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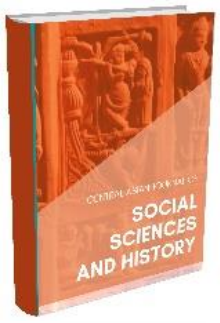

Music, Man and Artificial Intelligence

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Annotatsiya:
Makolada inson tomonidan yaratilgan suniy aqlning bajarayotgan ishlari haqida, shu jumladan suniy aql yordamida musiqa olamida qilingan va qilinayotgan ishlar yoritilgan.

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Artificial intelligence (AI) is intelligence that perceives, synthesizes and outputs information demonstrated by machines, as opposed to intelligence demonstrated by animals and humans. Examples of tasks in which this is done include speech recognition, computer vision, translation between (natural) languages, and other input data comparisons. OED (OED) defines artificial intelligence as:[1]

theory and development of computer systems capable of performing tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making and translation from one language to another.

New technologies, in particular artificial intelligence, are radically changing the nature of creative processes. Computers play a very important role in creative activities such as music, architecture, fine arts and science. After all, a computer is already a canvas, a brush, a musical instrument. However, we believe that we should strive for a more ambitious relationship between computers and creativity. Instead of considering the computer simply as a tool that helps a person create, we could consider it as an independent creative entity. This point of view led to the emergence of a new subfield of artificial intelligence called "Computational Creativity". This article discusses the possibility of achieving

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computational creativity using some examples of computer programs capable of reproducing aspects of creative artistic behavior.

Artificial intelligence has played a crucial role in the history of computer music almost since its inception in the 50s of the last century. But until recently, more effort was devoted to compositional and improvisational systems than expressive performance. In this article, we will look at some important advances in artificial intelligence approaches to music composition, musical performance and improvisation, with an emphasis on the performance of expressive music.

REVIEW

The work of Hiller and Isaacson (1958) on the ILLIAC computer is the most famous pioneering work in the field of computer music. Their best result is IlliacSuite, a string quartet composed based on the solution of the problem - "how to generate and test". The program generated notes pseudorandom using Markov chains. The generated notes were then tested using heuristic compositional rules of classical harmony and counterpoint. Only records satisfying the rules were saved. If none of the generated notes satisfied the rules, a simple return procedure was used to erase the entire composition up to that point, and a new cycle was started again. In an interview , Hiller and Isaacson said: "Before dealing with the problem of expressiveness, it is necessary to solve simpler questions." After this seminal work, many other researchers based their computer compositions on Markov probabilistic transitions, but with rather limited success in terms of melody quality.

AI can solve many problems by intelligently sorting through many possible solutions[2]. Reasoning can be reduced to performing a search. For example, a logical proof can be viewed as a search for a path leading from premises to conclusions, where each step is an application of the inference rule[3]. Planning algorithms perform a search through the trees of goals and sub-goals, trying to find a way to the intended goal, a process called means and goals analysis[4]. Robotics algorithms for moving limbs and capturing objects use local search in the configuration space.

However, not all early works on composition were based on probabilistic approaches. A good example is Moorer's work on generating a tonal melody. The program generated simple melodies with underlying harmonic sequences with simple internal patterns of repeating notes. This approach is based on process modeling using heuristic methods rather than Namarkian probability chains. Levitt also avoided using probabilities in the composition process. He argues that randomness tends to hide, rather than reveal, the musical constraints necessary to represent simple musical structures. His work is based on a description of musical styles based on constraints. He has developed a description language that allows expressing musically meaningful transformations of input data through a number of constraint relationships, which he calls "style patterns". He applied this approach to describe a simulation of a traditional jazz walking bass player, as well as a simulation of a two-handed ragtime piano.

Pioneers of artificial intelligence, such as Herbert Simon or Marvin Minsky, also published works related to computer music. Simon and Sumner describe a formal template language for music, as well as a template induction method for detecting patterns more or less implicit in musical works. Although the program was not completed, it is worth noting that it was one of the first devoted to the important issue of music modeling - a subject that has been and remains widely studied.

Marvin Minsky in his famous article "Music, Mind and Meaning" (1981) addresses the important question of how music affects our mind. He applies his concepts of the agent and his role in the society

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of agents as a possible approach to shed light on this issue. For example, he hints that one agent can do nothing but notice that the music has a certain rhythm. Other agents may perceive small musical patterns such as sound repetition, differences such as the same sequence of notes played one-fifth higher, and so on. His approach also takes into account more complex relationships within a piece of music with the help of higher-order agents capable of recognizing large fragments of music.

Among the composite systems, a large number solve the problem of automatic harmonization using several artificial intelligence techniques. One of the earliest works is the work of Rotgeb. He wrote the SNOBOL program to solve the problem of harmonizing an unstated bass (given a sequence of bass notes, output chords and leading voices that accompany these bass notes) using a set of rules. The main goal of Rotgeb was not automatic harmonization, but to test the computational reliability of the two theories of bass harmonization of the eighteenth century.

One of the most complete works on harmonization is the work of Ebcioglu. He developed the CHORAL expert system for harmonizing chorales in the style of J.S. Bach. CHORAL is given a melody, and it produces the appropriate harmonization using heuristic rules and constraints. The system is implemented in the logic programming language developed by the author. An important aspect of this work is the use of sets of logical primitives to represent different points of view in music (viewing chords, viewing a time interval, viewing a melody, etc.). This was done to solve the problem of presenting a large amount of complex musical knowledge.

MUSACT (Bharucha, 1993) uses neural networks to study a model of musical harmony. It was designed to capture the musical intuition of harmonic qualities. For example, one of the qualities of a dominant chord is to cause the listener to expect that a tonic chord is about to be heard. The greater the expectation, the stronger the feeling of consonance of the tonic chord. Composers can satisfy or violate these expectations to varying degrees. MUSACT is able to study such qualities and generate calculated expectations in a given harmonic context.

In HARMONET (Feulner, 1993), the problem of harmonization is solved using a combination of neural networks and constraint satisfaction methods. The neural network studies the so-called harmonic functionality of chords. MELONET uses a neural network to study and reproduce higher-level structures in melodic sequences. According to a given melody, the system invents a Baroque-style harmonization and a variation of any chorale voice.

Morales-Manzanares developed a system called SICIB capable of composing music using body movements. This system uses data from sensors attached to the dancer and applies output rules to link gestures to music in real time.

By far, the most famous work on computer composition using AI is the EMI project by David Cope (Cope, 1987, 1990). In this work, the main focus is on imitating the styles of different composers. He has successfully composed music in the styles of Kop, Mozart, Palestrina, Albinoni, Brahms, Debussy, Bach, Rachmaninoff, Chopin, Stravinsky and Bartok. It works by searching for repetitive patterns in several (at least two) works by a given composer. The detected patterns are called signatures. Since the signatures depend on the location, EMI uses one of the composer's works as a guide to fix them in the appropriate places when creating a new work. To compose musical motifs between signatures, EMI uses a compositional rule analyzer to detect the constraints used by the composer in his works. This analyzer considers musical events, such as voice prompts, the use of repeated notes, and presents

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them as a statistical model of the analyzed works. The program follows this model to make up the motives for inserting into the empty spaces between the signatures. To insert them correctly, EMI has to solve problems such as linking the initial and final parts of the signature with surrounding motifs, avoiding stylistic anomalies, maintaining vocal movements, taking notes within the range, etc.

Correct insertion is achieved using a network of extended transitions. The results, though not perfect, are quite consistent with the composer's style.

Thus, let the results be imperfect, but artificial intelligence is quite capable of not only recognizing, but also creating, processing and composing music, both its own and based on already known, received data.

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