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ASC
American Society for Cybernetics
a society for the art and
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… to hold discourse at least with a computer …

Herbert Brun[1]

Herbert Brun, Trustee of the ASC, was a Professor of Music in the School of Music, University of Illinois. He is credited with "widening the aperture" of the American Society for Cybernetics through introducing musicians, artists, performers, therapists and architects to the field. Herbert died on Nov. 6, 2000. The ASC is grateful for all that he contributed and for the inspiration he provided for many students and colleagues.

The composer who attempts to compose his music with the assistance of computers, and who, instead of keeping his mouth shut, responds to the request to tell why and how he proposes to breed immortal beauty for all of us by marrying mere technical logic to fertile inspiration, this composer has to override such exalted expectations with a careful report on the notions, theoretical and otherwise, on which he bases his various interests for experimental research in music. I shall attempt to do that now.

Anyone who attends either a concert of new music or a lecture on speculative ideas concerned with new music may occasionally come away with a question on his mind. Was this music? Is that music? Did he mean "music"? Did all this even have anything to do with music? In the attempt to do justice to these questions as well as to the events which provoked them, one usually comes to a full stop having reached the big question: What is music?

Three cases may arise: A question is answered, and dies. The discussion stops. Or, a question survives all its answers. The discussion then absorbs the answers and continues from there. Or, a discussion survives the already answered question. This is unpleasant to behold and therefore best skipped over with a charitable smile.

Nobody can, under all circumstances be quite sure with which of these three cases he is confronted. Nobody, however, can avoid implying by word, gesture and stress of choice, which case he assumes it to be. I would even go one step

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further and say which case I want it to be. And reasoning may be brought to bear on it. If I say that the question "What is Music?" survives all its answers: then it is because I have vested interest in music, being a composer, and because I know that once we know what music is-there won't be any. We may delve into the well of the past and inquire what each man thought music could be and come up with useful documentation as to what music was then. Useful, because without it, we, today, would know only what music was today. We then can go to the composers and ask them. And if they know their profession, they certainly know what music was, but if they begin to say what music is, something flips, and turns their good intentions into advertisements of what music is to be.

Still, there must be something that allows us to use the general term music, if only to be able to set it off against the general terms "acoustical phenomena" and "aurally perceivable sensations". That something, of course, can not ***be*** music, but it can be found ***in*** all music, can change continuously and tremendously while remaining the same something. I am speaking of a ratio, a rational relationship. In all music there is manifestly implied the rational relationship between the chaotic image of an unlimited, unconditioned and disordered universe of all audible phenomena and a tentatively defined image of an equally disordered, but artificially limited and conditioned sub-system that man at a given time considers his temporary acoustical ***all***. Every composer of music has testified to this relationship, knowingly or unknowingly measured it, and his work reports on what he was able to measure up to. If today we try it with computers, nobody can possibly say whether any result of this attempt will correspond to what has up to now been called a "work of art", or whether it will define what from then on will be called a "work of art", or whether it will miss altogether that function in society which makes some creative communication a "work of art". The contemporary relevance and significance of a composition should be achieved in that it does not appeal to existing means of understanding music but rather creates new means of musical understanding. It not only will show noticeable changes in the concept of the acoustical system, not only propose new schemes of organization, but also provoke the creation of new circuits in the listener's mind. This provocation is the aim and purpose of all creative and scientific projects. It is in this sense that the cooperation of composer and computer is, for here and now, considered to be a natural idea. Whether it will lead to "music" or to electronic brains" or to a new aspect of both is, a question fascinating enough to render fascinating all attempts at a satisfactory answer.

Compared to these somewhat lofty ideas, the work on and for their implementation proceeds in rather small steps and no man at, this moment has yet been given a chance ever to justly evaluate whether these small steps stumble in the right direction. The first step I took was to envisage both, the computer and what I call music, as two different systems, and to explore the possibility of their mutual compatibility. I use the term "system" whenever I mean to speak of a collection of elements wherein each element can be in either of at least two different states and where the change of state in one element results in a change of

state of the whole collection. The term ”element" I use when referring to something as a whole that I do not consider as made up of a set of elements. Indeed, it frequently depends on the observer and his particular purpose at a given time whether he regards an object as being a system or as being an element. A composer may at one time consider the piano to be a system which can adopt as many states as about 88 elements allow, each of which, and any number of which, can be “on” or “off”, at least. At another time he may think of the piano as an element which changes the state of a system called orchestral timbre. I hope he frequently considers all possible ways simultaneously, but think it vital that he know which way of looking at them determined his final choice.

Dependent on the number of elements in a system and on the number of states which each of these elements can adopt, each system has a definite number of states in which it can appear. This number of possible states of a system I shall call its information potential. As this is an important notion for my purpose, I shall express it as follows: If I am faced with a certain state of affairs, be it music, language, politics or family, I will, for the purpose of understanding and evaluating, not only need to know the precise present constellation of all the elements, but also the number of possible states out of which this particular one which faces me had been selected. If you play several little tunes on a recorder, you will find that not only is the system called “recorder” able to be in as many states as the tunes demand, but that the tunes exploit the system “recorder” to the limit. One can say that here two systems simulate each other almost completely, they even imply each other. No number of little tunes played on a piano will ever define the large system called piano for you. This means that each message which we receive has to be investigated in respect to two questions: (1) What kind of a source-system does this message imply? (2) How much of that system did the message exploit?

Every musical composition is in this sense a message. In order to hear the musical events as they are being carried to you by acoustical events, it is necessary to find out as much as possible about the originating system before you can be sure you have heard what actually had been played and that it was music. For how is anyone to say whether what he heard was music or not, as long as he is not even sure as to what “it” was that he heard? And in order to even begin to know what it was that he heard, he must be able at least to estimate how many “similar” acoustical events the choice of each particular one eliminated. Not only the results of the composition but also the processes of composition are parts of this message. Here, one can see that we noticeably approach that concept of musical composition which considers the interrelations and interdependence that join acoustical events together as even more important for musical meaning than the acoustical events as such alone. Every decent analysis of a musical work will try not only to state the kind, form, and quantity of acoustical events in the piece, but, more than that, will try to find out as much as possible about the schemes, plans, processes, and logics which the composer may have employed for his decision making. These last mentioned methods of bringing a specifically planned

order into a system of generally possible orders I shall call "the algorithms" by which changes in the system can be controlled. And I call them "algorithm" because this word has both a general and a specific meaning. It does not specify any one particular method; it does not imply any particular degree of complexity or convenience or efficiency. But it is specific in one point: It means any set of instructions which will control the changes of state in a system in such a way that from a given initial state to a given final state, each intermediate state generates its follower. If we now call an algorithmically controlled change of state a "transformation", then we can say that an algorithm produces an uninterrupted chain of transformations between a given initial and a given final state of a system. Or, the other way around: If two states of a system appear to be connected by an uninterrupted chain of transformations, then we may assume the presence of a controlling algorithm. Now, it is rarely the case that there is only one lonely algorithm responsible for what we hear, see or otherwise perceive when we look at systems. Usually there are many simultaneously active. But, usually, they are active in a kind of hierarchic power distribution. There are little algorithms which control counting, addition, multiplication, etc. They may obey an algorithm which tells them when to go into action. This may be controlled by an algorithm which controls the relative dimensions of sequences and thus may direct a "lower" algorithm to eliminate its product and to start again from another given state. And so on and so forth.

Let us cut this promising excursion short and say that we now have all I need in order to make the following statement: A system is defined by its information potential and by those algorithms that can control this particular system. Two systems are compatible with each other when they are similarly defined. The degree of compatibility of two systems determines the degree to which they can simulate each other, to which one system may behave in analogy to the other. We are interested here in three main degrees only: Fully analog, partially analog, and not analog at all. The system called "Thermometer" is fully analog to the system called "Temperature", partially analog to the system called "The Weather", and not at all analog to the system called "Language". An analogy is a chain of transformations in one system simulating a chain of transformations in another system. Communication is based on analogies, on degrees of compatibility between different systems.

The largest, most general and thus most flexible systems men can control today are found among the electronic high speed digital and analog computer installations. The number of states representable by such machines is enormous; the elements, simple and semantically uncommitted, can stand for almost anything ennumerable, quantizeable, measurable; the network potential offers the structural conditions for nearly any algorithm one can think of. Thus it is a system especially designed for utmost compatibility with all kinds of other systems, large or small, simple or complex, open or closed, numerical or logical. It is, therefore, up to the computer user to find or to construct the system in which his problems can be expressed and solved, in which the processes he desires to observe and to test can

be seen as chains of transformations. Once he has defined the system he needs, the user is able to plant it as a subsystem into the computer. This "planting" procedure is usually referred to as "programming".

A computer program is a set of instructions. If fed into the computer system in an appropriate code, the program communicates to the computer the structure, size, dimensions, rules, algorithms, etc. of a system which the computer system is to simulate. Under the control of such a program, the computer system will act as an analogy to the system which the programmer had in mind when he wrote the program. It is quite probable that not all composers think of their activities as being operations on and in systems; that not all processes leading to the final appearance of a musical work take place in only one or in any system. However that may be, the computer has to be programmed in order to be of any assistance, and a program can only be written by one who considers at least part of the work, the processes and the data with which he is concerned, as changes in and states of a system that he has defined.

If the term "composition" is taken to mean "programmed operation on given data", then a computer can "compose" music. If, on the other hand, the providing of the "given data" is taken to be an important part of "composition", then the computer only executes a program, for it can not "give data" as yet. An apparent middle of the way concept of composition programming offers itself: Let all of the data which the composer provides define the initial state of the computer system; let one part of the composer written program instruct the computer to adopt this initial state and then operate on it, so that the results of this operation can be used as "given data" by another part of the program; under control of a third program segment, every now and then, let some state of the system be interpreted and operated on as the next initial state; finally, let a fourth section of the program select from system-states lying between these "initial" ones, those that are to appear as results in the output. This section also instructs the machine as to the format in which the output is to appear.

Here the composer defines a point of departure and the various processes and algorithms by which "given data" are to be generated and operated upon and by which results are recognized and notated. It is quite correct, in such a case, to say that the computer generates the result of the composition, the piece, but rather careless to conclude that the computer composes it. Even without a machine the composer working at his desk with pencil and paper on a musical score, generates the finally notated result under control of some rules, conditions, stipulations, premises, liberties, memories, chances and so forth, all of which interact in ways that reflect a system, known or not known as such to the composer, which he considers his plan and idea of composition. This compositional concept initiates, accompanies, controls and eventually stops the process of generating data and results, but is not identical with it.

Every musical idea implies the system in which its acoustical realization may become its structural analogy. The compositional process begins with an analysis of the implication and continues with a search for, or with the construction of a

system with the appropriate generating potentials. It may just as well be stated here that every generating system also implies the musical ideas which it can represent. Bad composition usually results from some failure in compatibility between idea and generator.

A programmed computer can be a suitable generator if the program has been determined by a composer who is aware of the implications of his musical ideas and of the implications of computer systems. The most important step toward a correct recognition of such sometimes vague and "never heard of" implications is taken when the composer, through knowledge or deliberate stipulation or both, determines the invariants which significantly define his idea and which should be preserved in the generated analogy. Most readily preserved in analogies, and thus by computers, are proportions, relationships, quantities, weighted probabilities, functions, statistics and multivalent simultaneous hierarchies of either permissive or restrictive rules and conditions. In fact, it would mean by-passing the possibilities offered by the machine system if a program were to instruct the computer merely tautologically to code a specified set of determined, discrete data, fixed point by point; one would thus actually degrade the computer to the redundancy of a glorified typewriter. It is admittedly not always clear to the composing programmer whether he, at any given moment of his work, happens to be programming analogies or only tautological coding and bookkeeping procedures. Nor does he who composes without computer assistance always know whether he is creating a coherence of sound where this did not exist before, or whether he just keeps on using an existing one to fill preplanned, plausible slots in an orderly fashion. The difference being that it is usually easier to inspect and to correct a program, than to inspect and correct a composer without getting painfully involved with his "personality".

It is necessary, at this point, to mention that all composers who work with computers continue writing "pencil and paper" pieces which however show that the knowledge of immense possibilities they learned from machines keep encouraging them to look for a "like richesse" in their own minds. No matter how artificial man may make the systems he wishes to work with: their conception, their responses and the wealth of unpredicted questions they raise in man's mind as he contemplates their potentials are certainly not at all artificial, but genuine results of a feedback which provokes visions of unknown territories for research and creation, edging us on to ask for more, while the little conservative skeptics and the big official guardians of culture can only cry yea or nay, their own feed-back being the cud they chew.

The composition of music is an analogy to communication with and within society in the following sense: It refers to a practically unlimited system, namely the acoustical universe. It chooses more or less strictly defined fields of this system as its working ground. It decides on the algorithms which are to control the changes of state in this system. It determines whether a musical message is to consist of interrupted or uninterrupted chains of transformations, whether all the controlling algorithms are to be made known or whether some are to be kept

hidden and elusive. But the most important point is this: A composition of music attempts to be only analog to a communication. It does not attempt to be one. It has all the necessary makings; it obeys all the demands, it adheres to all the rules of communication; but it does not communicate anything but itself. Thus it expressly intends to simulate that which we usually define as "not intended messages", as "manifestations of circumstances", as "natural processes', only that this simulation is intended, and thereby represents and implies a criticism and a correction of conditions as they appear to be and a proposition and plan for conditions as man would rather have them be.

In this sense, the composition of music is much more difficult then one might think at first and, furthermore, will always be just as difficult again the next day. For nothing is sooner lost than new ways and new languages.

To conclude: It simply is not the computer that threatens to replace man, the human brain, the composer. Much rather it should be asked whether these three could eventually learn how to understand and to handle the systems which they themselves have valiantly conquered from chaos; whether man could and eventually would learn how to have discourse with music, with society, -or, at least, with a computer, so that it may slowly dawn on him where, in reality, substitution does threaten. With such knowledge, he then might successfully try to make himself once again, even briefly, appear irreplaceable.