A Semi-Supervised BERT Approach for Arabic Named Entity Recognition

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Introduction

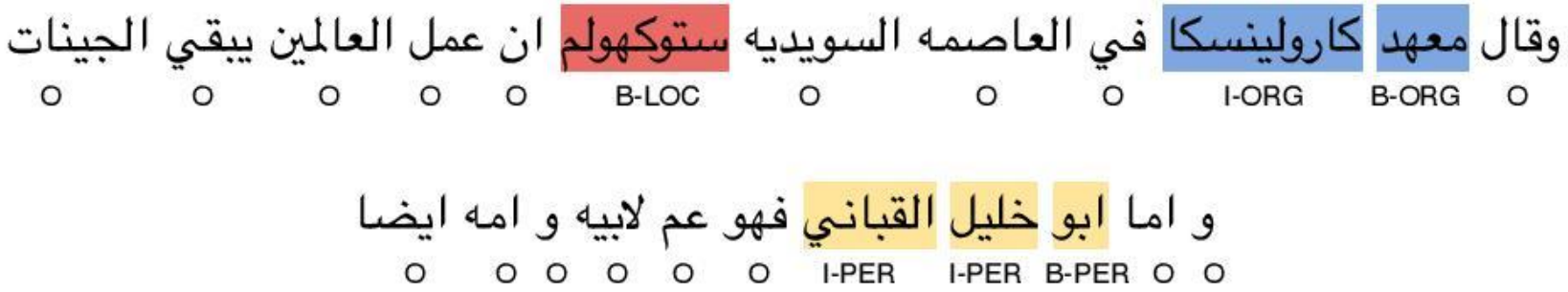
Introduction

In this paper, we proposed a semi-supervised BERT approach to detect and classify named entities in Arabic

Named Entity Recognition (NER):

- It is the task of extracting and locating, and classifying named entities in a given text
- A named entity can be: a proper noun, a numerical expression representing type unit or monetary value, or a temporal value that represents time

Example of NER



Arabic NER

NER in Arabic is considered a particularly difficult task:

- There is no capitalization in the Arabic script
- Arabic can be ambiguous
- Lack of sufficient resources

Solution ?

We proposed a BERT model trained in a semi-supervised fashion using two datasets: a small labeled dataset and a large semi-labeled dataset

Related Work

Related Work

Machine Learning Approaches	Rule Based Approaches	Hybrid Approaches
CRF models (Abdul-Hamid and Darwish [1], Benajiba and Rosso [2], Benajiba et al. [3])	Lexical Triggers (Abuleil [14], Al-Shalabi et al. [15])	Combination of machine learning models and rule based approaches (Abdallah et al. [21], Oudah and Shaalan [22], Shaalan and Raza [23])
SVM models (Abdelali et al. [4], Benjiba et al. [5], Koulali and Meziane [6], Pasha et al. [7])	Morphological Analysers (Elsebai et al. [16], Maloney and Niv [17], Mesfar [18])	
Approaches relied on meta-classifiers (AbdelRahman et al. [8], Benajiba et al. [9], Benajiba et al. [10])	Regular expressions and gazetteers (Shalan and Raza [19])	
Deep learning approaches (Gridach [11], Helwe and Elbassuoni [12], Antoun et al. [13])	Transliteration (Samy et al. [20])	

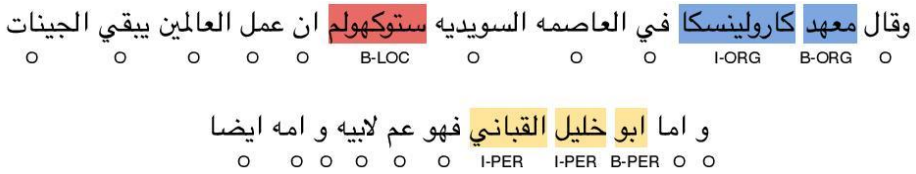
Approach

AraBERT Model

AraBERT model:

- It is a pre-trained Arabic language model developed by Antoun et al. [13]
- It has the same architecture of the BERT model developed by Devlin et al. [24]
- It was pretrained on two tasks:
  - Masked Language Modeling (MLM)
  - Next Sentence Prediction (NSP)
- The datasets used:
  - Arabic Wikidumps
  - 1.5B words Arabic Corpus
  - OSIAN corpus
  - Assafir, Al Akhbar, Annahar, AL-Ahram, and AL-Wafd (news websites)

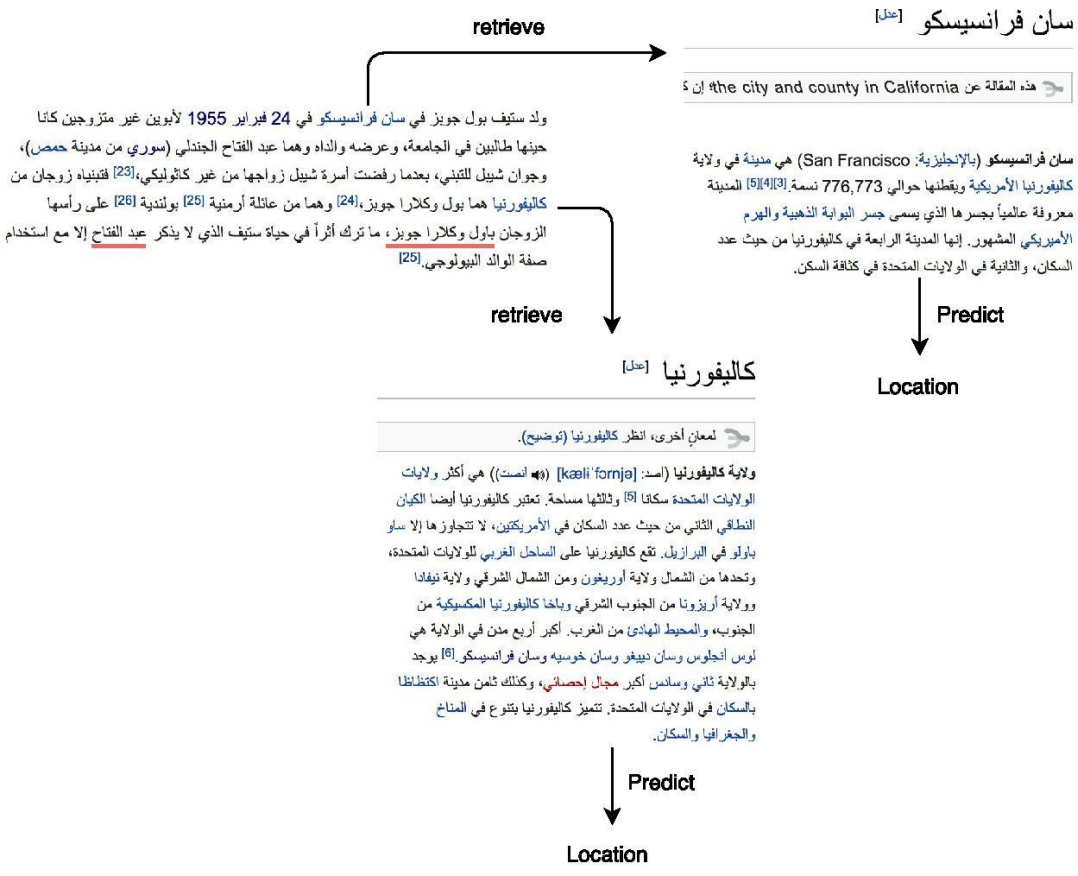
Examples of the Datasets



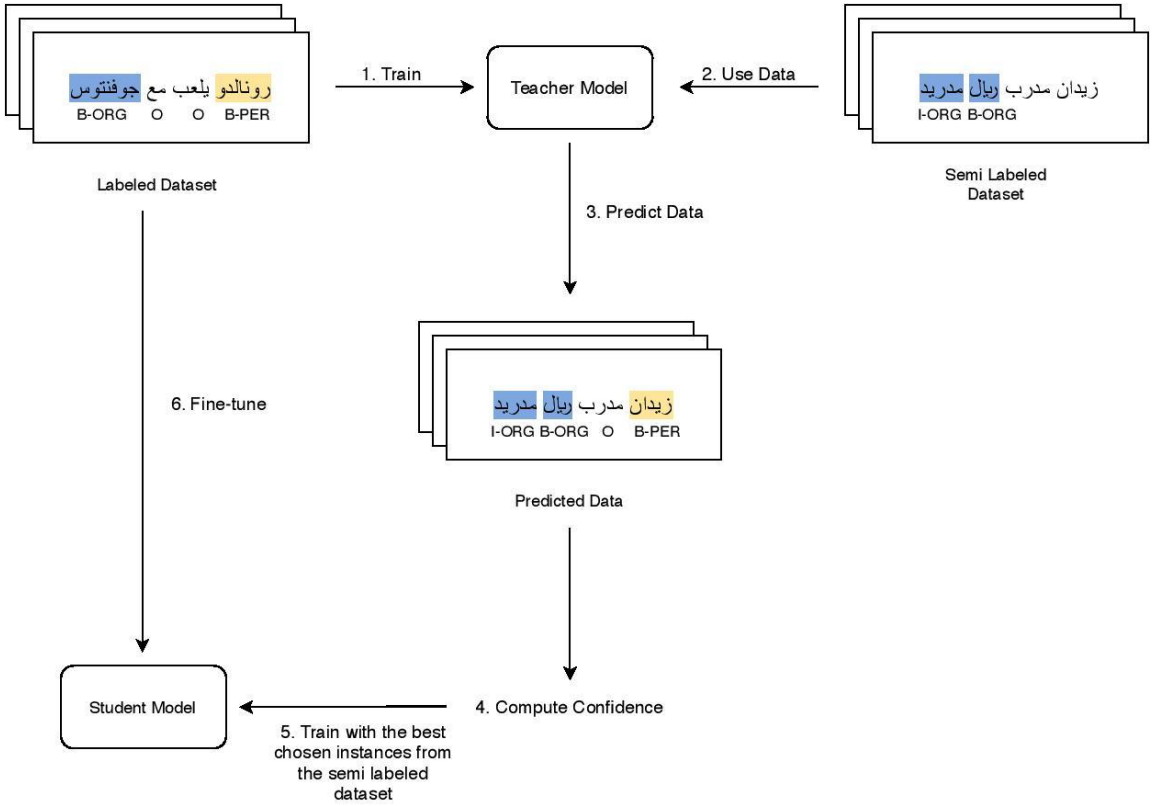
Instances of the Labeled Dataset

Instances of the Semi Labeled Dataset

Semi-labeled Dataset



Semi-Supervised Learning Model for Arabic NER



Evaluation

Datasets

Training and Validation:

- ANERcorp Dataset (Benajiba et al. [3]):
  - Training dataset 80%: 3,686 sentences
  - Validation dataset 20%: 461 sentences
- Semi-labeled Dataset (Helwe and Elbassuoni [12]):
  - 1,617,184 labeled and unlabeled tokens

Testing:

- AQMAR Dataset (Mohit et al. [25]):
  - Corpus of 28 Arabic Wikipedia Articles
  - 2,456 sentences
- NEWS Dataset (Darwish [24]):
  - 292 sentences
- TWEETS Dataset (Darwish [24]):
  - 982 tweets

AQMAR Benchmark

Model	LOC	ORG	PER	AVG
MADAMIRA [7]	39.4	15.1	22.3	29.2
FARASA [4]	60.1	30.6	52.5	52.9
Deep Co-learning [12]	67.0	38.2	65.1	61.8
AraBERT Fully Supervised	63.6	31.0	70.9	61.5
AraBERT Semi-Supervised	68.4	34.6	74.4	**65.5**

NEWS Benchmark

Model	LOC	ORG	PER	AVG
MADAMIRA [7]	38.8	12.6	29.4	28.4
FARASA [4]	73.1	42.1	69.5	63.9
Deep Co-learning [12]	81.6	52.7	82.4	74.1
AraBERT Fully Supervised	74.2	54.2	85.1	73.2
AraBERT Semi-Supervised	80.5	60.8	89.5	**78.6**

TWEETS Benchmark

Model	LOC	ORG	PER	AVG
MADAMIRA [7]	40.3	8.9	18.4	24.6
FARASA [4]	47.5	24.7	39.8	39.9
Deep Co-learning [12]	65.3	39.7	61.3	**59.2**
AraBERT Fully Supervised	57.9	30.7	60.9	54.0
AraBERT Semi-Supervised	63.3	42.1	59.4	57.3

Conclusion

Conclusion and Future Work

Conclusion:

- We proposed a semi-supervised BERT approach to detect and classify named entities in Arabic text
- Our model outperforms all other Arabic NER tools and approaches on two testing datasets: AQMAR and NEWS datasets

Future Work:

- We plan to pre-train the BERT model on tweets to make it more suitable for text that could contain misspelling and mistakes
- We plan to apply our approach on other NLP tasks such as part-of-speech tagging and dependency parsing

Thank You !!

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