Discussion 12

EE599 Deep Learning

Olaoluwa (Oliver) Adigun, Kuan-Wen (James) Huang

Spring 2020

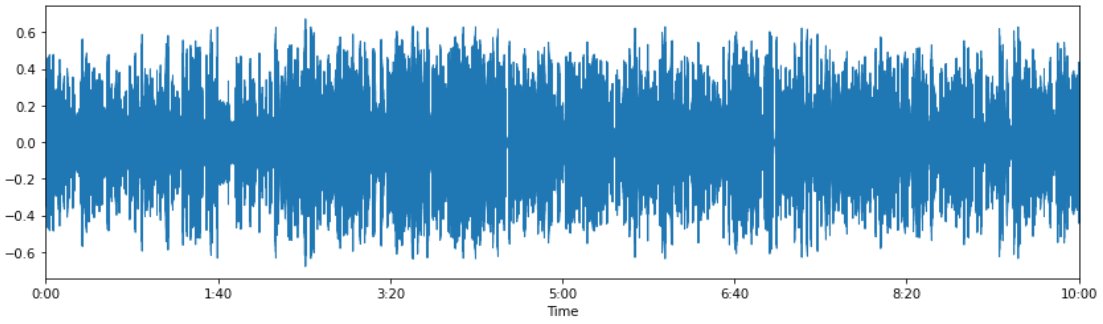
Homework 5: Language Recognition

- Dataset – Audio files (English, Mandarin, Hindi)
- Feature extraction – Mel-Frequency Cepstrum Coefficient (MFCC)
- Model – Recurrent neural network (LSTM or GRU)
- Potential Problems – Overfitting and class imbalance
- Preprocessing – Handling silence (Mask, Remove, or Label)
- Create a streaming-inference model - Remember to reset_states( ) after each sequence

Dataset and Feature Extraction

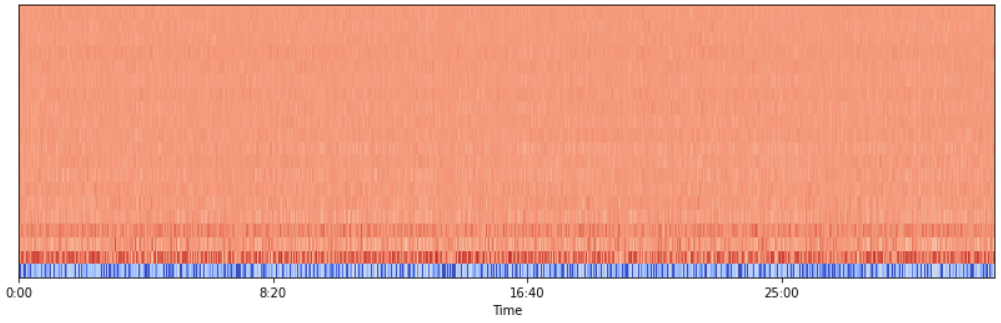
Audio file: sample_audio.wav

```
1 import librosa , librosa.display
2
3 x, fs = librosa.load("sample_audio.wav", sr = 16000)
4 librosa.display.waveplot(x, sr=fs)
```



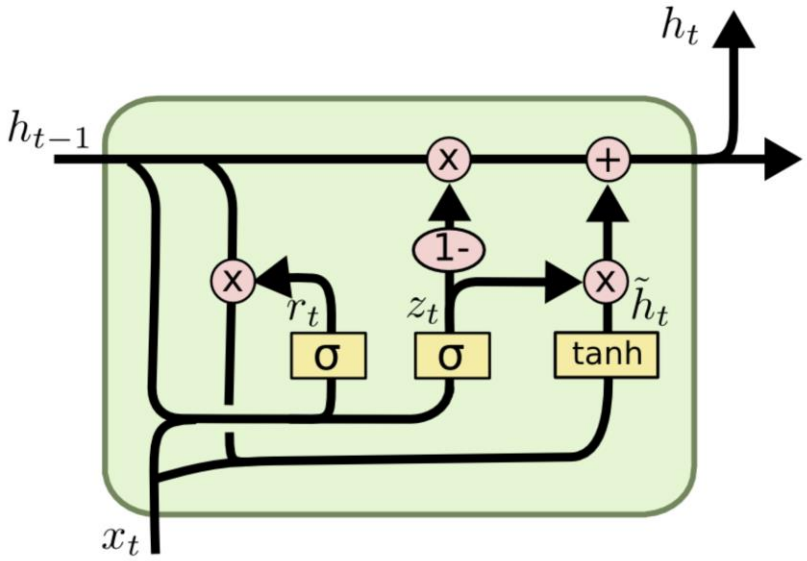
MFCC features: sample_audio.wav

```
1 mfccs = librosa.feature.mfcc(x, sr=fs,  n_mfcc=20,
2                               n_fft=int(fs*0.025),
3                               hop_length=int(fs*0.010))
4 librosa.display.specshow(mfccs, sr=fs, x_axis='time')
```



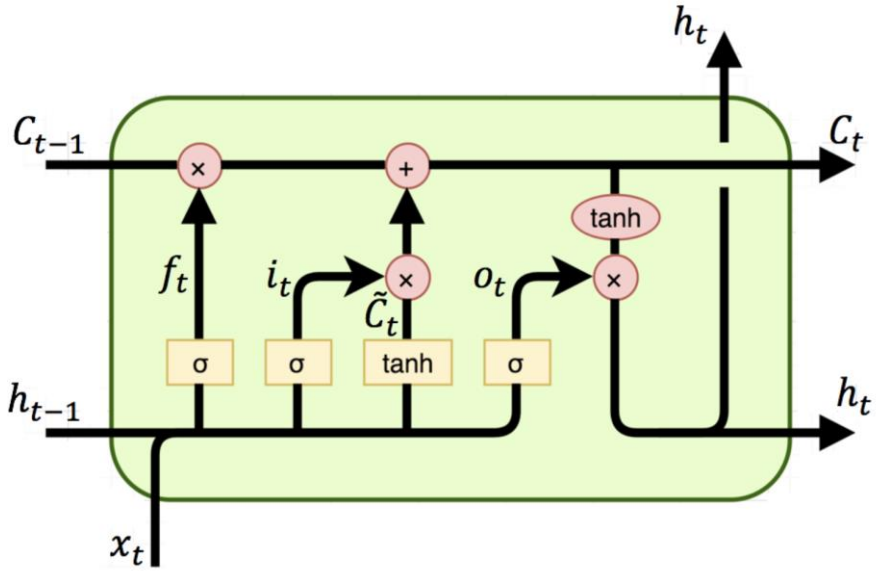
Recurrent Neural Network Architecture

Gated Recurrent Unit (GRU)



OR

Long Short Term Memory (LSTM)



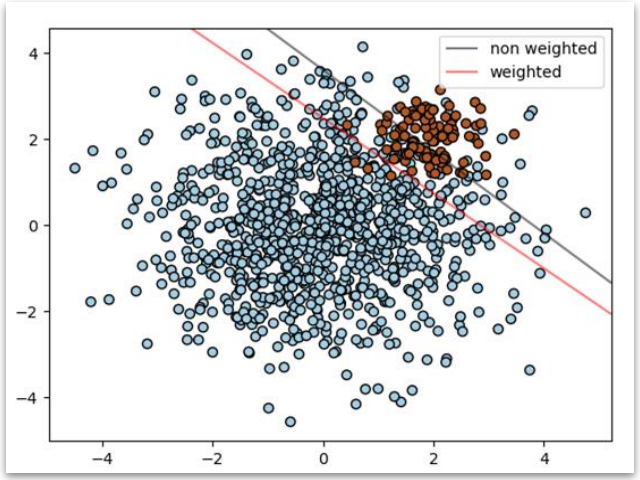
Reference: http://dprogrammer.org/rnn-lstm-gru

Model: Potential Problems

Class Imbalance

- Training dataset:

1. English – About 1,271 minutes (7,655,251 samples)
2. Hindi – About 347 minutes (2,321,676 samples)
3. Mandarin – About 893 minutes (5,347,300 samples)



- Samples from the classes are not represented equally. This is very common in real datasets.

How do we fix this problem?

Class Imbalance: Strategy

- Weighting the loss function by assigning more weights to the minority classes while less weights to the majority classes.
- How to assign weights.

```
fit(
    x=None, y=None, batch_size=None, epochs=1, verbose=1, callbacks=None,
    validation_split=0.0, validation_data=None, shuffle=True, class_weight=None
    sample_weight=None, initial_epoch=0, steps_per_epoch=None,
    validation_steps=None, validation_freq=1, max_queue_size=10, workers=1,
    use_multiprocessing=False, **kwargs
)
```

- **`class_weight`**: Optional dictionary mapping class indices (integers) to a weight (float) value, used for weighting the loss function (during training only). This can be useful to tell the model to "pay more attention" to samples from an under-represented class.

Class Imbalance: Strategy

- Under sampling the over-represented class
  - Data Loss
- Oversample the under-represented class
  - Non data loss, but validation or cross-validation needs to be handled carefully
- Ensemble of classifiers
  - Over-represented class is cut into M sub-classes
  - Under-represented classes are combined into a super-class
  - Make the set of new classes roughly balanced

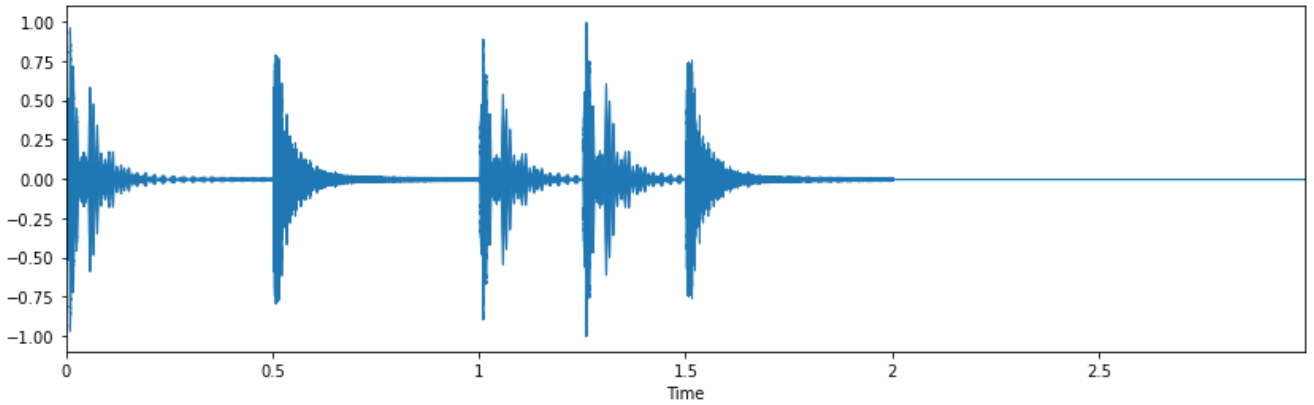
Overfitting

- Please, always do validation.
- Since we only provided the training dataset, there will be students having good result on their end but have poor result when we test it.
- Why and how to check? – train-valid-test data split

```
fit(
    x=None, y=None, batch_size=None, epochs=1, verbose=1, callbacks=None,
    validation_split=0.0, validation_data=None, shuffle=True, class_weight=None,
    sample_weight=None, initial_epoch=0, steps_per_epoch=None,
    validation_steps=None, validation_freq=1, max_queue_size=10, workers=1,
    use_multiprocessing=False, **kwargs
)
```

Handling Silence

- Mask the silence : Set the loss over the mask to zero
- Remove the silence :
- Label the silence: Create a class for the silent frames



Use SoX software : http://sox.sourceforge.net/sox.html

Streaming Inference Model

- Convert the *sequenced* trained model to a *streaming* model
- You can make a prediction on a single frame with the streaming model
- With the streaming model, remember to reset_states( ) after each sequence.

Homework 5: Submission

- Submit the following:
  - Code
  - Report
  - Streaming model
  - Model plot
  - Testing code
  - Others : E.g. Sequenced trained model
- Put the all the files in zipped folder and submit the zipped folder
- Check piazza for more details : https://piazza.com/class/k5cxqizvkb8236?cid=400

Final Project

1. Join a team :
   - If you don't have a team : Sign-up on the Google sheet.
   - If you have a team : Register your team on the Google sheet.

   https://docs.google.com/spreadsheets/d/16Ou4lW5i_keSXkL_NntWJH33MOo0ihiLef6TAVR2v4U/edit#gid=1688590681

2. Submit preliminary proposal: (Before 11.59pm on Saturday 04/11/2020)
   - Check piazza for more: https://piazza.com/class/k5cxqizvkb8236?cid=398

3. "We have a team but no topic" :
   - Check this page on piazza : https://piazza.com/class/k5cxqizvkb8236?cid=110
   - Discuss with the TAs.

Final Project

4. What is the format for the proposal ?
   - Check this page for the preliminary proposal: https://piazza.com/class/k5cxqizvkb8236?cid=398
   - We also have samples on piazza: https://piazza.com/class/k5cxqizvkb8236?cid=342.

5. What is the next thing after the preliminary proposal ?
   - Group meeting(s) with the professor or one of TAs.

6. Submitting the revised proposal.
   - This is after the meeting(s) with the professor or one of the TAs.

Final Project

7. Project Evaluation metrics & Presentation Guidelines.

   - Check these pages on piazza : https://piazza.com/class/k5cxqizvkb8236?cid=100, https://piazza.com/class/k5cxqizvkb8236?cid=101

8. OTHER QUESTIONS ????

THANK YOU