Parameter-Efficient Adapters Based on Pre-trained Models for Speech Translation

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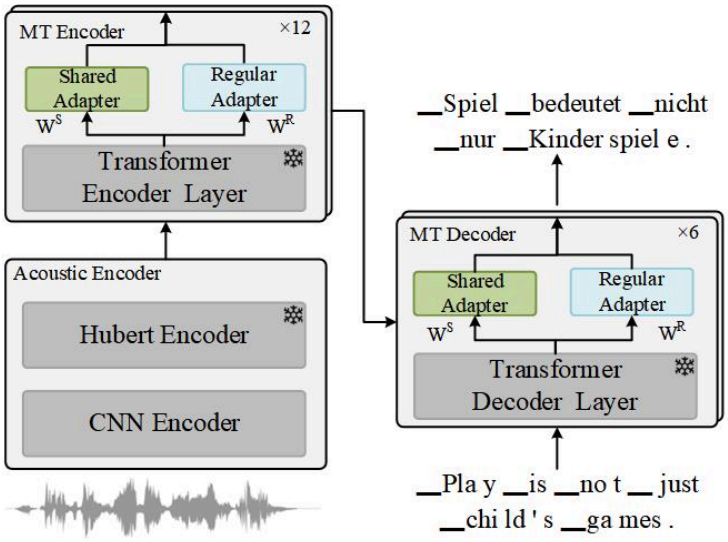
PyTorch

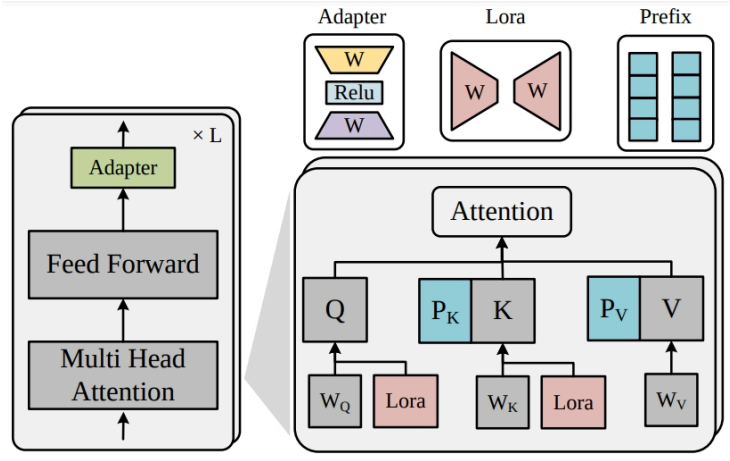
We're sorry that sometimes anonymous github cannot display README file.
The anonymous github we use sometimes cannot display the contents of the README file. We converted the contents of the readme file into pdf format.

Codes for our regular and share adapters for speech-to-text translation tasks (Under review).
After the review period, we will open-source the code on our GitHub.

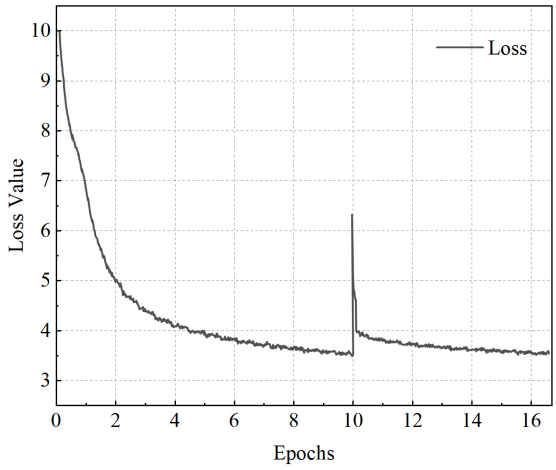
Overview



PEFT methods



Loss Curve of NAS



Installation

1. Create a conda environment with Pytorch:

```
conda create --name adapters python=3.9
conda activate adapters
```

2. Install fairseq

```
git clone https://github.com/pytorch/fairseq
cd fairseq
pip install --editable ./

# Next: Important!
python setup.py build develop
```

3. Other operations

   Notes: Due to the version compatibility of packages, you also need to reinstall the following packages:

```
# numpy np.float error
pip install numpy==1.23.5

# generation error: sacrebleu import error TOKENIZER
pip install sacrebleu==1.5.1
```

This repository is constructed using the codebase from fairseq. If you require information on the basic usage of fairseq, please refer to the fairseq documentation.

4. Other requirements

- pandas==2.0.3
- sacrebleu==1.5.1
- scikit-learn==1.3.0
- scipy==1.11.1
- sentencepiece==0.1.99
- tensorboard==2.14.0
- torch==2.0.1
- torchaudio==2.0.2
- tqdm==4.65.0

Datasets and Models

MuST-C Datasets Prepare

1. Please Download MuSTc-v1 datasets.
   Notes: It appears that the original dataset website hides the download link. However, the dataset can still be downloaded after filling out the dataset request form directly. So we recommend that you use this method.
2. Make directories to store ST (MuST-C) and datasets. Please specify the target language.

```
TARGET=de
MUSTC_ROOT=data/mustc
```

3. Unzip the mustc datasets.

```
cd $MUSTC_ROOT
tar -xzvf MUSTC_v1.0_en-${TARGET}.tar.gz
```

Deltalm Prepare

1. Download Vocabulary, Sentencepiece-model and Model of deltalm and you need to tokenize raw data to spm data.
2. Preprocess spm data.

Speech Pre-trained Model

1. We use Hubert model for speech pre-trained model for training. Before training, please download the HuBERT-Base model.

Training

Machine Translation Pre-train

Notes: We first pre-train machine translation model with transcribed speech data (text) and target text data to initialize the speech-to-text model parameters (except for the Hubert model). Besides, to ensure a fair comparison with other baseline models, we did not employ the multilingual machine translation settings during the training phase.

```
DATA_BIN=/workspace/s2t/mustc/en-de/binary
SAVE_DIR=/path/to/save
USER_DIR=/path/to/deltalm # deltalm dir
PRETRAINED_MODEL=/workspace/deltalm/pretrain_model/deltalm-base.pt

export CUDA_VISIBLE_DEVICES=3
PRETRAINED_MODEL=/workspace/deltalm/pretrain_model/deltalm-base.pt
DATA_BIN=/workspace/s2t/mustc/en-de/delta_data_bin



python train.py $DATA_BIN \
    --arch deltalm_base \
    --user-dir $USER_DIR \
    --pretrained-deltalm-checkpoint $PRETRAINED_MODEL \
    --share-all-embeddings \
    --max-source-positions 512 --max-target-positions 512 \
    --criterion label_smoothed_cross_entropy \
    --label-smoothing 0.1 \
    --optimizer adam --adam-betas '(0.9, 0.98)' \
    --lr-scheduler inverse_sqrt \
    --lr 8e-5 \
    --warmup-init-lr 1e-07 \
    --stop-min-lr 1e-09 \
    --warmup-updates 6000 \
    --max-update 400000 \
    --max-epoch 50 \
    --max-tokens 8192 \
    --update-freq 1 \
    --seed 1 \
    --tensorboard-logdir $SAVE_DIR/tensorboard \
    --save-dir $SAVE_DIR/checkpoints \
    --keep-last-epochs 50 --fp16
```

Speech-to-text Translation Training

Normal Adapter

```
target=it
cd /workspace/projects/s2t/data/en-$target
export CUDA_VISIBLE_DEVICES=0
target=it



pretrain_checkpoints_num=10

data_dir=/workspace/projects/s2t/data/en-$target
TEXT_DIR=/workspace/projects/s2t/deltalm_data/en-$target/binary

USER_DIR=/workspace/projects/s2t/st_adapter
HU_BERT=/workspace/projects/s2t/st/hubert
ARCH=deltalm_transformer_adapter_emd

adapters_bottle_num=128
SAVE_DIR=/workspace/projects/s2t/save_dir/$target/st_deltalm_adapters_emd_$adapters_bottle_num

fairseq-train $data_dir --text-data $TEXT_DIR --tgt-lang $target \
  --user-dir $USER_DIR \
  --config-yaml config.yaml --train-subset train --valid-subset dev \
  --save-dir $SAVE_DIR --num-workers 4 --max-tokens 3000000 --batch-size 32 --max-tokens-text 4(
  --task speech_and_text_translation --criterion speech_and_text_translation --label-smoothing (
  --arch $ARCH --optimizer adam --adam-betas '(0.9, 0.98)' --lr 1e-4 --lr-scheduler inverse_sqrt
  --ddp-backend=legacy_ddp \
  --warmup-updates 4000 --clip-norm 0.0 --seed 1 --update-freq 2 \
  --patience 10 \
  --fp16 \
  --st-training --mt-finetune \
  --hubert-model-path $HU_BERT/hubert_base_ls960.pt \
  --pretrained_deltalm_checkpoint /workspace/projects/s2t/save/$target/checkpoints/checkpoint$pr
  --max-source-positions 512 --max-target-positions 512  --adapters-bottle $adapters_bottle_num
```

Share Adapter

```
# change USER_DIR
USER_DIR=/workspace/projects/s2t/st_adapter_share
# change --arch
--arch deltalm_transformer_adapter_emd_share
```

Adapter NAS

```
# change USER_DIR
USER_DIR=/workspace/projects/s2t/st_adapter_share_nas
# change --arch
--arch deltalm_transformer_adapter_emd_share_nas
```

Prefix (referring to Prefix-v2)

```
# change --user-dir
USER_DIR=/workspace/projects/s2t/st_prefix
# change --arch
--arch deltalm_transformer_prefix
# remove --adapters-bottle
## add --prefix_length NUM
```

Lora (referring to Lora)

```
# pip install loralib
# change --user-dir
USER_DIR=/workspace/projects/s2t/st_lora
--arch deltalm_transformer_adapter_emd_share_lora
# remove --adapters-bottle
# change Lora hyper-parameter --lora_r NUM
```

Evaluation

```
export CUDA_VISIBLE_DEVICES=3
DATA_BIN=/workspace/s2t/mustc/en-de/delta_data_bin

SAVE_DIR=/workspace/deltalm/save_dir/delta_s2t_ted_en_de_right/checkpoints/checkpoint5.pt
python generate.py $DATA_BIN \
    --user-dir $USER_DIR \
    --path $SAVE_DIR \
    --batch-size 128 --beam 5 --remove-bpe=sentencepiece
```

It should be noted that for the sake of the reproducibility of our method, we do not use the average model parameter trick often used in other papers.

Acknowledgment

We refer to the code of Deltalm, LoRA and Prefix-v2. Thanks for their great contributions!