

*M a r c S a b a t*  
*Artificial Music for Machines*

P L A I N S O U N D M U S I C E D I T I O N

*M a r c S a b a t*

*Artificial Music for Machines*

*music for acoustic concert grand piano with MIDI output and electronically-amplified sinusoidal tones selected, generated, and tuned by computer*

PLAINSOUND MUSIC EDITION

## NOTES :

The piano part of the music is to be performed on a concert grand piano with MIDI output, which has been tuned to twelve-tone equal temperament (A-440 Hz). An ideal tuning would minimize the amount of octave stretching due to inharmonicity while still maintaining the piano's natural sound.

MIDI information produced by the piano - pitch, velocity, and controller changes - is to be sent (via an interface) into a computer running MAX/MSP software.\* The three piano pedals should be programmed to send controller messages on MIDI controllers #67 (soft pedal), #66 (sostenuto pedal) and #64 (sustain pedal). Depressing these pedals at any time will then respectively activate the patch changes for PATCH 1 (#67), PATCH 2 (#66), PATCH 3 (#64).

The output of the program consists of two independent channels of sinusoidal tones, to be amplified by two onstage loudspeakers to the left and right of the piano. The electronic sounds require a studio-quality two-channel sound system with monitors capable of producing sinetones as low as 27.5 Hz. If necessary, a subwoofer can be added to achieve the low frequency fidelity. It is especially important that these very low frequencies are physically perceptible in the room as vibrations. The volume of amplification should be balanced equally with the acoustic piano sound in such a manner that the electronic sounds at times blend entirely into the acoustic timbre while at other times producing piercing sounds on the edge of tolerance.

The three patches used in the music are described briefly as follows:

1. Only the 12 highest (MIDI Notes 97-108) and 12 lowest (MIDI Notes 21-32) pitches of the piano and their respective velocities are recognized (all other data is filtered out). Two processes take place in parallel. If one of the lowest tones has been played, the computer determines its frequency and then randomly selects a frequency corresponding to one of its first 24 harmonic partials. (The number 24 has been selected because in a system which considers octave transpositions as serving harmonically equivalent functions it produces 12 distinct microtonal pitch-classes for each of the 12 equal-tempered fundamentals.) The selected frequency is immediately produced on the left channel with a volume proportional to the intensity of the triggering note's acoustic attack. If one of the highest tones has been played, a similar process takes place in which the computer selects a frequency corresponding to one of the first 24 under-tones (frequencies whose theoretic harmonic spectra would contain the higher tone as a partial). These sounds are sent to the right channel.
2. All tones played are recognized by the computer in the order played by the performer (even in the case of a chord, MIDI data is still received sequentially) and the last two notes at any given time are retained in memory. The computer determines the frequency of each tempered pitch and calculates the difference and summation tones produced by these two frequencies. The resulting pitches, which reproduce as sounds part of the psychoacoustic phenomena associated with harmonic perception, are respectively sent to the left and right channels with intensities corresponding to the pianist's performance.
3. All tones played are recognized by the computer in the order played by the performer and the last two notes at any given time are retained in memory. The computer determines the frequency of each tempered pitch and randomly selects an octave transposition within the range of the piano. These new pitches, which are sinusoidal doubles of the equal-tempered pitches theoretically existing on the piano, are sent alternately to the left and right channels.

\*A freely-distributed runtime version of MAX/MSP for Mac OS and Windows is included on the enclosed CD along with the patch for this piece.

# Artificial Music for Machines,

to be played on an acoustic concert grand piano with MIDI output, which is used to initiate the selection of electronically-amplified sinusoidal tones, generated and tuned by computer to the frequencies of various overtones, under-tones, difference-tones, and summation-tones of the piano pitches and their combinations, presenting to the ear some harmonic properties of twelve-tone equal-temperament in the form of variations on Arnold Schoenberg's Op. 25.

"The criterion for the acceptance or rejection of dissonances is not that of their beauty, but rather only their perceptibility."  
- Arnold Schoenberg, Problems of Harmony (1934)

for Stephen Clarke

Marc Sabat

♩ = 144

PIANO

PATCH 1

always to be played without pedal

8

r.h.

15

p

23

8

*p f p fp*

*f fp*

*p*

*fp*

*f*

*p*

*p*

31

*p p f f p fp*

*sf*

*p*

*p*

*f p*

*fp*

*fp*

*fp*

*fp*

40

*f p p*

*p*

*f*

*p*

*sf*

*mp*

*p*

*p*

*f*

48

*p pp p*

*pp*

*p*

*pp*

*pp*

*p*

*pp*

*pp*

55 *poco ritardando*

*sf* *f* *diminuendo*

*sf* *f*

$\text{quarter note} = 96$  *accelerando*

62

*f* *f* *f* *f*

*crescendo*

$\text{quarter note} = 112$

68  $\text{quarter note} = 126$

*sf* *ff* *p*

*ritardando*

*r.h.* *l.h.*

3

73

*p*

*ritardando*

79  $\text{♩} = 96$

8

*r.h.*

16 16 16 16 16 16

85  $\text{♩} = 72$   $\text{♩} = 144$

8

*f*

*f*

*f*

16 16 16 16 16 16 16 16

93

8

*ff*

*r.h.*

*ff* *sf*

16 16 16 16 16 16 16 16

101

8

*l.h.*

16 16 16 16



126  $\text{♩} = 144$

Musical score for measures 126-133. The score is in 3/8 time and consists of four staves. The first staff is a treble clef with a key signature of one flat. The second staff is a treble clef with a key signature of one flat and a box labeled "PATCH 2". The third staff is a bass clef with a key signature of one flat. The fourth staff is a bass clef with a key signature of one flat. The measures are numbered 126, 127, 128, 129, 130, 131, 132, and 133. Dynamics include *p*, *mp*, and *mf*.

134

Musical score for measures 134-140. The score is in 4/16 time and consists of four staves. The first staff is a treble clef with a key signature of one flat. The second staff is a treble clef with a key signature of one flat. The third staff is a bass clef with a key signature of one flat. The fourth staff is a bass clef with a key signature of one flat. The measures are numbered 134, 135, 136, 137, 138, 139, and 140. Dynamics include *sf*, *p*, *pp*, and *ppp*.

141

Musical score for measures 141-148. The score is in 3/16 time and consists of four staves. The first staff is a treble clef with a key signature of one flat. The second staff is a treble clef with a key signature of one flat. The third staff is a bass clef with a key signature of one flat. The fourth staff is a bass clef with a key signature of one flat. The measures are numbered 141, 142, 143, 144, 145, 146, 147, and 148. Dynamics include *p*, *mp*, *mf*, and *sf*.

149

Musical score for measures 149-156. The score is in 12/16 time and consists of four staves. The first staff is a treble clef with a key signature of one flat. The second staff is a treble clef with a key signature of one flat. The third staff is a bass clef with a key signature of one flat. The fourth staff is a bass clef with a key signature of one flat. The measures are numbered 149, 150, 151, 152, 153, 154, 155, and 156. Dynamics include *p*, *sf*, *mp*, *mf*, *fp*, and *p*.

Musical score for measures 157-163. The score is in 16/16 time and consists of four staves. Measure numbers 157, 160, 163, 166, 169, and 172 are indicated above the staves. Dynamics include *p*, *sf*, and *f*.

Musical score for measures 164-171. The score is in 3/8 time and consists of four staves. Measure numbers 164, 166, 168, 170, 172, 174, 176, and 178 are indicated above the staves. Dynamics include *p*, *fp*, and *sf*.

Musical score for measures 172-178. The score is in 12/8 time and consists of four staves. Measure numbers 172, 174, 176, 178, 180, 182, 184, and 186 are indicated above the staves. Dynamics include *p*, *f*, *mp*, *mf*, *fp*, and *f*.

Musical score for measures 179-185. The score is in 13/8 time and consists of four staves. Measure numbers 179, 181, 183, 185, 187, 189, 191, and 193 are indicated above the staves. Dynamics include *p*, *sf*, *f*, *fp*, *f*, *mp*, and *p*.

Musical score for measures 186-192. The score consists of four staves. The time signatures are 23/16, 9/16, 24/16, 19/16, 24/16, 27/16, 5/16, and 16/16. Dynamic markings include *f*, *mf*, *ff*, *fp*, *p*, and *sf*.

Musical score for measures 193-200. The score consists of four staves. The time signatures are 16/16, 3/8, 5/4, 2/4, 3/8, 3/4, 11/8, 2/16, and 1/8. Dynamic markings include *mf*, *f*, *ff*, *p*, and *mp*.

Musical score for measures 201-208. The score consists of four staves. The time signatures are 8/8, 15/16, 9/16, 11/16, 29/16, 2/8, 16/16, 17/16, and 11/16. Dynamic markings include *p* and *pp*.

Musical score for measures 209-216. The score consists of four staves. The time signatures are 11/16, 24/16, 14/16, 19/16, 7/16, 10/8, 26/16, and 27/16. Dynamic markings include *p*, *mp*, and *sf*.



Musical score for measures 245-251. The score consists of four staves. The top two staves are in treble clef, and the bottom two are in bass clef. The time signature changes from 12/16 to 7/16, 9/16, 6/16, 5/16, 6/16, and 4/16. Dynamic markings include *f*, *mp*, and *sf*.

Musical score for measures 252-261. The score consists of four staves. The top two staves are in treble clef, and the bottom two are in bass clef. The time signature changes from 8/16 to 4/16, 8/16, 9/16, 4/16, and 8/16. Dynamic markings include *f*, *sf*, *ff*, and *mf*.

Musical score for measures 257-261. The score consists of four staves. The top two staves are in treble clef, and the bottom two are in bass clef. The time signature changes from 8/16 to 4/8, 6/8, 4/8, and 8/16. Dynamic markings include *mf*, *ff*, and *sf*.

Musical score for measures 262-266. The score consists of four staves. The top two staves are in treble clef, and the bottom two are in bass clef. The time signature changes from 8/16 to 6/8, 4/8, and 8/16. Dynamic markings include *ff*, *mf*, *pp*, and *pppp*.

267

$\text{♩} = 126$

Musical score for measures 267-271. The score consists of four staves: two treble clefs and two bass clefs. The music is in 6/8 time. Dynamic markings include *ppp*, *p*, *pp*, *mp*, and *mf*. There are slurs and hairpins indicating volume changes.

272

$\text{♩} = 144$

$\text{♩} = 160$

Musical score for measures 272-274. The score consists of four staves: two treble clefs and two bass clefs. The music is in 6/8 time. Dynamic markings include *mp*, *f*, *mf*, *p*, and *f crescendo*. There are slurs and hairpins.

275

$\text{♩} = 126$   
*poco pesante*

$\text{♩} = 144$

Musical score for measures 275-279. The score consists of four staves: two treble clefs and two bass clefs. The music is in 4/4 time. Dynamic markings include *ff*. There are triplets and slurs.

Berlin, February-March & June-August 2002