

AI Music Generation

Report Name	Project Outline
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Project Description

The "AI Music Generation" project is a pioneering initiative to transform the process of music creation and comprehension using artificial intelligence technology. This project's objective is to utilise the computational power of Markov chains to evaluate a massive library of MIDI files from great composers, extracting the essence of their musical genres to make new, creative songs. By focusing primarily on Markov chains, this research examines the potential of probabilistic models in capturing and recreating the intricate patterns inherent in music production [1]. In addition, I referred to this tutorial [2][3] for the program's starting point.

As the realm of music intertwines with the ever-evolving area of AI, the necessity for a complex yet accessible approach to music generation becomes clear. The "AI Music Generation" project is aimed to satisfy this requirement by going deep into the physics of Markov models, guaranteeing that every note created is a step towards bridging the gap between human creativity and artificial intelligence.

The project will commence with a detailed data preparation process, where MIDI files are turned into a structured format appropriate to Markov chain analysis. This entails recognising and classifying musical characteristics such as melody and harmony, which are necessary for teaching the AI to recognise and mimic various composer styles.

The primary development phase will involve designing and modifying the Markov chain model, focusing on establishing a delicate balance between randomness and determinism to generate creative, cohesive, and artistically compatible music with the composers' original compositions.

In addition to generating music, the project aims to provide a user-friendly interface that allows users to engage with the AI, set preferences, and compose compositions in real time. This interactive feature will democratise access to AI-generated music and give crucial data about user participation and preferences, driving future advancements to the AI model.

By completing the "AI Music Generation" project, the objective is to have established a new standard for AI in creative sectors, demonstrating the capability of Markov chains in making music that resonates with the complexity and depth of human compositions. This attempt is not simply a testament to the potential of AI music creation but also a step forward in the continuous discourse between technology and the arts, opening doors to future research and advancements in the field.

Proposed tasks

The following tasks are the proposed tasks of this project:

Investigation of Data Preparation and Model Build Process: - Conduct a full assessment of MIDI data collection, concentrating on acquiring a broad group of compositions. The assignment will entail preprocessing MIDI files to identify significant musical features (notes, rhythms, chords) needed for training the Markov chain model. This stage verifies the basic data matches with the project's aims to imitate composers' styles appropriately. For the Python libraries, Numpy and Music21 are going to be used, but there can be some changes during the process.

Setting Up Local Build Environment and Version Control System: - Establish a local development environment customised for AI music creation, employing the university's GitLab server for source code management. This setup will comprise establishing the development tools and libraries essential for Markov chain implementation and adopting git instructions for version control. This architecture facilitates efficient development and collaboration, maintaining code integrity and progress monitoring.

Development: - Engage in the iterative development of the Markov chain model for music production, from basic coding to refining algorithms that assess and recreate composers' musical styles. This step covers the integration of the model with a user-friendly interface, allowing users to engage with the AI to make music depending on provided criteria or preferences.

Project Meetings: Weekly Supervisor Meeting: - Maintain a schedule of weekly meetings with the project supervisor, allowing chances to monitor progress, discuss difficulties, and modify project directions. These monthly check-ins are critical for obtaining direction and ensuring the project remains aligned with its objectives and milestones.

Preparation for Demonstrations: - Plan and prepare for two significant demonstrations of the project's outcomes. The mid-project demonstration, expected around Easter, will display the early capabilities of the AI to make music, demonstrating the usefulness of the Markov chain model in capturing and replicating various musical genres. The final demonstration, following the completion of the Final Report and technical development, will offer a more thorough overview of the system's capabilities, including additional features for user interaction and the production of complex compositions. This final presentation highlights the project's success in accomplishing its objectives and the possibility for future applications and upgrades.

Project deliverables

Mid-Project Demonstration Notes: These notes will outline the progress and conclusions made during the mid-project showcase. They will discuss the basic capabilities of the AI system, including how the Markov chain model has been employed to make music based on learning composers' styles. The paper will also detail obstacles faced, solutions applied, and the comments received, laying the foundation for succeeding phases of the project.

Program Output: - The application's primary output will be music compositions made by the AI, structured as MuseScore files. This deliverable will demonstrate the AI's capacity to turn the Markov chain model's analysis into actual, playable music compositions. The MuseScore format enables simple sharing, critiquing, and performance of the compositions, highlighting the practical uses of AI's music production skills.

Test - Unit Tests: - Comprehensive unit tests will be built and documented to guarantee the reliability and correctness of the Markov chain model and the entire AI system. These tests will cover many project components, from data preparation to music creation techniques, ensuring each aspect performs correctly and effectively. The unit test documentation will include a complete overview of test cases, outcomes, and any discovered flaws or enhancements.

Final Report: - The Final Report will be a complete document covering the whole project from conception to conclusion. It will describe the AI music-generating system's aims, methodology, development process, and assessment. The report will include appendices for extensive technical details and recognise the usage of third-party libraries, frameworks, and tools that contributed to the project's development. This paper will be a significant reference for understanding the project's scope, problems, and successes.

Final Demonstration: - Although no paperwork will be provided for the final demonstration, it remains a vital deliverable. This event will display the fully developed AI system's capacity to make music that reflects the learnt styles of diverse composers. It will illustrate the system's user interface, the diversity of the music-generating process, and the quality of the output. The final demonstration will be a chance to

demonstrate the project's achievements and possibilities for future applications to a larger audience.

Initial Annotated Bibliography

[1] Shapiro, I. and Huber, M., 2021. Markov Chains for Computer Music Generation. *Journal of Humanistic Mathematics*, 11(2), pp.167-195. doi: 10.5642/jhummath.202102.08.

This offers a basic theorem and the guideline for AI Music Generation using the Markov Chains.

[2] Valerio Velardo – The Sound of AI, 2023. 11. Markov Chains - Generative Music AI Course. YouTube. Available at: <https://www.youtube.com/watch?v=gn-ocUaGY> [Accessed 2 Feb 2024].

This offers a tutorial video of AI Music Generation using the Markov Chains.

[3] Valerio Velardo – The Sound of AI, 2023. 12. Melody Generation with Markov Chains - Generative Music AI YouTube. Available at: <https://youtu.be/V7OPB6zmSdM?feature=shared> [Accessed 2 Feb 2024].

This offers a tutorial video of AI Music Generation using the Markov Chains on Python.