HW2
Instrument Classification

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Prerequisite: the following Python libraries are suggested for this assignment.

- `librosa`, a Python library for music and audio signal processing.
- `mir-data`, an Python library that provides tools for working with MIR datasets.
- `scikit-learn`, a Python library for machine learning..

1. (20%) Below is an example of TinySol[1] dataset's track ID annotation. Please explain the meaning of this ID.

   Track ID: Cb-ord-A2-ff-1c-R100d

2. (20%) Find an audio file you like and plot its spectrogram, mel-spectrogram, and MFCC using the librosa functions. Please explain the differences between these features and choose one you think the most suitable for instrument and pitch classification in the following questions.

3. (30%) Use machine learning models from scikit-learn and implement feature extraction on the TinySol dataset to perform an instrument classification task. Discuss the results, including the confusion matrix, precision, and recall. Please implement all the three models with scikit-learn.

   (a) Use SVM model.

   (b) Use decision tree model.

   (c) Use MLP model.

4. (30%) Use machine learning models from scikit-learn and implement feature extraction on the TinySol dataset to perform a pitch classification task. Discuss the results, including the confusion matrix, precision, and recall. Please implement all the three models with scikit-learn.

   (a) Use SVM model.

   (b) Use decision tree model.

   (c) Use MLP model.

5. (Bonus 20%) Please use Grid Search to find the best hyperparameters based on the cross-validation score for SVM, Decision Tree, and MLP models. For SVM, please tune hyperparameters C and Gamma. For Decision Tree, please tune hyperparameters Criterion and Maximum Depth. For MLP, please change the Hidden Layer Sizes and the strength of the L2 Regularization Term. Please also analyze how these factors affect the results.

We suggest you refer to the start code, and apply it in this assignment: https://colab.research.google.com/drive/1Vl_DgmmN_vdE1w_4t6MbSS783OM52JR4?usp=sharing

Please submit your .zip file containing the report (.pdf) and your code (.ipynb), with the file name "HW2_[your ID]" to the course website. The deadline of Assignment #2 is May 8th.

[1] https://zenodo.org/record/3685331