When Harry Met Iannis

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Who Am I?

- ▶ Mathematician / Computer Scientist
- ▶ Computer Performance Engineer
- ▶ Studio Composer
- ▶ Karaoke / Folk Singer
- ▶ Actor
- ▶ Etc.

Who Was Harry Partch?

- ▶ Born 1901, died 1974
- ▶ Composed in a 43-tone Just scale
- ▶ Had elaborate theory behind the scale
- ▶ Wrote theatrical pieces
- ▶ Built his own instruments
- ▶ *Genesis of a Music* (1974), Da Capo Press, New York, ISBN 0-306-80106-X

Partch Concepts in the Piece

- ▶ The Tonality Diamond
    - ▶ Otonality / Utonality
    - ▶ Numerary Nexus
    - ▶ Odentity / Udentity
    - ▶ $1/1 = $ G 392
- ▶ Building your own instruments

Who Was Iannis Xenakis?

- ▶ Born 1922, died 2001
- ▶ Born in Romania, Greek parents, French citizen
- ▶ Most famous work was the Philips Pavilion at the Brussels Worlds Fair
- ▶ Composed for both conventional and electronic instruments
- ▶ Mostly algorithmic composition
- ▶ *Formalized Music* (1992), Pendragon Press, Stuyvesant, NY, ISBN 0-945193-24-6

Xenakis Concepts in the Piece

- Stochastic algorithmic composition
- Electronic instruments

Tonality Diamond for "When Harry Met Iannis"

Partch Terminology

- A pitch is defined as a *ratio* of two numbers
- The numerator is called the *Over* number
- The denominator is called the *Under* number
- 1/1 has frequency 392 Hz (G below A440)
- 1/2 has frequency 196 Hz (G below A220)
- Etc.

Conventions

- ▶ Differs from the version in *Genesis of a Music*:
  - ▶ "lower octave" is pitches *below* G 392!
- ▶ Over or under number is multiplied by powers of two to place pitch in the desired octave
- ▶ Ratios are reduced to lowest terms
- ▶ The numbers 1, 9, 5, 11, 3, 7 are called *Identities*
- ▶ *Otonalities* go up to the right between solid lines
  - ▶ Pitches increase in frequency
- ▶ *Utonalities* go up to the left between dotted lines
  - ▶ Pitches decrease in frequency

Otonality

- An *Otonality* is a collection of pitches with a common *Under* number
- This Under number is called the *Numerary Nexus*
- The *Over* numbers are called *Odentities*
- Corresponds to a "major" key in conventional notation
- Six Otonalities in the diamond, going upwards in pitch

Utonality

- A *Utonality* is a collection of pitches with a common *Over* number
- This Over number is called the *Numerary Nexus*
- The *Under* numbers are called *Udentities*
- Corresponds to a "minor" key in conventional notation
- Six Utonalities in the diamond, going downwards in pitch

Coding of Chords in "When Harry Met Iannis"

- ▶ The piece consists of a sequence of chords from the diamond
- ▶ A chord has four components:
    - ▶ Otonality/Utonality switch: $+1 = $ O, -1 $= $ U
    - ▶ Octave multiplier relative to G 392
    - ▶ Numerary Nexus
    - ▶ List of Identities

Stochastic Composition

- *Stochastic* means that it has random elements
- Any or all elements of a stochastic composition may be random
- Examples go back to Mozart's time, using dice
- Modern stochastic composition using computers started in the late 1950s / early 1960s by Hiller, Isaacson and Xenakis

Structure of "When Harry Met Iannis"

- ▶ The piece starts with the full six-pitch chord (hexad) in the Otonality with Numerary Nexus 1
  - ▶ Bottom Otonality in the diamond
- ▶ Each successive chord is generated by a random transformation of the preceding chord
- ▶ Durations of the chords are generated at random

Major Transformations

- ▶ Flip the Otonality / Utonality switch
- ▶ Go up or down an octave
- ▶ Replace the Numerary Nexus with one of the other five
- ▶ Add or delete one of the Identities

Octave Jumps

- ▶ Pick a direction (*up* or *down*) at random
- ▶ If the new octave would be too high or too low, go the other way
- ▶ Random walk with reflecting barriers

Adding / Deleting Identities

- ▶ Choose *add* or *delete* at random
- ▶ If the new list would have too few or too many, do the other one
- ▶ If adding, add one that isn't already there at random
- ▶ If dropping, delete one at random

Final Chord Generation

- ▶ One of the Identities is chosen at random as the "root" of the chord
- ▶ This "root" is placed in the octave between $1/1$ and $2/1$ for an Otonality and between $1/2$ and $1/1$ for a Utonality
- ▶ The rest of the pitches in the chord are placed in the octave up from the root for an Otonality and down from the root for a Utonality
- ▶ The whole chord is then transposed according to the octave multiplier

Where We Are

- ▶ What we've described so far is the composition process
- ▶ Implemented as a Perl script
- ▶ Output is a score for a computer sound generation language
- ▶ Could be modified to produce scores for other instruments, MIDI with pitch bends, etc.