KA: A COMPOSITION FOR CHAMBER ORCHESTRA IN ONE MOVEMENT

THESIS

Presented to the Graduate Council of the University of North Texas in Partial Fulfillment of the Requirements

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By

By Christopher R. Morgan, B.M.

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*Ka* is a one movement composition for chamber orchestra consisting of three sections. The work's harmonic, melodic and rhythmic materials are derived from the Chinese *I Ching* ("Book of Changes"). The middle section was composed with the aid of a computer program written by the composer. The program generated the interval sequence arrays forming the harmonic basis for the piece. *Ka* is scored for flute, oboe, Bb clarinet, bassoon, French Horn, trumpet, trombone, three percussionists, violin, viola, cello and double bass. The score is 62 pages with a 39 page analysis preceding the score. *Ka* has a duration of approximately 10 minutes with no pauses between sections.
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INTRODUCTION

This thesis is divided into two sections: (1) a composition entitled *Ka*; and (2) an analysis of the composition. The analysis portion of this thesis explores the compositional techniques and approaches that were employed in the creation of *Ka*. The "Overview of the Work" (pp. viii-ix) points out the fundamental compositional aspects of the work such as the origins of the materials used to compose the piece, the scoring and overall form as well as an explanation of the title. Chapters 1 and 2 give brief histories of important features of the composition. Chapter 3 is a detailed compositional analysis of how the piece was actually composed using these non-musical materials. And finally, Chapter 4 explains in further detail the computer program which was created and used for *Ka*. A bibliography and two appendices follow the analysis.
OVERVIEW OF THE WORK

Ka is a one movement composition for chamber orchestra based on mapping aspects of the Chinese I Ching ("Book of Changes") to different musical parameters. The permutations of the six solid or broken lines making up each of the 64 hexagrams of the I Ching provide a unique compositional environment in which a high degree of atonality can be controlled and structured toward a musical end. The consistent use of the Confucian Ordering of the hexagrams allows for a subtle sub-structure to emerge in the otherwise random harmonic and melodic materials dictated by each individual hexagram. In addition, the trigrams making up each hexagram are used as a source of rhythmic motives to create a connection between the harmonic and rhythmic aspects of this piece.

Ka is scored for fourteen instrumentalists: flute/piccolo, oboe, Bb clarinet, bassoon, C trumpet, French horn, trombone, three percussionists, violin, viola, cello and double bass. Each percussionist is assigned two or more instruments. The first percussion part is scored for timpani and glockenspiel, the second for snare, kick drum and xylophone, and the third for marimba and wind chimes.

The large scale form of the composition is A-B-A. The first and third sections are slow, rhythmically less confined to one meter and more episodic. In contrast, the second section is fast, metrically strict and melodically concise. The outer sections are composed from a harmonic sketch based on the sixty-four hexagrams of the I Ching. With the use of a computer program, the middle section represents a complete listing of the interval sequence arrays based on these hexagrams.

The title “Ka” was taken from ancient Egyptian mythology of the same period as the development of the Chinese I Ching. Webster’s Third New International Dictionary
defined "ka" as follows.

ka [Egypt] the personality double believed in ancient Egypt to be born with an individual and after death to reside in the statue of the deceased in the tomb dependent upon the preservation and nourishment of the body.

A person's ka was the energetic life principle which left the body when a person died. Joseph Campbell explained the connection in his book *Oriental Philosophy: The Masks of God* when he described the purpose behind the elaborate Egyptian burial rituals.

And the function of the cult was to reunite by magic the corporeal soul (ba) and the incorporeal energetic principle (the ka) which had slipped away at death. This done, it was supposed, there would be no death. (Campbell 1962, 80)

The title was also chosen because of its phonetic similarity with an influential orchestral piece by the American composer Eugene Kurtz entitled Ça.

*Ka* was not written as a programmatic listing of the philosophy or images of the individual hexagrams of the *I Ching*. Rather, it was intended as abstract music exploring the possibilities of modeling a musical composition on a non-musical artistic structure.
CHAPTER I

HISTORY OF THE I CHING

The I Ching is the second oldest book in Chinese. Twice spared in cultural purgings and book burnings, its importance to Chinese culture and history is beyond calculation. One of its sixty-four hexagrams was often used as the foundation of an entire religious belief system. The composer was particularly interested in the I Ching’s early foundations in philosophical Taoism and the syncretism these two mythologies have shared over the last 3,000 years.

Although the I Ching’s origins are unclear, it is believed to have been developed as a method of divination. A person inquires into one of the hexagrams for advice on how to proceed when dealing with a problem. This advice indicates not only whether to act aggressively or passively, but also how the situation itself is likely to change.

The I Ching is made up of sixty-four hexagrams which are, in turn, each composed of two trigrams. Each trigram is made up three lines which are either broken or solid. These trigrams are thought to have been inspired by the patterns on the back of tortoises. The text of each hexagram begins with a short aphorism and proceeds into more detail based on which of the lines are considered “moving”. A moving line is determined during the selection process to be in one state (solid or broken) but likely to change into its opposite state thereby changing the identity of the hexagram. In this case, the individual also reads the other hexagram. (Cleary 1986, xiv)

The hexagrams are not ordered simply with one hexagram being the next permutation of the previous hexagram. Rather, the ordering that has come down to the present is attributed to Confucius who also wrote commentary on the I Ching. This ordering
takes into consideration the cycle of change in nature so that the last hexagram (64) leads directly back to the first hexagram (1). This characteristic greatly influenced the composer’s decision to investigate the use of the *Book of Changes* as a musical structure.

Below is an example of a typical hexagram in the *I Ching*.

![Hexagram 52: Mountain](image)

### 52. MOUNTAIN

Mountains stand back to back. If you do not recognize yourself, and while going through the yard do not see the people, there is no blame.

**Overall Judgment**

Mountains represent stopping. When it is time to be still, then stop; when it is time to act, then go ahead. When action and stillness do not miss their timing, the patch is illumined. Mountains mean stillness, in the sense of stopping or staying in the appropriate place. When those above and those below are opposed to each other, they do not have anything to do with each other. This is why there is no blame when you do not recognize yourself and do not see the people while going through the yard. (Cleary 1986, 116)

A hexagram is chosen by a combination of chance (tossing coins or yarrow sticks) and holding to the belief that there are really no chance events in the universe. The process of determining which of the 64 hexagrams applies to the circumstances of the questioner is therefore unique to each person and situation. The seeker is instructed to meditate over the question for several days. In theory, this action actually influences how the yarrow sticks fall because the seeker’s unconscious mind already knows the answer, and in attempting to inform the conscious mind of this, influences the way the sticks fall.
The sticks are thrown several times to determine each of the six lines and also which of the lines are "moving".

After the hexagram is determined, the questioner finds the hexagram in the *I Ching* and studies the selection. The text of the hexagram is not intended to give an answer to the specific issue, but rather, to indicate the manner in which to proceed in a given situation. The *Book of Changes* is built on the principle that everything is constantly changing and that each situation requires a novel approach for its resolution.

Another view of the *I Ching* comes from Thomas Cleary in his *Taoist I Ching*. In the introduction, he presents the book not as a method of divination but as a daily meditational guide. He espouses reading a hexagram in the morning and another at night before going to sleep. In this way, the seeker is constantly reminded of the processes of decay, growth and constant oscillation from one pole to the other. (Cleary 1986, 327)

Julian Jaynes in his book *The Origin of Consciousness in the Breakdown of the Bicameral Mind* suggests that all practices of divination came about as a result of the absence of internal voices which were thought to be gods. Before the human species had achieved conscious awareness, the right hemisphere which solved problems would be perceived as "voices" by the left hemisphere which contained the language skills. These voices, thought to be gods, faded and conscious awareness arose after they were no longer helpful in dealing with the novel situations of the tumultuous second and third millennium BC. In an effort to hear the voices again, or at least get some sign from the gods, early civilizations resorted to interpreting chance events such as throwing bones and reading entrails of sacrificed animals. It was their belief that these events were not really chance (an unknown concept at the time) and could therefore offer some indication of what to do. (Jaynes 1976, 50)
CHAPTER II

JOHN CAGE’S MUSIC OF CHANGES

A significant twentieth century work making use of the I Ching is John Cage’s Music of Changes. This work was composed at a time when absolute determinism in music was beginning to be challenged both philosophically and sonically by absolute indeterminancy. John Cage bridged the theoretical gap between these two approaches in his use of the I Ching. The musical events were completely determined but their occurrence was governed by chance (tossing of coins). Below is a quote from Glen Watkins’ Soundings.

Beginning in 1951, however, Cage’s infatuation with Oriental philosophy led him to a new liberating structural argument, which in the eyes of many seemed to threaten chaos. Cage, who had begun to work with the concept of the Magic Square, found in the Oriental I Ching (“Book of Changes”) a work that illustrates the generation of random numbers by throwing coins or yarow stalks. Intrigued by the similarity of its philosophy with his own, he set about to write Music of Changes (1951). Each detail of his score was determined by the toss of three coins six times, which directed him to a specific number in I Ching; this in turn sent him to a numbered position on one of twenty-six charts he had devised. Thus a single pitch was determined. The procedure was then repeated in the determination of duration, timbre, and other parameters. The process, while purportedly based on chance, required for the forty-three minute piece, an incalculable number of tosses, a rigorous mathematical method, and a precisely notated score whose directions to the performer were ultraspecific. As Peyser has stated, “The music of changes was to be Cage’s “Structures,” and Boulez himself, who frequently corresponded with Cage at the time, openly observed in an article, “Eventuellement,” that “The direction of John Cage’s experiments is too near that of my own for me not to take note of it.” A piano recital given by David Tudor on New Year’s Day, 1952 which programmed both Boulez’s Second Sonata and Cage’s Music of Changes, vividly registered their compatibility at the time. (Watkins 1988, 560)
Ka also bridges this imagined boundary between chance and determinism. Chance is present because the majority of the sixty-four scales based on the I Ching hexagrams are unfamiliar to most listeners and have the aural effect of randomness. The deterministic foundation for Ka lies in the Confucian Ordering of the hexagrams of the I Ching. The ordering and frequency of the hexagrams and trigrams (in the middle section) create a harmonic environment which, as in Music of Changes, strikes a middle ground between chance (random pitches) and determinism (consistent ordering of the random pitches).
CHAPTER III

MATERIALS AND COMPOSITIONAL PROCESSES

Hexagrams For Pitch in the First and Third Sections

The first and last sections of Ka were freely composed using interval sequence arrays. These interval sequence arrays were derived from the six lines that make up the graphic representations of hexagrams in the Chinese I Ching. Using a process of mapping, the six lines of the sixty-four hexagrams which make up the I Ching determined whether the adjacent pitches of a single seven-note interval sequence array were separated by a whole step or half step. For example, the first hexagram, named Heaven, contained six solid lines stacked on top of each other. Read from bottom to top, a solid line designated a half-step and a broken line designated a whole-step between adjacent pitches. In this example using the Heaven hexagram, the pitches began on C and moved by half steps to F#. Since there were six lines in each hexagram and each sequence began on C (pitch class 0) each interval sequence array contained seven pitches. The first hexagram, Heaven, produced a scale from C to F#. The second hexagram, Earth, contained six broken lines. As a result, a whole tone scale was produced beginning on C. A complete listing of all sixty-four scales based on the hexagrams is given in Appendix A.

Hexagrams For Pitch in the Middle Section

The middle section of Ka was less intuitively composed than the outer sections. It’s aim was to list musically each of the hexagrams. It was the composer’s intent that the
structure be subconsciously perceived by the repetition of certain specific intervallic and color relationships occurring at a fast tempo. Using a computer program written by the composer to aid in manipulating the large number of interval sequence arrays, these arrays (artificial scales) were easily stated in their basic form. Modifying the original program made it possible to couple each array with a parallel statement of a transformation of that array. This added a vertical aspect to the statements of the arrays by providing a changing set of intervallic relationships between the two parallel forms of interval sequence arrays.

The transformations of each interval sequence array were obtained by first listing each array as a pitch class set. The numbers in each pitch class set were then subjected to transformations such as T7 wherein each pitch class number was multiplied by 7. As a result, all half steps were converted into perfect fifths and all whole steps remained at the same pitch class. For example, the first interval sequence array could be stated as a pitch class set.

\[
\begin{align*}
\text{Example 1:} & \quad \text{Heaven interval sequence array.} \\
\text{When multiplied by 7, the array became:} & \quad 0, 7, 14, 21, 28, 42, 49.
\end{align*}
\]

This new interval sequence array was converted back into pitch classes within an octave via a mod 12 function. Example 2 illustrates the final result.

\[
\begin{align*}
\text{Example 2:} & \quad \text{Heaven interval sequence array after T7 transformation} \\
\text{via mod 12 function.} & \quad 0, 7, 2, 9, 4, 11, 6
\end{align*}
\]
To further emphasize the unique interval relationships in each hexagram, the composer sought a means of assigning instrumental color to each hexagram. Given the number of hexagrams (64) and the size of the ensemble (14), it was impossible to devote a specific instrument color to each hexagram. It was also not practical for performance in a fast section to devise 5 or 6 unique timbres through the use of extended techniques for each instrument. The problem was simplified by concentrating on the trigrams.

The sixty-four hexagrams represent the total number of possible pairings of the eight trigrams which, in turn, represent the total number of combinations of three broken or unbroken lines. If each instrumentalist were assigned a trigram, then only eight timbres would be required. However, since two versions of each trigram (the original and the transformation) were simultaneously stated, sixteen unique timbres were required. Certain players were, therefore, assigned two trigrams based on their ability to easily produce unique, readily distinguishable timbres. The muted horn was juxtaposed with the normal horn, the *pizzicato* viola against the *arco* viola, and the violin in its highest register against its lowest register. The resulting orchestration for each statement of the middle section is given in Table 1.

Each time one of these trigrams was present in a hexagram, the timbre assigned to it played the four notes which that trigram dictated. The middle section was scored in 6/8 so that the fourth pitch of a trigram overlapped the first pitch of the next trigram on a dotted-quarter beat. This created a continuous transition from hexagram to hexagram.

To add interest to this texture, the opening rhythmic motif of the first section was used as an ostinato in the three percussive instruments: glockenspiel, xylophone and marimba. Beginning with the last note of their trigram, the rhythmic ostinato was played for one full statement. When a trigram occurred before the completion of the rhythmic ostinato, it simply started over with the final note of the trigram. This created overlapping rhythmic ostinati and served to thicken the texture. In the second half of the middle
section, all of the instrumentalists except the percussionists and the French horn player followed statements of their trigrams with the ostinato.

<table>
<thead>
<tr>
<th>Trigram</th>
<th>Original</th>
<th>Transformed</th>
</tr>
</thead>
<tbody>
<tr>
<td>heaven</td>
<td>glockenspiel</td>
<td>flute</td>
</tr>
<tr>
<td>earth</td>
<td>xylophone</td>
<td>oboe</td>
</tr>
<tr>
<td>first brother</td>
<td>marimba</td>
<td>clarinet</td>
</tr>
<tr>
<td>second brother</td>
<td>high violin</td>
<td>bassoon</td>
</tr>
<tr>
<td>third brother</td>
<td>low violin</td>
<td>French horn</td>
</tr>
<tr>
<td>first sister</td>
<td>pizz. viola</td>
<td>mute F. horn</td>
</tr>
<tr>
<td>second sister</td>
<td>cello</td>
<td>trumpet</td>
</tr>
<tr>
<td>third sister</td>
<td>double bass</td>
<td>trombone</td>
</tr>
</tbody>
</table>

Table 1: Timbral assignments of the trigrams.

All sixty-four hexagrams were stated twice. The first statement utilized the original form plus the T7 transformation. Both forms ascended. The second half of the middle section, following a brief, freely composed break for strings and clarinet, utilized the descending form of the original (begun at C and using the same interval sequence array descending) as well as a descending T5 transformation. The T5 transformation converted half steps into perfect fourths but otherwise did not change the interval sequence array.

Trigrams For Rhythm

Although the rhythmic ideas for most of the piece were intuitively composed, the composer desired to establish some connection between the structure of the rhythmic material and the structure of the pitch material which was determined by the hexagrams.
For this reason, a rhythmic cell was created out of each of the trigrams. Because there was no beginning reference point such as middle C in the case of the pitch mappings, each cell was independent and consisted of three rhythmic values for a trigram. This precluded a direct mapping of pitch and rhythm together since each trigram produced four pitches. A rhythmic motive was therefore created by stating the eight trigrams in order.

As in the case of the Confucian Ordering of the hexagrams, this ordering of the trigrams is not simply a variation on the preceding trigram by the alteration of one parameter (broken or unbroken lines). The ordering, instead, is based on the mythological importance and meaning of each trigram. For example, the heaven trigram (three solid lines) is followed by the earth trigram (three broken lines). These two trigrams, which represent absolutes, are followed by three variations of trigrams with two solid lines (sons) and finally three variations of trigrams with two broken lines (daughters).

This motif appears in the very beginning of Ka as a timpani solo and is stated several times in augmentation and diminution throughout the piece. As mentioned above, it is also used in the middle section of the piece to thicken the texture. Table 2 illustrates the relationships between the trigrams and the resulting rhythmic cells. The eight trigrams are listed by name in the first column, by graphical representation of solid or broken lines in the second column, and in the third column are converted into rhythmic motives.
Table 2: Rhythmic cell assignments of the trigrams.

<table>
<thead>
<tr>
<th>Trigram</th>
<th>Figure</th>
<th>Rhythmic Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>heaven</td>
<td></td>
<td>⧨⧨⧨</td>
</tr>
<tr>
<td>earth</td>
<td></td>
<td>⧨⧨</td>
</tr>
<tr>
<td>first son</td>
<td></td>
<td>⧨⧨</td>
</tr>
<tr>
<td>second son</td>
<td></td>
<td>⧨⧨</td>
</tr>
<tr>
<td>third son</td>
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<td>⧨⧨</td>
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<tr>
<td>first daughter</td>
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<td>⧨⧨</td>
</tr>
<tr>
<td>second daughter</td>
<td></td>
<td>⧨⧨</td>
</tr>
<tr>
<td>third daughter</td>
<td></td>
<td>⧨⧨</td>
</tr>
</tbody>
</table>

Yes
Original Sketch

By using each hexagram to determine two measures of music, a 128-measure sketch was composed from the original collection of sixty-four interval sequence arrays. Two excerpts from this sketch are reprinted below. Example 3 is an excerpt from the first five bars and Example 4 is an excerpt from the final five bars.

Example 3: First five bars of original sketch.

Example 4: Last five bars of original sketch.

Three staves were added to this sketch in order to begin dividing material among the different choirs of the orchestra. The first staff was utilized for woodwinds, the second for brass, the third for percussion and the fourth and fifth for strings. Many of the intuitive compositional processes used in Ka occurred during this stage of expanding the sketch. Example 5 is an excerpt from the first five bars of this sketch.

After expanding the original sketch, the next phase of composition involved orchestrating for the entire chamber ensemble. Many of the original ideas on orchestration needed little adjustment, but significant portions which were originally assigned to
the strings were later given to the woodwinds. Much of what had been composed as a harmonic progression became melodic at this point. Unlike the middle section of Ka, there was no process at work to determine which instruments played which notes of the interval sequence array.

Example 5: First five bars of expanded sketch.

This score was divided at a climactic point to allow for the insertion of the fast middle section discussed earlier in this essay. The treatment of the material of the original harmonic sketch is resumed in the third section. Here it was necessary to vary the orchestrational approach. Less of the original harmonic progression was preserved in favor of creating a more contrapuntal texture with choirs exchanging melodies. Later, portions of the third section were removed and reinserted into the first section to break up the rhythmic monotony which existed there. Example 6 is an excerpt from the final seven bars of the completed score.
Example 6: Last seven bars of completed score of *Ka.*
CHAPTER IV

COMPUTER PROGRAM FOR PITCH MANIPULATION

The middle section of *Ka* was composed with the aid of a computer program written by the composer. The aim of the middle section was to give a musical cataloging of the hexagrams of the *I Ching*. A single listing of all sixty-four hexagrams did not yield a sufficient musical experience; therefore, the program was also designed to yield three transformations. Because of the number of notes involved (1792) the computer program made experimentation simpler and more efficient.

The computer program generated interval sequence arrays from the structure of the hexagrams and consequently, the trigrams, in the Confucian Ordering. The program only contained information (in the form of data statements) for the construction of each of the eight trigrams and the order of their appearance in the *I Ching*. For example, trigram one, *heaven*, was expressed in the program as 0-0-0 and *earth* was expressed as 1-1-1. The “0” and “1” signified a solid or broken line, respectively.

The hexagrams were then constructed as combinations of trigrams. For example, out of the eight possible trigrams comprising a hexagram, the *heaven* hexagram was expressed as 1-1 (two heaven trigrams). The *earth* hexagram was expressed as 2-2 (two earth trigrams).

Running the program generated a list of the hexagrams in the form of sixty-four rows and six columns made up of ones (half-step) and twos (whole steps). Middle C was designated as the arbitrary starting point for the interval sequence arrays which were then constructed when the computer program added the six ones and twos, one after another, to yield a scale of seven notes (including middle C). For example, adding sixty (MIDI
note number for middle C) to 1-1-1-1-1 (Heaven) produced the scale 60-61-62-63-64-65-66 or C-Db-D-Eb-E-F-F#.

Once this portion of the computer program was complete, it was a simple matter to insert a multiplier and rerun the code to transform the scale. The generation and use of these transformations is discussed in Chapter I, section 2. The complete computer program is listed in Appendix B.
APPENDIX A

INTERVAL SEQUENCE ARRAYS
AND TRANSFORMATIONS
Original Interval Sequence Arrays.

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xxvii
T7 Transformations of Interval Sequence Arrays
Descending T5 Transformations of Interval Sequence Arrays.
Descending Interval Sequence Arrays
APPENDIX B

COMPUTER PROGRAM FOR INTERVAL SEQUENCE ARRAY GENERATION
Computer Program for Translating Hexagrams into Interval Sequence Arrays

DIM channels(2000), hexagram(64,2,7)
DIM hextri(64,2),trigram(8,3),trinumber(2),hexpc(64,7),art(128)
DIM hexpan(64),panout(64),hexrc(64,7),tempo(8)
y = 32
FOR x = 1 TO 8
  y = y + 32
  tempo(x) = y
NEXT x
INPUT “Do you need to generate new data? (y = yes)”, answer$ 
IF answer$ = “y” THEN GOSUB 9999 ELSE 100
GOTO 200
100 INPUT “enter input filename for channels: “, inputfile1$
INPUT “enter input filename for rhythms: “, inputfile2$
INPUT “enter input filename for articulation and velocity: “, inputfile3$
INPUT “enter input filename for pitches: “, inputfile4$
INPUT “enter input filename for panning: “, inputfile5$
200 INPUT “Enter outfile name “, outfile6$
REM*********************************************************
REM Pitch Generation Routine
REM*********************************************************
OPEN “I”, #4, inputfile4$
FOR y = 1 TO notes
  INPUT #4, p(y)
  p(y) = p(y) + 60
  PRINT p(y)
NEXT y
REM*********************************************************
REM Rhythm Generation Routine
REM*********************************************************
z = 1
FOR y = 1 TO notes/128
  OPEN “I”, #1, inputfile1$
  FOR x = 1 TO 128
    INPUT #1, channels(z)
    PRINT channels(z)
  z = z + 1
  NEXT x
  CLOSE #1
  NEXT y
REM*********************************************************
REM Channel Selection Routine
REM*********************************************************
FOR x = 1 TO notes/448
OPEN "I", #2, inputfile2$
FOR y = 1 TO 448
INPUT #2, rhythm
d(z) = rhythm
PRINT d(z)
z = z + 1
NEXT y
CLOSE #2
NEXT x

REM*********************************************************
REM Panning Generation Routine
REM*********************************************************
z = 1
FOR y = 1 TO notes/64
OPEN "I", #5, inputfile5$
FOR x = 1 TO 64
INPUT #5, Pan(z)
PRINT Pan(z)
z = z + 1
NEXT x
CLOSE #5
NEXT y

REM*********************************************************
REM Velocity Generation Routine
REM*********************************************************
z = 1
FOR y = 1 TO notes/64
OPEN "I", #3, inputfile2$
FOR x = 1 TO 64
INPUT #3, v(z)
v(z) = INT((v(z)/100)*127)
PRINT v(z)
z = z + 1
NEXT x
CLOSE #3
NEXT y
CLOSE #3

REM*********************************************************
REM Articulation Generation Routine
REM*********************************************************
z = 1
FOR y = 1 TO notes/64
OPEN "I", #3, inputfile2$
FOR x = 1 TO 64
INPUT #3, r(z)
r(z) = r(z)/100
r(z) = INT(r(z) * d(z))
z = z + 1
NEXT x
CLOSE #3

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NEXT y
1000 PRINT
REM******************************************************************************
REM Writing to Outfile Routine
REM******************************************************************************
OPEN "O",#6,outfile6$

z = 1
FOR x = 1 TO notes/7
PRINT #6, channels(z) TAB(10) 1 TAB(20) ticks;
PRINT #6, TAB(30) "ctrl" TAB(40) 10 TAB(50) Pan(z)
PRINT channels(z) TAB(10) 1 TAB(20) ticks;
PRINT TAB(30) "ctrl" TAB(40) 10 TAB(50) Pan(z)
FOR y = 1 TO 4
c = c + 1
PRINT #6, channels(z) TAB(10) 1 TAB(20) ticks;
PRINT #6, TAB(30) ticks2 TAB(40) p(c) TAB(50) v(c)
PRINT channels(z) TAB(10) 1 TAB(20) ticks;
PRINT TAB(30) ticks2 TAB(40) p(c) TAB(50) v(c)
ticks = ticks + d(c)
ticks2 = ticks2 + r(z)
NEXT y
 ticks = ticks - d(c)
z = z + 1
c = c - 1
PRINT #6, channels(z) TAB(10) 1 TAB(20) ticks;
PRINT #6, TAB(30) "ctrl" TAB(40) 10 TAB(50) Pan(z)
PRINT channels(z) TAB(10) 1 TAB(20) ticks;
PRINT TAB(30) "ctrl" TAB(40) 10 TAB(50) Pan(z)
FOR y = 1 TO 4
PRINT #6, channels(z) TAB(10) 1 TAB(20) ticks;
PRINT #6, TAB(30) ticks2 TAB(40) p(c) TAB(50) v(c)
PRINT channels(z) TAB(10) 1 TAB(20) ticks;
PRINT TAB(30) ticks2 TAB(40) p(c) TAB(50) v(c)
c = c + 1
ticks = ticks + d(c)
ticks2 = ticks2 + r(c)
NEXT y
z = z + 1
IF c = notes THEN STOP
NEXT x
STOP
9999 PRINT
REM******************************************************************************
REM******************************************************************************
REM Data Generation Routines******************************************************************************
REM******************************************************************************
PRINT "Please enter the filename for the following parameters followed"
PRINT "by a comma and a 'y' if you need to generate then again."
INPUT "enter filename for channels", inputfile1$,need1$
INPUT "enter filename for rhythms (hexagrams)", inputfile2$,need2$
INPUT "enter filename for articulations", inputfile3$,need3$
INPUT "enter filename for pitch class sets", inputfile4$,need4$

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INPUT “enter filename for panning”, inputfile5$,need5$
PRINT 1;need1$,need2$,need3$,need4$,need5$
OPEN “O”,#1,inputfile1$
OPEN “O”,#2,inputfile2$
OPEN “O”,#3,inputfile3$
OPEN “O”,#4,inputfile4$
OPEN “O”,#5,inputfile5$
REM********************Loading lines into Trigrams****************
FOR a = 1 TO 8
FOR b = 1 TO 3
READ trigram(a,b)
PRINT trigram(a,b);
NEXT b
PRINT
NEXT a
REM****loading trigrams to hexagrams and writing channels to outfile****
FOR c = 1 TO 64
FOR d = 1 TO 2
READ hextri(c,d)
IF needle$ = “y” THEN PRINT hextri(c,d);
IF needle$ = “y” THEN PRINT #1, hextri(c,d);
NEXT d
NEXT c
IF need3$ <> “y” THEN GOTO 9999
REM*************writing outfile of articulations and velocities**********
z = 1
FOR c = 1 TO 64
FOR d = 1 TO 2
art(z) = ((hextri(c,d) - 1)* 12) + 16
PRINT art(z);
PRINT #3, art(z);
z = z + 1
NEXT d
PRINT
NEXT c
9999 REM
REM*************Loading trigrams numbers to hexagrams************
FOR a = 1 TO 64
FOR b = 1 TO 2
x = hextri(a,b)
FOR c = 1 TO 3
hexagram(a,b,c) = trigram(x,c)
PRINT hexagram(a,b,c);
NEXT c
NEXT b
PRINT
NEXT a
REM*************loading hexagrams as pitch class successions**********
FOR a = 1 TO 64
root = 0
hexpc(a,1) = root

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FOR c = 2 TO 4
  d = c-1
  pc = hexagram(a,1,d) + root
  hexpc(a,c) = pc
  root = pc
NEXT c
FOR c = 5 TO 7
  d= c-4
  pc = hexagram(a,2,d) + root
  hexpc(a,c) = pc
  root = pc
NEXT c
NEXT a
IF need4$ <> "y" THEN GOTO 999
REM: loop to check pitch class loading and write outfile
FOR a = 1 TO 64
  FOR c = 1 TO 7
    PRINT hexpc(a,c);
    PRINT #4, hexpc(a,c);
  NEXT c
  PRINT
NEXT a
REM: loop to check pitch class loading and write outfile at T7 transform
FOR a = 1 TO 64
  FOR c = 1 TO 7
    PRINT (7*hexpc(a,c)MOD 12);
    PRINT #4, (7*hexpc(a,c)MOD 12);
  NEXT c
  PRINT
NEXT a
REM: loop to check pitch class loading and write outfile at T5 transform
REM: as descending values
REM: loop to check pitch class loading and write outfile as descending values
FOR a = 1 TO 64
  FOR c = 1 TO 7
    PRINT hexpc(a,c)*(-1);
    PRINT #4, hexpc(a,c)*(-1);
  NEXT c
  PRINT
NEXT a
999 REM
REM******************************************************************************
REM**********************Pan Data Generation************************************
REM******************************************************************************
b = 1

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FOR x = 1 TO 8
FOR y = 1 TO 8
Pan(b) = y + (x * 10)
b = b + 1
NEXT y
NEXT x
FOR count = 1 TO 64
READ hexpan(count)
NEXT count
FOR firstcount = 1 TO 64
FOR nextcount = 1 TO 64
IF hexpan(firstcount) = Pan(nextcount) THEN GOTO 5000
NEXT nextcount
5000 panout(firstcount) = nextcount*2-2
NEXT firstcount
IF need5$ <> "y" THEN GOTO 99
REM********************writing to outfile**************************
FOR x = 1 TO 64
PRINT #5, panout(x)
NEXT x
REM********************loading hexagrams as rhythm successions**************
99 IF need2$ <> "y" THEN GOTO 9
FOR a = 1 TO 64
hexrc(a,1) = panout(a)
FOR c = 2 TO 4
d = c-1
rc = hexagram(a,1,d) * 24
hexrc(a,c) = rc
NEXT c
FOR c = 5 TO 7
d = c-4
rc = hexagram(a,2,d) * 24
hexrc(a,c) = rc
NEXT c
NEXT a
REM********************loop to check rhythm class loading and write outfile**************
FOR a = 1 TO 64
FOR c = 1 TO 7
PRINT hexrc(a,c);
PRINT #2, hexrc(a,c);
NEXT c
PRINT
NEXT a
REM********************Closing outfiles and returning to Main**************************
9 REM
CLOSE #1
CLOSE #2
CLOSE #3
CLOSE #4
CLOSE #5
RETURN
REM************************Makeup of each Trigram**************************
DATA 1,1,1,2,2,2,1,2,2,1,1,1,1,2,1,1,1,2,1,1,1,2,1,1,1,2,1,1,1,2
REM*************************hexagrams 1 through 16*************************
DATA 1,1,2,2,3,4,4,5,1,4,4,1,4,2,2,4,1,6,8,1,1,2,2,1,7,1,1,7,5,2,3
REM******************************hexagrams 17 through 32*********************
DATA 3,8,6,5,8,2,2,6,3,7,7,5,2,5,3,2,3,1,1,5,3,5,6,8,4,4,7,7,5,8,6,3
REM******************************hexagrams 33 through 48*********************
DATA 5,1,1,3,2,7,2,7,6,8,7,5,4,4,3,8,5,3,6,1,8,6,1,1,2,8,6,2,4,8,6,4
REM******************************hexagrams 49 through 64*********************
DATA 7,8,6,7,3,3,5,5,6,8,3,7,3,5,7,6,6,8,8,4,6,8,8,5,3,7,4,4,7
REM******************************hexagrams 1 through 16**********************
DATA 11,22,34,45,14,41,42,24,16,81,12,21,71,17,52,23
REM******************************hexagrams 17 through 32*********************
DATA 38,65,82,26,37,75,25,32,31,15,35,68,44,77,58,63
REM******************************hexagrams 33 through 48*********************
DATA 51,13,27,72,76,87,54,43,85,36,18,61,28,62,48,64
REM******************************hexagrams 49 through 64*********************
DATA 78,67,33,55,56,83,73,57,66,88,46,84,86,53,74,47
REM******************************The eight Tempos*****************************
DATA 64,96,128,160,192,224,256

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LIST OF REFERENCES


Ka

A Composition for Chamber Orchestra
in One Movement

Christopher R. Morgan
(1993)
KA

Instrumentation

Flute/Piccolo
Oboe
Clarinet in B♭
Bassoon
French Horn
Trumpet in C
Trombone
Percussion I - Tympani/Glockenspiel
Percussion II - Snare/Kick Drum/Xylophone
Percussion III - Mark Tree/Marimba
Violin
Viola
Cello
Contrabass

Duration: ca. 10 minutes.