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*

[`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)

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[`export_optimized_onnx_model()`](../../docs/package_reference/util.html#sentence_transformers.backend.export_optimized_onnx_model)

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[`export_static_quantized_openvino_model()`](../../docs/package_reference/util.html#sentence_tra

nsformers.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)

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[manhattan_sim()](../../docs/package_reference/util.html#sentence_transformers.util.manhattan_sim)

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[pairwise_cos_sim()](../../docs/package_reference/util.html#sentence_transformers.util.pairwise_cos_sim)

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[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)

* Training with PEFT Adapters

* [Edit on

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

* * *

Training with PEFT Adapters

Sentence Transformers has been integrated with

[PEFT](https://huggingface.co/docs/peft/en/index) (Parameter-Efficient Fine-Tuning), allowing you to finetune embedding models without fine-tuning all of the model parameters. Instead, with PEFT methods you are only finetuning a fraction of (extra) model parameters with only a minor hit in performance compared to full model finetuning.

PEFT Adapter models can be loaded just like any others, for example

[tomaarsen/bert-base-uncased-gooaq-peft](https://huggingface.co/tomaarsen/bert-base-uncased-gooaq-peft) which does not contain a `model.safetensors` but only a tiny `adapter_model.safetensors`:

```
from sentence_transformers import SentenceTransformer
```

```
# Download from the HuggingFace Hub
```

```

model = SentenceTransformer("tomaarsen/bert-base-uncased-gooaq-peft")

# Run inference

sentences = [
    "is toprol xl the same as metoprolol?",
    "Metoprolol succinate is also known by the brand name Toprol XL. It is the extended-release form of metoprolol. Metoprolol succinate is approved to treat high blood pressure, chronic chest pain, and congestive heart failure.",
    "Metoprolol starts to work after about 2 hours, but it can take up to 1 week to fully take effect. You may not feel any different when you take metoprolol, but this doesn't mean it's not working. It's important to keep taking your medicine"
]

embeddings = model.encode(sentences)

print(embeddings.shape)

# [3, 768]

# Get the similarity scores for the embeddings

similarities = model.similarity(embeddings[0], embeddings[1:])

print(similarities)

# tensor([[0.7913, 0.4976]])

```

Compatibility Methods

The

[`SentenceTransformer`](../docs/package_reference/sentence_transformer/SentenceTransformer.html#sentence_transformers.SentenceTransformer) supports 7 methods for

interacting with the PEFT Adapters:

```
> *  
  
>  
  
[`add_adapter()`](../../docs/package_reference/sentence_transformer/SentenceTransformer.html#  
sentence_transformers.SentenceTransformer.add_adapter  
  
> "sentence_transformers.SentenceTransformer.add_adapter"): Adds a fresh new  
  
> adapter to the current model for training.  
  
>  
  
> *  
  
>  
  
[`load_adapter()`](../../docs/package_reference/sentence_transformer/SentenceTransformer.html#  
sentence_transformers.SentenceTransformer.load_adapter  
  
> "sentence_transformers.SentenceTransformer.load_adapter"): Load adapter  
  
> weights from a file or Hugging Face Hub repository.  
  
>  
  
> *  
  
>  
  
[`active_adapters()`](../../docs/package_reference/sentence_transformer/SentenceTransformer.ht  
ml#sentence_transformers.SentenceTransformer.active_adapters  
  
> "sentence_transformers.SentenceTransformer.active_adapters"): Gets the  
  
> current active adapters.  
  
>  
  
> *  
  
>  
  
[`set_adapter()`](../../docs/package_reference/sentence_transformer/SentenceTransformer.html#s  
entence_transformers.SentenceTransformer.set_adapter
```

> "sentence_transformers.SentenceTransformer.set_adapter"): Tell your model to

> use a specific adapter and disable all others.

>

> *

>

[`enable_adapters()`](../../docs/package_reference/sentence_transformer/SentenceTransformer.html#sentence_transformers.SentenceTransformer.enable_adapters

> "sentence_transformers.SentenceTransformer.enable_adapters"): Enable all

> adapters.

>

> *

>

[`disable_adapters()`](../../docs/package_reference/sentence_transformer/SentenceTransformer.html#sentence_transformers.SentenceTransformer.disable_adapters

> "sentence_transformers.SentenceTransformer.disable_adapters"): Disable all

> adapters.

>

> *

>

[`get_adapter_state_dict()`](../../docs/package_reference/sentence_transformer/SentenceTransformer.html#sentence_transformers.SentenceTransformer.get_adapter_state_dict

> "sentence_transformers.SentenceTransformer.get_adapter_state_dict"): Get the

> adapter state dict with the weights.

>

>

Adding a New Adapter¶

Adding a new adapter to a model is as simple as calling

```
[`add_adapter()`](../docs/package_reference/sentence_transformer/SentenceTransformer.html#
```

```
sentence_transformers.SentenceTransformer.add_adapter
```

```
"sentence_transformers.SentenceTransformer.add_adapter") with a (subclass of)
```

```
[`PeftConfig`](https://huggingface.co/docs/peft/main/en/package_reference/config#peft.PeftConfig
```

```
"\n(in peft vmain)\n") on an initialized Sentence Transformer model. In the
```

following example, we use a

```
[`LoraConfig`](https://huggingface.co/docs/peft/main/en/package_reference/lora#peft.LoraConfig
```

```
"\n(in peft vmain)\n") instance.
```

```
from sentence_transformers import SentenceTransformer
```

```
# 1. Load a model to finetune with 2. (Optional) model card data
```

```
model = SentenceTransformer(
```

```
    "all-MiniLM-L6-v2",
```

```
    model_card_data=SentenceTransformerModelCardData(
```

```
        language="en",
```

```
        license="apache-2.0",
```

```
        model_name="all-MiniLM-L6-v2 adapter finetuned on GooAQ pairs",
```

```
    ),
```

```
)
```

```
# 3. Create a LoRA adapter for the model & add it
```

```
peft_config = LoraConfig(
```



```

task_type=TaskType.FEATURE_EXTRACTION,

inference_mode=False,

r=64,

lora_alpha=128,

lora_dropout=0.1,

)

model.add_adapter(peft_config)

```

Proceed as usual... See https://sbert.net/docs/sentence_transformer/training_overview.html

Loading a Pretrained Adapter

We've created a small adapter model called [tomaarsen/bert-base-uncased-gooaq-peft](<https://huggingface.co/tomaarsen/bert-base-uncased-gooaq-peft>) on top of the [bert-base-uncased](<https://huggingface.co/bert-base-uncased>) base model.

The `adapter_model.safetensors`` is 9.44MB, only 2.14% of the size of the base model's `model.safetensors``. To load an adapter model like this one, you can either load this adapter directly:

```

from sentence_transformers import SentenceTransformer

```

```

model = SentenceTransformer("tomaarsen/bert-base-uncased-gooaq-peft")

```

```
embeddings = model.encode(["This is an example sentence", "Each sentence is converted"])  
print(embeddings.shape)  
# (2, 768)
```

Or you can load the base model and load the adapter into it:

```
from sentence_transformers import SentenceTransformer  
  
model = SentenceTransformer("bert-base-uncased")  
model.load_adapter("tomaarsen/bert-base-uncased-gooaq-peft")  
embeddings = model.encode(["This is an example sentence", "Each sentence is converted"])  
print(embeddings.shape)  
# (2, 768)
```

In most cases, the former is easiest, as it will work regardless of whether the model is an adapter model or not.

Training Script

See the following example file for a full example of how PEFT can be used with Sentence Transformers:

`**[training_gooaq_lora.py](https://github.com/UKPLab/sentence-transformers/tree/master/examples/training/peft/training_gooaq_lora.py)**` : This is a simple recipe for finetuning `[bert-base-uncased](https://huggingface.co/google-bert/bert-base-uncased)` on the GooAQ question-answer dataset with the excellent `MultipleNegativesRankingLoss`, but it has been adapted to use a `[LoRA adapter](https://huggingface.co/docs/peft/en/package_reference/lora)` from PEFT.

This script was used to train `[tomaarsen/bert-base-uncased-gooaq-peft](https://huggingface.co/tomaarsen/bert-base-uncased-gooaq-peft)`, which reached 0.4705 NDCG@10 on the NanoBEIR benchmark; only marginally behind `[tomaarsen/bert-base-uncased-gooaq](https://huggingface.co/tomaarsen/bert-base-uncased-gooaq)` which scores 0.4728 NDCG@10 with a modified script that uses full model finetuning.

[Previous](../prompts/README.html "Training with Prompts") [Next](../unsupervised_learning/README.html "Unsupervised Learning")

* * *

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