R244

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Object Detection in Snorkel

Snorkel

Data Programming – Labelling functions

- Express knowledge as labelling functions
  - Can have unknown accuracies and correlations
  - Assign a class label or abstain

```
def LF_wife_in_sentence(c):
    """A simple example of a labeling function"""
    return 1 if 'wife' in c.get_parent().words else 0
```

Generative Model

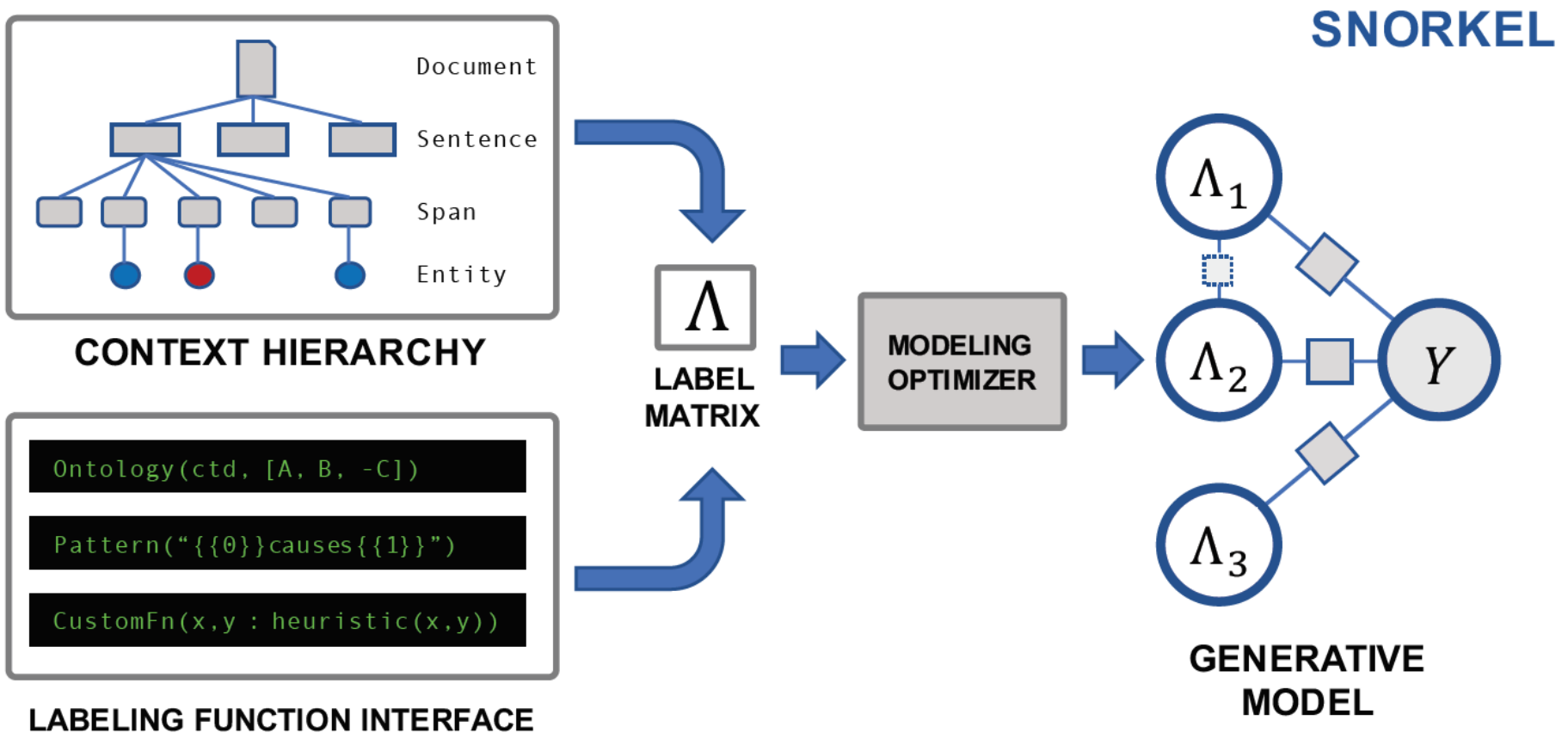
- Probabilistic Model
  - Optimized by minimizing the negative log marginal likelihood given the observed label matrix Λ

$$p_w(\Lambda, Y) = Z_w^{-1} \exp\left(\sum_{i=1}^{m} w^T \phi_i(\Lambda, y_i)\right)$$

- Generate probabilistic training labels

$$\tilde{Y} = p_{\hat{w}}(Y|\Lambda)$$

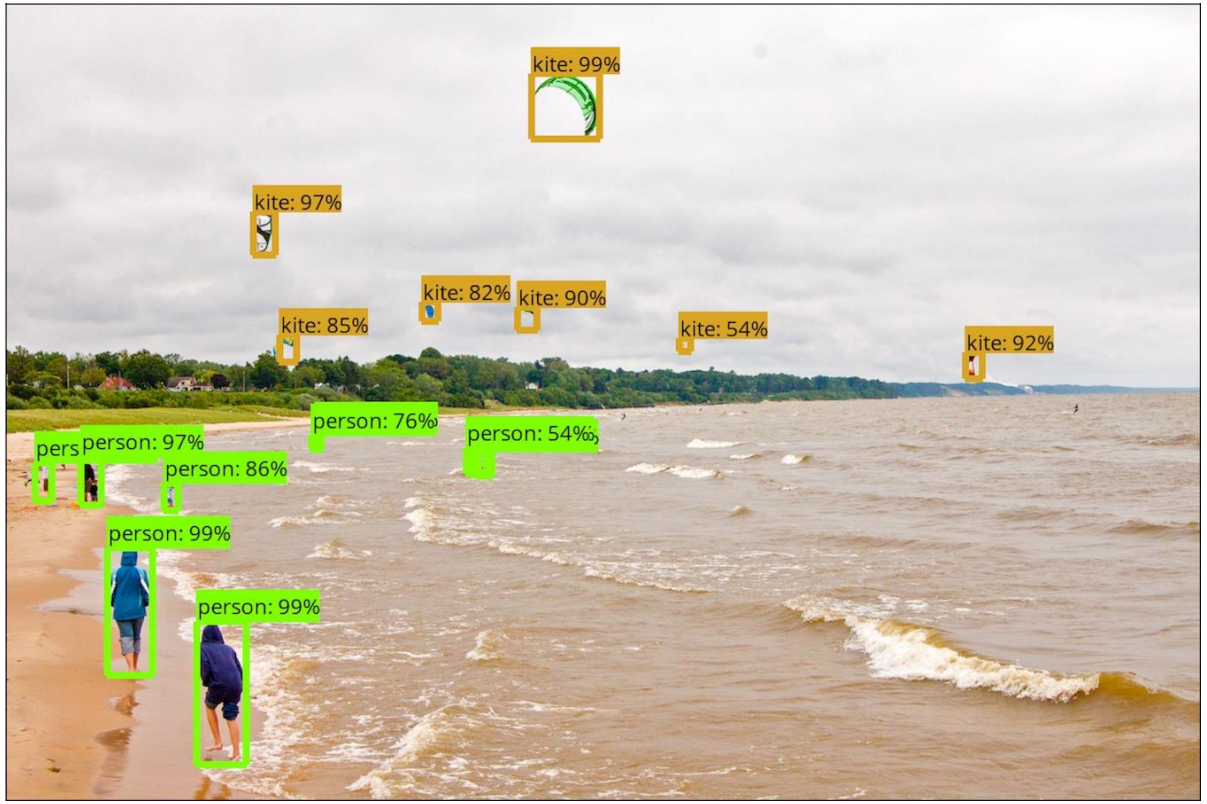
Overview


SNORKEL
Document
Sentence
Span
Entity
CONTEXT HIERARCHY
Ontology(ctd, [A, B, -C])
Pattern("{{0}}causes{{1}}")
CustomFn(x,y : heuristic(x,y))
LABELING FUNCTION INTERFACE
Λ
LABEL MATRIX
MODELING OPTIMIZER
Λ_1
Λ_2
Λ_3
Y
GENERATIVE MODEL

Object Detection

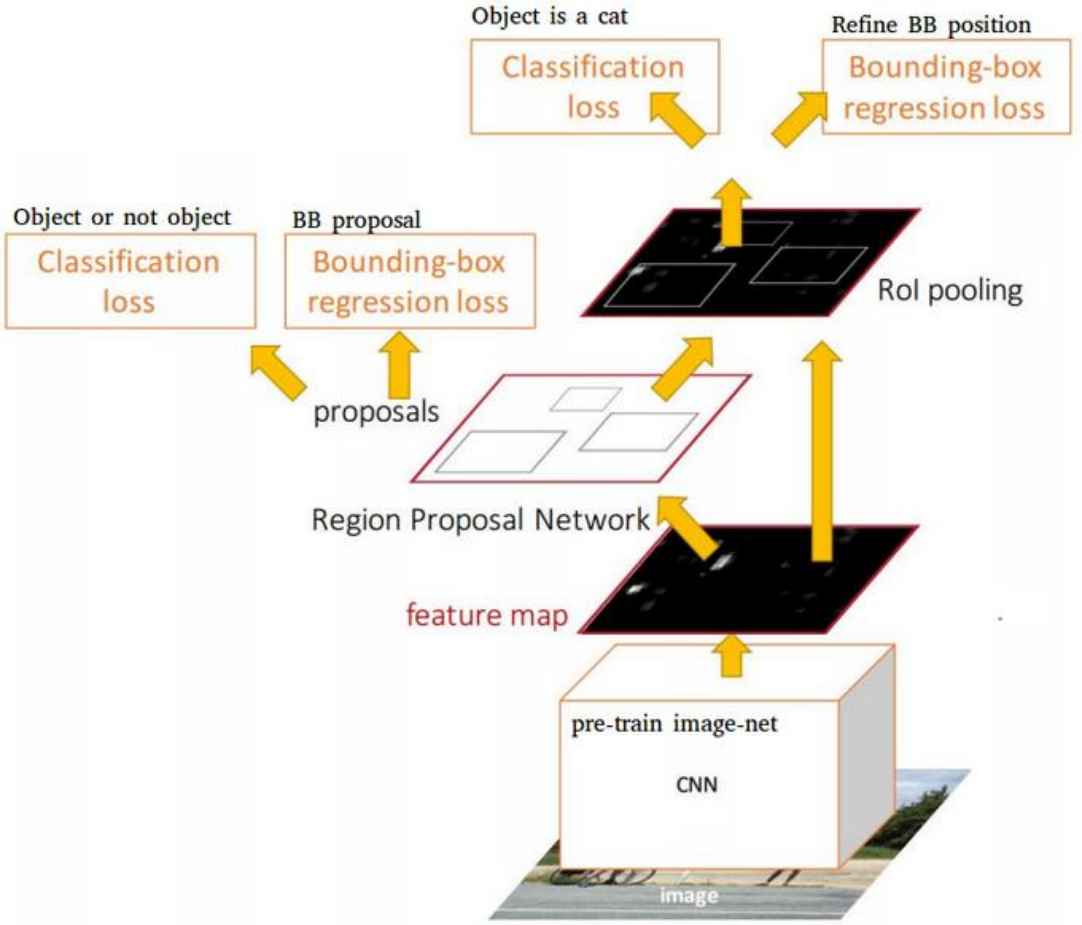
Object Detection

- Localize and classify objects in an image
- Multiclass & Variable number of labels



Architectures

- Region-based Convolutional Network
  - R-CNN (2014), Fast R-CNN (2015), Faster R-CNN (2015), R-FCN (2016)
  - More accurate, Slow
- You Only Look Once (YOLO)
  - YOLO (2016), YOLOv2 (2016), YOLOv3 (2018)
  - Less accurate, Real-time



Object Detection in Snorkel

Approach

- Regions as candidates
- Models as labelling functions
- Combining labels from different detection models
- Extension with image classification models
- Augmenting the dataset with new images

Regions as candidates

- Each detected region is treated as a candidate

Models as labelling functions

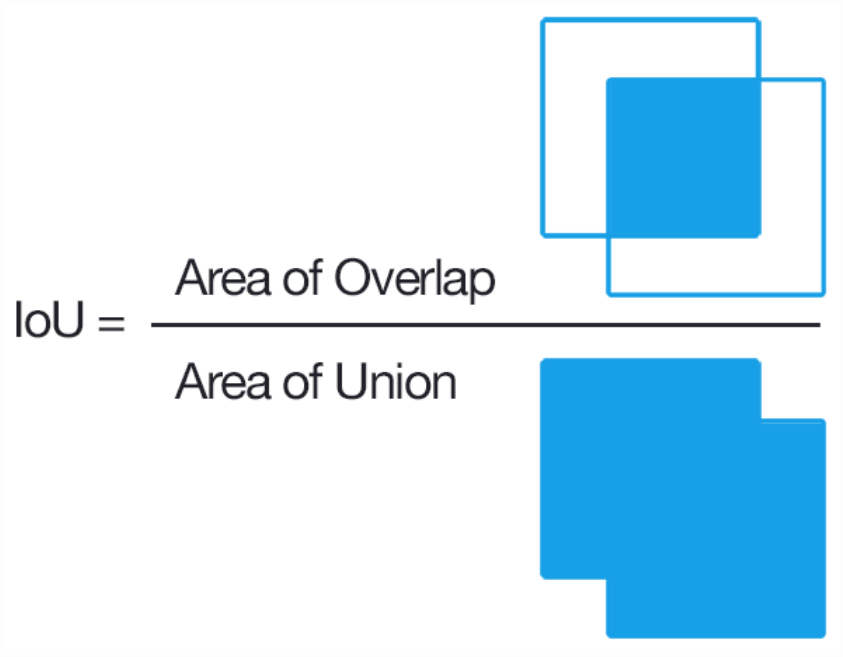
- Treat each trained model as a labelling function

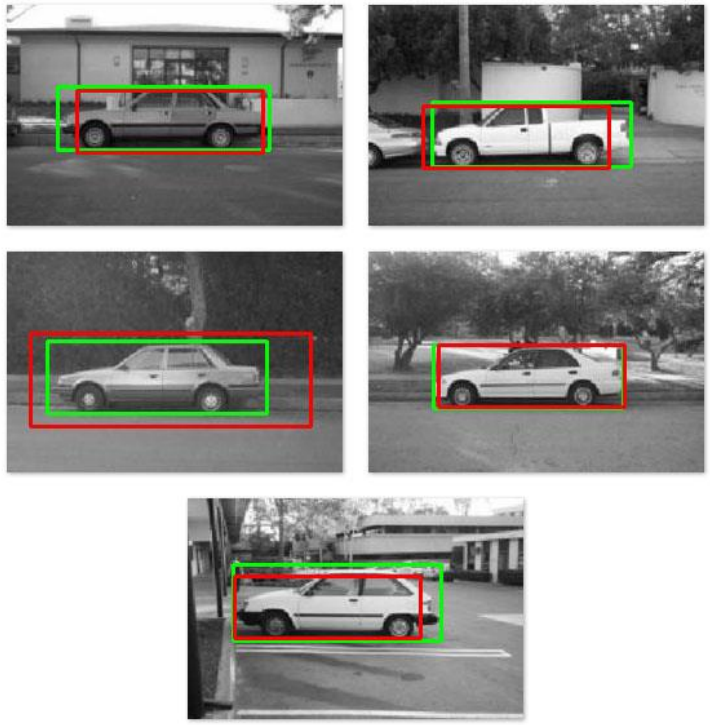
```
def LF_resnet(im):
    return resnet_model.predict(im)
```

```
def LF_inception(im):
    return inception_model.predict(im)
```

Combining labels from different models

- Object detection models
  - Combine regions based on IoU (intersection over union) measure
  - Abstain for non-detected regions



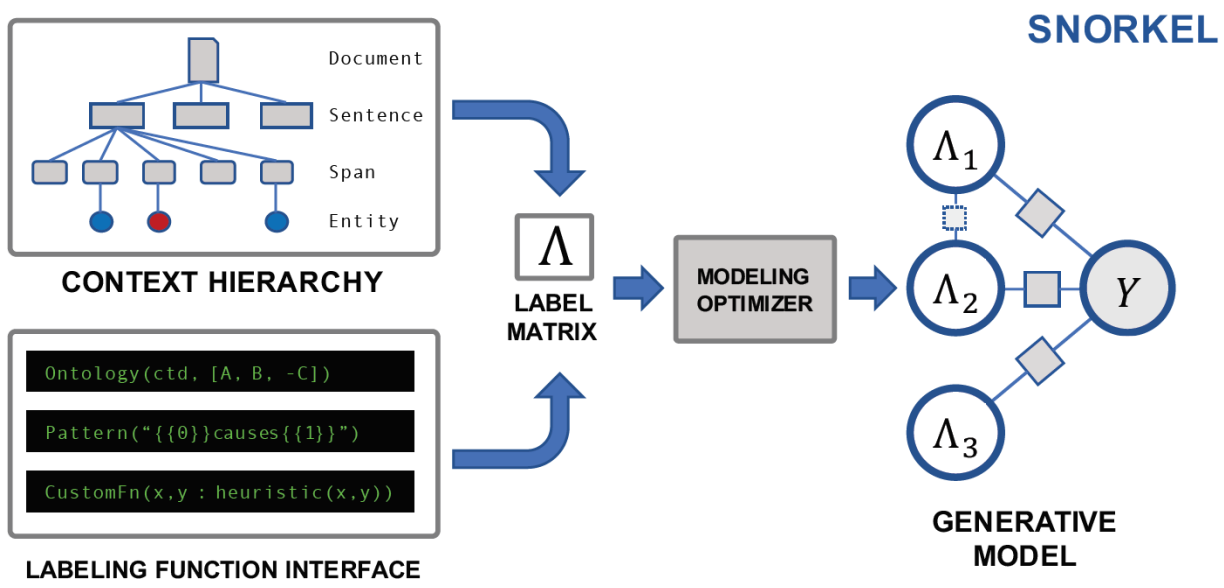


Extension with image classification models

- Apply simple image classification models to the candidate regions

Augmenting the existing dataset

- Train a generative model based on the labels
- New training samples from new images using the generative model



Evaluation

- Retrain existing machine learning models with augmented dataset
- Effects of extra data
- Effects of using probabilistic labels
- Manual investigation of random samples