# Interactive Intelligent Systems Workshop: Music Constraint Programming (1) Music Theory Introduction

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# Warm-Up

- What is your programming experience (programming languages and programming paradigms)?
- What do you know about music (theory)?
- How can we use computers for making music?

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# Computer-Aided Composition (CAC) I

- User writes a computer program which outputs music (score synthesis)
- Motivation:
  - Speeding up of formalisable compositional decisions
  - Working on a more abstract level (e.g., changes to single algorithm argument may change whole composition)
  - Composer may surprise herself

# Computer-Aided Composition (CAC) II

- Many different CAC techniques exist. Examples:
  - Stochastic processes (e.g., various random distributions, Markov chains)
  - Grammars and automata (e.g., cellular automata, chaotic systems and fractals such as Lindenmayer-Systems)
- Many different CAC systems exist (e.g., OpenMusic, PWGL, Common Music, SuperCollider, Max/MSP)

# Constraint-Based Computer-Aided Composition

- We study one technique, constraint-based CAC
- Main idea: a music theory model for resulting music is defined by rules

# Overview Over Four Lectures

Lecture 1 (today) What do we want to model: introduction to music theory

Lecture 2 Introduction to music representation

Lecture 3 Introduction to constraint-based computer-aided composition

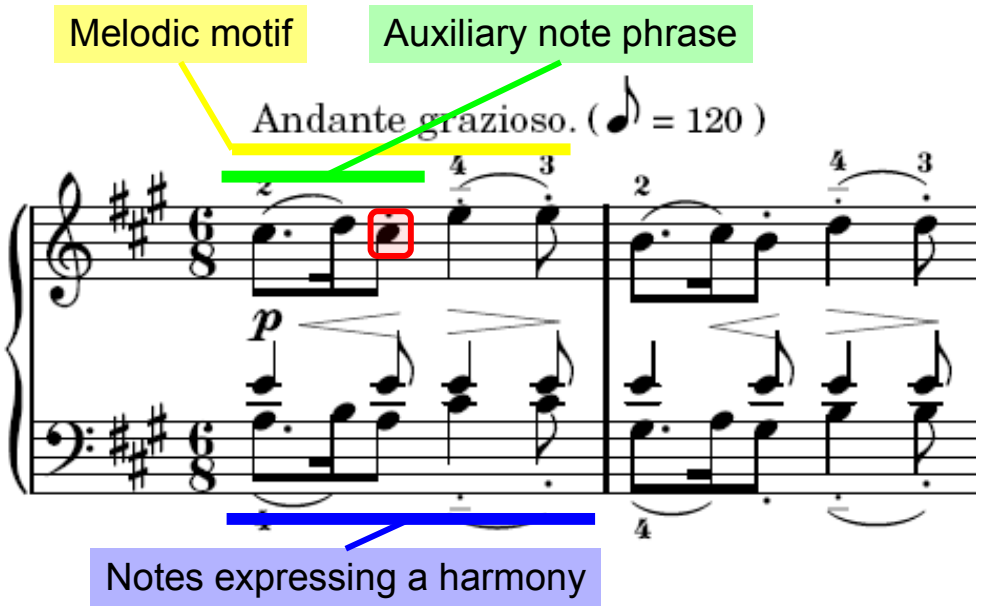
Lecture 4 How to solve musical constraint problems efficiently?

# What Will We Do Today?

- Study fundamental principles: how is music organised?
- Discuss the following music theory sub-fields
  - Counterpoint
  - Harmony
  - Form
  - Instrumentation
- Listen to many musical examples

# Music is Multi-Contextual (1)

A single note pitch (marked red) can play many roles at the same time



# Music is Multi-Contextual (2)

- Music forms a complex net of relations between score objects
- Even single events and their parameters are part of many score contexts (e.g. rhythmical, harmonic, contrapuntal, and formal score contexts)

Different music theory sub-fields study different musical contexts

# Counterpoint Examples

## Examples

- Pérotin (ca. 1200): *Sederunt principes*
- Johannes Ockeghem (1410 – 1497): *Missa Mi-Mi (Kyrie)*

## Task

Listen to two music pieces.

- What is different?
- What is similar?

# What is Counterpoint?

## Definition: counterpoint

Compositional approach where the music consists of melodic lines which 'fit' together.
Also teaching and theory of such an approach.

## Important musical aspects

- Scales and pitch range (orig. vocal music)
- Forming of melodic lines: the rhythmical structure, intervals between two and more note pitches, the melodic contour ...
- Careful treatment of simultaneously sounding intervals

# Counterpoint Rules

- Various, style-dependent rule sets exist
- Rule set can be highly complex: even a single rule can restrict rhythmical and metrical structure, intervals between melodic notes, intervals between simultaneous notes – all at the same time (example: passing tones)
- NB: rules are defined for pedagogical and theoretical purposes, they are *not* laws for the composer

# Counterpoint Today

The development of counterpoint is still ongoing

**Example**

György Ligeti (1923 – 2006): *Lux Aeterna*

# Harmony Examples

## Musical examples

- Claudio Monteverdi (1567 – 1643): *L'Orfeo (excerpt)*
- The Beatles: *Strawberry Fields Forever*

## Task

Listen to two music pieces.

- What is different?
- What is similar?

# What is Harmony?

## Definition: harmony

Compositional approach where the music is based on a harmonic progression.

## Important musical aspects

- Characteristics of individual chords
- Scales defining chords
- Progression of chord roots
- Dissonance treatment (example: V7 -> I)

# Harmony Development

- Compared with counterpoint, harmony developed more gradually
- Its development is still ongoing

## Examples

- Richard Wagner (1813 – 1883): *Tristan und Isolde (prelude)*
- Ben Johnston (born 1926): *Suite for Microtonal Piano, No. 4, Song*

# What is Harmonic Counterpoint?

## Definition: harmonic counterpoint

Compositional approach which combines the notion of counterpoint and harmony: music consists of melodic lines which express a harmonic progression.

## Important musical aspects

- Harmonic aspects (discussed before)
- Forming of melodic lines which together express the harmony

# Example for Harmonic Counterpoint

**Example**

Johann Sebastian Bach (1685 – 1750): *Mass in B Minor, Kyrie II*

# Musical Form

## Definition: musical form

Organisation principles to construct music from musical segments.

## Important musical aspects

- Organisation of the formal micro structure (e.g., motivic organisation)
- Organisation of the formal macro structure (e.g., form parts of a song, development of a symphony)
- Highly style-specific, and various musical forms exist

# Form Example

## Example

Wolfgang Amadeus Mozart (1756 – 1791): *Sonate Opus KV 331 (Theme)*

## Notice

- Motivic organisation (micro structure)
- (Variant of) ABA form (macro structure)

# Orchestration

**Definition: orchestration**

Writing for musical instruments so that the music is (i) playable by the instruments and (ii) specific timbres are achieved.

**Example**

Richard Wagner (1813 – 1883): *Tristan und Isolde (prelude)*

# Homework

Listen to some Classical or 19th century music (e.g., Mozart, Schubert) and try to consciously perceive the following:

- Listen to the bass: it forms a melody of its own
- Where do chord changes happen (e.g., mark them in the air with your arm)
- Listen to the melody: can you recognise repeated or similar form segments (small scale and large scale form segments)

# Summary

- Computer-aided composition (CAC): composer formalises musical intentions and implements them in computer programs
- Constraint-based CAC formalises music theories
- Lecture surveyed important music theory sub-fields
  - Counterpoint
  - Harmony
  - Form
  - Instrumentation