Sequential Rule Learning for melodies with Neural Networks

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The key idea behind this work is to build a neural network model which can understand and learn abstract patterns in music and language. This has been inspired from the work by Marcus et al. (Marcus, Vijayan, Rao, & Vishton, 1999), who performed an experiment on 7 month old infants by presenting them with stimuli of simple ABA and ABB grammar patterns. It was observed from the experiment that children were able to distinguish these patterns after a short familiarization which is evidence for the hypothesis that humans have innate understanding of identity rules. When tried to reproduce the same experiment using Neural Networks, the networks failed to significantly identify ABA and ABB patterns (Elman, 1900; Altman, 2002; Altman & Dienes, 1999; Alhama & Zuidema, 2016). To address this problem, we created a neural network that can learn identity rules by design. We construct a neural network which can act as a repetition detector and subsequently act as a predictor. The network includes one input and a time delayed version of the first input as a second input, a differential rectifier unit that enables the detection of identities, which via a *tanh(x)* unit is used to control gate units to make a prediction at the output neurons. The network can learn the grammars proposed by Marcus et al. from the data when trained with stochastic gradient descent. The implementation is done in Pytorch (http://pytorch.org/). This may provide new generalization capabilities to neural networks when dealing with musical sequences. It can be naturally applied to detect musical transpositions and other variations.

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