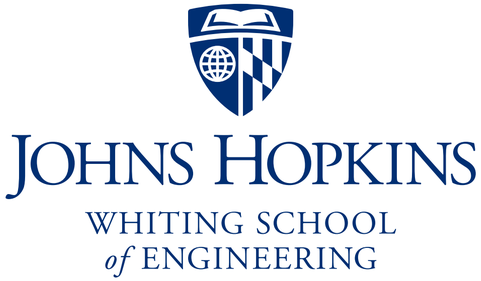

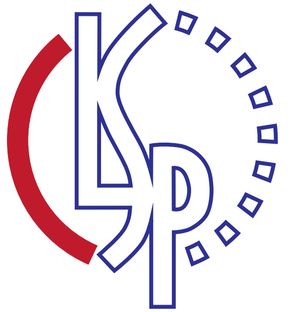

Knowledge Base - Based Language Model Pre-training

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Oct 2, 2020

1 Johns Hopkins University
2 Microsoft Research

BERT

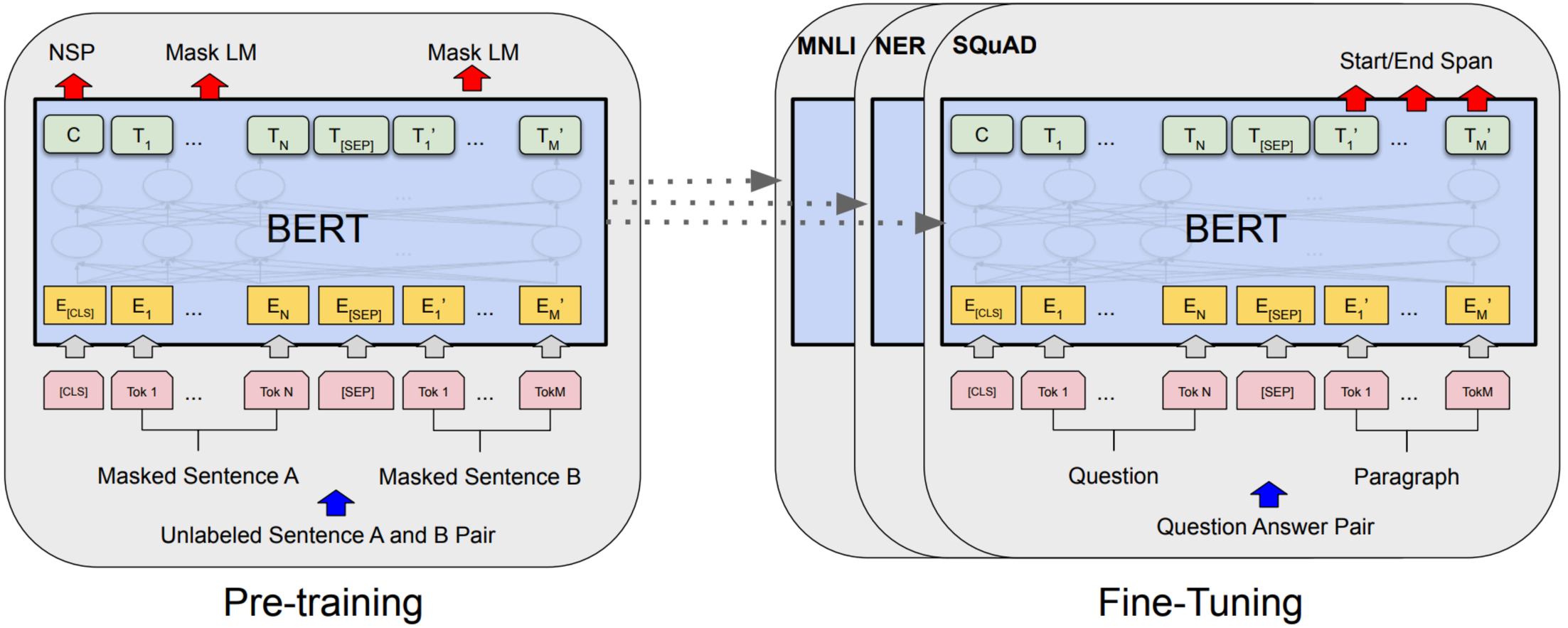


Figure 1. Overall pre-training and fine-tuning procedures for BERT.*

* BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding, Devlin et al.

Domain-Specific Pre-training - Biomedicine

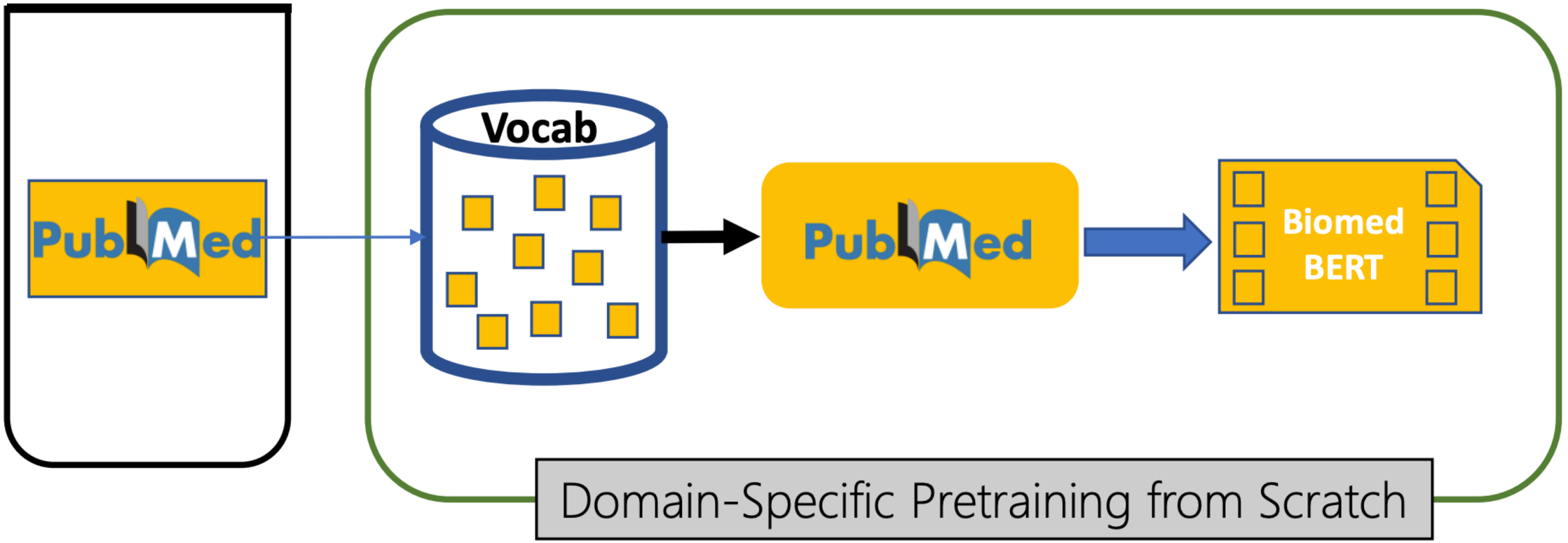


Figure 2. Domain-specific pretraining from scratch for biomedicine.*

*Domain-Specific Language Model Pretraining for Biomedical Natural Language Processing, Gu et al.

Masked LM

Sentence: In the present study, we provide first evidence that agrin is absent from basal lamina of tumor vessels if the TJ molecules occluding, claudin-5 and claudin-1 were lacking in the endothelial cells.

BERT: In the [MASK] study, we provide [MASK] evidence that agrin is [MASK] from basal lamina of tumor [MASK] if the TJ molecules [MASK], claudin-5 and claudin-1 were [MASK] in the endothelial cells.

Entity-Level Masking (this work)

Sentence: In the present study, we provide first evidence that agrin is absent from basal lamina of tumor vessels if the TJ molecules occluding, claudin-5 and claudin-1 were lacking in the endothelial cells.

BERT: In the [MASK] study, we provide [MASK] evidence that agrin is [MASK] from basal lamina of tumor [MASK] if the TJ molecules [MASK], claudin-5 and claudin-1 were [MASK] in the endothelial cells.

Entity-Level Masking:

In the [MASK] study, we provide first evidence that [MASK] is absent from basal lamina of tumor [MASK] if the TJ molecules [MASK],[MASK] and [MASK] were lacking in the endothelial cells.

Bigram Masking (this work)

Sentence: In the present study, we provide first evidence that agrin is absent from basal lamina of tumor vessels if the TJ molecules occluding, claudin-5 and claudin-1 were lacking in the endothelial cells.

BERT: In the [MASK] study, we provide [MASK] evidence that agrin is [MASK] from basal lamina of tumor [MASK] if the TJ molecules [MASK], claudin-5 and claudin-1 were [MASK] in the endothelial cells.

Bigram Masking (consecutive words that frequently co-occur):

In the [MASK] [MASK], we provide first evidence that agrin is absent from basal lamina of [MASK] [MASK] if the TJ molecules occluding, claudin-5 and claudin-1 were lacking in the [MASK] [MASK].

Distant Pair Masking (this work)

Sentence: In the present study, we provide first evidence that agrin is absent from basal lamina of tumor vessels if the TJ molecules occluding, claudin-5 and claudin-1 were lacking in the endothelial cells.

BERT: In the [MASK] study, we provide [MASK] evidence that agrin is [MASK] from basal lamina of tumor [MASK] if the TJ molecules [MASK], claudin-5 and claudin-1 were [MASK] in the endothelial cells.

Pair Masking (bigram/distant pairs that frequently co-occur, high pmi socre): In the [MASK] [MASK], we provide first evidence that [MASK] is absent from basal lamina of tumor vessels if the TJ molecules [MASK], [MASK] and [MASK] were lacking in the endothelial cells.

Dataset

- **Pre-training: Biomedical abstracts**

  #sentences: 171million average length: 22 22% sentences contain entities

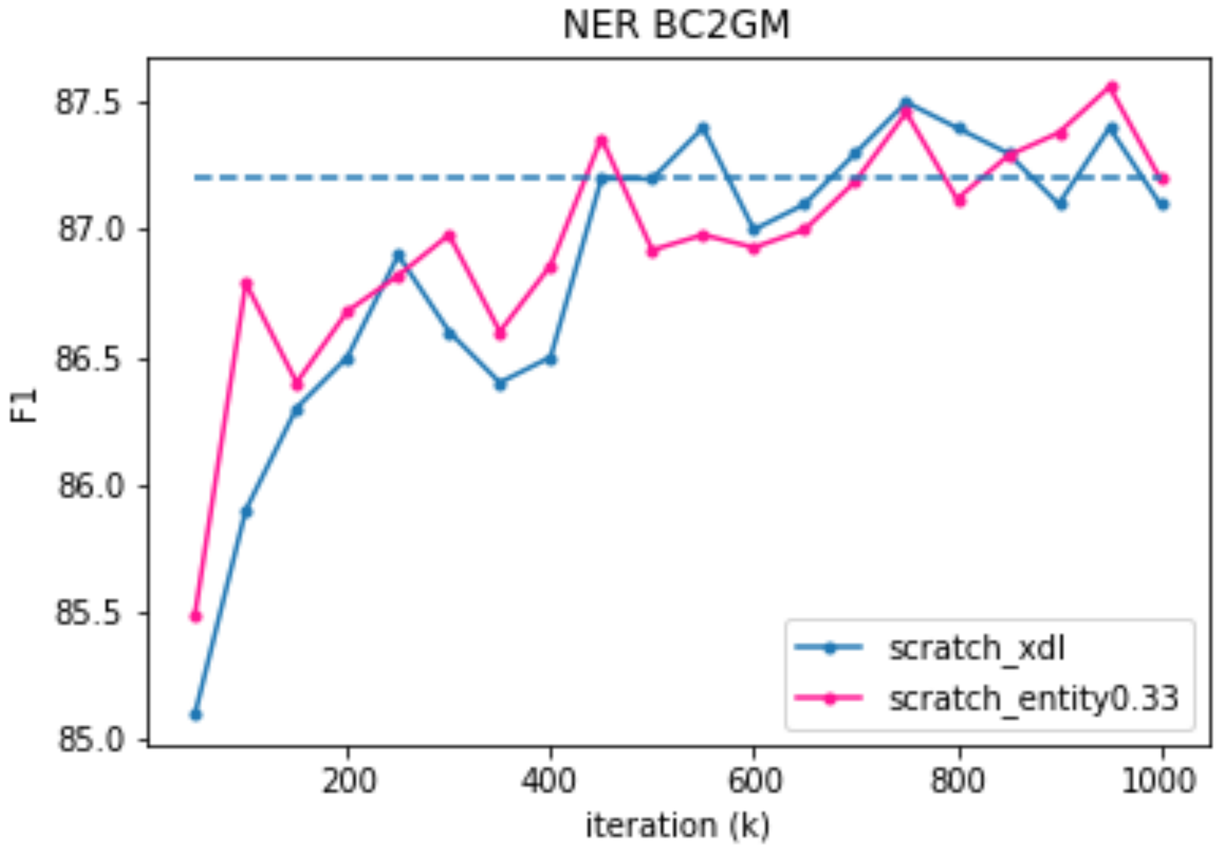
  54 million entity appearances

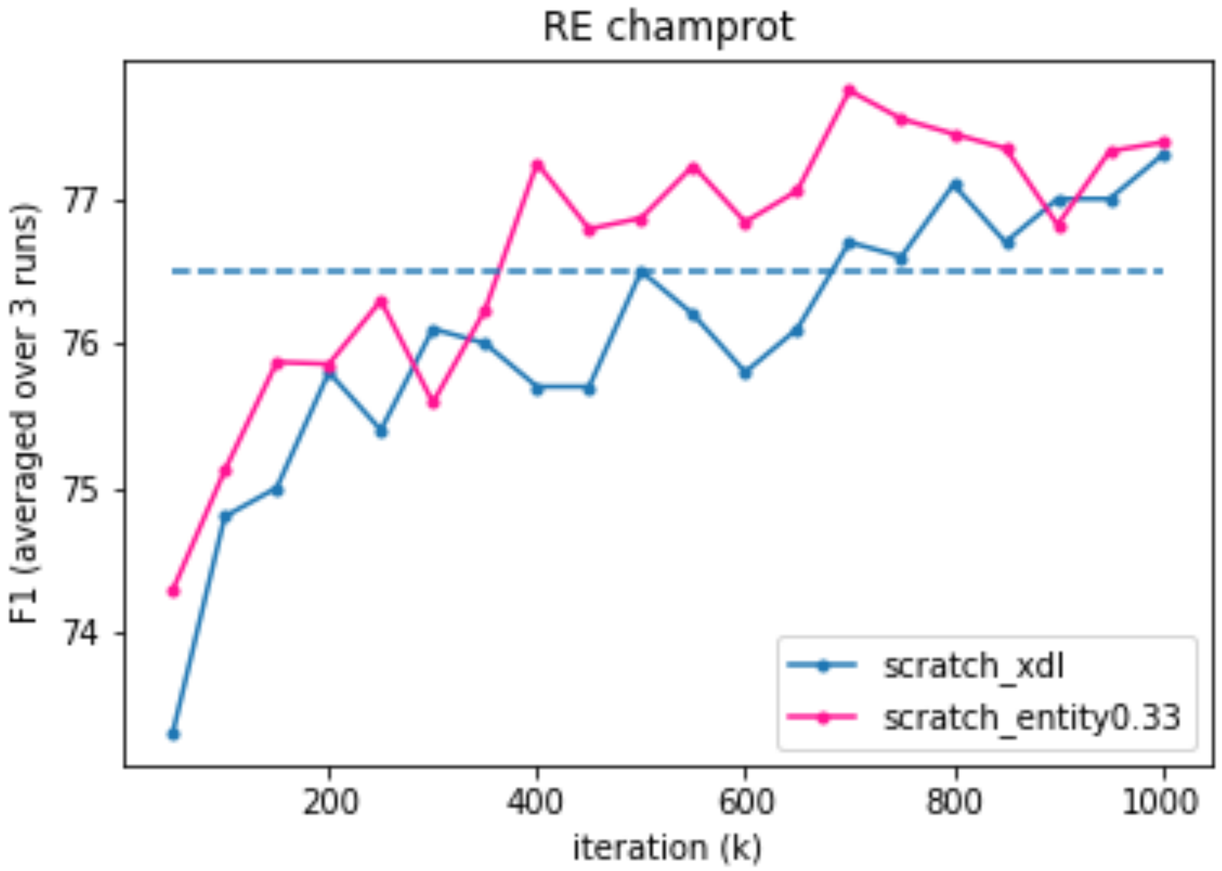
- **Fine-tuning:**

  Named entity recognition: 12k samples

  Relation extraction: 18k samples

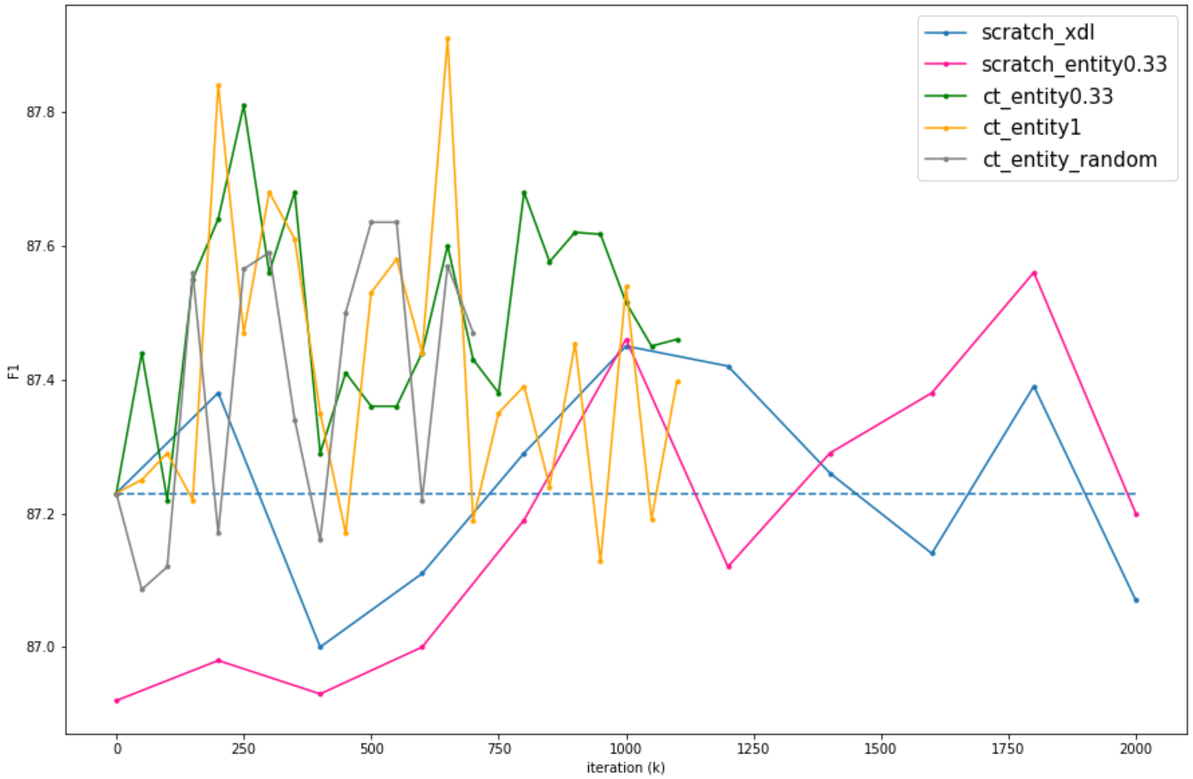
Result 1. Train from scratch



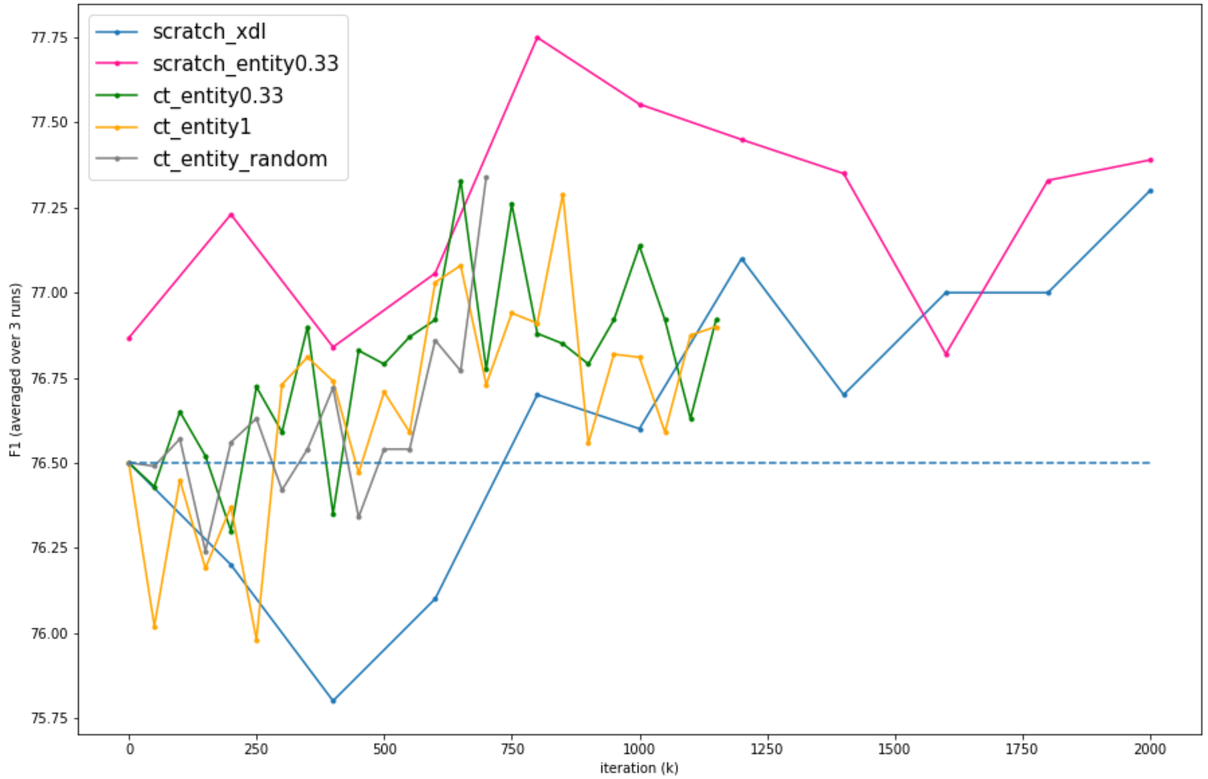


Result 2 . Continued-Training

NER BC2GM

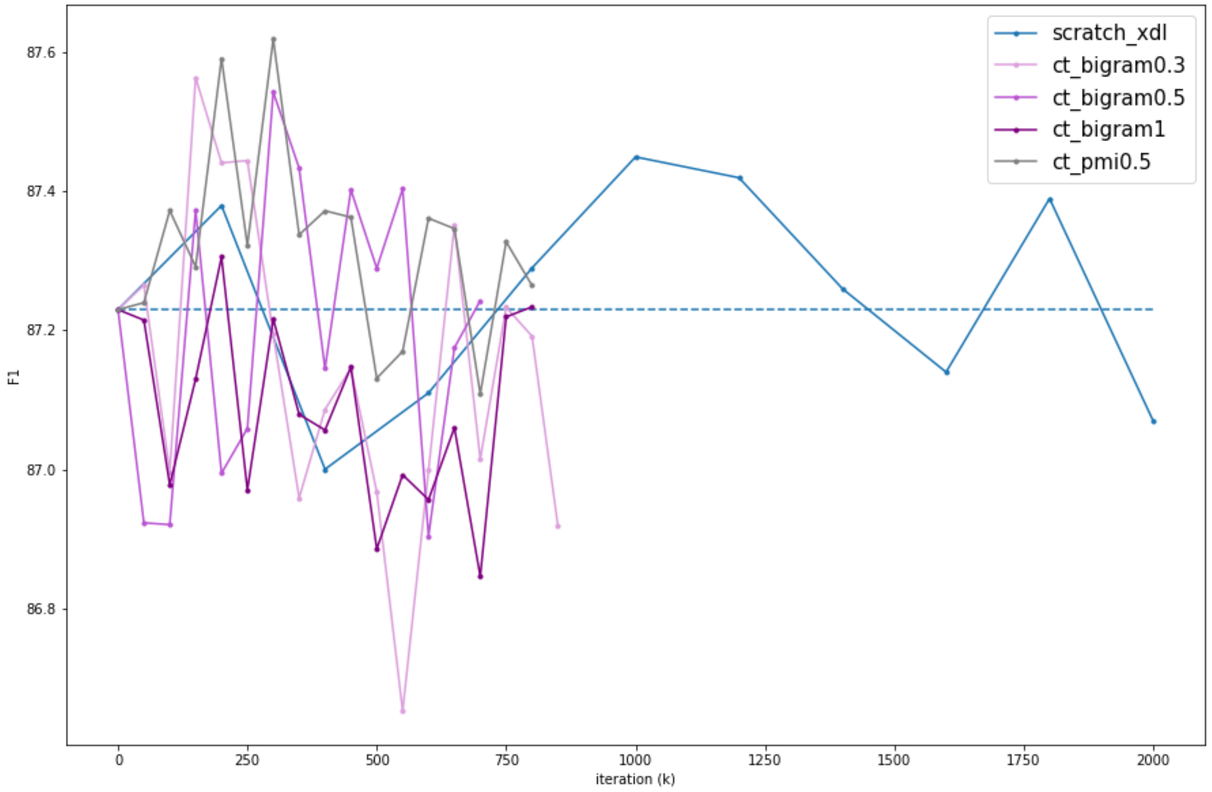


RE Chemprot

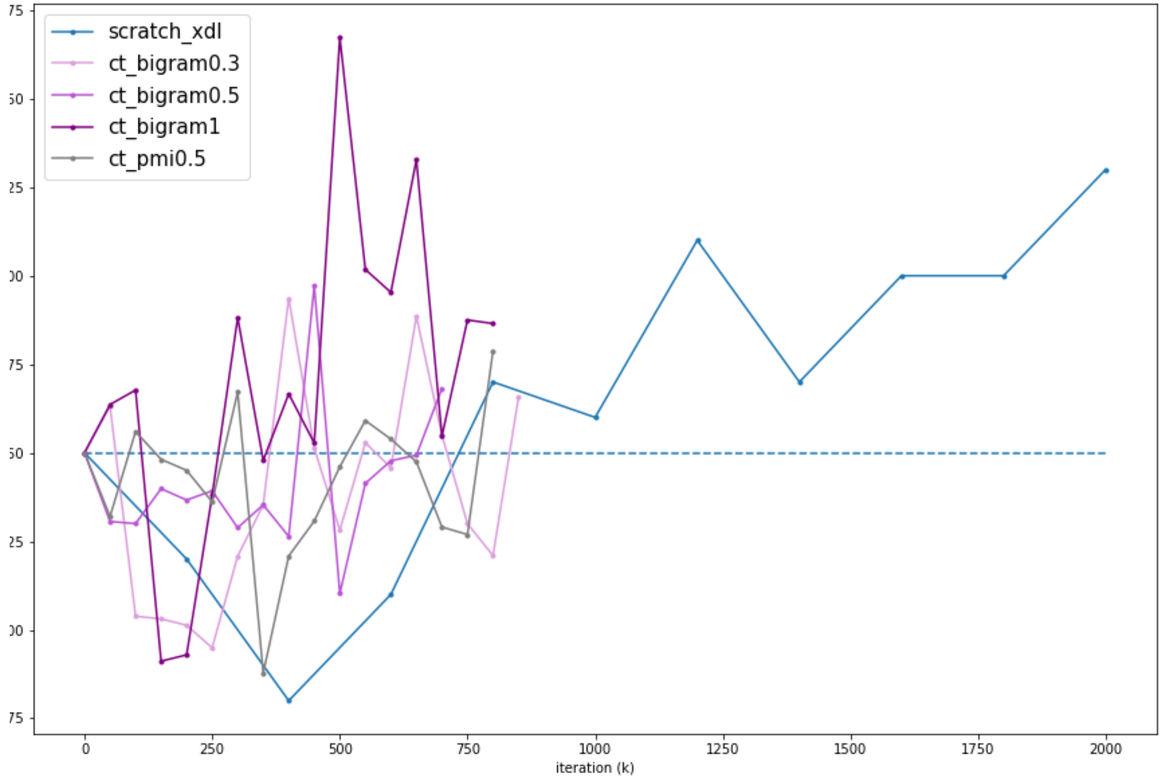


Result 3 . Pair Masking

NER BC2GM



RE Chemprot



Results

	NER	RE
scratch_xdl	87.5	77.30
scratch_entity0.33	87.56 (+0.06)	**77.75 (+0.45)**
ct_entity_random	87.64 (+0.14)	77.34 (+0.04)
ct_entity0.33	87.81 (+0.31)	77.33 (+0.03)
ct_entity1	**87.91 (+0.41)**	77.29 (-0.01)
ct_entity0.33_entity0.5	87.70 (+0.20)	77.33 (+0.03)
ct_entity0.33_entity1	87.80 (+0.30)	77.51 (+0.21)
ct_bigram0.33	87.56 (+0.06)	76.94 (-0.26)
ct_bigram0.5	87.54 (+0.04)	76.97 (-0.23)
ct_bigram1	87.31 (-0.19)	77.67 (+0.37)
ct_pmi0.5	87.62 (+0.12)	76.79 (-0.51)