

# Machine Learning and Artificial Intelligence for Musical Applications

## Background

The rise of Machine Learning (ML) and Artificial Intelligence (AI) trends have also made their way into artistic practices and applications. The musical applications of ML and AI diverge from the conventional understanding of Machine Learning and AI because Music, like any other arts discipline, lacks objective measures for comparison. We may not find an objective way to conclude if one musical composition is better than another. Hence, the implementations of ML and AI in Music are different from conventional applications of Machine Learning. The production of artworks using AI systems involve iterative design processes where “errors” are welcomed. Convergence and divergence in the outputs of AI systems guide the evolution of artwork in an interleaved manner.

## Problem Description

Musical tasks can be,

- **Composition:** Generate a musical score, MIDI file or audio that constitutes a piece of music.
- **Assisted composition** systems recommend musical ideas to composers by automatising any sub-tasks of musical composition, such as melody generation, chord generation etc.
- **Interpretation:** Performers interpret a set of musical instructions to produce sounds or generate audio, which we refer to as interpretation tasks. Interpretation tasks also appear in the musical tasks of symbolic (notated) music.
- **Improvisation:** A system that generates music in real time, by itself, or as a reaction to the playing of other (possibly human) musicians.
- **Accompaniment** tasks incorporate following and supporting a leading performer or musical part. Accompaniment task can appear in composition, interpretation and improvisation tasks.
- **Melody, rhythm and harmony** generation tasks appear as sub-tasks of composition, assisted composition, interpretation and improvisation.
- **Continuation** consists of having a musician play or improvise, and the system taking over once the musician stops.
- **Style imitation:** Given a group of similar music, style imitation is to generate new instances that would be

classified as belonging to that musical group by an unbiased observer.

Please select a musical task that you would like to pursue. Then, please choose a family of AI algorithms that you would like to use to partially or completely automate your musical task. The family of AI algorithm can be,

- **Good-old fashioned AI**, i.e. logic-based systems, i.e. expert systems
- **Statistical Sequence Models**, such as Markov Models and Factor Oracle
- **Evolutionary Computation**, such as Genetic Algorithms or Genetic Programming
- **Machine Learning**, for example k-Nearest Neighbours, Support Vector Machines
- **Deep Learning**, Generative Adversarial Networks, Recurrent Neural Networks, Variational Autoencoders etc.
- **Reinforcement Learning**, such as Proximal Policy Optimization, Actor-Critic methods
- **Multi-agent Systems**, such as cognitive or reactive architectures
- **Artificial Life**, such as computer simulations inspired from mechanics of biological ecosystems

The final result of the project consists of a working prototype of a system that solves the chosen task, music generated with this system, and of course a bachelor thesis report describing the system, the process, conclusions, etc.

### **Suggested resources**

Sounds unheard of: evolutionary algorithms as creative tools for the contemporary composer, PhD thesis by Palle Dahlstedt:

[https://www.researchgate.net/publication/270819105\\_Sounds\\_unheard\\_of\\_evolutionary\\_algorithms\\_as\\_creative\\_tools\\_for\\_the\\_contemporary\\_composer](https://www.researchgate.net/publication/270819105_Sounds_unheard_of_evolutionary_algorithms_as_creative_tools_for_the_contemporary_composer)

Google Deepminds WaveNet:

<https://deepmind.com/blog/article/wavenet-generative-model-raw-audio>

OpenAis Jukebox:

<https://openai.com/blog/jukebox/>

Aiva:

<https://aiva.ai/>

Youtube: An introduction to evolutionary algorithms

<https://www.youtube.com/watch?v=L--IxUH4fac>

Videos on AI-generated music:

<https://youtu.be/UWxfnNX1Vy8>

<https://youtu.be/2f20d0LJSuk>

(and many many more)

A "Music Engineering" tracks course project that uses evolutionary algorithms to generate fugues:

<https://github.com/JohannaWarnqvist/FugueGenerator>

MITs music21, a python package for handling music:

<https://web.mit.edu/music21/>

## **Prerequisites**

Knowledge and interest in programming (python is strongly recommended) and mathematics. Other useful skills are knowledge and interest in music theory, musicianship, AI, evolutionary algorithms, statistics, etc.

The report will be written in Swedish

## **Target group**

D, DV, IT, TM or F.

## **Suggestion submitters**

Palle Dahlstedt, composer/artist, Prof. of Interaction Design, CSE,  
[palle@chalmers.se](mailto:palle@chalmers.se)

Kıvanç Tatar, musician/artist, Assistant Professor of Interactive AI, [tatar@chalmers.se](mailto:tatar@chalmers.se)

## **Suggested supervisors**

(same as submitters above)