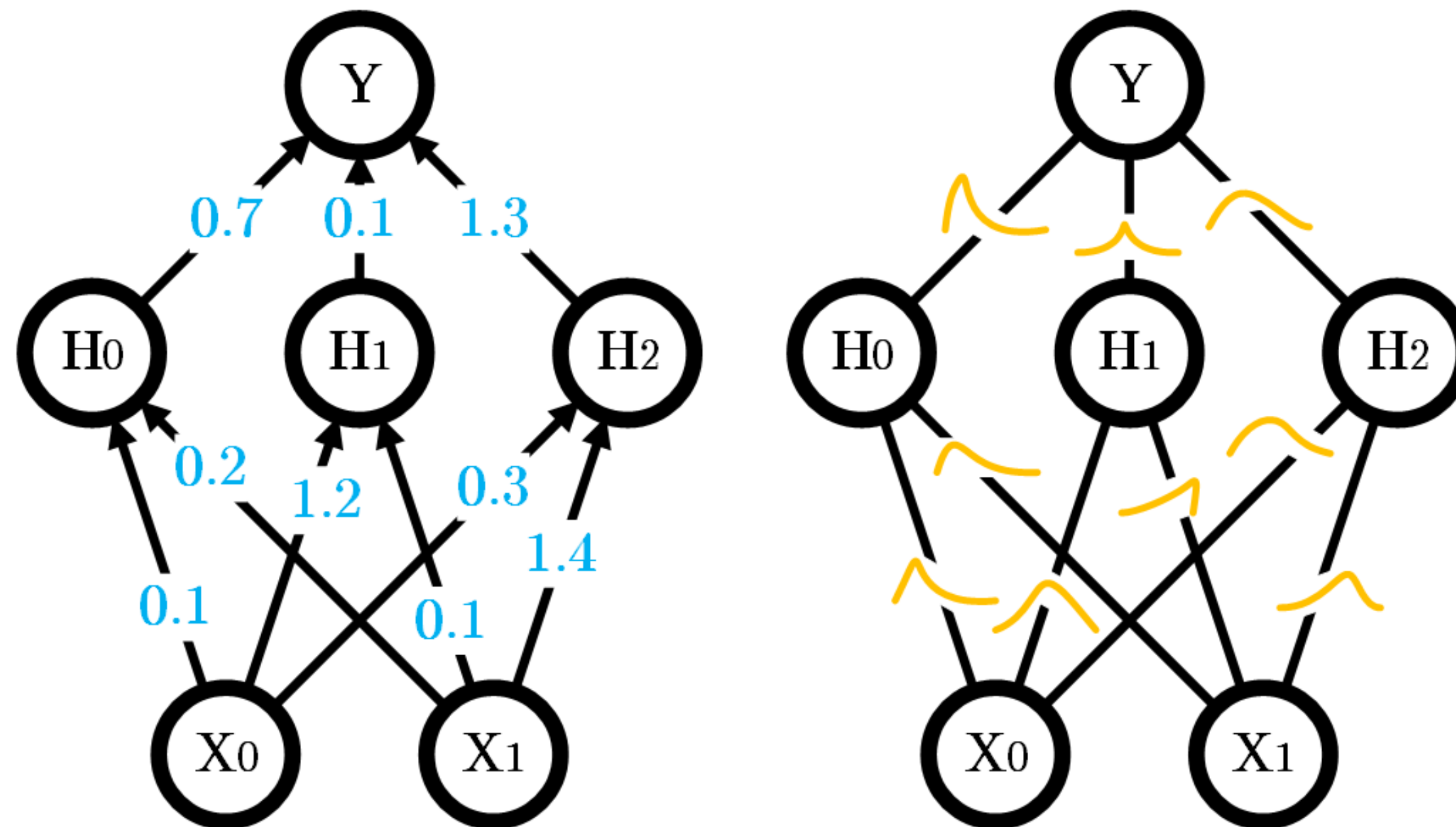


Uncertainty in Neural Networks



Uncertainty in Neural Networks

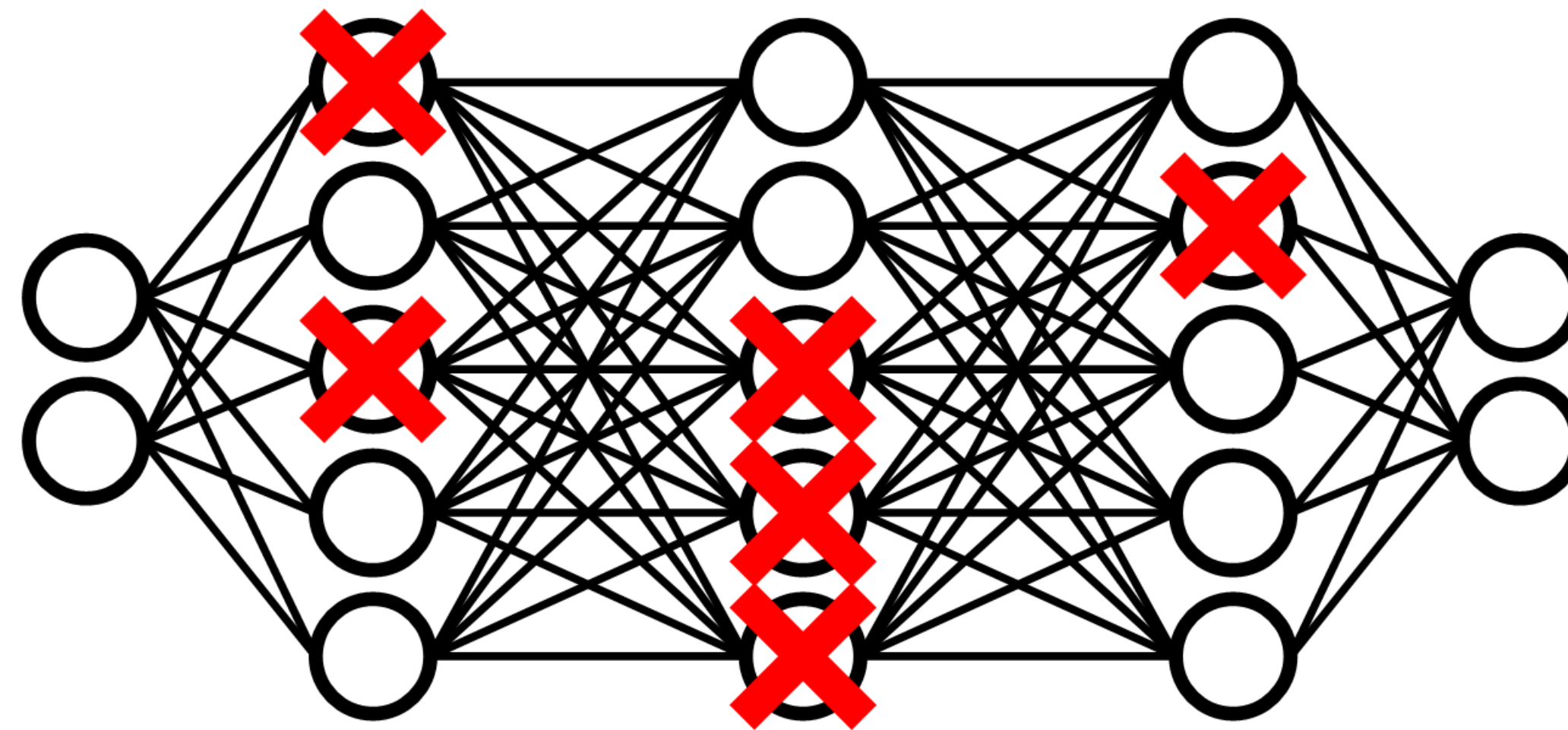
Idea: Express uncertainty about weights using probability distribution over weights



Problem: Distribution is difficult to determine.

Dropout in Neural Networks

Approximate variational distribution over weights using Monte-Carlo Dropout



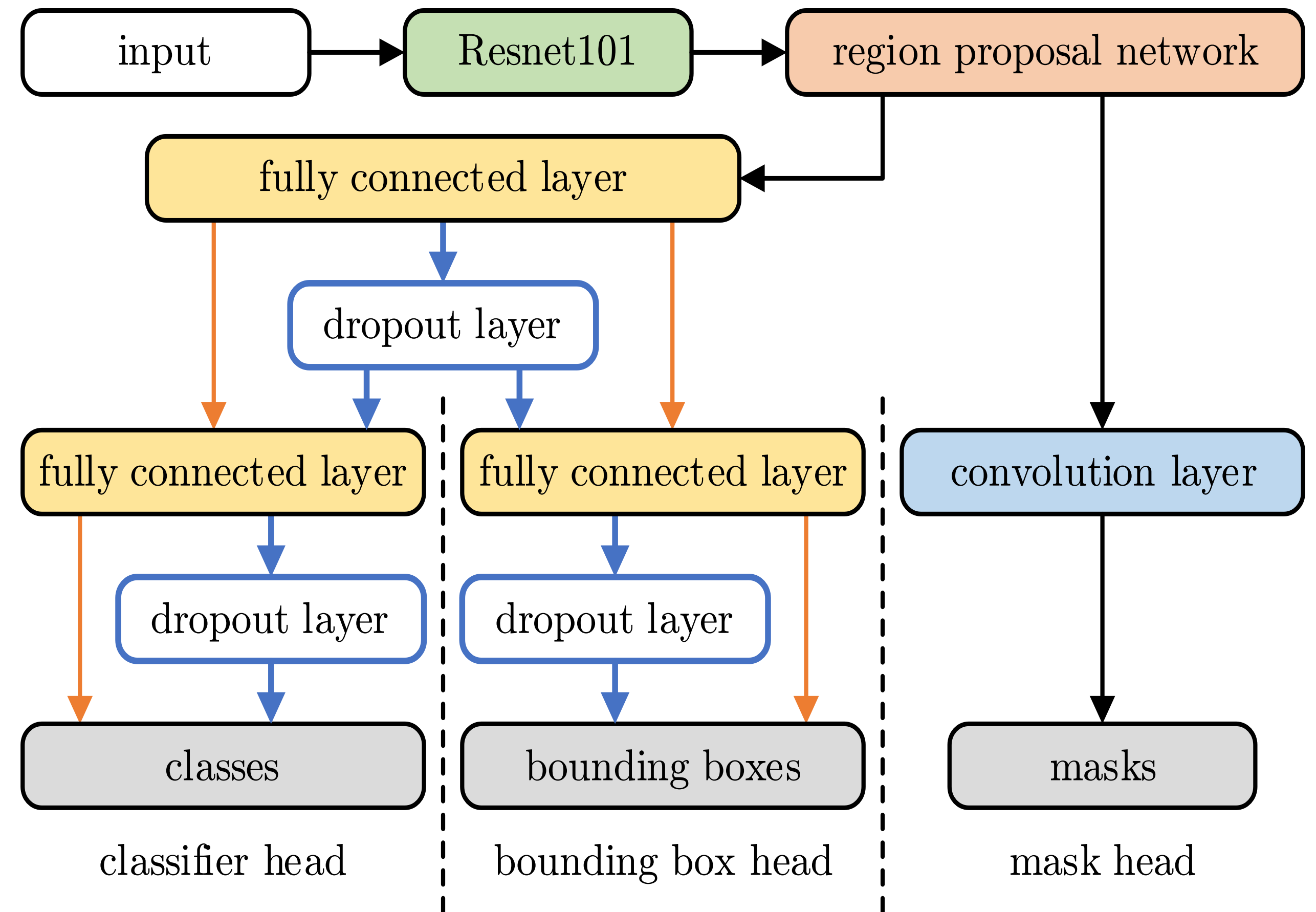
Disabling neurons or connection randomly:

- **Training:** Regularization
- **Inference:** Approximate “network” weight uncertainty

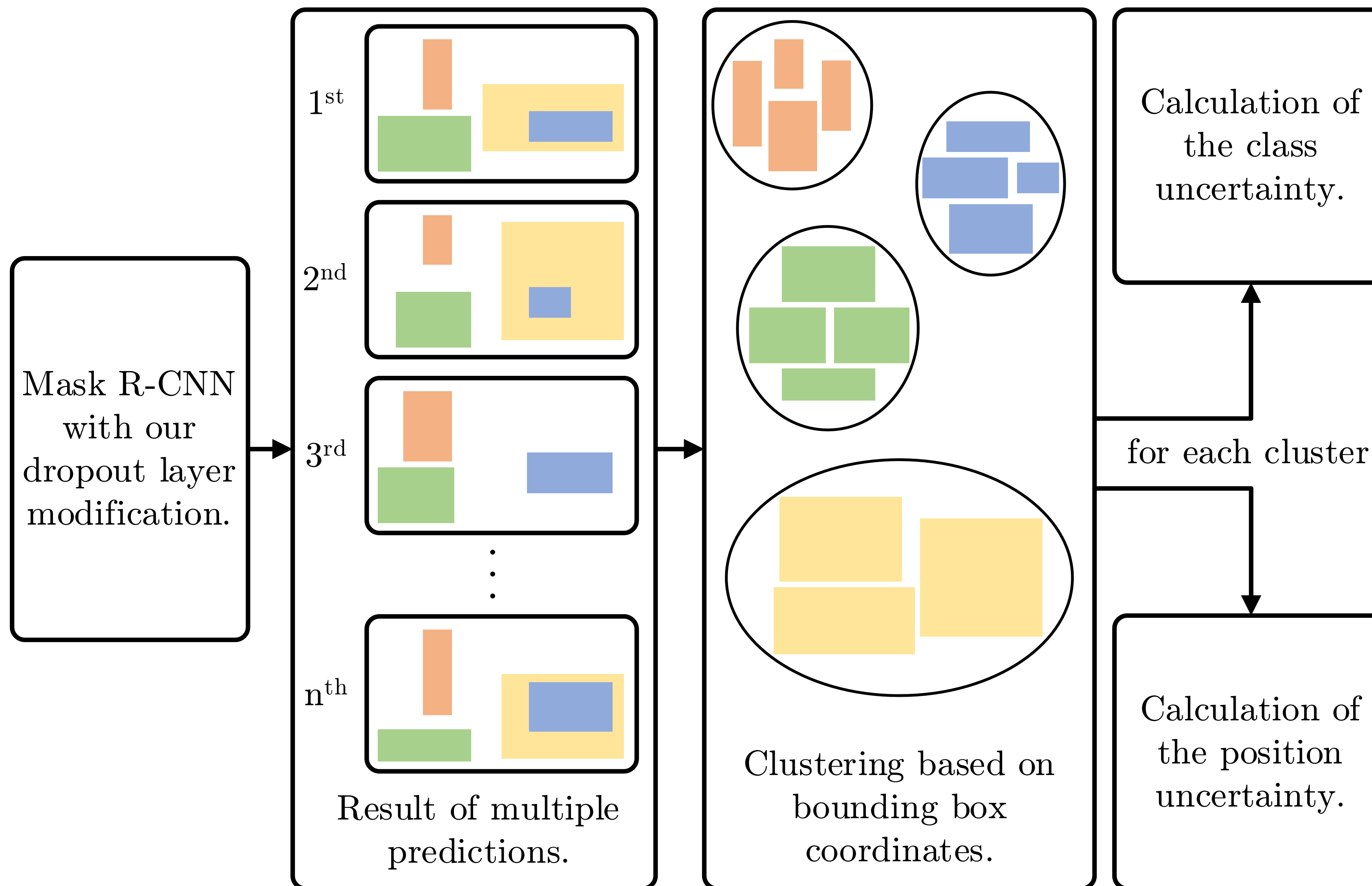
Dropout in Mask R-CNN

Goal: Model epistemic and aleatoric uncertainty in R-CNN

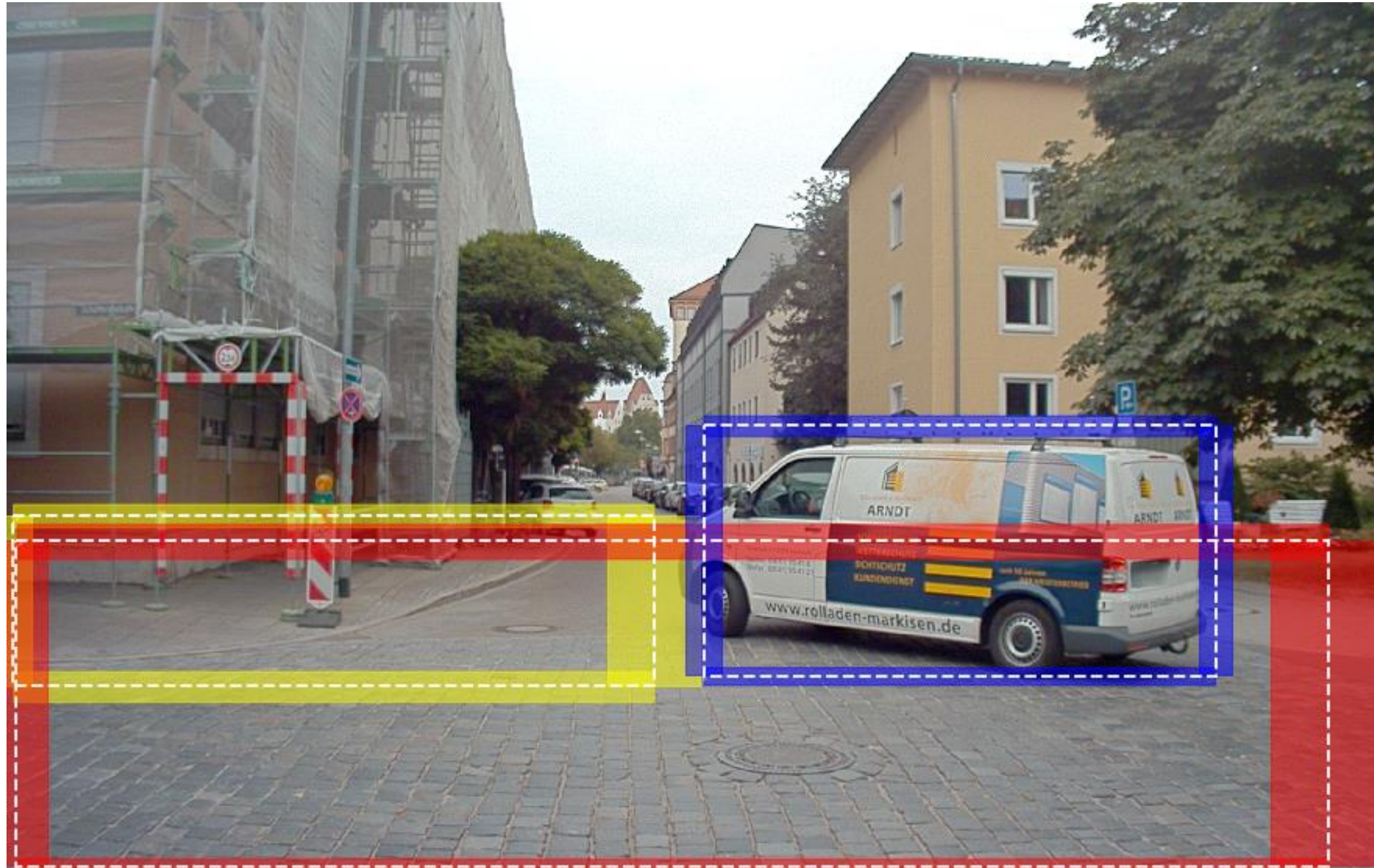
- Introduce the dropout “layer” after FC layers
- Model:
 - Position/ Bounding Box uncertainty
 - Classification uncertainty.



Dropout in Mask R-CNN

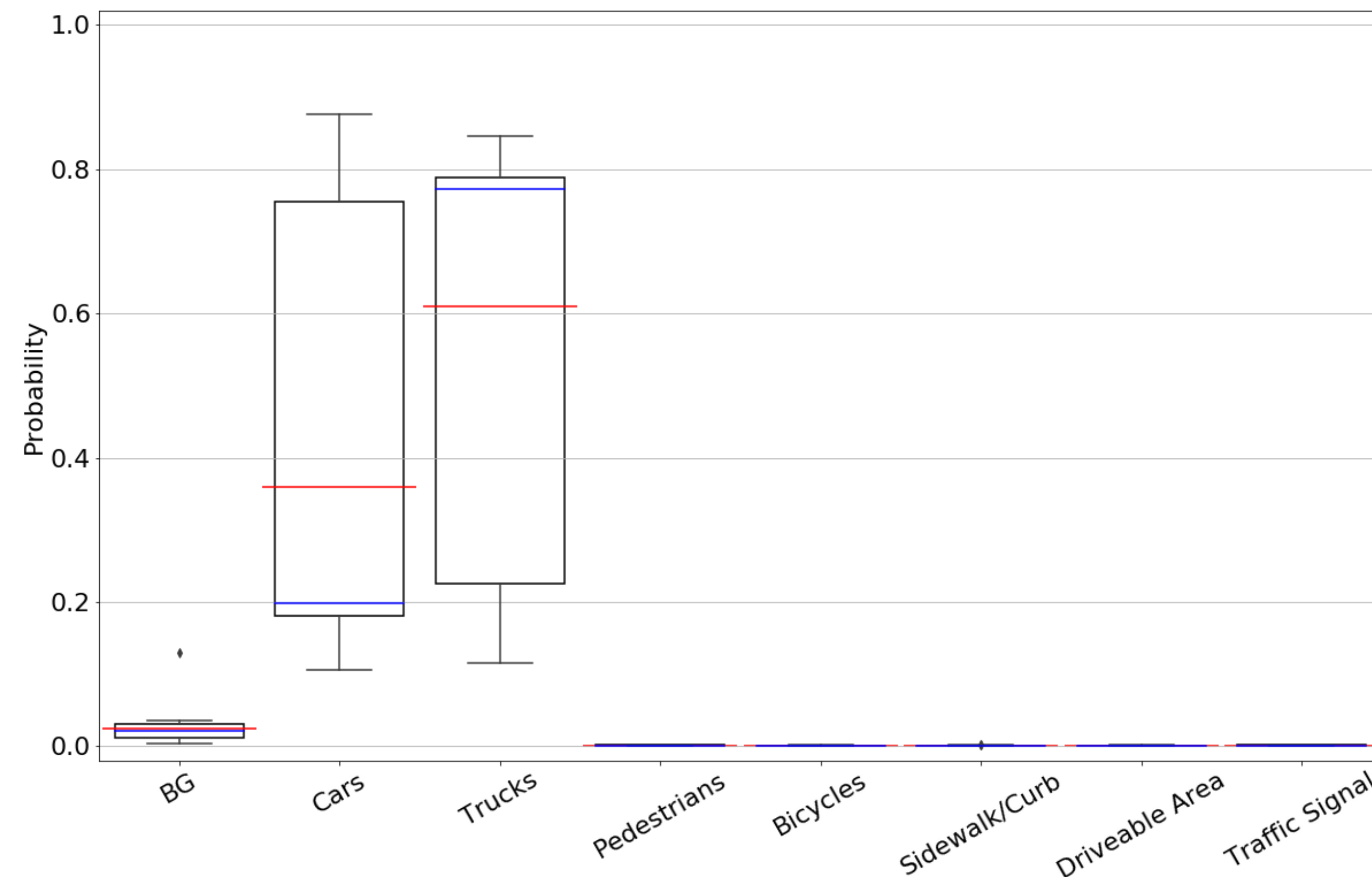


Bounding Box Uncertainty



Classification Uncertainty

- Compute:
 - class assignment probability
 - entropy for each detected object



Corner Case Detection

On Going

- Use classification and bounding box uncertainty to detect corner cases, e.g.

$$\text{criterion}(class) = \begin{cases} 1 & \text{if } class_{std_{max}} > t_{class} \\ 0 & \text{else} \end{cases}$$

Algorithm 1 Corner Case Detection

```
for each image do
  for each instance in image do
    if criterion(class) or criterion(bbbox) then
      buffer.append(instance, image)
      break
    end if
  end for
end for
```

Outlook and Future Work

- Improvement of the Clustering.
 - Clusters located close to each other are often combined.
 - Using also the mask contour for clustering.
- Prediction of the mask uncertainty.
- Improvement of the criterion for corner case detection.
- How to evaluate corner case methods quantitative, because there is no ground truth.

Thanks for your attention.

