ARS ELECTRONICA

Workshop
Recommenders and Intelligent Tools in Music Creation: Why, Why Not, and How?

Speakers

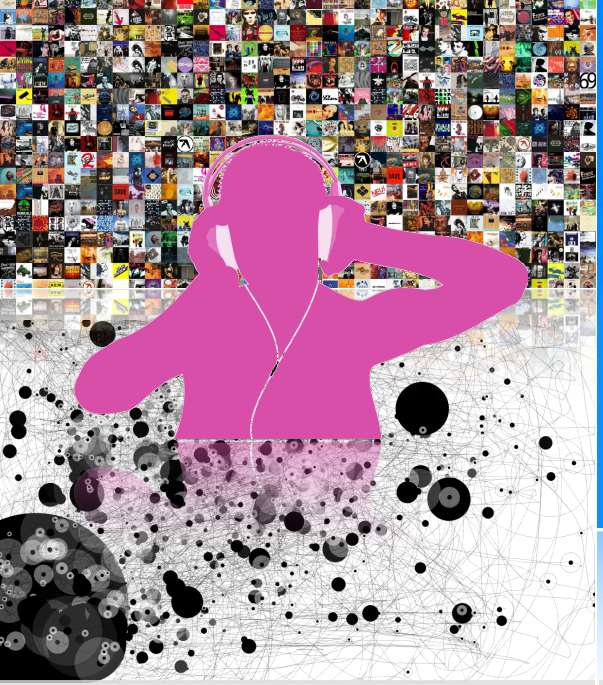
Christine Bauer
Johannes Kepler University Linz

Peter Knees
TU Wien

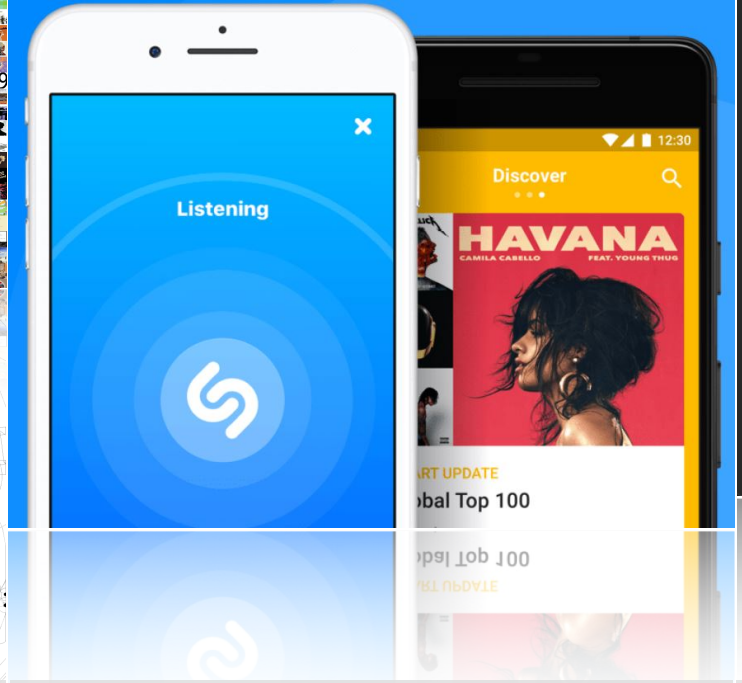
Richard Vogl
TU Wien

Hansi Raber
Hansi Raber

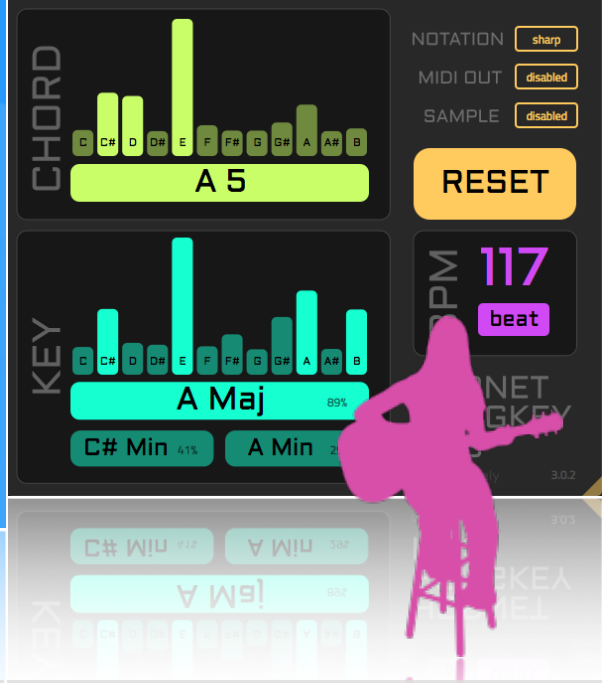
Artificial Intelligence and Music



Recommendations for listeners

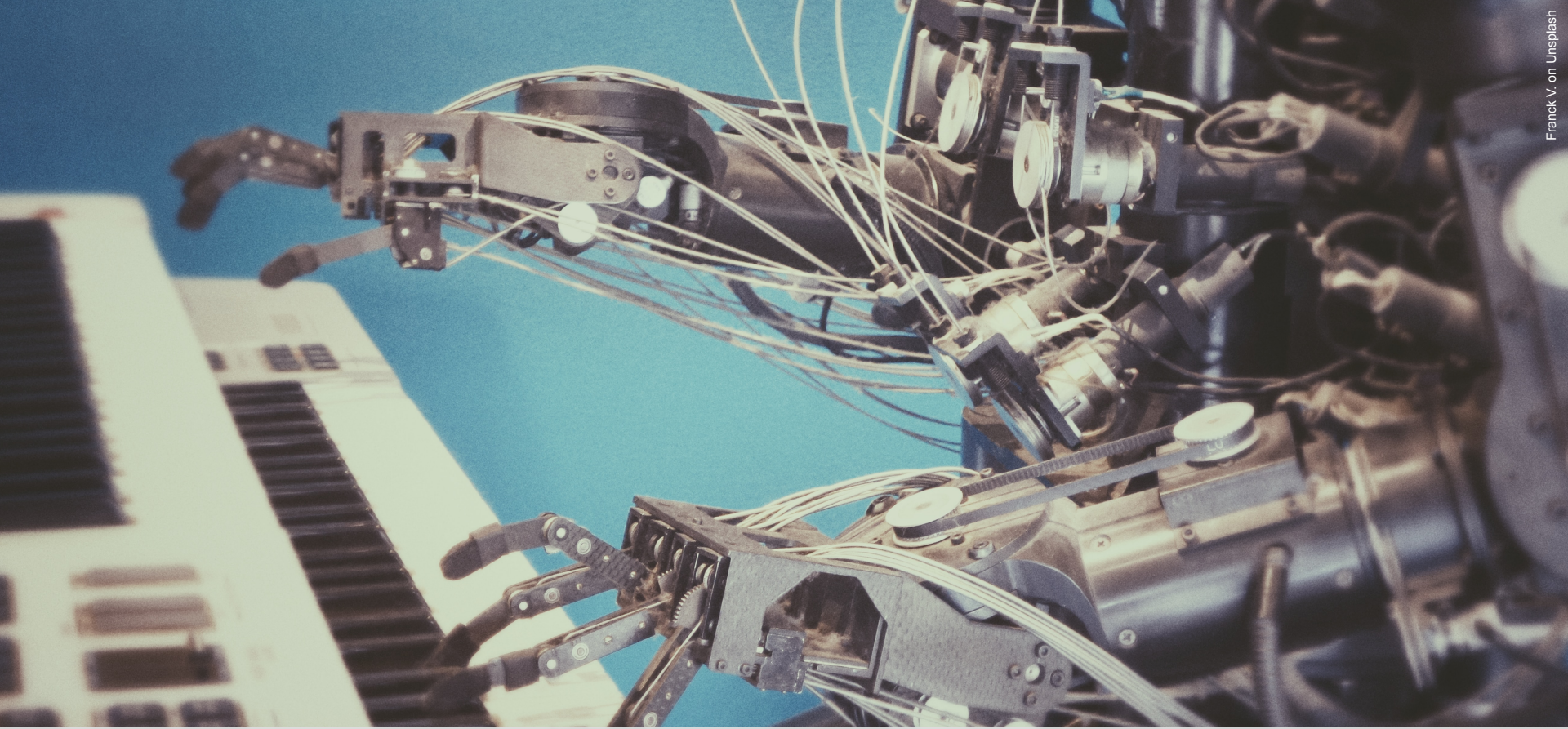


Song identification



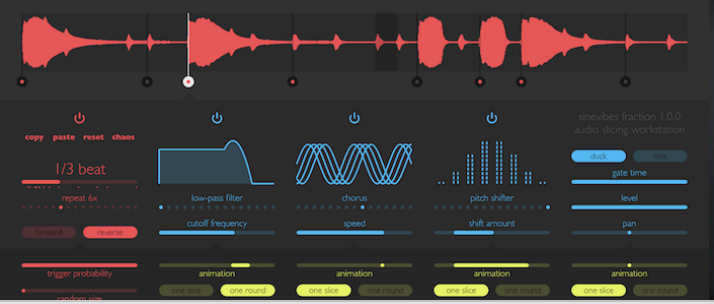
Chord and key identification

Typical associations

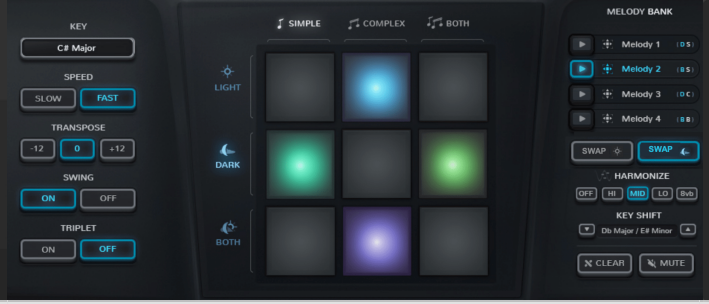


Franck V. on Unsplash

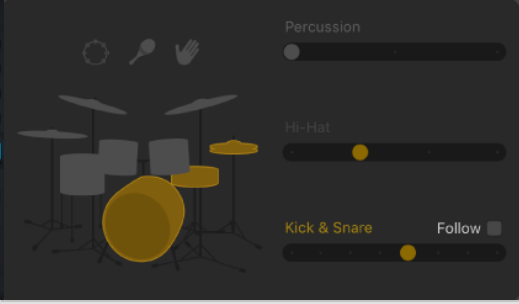
AI as music creator – the future?



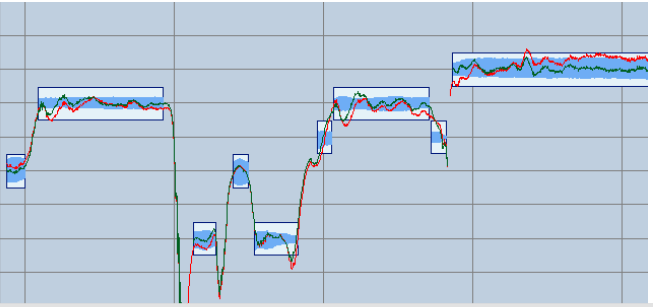
Quantization & Slicing



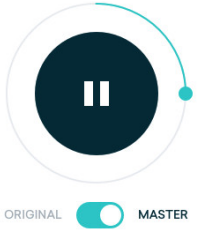
Melody assistant

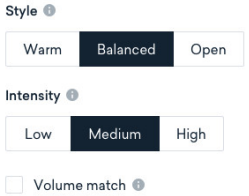


Automatic drumming

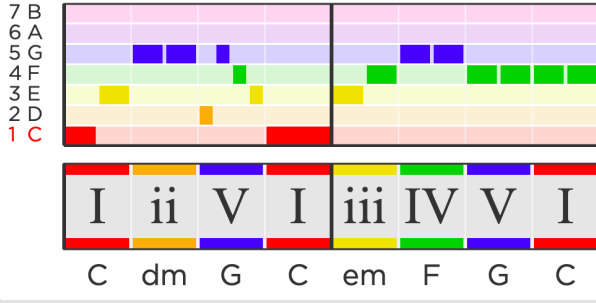


Autotune





Automatic mixing

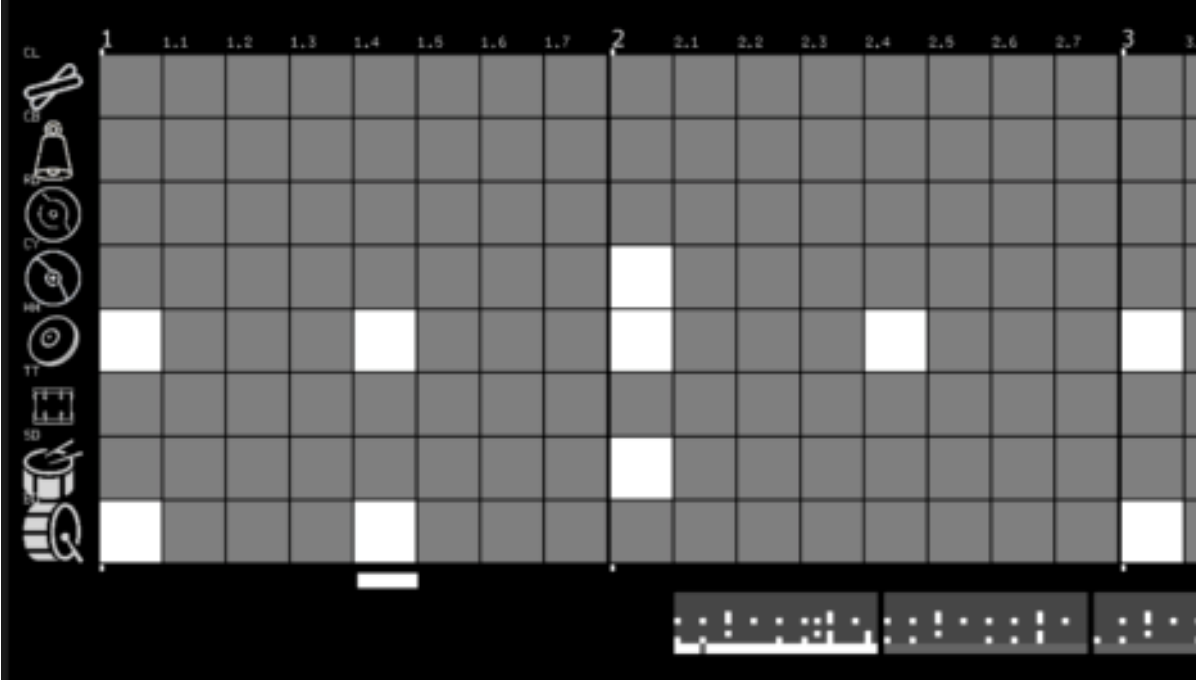


Chord suggestions

Intelligent tools in music creation

Peter Knees

Recommenders and intelligent tools for creative music making



Richard Vogl

Hansi Raber

Technology demos

Christine Bauer

Reflection and open questions

Recommenders for Music Makers


LIB
DISK
FX
BANK
TYPE
SUBTYPE
Factory
Favorites
Samples
User
NEW ...
Kick
Snare
Clap
Hihat
Cymbal
Tom
Shalker
Metallic
Wooden
Hand Drum
Mallet Drum
Rim Shot
Side Stick
Roll
Brush
Analog
Digital
Acoustic
Distorted
Noisy
Dry
Wet
Type here to filter...
SAMPLE NAME
Snare-RnBB.wav
Snare-Runaround.wav
Snare-SoulOne.wav
Snare-StudioA.wav
Snare-StudioB.wav
Snare-StudioC.wav
Snare-StudioD.wav
Snare-SweatItOut.wav
SnareRim-Dakeat.wav
SnareRim-DraculaEast.wav
SnareRim-Dragon.wav
Snare-SoulOne
JWH
Fills
User 1
Sojourner Truth
SYNC: Scene
RETRIG
DeeJay Kit
Deez Kit
Synths
Rhodes
Guitars
Strings
Bass
Group H
Intro
Drop
Section 1
Section 2
Outro
MASTER
GROUP
SOUND
1 SAMPLER
2 COMPRESSOR
3 BEAT DELAY
4
FX Compressor
No Preset
SRC
GRV
MCR
OUT
Depth
Time
Output
Threshold
Amount
Knee
Attack
Release
Gain
Rhodes
Chord EP Rhodeo 1
Chord EP Rhodeo 2
Lick EP Rhodeo 1
Lick EP Rhodeo 2
Lick EP Rhodeo 3
Lick EP Rhodeo 4
Lick EP Rhodeo 5
Lick EP Rhodeo 5
Chord EP Rhodeo 1
Chord EP Rhodeo 2
Chord EP Rhodeo 3
Lick EP Rhodeo
Lick EP Rhodeo 1
Lick EP Rhodeo 2
Lick EP Rhodeo 3
RECORD
EDIT
SLICE
MAP
Start
End
LOOP
Crossfade
Attack
Decay
Lick EP[90] Rhodeo 2.wav
Length: 05.35s
0s
1.0s
2.0s
3.0s
4.0s
5.0s

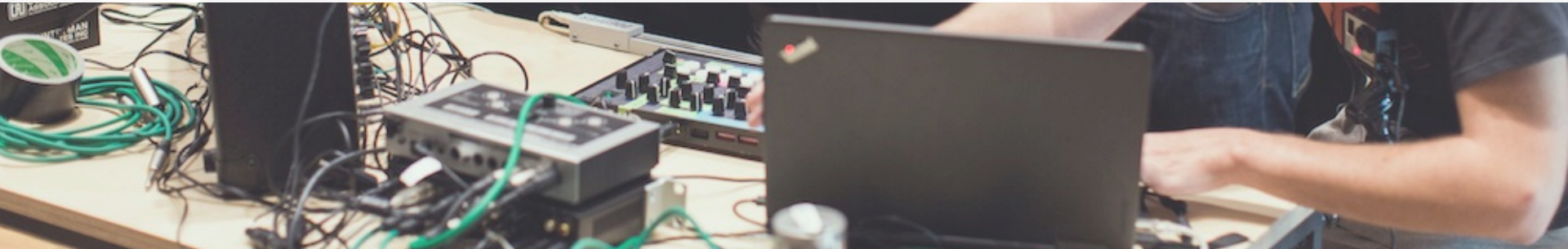
Choice overload

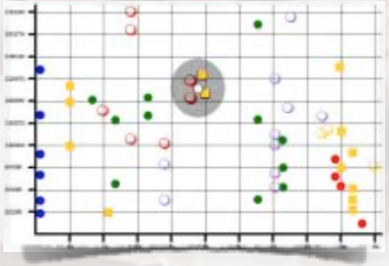
Finding the right sound remains a central challenge

courtesy of Red Bull Music Academy

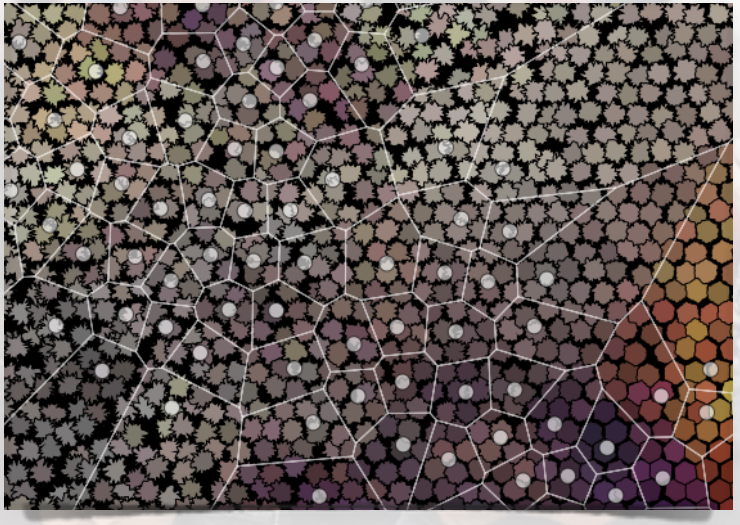
“We usually have to browse really huge libraries [...] that most of the time are not really well organized.” (TOK003)

“[I have] like, two hundred gigabytes of [samples]. I try to keep some kind of organization.” (TOK006)



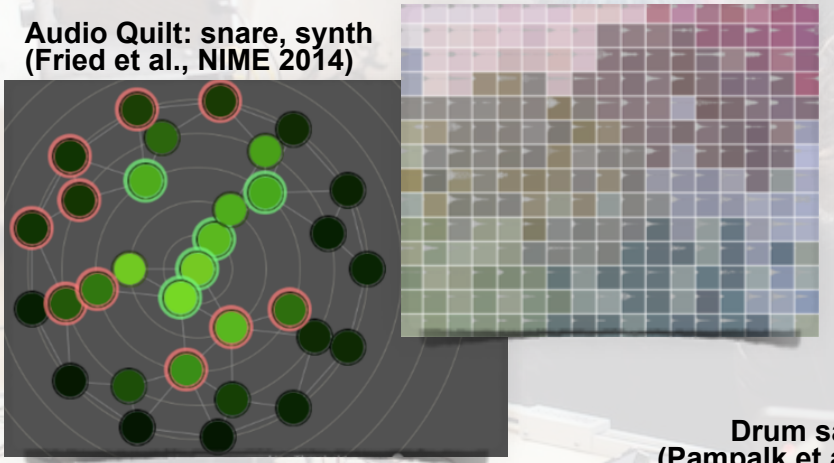


Sonic browser
(Fernström and
Brazil, ICAD 2001)



Texture browser
(Grill and Flexer, ICMC 2012)

Audio Quilt: snare, synth
(Fried et al., NIME 2014)



Drum sample browser
(Pampalk et al., DAFx 2004)

Sample Browsing Interfaces

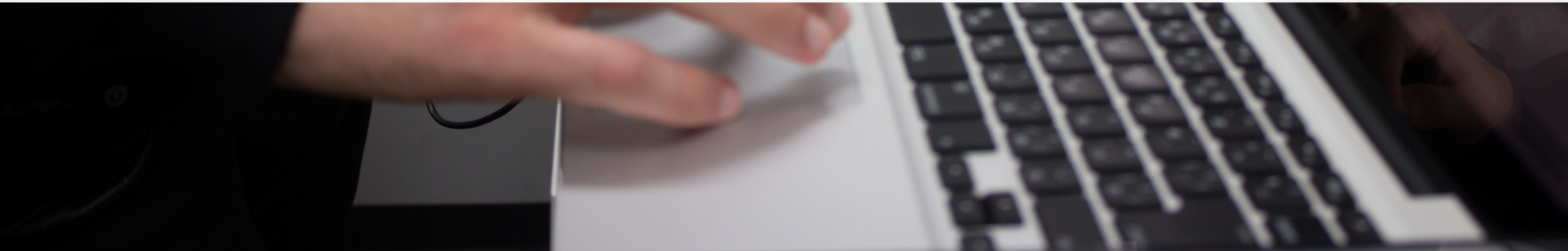
User-centric approach

- participatory workshops, semi-structured interviews
- conversations with international up-and-coming musicians

Image courtesy of Red Bull Music Academy

Recommenders are seen critical in creative work

"I am happy for it to make suggestions, especially if I can ignore them" (TOK007)



Who is in charge?

"as long as it is not saying do this and do that." (TOK009)

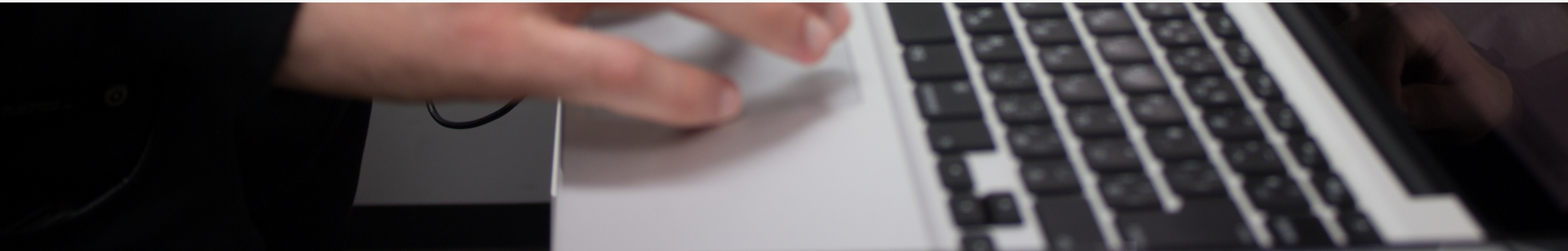
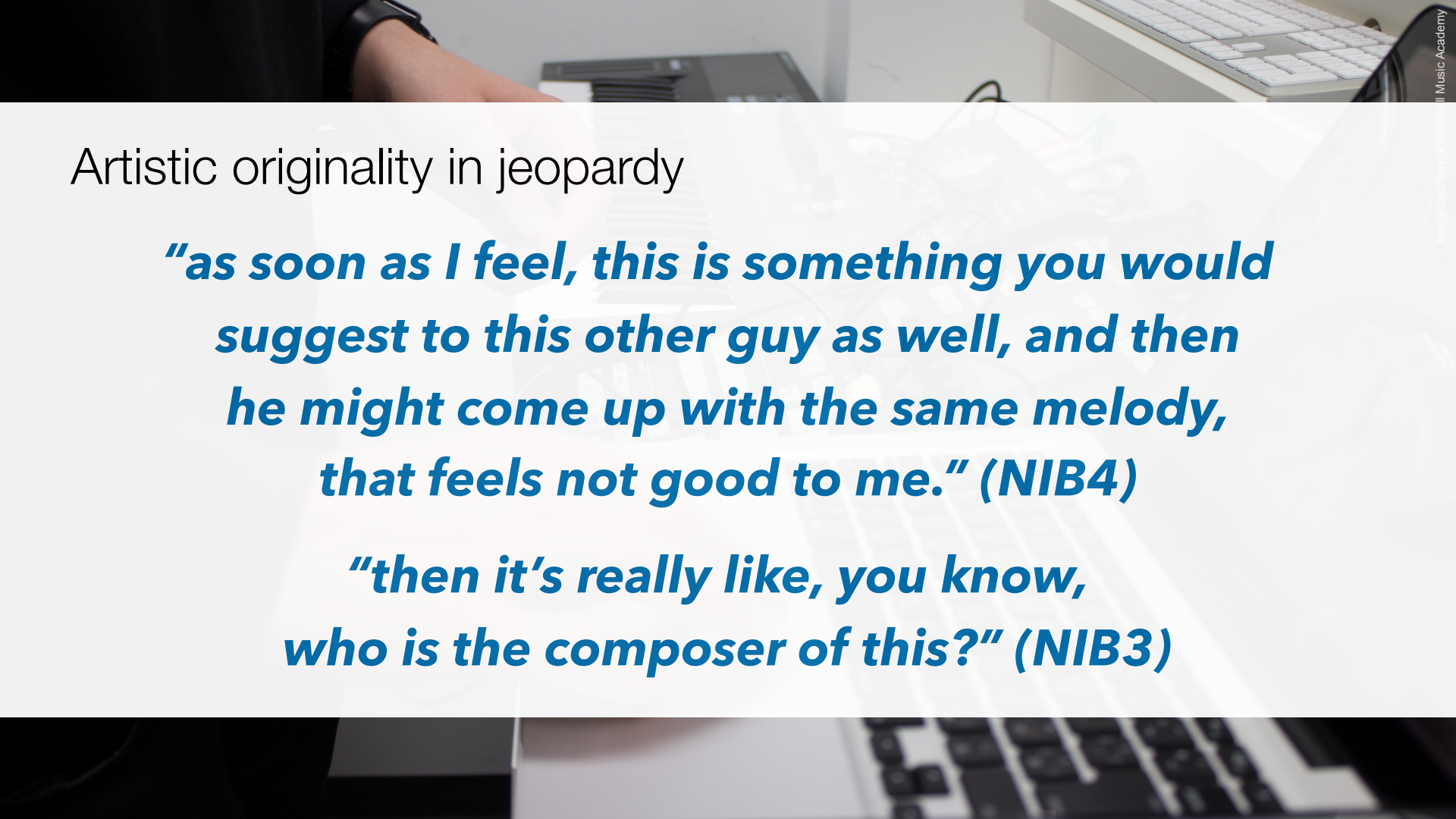


Image courtesy of Red Bull Music Academy



Artistic originality in jeopardy

"as soon as I feel, this is something you would suggest to this other guy as well, and then he might come up with the same melody, that feels not good to me." (NIB4)

"then it's really like, you know, who is the composer of this?" (NIB3)

Image courtesy of Red Bull Music Academy

Users open to **personalization**

"You could imagine that your computer gets used to you, it learns what you mean by grainy, because it could be different from what that guy means by grainy" (PA008)

Imitation is not the goal, **opposition** is the challenge

"I'd like it to do the opposite actually, because the point is to get a possibility, I mean I can already make it sound like me, it's easy." (TOK001)

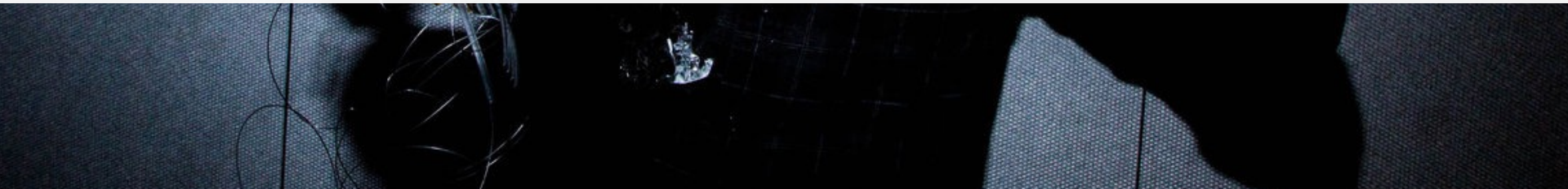
Image courtesy of Red Bull Music Academy

Image courtesy of Red Bull Music Academy

“Make it complex in a way that I appreciate, like I would be more interested in something that made me sound like the opposite of me, but within the boundaries of what I like, because that’s useful. Cause I can’t do that on my own, it’s like having a bandmate basically.” (TOK007)

Theme 1: **Virtual band mate** (controlled “collaborator”)

“I like to be completely in charge myself. I don’t like other humans sitting the chair, but I would like the machine to sit in the chair, as long as I get to decide when it gets out.” (TOK014)



Theme 2: **Exploring non-similarity** (“the other/strange”)

“So if I set it to 100% precise I want it to find exactly what I am searching for and probably I will not find anything, but maybe if I instruct him for 15% and I input a beat or a musical phrase and it searches my samples for that. That could be interesting.” (TOK003)

Image courtesy of Red Bull Music Academy

The “Other” in Creative Work

- no interest in imitating existing ideas and “filter bubbles”
- challenge and question expectations and past behavior

Opposite goals when recommending for creative work

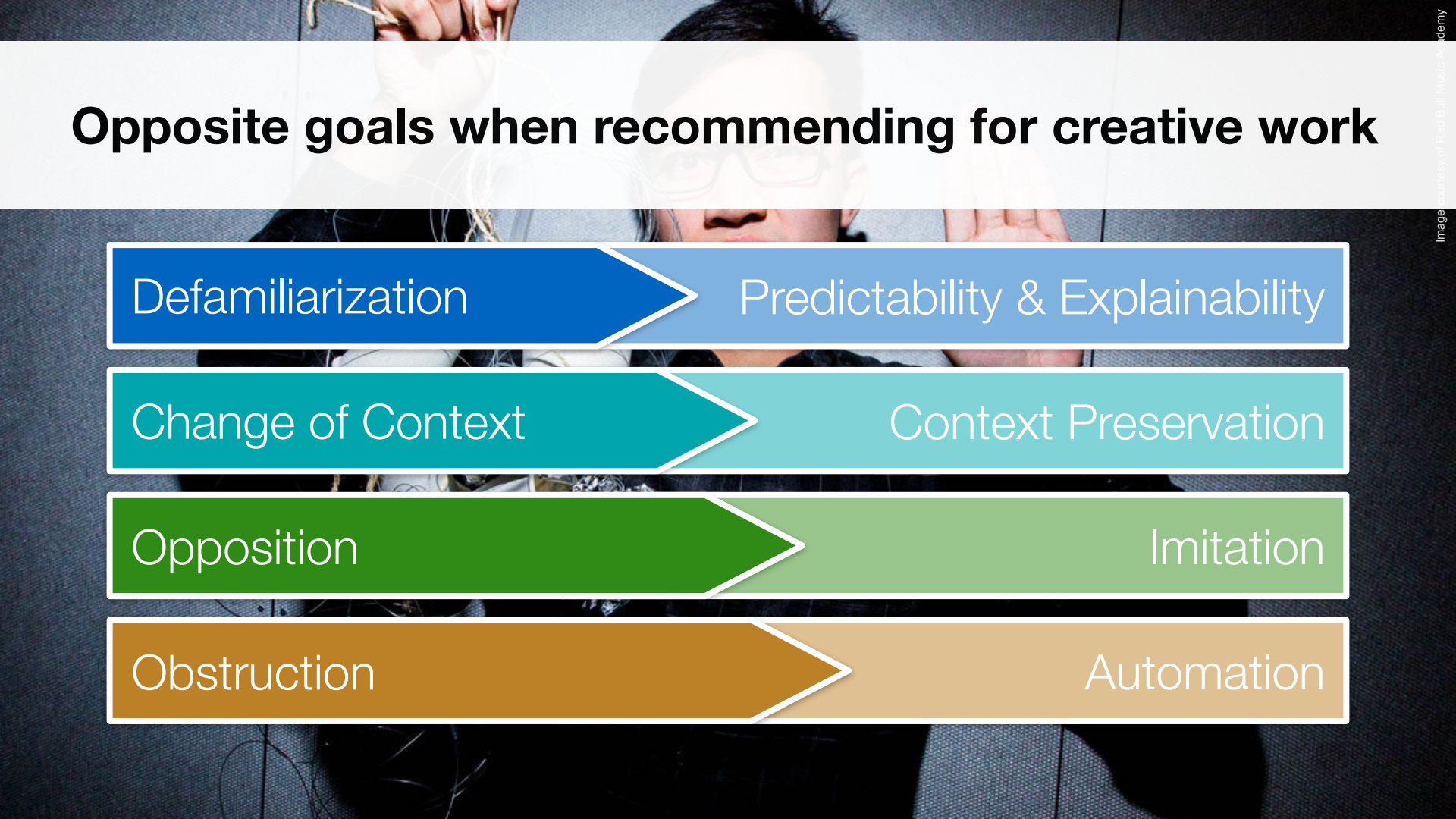
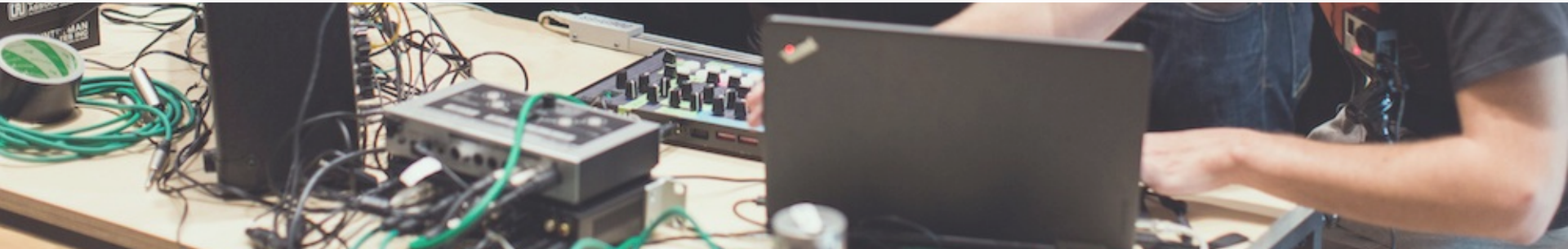


Image courtesy of Red Bull Music Academy

Takeaways

- experts need recommenders mostly for **inspiration**
- a useful recommender needs to be a **collaborator**



Technology Demo:
AI Drummers

Why AI Drummers

- As an **inspirational tool**
- Increase **productivity**
- **Use cases:**
  - Music production
  - Live performances
- **Challenges:**
  - Many degrees of freedom
  - Genre dependent
  - No well defined measure of quality
  - Original, meaningful, but not random patterns!

Reactable ROTOR

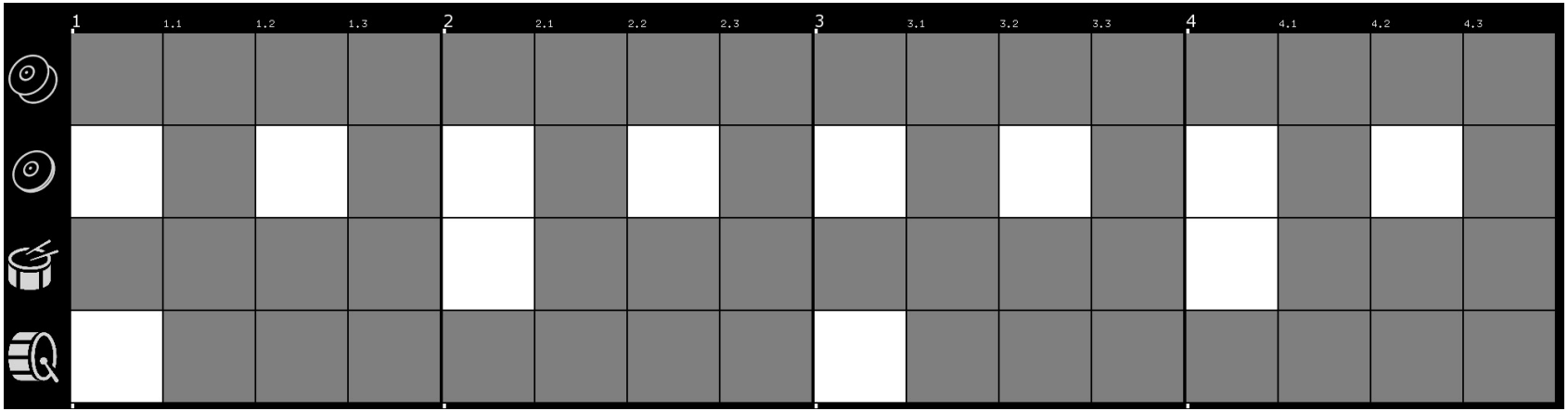
NI Maschine

Examples for AI Drummers

- Drum Pattern Variation
  Generate variations of a seed pattern

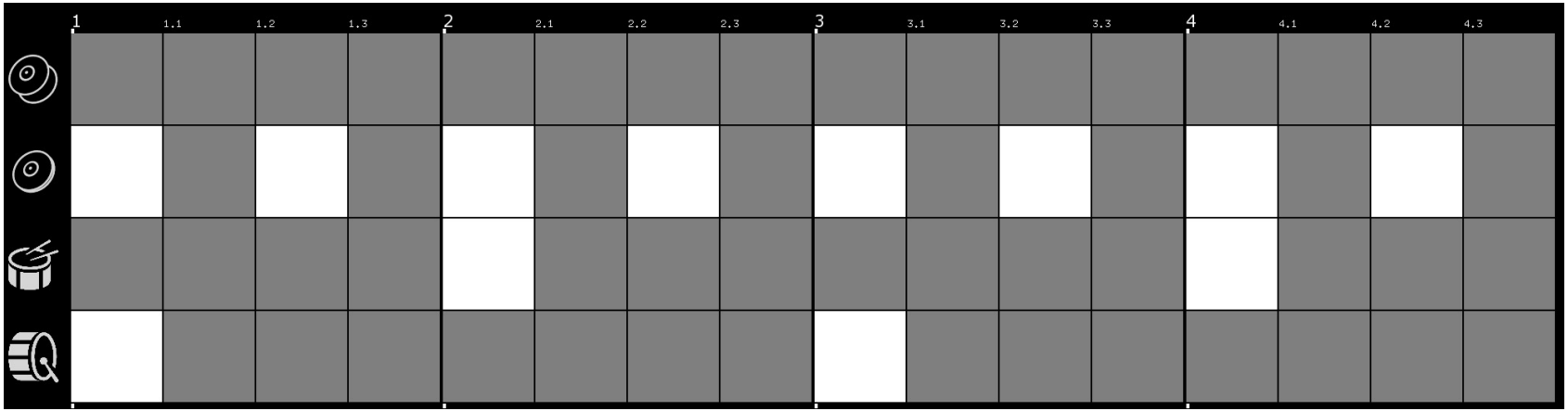
- Parametric Drum Pattern Generation
  Control properties of drum pattern which should be created

Drum Pattern Variation



This is a step-sequencer...

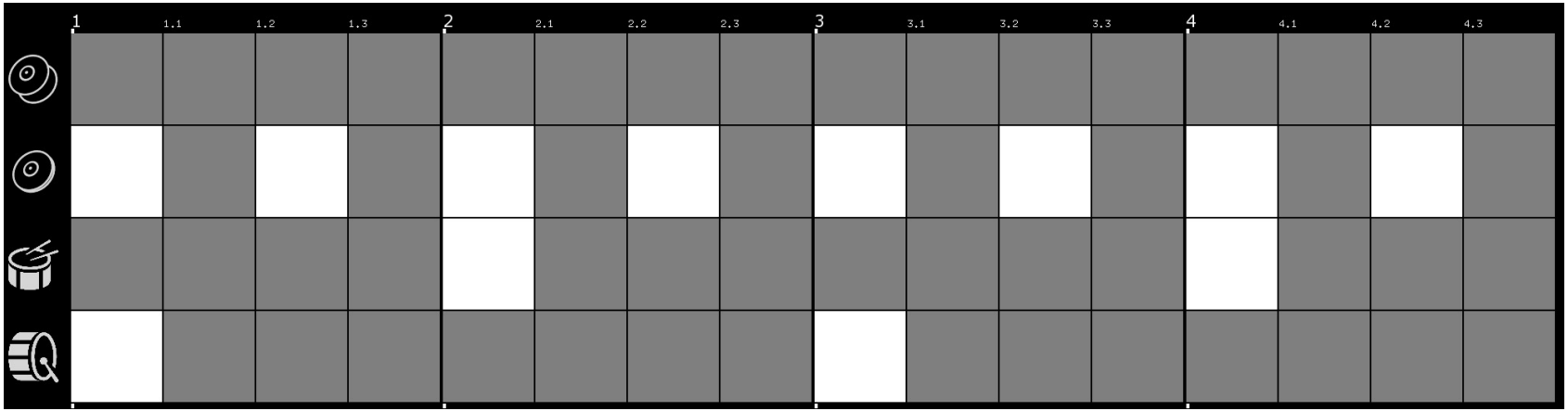
Drum Pattern Variation



- Create modifications of a given seed pattern
- Maintain characteristic of the drum pattern (the beat)

This is a step-sequencer...

Drum Pattern Variation



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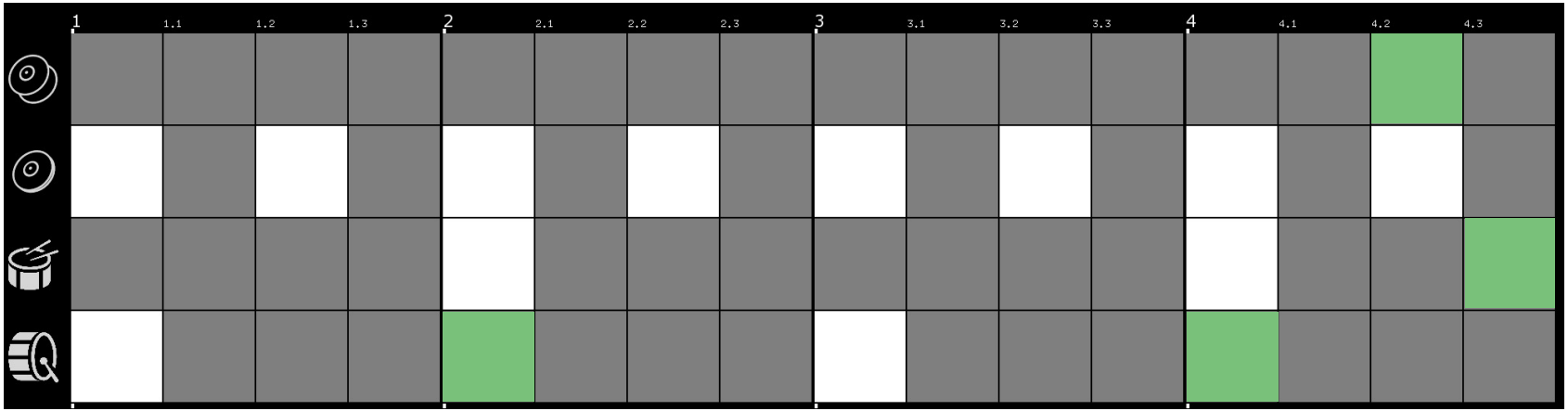
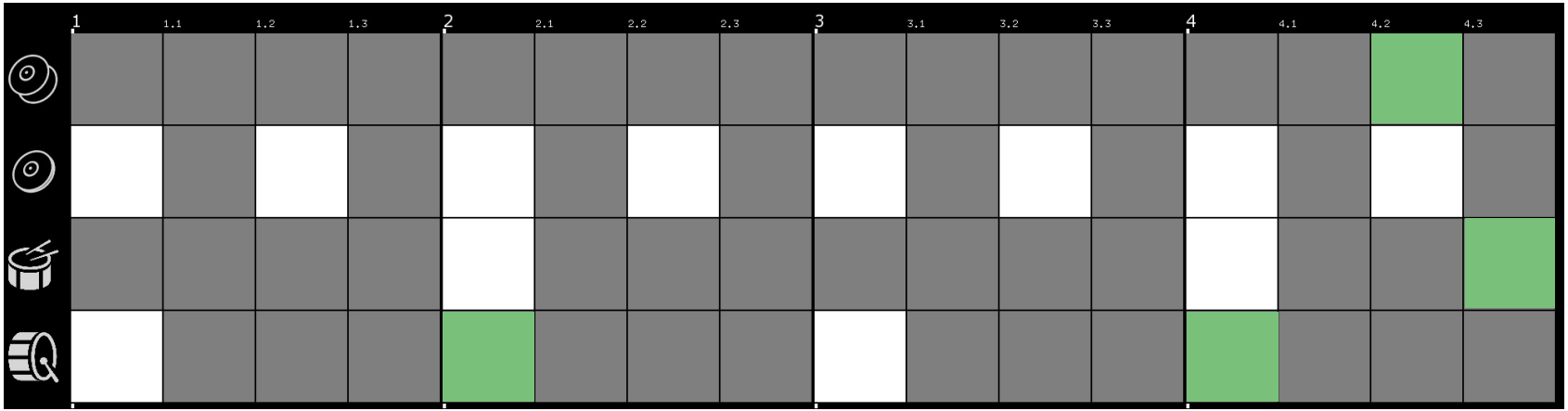


- Create modifications of a given seed pattern
- Maintain characteristic of the drum pattern (the beat)
- **Add details** to increase intensity

This is a step-sequencer...

Drum Pattern Variation



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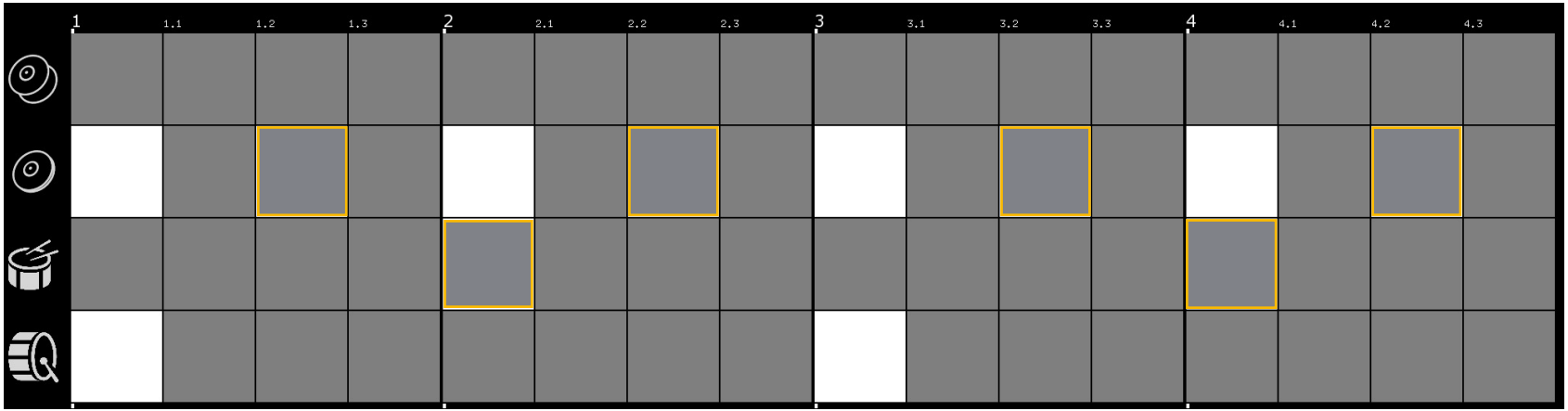
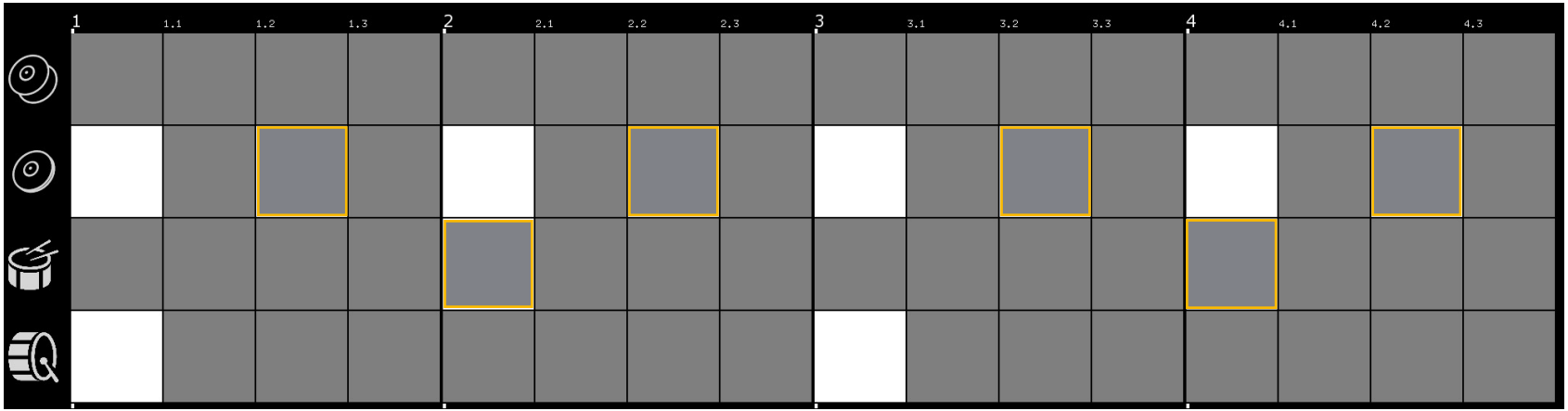


- Create modifications of a given seed pattern
- Maintain characteristic of the drum pattern (the beat)
- **Add details** to increase intensity
- **Remove notes** to make it more simple

This is a step-sequencer...

Drum Pattern Variation



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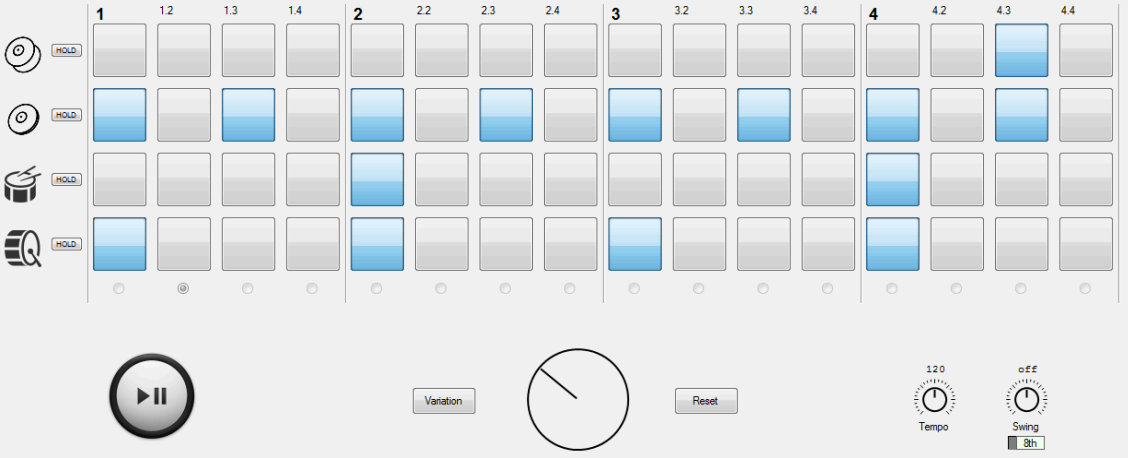
User Interface



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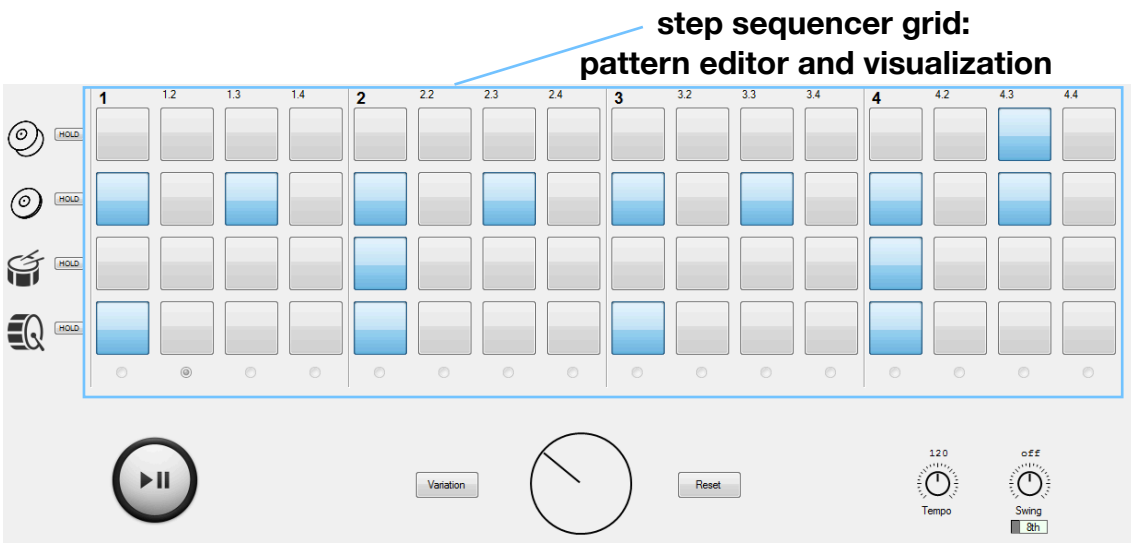

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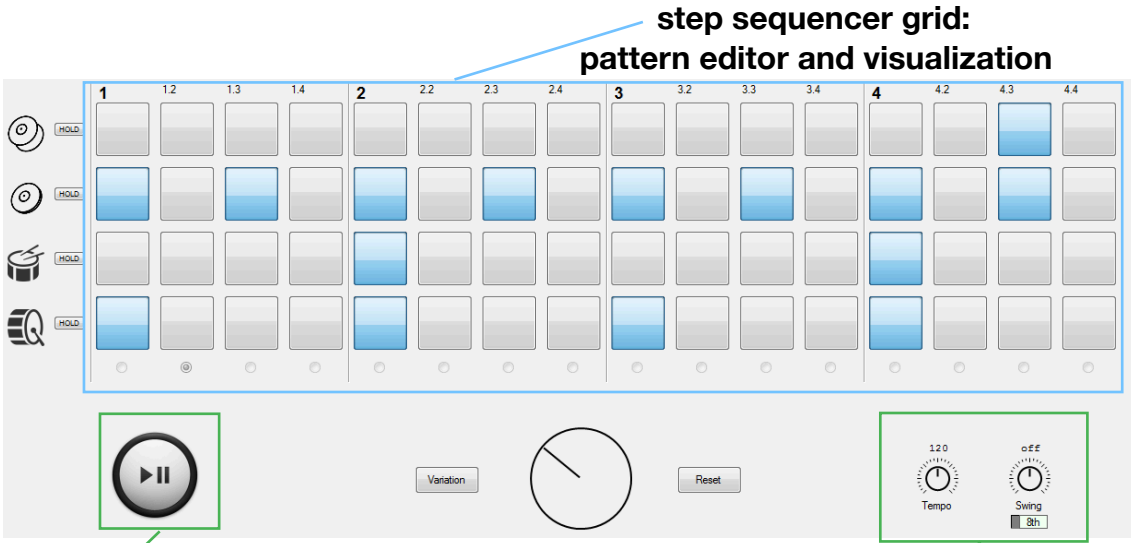

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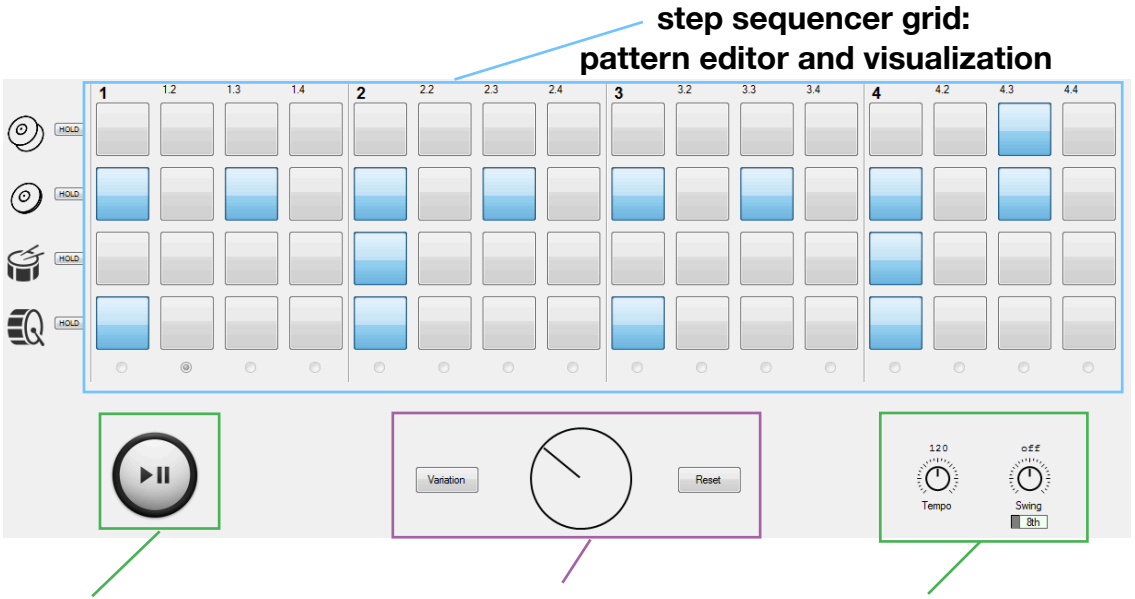
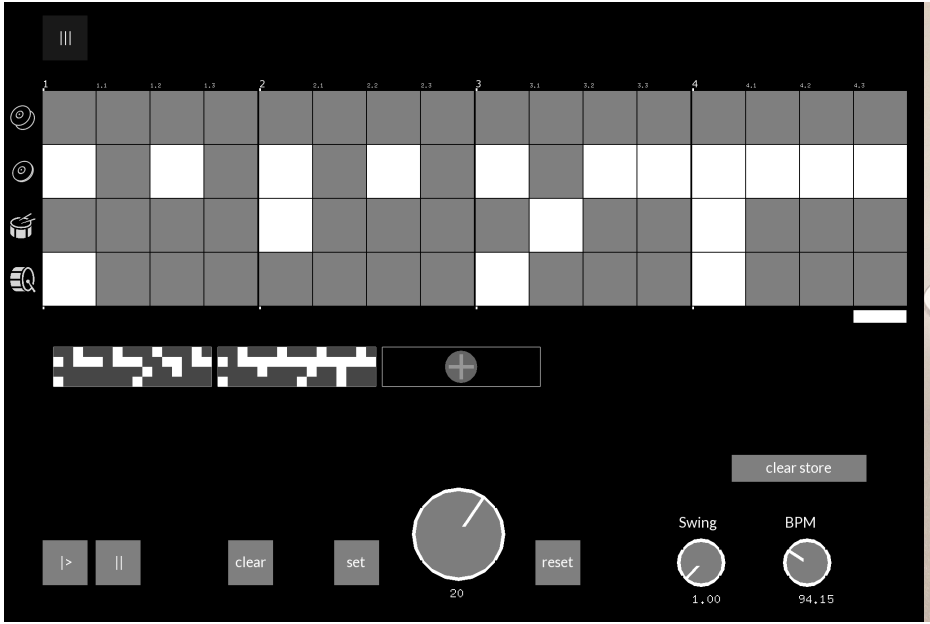
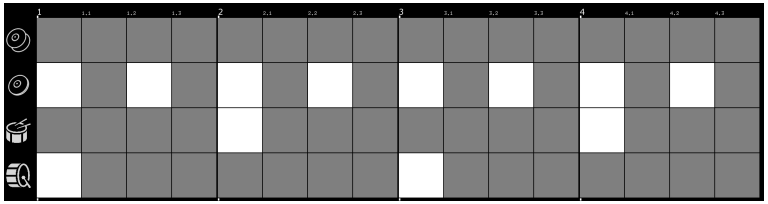


Touch UI


|||
clear store
|>
||
clear
set
reset
20
Swing
1.00
BPM
94.15

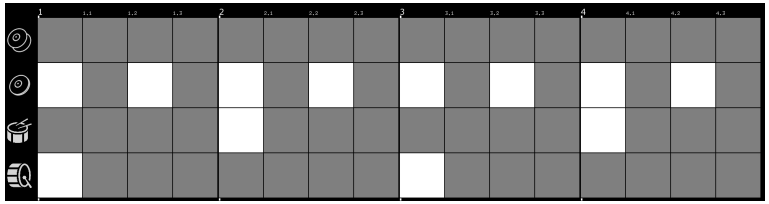

DEPARTMENT OF COMPUTATIONAL PERCEPTION
JKU

Pattern Variation Method



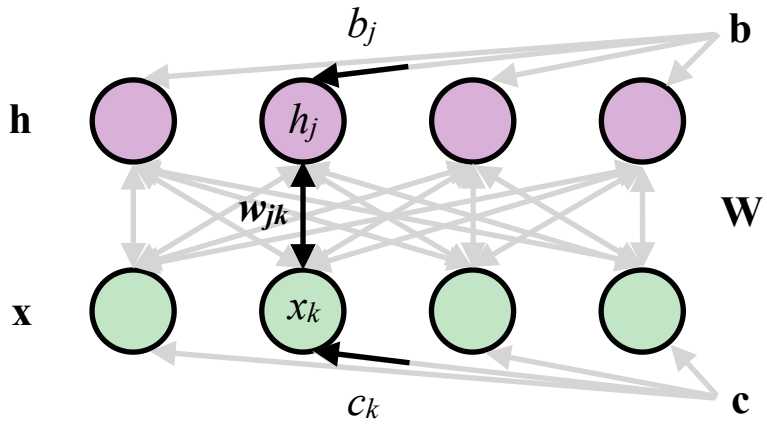
Pattern Variation Method

- Focus on **electronic dance music** (EDM)
- **Step sequencer interface**
  - 4/4 time signature
  - 16th note resolution, 4 instruments
  - Fixed pattern grid size

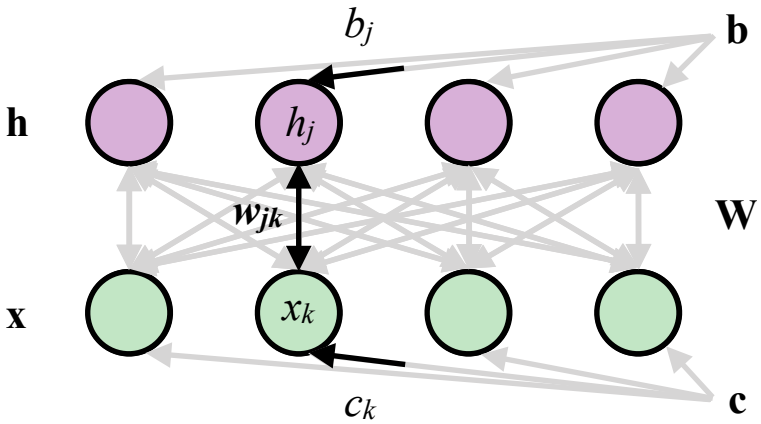


Pattern Variation Method

- Focus on **electronic dance music** (EDM)
- **Step sequencer interface**
  - 4/4 time signature
  - 16th note resolution, 4 instruments
  - Fixed pattern grid size
- **Stochastic generative model**
  - Sampling of **restricted Boltzmann machine** (RBM)
  - Trained on EDM **drum loop library** (NI Maschine)

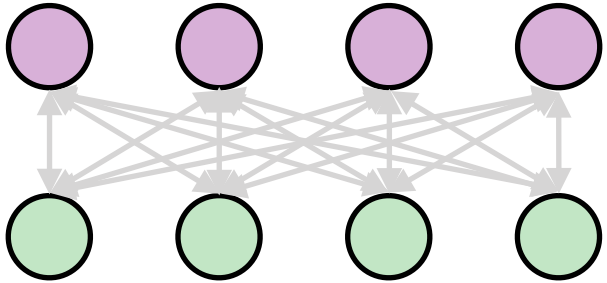


Pattern Variation Method



Pattern Variation Method

Latent Feature Space
One Node = Property of the Drum Pattern
500 Nodes



Pattern Space
One Node = Note of the Drum Pattern
-> 64 Nodes (4x16 patterns)

Pattern Variation Method

Latent Feature Space
One Node = Property of the Drum Pattern
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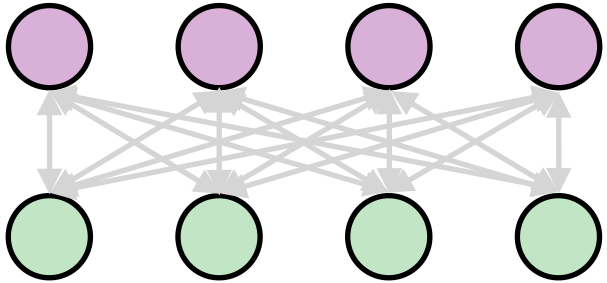

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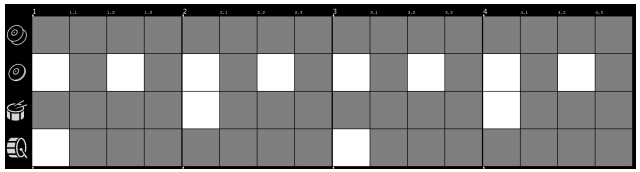
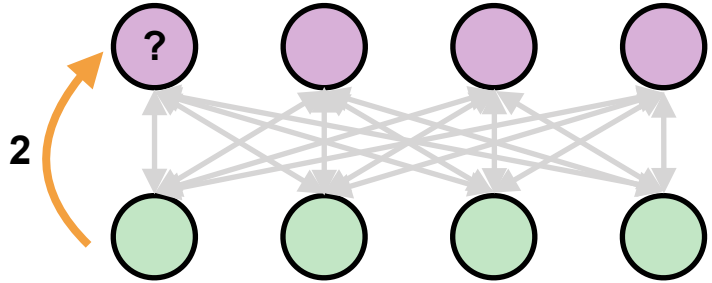


Seed Pattern

1

Pattern Variation Method

Latent Feature Space
One Node = Property of the Drum Pattern
500 Nodes



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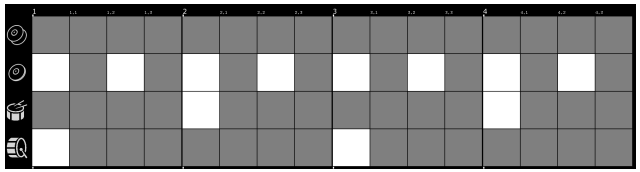
One Node = Note of the Drum Pattern
-> 64 Nodes (4x16 patterns)

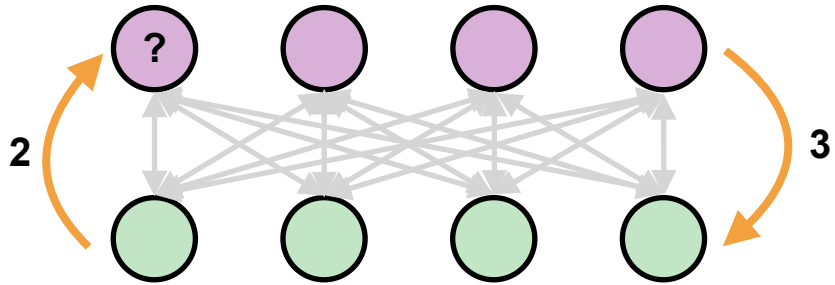
1



Seed Pattern

Pattern Variation Method

Latent Feature Space
One Node = Property of the Drum Pattern
500 Nodes



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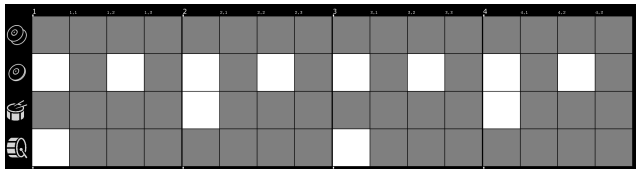

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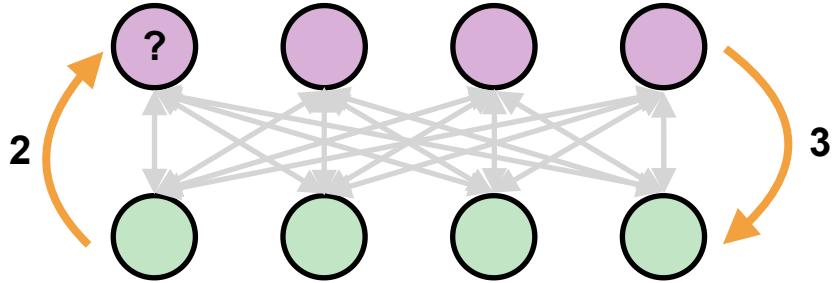

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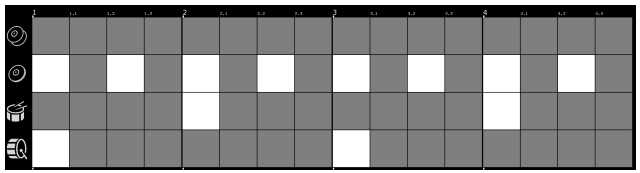
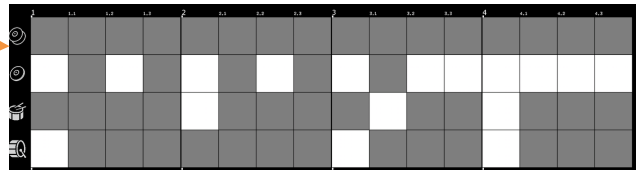


Seed Pattern

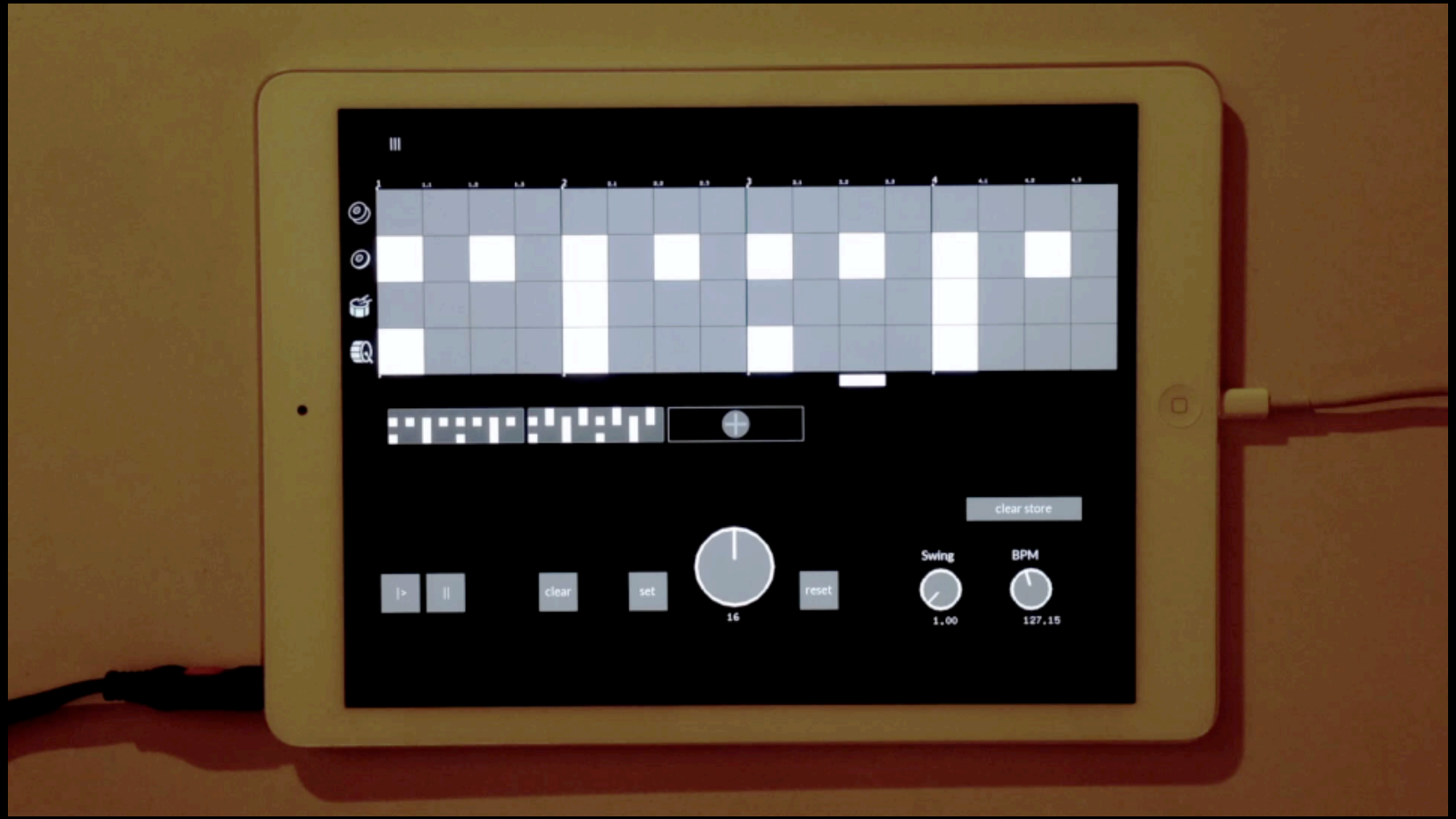
1

4

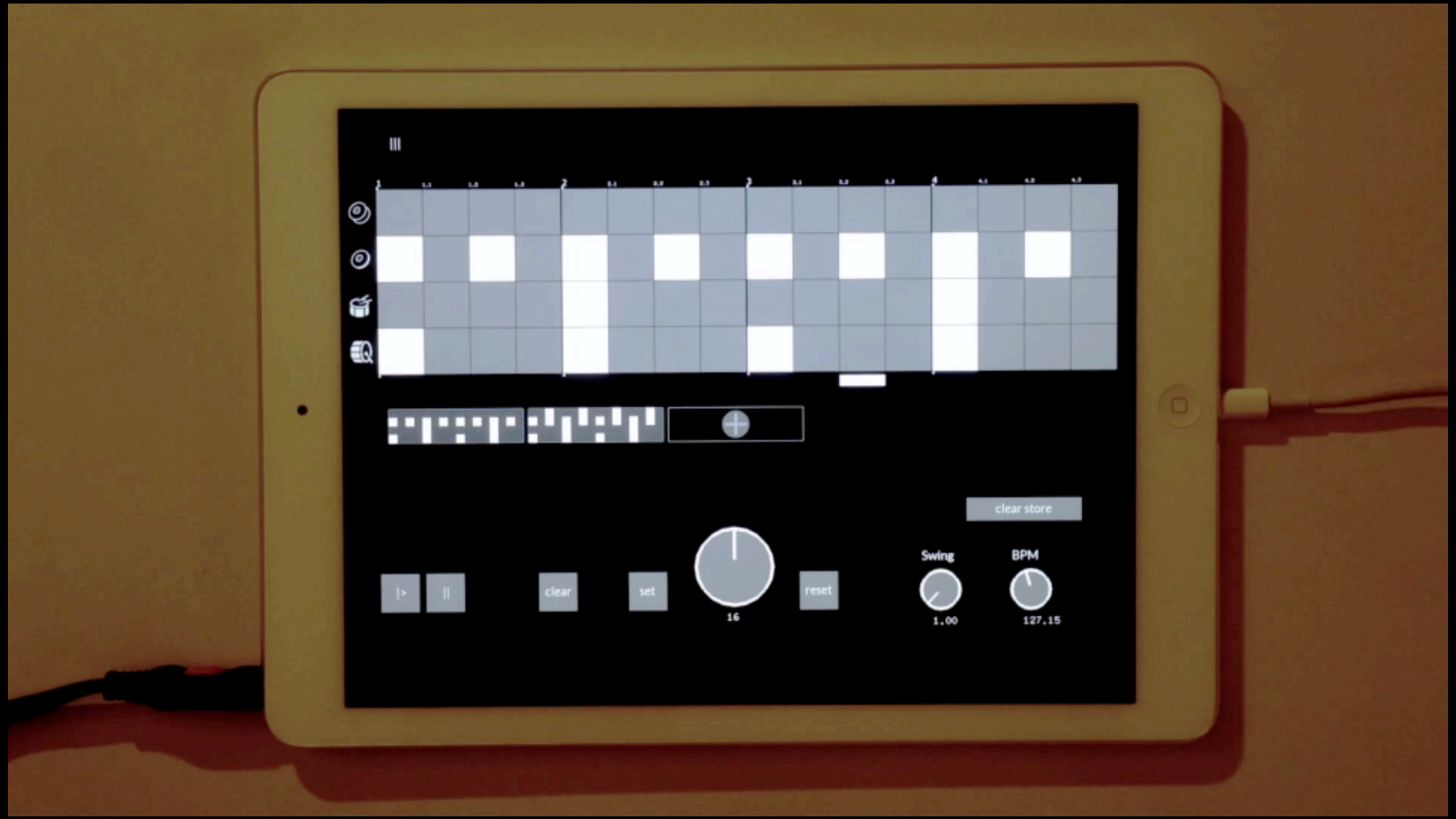


Output Pattern

Demo



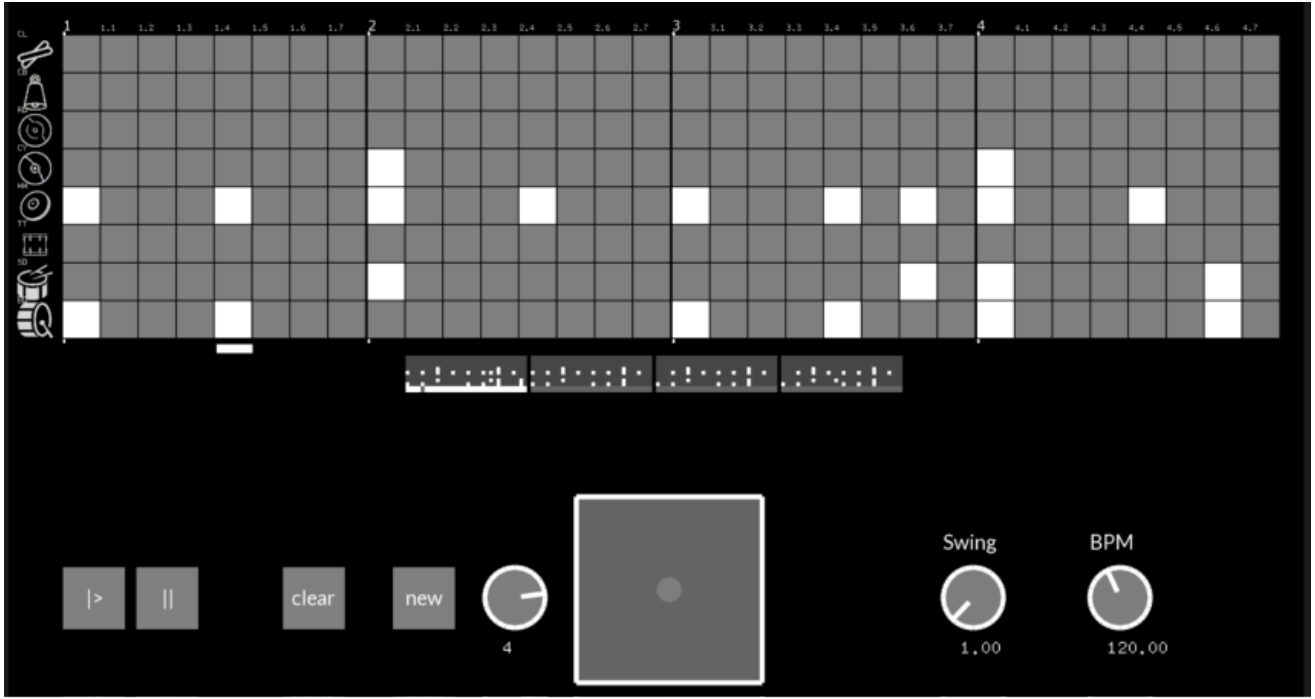
Demo



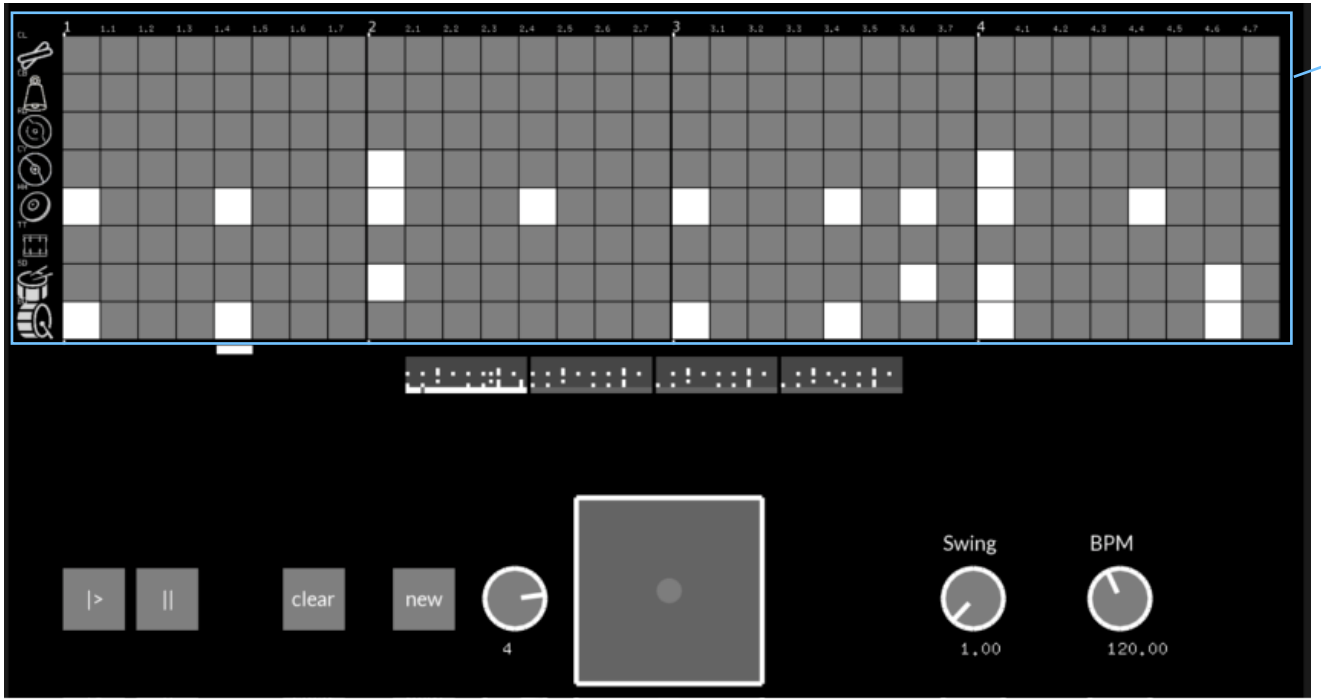
Parametric Drum Pattern Generation

- Create drum patterns given certain properties:
  - Genre
  - Complexity
  - Loudness
- Usually this is done using labeled pattern libraries
  - e.g.: Logic Drummer
  - Often perceived to be unoriginal
- Let’s use a stochastic generative model!

User Interface



User Interface



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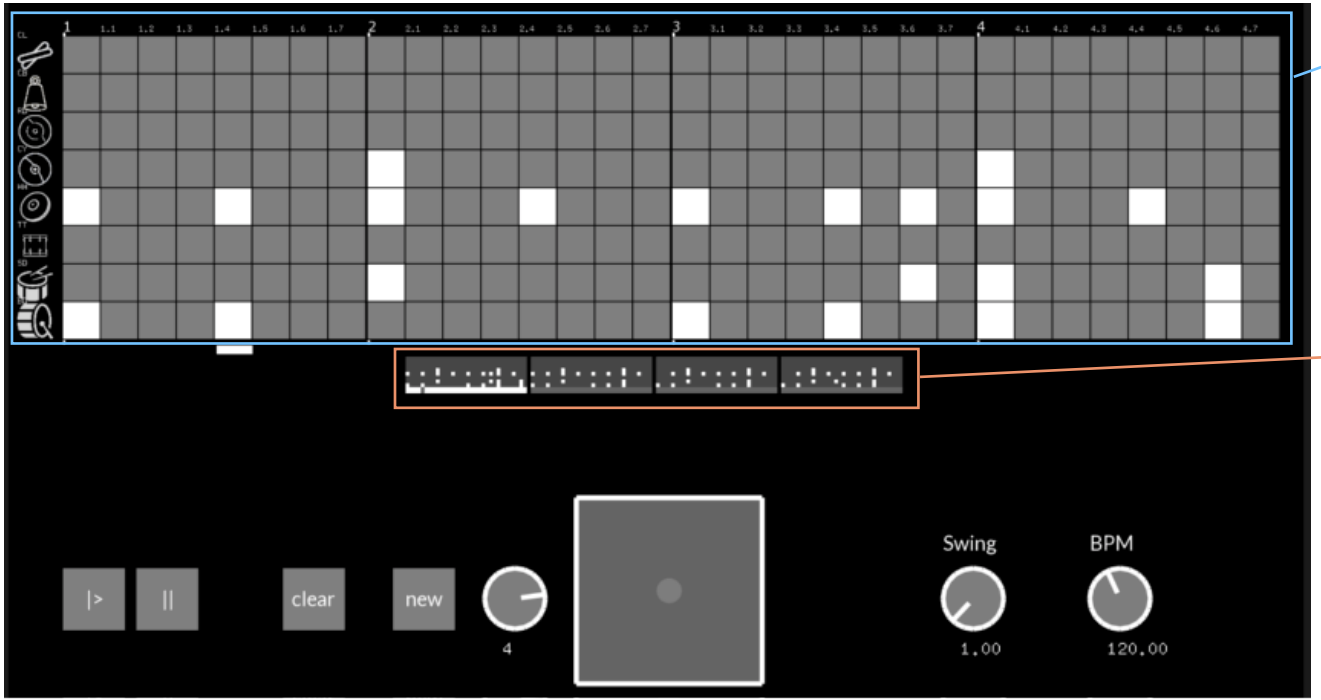
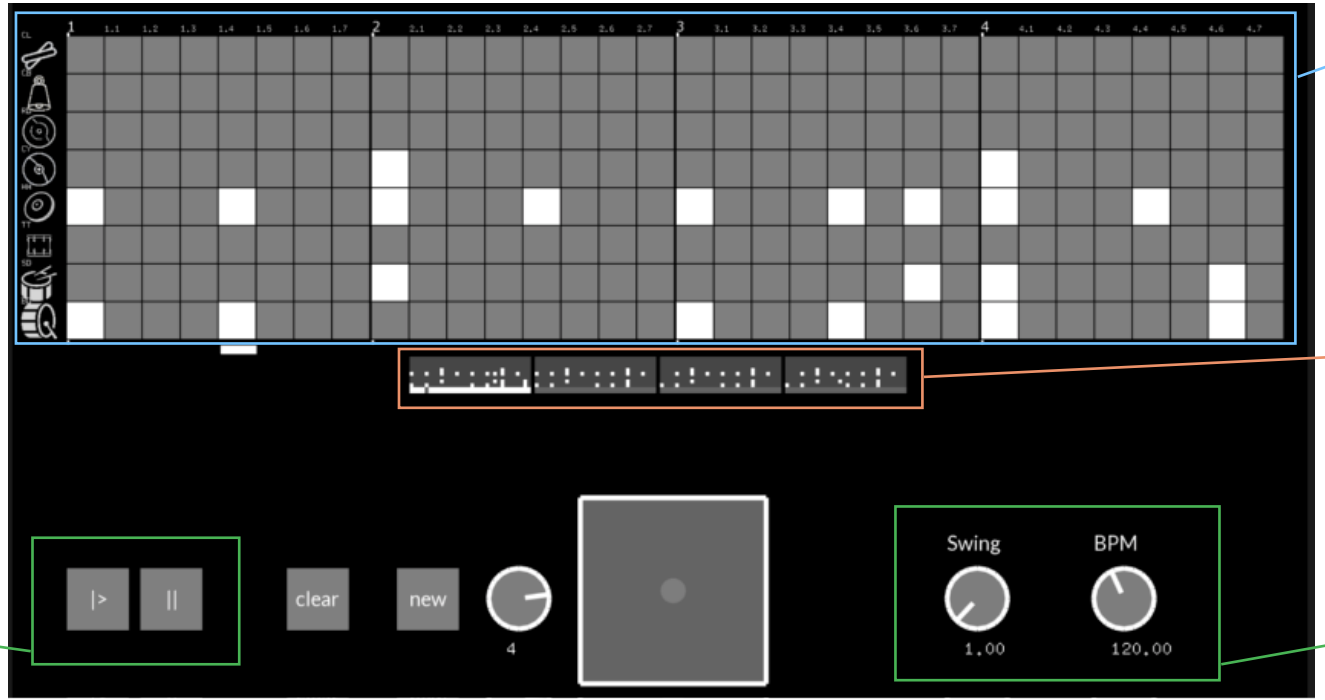


User Interface



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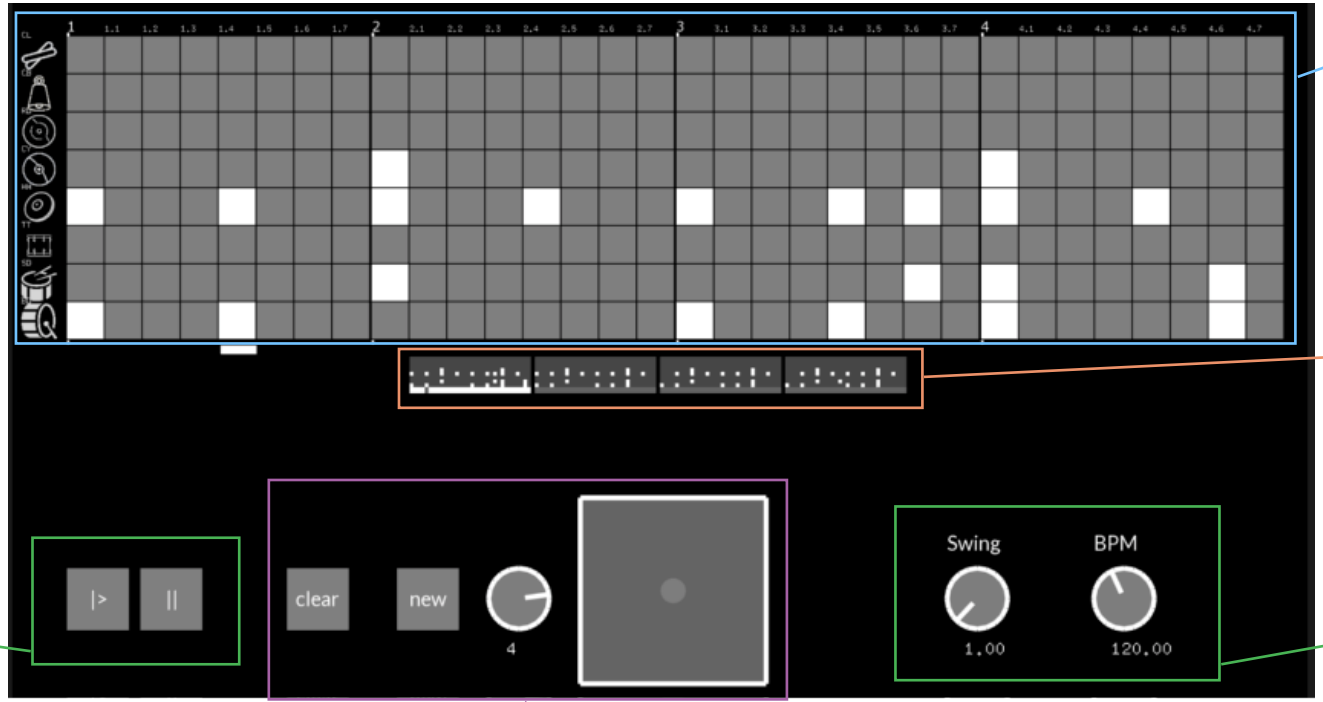

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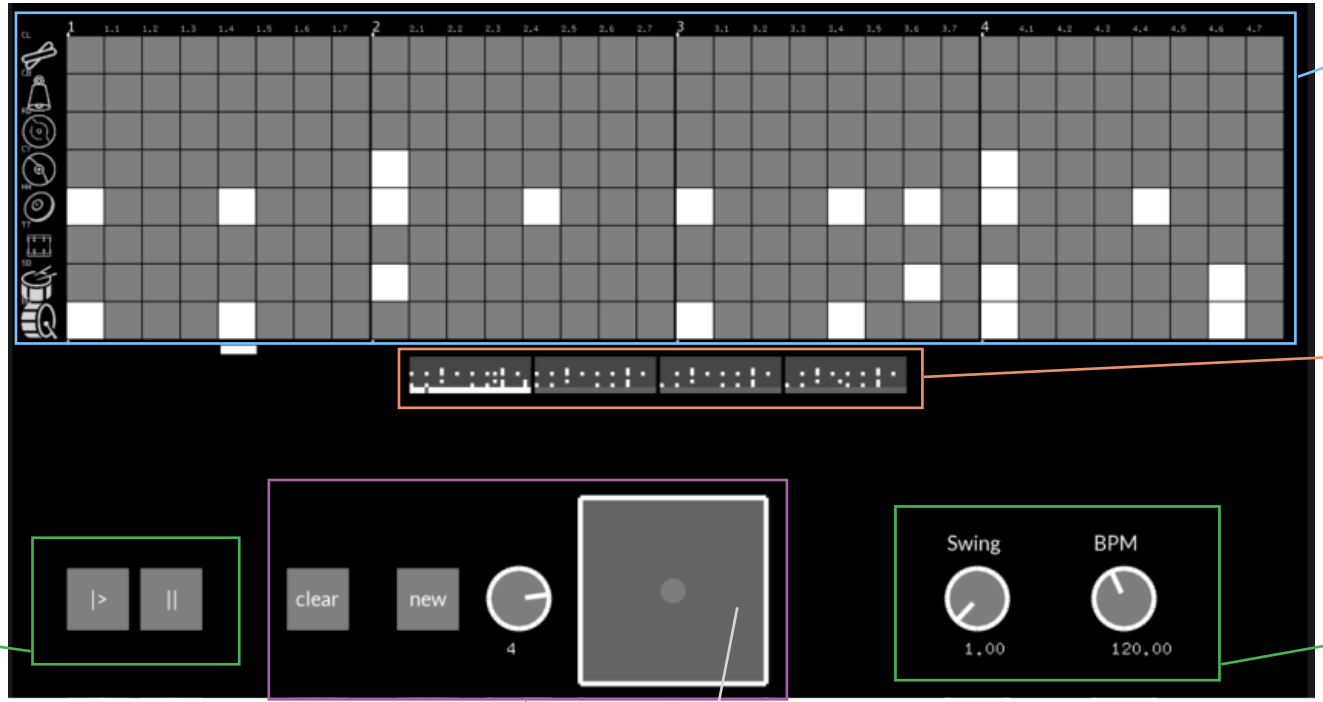


Generation Method

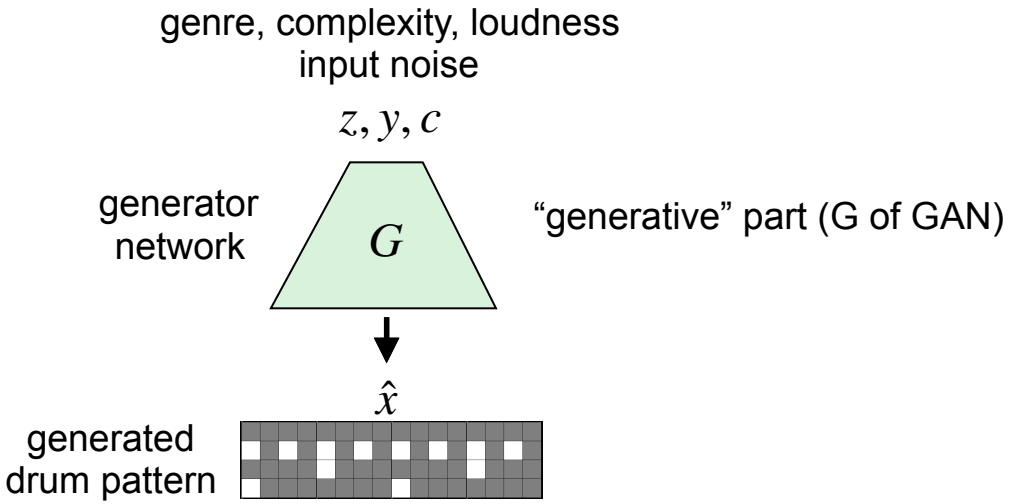
Generation Method

- Train on dataset with **multiple musical genres**
- **Step sequencer interface**
  - 4/4 time signature
  - 32nd note resolution, 8 instruments

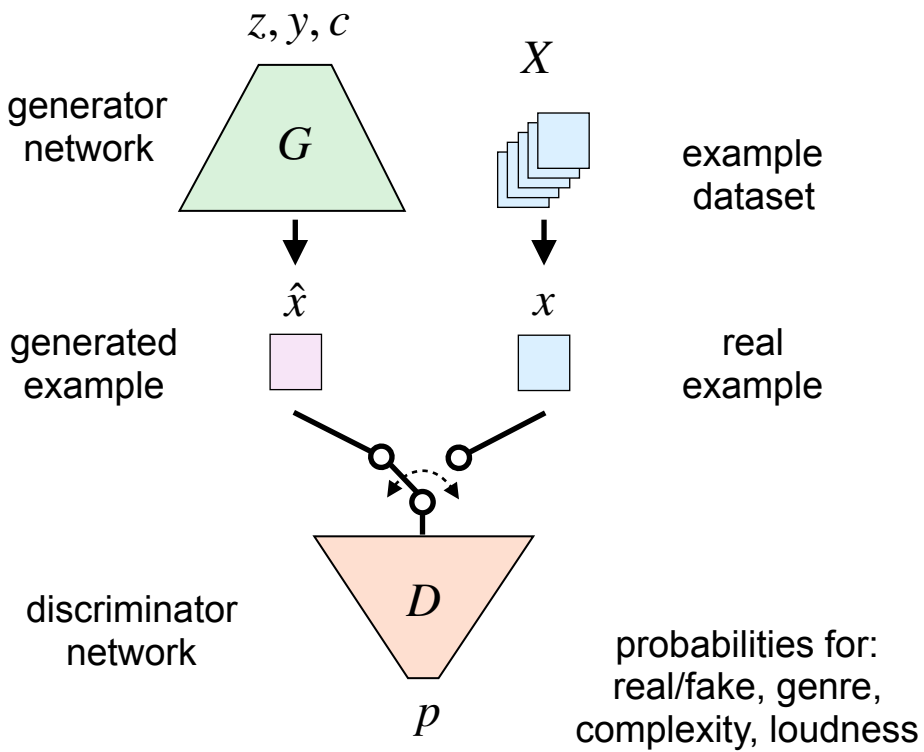
Generation Method

- Train on dataset with **multiple musical genres**
- **Step sequencer interface**
  - 4/4 time signature
  - 32nd note resolution, 8 instruments
- **Generative model**
  - Generative Adversarial Neural Network (GAN)

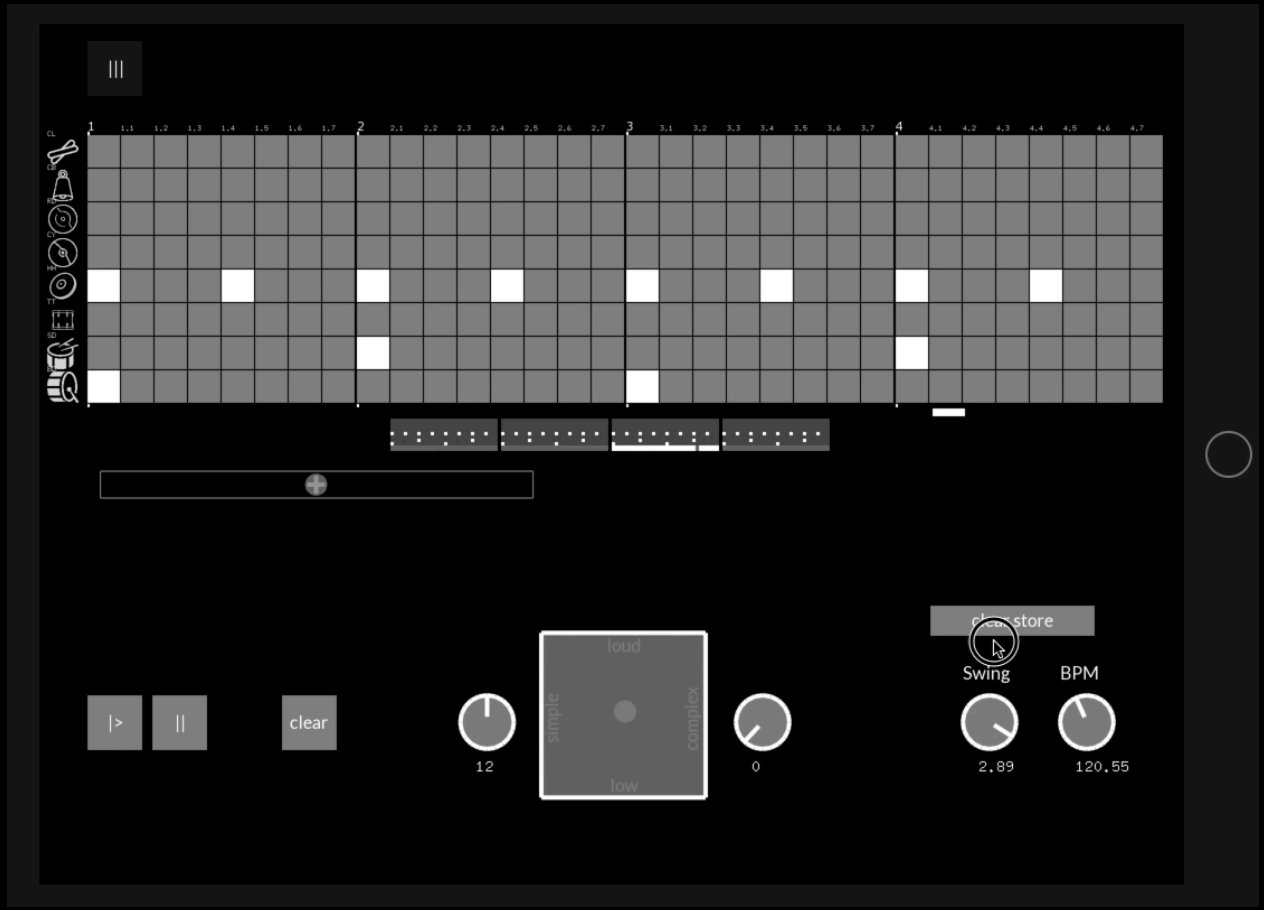
Pattern Generation Method



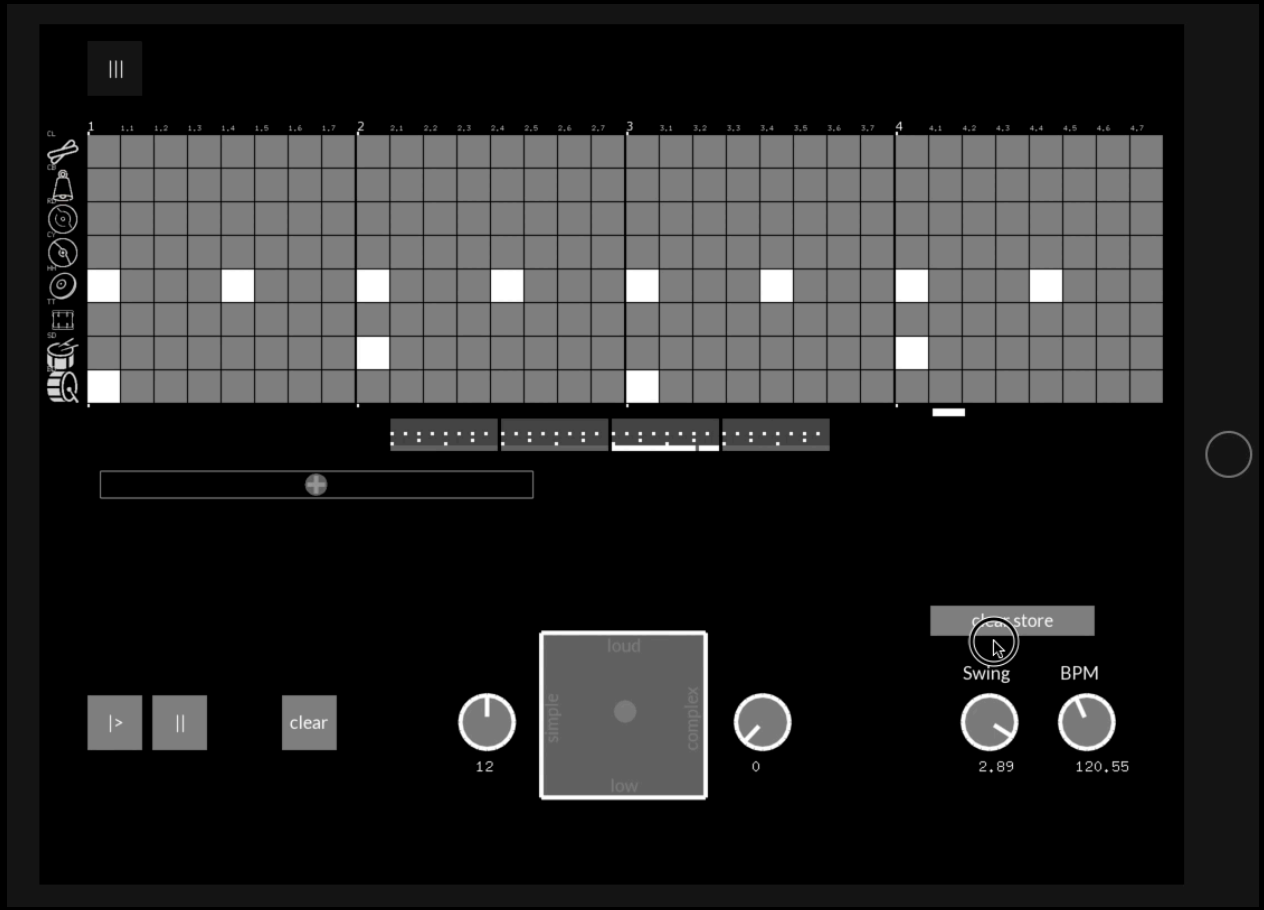
Pattern Generation Method



Demo

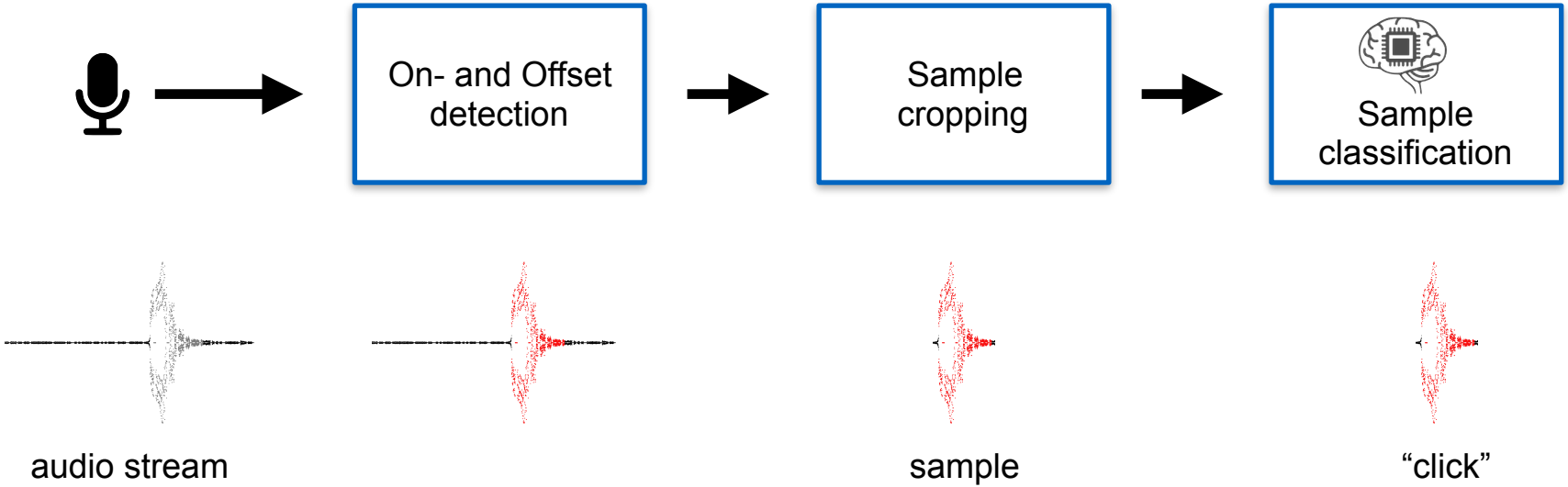


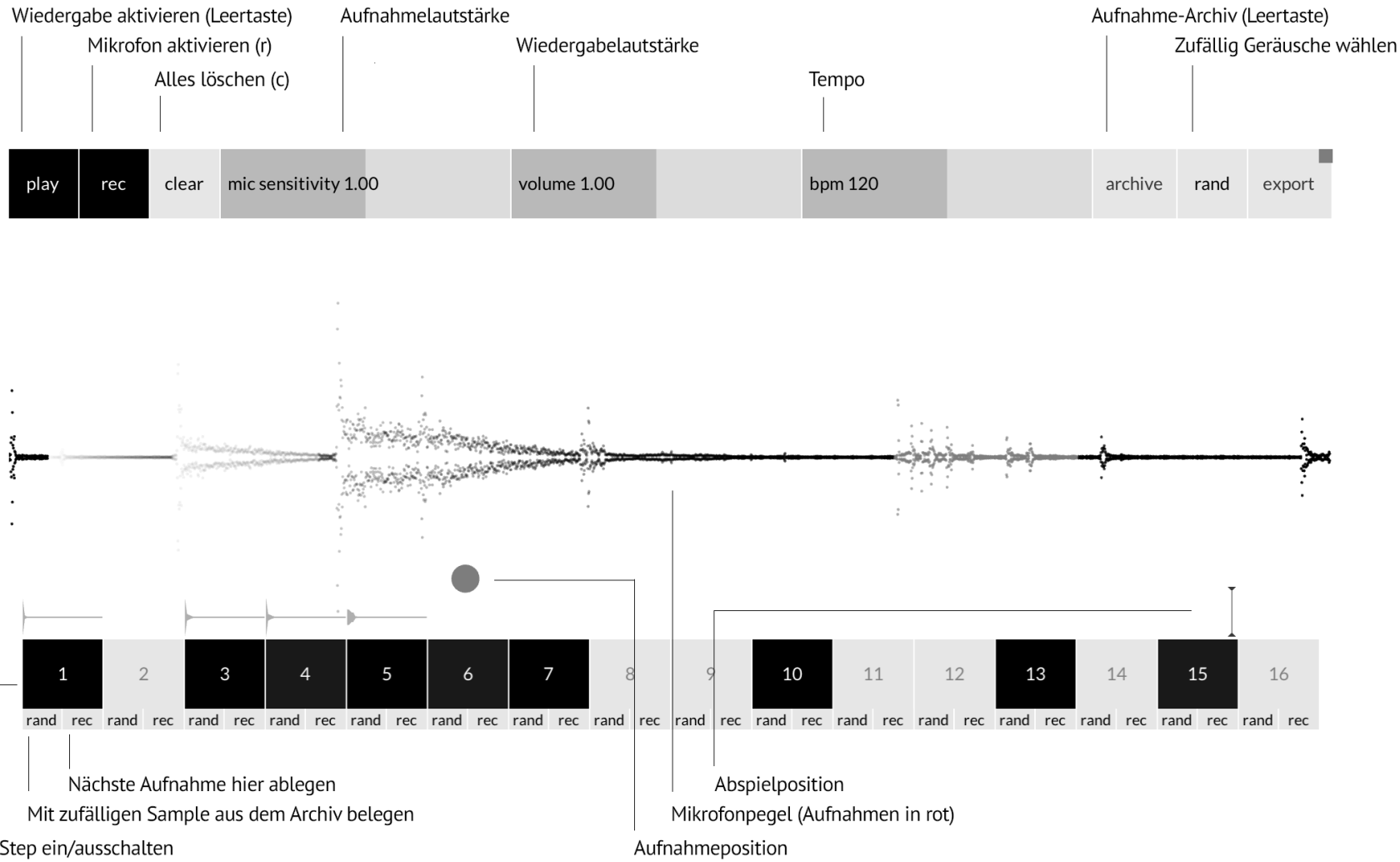
Demo



Technology Demo: ClinkyDinky

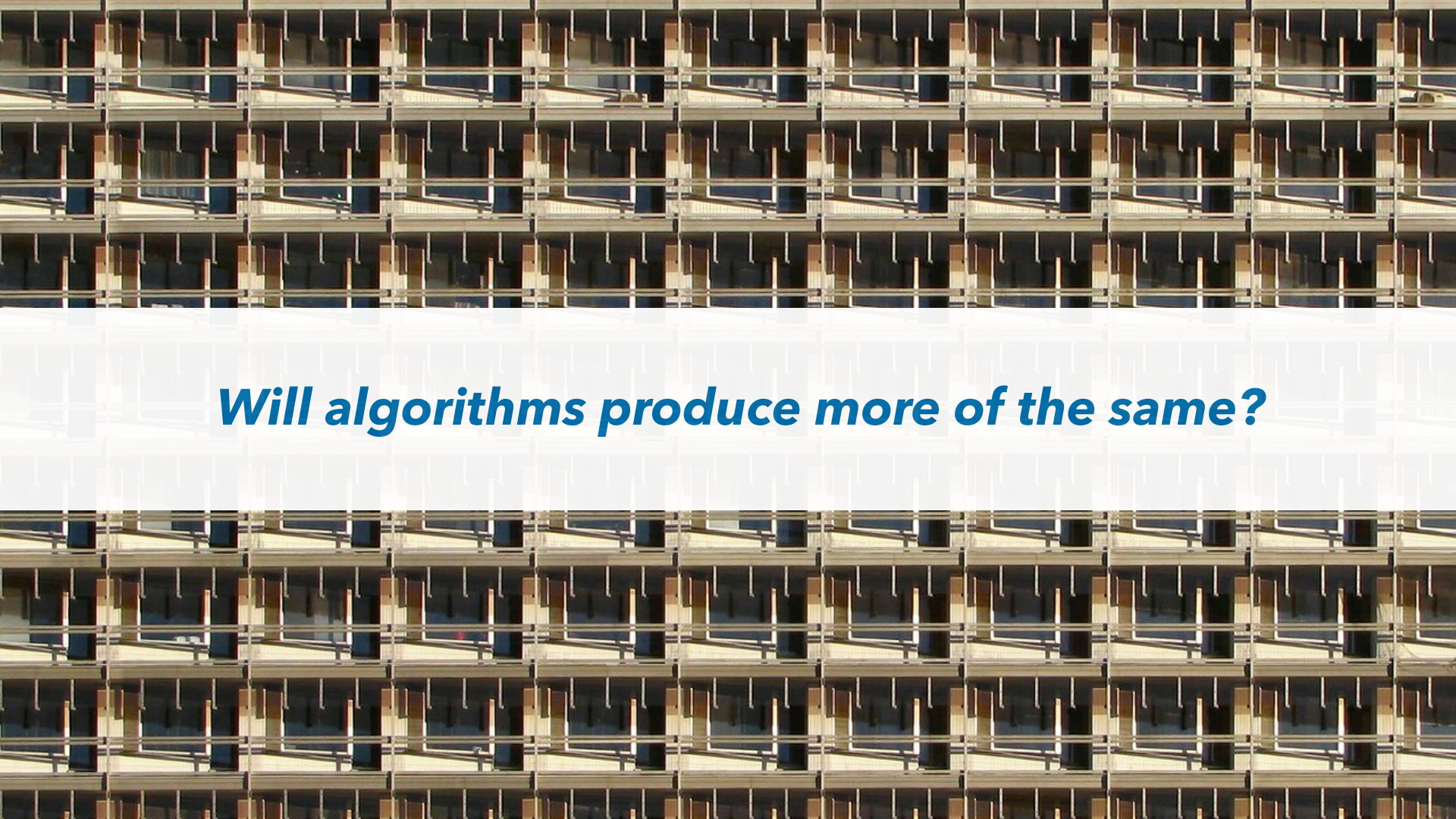
Audio Flow


On- and Offset detection
Sample cropping
Sample classification
audio stream
sample
“click”


Wiedergabe aktivieren (Leertaste)
Mikrofon aktivieren (r)
Alles löschen (c)
Aufnahmelautstärke
Wiedergabelautstärke
Tempo
Aufnahme-Archiv (Leertaste)
Zufällig Geräusche wählen
play
rec
clear
mic sensitivity 1.00
volume 1.00
bpm 120
archive
rand
export
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
rand
rec
Nächste Aufnahme hier ablegen
Mit zufälligen Sample aus dem Archiv belegen
Step ein/ausschalten
Aufnahmeposition
Mikrofonpegel (Aufnahmen in rot)
Abspielposition

Reflection

There are many challenging questions left open.



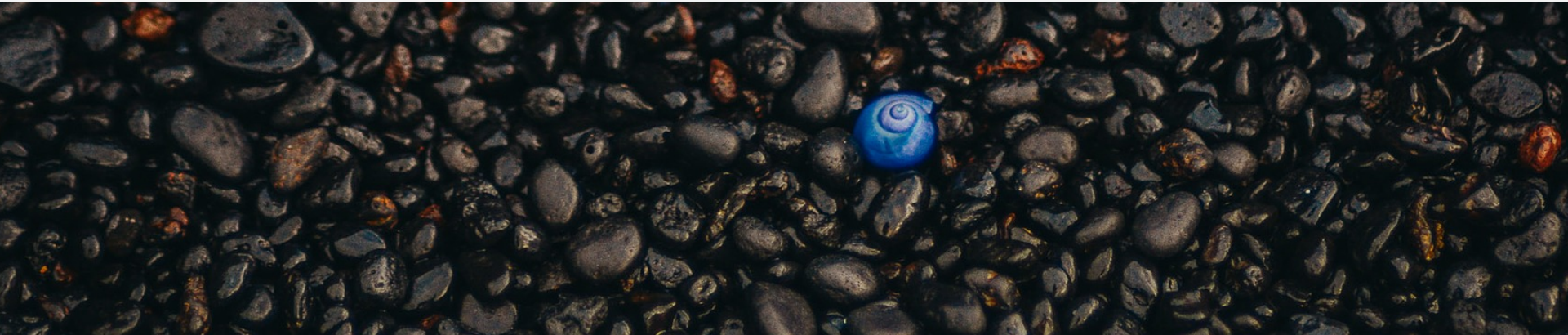
Will algorithms produce more of the same?

Will music creators be satisfied with what they deliver?

Will music consumers be satisfied with what they get?

Will there by a rush of self-appointed creators?

Will it be easy to identify the good creations?



Will music lose its value?

Will human artists lose their value?


What about copyright / right d'auteur?
Who is the creator / author?

Various stakeholders are affected!

end consumers

music creators

performers

music companies

platform providers

the society

European Platform for Digital Humanism

Out of the Box

The Midlife Crisis of the Digital Revolution

ARS ELECTRONICA

Festival for Art, Technology and Society

POSTCITY Linz

September 5–9, 2019

AI x Music Festival

Encounters in the uncharted territories between human creativity and mechanical perfection

Das Festival AIxMusic (AI trifft Musik) wird von Ars Electronica und der Europäischen Kommission im Rahmen der Initiative STARTS in Kooperation mit vielen Partnern aus Industrie, akademischer Forschung sowie Kunst- und Bildungseinrichtungen organisiert. Es ist ein Hybrid aus Musikfestival und KI-Konferenz, aus einem philosophischen Symposium und einer Präsentation von Start-ups. Es beschäftigt sich mit Kunst und Musik, um die neuesten Errungenschaften der KI-Forschung im Hinblick auf ihre möglichen Auswirkungen auf unser Leben zu demonstrieren und zu diskutieren.

Musik trifft Technologie trifft Musik

Kreativität – die Fähigkeit, neue und unerwartete Ausdrucksformen hervorzubringen, über die Wiederholung und Veränderung des Bestehenden hinauszugehen – wird oft als ultimative Grenze angesehen, die nur dem menschlichen Geist möglich ist.

- Werden Maschinen in der Lage sein, überzeugende Kunstwerke oder wissenschaftliche Theorien zu schaffen?

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Image courtesy of Red Bull Music Academy

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Regarding Digital Humanism...

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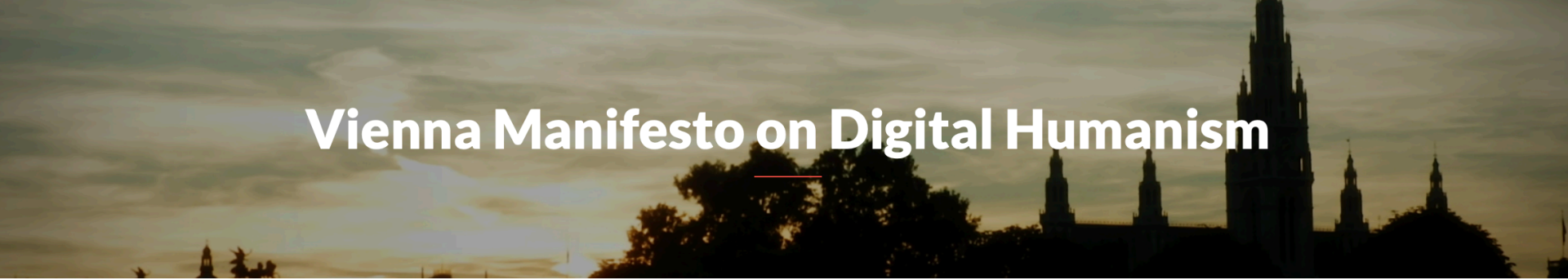
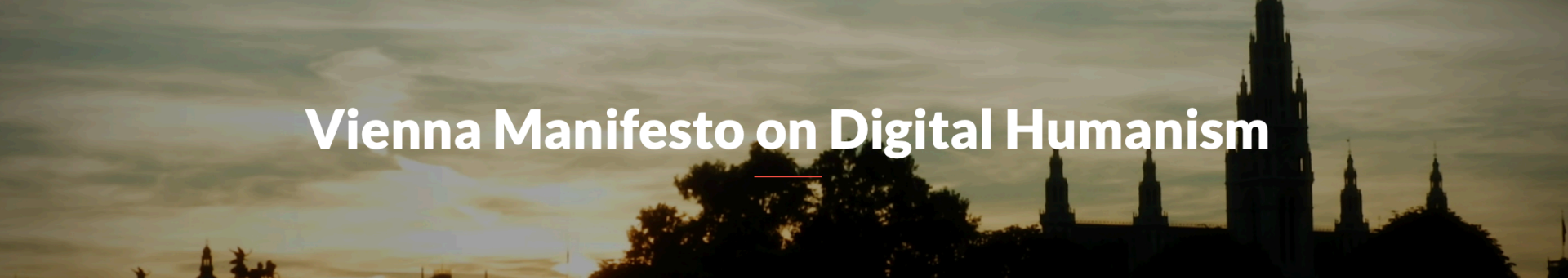


Vienna Manifesto on Digital Humanism

A call for action!

Digital Humanism refers to an approach that describes, analyzes, and influences the complex interplay of technology and humankind. Its goal is to **put the human at the center of technological progress** to shape current and future technologies.



Vienna Manifesto on Digital Humanism

…promote **democracy and inclusion** … safeguard **free expression** … regulations should **ensure fairness, accountability, and transparency** of algorithms … **intervene with tech monopolies** … **breaking disciplinary silos** … **engage** with the wider society … **take responsibility** … technology is not neutral … a vision is needed for **new educational curricula** …

…**we must go into action and take the right direction!**

VIENNA MANIFESTO ON DIGITAL HUMANISM

VIENNA, MAY 2019

››The system is failing‹‹ — stated by the founder of the Web, Tim Berners-Lee — emphasizes that while digitalization opens unprecedented opportunities, it also raises serious concerns: the monopolization of the Web, the rise of extremist opinions and behavior orchestrated by social media, the formation of filter bubbles and echo chambers as islands of disjoint truths, the loss of privacy, and the spread of digital surveillance. Digital technologies are disrupting societies and questioning our understanding of what it means to be human. The stakes are high and the challenge of building a just and democratic society with humans at the center of technological progress needs to be addressed with determination as well as scientific ingenuity. Technological innovation demands social innovation, and social innovation requires broad societal engagement.

This manifesto is a call to deliberate and to act on current and future technological development. We encourage our academic communities, as well as industrial leaders, politicians, policy makers, and professional societies all around the globe, to actively participate in policy formation. Our demands are the result of an emerging process that unites scientists and practitioners across fields and topics, brought together by concerns and hopes for the future. We are aware of our joint responsibility for the current situation and the future – both as professionals and citizens.

Today, we experience the co-evolution of technology and humankind. The flood of data, algorithms, and computational power is disrupting the very fabric of society by changing human interactions, societal institutions, economies, and political structures. Science and the humanities are not exempt. This disruption simultaneously creates and threatens jobs, produces and destroys wealth, and improves and damages our ecology. It shifts power structures, thereby blurring the human and the machine.

The quest is for enlightenment and humanism. The capability to automate human cognitive activities is a revolutionary aspect of computer science / informatics. For many tasks, machines surpass already what humans can accomplish in speed, precision, and even analytic deduction. The time is right to bring together humanistic ideals with critical thoughts about technological progress. We therefore link this manifesto to the intellectual tradition of humanism and similar movements striving for an enlightened humanity.

Like all technologies, digital technologies do not emerge from nowhere. They are shaped by implicit and explicit choices and thus incorporate a set of values, norms, economic interests, and assumptions about how the world around us is or should be. Many of these choices remain hidden in software programs implementing algorithms that remain invisible. In line with the renowned Vienna Circle and its contributions to modern thinking, we want to espouse critical rational reasoning and the interdisciplinarity needed to shape the future.

We must shape technologies in accordance with human values and needs, instead of allowing technologies to shape humans. Our task is not only to rein in the downsides of information and communication technologies, but to encourage human-centered innovation. We call for a Digital Humanism that describes, analyzes, and, most importantly, influences the complex interplay of technology and humankind, for a better society and life, fully respecting universal human rights.

In conclusion, **we proclaim the following core principles:**

- **Digital technologies should be designed to promote democracy and inclusion.** This will require special efforts to overcome current inequalities and to use the emancipatory potential of digital technologies to make our societies more inclusive.
- **Privacy and freedom of speech are essential values for democracy and should be at the center of our activities.** Therefore, artifacts such as social media or online platforms need to be altered to better safeguard the free expression of opinion, the dissemination of information, and the protection of privacy.
- **Effective regulations, rules and laws, based on a broad public discourse, must be established.** They should ensure prediction accuracy, fairness and equality, accountability, and transparency of software programs and algorithms.
- **Regulators need to intervene with tech monopolies.** It is necessary to restore market competitiveness as tech monopolies concentrate market power and stifle innovation. Governments should not leave all decisions to markets.
- **Decisions with consequences that have the potential to affect individual or collective human rights must continue to be made by humans.** Decision makers must be responsible and accountable for their decisions. Automated decision making systems should only support human decision making, not replace it.
- **Scientific approaches crossing different disciplines are a prerequisite for tackling the challenges ahead.** Technological disciplines such as computer science / informatics must collaborate with social sciences, humanities, and other sciences, breaking disciplinary silos.
- **Universities are the place where new knowledge is produced and critical thought is cultivated.** Hence, they have a special responsibility and have to be aware of that.
- **Academic and industrial researchers must engage openly with wider society and reflect upon their approaches.** This needs to be embedded in the practice of producing new knowledge and technologies, while at the same time defending the freedom of thought and science.
- **Practitioners everywhere ought to acknowledge their shared responsibility for the impact of information technologies.** They need to understand that no technology is neutral and be sensitized to see both potential benefits and possible downsides.
- **A vision is needed for new educational curricula, combining knowledge from the humanities, the social sciences, and engineering studies.** In the age of automated decision making and AI, creativity and attention to human aspects are crucial to the education of future engineers and technologists.
- **Education on computer science / informatics and its societal impact must start as early as possible.** Students should learn to combine information-technology skills with awareness of the ethical and societal issues at stake.

We are at a crossroads to the future; we must go into action and take the right direction!

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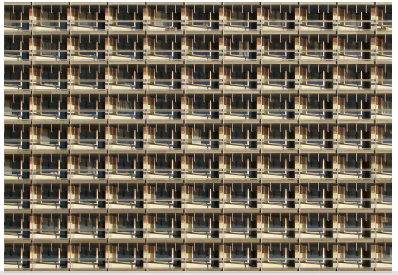
Support the Manifesto as an individual or organization and help us spread the word

https://www.informatik.tuwien.ac.at/dighum/

Summing up

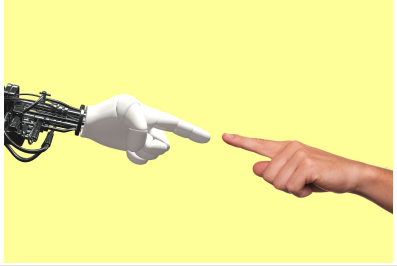
New ideas

Getting out of the bubble

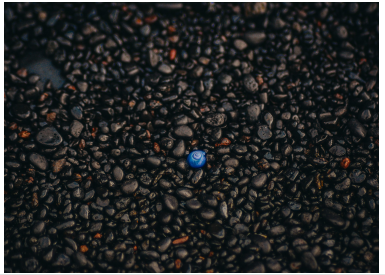


More of the same

Rush of creators



Human-computer symbiosis



Filtering noise

Wrap up

Many open questions

Speakers

Christine Bauer
Johannes Kepler University Linz
christine.bauer@jku.at
@christine_bauer

Peter Knees
TU Wien
peter.knees@tuwien.ac.at
@peter_knees

Richard Vogl
TU Wien
richard.vogl@tuwien.ac.at
@richard_vogl

Hansi Raber
super@superduper.org
@kritzikratzi
https://www.youtube.com/hansiraber