AN AUTOMATED MUSIC PROGRAMMER (MUSPROG)

David F. HARRISON, Music Director, WSUI-KSUI, and Randolph J. HERBER, Applications Programmer, University Computer Center, The University of Iowa, Iowa City, Iowa

A system to compile programs of recorded music for broadcast by the University of Iowa's radio stations. The system also provides a permanent catalog of all recorded music holdings and an accurate inventory control. The program, which operates on an IBM 360/65, is available in FOR- TRAN IV, COBOL and PL/1, with assembly language subroutines and external maintenance programs.

The State University of Iowa (Iowa City) owns and operates two broadcasting stations, WSUI, at 910 KC, and KSUI, at 91.7 MC. WSUI was the first educational radio station in operation west of the Mississippi, and ranks among the oldest stations in the country; KSUI was among the earliest of the frequency modulation outlets in the area to offer programming in multiplex stereo.

In the Spring of 1967, when it became necessary to completely reorganize their recorded music libraries, an investigation was simultaneously underway to determine the feasibility of utilizing automated data processing (A.D.P.) techniques in the discographic operations of the stations. At the time there were several working bibliographic applications (1), ranging from relatively simple record-keeping (Where is...?) to more ambitious cross-referencing and indexing operations, one of which uses the KWIC (keyword-in-context) computer program to classify musical recordings (1). On the basis of the awareness of these applications, and a belief that the intrinsic principles could be utilized and extended to cover somewhat different needs, it was proposed that the facilities of the Uni-

versity Computer Center be employed in the selection and updating of recorded music programs. In designing a coded set of instructions to perform these tasks, it was deemed necessary that any attempt at the selection or compilation of a series of music programs should be made in accordance with certain criteria supplied to the system by the user, and that these selection specification parameters should closely parallel those which would be employed were such an extraction from the total libraries to be performed manually. Additional requisites were that provision be made for updating and enlarging the master file as new items were acquired, and that the coding of the programmed instructions should be sufficiently flexible to permit inclusion of supplemental criteria as they became desirable.

The above proposal met with a certain degree of opposition, the main bone of contention being that such an application would necessarily "dehumanize" music programming. There have been, and will continue to be, similar objections raised by those who are unaware of the advantages offered by A. D. P. and concomitantly unaware of the mental processes which result in what is commonly referred to as "artistic judgment." It is not the purpose of this article to attempt an exhaustive analysis of such processes, nor to castigate the objectors; it is rather simply to bring forth several basic observations dealing with the problem under discussion.

A contemporary composer-theorist interested in the applications of A. D. P. techniques to the process of musical composition has observed that no paradoxical "almighty force" exists in science, which, in actual fact, progresses by discrete steps which are at once limited but unpredictable (3, 4). The following list of conclusions, although relating specifically to the problems of machine-"created" music, find no less an application to the current problem: Creative human thought is an aggregate of restrictions or choices in all fields of human activity, including the arts. Certain aspects of these judgments can be mechanized and simulated by certain physical mechanisms currently extant, including the computer.

The rapidity of calculation or decision by computer frees human beings from the long and arduous task of manually selecting, compiling and checking of programmed works. The time thus saved can be better spent on such amenities as scripting, with complete performance information and record data, and the always-too-necessary pronouncing aids. Moreover, the computer program can be "exported" to any place similarly equipped to be used by other individuals, or where other programmers are able to alter the algorithm to meet their specific needs.

The Automated Music Programmer (MUSPROG) was interpreted as being a series of steps, the first of which specifies that complete music programs are to be selected in accordance with a table of specifications introduced as data, each card containing information pertinent to a discrete program.

The second step requires that each and every entry in the catalog be

checked for availability by any program in the tables established in the preceding step, this status to be determined on the basis of a satisfactory comparison with the individual criteria supplied on the selection specification card. Among these are "tests" (note that a failure to meet the requirements in any step disqualifies the item) to determine when the item was last selected, as well as the number of times selected; a check for allowable time length; a check for duplication of composer and/or title; a statement that stereo recordings are to be used only for FM; a check for acceptable period, style and type of composition; and the decision to update the master file.

In the final operation of the program, each duplicate title of a work selected is also updated, simulating selection to prevent its selection during the next month. If each duplicate were given the date factor of the item actually selected, the latter would tend to appear much more frequently than its companions because the program would continue to select the longest available item, and it is reasonably safe to assume that the selected item is the longest version of the title in question. It was necessary, therefore, to devise a means by which each version of a given work (indicated by both title and composer) be given equal weight for "fair" selection. A unidimensional array called ITEM was constructed with ten positions as follows: ITEM (10)/'0', '0', '0', '0', '1', '1', '1', '2', '2', '3'/. The index of the array was then selected by referencing a routine which generates random, positive integers in the range one through ten. The contents of that position in ITEM are added to the date factor of the record selected, and the result placed in the corresponding field of the duplicate title under scrutiny. Thus there exists a 40% probability that the duplicate will have the same "weight" as the selected item, a 30% chance that the duplicate will be "pushed back" one month, 20% for two months, and a 10% probability that the date factor of the duplicate title will be increased by three months. When all the titles have been thus read or updated, the run concludes.

Figure 1 is the flowchart that is the basic design of MUSPROG and from which the computer program was coded. The program runs on an IBM 360/65 and is available in FORTRAN IV, COBOL, and PL 1 with assembly language subroutines and external maintenance programs. Copies of these programs may be obtained from the National Auxiliary Publications Service (NAPS #00278).

The machine readable catalog system currently employed by the University's radio stations is, on the whole, independent of the record's origin or manufacture. (The catalog number could be considered as nothing more than an indication of a discrete shelf space.) The system was designed to facilitate maximally efficient use of the 80 columns available on a punch card. By utilizing two alaphabetic and two decimal characters ranging from A00 through ZZ99 provision is made for identification of records and tapes in quantities somewhat in excess of seventy-thousand
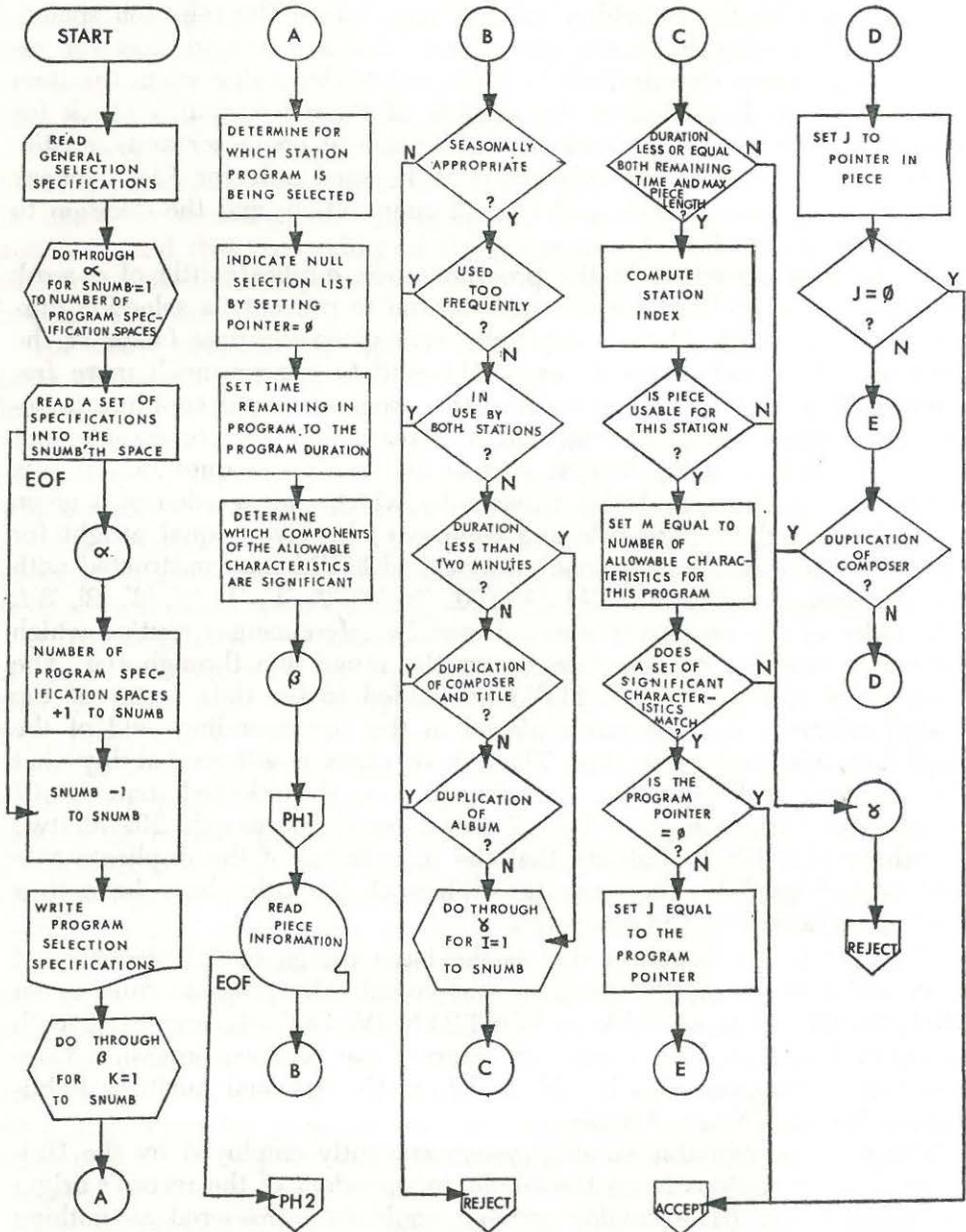
Fig. 1.   Flowchart for MUSPROG.

Fig. 1 continued.

individual discs or reels. The total of actual single titles possible to catalog in this manner is at least twice that number.

The card catalog is made up along more or less standard, triple-reference lines on the familiar 3x5-inch card. These remain in the master card file, but are actually used only for reference purposes, rather than for actual selection. The "real" Master Library exists in the form of punched cards (later transferred to magnetic tape). Each card image contains the following information, with blank columns separating contiguous fields:

Columns

1-10	Composer, or first ten characters if abbreviation necessary.
12-27	Title, abbreviations standardized
29-33	Duration of work in seconds.
35-37	Period of composition.
39-40	Type of composition.
42-45	Catalog number.
47-57	Physical location of item on cataloged disc or tape.
59-64	"Date fields, used for updating and usage factors.
66-69	Seasonal key, a blank indicating general usefulness.
71-80	Field used by MUSPROG for internal record-keeping.

OPERATION

Selection of music by the system is performed in accordance with a table of program specifications which includes information pertinent to the length of the desired program and maximum permissible length of any single work within it, the type of music desired, and additional information, such as date, time and title of the program to be aired and an indication of the station for which the program is to be selected. All the selections for KSUI(FM) are required to be stereophonic. Classification into stereophonic and monophonic groups is a function of the catalog number, A00 through Z99 being stereophonic and AA00 through ZZ99 being monophonic.

A program selection card contains the following data:

Columns

1	Station code: W for WSUI, blank for KSUI
2-6	Duration of program in seconds.
7-11	Maximum duration of each item to be selected (0 or blank indicates program may consist of but a single work equivalent in length to program duration.
12	Number of types being specified.
13-27	Three three-plus-two character fields to specify period and type (MODIA equals "twentieth-century, orchestra"). If any field is blank, MUSPROG assumes anything acceptable.
28-79	Title of program to be selected, day and time.

As an example, the following specifications were made for a program called "Aubade" which was aired at 10:00 a.m. on Tuesday, July 30, by WSUI. Program duration was to be 3400 seconds (56:40), allowing 3:20 for continuity. Maximum length of any single work within the program was to be 900 seconds (15:00). Music could be chosen from the contemporary orchestral repertoire, any instrumental work from the Classic period, or any type "3" work, i. e., soloist and piano, or chorus *a cappella*. Figure 2 shows a printout of selections for two programs.

```
MUSIC SELECTED FOR WSUI      EVENING CONCERT   5:30 PM THURSDAY, JULY 25

  PROGRAM NO. 69 LENGTH  8600 UNUSED TIME IS    1 TOTAL 2:23:19

RANGSTROM   DIV ELEGIACO
     FA41 S2/B2                          0:15:32

PROKOFIEV   SEMYON KOTKO SUI
     KA47 S1-2/E                         0:42:12

BACH        CANTATA 146
     MA19 S1-2/E                         0:42:25

BEETHOVEN   PIA CON ARR VN C
     K847 S1-2/E                         0:43:10


MUSIC SELECTED FOR WSUI      EVENING CONCERT   5:30 PM TUESDAY, JULY 30

  PROGRAM NO. 67 LENGTH  8600 UNUSED TIME IS    0 TOTAL 2:23:20

HAYDN       SYMPHONY 38
     K821 S1/E                           0:13:40

TCHAIKOVSK SYMPHONY 5
     GA50 S1-2/E                         0:42:58

IVES        PIA SON 2 CONCOR
     NA81 S1-2/E                         0:43: 0

BEETHOVEN   STRING QRT 15
     CA12 S7-8/E                         0:43:42
```

Fig. 2   Printout of Selections.

An additional feature of MUSPROG is provision for a periodic summary of library usage, affording the Librarian a concise account of frequently played items, as well as an indication of those works which have been selected infrequently or ignored altogether. This report allows the programmer to assess more accurately the maximum number of times a selection may be programmed before it is declared unacceptable. The system also puts out printed lists of works extracted from the library in accordance with a user-specified table of reference fields: e. g., all symphonies, all works by Bach, all works of under ten minutes in length, all Christmas music; or conceivably, any symphonies by Bach which are

suitable for Christmas and less than ten minutes long. This latter step could also include, with minor alterations in the computer program, provision for performances by one specific ensemble or artist only.

An external program allows adding items to the master tape, deleting those no longer needed and correcting any of the various fields within individual records; thus if mis-timings or other inaccuracies are noted, it becomes a relatively simple matter to correct them.

DISCUSSION

It can readily be seen that "the machine" neither possesses nor displays "taste" in any conventional sense of that word, since it can select only those types of music which the programmer has declared acceptable. It does not, indeed cannot, show any predilection toward certain types of music to the detriment or exclusion of others, save those which have been removed from the list of potential selections by the programmer. It performs no independent judgments. Without doubt, then, there is no logical basis for the cry of "dehumanization," since the program was originally designed by human minds and is, at each step of the process of selection, governed by the human-designed control parameters and program specifications; therefore it cannot select music willy-nilly, but must be told what to do and how to do it. It also has been found that specifications cannot be "plugged in" at random, for the programs thus selected would prove little more than a conglomerate of sundry works bearing no relation to one another. It is very much a necessity that organization and logic be designed into each program to have any coherent programming result. The machine does not "know" what to do unless told.

It should be brought out that because of a built-in logic and the order of titles on the master file the program will tend to select the longest works available to fill the specified program time, making up the difference, if any, with progressively shorter pieces until the time is filled, or until no work of acceptable type and sufficient brevity can be located. Since the longer works tend to occur among certain types and/or styles of music, there may be some tenuous grounds for a suspicion of bias.

It will be observed that MUSPROG does not include information pertinent to performer, conductor, etc. One of the several reasons for this apparent oversight is that such information would, at the outset, have required the use of one to four additional data cards per title. Since this information was not deemed absolutely essential to the immediate functions of the program, it was decided to postpone inclusion of such a refinement to some future date.

CONCLUSION

MUSPROG has been utilized by the State University of Iowa since March, 1968, and has resulted in considerable time-saving. For example, the July, 1968, programming required one hundred and two programs

varying in length from thirty minutes to somewhat over four hours, and consisting of a variety of musical styles and representing a diversity of programming difficult to achieve efficiently by ordinary means. In three minutes and twelve seconds, MUSPROG selected the programs, updated the catalog, checked for duplication of selections, timed each program, and printed out the resultant copy properly headed. At an approximate cost of $250.00 per hour, this comes to less than fifteen dollars per month to perform tasks which might normally require two persons, at perhaps two or three dollars per hour, to work an entire week or more. It is doubtful that even then each catalog entry could be examined and an accurate record of usage be kept.

ACKNOWLEDGMENTS

REFERENCES

1. Wilhoit, G. Cleveland: "Computerized Indexing for Broadcast Music Libraries," *Journal of Broadcasting*, 11 (Fall, 1967) 325-337.
2. Brook, Barry S.: "RILM, Repertoire Internationale de la Litterature Musicale," *Notes; the Quarterly Journal of the Music Library Association*, 23 (March, 1967) 462-467.
3. Xenakis, Iannis: "In Search of a Stochastic Music," *Gravesano Review*, 11 (1958).