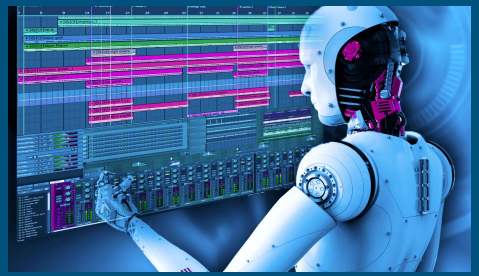
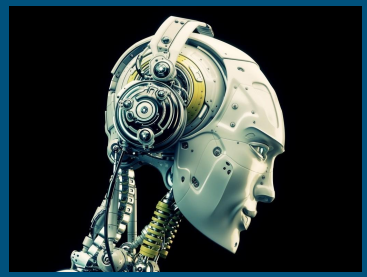


Neural-Knob

ML in Music Technologies

By Sudhin Domala



Background

The music industry embodies many different individuals of skill sets in its workplace from performers, technicians, to distributors.

Technology now is an integrated framework that connects these individuals to the market and to each other via communication, sound engineering, and electronic/digital instruments.

Thus the application of an upcoming but latent form of computing or “Artificial Intelligence” will propel the application of song creation/selection to the next level in the terms of the consumer/artist specifications.

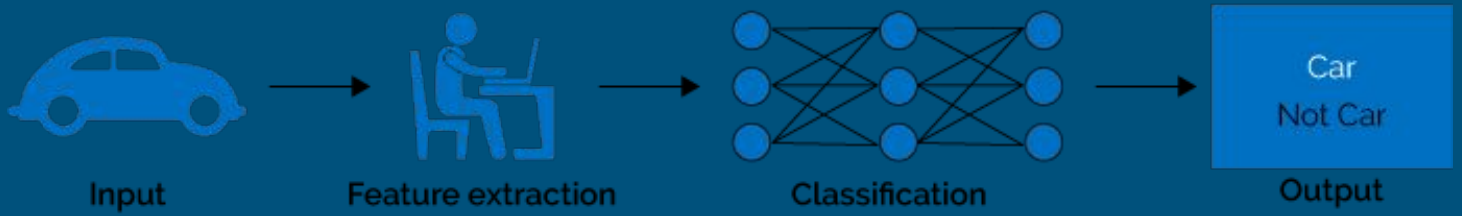
Current Music-Tech Related Ventures

"Flow Machines software learns music styles from a huge database of songs. Then, exploiting unique combinations of style transfer, optimization and interaction techniques, it can compose in any style."

https://www.youtube.com/watch?v=LSHZ_b05W7o

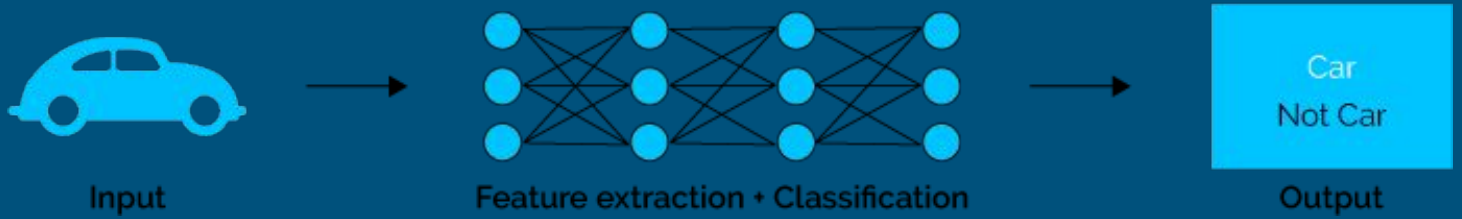
Modern technologies like IBM Watson and Google Magenta have established indicators of "robust understanding necessary to create A.I. music curators and even A.I. music critics." Illustrating the idea of computers being able to break/analyze music down to its components is a principle already applied in Pandora and Spotify. The future of this technology resides in the pursuit that A.I curators and doesn't need to hesitate any no longer.

Machine Learning



Input → Feature extraction → Classification → Output

Deep Learning



Input → Feature extraction + Classification → Output

Target Audience

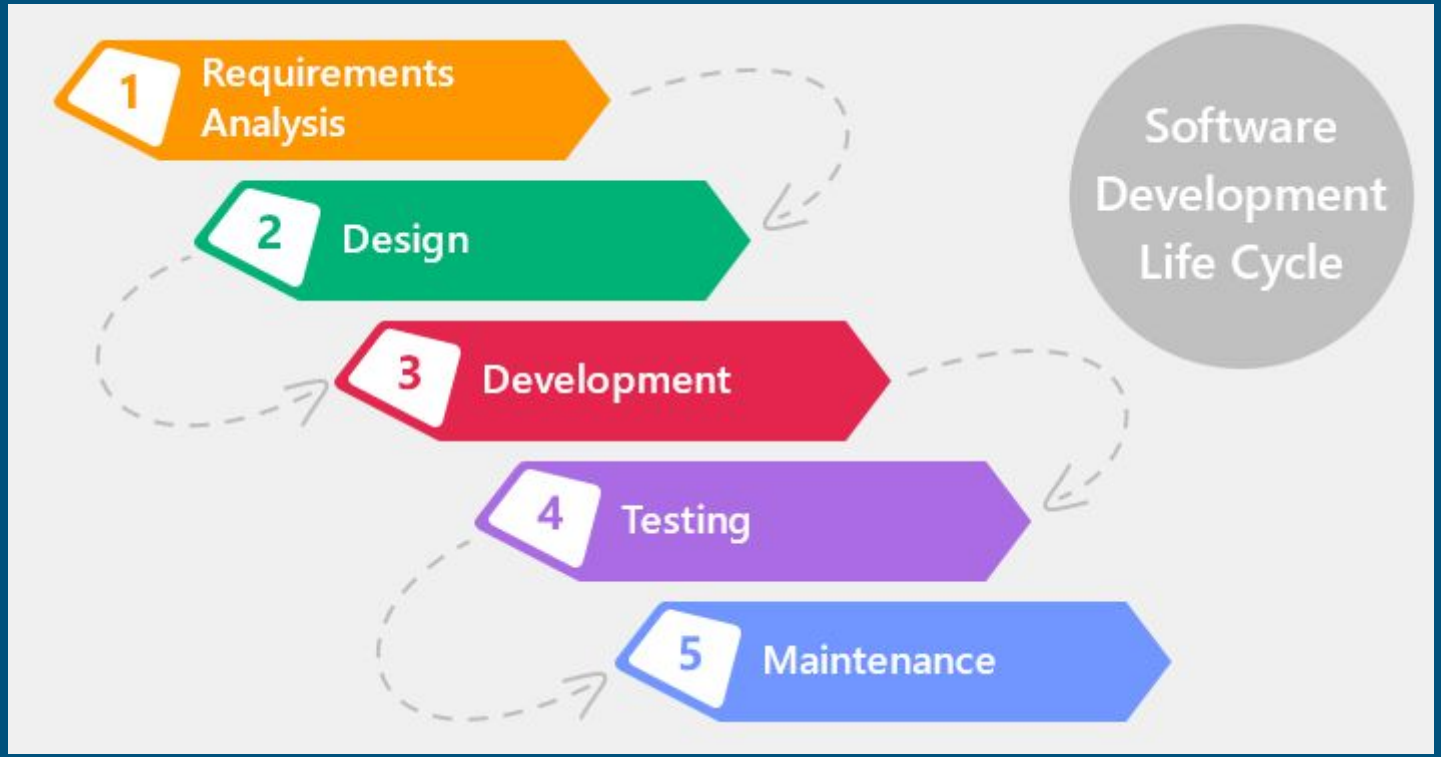
The primary genre for the incorporation of such technology is electronic dance music due to its various computer

-Hardware (synthesizers, portable audio interfaces)

-Software (Digital Audio Workstation and Virtual Instruments plugins).

Given the nature of AI, the project will seek to develop a product around software deployment on consumer machines and follow a general software development life cycle.

Software Development Life Cycle (SDLC). Waterfall Model



Organizational Purpose

This project emulates the extent of computational creativity that one technical concept can have on the entertainment industry and specifically in the music technology sector.

This project's mission is to facilitate EDM artists through the use of AI as a tool to augment human music generation. The core software product will be designed for correlating song proportions to music style, interaction, and optimization under user discretion.

Software Layout and Plugin Extensions

FL studio, Reaper, Ableton, Logic Pro X

Quality Realization

Artificial Intelligence or the progress of Machine Learning has the requirement to be taught proper ethics and company practices in order to be reliable or even viable in such a respected market.

Maintaining a sense of civility, creativity, and equity in the AI system will greatly justify this utilization.

Benefits to the Actual User

Benefits of the software product can be not realized and quality of product use can be undermined given a not tech-savvy audience. Thus to solve this issue, management (for the development Life Cycle) and consulting will be an essential part of this software deployment to provide the best customer service.

By educating the staff to provide commendable and professional consulting services, we can partake to improve a wide range of music industry disciplines down in the road.

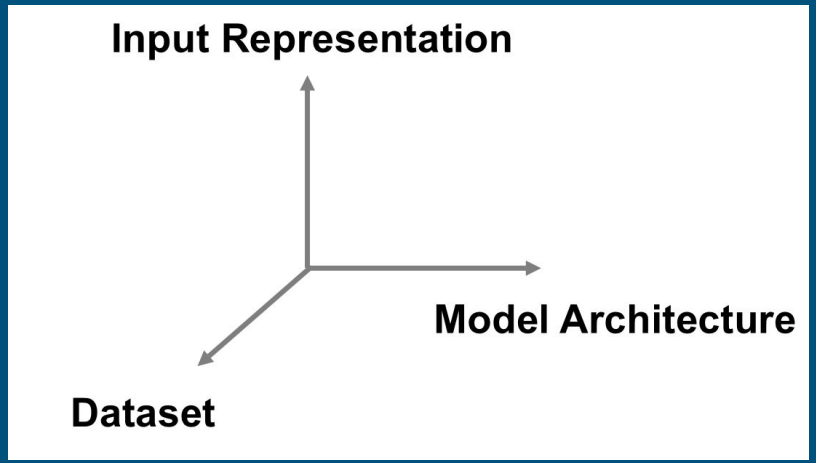
Requirements & Software Design Phase

Innovative Procedures:

Taking note on the technical limitations that may arise in the client's side and following ready-to-follow specifications that meet the needs of clients. Being documented in a problem vision document with a "business vs innovation" criteria in mind.

All in all, The primary idea of this future application needs to be set in stone with requirements gathering to progress in the development cycle without being sidetracked. Questionnaires, interviews or just basic access to current technology preferences are some examples for such client-based information gathering.

Development Phase: Music Similarity Estimation



In terms of input, music can either be a

-melody (single instrument) or polyphony (multiple instruments)

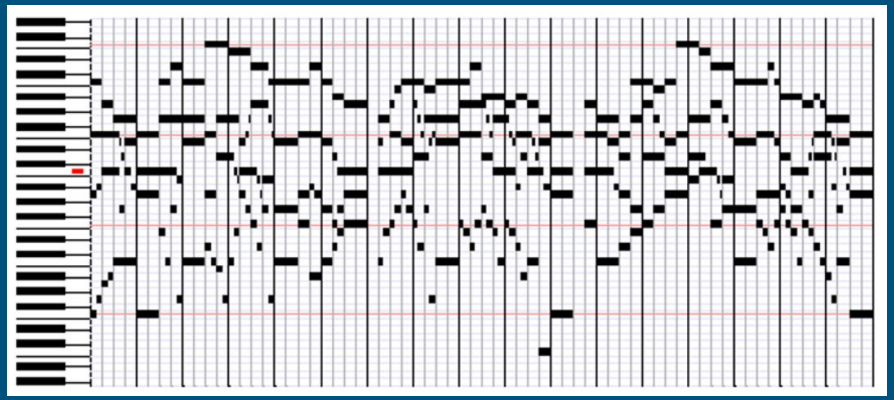
-what degrees are these in accompaniment (being complementary or supplementary to another musical part).

Development Phase: Music Similarity Estimation

In a metric manner, there are various forms of measurement that exist in music technologies depending on the sound from the closest to the natural form (raw audio like wav and mp3) to the fullest semantic meaning (MIDI, ABC, sheet music, etc.). These attributes are all part of the first stage of Machine Learning: Data Pre-Processing.

Example: MIDI Code

“Musical Instrument Digital Interface” (MIDI) is the biggest and easiest factor to quantify and translate for our technology purposes in the EDM sphere (at least). This format can be said to a uniform “sheet music” for various instruments or plugins at the client’s disposal. This format can be codable in the functional sense where u can set actions like setting tempos/notes in event-by-event iterations.



```
midi.Pattern(format=0, resolution=480, tracks=\            #Resolution = 480 TPB
[midi.Track(\
 [midi.SetTempoEvent(tick=0, data=[7, 161, 32]),           #Tempo = 120 BPM = 2 BPS
  midi.NoteOnEvent(tick=0, channel=0, data=[60, 127]),
  midi.NoteOnEvent(tick=0, channel=0, data=[64, 127]),
  midi.NoteOnEvent(tick=0, channel=0, data=[67, 127]),
  midi.NoteOffEvent(tick=100, channel=0, data=[60, 90]),
  midi.NoteOffEvent(tick=0, channel=0, data=[64, 90]),
  midi.NoteOffEvent(tick=0, channel=0, data=[67, 90]),
  midi.EndOfTrackEvent(tick=1, data=[])])])
```

Total ticks = 101
Time per time slice = 0.02s
Ticks per second = Resolution * Tempo = 480 * 2 = 960
Ticks per time slice = 960 * 0.02 = **19.2**
Piano roll width = ceil (Total ticks / Ticks per time slice) = **6**

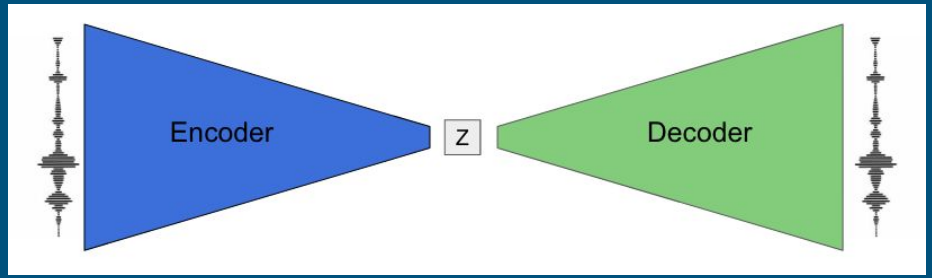
Dataset

Name	#songs	Format	License
Scale-chords	156	MIDI	Scale Chords License
Piano-midi.de (Classical)	124	MIDI	cc-by-sa Germany License
Nottingham (Folk)	1000	MIDI/ABC	GNU GPL v3
Yamaha e-Piano	1400	MIDI	Free
MusicNet	330	WAV	Creative Commons

Model Architecture: Testing & Training

It can be in Sequence-by- Sequence basis where there is an encoder, a decoder, and their own relative lengths to formulate an experimental setup for test output (in units of datasets).

This is where you fetch the sequence (input dataset) to predict the steps that follow. Every time there is a prediction, the weights (significance of each step) changes to “Update” and “Repeat” the observed data to output the desired result (be it a playlist of likable songs/song bites or genre-oriented melody that is most optimal to follow with).

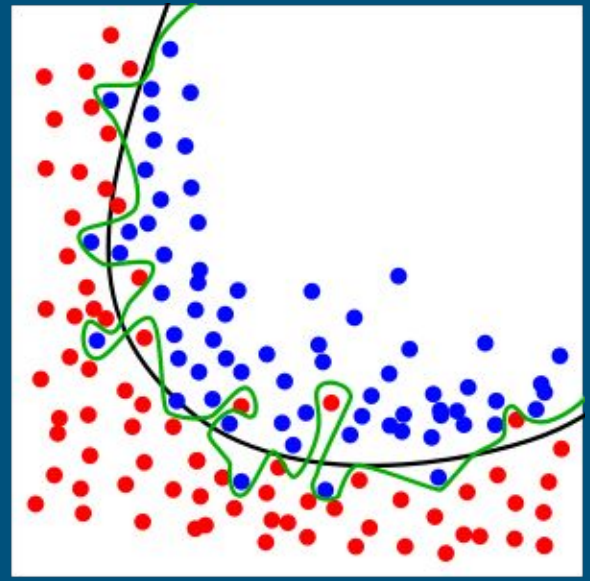


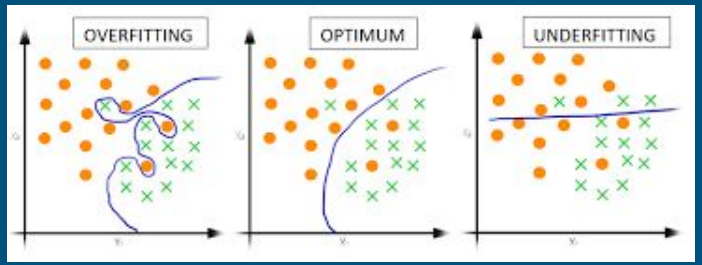
Model Architecture: Overfitting

Overfitting: It is essential to avoid reduced accuracy in where the threshold exists of what music pieces are similar to one another while what aren't.

This can't be overlooked thus giving outlier suggestions to the client that will evidently lead to a lack of customer satisfaction.

Testing phase will be on the task to evaluate which version of the software best fits the user's intentions in finding new music pieces or exploring the nuances of his/her own.





Development Phase: Musician-Machine Interactivity

A prototype software toolkit to enable non-technical users to design artificially intelligent agents (models)

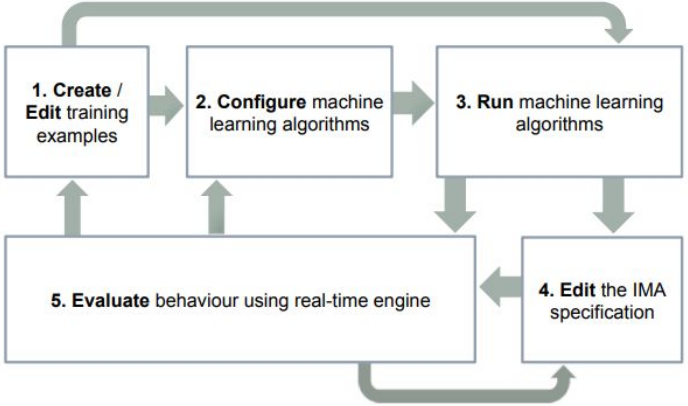


Figure 2. The interactive machine learning workflow supported by the toolkit.

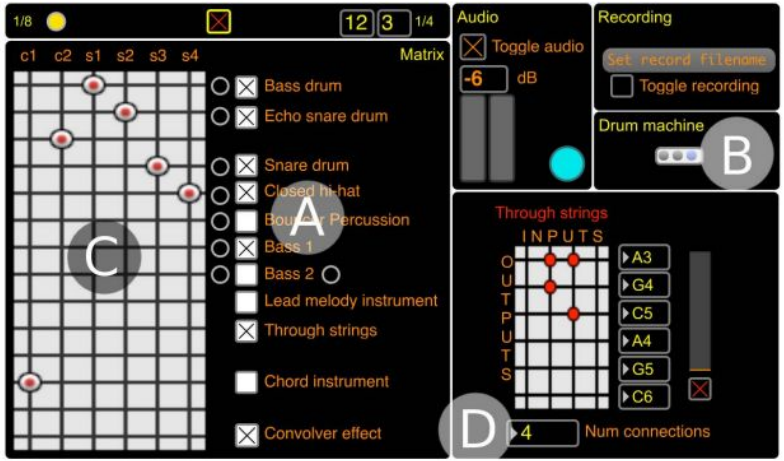


Figure 1. User interface of a software music system which could be controlled by a musician and an IMA in tandem. The labels A-D are referred to in the text.

The Magenta Successor

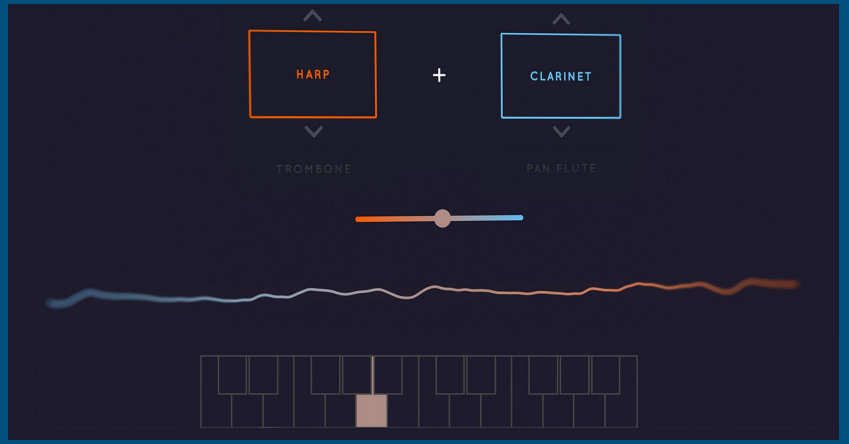
These algorithms partake in Music Theory and this project seeks to expand their applications/framework to robust creations.

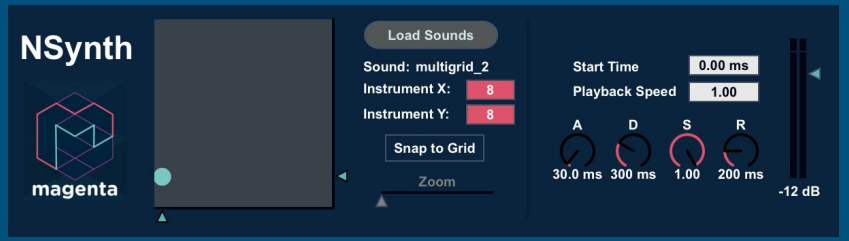
NSynth Algorithm:
https://magenta.tensorflow.org/nsynth-instrument

Performance RNN Algorithm:
https://magenta.tensorflow.org/performance-rnn

an LSTM-based recurrent neural network designed to model polyphonic music with expressive timing and dynamics.

Note-off, note-on, time-shift , velocity events in every MIDI pitch





Project Development Strategy

Database & Automation Design

Prototype Testing & Evaluation

Product Cycle Modifications (Maintenance Phase)

Employee Allocation: Engineering vs Management vs Consulting

Return on Investment: Sponsors, Angel Investors, and returning/concurrent users

Copyright Infringement and Other Problems

Music Subjectivity

General Computation Obstacles:

- AI is mainly in the research sector
- Translating to practical user or consumer packaging

Open Source (Frameworks/APIS) vs Revenue Opportunities

Thank You

Any Questions?