The Wekinator: A System for Real-time, Interactive Machine Learning in Music

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THE WEKINATOR: A SYSTEM FOR REAL-TIME, INTERACTIVE MACHINE LEARNING IN MUSIC

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ABSTRACT

We propose a demonstration of The Wekinator, our software system that enables the application of machine-learning based music information retrieval techniques to real-time musical performance, and which emphasizes a richer human-computer interaction in the design of machine learning systems.

1. MOTIVATION

Live music performance remains an underexplored application domain of the audio analysis methods employed in music information retrieval research. We believe that with tools that provide better access to state-of-the art MIR algorithms for tasks such as harmony analysis, beat tracking, similarity analysis, and others, composers and performers may be inspired to create new and imaginative musical works, incorporating more MIR techniques into computer systems for accompaniment, improvisation, visualization, and more. In this work, we focus on supporting access to analysis algorithms driven by supervised learning, a cornerstone of much MIR research.

The most basic requirement for applying such algorithms to live music is that the process of feature extraction and analysis run in real-time during performance; while popular general-purpose machine learning tools such as Weka or Matlab do not generally fit this requirement out of the box, some MIR tools such as Marsyas [3] have been designed for this purpose. Beyond just running in real-time, though, our work [1] suggests that it is crucial that tools effectively support end-user real-time interaction with the underlying algorithms in the *creation, refinement,* and *evaluation* of machine learning systems. Also, composers and performers may require access to workflows and algorithm evaluation methods that differ from those traditionally used in offline MIR applications.

2. THE WEKINATOR

For these reasons, we developed The Wekinator, which we introduced in 2008 [2] and have continued to develop and use in live performance in collaboration with several composers. The Wekinator is a freely available[1], cross-platform, open-source software application built on the popular Weka framework [4], and it supports interactive design and application of real-time supervised learning systems. It is tailored for musical applications including real-time audio analysis and gestural control of music.

The key relevant features of The Wekinator include:

- Interactive training set creation and iterative training set modification in the same GUI as selecting features, configuring and training learning algorithms, and running in real-time performance.
- Real-time, hands-on, qualitative evaluation of model performance alongside objective evaluation metrics.
- Built-in basic audio feature extraction and full compatibility with any external real-time feature extractor that outputs feature vectors via Open Sound Control.
- Ability to patch the analysis results to control sound synthesis, visualization, or any other dynamic real-time process running in ChucK, Max/MSP, Processing, or any other environment that receives the learning algorithms' outputs via Open Sound Control.
- GUI support for configuring and using several standard learning algorithms (SVMs, AdaBoost.M1, decision trees, k-nearest neighbor).
- Full compatibility with Weka, allowing Wekinator-created datasets and classifiers to be exported to Weka and enabling any Weka classifier trained elsewhere to be run (and possibly re-trained) in real-time within Wekinator.

We propose to demonstrate the use of Wekinator to quickly prototype a fully functional, machine-learning based audio analysis system that would be useful in live performance, such as a timbre-driven visualization and/or a computer-improvised melody engine influenced by sung pitch.

3. REFERENCES

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[1] http://code.google.com/p/wekinator/