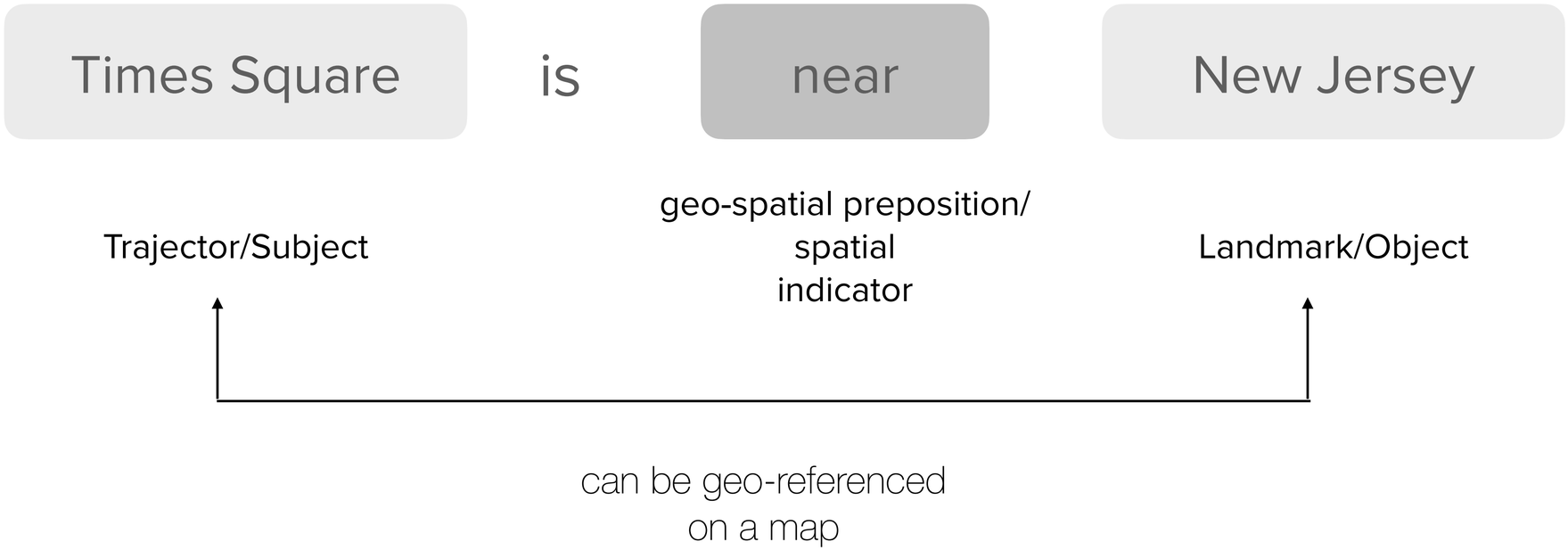
# Disambiguating spatial prepositions: the case of geospatial sense detection

Abhibha Gupta

# Problem Statement

## Disambiguate *geo-spatialness* of a preposition

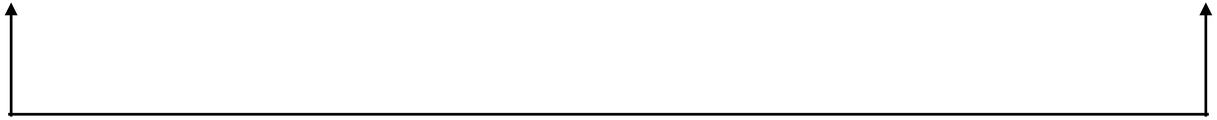


# Problem statement

## Disambiguate *geo-spatialness* of a preposition

The book is on the table

Trajector/Subject — spatial preposition — Landmark/Object



cannot be geo-referenced on a map

I can count on him

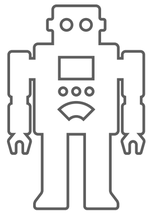
non-spatial preposition

# Applications

Direction Understanding

Exit this room and turn right. Go down the hallway past the elevators. The lobby is straight ahead.

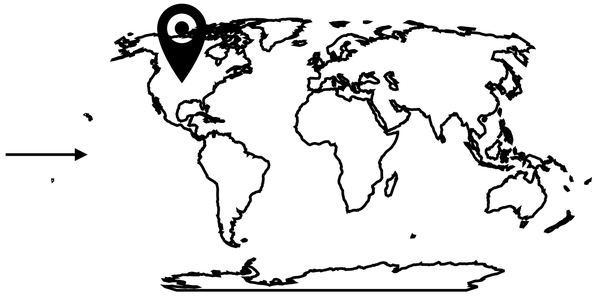
Understood!



Reference: Kollar et al

Automated Geo-referencing

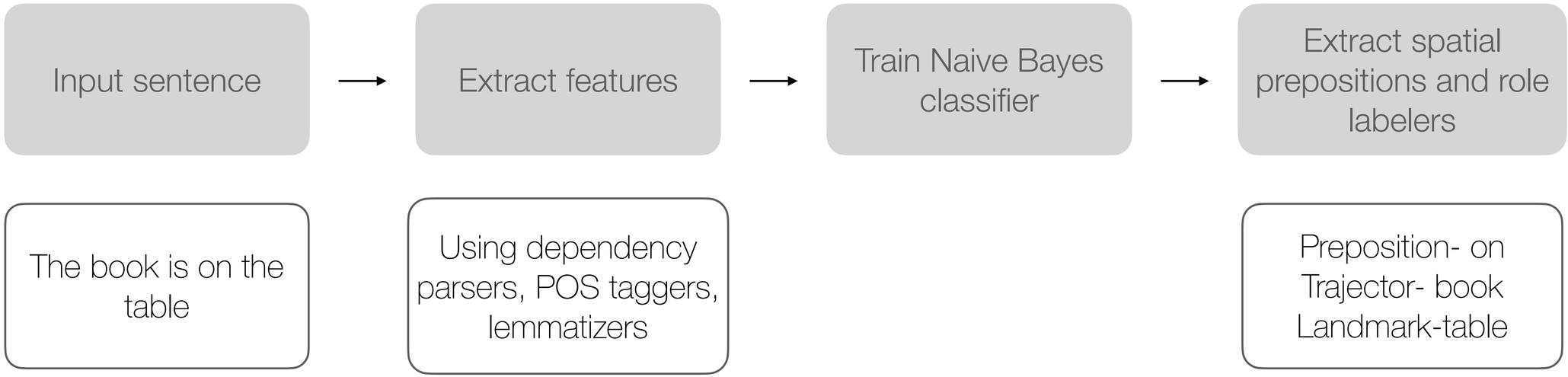
‘Near’ New York



# Previous Work

## Kordjamshidi et al

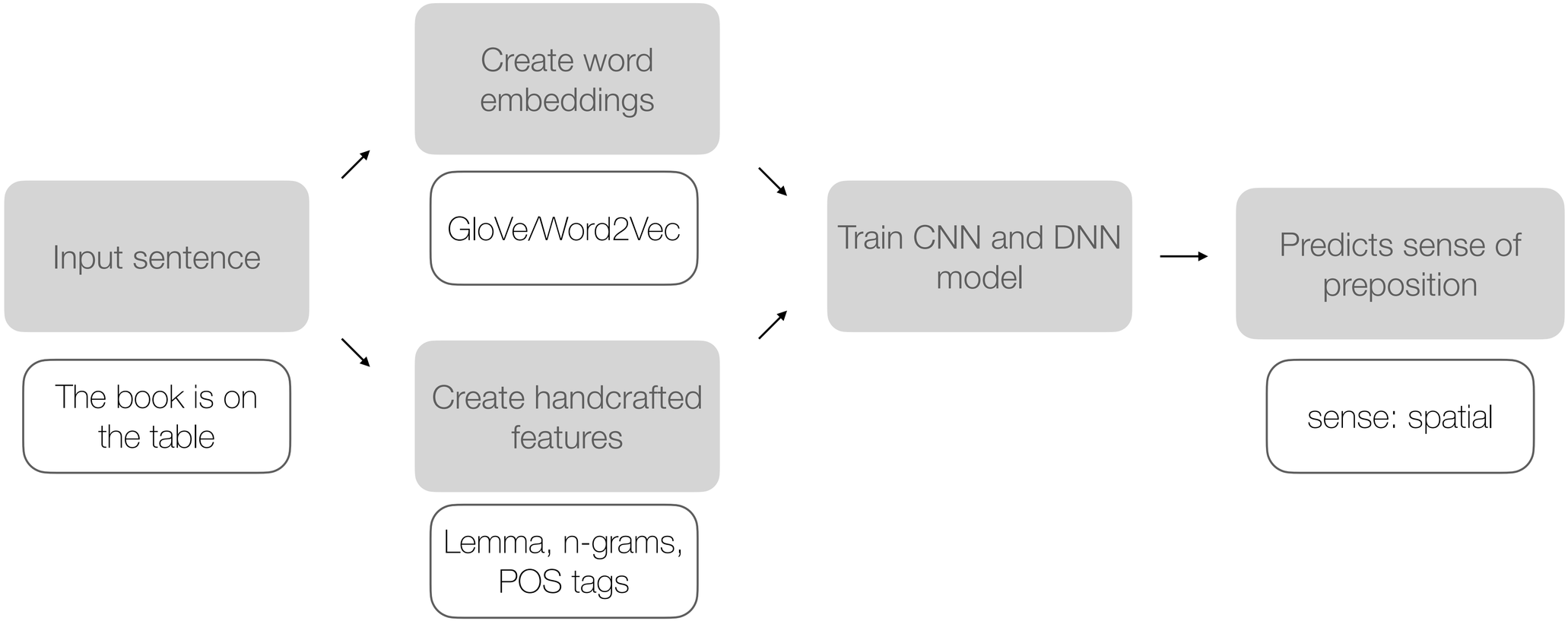
Introduces the notion of spatial role labelling to extract spatial relations in text



# Previous Work

## Hassani et al

Distinguishes between generic and non spatial sense of prepositions in text.



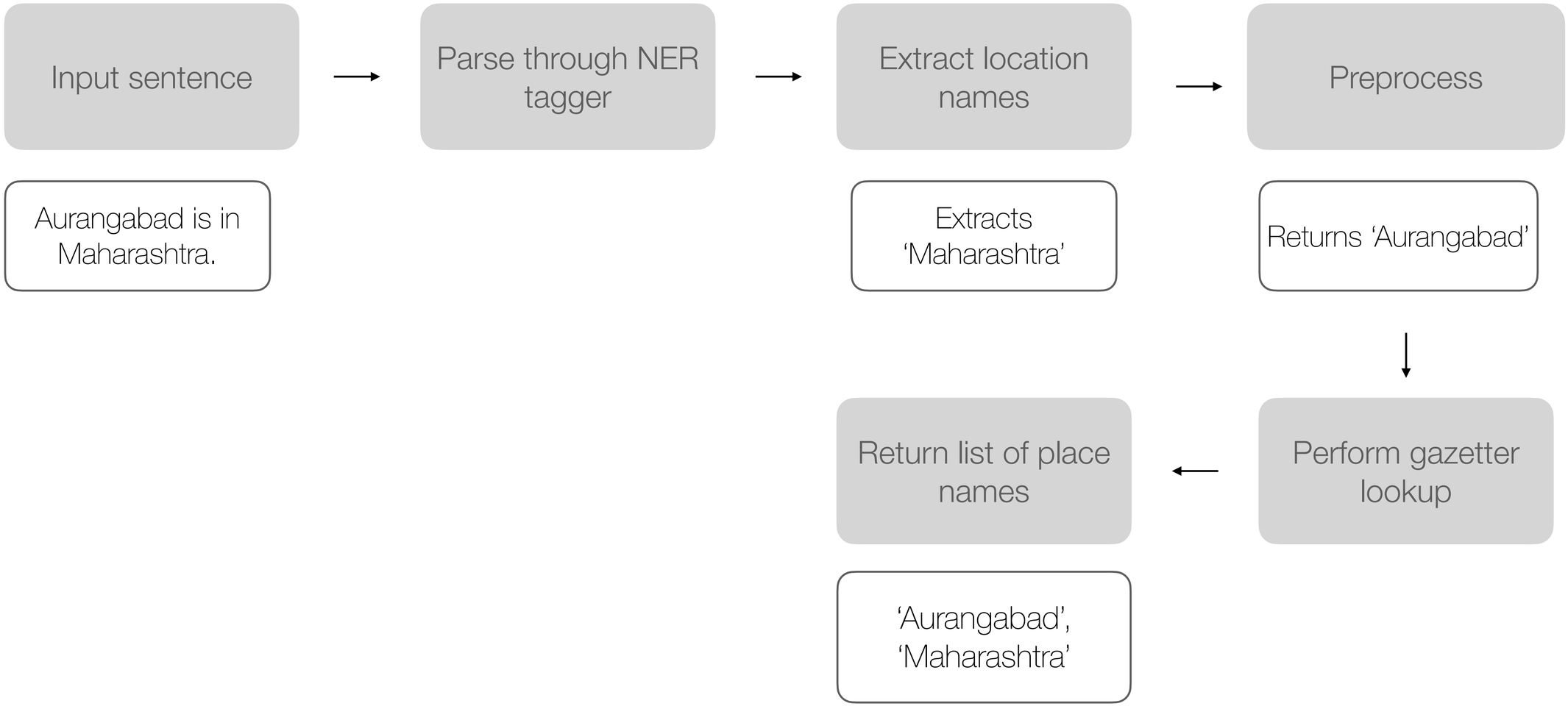
# Dataset

We hand annotated over 18000 sentences derived from the  Nottingham Corpus of Geospatial Language.

| Preposition | Sense |
| --- | --- |
| Peoples Republic **of** China | Non-spatial |
| **After** 50m you will reach a road | Geo-spatial |
| She is sitting **at** the back of a room | Spatial |

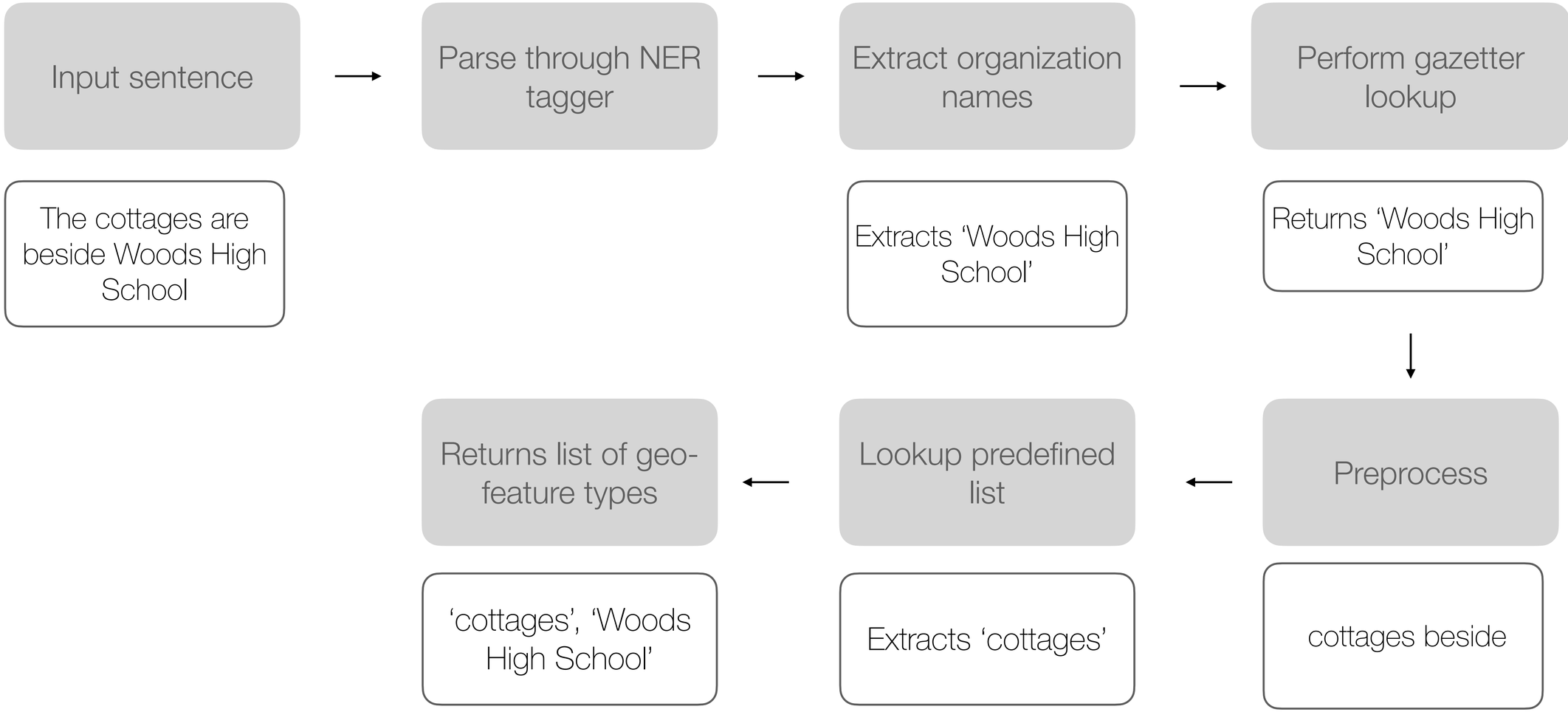
# Approach

## Geo-parser (Place names)



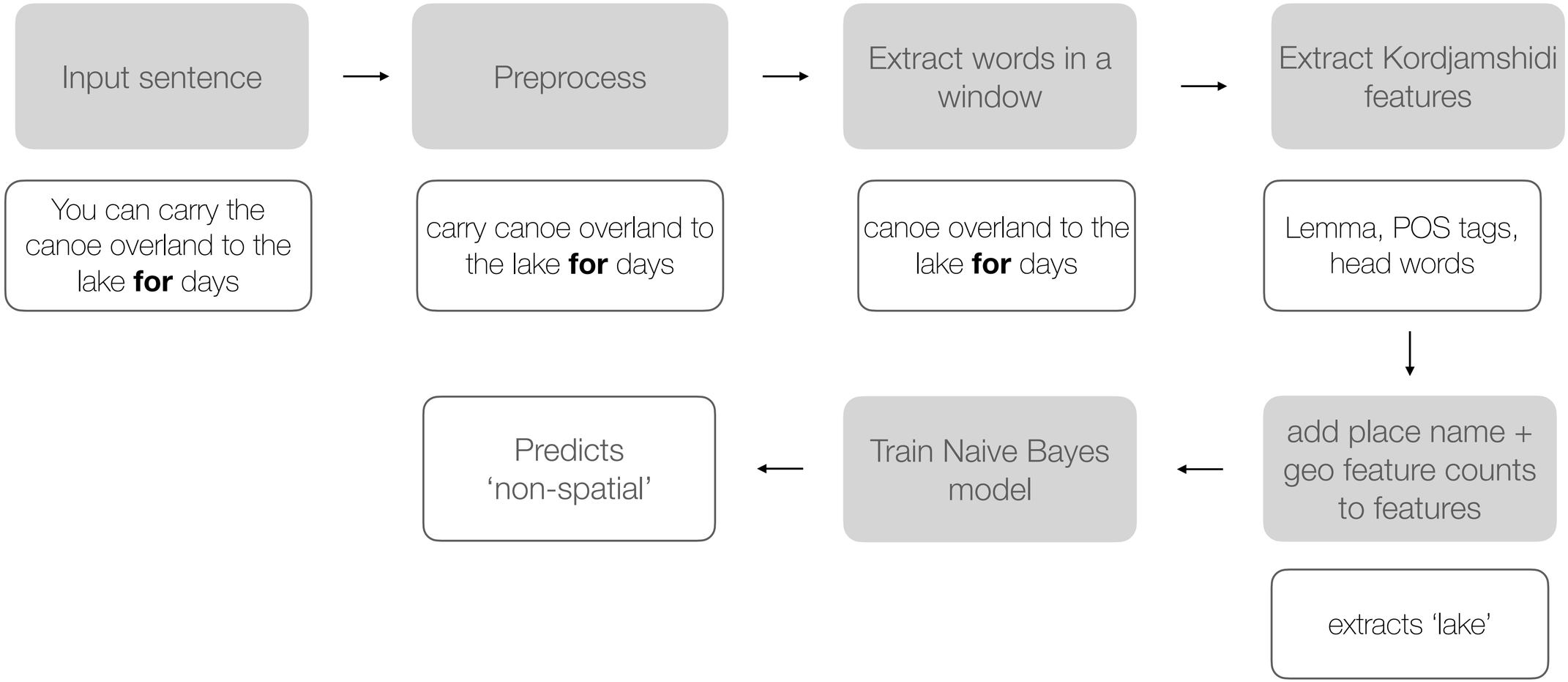
# Approach

## Geo-parser (Geo-feature types)



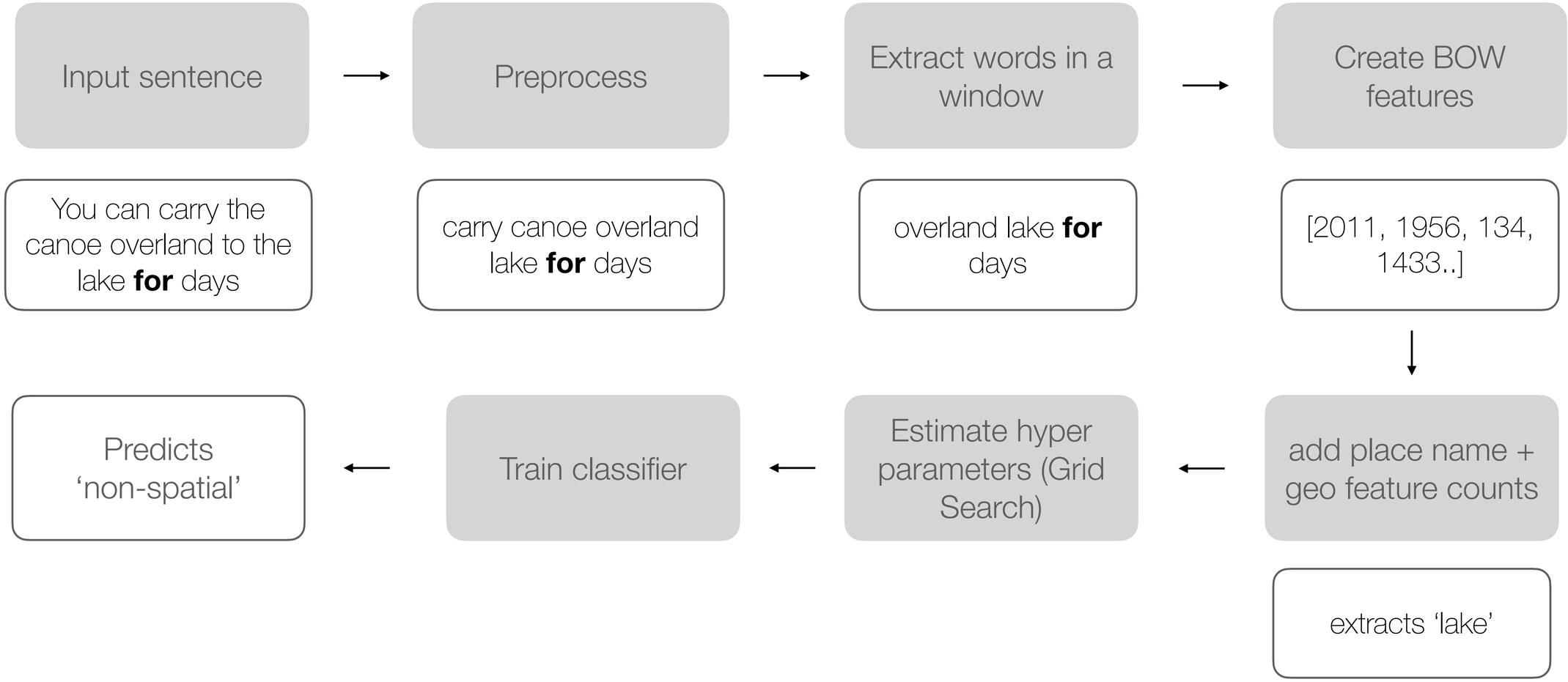
# Approach

## Baselines



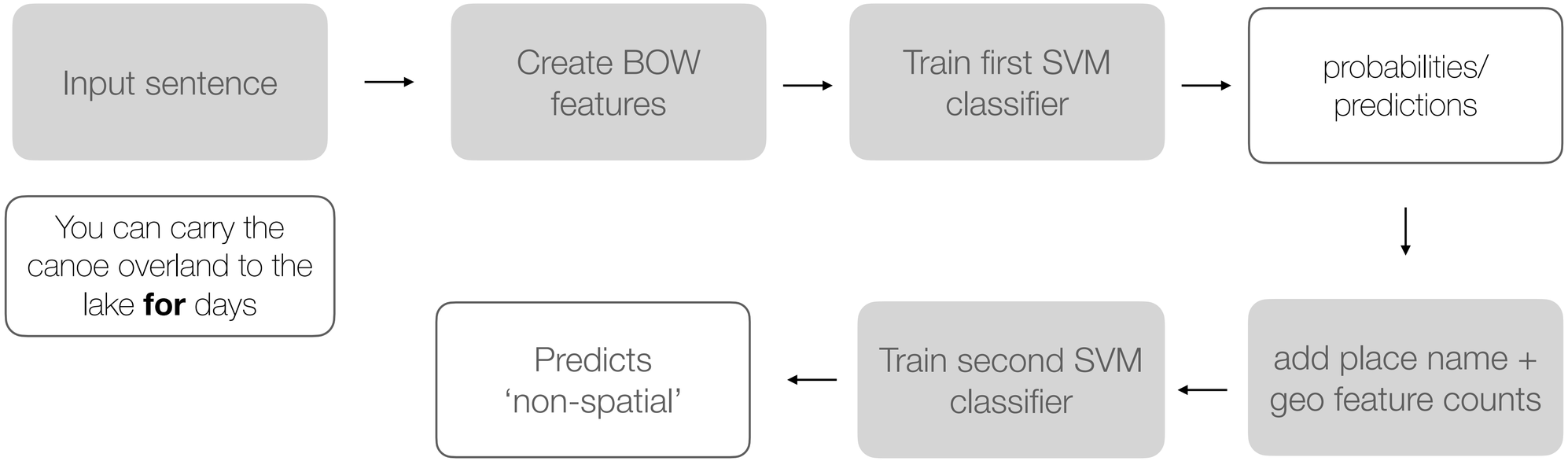
# Approach

## Baselines



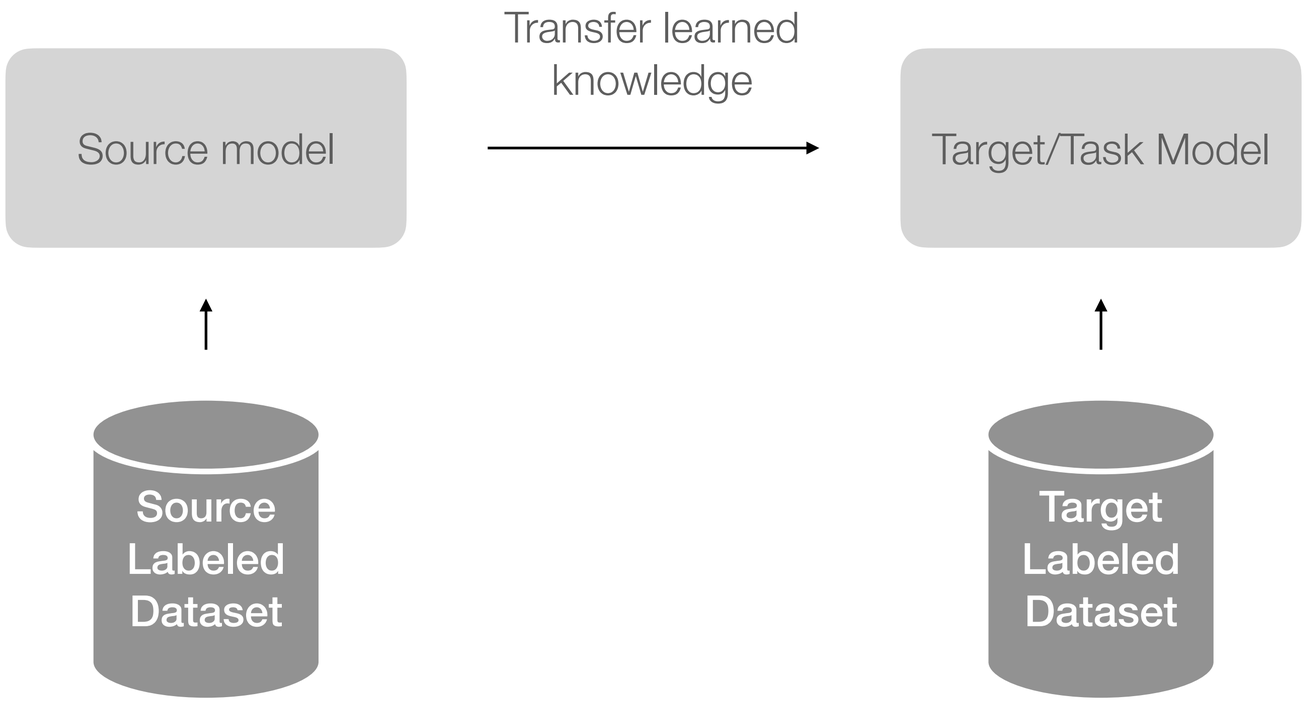
# Approach

## Meta-classifiers



# Approach

## Transfer learning

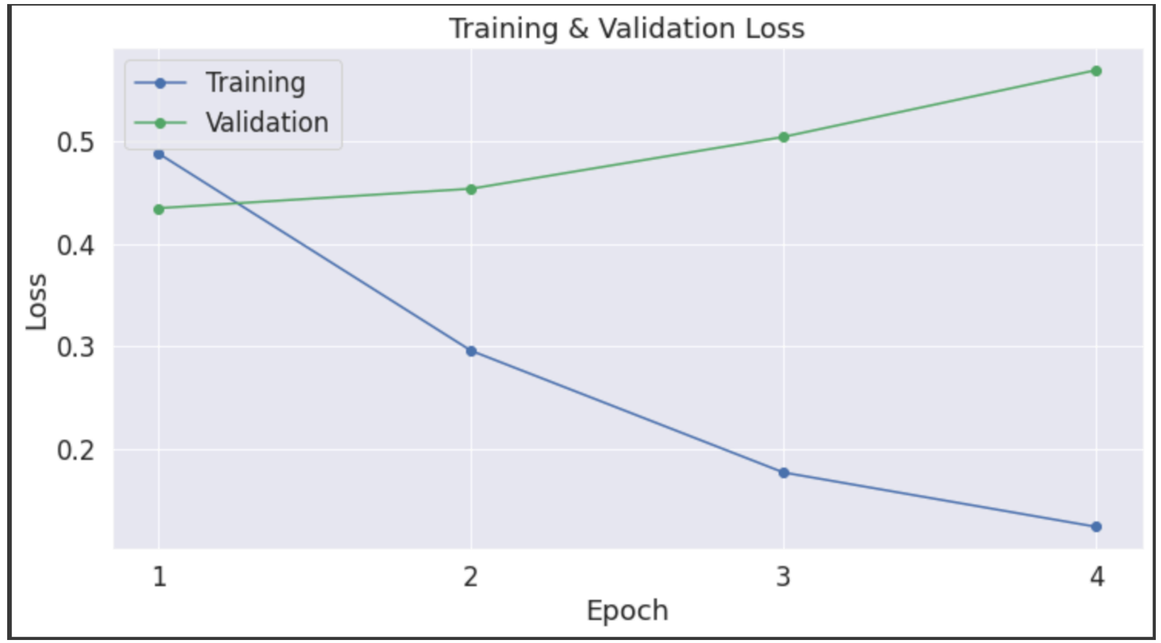



Source: Transfer learning tutorial

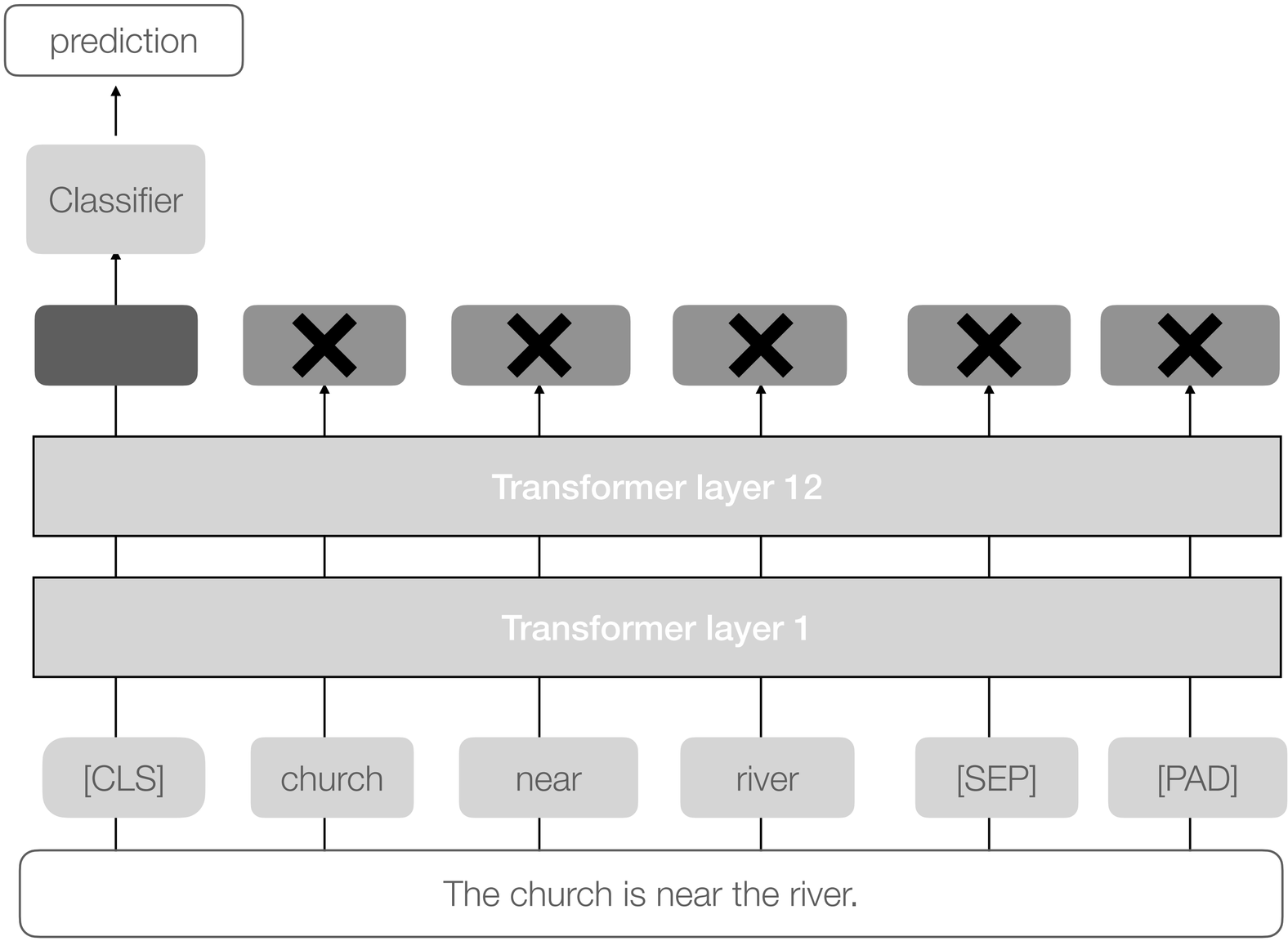
# Approach

## Transfer learning (Implementation details)

- BERT pre trained model ( from Hugging face library (Pytorch)
- Random batch sampling
- learning scheduler ( learning rate= 2e-5 , epochs=4)
- BERT tokenizer (cased version)
- BERT’s Adam optimizer



# Architecture




Reference: BERT Fine tuning

# Results

Task: Geospatial vs (spatial + non spatial) sense

| **Classifier** | **Naive Bayes** | **Naive Bayes** | **Random Forest** | **SVM's** | **SVM-SVM metaclassifier** | | **BERT** |
|---|---|---|---|---|---|---|---|
| **Features** | Kord features | BOW representation | | | o/p probabilties | o/p predictions | |
| **Precision** | 0.746 | 0.773 | 0.94 | 0.87 | 0.946 | 0.90 | 0.938 |
| **Recall** | 0.902 | 0.874 | 0.64 | 0.84 | 0.770 | 0.851 | 0.939 |
| **F1-scores** | 0.816 | 0.82 | 0.77 | **0.86** | 0.849 | **0.875** | **0.939** |

# Results

Task: (Geospatial +spatial) vs non spatial sense

| | **Kordjamshidi et al** | **Hassani et al** | **Ours (using BERT)** |
|---|---|---|---|
| **F1-scores** | 0.88 | 0.9398 | **0.951** |