# BERT is Not a Knowledge Base (Yet):

## Factual Knowledge vs. Name-Based Reasoning in Unsupervised QA

집현전 논문 리뷰 중급반 김병진

2021.05.09

# Abstract

<BERT>

난 왜?..

BERT

Relational fact

Cloze-style question

난 원래 Factual knowledge 잘 외움..

High Acc..

응 그럼 너 pretrain할 때 fact 가려봄

... ㅇㅋ

Filter1 BERT Filter2

??? 모르겠네

Low Acc.....

그럼 그렇지 E거 가져가서 다시 공부해

E BERT

# Introduction


Jean Marais의 모국어가 뭐야? → 프랑스어!

Daniel Ceccaldi의 모국어는? → 이탈리아어!

Jean Marais의 모국어가 뭐야? → 프랑스어!

Daniel Ceccaldi의 모국어는? → 프랑스어!

# Introduction

**Section2**

- **LAMA-google-RE, LAMA-UHN 구성**
- **BERT에서 성능 저하됨 보여줌**

**Section3**

- **Entity Mention 사용하는 E-BERT 제안**

**Section4**

- **E-BERT가 BERT나 ERNIE와 경쟁할 수 있음을 보여줌**
- **E-BERT와 BERT의 앙상블 모델 성능을 보여줌**

# Section

## 2. LAMA(LAnguage Model Analysis)


- **Google-RE**
  - Google-RE에는 Wikipedia에서 수동으로 추출한 ~60k개의 fact가 포함
  - 다섯가지 관계가 포함되어 있지만 3가지(태어난곳, 생년월일, 사망지)만 고려
  - 각각의 고려된 관계에 대한 템플릿을 수동으로 정의
- **T-REx**
  - T-REx knowledge source는 wikipedia triple의 subset
  - T-REx dataset에서 파생되었으며 더 광범위한 관계를 가진 Google-RE보다 훨씬 큼
  - Google-RE와 마찬가지로 각 관계에 대한 템플릿을 수동으로 정의
- **UHN**
  - UnHelpfulNames, LAMA-T-REx 의 actual 하위 집합

Knowledge Base Triple - (subject, relation, object) – (S, R, O)

ex - (Jean Marais, native-language, French)

The native Language of Jean Marais is [MASK]

# Section

## 2.1 LAMA-UHN

### Filter1

String Match Filter

| | relation | % del | example of a deleted query | |
|---|---|---|---|---|
| string match filter | P176:manufacturer | 81% | [Fiat Multipla] is produced by [Fiat]. | |
| | P138:named after | 75% | [Christmas Island] is named after [Christmas]. | |
| | P1001:applies to jurisdiction | 73% | [Australian Senate] is a legal term in [Australia]. | |
| | P279:subclass of | 51% | [lenticular galaxy] is a subclass of [galaxy]. | |
| | P31:instance of | 39% | [Tantalon Castle] is a [castle]. | |
| | P178:developer | 38% | [IBM AIX] is developed by [IBM]. | |
| | P276:location | 35% | [Cologne Cathedral] is located in [Cologne]. | |
| | P127:owned by | 34% | [Atari Interactive] is owned by [Atari]. | |
| | P361:part of | 32% | [South Asia] is part of [Asia]. | |
| | P36:capital | 24% | The capital of [Aberdeenshire] is [Aberdeen]. | |
| | P131:located in territory | 20% | [California State Route 9] is located in [California]. | |
| | P527:has part | 18% | [apple strudel] consists of [apple]. | |
| | P159:headquarters location | 13 % | The headquarter of [Paris Saint-Germain F.C.] is in [Paris]. | |
| person name filter | P1412:language used | 63% | [Fulvio Tomizza] used to communicate in [Italian]. | (1,1) |
| | | | [Rajit Kapur] used to communicate in [Hindi]. | (1,1) |
| | P103:native language | 58% | The native language of [Tommy Nilsson] is [Swedish]. | (-,1) |
| | | | The native language of [Andrey Malakhov] is [Russian]. | (1,1) |
| | P27:nationality | 56% | [Harumi Inoue] is a [Japan] citizen. | (1,-) |
| | | | [Yves Mirande] is a [France] citizen. | (1,-) |
| | P20:place of death | 31% | [Avraham Harman] died in [Jerusalem]. | (1,-) |
| | | | [Pierre Cartellier] died in [Paris]. | (2,1) |
| | P19:place of birth | 23% | [Christel Bodenstein] was born in [Munich]. | (3,3) |
| | | | [Masako Natsume] was born in [Tokyo]. | (2,1) |
| | Google-RE:place-of-birth | 17% | [Marcel Bertrand] was born in [Paris]. | (-,3) |
| | | | [Jan Jacob Kieft] was born in [Amsterdam]. | (2,-,-) |
| | Google-RE:place-of-death | 14% | [Bernardo López Piquer] died in [Madrid]. | (-,1,-) |
| | | | [Nikolay Alexandrovich Milyutin] died in [Moscow]. | (1,1,1) |

Table 3: Statistics and examples of deleted queries. String match filter (top): most stongly filtered relations only. Person name filter (bottom): Numbers in brackets indicate which part(s) of the person name triggered the filter, and at what rank. For instance, (-,1) means that the correct answer was ranked first for the person's last name, but was not among the top-3 for their first name. Architecture: $\text{BERT}_{\text{base}}$.

# Section

## 2.1 LAMA-UHN

### Filter2

**Person Name Filter**

- **cloze-style question을 사용하여 BERT에 내재된 name association을 이끌어내고 이와 연관된 KB triple을 삭제**
- **예를들어**
  (Jean Marais, 모국어, 프랑스어) - Triple을 봤을때, subject name인 Jean과 Marais를 공백으로 토큰화
- BERT가 두 이름 중 하나를 공통 프랑스 이름으로 간주하더라도 Jean Marais Entity에 대한 Factual Knowledge에 대한 증거가 충분하지 않음
- 반면에 Jean과 Marais모두 프랑스어로 간주되지 않지만 정답이 제시되면 factual knowledge에 대한 증거를 고려

[X] is a common name in the following language: [MASK].

**위 문장에 대한 답을 아래와 같이 BERT에 쿼리 했을 때, correct answer의 top-3에 이 두 쿼리가 속하면 triple 삭제**

[X] = Jean　　[X] = Marais

# Section

## 2.1 LAMA-UHN

**Filter2**

Person Name Filter

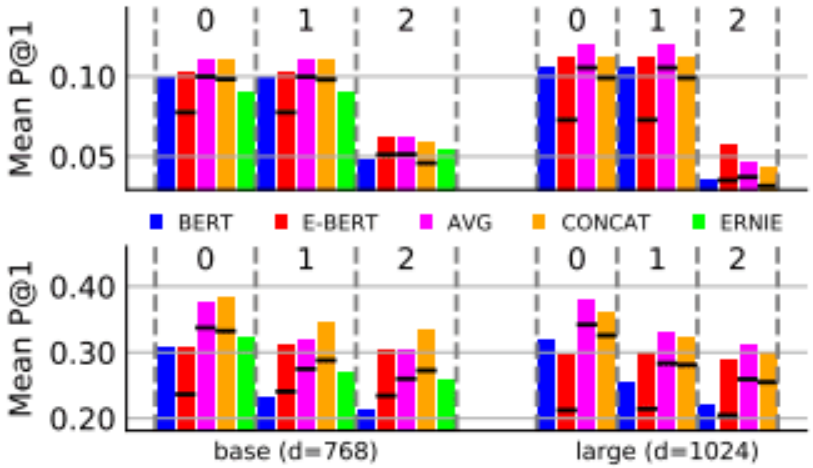


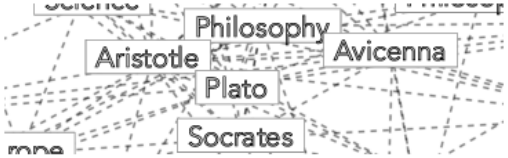

Figure 1: Mean P@1 on LAMA-Google-RE (top) and LAMA-T-REx (bottom). 0: unfiltered, 1: string match filter, 2: person name filter. Filters are applied sequentially. Black horizontal bars: Performance of wikipedia2vec without link graph loss.

# Section

### 3. E-BERT

**Wikipedia2Vec**

**Wikipedia link graph model**




The neighboring entities of each entity in Wikipedia's link graph are used as contexts

**Word-based skip-gram model**

Aristotle was a philosopher

The neighboring words of each word are used as contexts

**Anchor context model**

Aristotle was a philosopher

The neighboring words of a link pointing to an entity are used as contexts

$$\mathcal{F} : \mathbb{L}_w \cup \mathbb{L}_e \rightarrow \mathbb{R}^{d_{\mathcal{F}}}$$


<E-BERT>

# Section

## 3. E-BERT


$$\text{argmin}_{\mathcal{W}} \quad \mathbb{E}_{x \in \mathbb{L}_b \cap \mathbb{L}_w} ||\mathcal{W}(\mathcal{F}(x)) - \mathcal{E}_{\mathcal{B}}(x)||_2^2$$

**BERT**

*Jean Mara ##is is [MASK].*

**E-BERT**

*The native language of Jean_Marais is [MASK].*

**Ensemble**

*Mean-pooling(outputs) - AVG*

*Concat – jean_Marais / Jean Mara ##is.*

# Section

## 4. Experiment

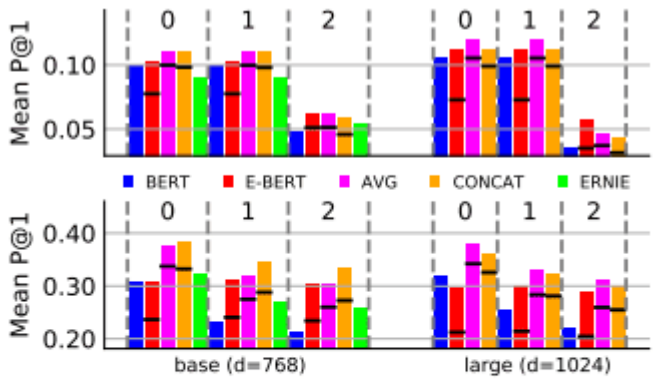



Figure 1: Mean P@1 on LAMA-Google-RE (top) and LAMA-T-REx (bottom). 0: unfiltered, 1: string match filter, 2: person name filter. Filters are applied sequentially. Black horizontal bars: Performance of wikipedia2vec without link graph loss.

평가모델


<BERT>

<E-BERT>


<ERINE>

**BERT:** *[CLS] $ Tang ##ier $ ' s # Ibn Bat ##to ##uta Airport # is the busiest airport in the region . [SEP]*

**E-BERT:** *[CLS]* `$ Tangier $ ' s # Tangier_Ibn_Battouta_Airport` *# is the busiest airport in the region . [SEP]*

**CONCAT:** *[CLS]* `$ Tangier` */* *Tang ##ier* `$ ' s # Tangier_Ibn_Battouta_Airport` */* *Ibn Bat ##to ##uta Airport # is the busiest airport in the region . [SEP]*

# Section

## 4. Experiment

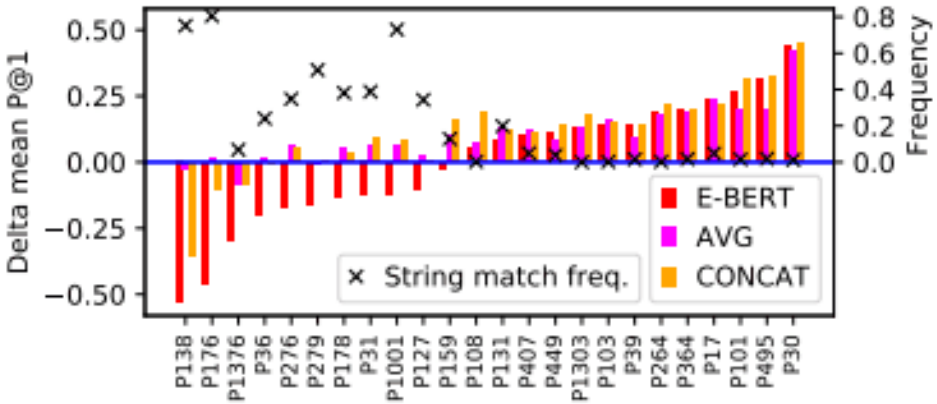



Figure 2: Delta in mean P@1 on unfiltered LAMA-T-REx relations w.r.t. $\text{BERT}_{\text{base}}$ (blue baseline). Cross: frequency of triples where the object name is a substring of the subject name. We omit relations with absolute delta below 10% due to space constraints.

# Section

## 4. Experiment

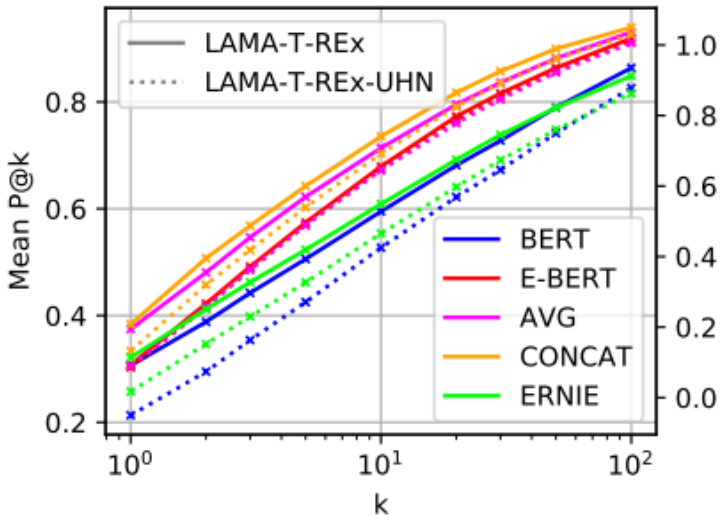



Figure 3: Mean P@k for different k on LAMA-T-REx (before filtering) and LAMA-T-REx-UHN. Architecture: $\text{BERT}_{\text{base}}$.

Welcome to ***FewRel***

a ***Few***-shot ***Rel***ation classification dataset

| | P | R | F1 |
|---|---|---|---|
| $\text{BERT}_{\text{base}}$ | 85.87 | 85.74 | 85.71 |
| $\text{E-BERT}_{\text{base}}$ | 87.29 | 87.33 | 87.18 |
| AVG ensemble | 88.28 | 88.34 | 88.19 |
| CONCAT ensemble | **88.58** | **88.54** | **88.46** |
| $\text{BERT}_{\text{base}}$ (Zhang et al., 2019) | 85.05 | 85.11 | 84.89 |
| $\text{ERNIE}_{\text{base}}$ (Zhang et al., 2019) | 88.49 | 88.44 | 88.32 |

Table 2: Macro Precision, Recall, F1 (%) on FewRel.

# Conclusion

I'm Factual knowledge BASE!

ㄴㄴ 넌 그저 Entity name으로 추론

Filter1, Filter2

LAMA-Google-RE

LAMA-T-REx

LAMA-UHN

하... 어렵네...

wikipeia2vec

E거랑 내꺼랑 앙상블

그럼 FewRel도 해봐

난 왜?..

ERNIE도 이김 ㅎ


Thank you

# Reference


https://arxiv.org/abs/1911.03681v1

https://arxiv.org/abs/1911.03681v2

https://thunlp.github.io/2/fewrel2_da.html

https://arxiv.org/abs/1810.10147

https://arxiv.org/abs/1905.07129

https://github.com/facebookresearch/LAMA

https://arxiv.org/abs/1909.01066

https://wikipedia2vec.github.io/wikipedia2vec/