

Wolfgang: "Emotions" plus Goals enable Learning

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For at best, the very aim of syntax oriented theories is misdirected; they aspire to describe the things that minds produce -- without attempting to describe how they're produced. --Marvin Minsky [4]

In this extended abstract, I reflect on the design motivations for a system called WOLFGANG that composes tonal monodies. The investigated problem concerns the definition of the evaluation criteria guiding Wolfgang's compositional processing and learning. The thesis of this work is derived from the hypothesis that a system's innate sense of (musical) sound strongly influences the development of its perception, as well as composing habits. As the system develops its musical skills, it also develops a subjective use of a musical language biased by its sense of musical sounds, and its adaptation to the cultural musical grammar of its environment.

In 1987 I began a study in machine learning with a rather simple software system called Wolfgang. Wolfgang was a research project which focused on the development of compositional performance. This initial system applied Michalski's STAR methodology [2] for inductive machine learning in a knowledge-based system. In this first generation of Wolfgang, the evaluation criteria for guiding the composition process was derived from an implied grammar of Western music; Wolfgang learned to compose simple compositions based on learning simple rules of syntax. In essence, the Wolfgang system was "programmed" to learn the syntax rules of a cultural grammar.

It did not seem clear, that this form of learning captured the "true spirit" of learning to compose music. It would appear, that when an "individual" first hears or plays a new (musical) idea, some type of physical/"emotional" reaction should occur. If Wolfgang was going to learn, it must have fundamental biases which shape its behavior with each learning experience. In essence, Wolfgang should be "programmed" to formulate biases based on the emoting properties of an "auditory/musical" experience, not on the rules of syntax.

The motivation for this theory has similarities to learning in Lenat's AM system [1], in so much that the AM system was designed to be "curious" via a heuristic search of number theory concepts. Thus, a second design of Wolfgang began.

The second generation of Wolfgang introduces "emotional" criteria to constrain goal formulation both when Wolfgang learns and composes [7][9]. Wolfgang was now designed to guide its composition process biased by a cultural grammar of music, as well as by a disposition for crafting musical phrases such that they express a specific emotional characteristic. Specifically, the evaluation criteria guiding Wolfgang's composing process consists of: (1) a cultural grammar reflective of Wolfgang's musical development, and (2) an ability to realize the emotive potential of musical elements represented in the respective cultural grammar.

An abstract description of Wolfgang's composition process is as follows. Based on the grammatical context of a given compositional decision, Wolfgang defines a set of legal solutions from its domain knowledge of music which satisfy the cultural grammar; then Wolfgang selects from this set of legal solutions that solution which best satisfies Wolfgang's current disposition, in order to endow the current musical phrase with a specific emotive potential. Wolfgang was first presented in 1989 at the first AAI IAAI [6].

Key enablers in the design and implementation of Wolfgang was an approach to KR based on Minsky's K-line theory [3] and Trans-Frames as presented in his Society of Mind (SOM) theory [5]. Wolfgang's architecture required that domain knowledge be represented in "micro" element structures so that they could be used to formulate and reformulate various partial solutions dynamically. The idea is not to represent whole ideas or facts, but to let the learning encode parts of ideas and facts as "simple" structures which can be "chained" together to form various partial orderings of knowledge. This is a core feature in SOM theory were multiple "agencies" of reasoning are engaged to provide multi-strategy reasoning and KR.

This architectural design was applied due to the necessity that Wolfgang's ontology support extreme fluid representations of knowledge. Thus, Wolfgang, over time could learn new ideas, versus the classic problem of the "plastic expert system". Wolfgang had the ability to change its "behavior". Consider the composer who lived for the first 30 years of his/her life in Brooklyn, NY and then for the next 12 years in South America. Clearly, the fluidity of the human mind enables such a composer to evolve to a new style of composing behavior possibly influenced by being immersed in a "different" culture; such is the requirement of a composing learning system guided by its "emotional" experiences. (Note: Wolfgang's architecture was later extended to develop a multi-strategy reasoning system based on SOM theory which performed recognition and classification tasks supporting individuals in a collaborative desktop conferencing system [8])

The Wolfgang architecture based on an interpretation of K-line theory, enabled the implementation of fundamental "emoting" biases representing Wolfgang's initial sensation of sound and later its learning and perception of "musical sounds" and knowledge along with their respective emoting potentials. It was necessary that the emoting potentials be represented in a dynamic K-line network so that they would assert Wolfgang's "emotional" disposition towards the current composing task and/or learning experience.

Wolfgang provided a working model of music composition in which "dispositions" are instrumental in deciding about steps in the elaboration of tonal monodies. The research and design of Wolfgang has resulted from a subjective view of musical composing according to which the emoting potential of high level musical constructs is more important to the musical logic of a monody than are their syntactic features. A musical composition is thought to be an artifact which stimulates the senses and cognitive awareness of both its creator and any intended listener. I therefore view composing as a process that creates an artifact to communicate some cognitive "emotional" effect. The composing process necessitates the development of a set of musical skills, and the application of these skills based on the disposition of the composer. We might consider Wolfgang's compositional processing as constrained by its cultural grammar, and guided by its disposition to musically communicate some emoting quality.

References

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