

Assignment 1: Forced Alignment using Montreal Forced Aligner (MFA)

Objective

The goal of this assignment is to set up and execute a complete forced alignment pipeline using the Montreal Forced Aligner (MFA) tool, and to understand how automatic alignment works between speech audio and phonetic transcription.

Forced alignment is the process of automatically matching an audio recording with its corresponding text transcription at the word and phoneme level. It determines when each word or sound begins and ends in the speech signal.

Environment Setup

- **Operating System:** Windows 11
- **Environment:** Conda (`PythonProject13`)
- **Tools Used:** Montreal Forced Aligner (MFA), Praat, PyCharm , ChatGPT (for understanding the synopsis of the assignment given and for code correction at the end)

Corpus Preparation

- All `.wav` files are mono, 16kHz, signed 16-bit PCM
- All `.lab` files are uppercase, punctuation-free, and dictionary-compatible
- Both `.wav` and `.lab` files are placed in the same `wav/` folder for MFA compatibility

Model Used

- **Pronunciation Dictionary:** `english_us_arpa`
- **Acoustic Model:** `english_us_arpa`
- Both models were downloaded using MFA's CLI:

MFA model download dictionary `english_us_arpa` mfa model download acoustic
`english_us_arpa`

Alignment Execution

The alignment was performed using the following Python script (`align.py`):

```
import subprocess
```

```
import os
```

```
# Define paths

corpus_dir = "wav"

dictionary = "english_us_arpa"

acoustic_model = "english_us_arpa"

output_dir = "output"
```

```
# Optional: Clean MFA cache before running

clean_flag = "--clean"
```

```
# Build the MFA command
```

```
command = [
    "python", "-m", "montreal_forced_aligner",
    "align",
    clean_flag,
    corpus_dir,
    dictionary,
    acoustic_model,
    output_dir
]
```

```
# Run the alignment

try:
    print ("Running Montreal Forced Aligner...")
```

```

subprocess.run(command, check=True)

print ("Alignment complete. Check the 'output/' folder for TextGrid files.")

except subprocess.CalledProcessError as e:

    print (" Alignment failed. Check your paths and model setup.")

    print ("Error:", e)

```

The screenshot shows the PyCharm IDE interface with the align.py script open. The terminal window at the bottom displays the command-line output of the MFA alignment process. The output shows the following steps:

- INFO Calculating Lmv...
- INFO Generating final features...
- INFO Creating corpus split...
- INFO Compiling training graphs...
- INFO Performing first-pass alignment...
- INFO Generating alignments...
- INFO Collecting phone and word alignments from alignment lattices...
- INFO Analyzing alignment quality...
- INFO Exporting alignment TextGrids to output...
- INFO Finished exporting TextGrids to output!

The process completed in approximately 115 seconds.

MFA successfully aligned all six files and exported TextGrid files to the `output` folder. The process completed in approximately 115 seconds.

Alignment Quality Analysis

The alignment analysis was exported as a CSV file. Key metrics include:

| File | Duration (s) | Phone Deviation | SNR | Speech Log-Likelihood |
|----------------------------------|--------------|-----------------|-------|-----------------------|
| F2BJRLP1 | 25.31 | 3.89 | 8.11 | -45.95 |
| F2BJRLP2 | 28.65 | 3.59 | 7.89 | -45.83 |
| F2BJRLP3 | 30.71 | 3.66 | 10.33 | -46.88 |
| ISLE_SESS0131_BLOCKD02_01_spref1 | 4.13 | 2.72 | 11.85 | -52.37 |
| ISLE_SESS0131_BLOCKD02_02_spref1 | 3.88 | 2.53 | 12.36 | -50.91 |
| ISLE_SESS0131_BLOCKD02_03_spref1 | 4.50 | 3.88 | 11.44 | -53.55 |

All files show acceptable alignment quality with good SNR and consistent timing.

Praat Inspection

Each TextGrid file was opened in Praat using “View and Edit with Sound.” Word and phoneme boundaries were visually inspected against the waveform and spectrogram. No major misalignments were observed.

Conclusion

The forced alignment pipeline was successfully implemented using MFA. All audio files were aligned with their transcripts, and TextGrid outputs were validated using Praat. The alignment quality metrics confirm that the process was accurate and reproducible.