THEMATIC TRANSFORMATIONS IN THE TRANSFORMATION ENGINE
What is Algorithmic Music Composition?

- **“Algorithmic composition** is the technique of using algorithms to create music.” - Wikipedia

- An Algorithm is a series of operations for accomplishing a task, with the following characteristics:
  - Finiteness - the method must not take forever.
  - Definiteness - Each step must have significance...
  - Input - the method must have valid materials on which to operate
  - Output - the method must produce at least one result
  - Effectiveness - the method must always produce the same output from the same input...
  - (adapted from Gareth Loy, Musimathics, Vol. 1)

- “Many algorithms that have no immediate musical relevance are used by composers as creative inspiration for their music. Algorithms such as fractals, L-systems, statistical models, and even arbitrary data (e.g. census figures, GIS coordinates, or magnetic field measurements) are fair game for musical interpretation.” - Wikipedia
Algorithmic Music
Examples

- Mozart’s *Musikalisches Würfelspiel* (1787)
- Guido’s Hand - (ca. 1026)
- Winkel’s *Componium* (ca. 1820)
Algorithmic Music Examples

- Serial Music - mid 20th Century, especially later developments

- George Gershwin, *Porgy and Bess* (composed under Schillinger’s influence)

Algorithmic Music Examples

- Gottfried Michael Konig - *Project 1 (serial music computer program)* (1964)
- Brian Eno - pieces composed with the Koan Generative System
- Microsoft's patent 5753843 (1998) “A system and process for comprising a musical section in response to a user's interaction with a multimedia presentation is disclosed. The system includes a composition engine, performance engine, and arbitrator...”
Recent Work in Algorithmic Composition

A sampling of titles from the 2009 International Computer Music Conference

- **Hierarchical Markov Modelling for Generative Music** - Chris Thornton, Dept. of Informatics, University of Sussex, Brighton, England
- **Melody Extrapolation, A GTTM Approach** - Satoshi Tojo et al, Japan Advanced Institute of Science and Technology
- **A Symbolic Sonification of L-Systems** - Adam James Wilson, Center for Research in Computing and the Arts, UCSD
- **Perceptually Motivated Sonification of Moving Images** - Jean-Marc Pelletier, School of Media, Keio University, Kanagawa, Japan
- **Lyric-Based Rhythm Suggestion** - Eric Nichols, Center for Research on Cognition, Indiana University
- **Ecosystem Models for Real-time Generative Music** - Oliver Brown, Monash University, Clayton, Australia
- **Artistic Research in “Embodied Generative Music”** - Gerhard Eckel, et al, University of Music and Performing Arts, Graz, Austria
- Generated music based on the planetary motions as they relate to an individual’s birthchart
- Each planet in an individual’s birthchart was represented by a particular instrument: Jupiter - Brass, Saturn - Bass, Mars - Drums, etc.
- Instrumental dynamics were calculated by traditional astrological methods for planetary intensity
- Planetary motions were calculated at the rate of one year of life = one minute of music.
Schenkerian Synthesis in Harmonices Vitae

- Deeper musical structure was calculated based on the notion of “Schenkerian Synthesis”

- Apply Schenker’s analytical technique in reverse:
  
  Instead of analysing an existing piece to obtain foreground and background structures, we synthesize foreground and background structures to create a piece.

- In Harmonices Vitae:
  
  - Transiting Planet data called up foreground structures (i.e. motifs, themes) from a pre-composed library.
  
  - Moon progressing through the signs of the Zodiac called up background structures (i.e Voice Leading) from pre-composed voice leading sequences.
Mozart, k457, Voice Leading Reduction
Scriabin, Prelude, op. 15, no. 4
Schenkerian analysis and voice leading reduction

from:
Neumeyer and Tepping, A Guide to Schenkerian Analysis (Prentice-Hall, 1992)
The Transformation Engine is a software program which enables users to apply compositional transformations to musical information in realtime. Its aim is to extend and enhance the abilities of composers of instrumental music in the Western tradition of motivic and thematic composition.

This is a timeline representation of the musical composition, familiar from such programs as Apple Logic or Final Cut Pro. Time proceeds from left to right along the horizontal axis of the window, indicated by bar numbers across the topmost pane.
The Transformation Engine

The Transformation Engine is a software program which enables users to apply compositional transformations to musical information in realtime. Its aim is to extend and enhance the abilities of composers of instrumental music in the Western tradition of motivic and thematic composition.

An important and fundamental feature is that it allows for the artificial separation of Thematic Structure from Harmonic Structure.
Themes, the Engine’s fundamental musical unit, are displayed in several parallel tracks as colored rectangular blocks presenting both a simplified graphic representation of the musical content and a summary of the principal controls.

Each colored block is a pointer to a MIDI recording of the data for the theme it represents.
Harmonic Structure is displayed in a schematic musical notation in a track along the bottom of the window.
The “resultant” is the combination of a theme with a harmonic structure. It is displayed in a schematic musical notation in the central pane of the window.
Global Pitch Transformations

- Harmonization and Re-voicing
  - many modes/scales available
    - Ionian, Dorian, Phrygian, etc
    - Octatonic, Whole-tone, Bitonal
    - Jazz chords, e.g. Dom.7 #9
    - Blues scale
    - etc.
Individual track
Pitch Transformations

- Controls
  - Tessitura
  - Pitch Width - including inversion
  - Voicing
  - Doubling
  - Repeated Notes

- Embellishments
- Resultants of two or more Themes
Types of Transformation

- Temporal Transformations
- Articulation
- Time Scaling - (diminution and augmentation)
- Temporal Distortion

1:02:00, 1.120 - syncopated long and normal
3:00:00, 2.120 - alternating double-time and normal
29:00:00, 2.000 - alternating 1/8s & triplet 1/8s
28:00:00, 1.000 - triplet lilt
APPLICATIONS

- Traditional Composition
- Algorithmic Composition
- Analysis - Resynthesis
APPLICATION TO COMPOSITION

3. Hyper Rondo mm 0 - 65
2. Largo mm 36 ff
1. Moderato mm 94 ff
Analytical Application

- Mozart Piano Sonata Hybrid
- Harmonic Structure from k.457
- Thematic Structure from k.311
Harmonic Structure
voice leading reduction
how much to reduce?
**K.457, EXPOSITION - THEMATIC ANALYSIS (SIMPLIFIED)**

<table>
<thead>
<tr>
<th>Measure #</th>
<th>Theme</th>
<th>Comment</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-8</td>
<td>Principal theme 1 (PS1)</td>
<td>I-V, V-I</td>
<td>C minor</td>
</tr>
<tr>
<td>9-18</td>
<td>Principal theme 2 (PS2)</td>
<td>prominent pedal on I→IV, V7 8 measures, plus two measure codetta</td>
<td>C minor</td>
</tr>
<tr>
<td>19-22</td>
<td>Bridge</td>
<td>begins with repetition of PS1</td>
<td>C minor (I) to V of E-flat</td>
</tr>
<tr>
<td>23-35</td>
<td>Second Subject 1 (SS1)</td>
<td>lyrical, wide range of note durations; extended with unusual C-flat harmony (bVI of E-flat)</td>
<td>E-flat Maj.</td>
</tr>
<tr>
<td>36-58</td>
<td>Second Subject 2 (SS2)</td>
<td>RH and LH in call/answer; German 6th in m.44, 49</td>
<td>E-flat Maj.</td>
</tr>
<tr>
<td>59-66</td>
<td>Closing Subject 1 (CS1)</td>
<td>4 measures long, with elaborated repeat</td>
<td>E-flat Maj.</td>
</tr>
<tr>
<td>67-74</td>
<td>Closing Subject 2 (CS2)</td>
<td>ends with stretto on PS1</td>
<td>E-flat Maj.</td>
</tr>
</tbody>
</table>
HYBRID #1 - “MAPLE LEAF RAG”

- regular phrasing (2+2+2+2...)
- clearly separated “theme sections”
- simple harmonic language
- most passages built from broken chords
BASIC PROCEDURE

- following Thematic analysis of k.457, substitute appropriate “themes” from Joplin’s MLR
- this procedure carried out independently for left and right hands
- tweak Tessitura of LH and RH separately to follow principal tones of Bass and Melody

PS1 becomes

PS2 becomes

SS1 becomes

Tuesday, November 23, 2010
**MikroKosmos 152 Substitutions**

- **PS1**
  - Becomes

- **PS2**
  - Becomes

- **SS1**
  - Becomes

- **SS2**
  - Becomes

**Notes:**
- **MK 152, m.27**
- **MK 152, m16-17**  NB - LH in doubled note values
- **MK 152, m.25**

*Tuesday, November 23, 2010*
Hybrid #3 - K.311

PS1

PS2

SS1

SS2

Tuesday, November 23, 2010
Hybrid #3 - k.311

- stylistically consistent with HS
- voice leading problems more evident
- shorter sonata has fewer and less elaborated themes