https://github.com/alexanderlerch/2024-AI-and-Music

artificial intelligence and music

an overview

alexander lerch

Georgia Tech Center for Music Technology
College of Design

about
about me

Georgia Tech Center for Music Technology
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- **education**
  - Electrical Engineering (Technical University Berlin)
  - Tonmeister (music production, University of Arts Berlin)

- **professional**
  - Associate Dean for Research & Creative Practice and Associate Professor at the School of Music, Georgia Institute of Technology
  - 2000-2013: CEO at zplane.development

- **background**
  - music information retrieval (20+ years)
  - audio algorithm design (20+ years)
  - commercial music software development (10+ years)
  - entrepreneurship (10+ years)

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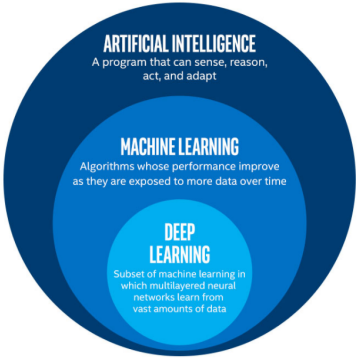
introduction
artificial intelligence

- **artificial intelligence**
  - unclear definition: everything that is perceived to act intelligently
  - changes over time
- **machine learning**
  - data-driven: algorithm is more agnostic to task and is parametrized through training with data
- **deep learning**
  - deep neural networks are 'the algorithm'



machine learning
importance of data

machine learning: generic algorithm mapping an input to an output

- mapping function is learned from patterns and characteristics **from data**

⇒ model **success largely depends on training data**

- **technical challenges** concerning data
  - *imbalance & bias* (data distribution is skewed, biased)
  - *diversity & representativeness* (data does not reflect target distribution)
  - *subjectivity* of annotations
  - *noisiness* (bad quality, bad annotations, unrelated data points, ...)

https://imgs.xkcd.com/comics/machine_learning.png

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machine learning categorization based on output types

- **classification**:
  input data is categorized into pre-determined output categories (e.g., music genres)
- **clustering**:
  input data is grouped into prevalent clusters (no pre-determined categories)
- **regression**:
  predict a numerical value based on an input (e.g., estimate how danceable a piece of music is)
- **generation**:
  input is control data, output is target data (e.g., a composition)

introduction
chain of musical communication

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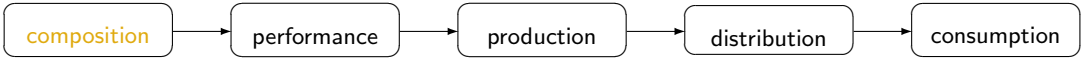
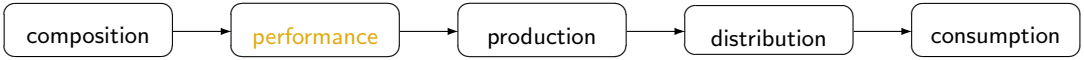


- **creation of musical ideas** ("score")
  - defines style and idea
- **realization of musical ideas** into acoustical rendition
  - interpretation, modification, addition, and dismissal of score information
  - unique acoustic representation of score
- **recording, mixing, and editing** (in case of record media)
  - editing and splicing of recorded data; timbre, equalization choices
  - not separable from performance in a recording
- **distribution & listening**
  - music recommendation and discovery

introduction
chain of musical communication



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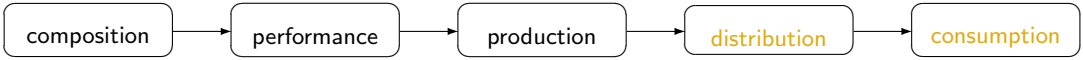

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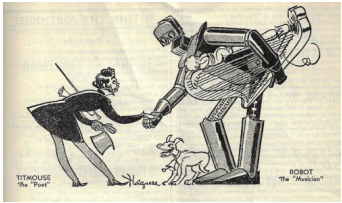
introduction

musical communication and AI

composition → performance → production → distribution → consumption

- **composition**
  - intelligent assistance, e.g., ideas, auto-arrangements
  - automatic composition
- **performance**
  - interactive music education systems
  - generation of 'human' performance
- **production**
  - auto-edit and auto-mix
- **distribution**
  - match music style and consumer
- **consumption**
  - intelligent music discovery & adaptable music

- example:
  DeepBach



longstreet.typepad.com/thesciencebookstore/2017/06/the-invasion-of-musical-robots-1929

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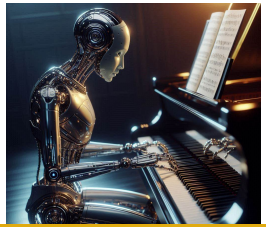
- example:

  Hatsune Miku

  Shimon



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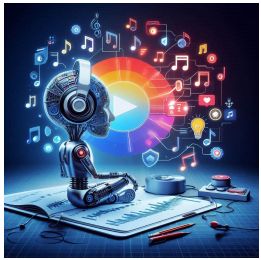

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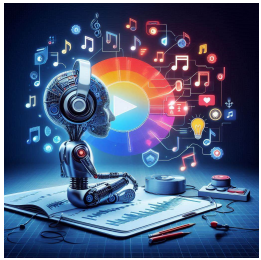

challenges

challenges in (music) ai 1/2

- **ethical considerations**
  - training data (copyright, privacy)
  - responsible system usage
  - addressing bias
- **economic impact**
  - understanding the implications for music professionals
  - adapting to new business models and revenue streams
- **quality and auhenticity**
  - plagiarism
  - balancing novelty and predictability
  - hallucination

challenges

challenges in (music) ai 2/2

- **sustainability**
  - energy consumption
- **ownership and copyright**
  - protecting rights of content creators while democratizing the creative process
  - navigating complex copyright laws
  - accountability
- **regulatory framework**
  - fair use terms
  - transparency and interpretability
  - labeling of ai-created content
  - public perception

thank you!

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links

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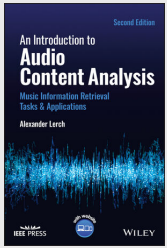
book: www.AudioContentAnalysis.org

music informatics group: musicinformatics.gatech.edu



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