Machine Learning HW4

ML TAs
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Outline

- Task Description
- Dataset
- Data segmentation
- Kaggle
- Guidelines

Task Introduction

- Self-attention
  - Proposed in GOOGLE's work, Attention is all you need . It combines the strengths of RNN (consider whole sequence) and CNN (processing parallelly).
- Main goal: Learn how to use transformer.

HW2: Phoneme classification

Machine

Task: Multiclass Classification

Framewise phoneme prediction from speech.

What is a phoneme?

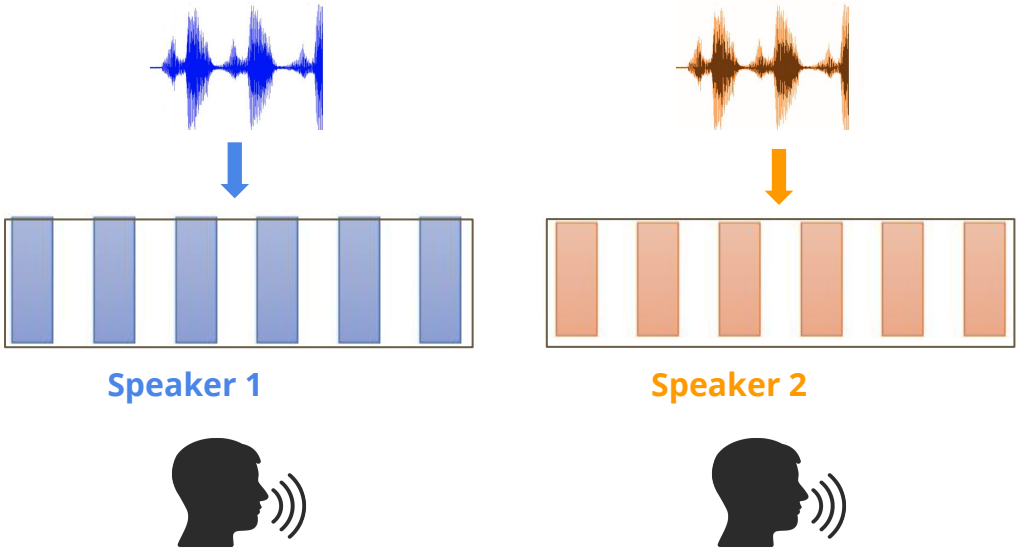
A unit of speech sound in a language that can serve to distinguish one word from the other.

- bat / pat , bad / bed
- Machine Learning → M AH SH IH N L ER N IH NG

HW4: Speaker classification

Task: Multiclass Classification

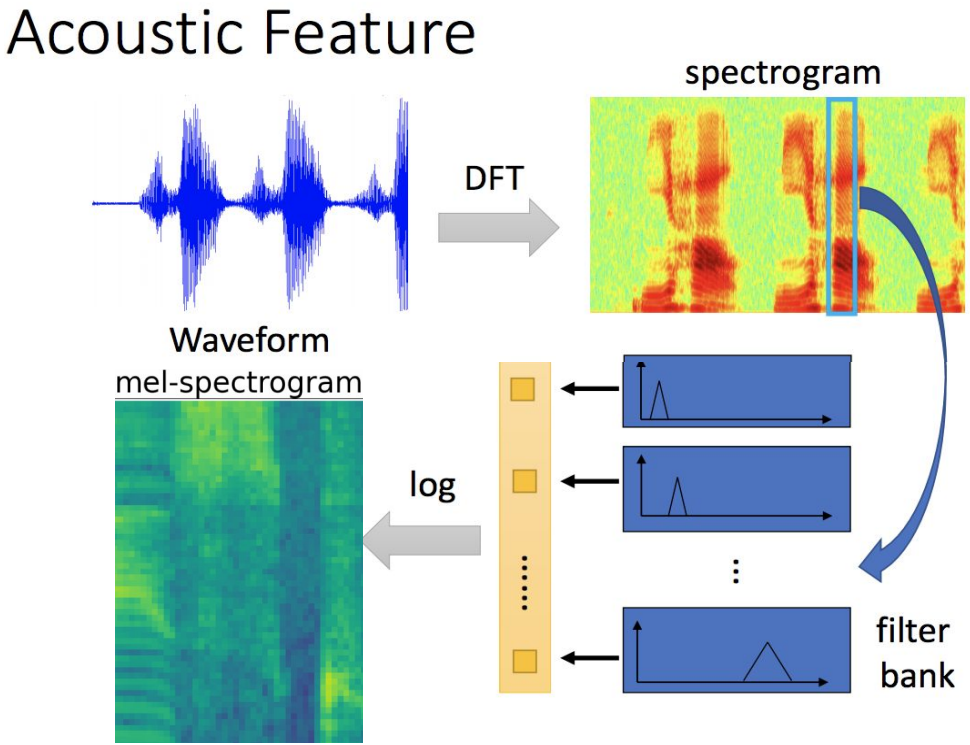
Predict speaker class from given speech.



Dataset

- Training: 69438 processed audio features with labels.
- Testing: 6000 processed audio features without labels.
- Label: 600 classes in total, each class represents a speaker.

Data Preprocessing



ref.
prof. Hung-Yi Lee
[2020Spring DLHLP] Speech Recognition

Data formats

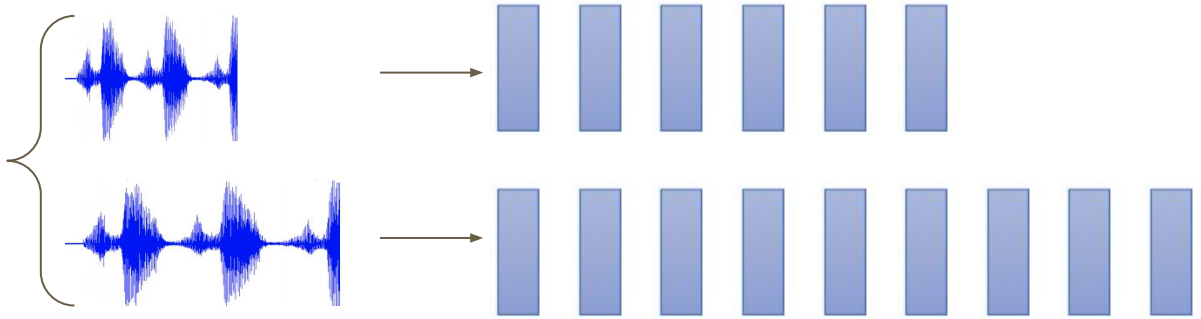
- Data Directory
  - metadata.json
  - testdata.json
  - mapping.json
  - uttr-{random string}.pt
- The information in metadata
  - "n_mels": The dimention of mel-spectrogram.
  - "speakers": A dictionary.
    - Key: speaker ids.
    - value: "feature_path" and "mel_len"

```
metadata.json
testdata.json
uttr-fff235bfc70d45b6b434c754a8136cd4.pt
uttr-fff284c8dfb94ed99010fb09208d7bcf.pt
uttr-fff286c666464b7ea2ca28811acf8f34.pt
uttr-fff3b487f8cd4905bca421b2d585bcf5.pt
uttr-fff461c64f7e4194b509b5246d2a1851.pt
```


```
"n_mels": 40,
"speakers": {
  "id10473": [
    {
      "feature_path": "uttr-5c88b2f1803449789c36f1
      "mel_len": 652
    },
    {
      "feature_path": "uttr-022a67baccc54bfda3567a
      "mel_len": 564
    },
    {
      "feature_path": "uttr-6a5c6e7231d642568633db
      "mel_len": 952
    },
```

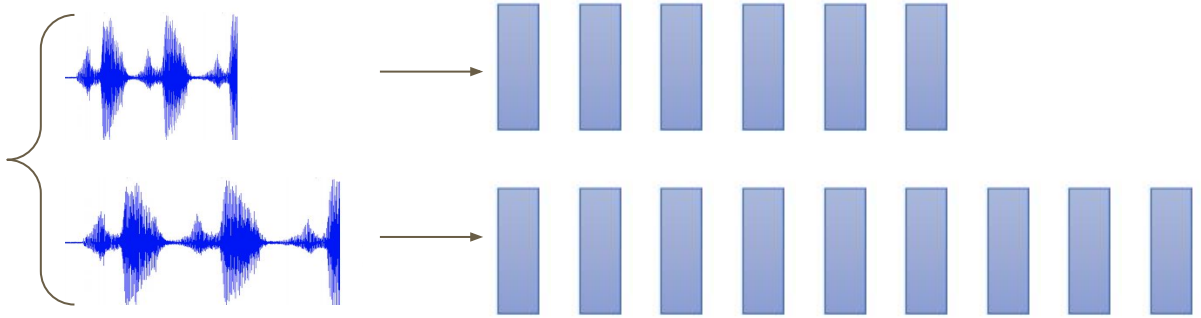
Data segmentation during training

Different length



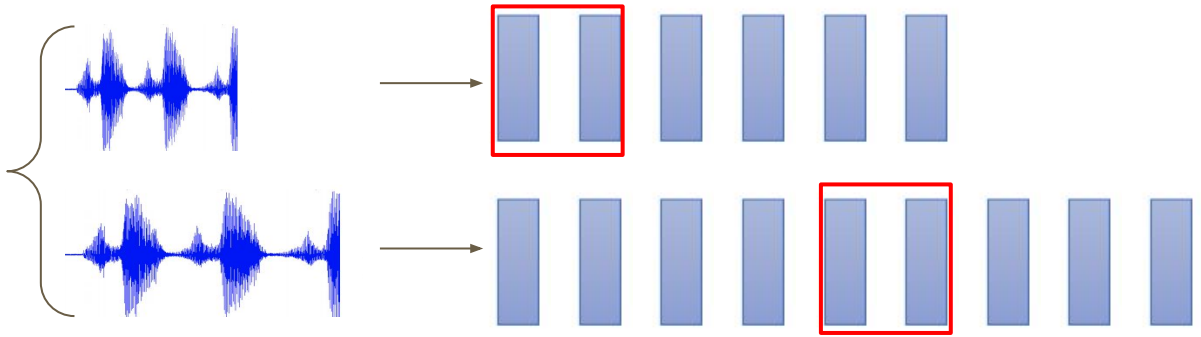
Data segmentation during training

Different length



Segment
during training

Segment = 2



Sample Code

Colab Link: link

- Baselines:
  - Simple: Run sample code and know how to use transformer.
  - Medium: Know how to adjust parameters of transformer.
  - Hard: Construct conformer which is a variety of transformer.

Requirements- Simple

- Build a self-attention network to classify the speaker with the sample code.
- Simple public baseline: 0.82523

Requirements- Medium

- Modify the parameters of the transformer modules in the sample code.
- Medium public baseline: 0.90547

```
class Classifier(nn.Module):
  def __init__(self, d_model=80, n_spks=600, dropout=0.1):
    super().__init__()
    # Project the dimension of features from that of input into d_model.
    self.prenet = nn.Linear(40, d_model)
    # TODO:
    #   Change Transformer to Conformer.
    #   https://arxiv.org/abs/2005.08100
    self.encoder_layer = nn.TransformerEncoderLayer(
      d_model=d_model, dim_feedforward=256, nhead=2
    )
    # self.encoder = nn.TransformerEncoder(self.encoder_layer, num_layers=2)

    # Project the the dimension of features from d_model into speaker nums.
    self.pred_layer = nn.Sequential(
      nn.Linear(d_model, d_model),
      nn.ReLU(),
      nn.Linear(d_model, n_spks),
    )
```

Requirements- Hard

- Improve the performance by constructing the conformer layer.
- Hard public baseline: 0.95404

```
class Classifier(nn.Module):
  def __init__(self, d_model=80, n_spks=600, dropout=0.1):
    super().__init__()
    # Project the dimension of features from that of input into d_model.
    self.prenet = nn.Linear(40, d_model)
    # TODO:
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    self.pred_layer = nn.Sequential(
      nn.Linear(d_model, d_model),
      nn.ReLU(),
      nn.Linear(d_model, n_spks),
    )
```

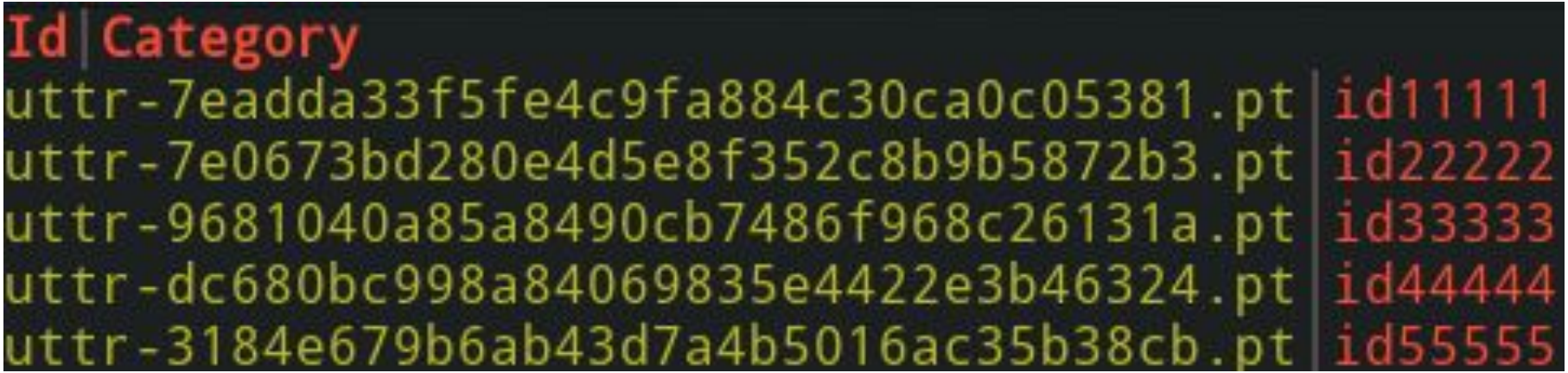
Grading

Evaluate Metrics = @1 Accuracy。	
Simple baseline (public)	+1 pt (sample code)
Simple baseline (private)	+1 pt (sample code)
Medium baseline (public)	+1 pt
Medium baseline (private)	+1 pt
Hard baseline (public)	+1 pt
Hard baseline (private)	+1 pt
Upload code to NTU COOL	+4 pts

Total: **10** pts

Submission Format

- "Id, Category" split by ',' in the first row。
- Followed by 6000 lines of "filename, speaker name" split by ','.



Deadlines

- Kaggle: **2021/04/16 23:59 (UTC+8)**
- NTU COOL: **2021/04/18 23:59 (UTC+8)**

Grading -- Bonus

- **If you got 10 points**, we make your code **public** to the whole class.

- In this case, if you also submit **a PDF report briefly describing your methods** (<100 words in English), you get a bonus of **0.5 pt**. (your report will also be available to all students)

- Report template

Code Submission

- **NTU COOL** (4pts)
  - Compress your code and report into

    <student ID>_hw4.zip

    *** e.g. b06901020_hw4.zip**

  - We can only see your last submission.
  - Do not submit your model or dataset.
  - If your code is not reasonable, your semester grade x 0.9.

Code Submission

- Your .zip file should include only
  - **Code**: either .py or .ipynb
  - **Report**: .pdf (only for those who got 10 points)

- Example:

Links

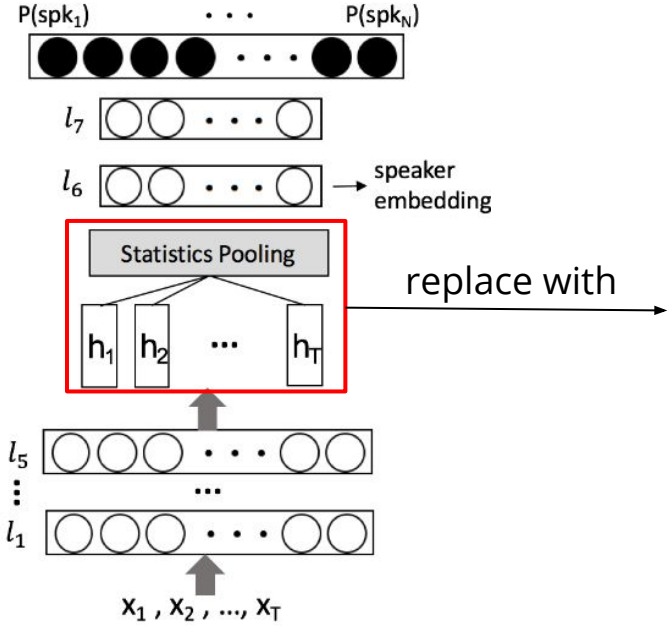
Kaggle: link

Colab: link

Data: link

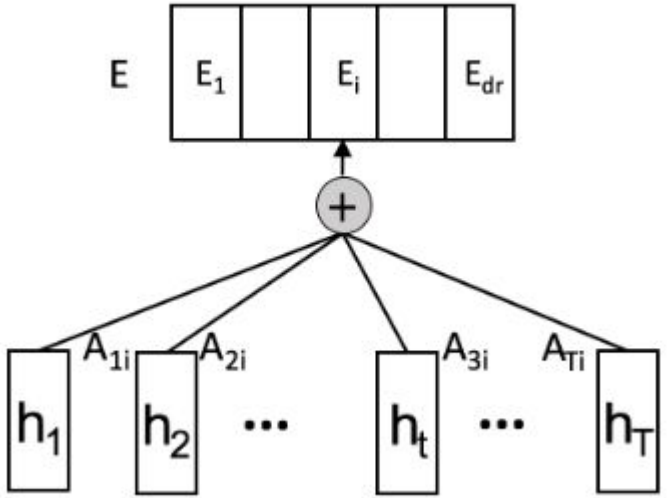
Hints

Self-Attentive Speaker Embeddings: link



Speaker classification system

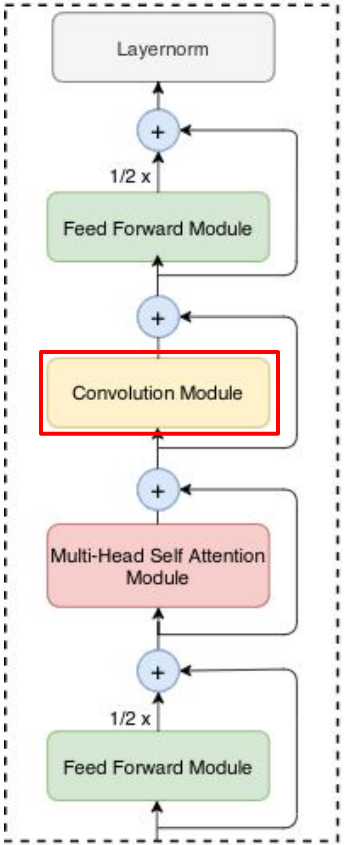
replace with

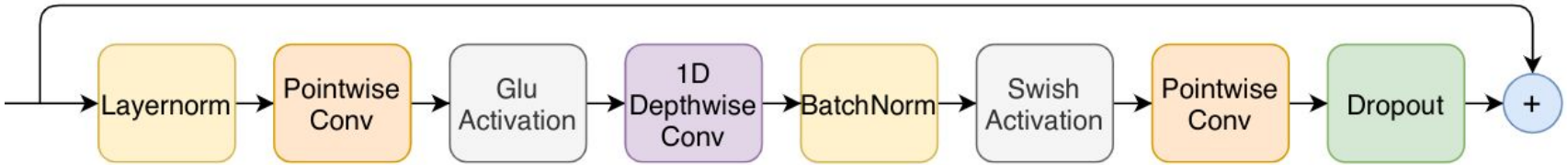


Self-attention pooling

Hints

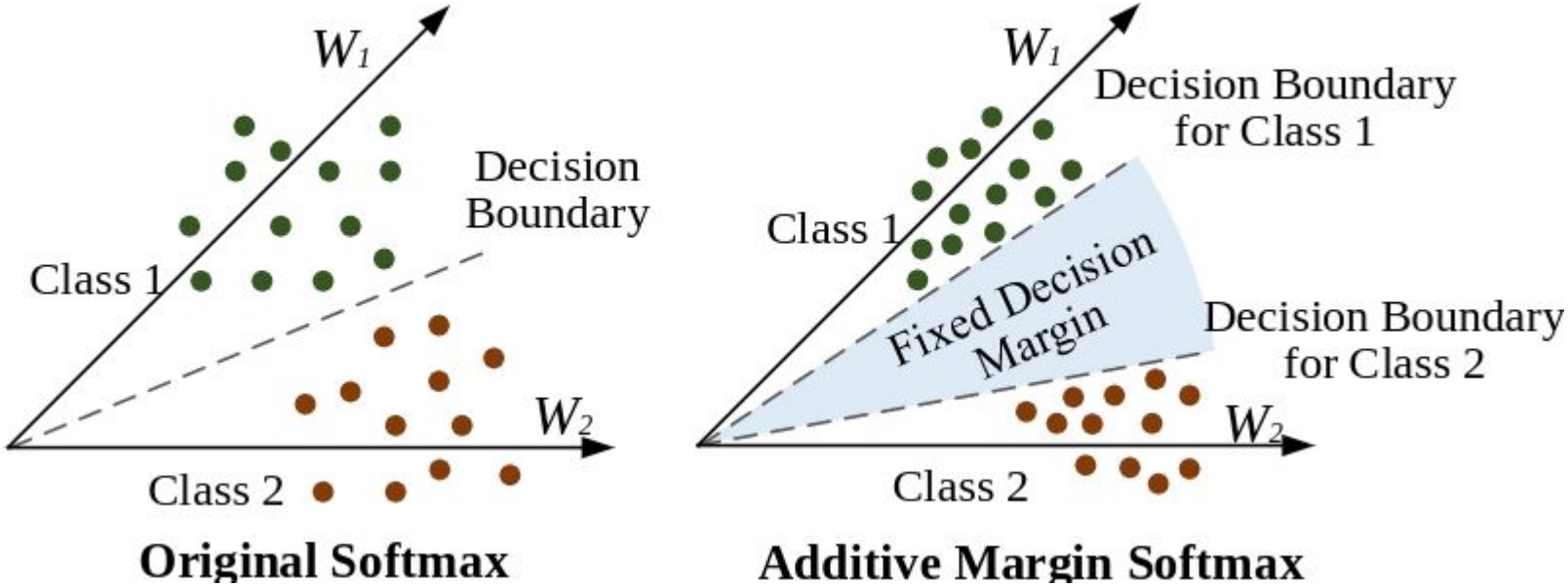
Conformer: [link]





Hints

Additive margin softmax: link



Regulation

- You should NOT plagiarize, if you use any other resource, you should cite it in the reference. (*)
- You should NOT modify your prediction files manually.
- Do NOT share codes or prediction files with any living creatures.
- Do NOT use any approaches to submit your results more than 5 times a day.
- **Do NOT search or use additional data or pre-trained models.**
- Your **final grade x 0.9** if you violate any of the above rules.
- Prof. Lee & TAs preserve the rights to change the rules & grades.

(*) Academic Ethics Guidelines for Researchers by the Ministry of Science and Technology

If any questions, you can ask us via...

- NTU COOL (recommended)
  - https://cool.ntu.edu.tw/courses/4793
- Email
  - ntu-ml-2021spring-ta@googlegroups.com
  - The title should begin with “[hw4]”
- TA hour
  - Each Friday during class