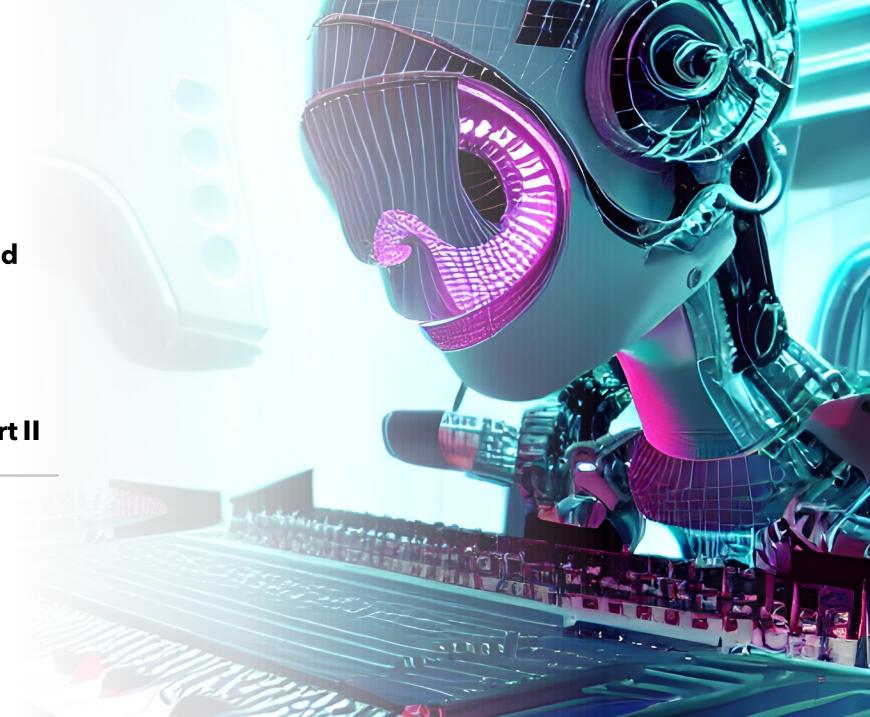
Selected Topics in Music and Acoustic Engineering: Build AI-enhanced Audio Applications in C++

Lecture 7: Al improviser part II

Dr Matthew Yee-King Spring 2023



## Lecture summary

- Part 1: Background on musical agents
- Part 2: Markov models review
- Part 3: Building a musical agent: pitch, polyphony and timing... and behaviour



### Where are we?

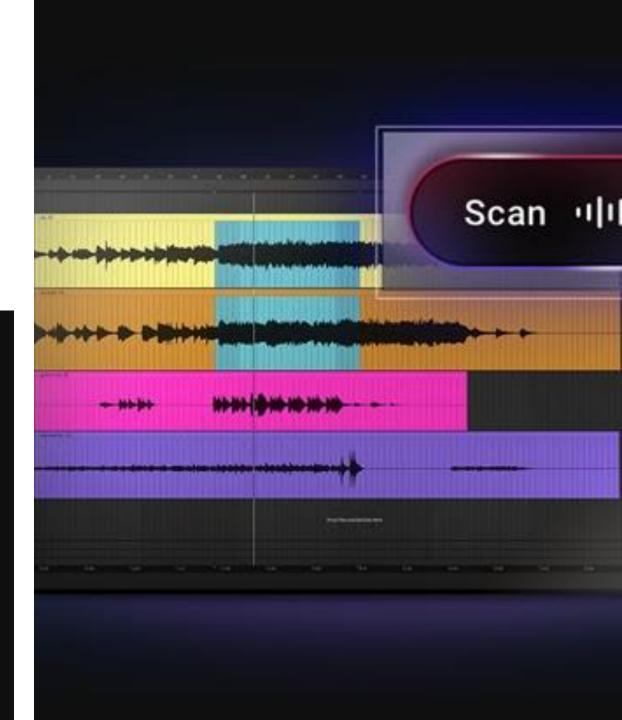
#### **News flash**

https://www.youtube.com/watch?v=nZLnHS89WoE

When you click "Scan" in StudioVerse, our advanced audio neural network analyzes your track's unique sonic fingerprint and recommends the best plugin chains that match your sound.

It's all done in an instant, so you can find what you need quickly—and stay in your creative flow.

Best of all, each plugin chain includes macros: easy-to-use multi-function controls, so you can take your mix from rough to polished in seconds.





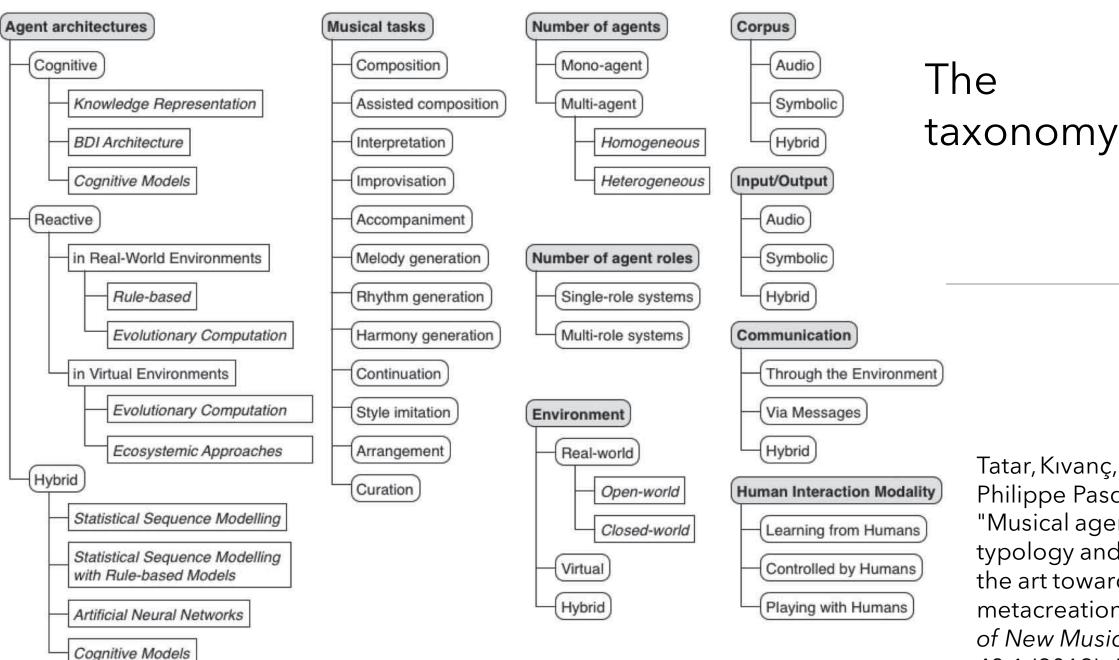


# Example: Finn Peters/ Nick Collins

https://www.youtube.com/watch?v=4YKoZinQLRY

"Musical agents are artificial agents that tackle musical creative tasks, partially or completely."

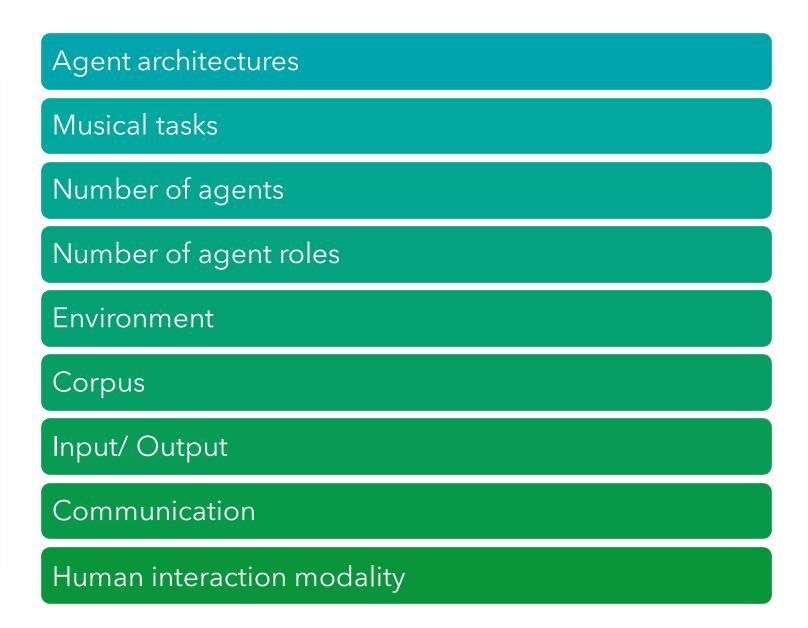
Tatar, Kıvanç, and Philippe Pasquier. "Musical agents: A typology and state of the art towards musical metacreation." *Journal of New Music Research* 48.1 (2019): 56-105.



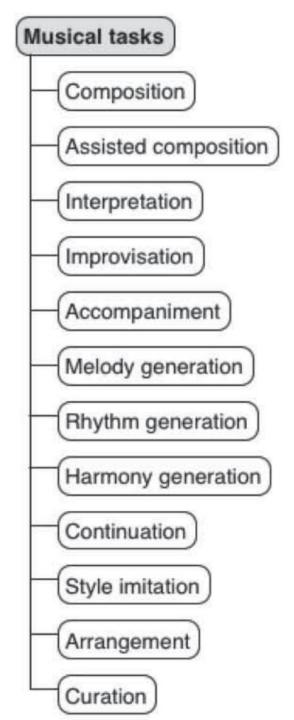
Tatar, Kıvanç, and Philippe Pasquier. "Musical agents: A typology and state of the art towards musical metacreation." Journal of New Music Research 48.1 (2019): 56-105.

Things to consider when designing a musical agent:

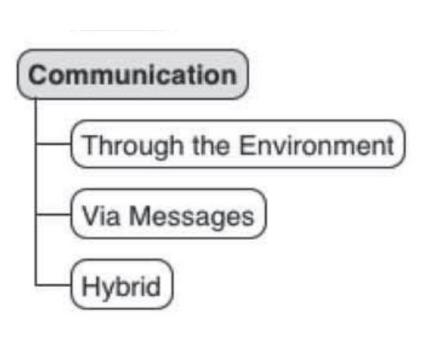
let's apply those to some examples

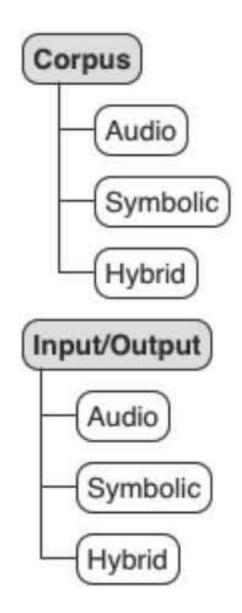


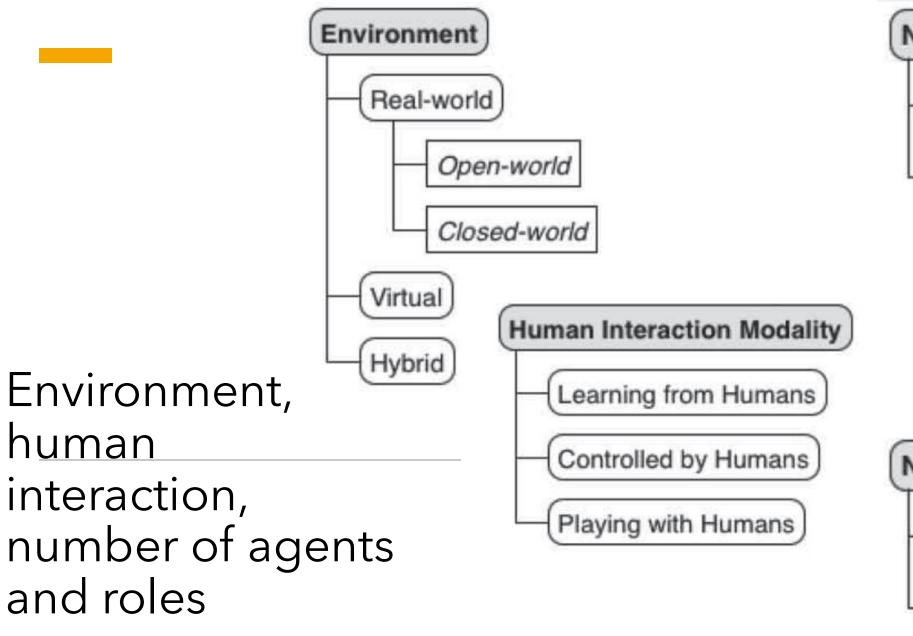
# Musical tasks: What will it do?



Communication, corpus and input/output

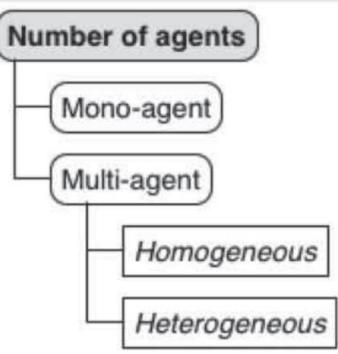




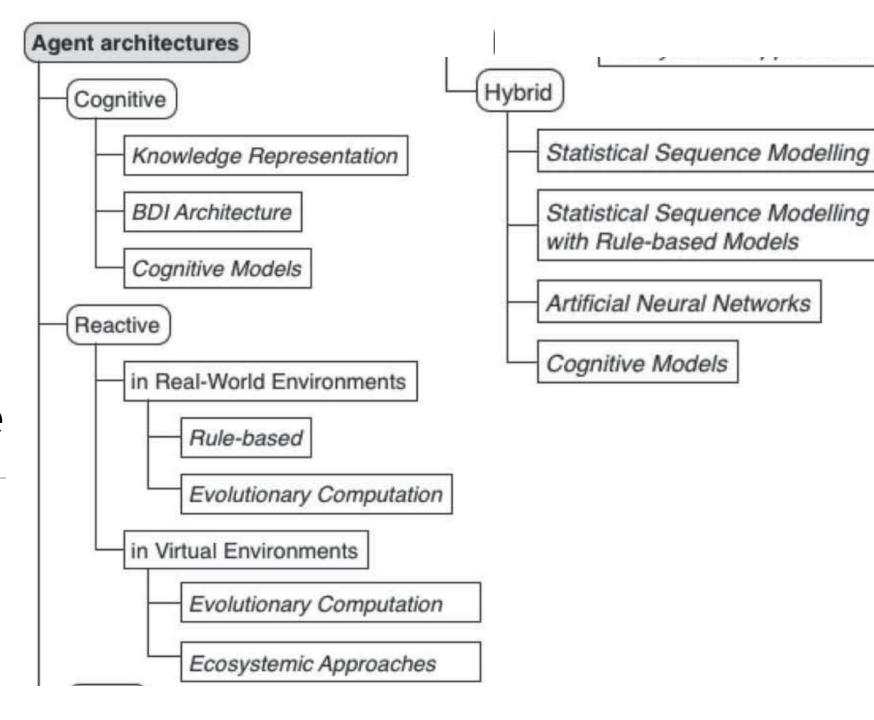


human

and roles



Number of agent roles Single-role systems Multi-role systems



Architecture

#### Musical agent resources

#### MUME/ Musebots

- https://musicalmetacreation.org/about/
- <a href="https://www.youtube.com/@musicalmeta">https://www.youtube.com/@musicalmeta</a> <a href="mailto:creation8321/videos">creation8321/videos</a>

The original 'Musebot' spec from 2008:

 https://github.com/yeeking/algo-improvorch



#### Musical Metacreation

@musicalmetacreation8321 22 subscribers 15 videos

Concerts and videos from the Musical Metacreation (MuMe) series >

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Musebot example: CleanBeat & Multisynth

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Musebot example: ProducerBot

87 views • 7 years ago



The Indifference Engine vs Brian Nesselroad

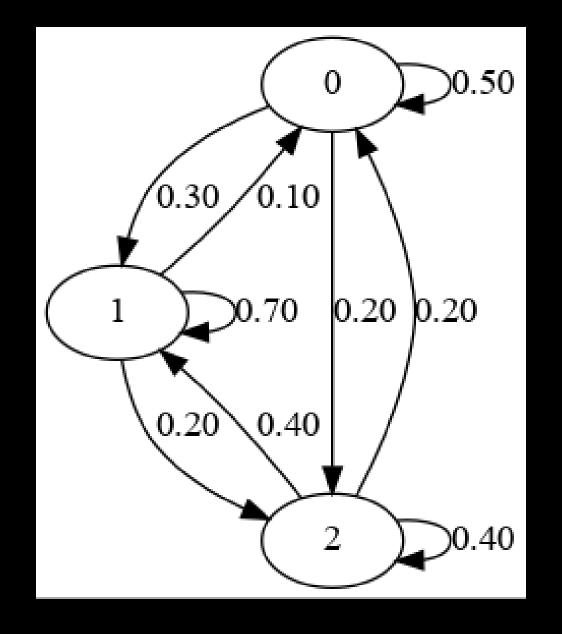
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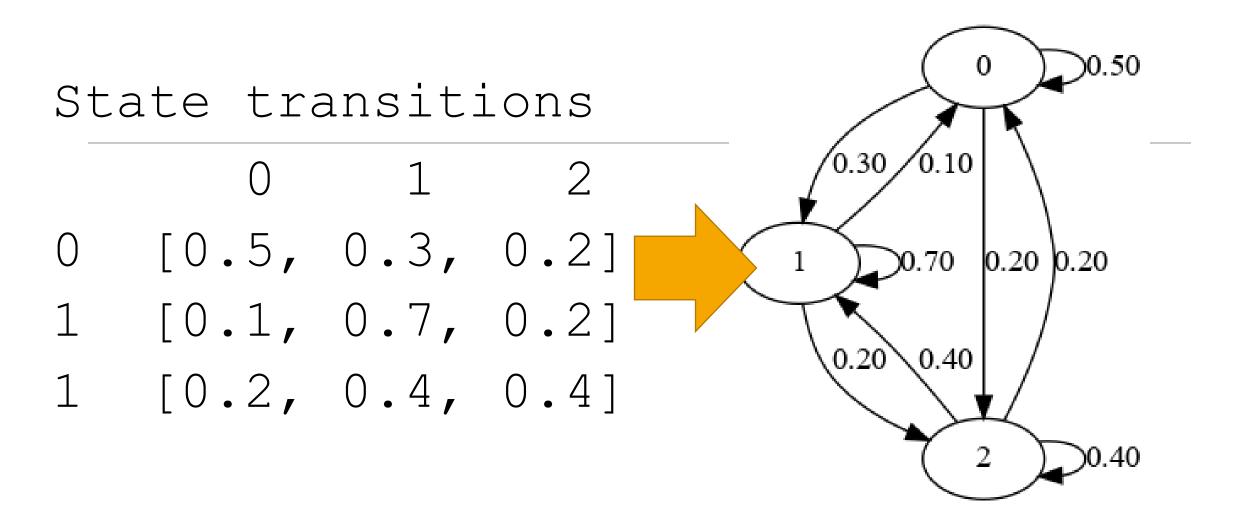




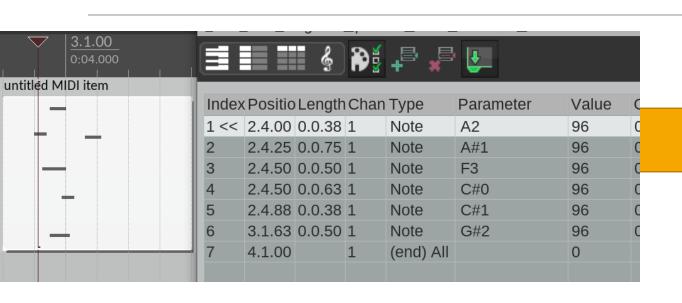
# Part 2: Markov models review

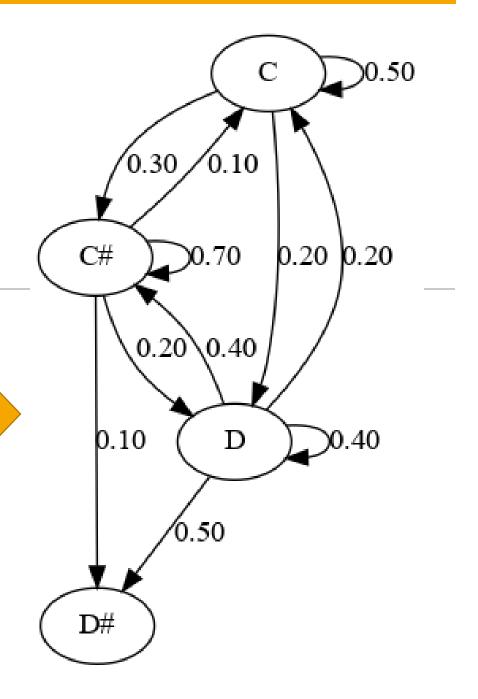


### First order Markov model: transitions



## Musical markov

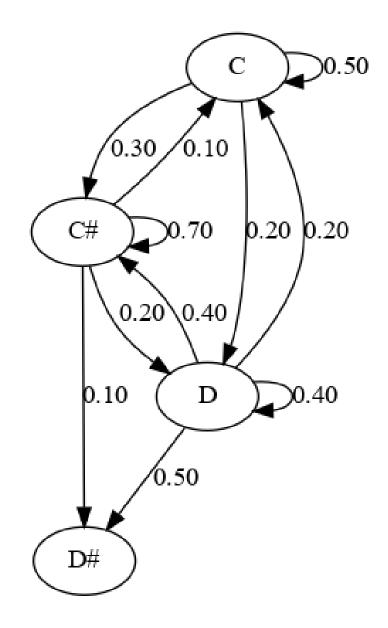




#### Generating

- Select a starting state
- Rand(0,1)
- Select next state

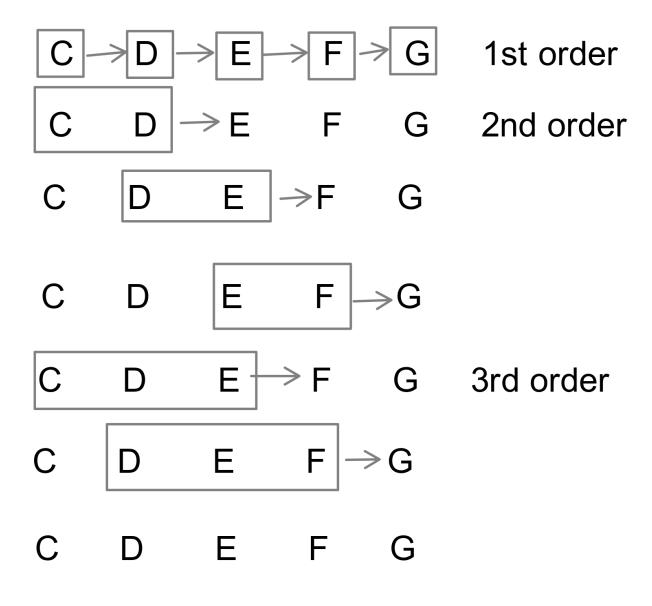
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#### **Higher order**

How many previous states?

Longer memory, less observations

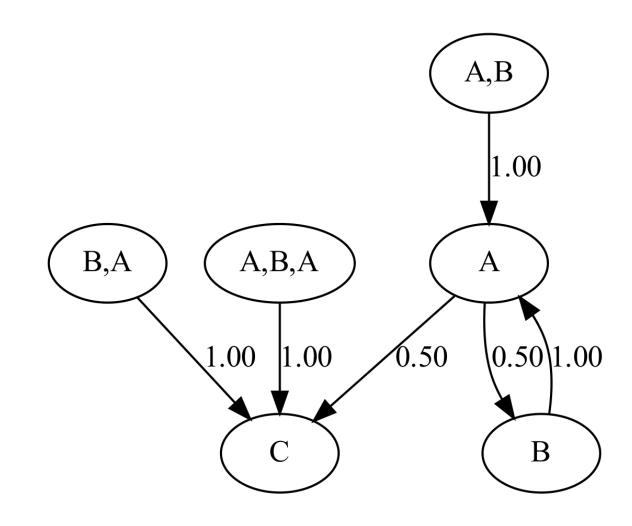


#### Variable order

Builds a model with multiple orders

Not so bad, just make states as compounds: ABA->C

Slight complexity for visualisation: only ever generate single notes

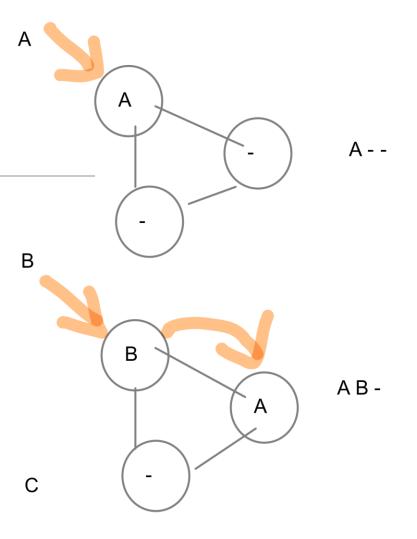


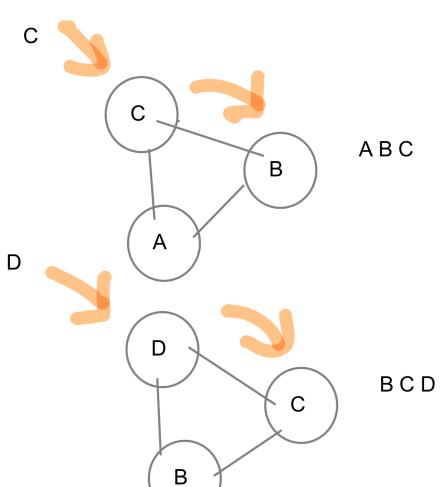
#### Memory

Need to remember previous states

FIFO 'stack'

Or... delay line:)





Create

MarkovManager class

Put event

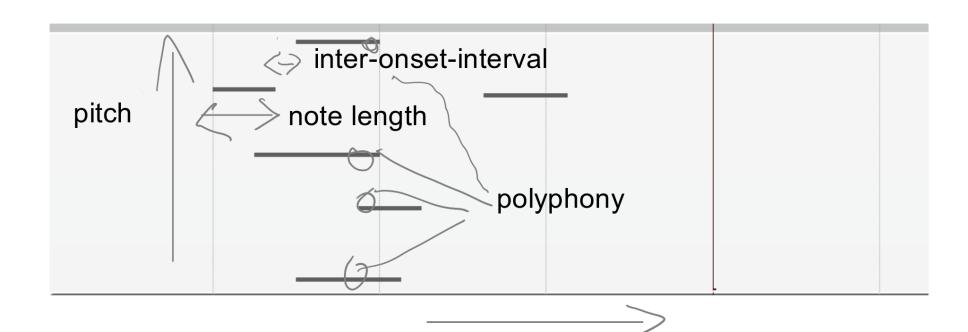
Get event

Get last event order



# What are the states in music?

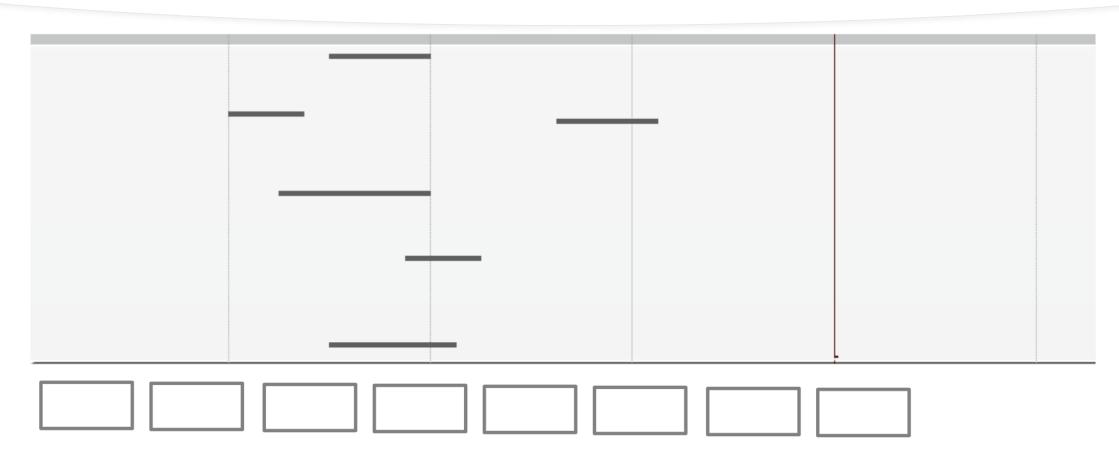
- Notes and rests: ["C", "D", "-", "-"]
- Velocity: ["127", "65" .. ]
- Note length ["0.5", "0.1"]
- Inter-onset-intervals ["1.0", "0.5"]



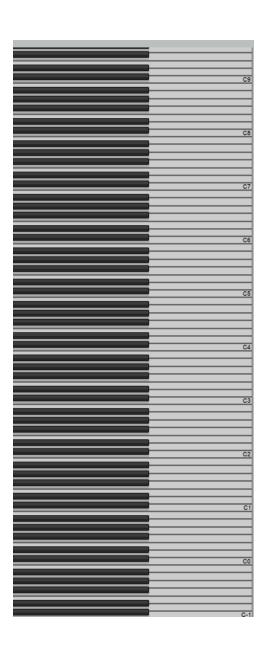
#### Three models

- Polyphonic pitch
- Note length
- Inter-onset-interval

# Need to remember state between processBlock calls



events occur across calls to processBlock



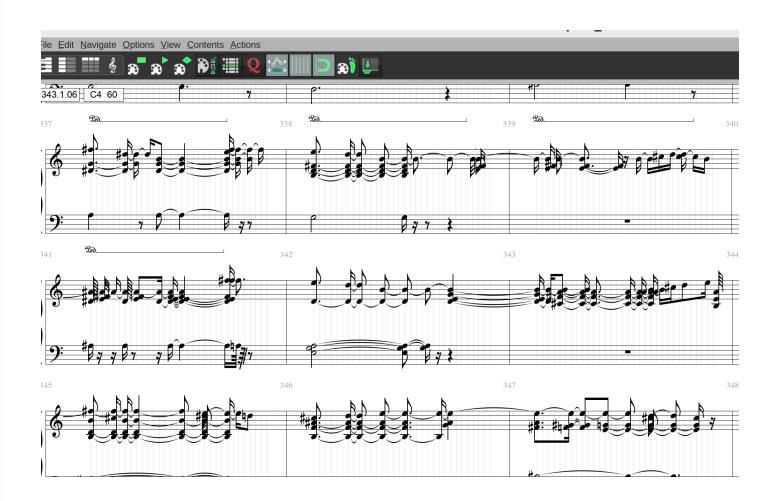
# Use arrays to remember on and off times

- Modelling: when did this note state?
- Generating: when should this note end?

On and off times for every note

#### **DEMO**

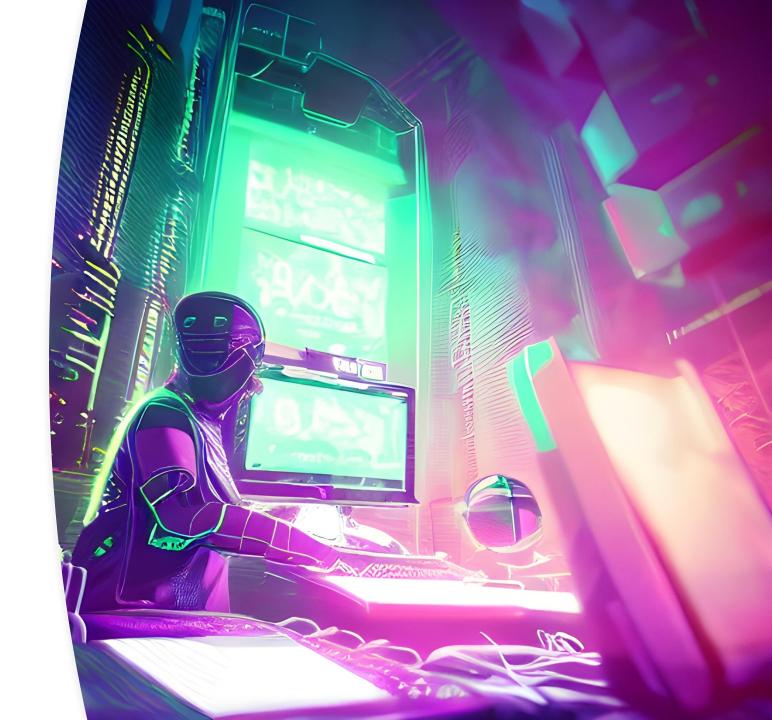
- Chick Corea: Spain solo
- Listen to solo
- Train model on solo
- Play from model



MIDI file from here: https://midkar.com/jazz/jazz\_11.html

#### **About the lab**

- Modelling polyphony
- Modelling note length
- Modelling inter-onsetinterval



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