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\* [`http\_get()`](../../docs/package\_reference/util.html#sentence\_transformers.util.http\_get)

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[`is\_training\_available()`](../../docs/package\_reference/util.html#sentence\_transformers.util.is\_training\_available)

\*

[`mine\_hard\_negatives()`](../../docs/package\_reference/util.html#sentence\_transformers.util.mine\_hard\_negatives)

\*

[`normalize\_embeddings()`](../../docs/package\_reference/util.html#sentence\_transformers.util.normalize\_embeddings)

\*

[`paraphrase\_mining()`](../../docs/package\_reference/util.html#sentence\_transformers.util.paraphrase\_mining)

\*

[`semantic\_search()`](../../docs/package\_reference/util.html#sentence\_transformers.util.semantic\_search)

\*

[`truncate\_embeddings()`](../../docs/package\_reference/util.html#sentence\_transformers.util.truncate\_embeddings)

\*

[Model

Optimization](../../docs/package\_reference/util.html#module-sentence\_transformers.backend)

\*

[`export\_dynamic\_quantized\_onnx\_model()`](../../docs/package\_reference/util.html#sentence\_transformers.backend.export\_dynamic\_quantized\_onnx\_model)

\*

[`export\_optimized\_onnx\_model()`](../../docs/package\_reference/util.html#sentence\_transformers.backend.export\_optimized\_onnx\_model)

\*

[`export\_static\_quantized\_openvino\_model()`](../../docs/package\_reference/util.html#sentence\_transformers.backend.export\_static\_quantized\_openvino\_model)

\* [Similarity Metrics](../../docs/package\_reference/util.html#module-sentence\_transformers.util)

\* [`cos\_sim()`](../../docs/package\_reference/util.html#sentence\_transformers.util.cos\_sim)

\* [`dot\_score()`](../../docs/package\_reference/util.html#sentence\_transformers.util.dot\_score)

\*

[`euclidean\_sim()`](../../docs/package\_reference/util.html#sentence\_transformers.util.euclidean\_sim)

\*

[`manhattan\_sim()`](../../docs/package\_reference/util.html#sentence\_transformers.util.manhattan\_sim)

\*

[`pairwise\_cos\_sim()`](../../docs/package\_reference/util.html#sentence\_transformers.util.pairwise\_cos\_sim)

\*

[`pairwise\_dot\_score()`](../../docs/package\_reference/util.html#sentence\_transformers.util.pairwise\_dot\_score)

\*

[`pairwise\_euclidean\_sim()`](../../docs/package\_reference/util.html#sentence\_transformers.util.pairwise\_euclidean\_sim)

\*

[`pairwise\_manhattan\_sim()`](../../docs/package\_reference/util.html#sentence\_transformers.util.pairwise\_manhattan\_sim)

\_\_[Sentence Transformers](../../index.html)

\* [(../../index.html)

\* [Training Examples](../../docs/sentence\_transformer/training/examples.html)

\* Augmented SBERT

\*

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on

GitHub](https://github.com/UKPLab/sentence-transformers/blob/master/examples/training/data\_augmentation/README.md)

\* \* \*

# Augmented SBERTif•

## Motivationif•

Bi-encoders (a.k.a. sentence embeddings models) require substantial training data and fine-tuning over the target task to achieve competitive performances. However, in many scenarios, there is only little training data available.

To solve this practical issue, we release an effective data-augmentation strategy known as **Augmented SBERT** where we utilize a high performing and slow cross-encoder (BERT) to label a larger set of input pairs to augment the training data for the bi-encoder (SBERT).

For more details, refer to our publication - [Augmented SBERT: Data Augmentation Method for Improving Bi-Encoders for Pairwise Sentence Scoring Tasks](<https://arxiv.org/abs/2010.08240>) which is a joint effort by Nandan Thakur, Nils Reimers and Johannes Daxenberger of UKP Lab, TU Darmstadt.

Chien Vu also wrote a nice blog article on this technique: [Advance BERT model via transferring knowledge from Cross-Encoders to Bi-Encoders](<https://towardsdatascience.com/advance-nlp-model-via-transferring-knowledge-from-cross-encoders-to-bi-encoders-3e0fc564f554>)

## Extend to your own datasetsif•

**\*\*Scenario 1: Limited or small annotated datasets (few labeled sentence-pairs (1k-3k))\*\***

If you have specialized datasets in your company or research which are small-sized or contain labeled few sentence-pairs. You can extend the idea of Augmented SBERT (in-domain) strategy by training a cross-encoder over your small gold dataset and use BM25 sampling to generate combinations not seen earlier. Use the cross-encoder to label these unlabeled pairs to create the silver dataset. Finally train a bi-encoder (i.e. SBERT) over your extended dataset (gold+silver) dataset as shown in

[train\_sts\_indomain\_bm25.py](https://github.com/UKPLab/sentence-transformers/tree/master/examples/training/data\_augmentation/train\_sts\_indomain\_bm25.py).

**\*\*Scenario 2: No annotated datasets (Only unlabeled sentence-pairs)\*\***

If you have specialized datasets in your company or research which only contain unlabeled sentence-pairs. You can extend the idea of Augmented SBERT (domain-transfer) strategy by training a cross-encoder over a source dataset which is annotated (for eg. QQP). Use this cross-encoder to label your specialised unlabeled dataset i.e. target dataset. Finally train a bi-encoder i.e. SBERT over your labeled target dataset as shown in

[train\_sts\_qqp\_crossdomain.py](https://github.com/UKPLab/sentence-transformers/tree/master/examples/training/data\_augmentation/train\_sts\_qqp\_crossdomain.py).

**## Methodology**

There are two major scenarios for the Augmented SBERT approach for pairwise-sentence regression or classification tasks.

## Scenario 1: Limited or small annotated datasets (few labeled sentence-pairs)¶

We apply the Augmented SBERT (\*\*In-domain\*\*) strategy, it involves three steps

-

- \* Step 1: Train a cross-encoder (BERT) over the small (gold or annotated) dataset
- \* Step 2.1: Create pairs by recombination and reduce the pairs via BM25 or semantic search
- \* Step 2.2: Weakly label new pairs with cross-encoder (BERT). These are silver pairs or (silver) dataset
- \* Step 3: Finally, train a bi-encoder (SBERT) on the extended (gold + silver) training dataset



## Scenario 2: No annotated datasets (Only unlabeled sentence-pairs)¶

We apply the Augmented SBERT (\*\*Domain-Transfer\*\*) strategy, it involves three steps -

- \* Step 1: Train from scratch a cross-encoder (BERT) over a source dataset, for which we contain annotations
- \* Step 2: Use this cross-encoder (BERT) to label your target dataset i.e. unlabeled sentence pairs

\* Step 3: Finally, train a bi-encoder (SBERT) on the labeled target dataset



## ## Training

The [examples/training/data\_augmentation](https://github.com/UKPLab/sentence-transformers/blob/master/examples/training/data\_augmentation/) folder contains simple training examples for each scenario explained below:

[train\_sts\_seed\_optimization.py](https://github.com/UKPLab/sentence-transformers/tree/master/examples/training/data\_augmentation/train\_sts\_seed\_optimization.py)

\* This script trains a bi-encoder (SBERT) model from scratch for STS benchmark dataset with seed-optimization.

\* Seed optimization technique is inspired from [(Dodge et al., 2020)](https://arxiv.org/abs/2002.06305).

\* For Seed opt., we train our bi-encoder for various seeds and evaluate using an early stopping algorithm.

\* Finally, measure dev performance across the seeds to get the highest performing seeds.

\*

[train\_sts\_indomain\_nlpaug.py](https://github.com/UKPLab/sentence-transformers/tree/master/examples/training/data\_augmentation/train\_sts\_indomain\_nlpaug.py)

\* This script trains a bi-encoder (SBERT) model from scratch for STS benchmark dataset using easy data augmentation.

\* Data augmentation strategies are used from popular [nlpaug](https://github.com/makcedward/nlpaug) package.

\* Augment single sentences with synonyms using (word2vec, BERT or WordNet). Forms our silver dataset.

\* Train bi-encoder model on both original small training dataset and synonym based silver dataset.

\*

[train\_sts\_indomain\_bm25.py](https://github.com/UKPLab/sentence-transformers/tree/master/examples/training/data\_augmentation/train\_sts\_indomain\_bm25.py)

\* Script initially trains a cross-encoder (BERT) model from scratch for small STS benchmark dataset.

\* Recombine sentences from our small training dataset and form lots of sentence-pairs.

\* Limit number of combinations with BM25 sampling using [Elasticsearch](https://www.elastic.co/).



\* Retrieve top-k sentences given a sentence and label these pairs using the cross-encoder (silver dataset).

\* Train a bi-encoder (SBERT) model on both gold + silver STSb dataset. (Augmented SBERT (In-domain) Strategy).

\*

[train\_sts\_indomain\_semantic.py](https://github.com/UKPLab/sentence-transformers/tree/master/examples/training/data\_augmentation/train\_sts\_indomain\_semantic.py)

\* This script initially trains a cross-encoder (BERT) model from scratch for small STS benchmark dataset.

\* We recombine sentences from our small training dataset and form lots of sentence-pairs.

\* Limit number of combinations with Semantic Search sampling using pretrained SBERT model.

\* Retrieve top-k sentences given a sentence and label these pairs using the cross-encoder (silver dataset).

\* Train a bi-encoder (SBERT) model on both gold + silver STSb dataset. (Augmented SBERT (In-domain) Strategy).

\*

[train\_sts\_qqp\_crossdomain.py](https://github.com/UKPLab/sentence-transformers/tree/master/examples/training/data\_augmentation/train\_sts\_qqp\_crossdomain.py)

\* This script initially trains a cross-encoder (BERT) model from scratch for STS benchmark dataset.

\* Label the Quora Questions Pair (QQP) training dataset (Assume no labels present) using the cross-encoder.

\* Train a bi-encoder (SBERT) model on the QQP dataset. (Augmented SBERT (Domain-Transfer Strategy)).

## Citation

If you use the code for augmented sbert, feel free to cite our publication

[Augmented SBERT: Data Augmentation Method for Improving Bi-Encoders for Pairwise Sentence Scoring Tasks](<https://arxiv.org/abs/2010.08240>):

```
@article{thakur-2020-AugSBERT,  
  title = "Augmented SBERT: Data Augmentation Method for Improving Bi-Encoders for Pairwise  
Sentence Scoring Tasks",  
  author = "Thakur, Nandan and Reimers, Nils and Daxenberger, Johannes and Gurevych,  
Iryna",  
  journal= "arXiv preprint arXiv:2010.08240",  
  month = "10",  
  year = "2020",  
  url = "https://arxiv.org/abs/2010.08240",  
}
```

[ Previous](../distillation/README.html "Model Distillation") [Next  
(../prompts/README.html "Training with Prompts")

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