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ALGORITMHIC MUSIC AND SOUND COMPUTING
A.Y. 2023-24

JUST ANOTHER QUANTUM ORCHESTRA

# PROJECT JAQO

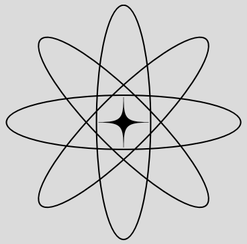
# TABLE OF CONTENT



HTTPS://GITHUB.COM/MUSIMATHICSLAB/JAQO

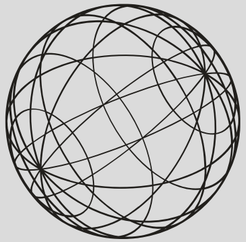
# INTRODUCTION AND MOTIVATIONS

What led us to try and experiment with Quantum Music Generation?



## THE GENERATIVE ART PHENOMENA

AI Generative art is creating a wide number of controversy, in both visual and musical art. We thought it could be interesting to try and do a little step back...



## THE FUTURE OF COMPUTING

...while keeping an eye to the future. Quantum Computing will undoubtebly be the future of computing, and will change the world we know. Better be prepared!

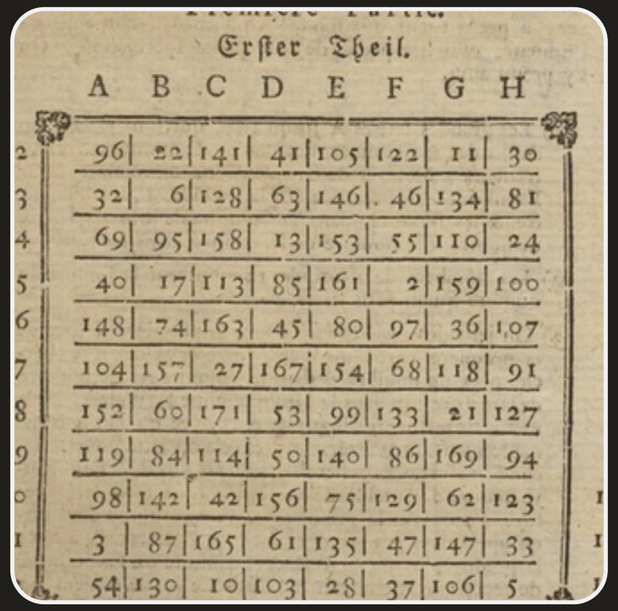
## HAVE FUN EXPERIMENTING

Art and music make our life better. Creativity feeds our mind and soul; if we can achieve something scientifically interesting while having fun, why not doing this?

A quick look at

# STOCHASTIC MUSIC

The term stochastic music refers to the composition of musical pieces by the use of the laws of probability.




## Mozart Dice Game

Even the notorious Viennese musician Wolfgang Amadeus Mozart himself, among the others, is said to have overcame the writer's block thanks to a dice-based composition system.

Fun fact: the system is attributed to him, but he was not even the first composer to try this approach!

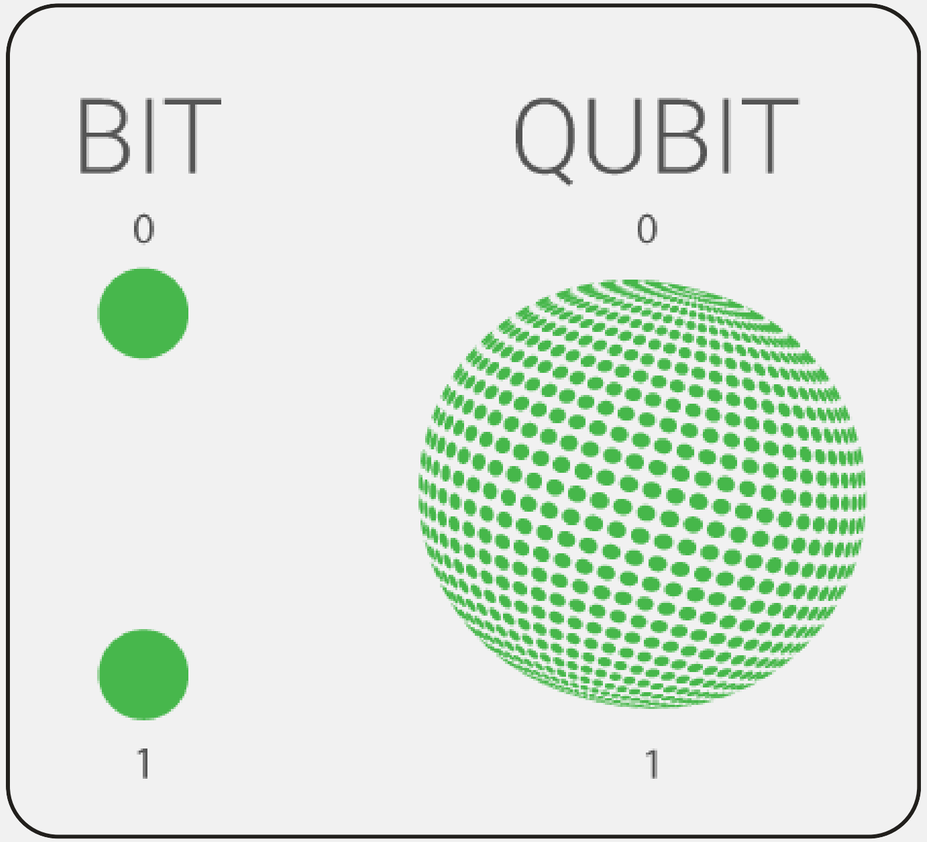

## Xenakis Iannis

Xenakis Iannis (1922 - 2001) was a Romanian avant-garde composer, music theorist, architect, performance director and engineer.

He is widely considered as a pioneer in music, and he experimented with a lot of creative approachs, like stochastic music.

Give him a listen!

# QUANTUM COMPUTING




## QUANTUM GATES

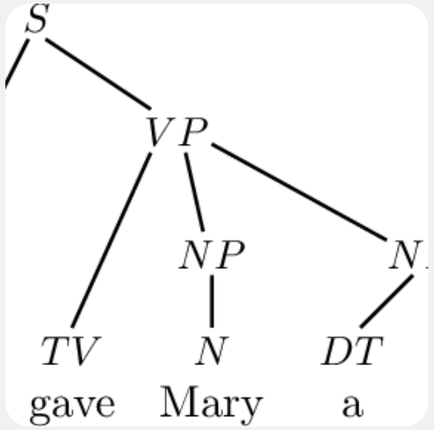
**Hadamard Gate** - initialize qubits in a superposition

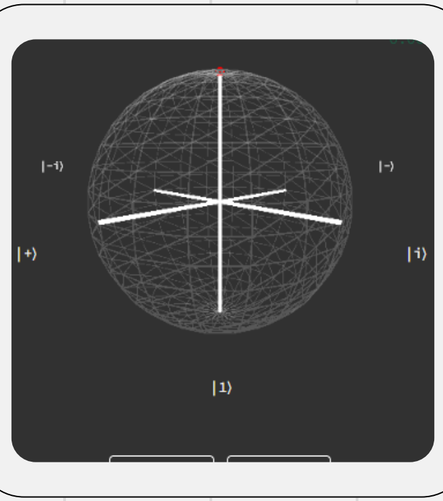
**CNOT Gate** - flips the state of the target qubit

**Z Gate** - rotates the bloch sphere around z-axis by pi radians

**SWAP Gate** - swaps the states of two qubits

**T and Ry Gate** - useful for the rotation of the sphere

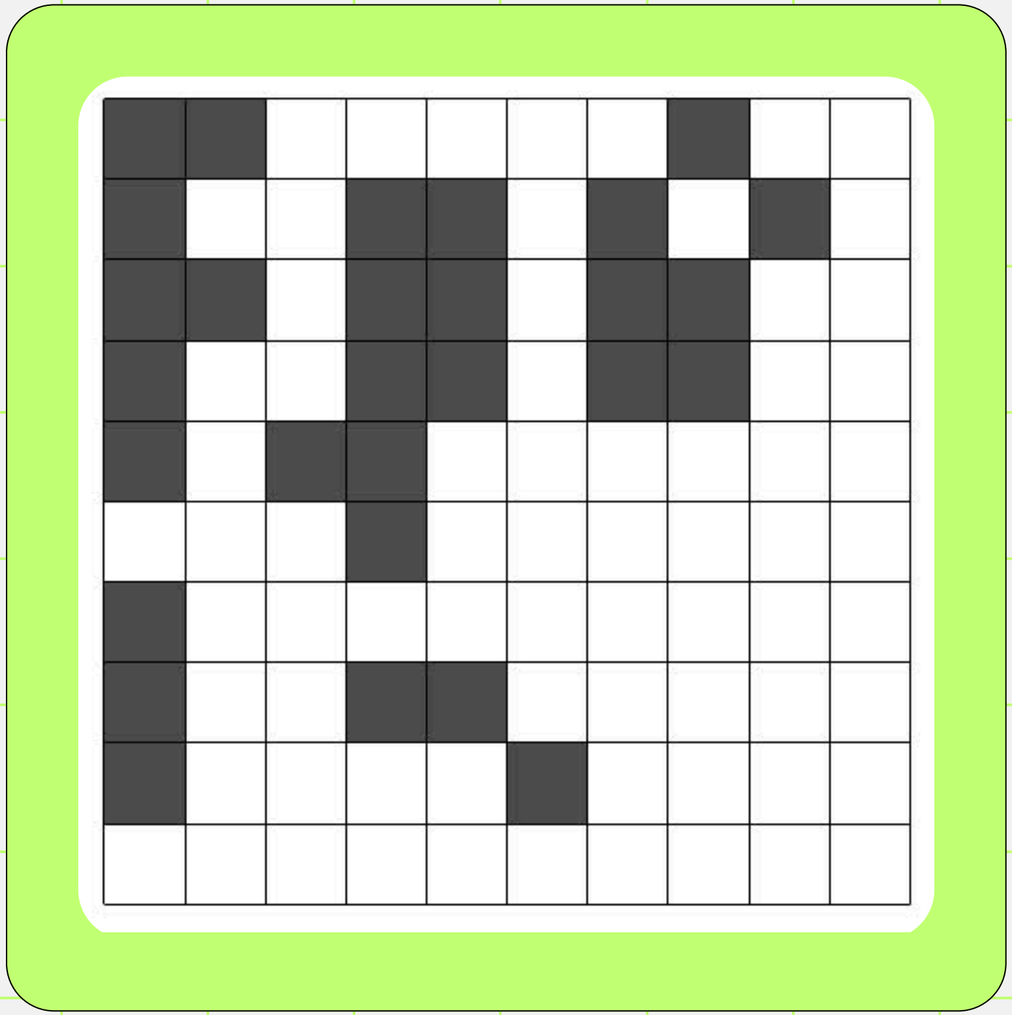



# QUANTUM COMPUTING AND MUSIC

Quantum Computing can have a strong impact on research about algorihmic computer music, encouraging creativity and fun in projects and making possible to *hear* outputs.

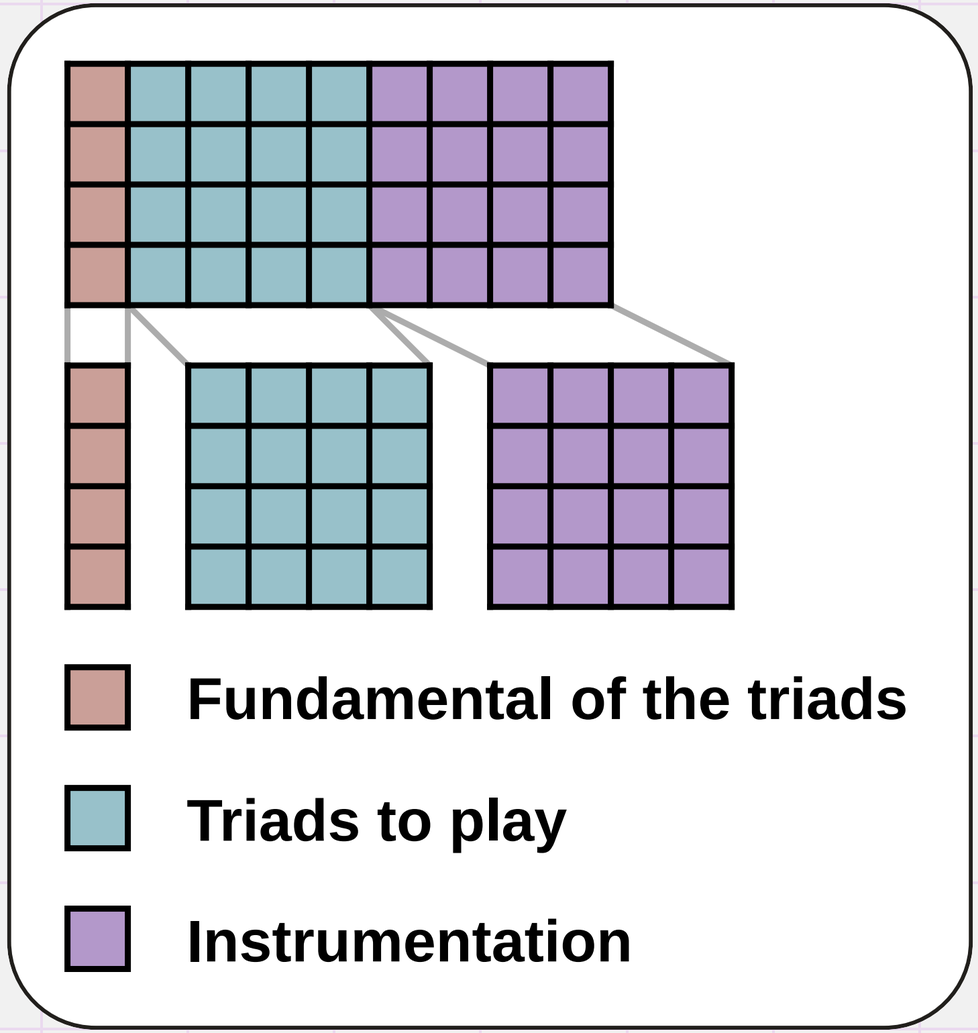
It’s just like magic, but with a scientific added taste!



# CELLULAR AUTOMATA AND PQCA

We all know how cellular automata and, in particulare, Conway’s Game of Life has been used in algorithmic music.
But if we want to make it quantum while guaranteeing good performances?

In literature, an alternative named PQCA has been proposed: the idea is to use the ruleset only on some partitions of the grid, then putting everything together thanks to update frames.

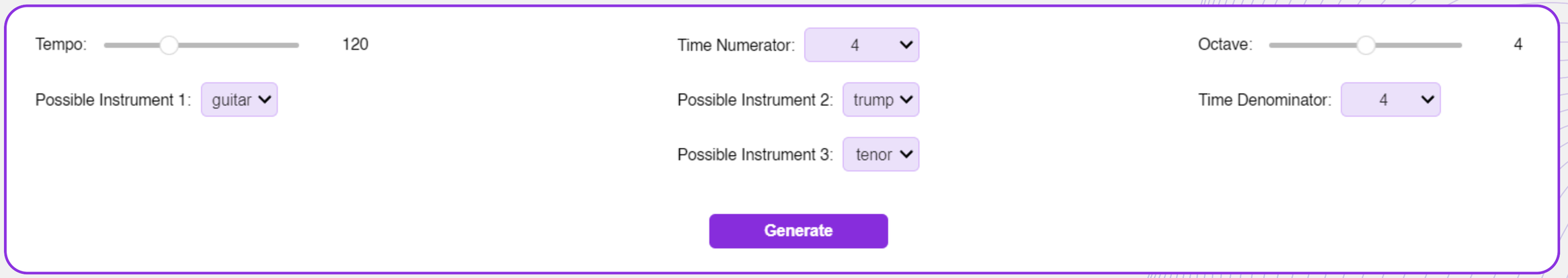



Straight outta 1991

# THE CAMUS PROTOCOL

# PROJECT JAQO

# MAIN TWEAKS AND FIXES




**Snap to Scale** - let’s make sure that notes stay in tune!

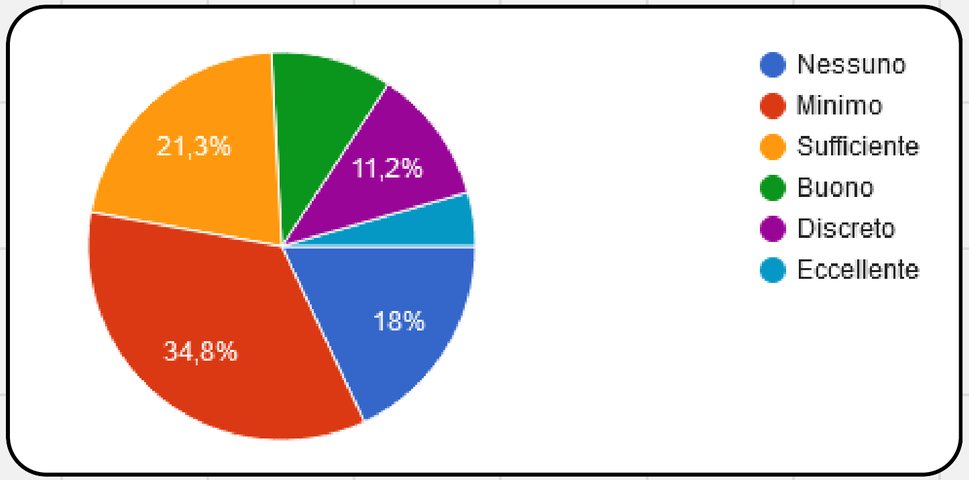
**Ensure Minimal Duration** - durations of notes could represent a problem. We also tested quantization of notes.

**Changes to notes interval** - original algorithm used to make predictable and not thrilling compositions... let’s fix that.

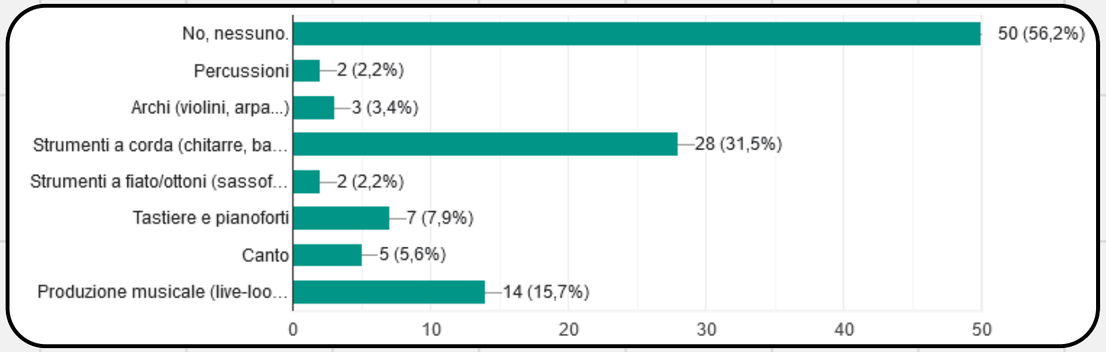
**User-Friendly Interface** - full customizable experience.

# SURVEY TIME

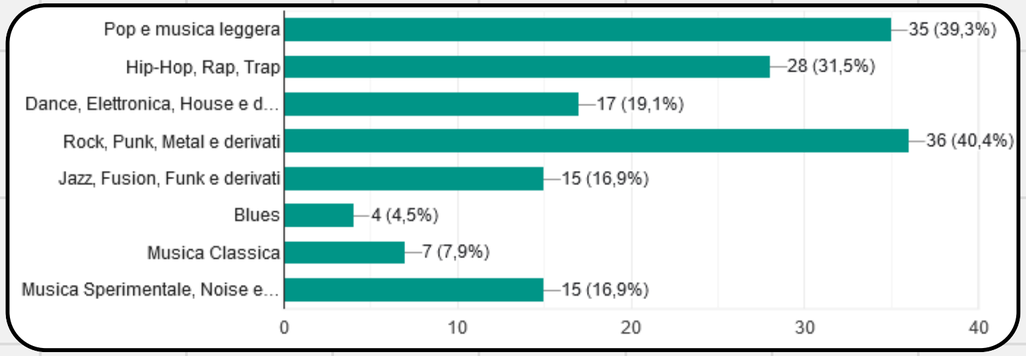
What do people think of JaQo?




LEVEL OF WESTERN MUSIC THEORY KNOWLEDGE

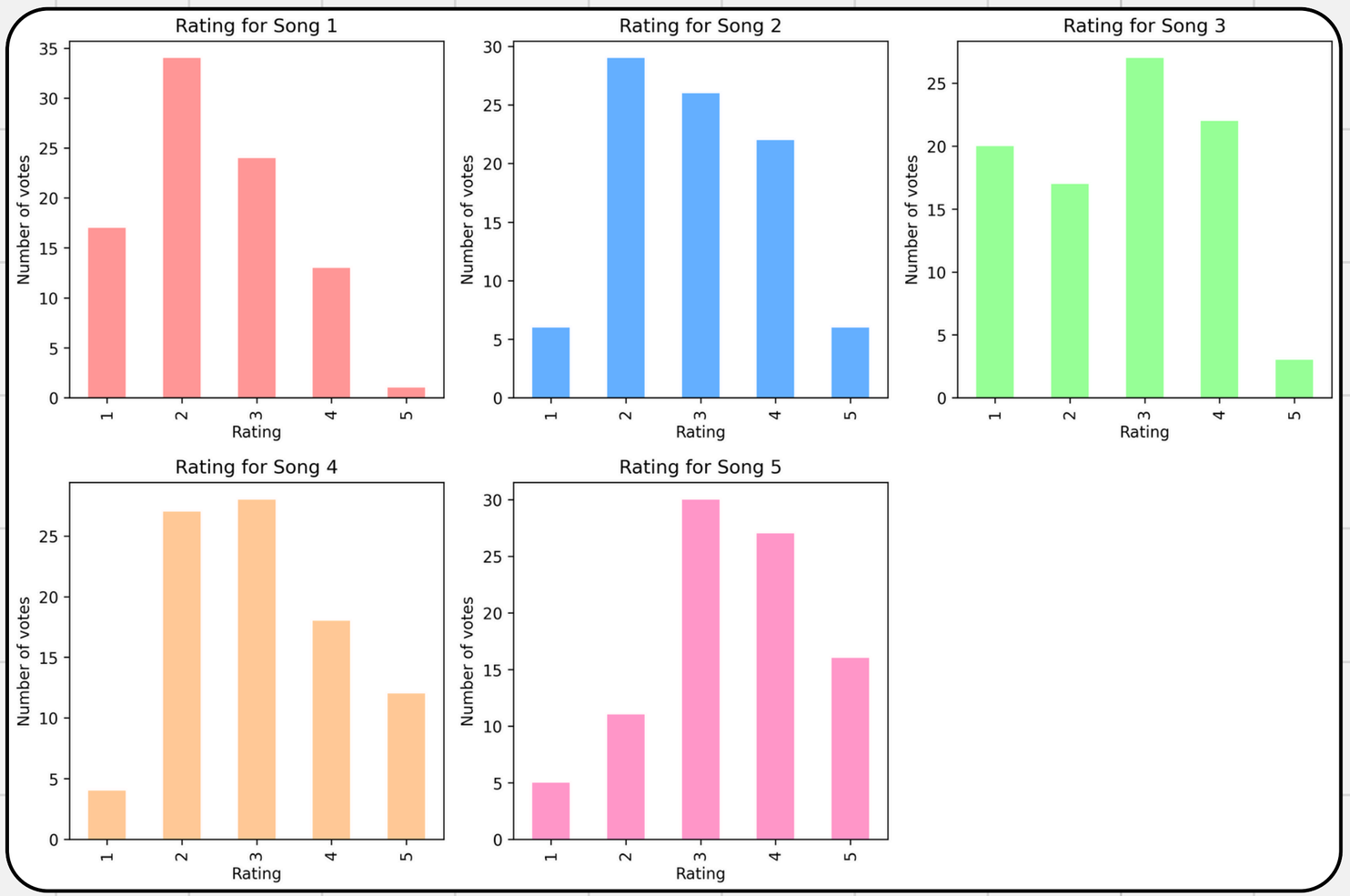



ANALYSIS OF PLAYED INSTRUMENTS




ANALYSIS OF FAVOURITE GENRES

# SONG RATINGS




SONG 1

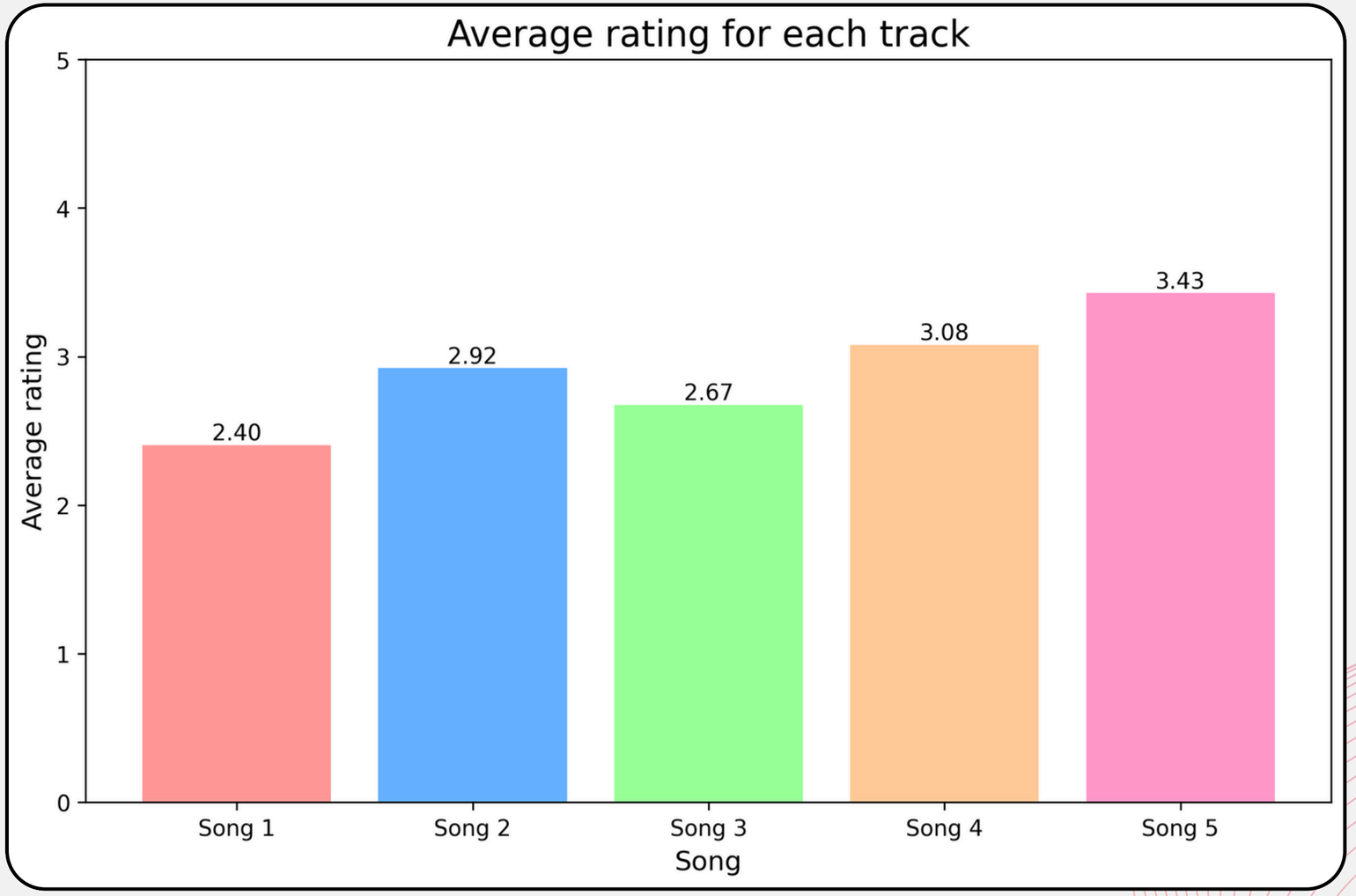
SONG 2

SONG 3

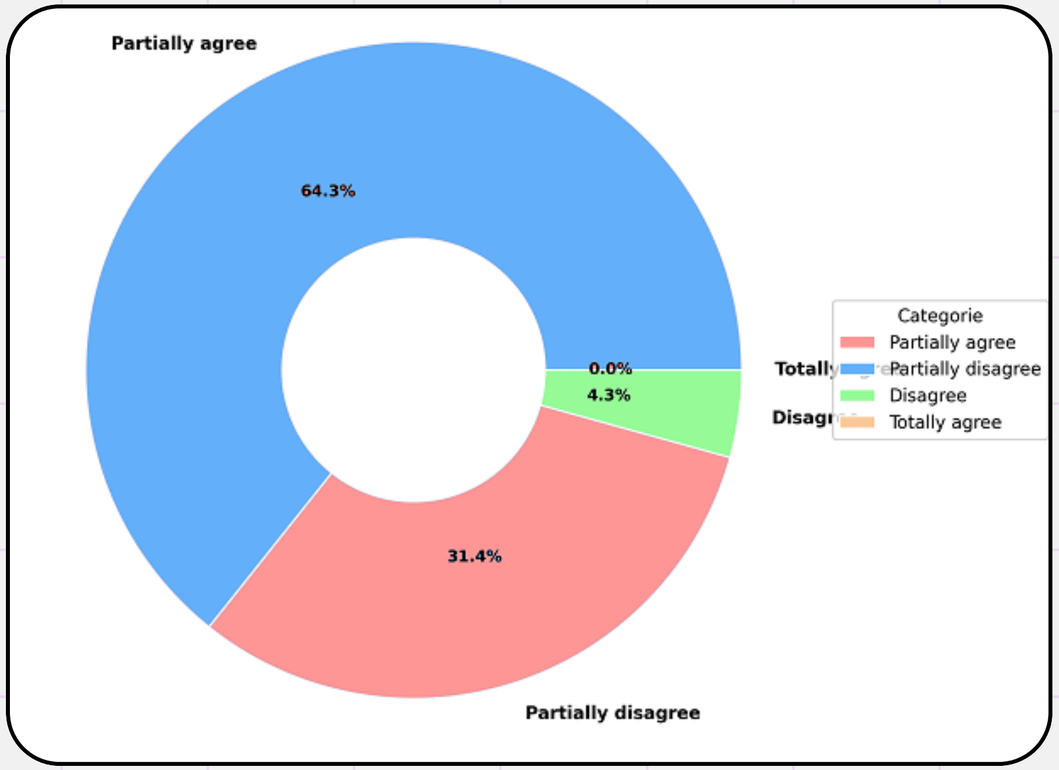
SONG 4

SONG 5

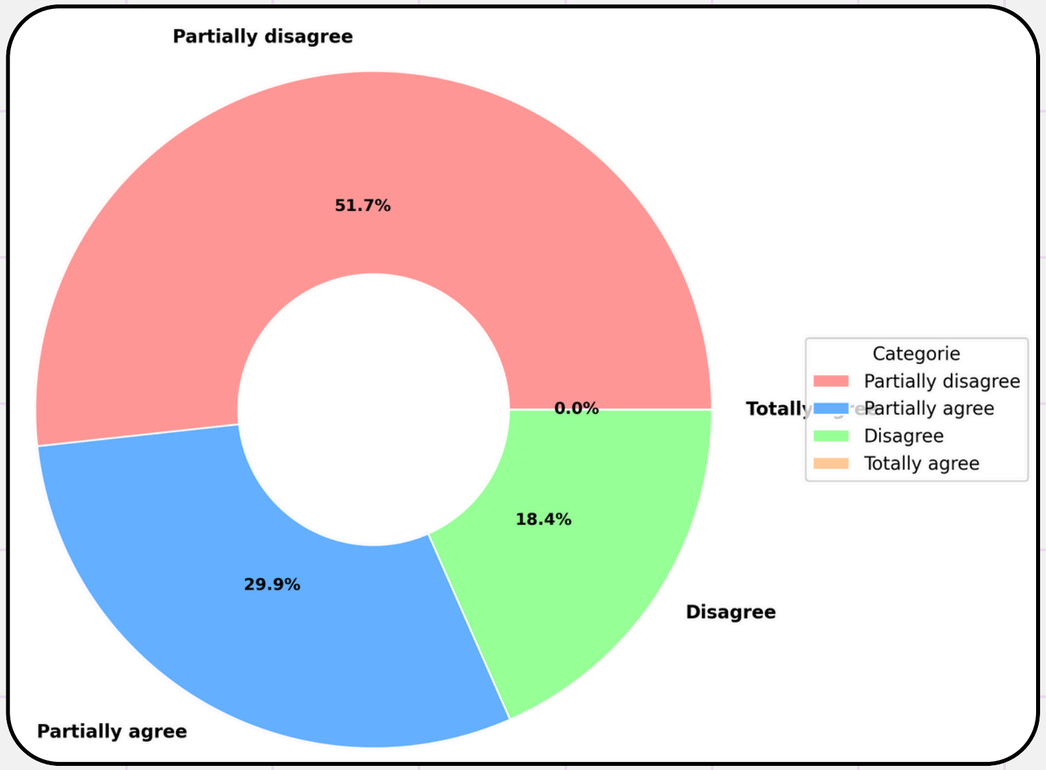
# AVERAGE SONGS RATING



# CONSENSUAL ASSESSMENT TECHNIQUE

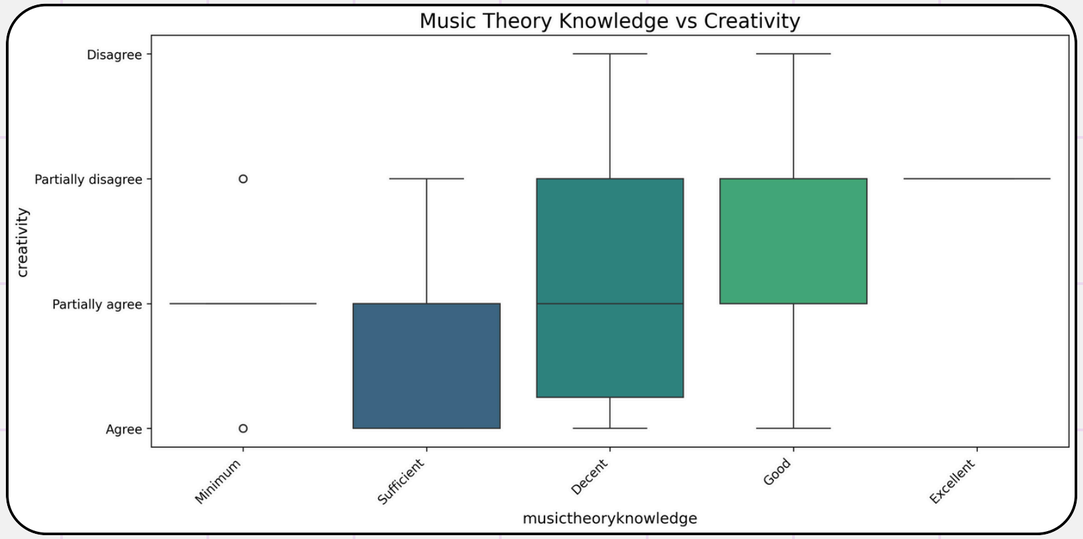



## CREATIVE ASSESSMENT

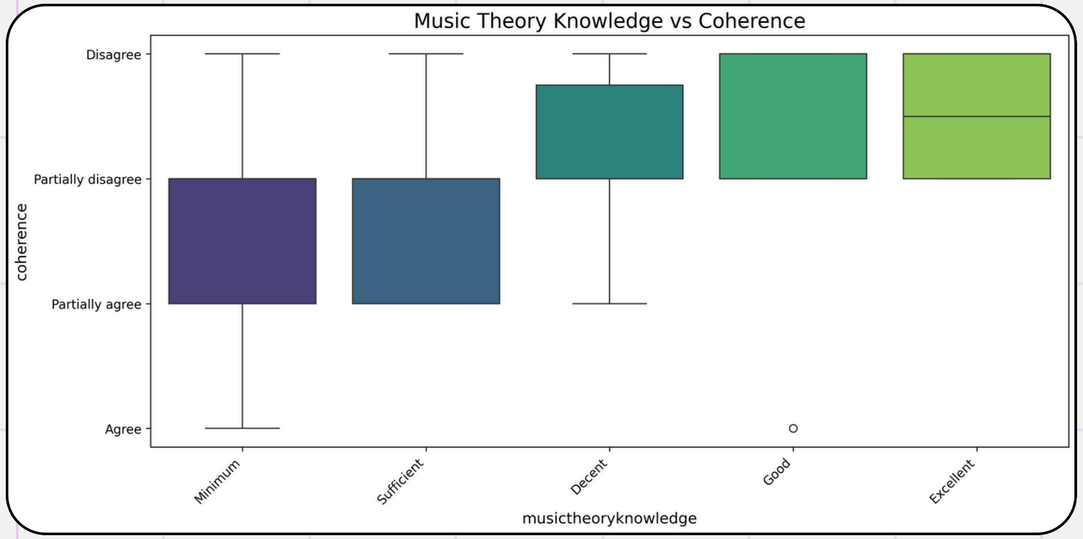



## CORRECTNESS ASSESSMENT

# CORRELATION - THEORY LEVEL VS CAT




## CREATIVE ASSESSMENT




## CORRECTNESS ASSESSMENT

### QUANTUM HARDWARE

We had no budget and we were a bit short on time... maybe this could lead to some interesting stuff!

### LISTEN TO THE PEOPLE

Survey results can lead to changes to the algorithm, maybe giving a more human structure to the scores.

### TRY TO POST-PRODUCE

The produced .MIDI files have been run on MuseScore and not mixed or mastered in any way. This may have caused some bias in the study.

### TRY, TRY AND RETRY

It’s kinda self-explanatory, but with this type of projects one be creative in order to succeed. Have fun!

# FUTURE WORKS

Survey results and produced code can be highly inspirational to some people who may want to take this work on another level.
There is a strong potential, so please feel free to bring the work on!

COCCORULLO DAVID

# THANK YOU

Feel free to ask any question!