Sound Innovation Engine 1.0

Towards Sound Innovation Engines
Using Pattern-Producing Networks and Audio Graphs

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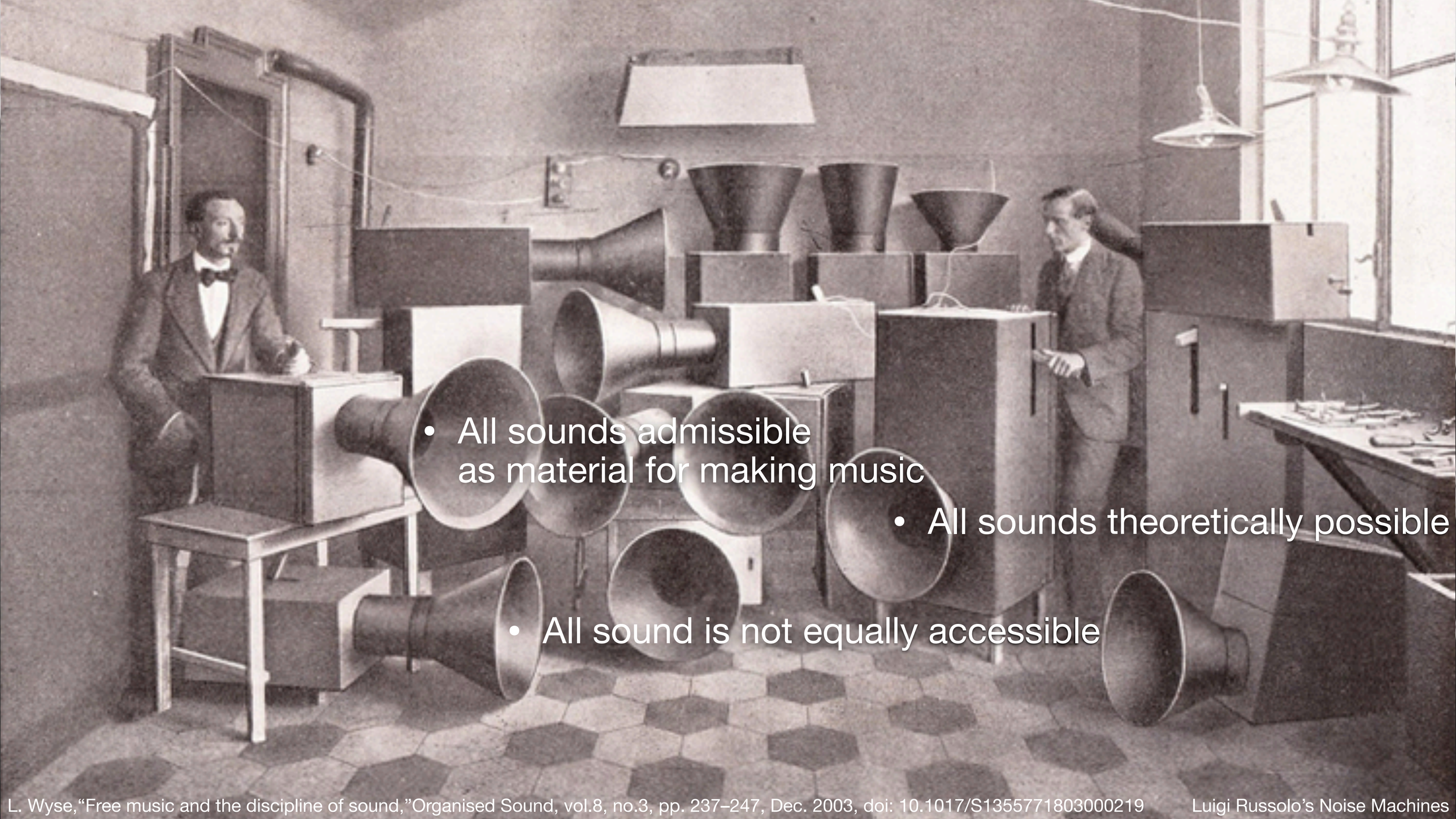
University of Oslo


• All sounds admissible
as material for making music
• All sounds theoretically possible
• All sound is not equally accessible

recognising sounds you've never heard

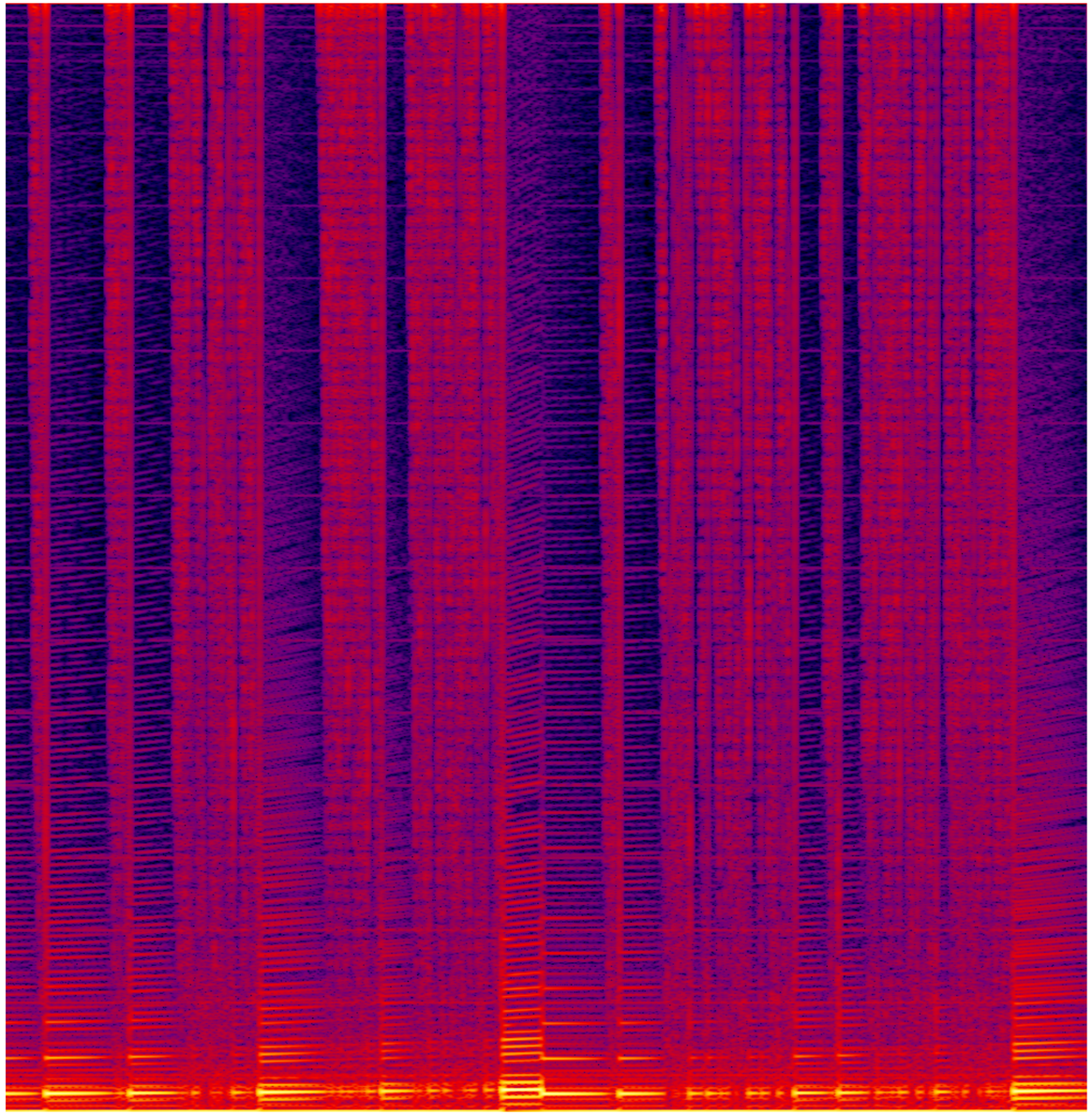
finding sounds recognised as pleasing but unfamiliar

Quality Diversity
to discover stepping stones
with goal switching
on a path to greatness

Innovation Engines

Automate QD exploration with a model capable of:

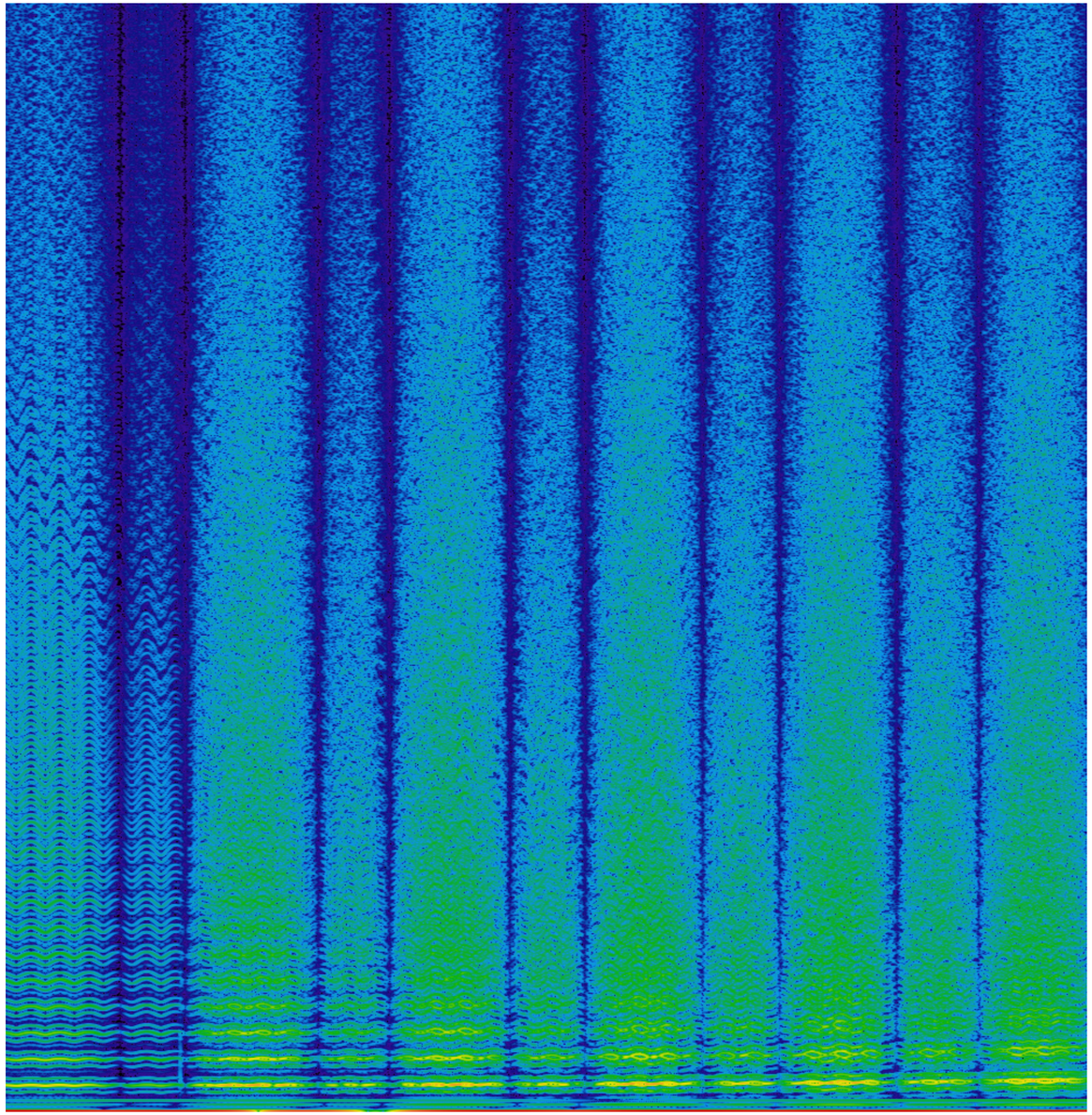
- distinguishing novelty
- evaluating quality



Innovation Engines

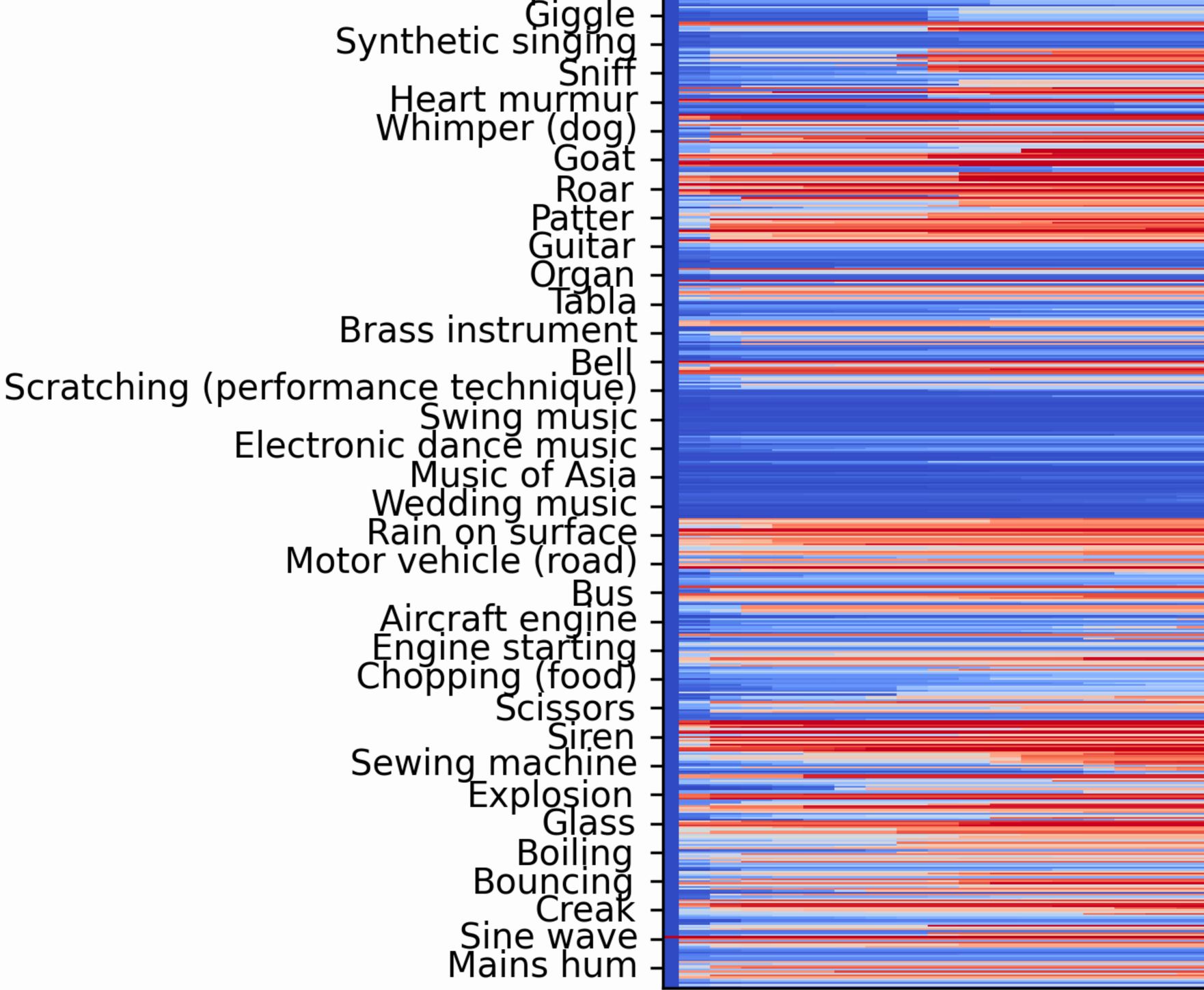
Ultimate goal:

- Unsupervised classification
- Produce new types of things



Behavioural Descriptor

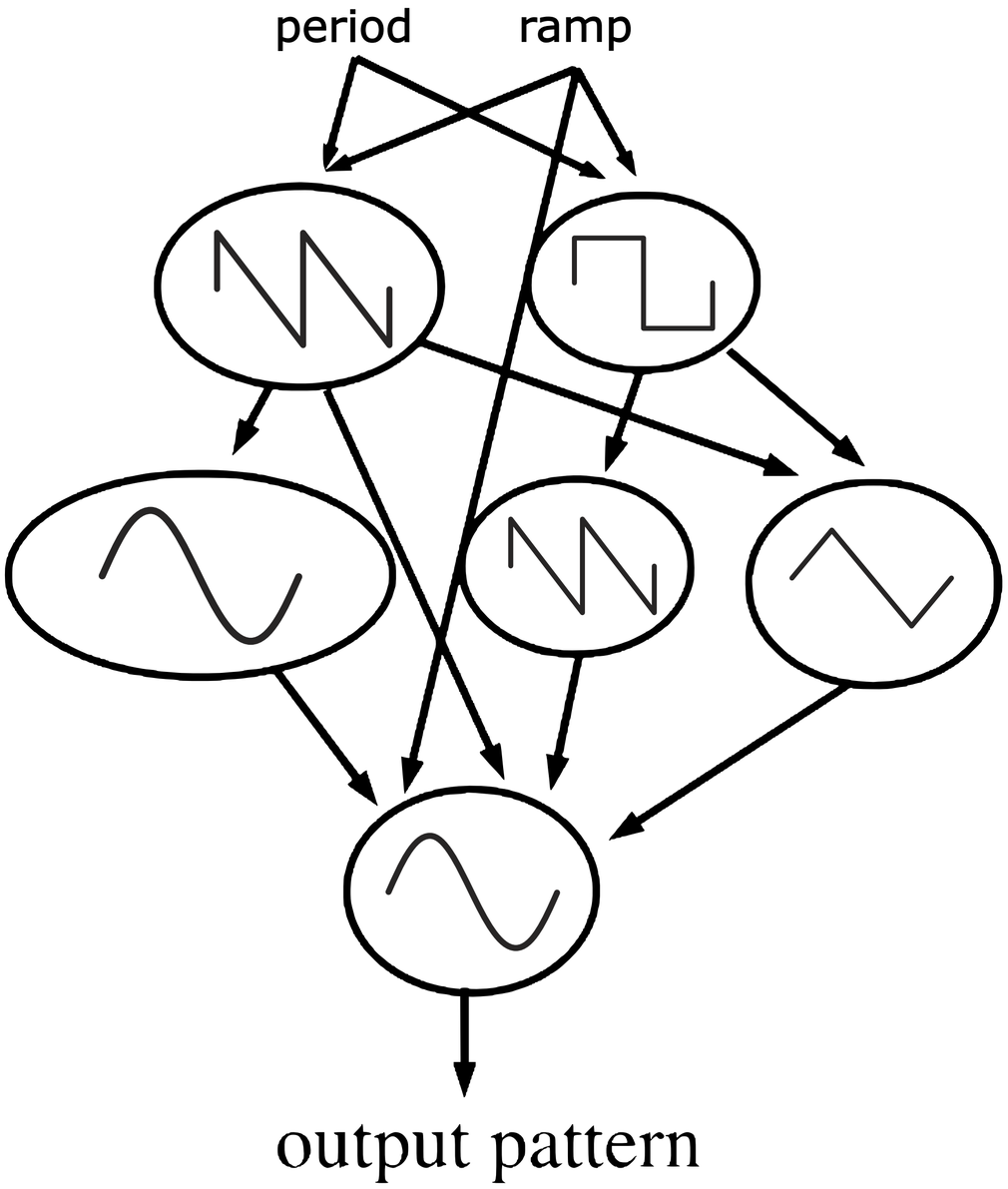
YAMNet

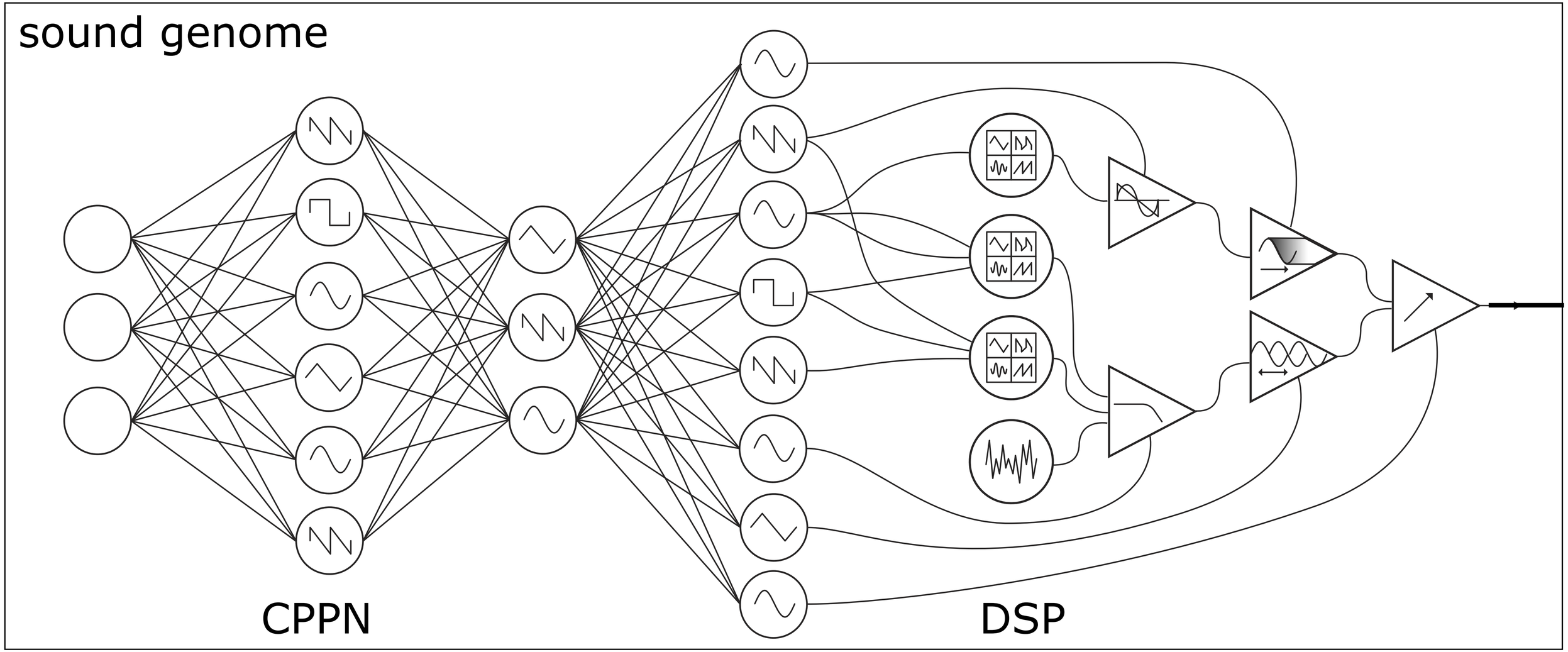


Compositional Pattern Producing Networks

CPPNs

- Abstract unfolding development in evolutionary processes
- Applied to timbral development
  - Combined with DSP graphs



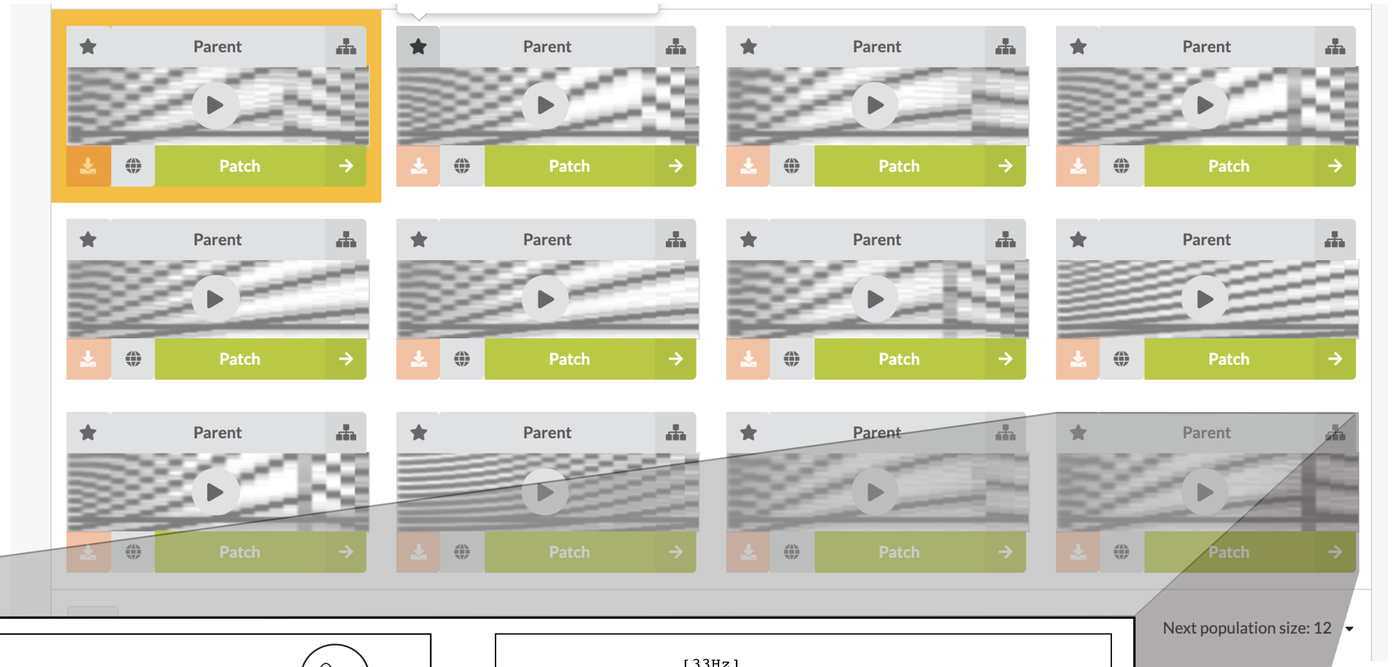


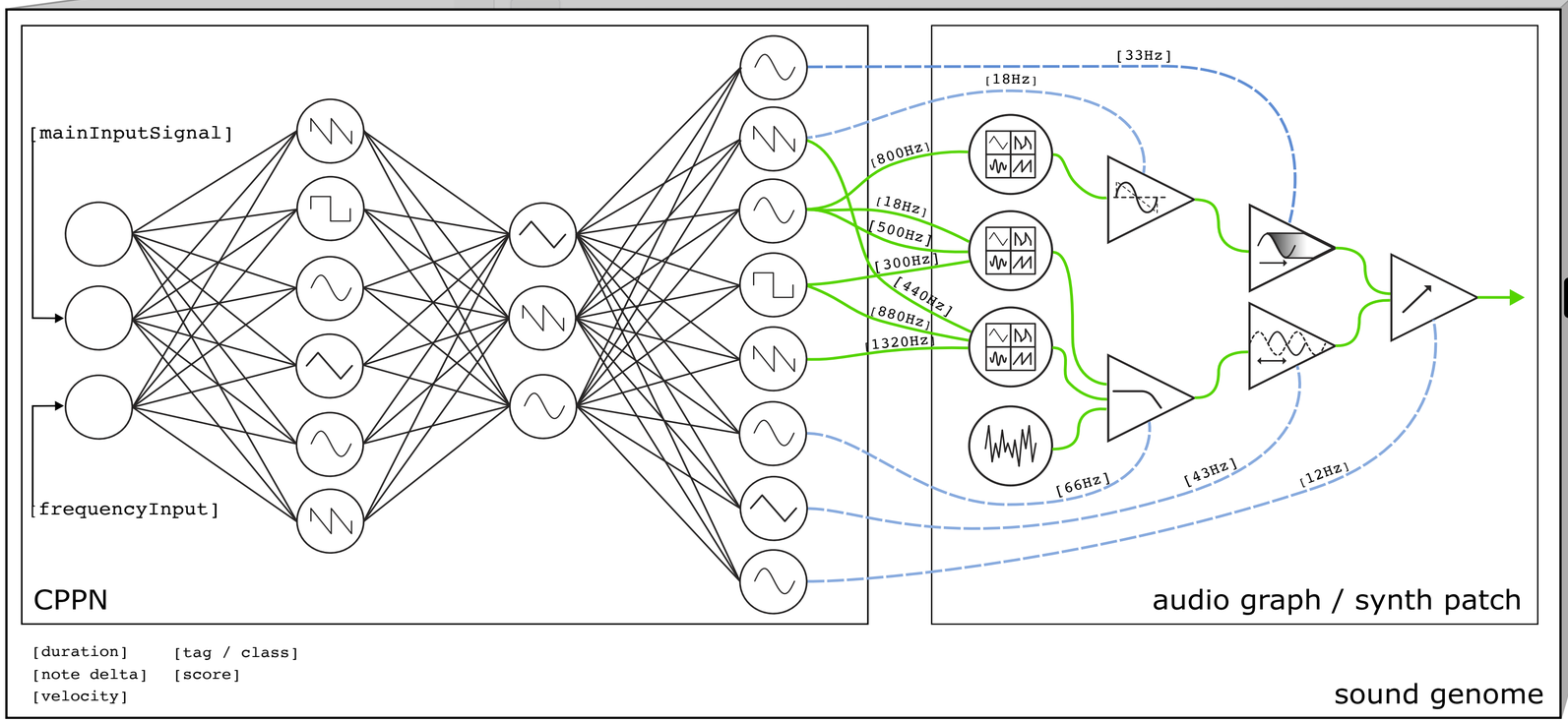
Signal Composition

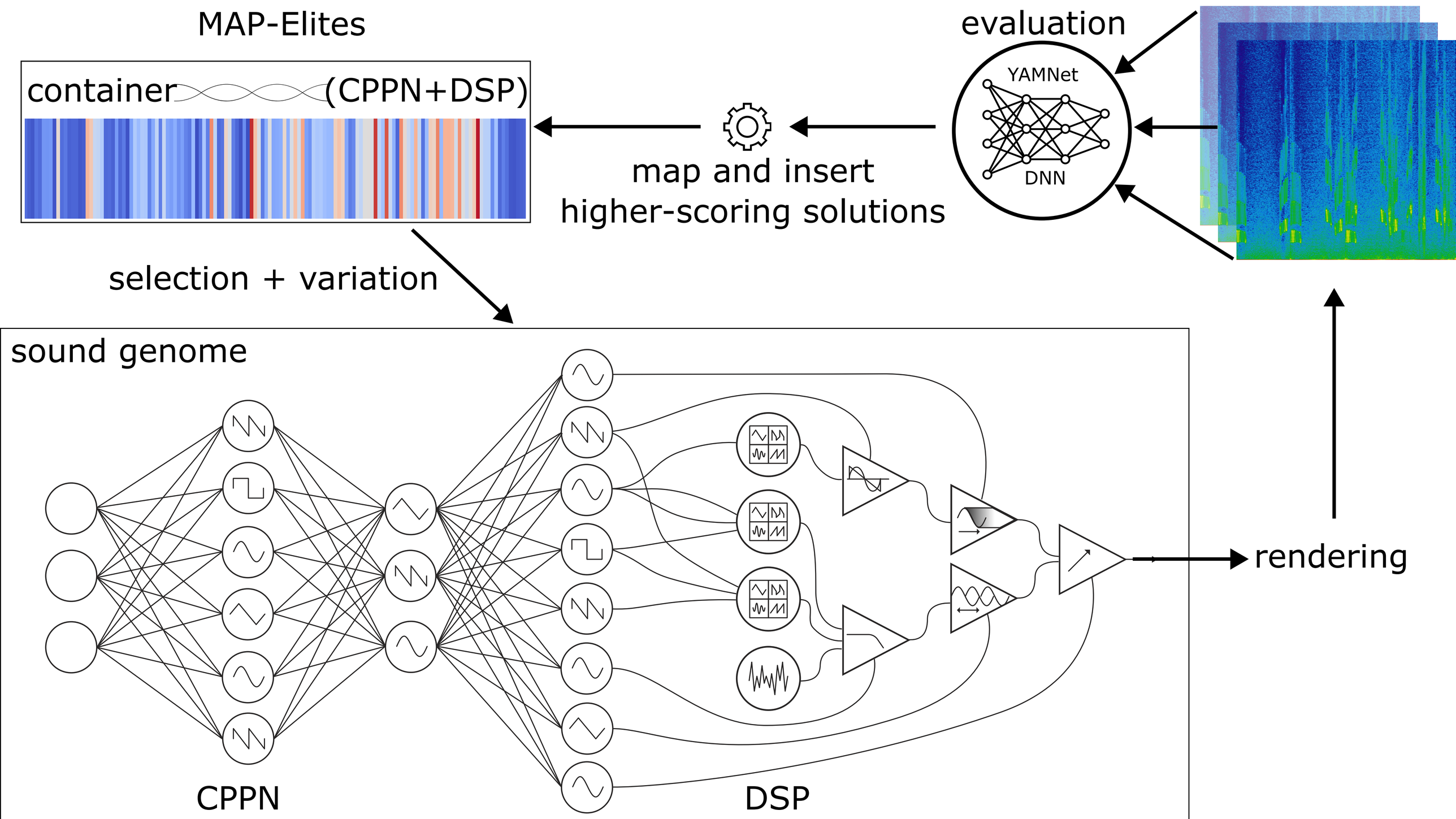
CPPN + DSP

QD algorithm

MAP-Elites



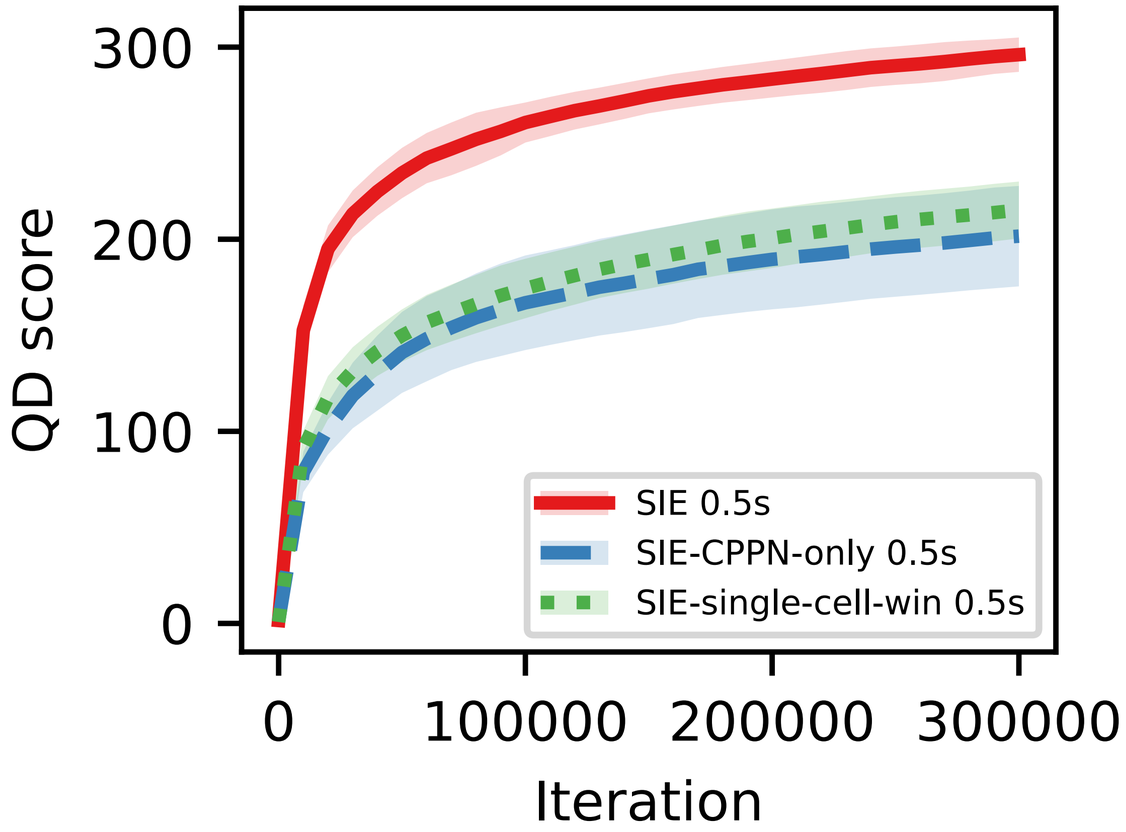



MAP-Elites
container
(CPPN+DSP)
evaluation
YAMNet
DNN
map and insert
higher-scoring solutions
selection + variation
sound genome
CPPN
DSP
rendering

Results

Signal Processing Graph

- QD-score:
  - CPPN + DSP
    - vs
  - CPPN only



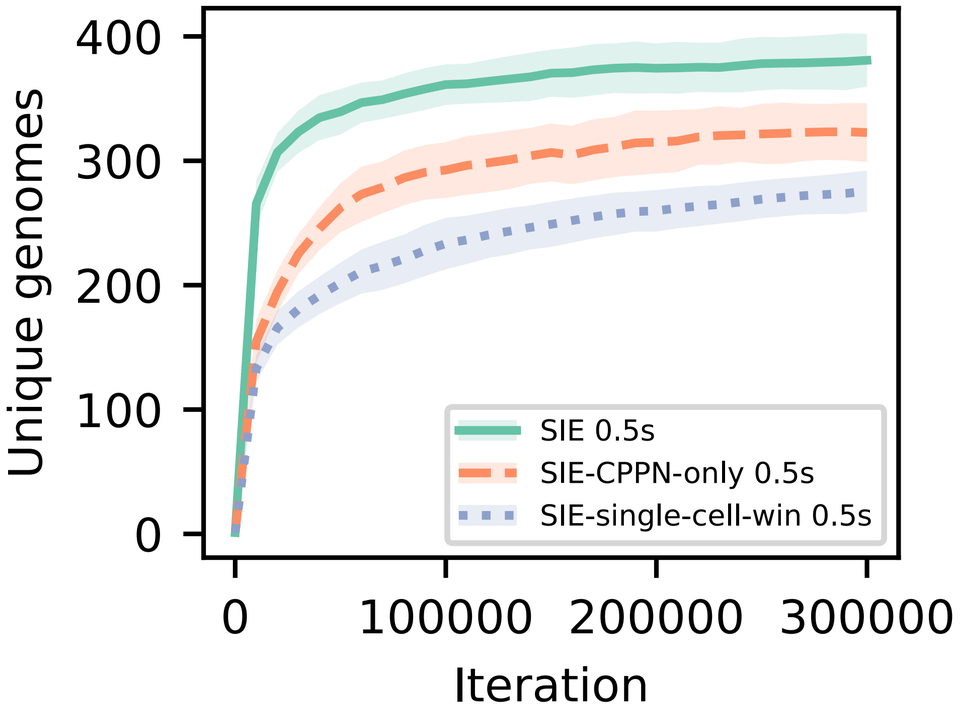
57.4%±3.4%

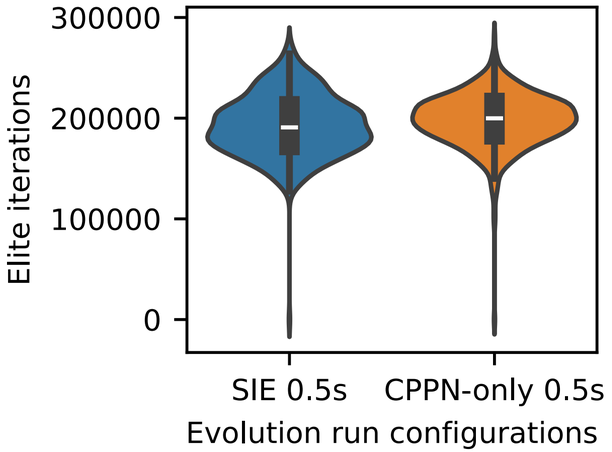
- map coverage, when incremental - otherwise immediately full coverage

Results

Elite Populations

- More diversity when evaluating sound objects from CPPN + DSP genomes

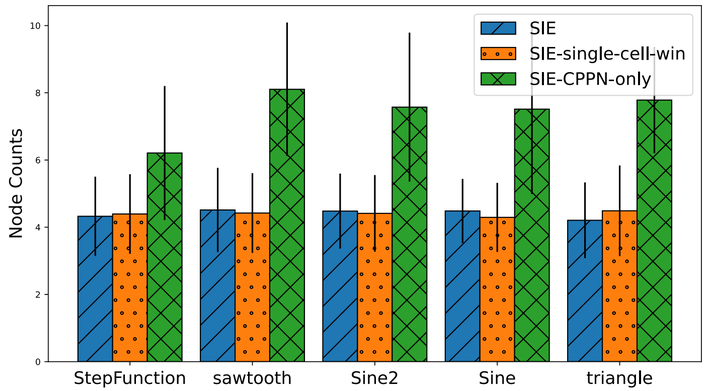


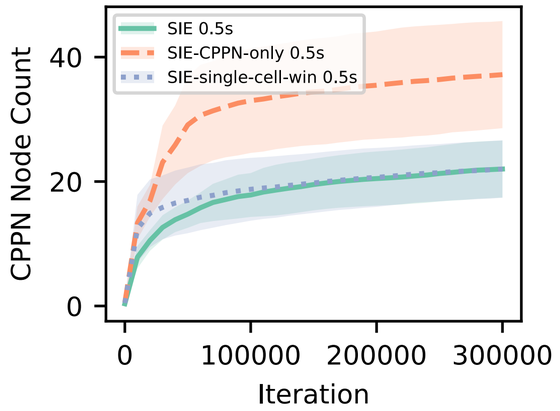


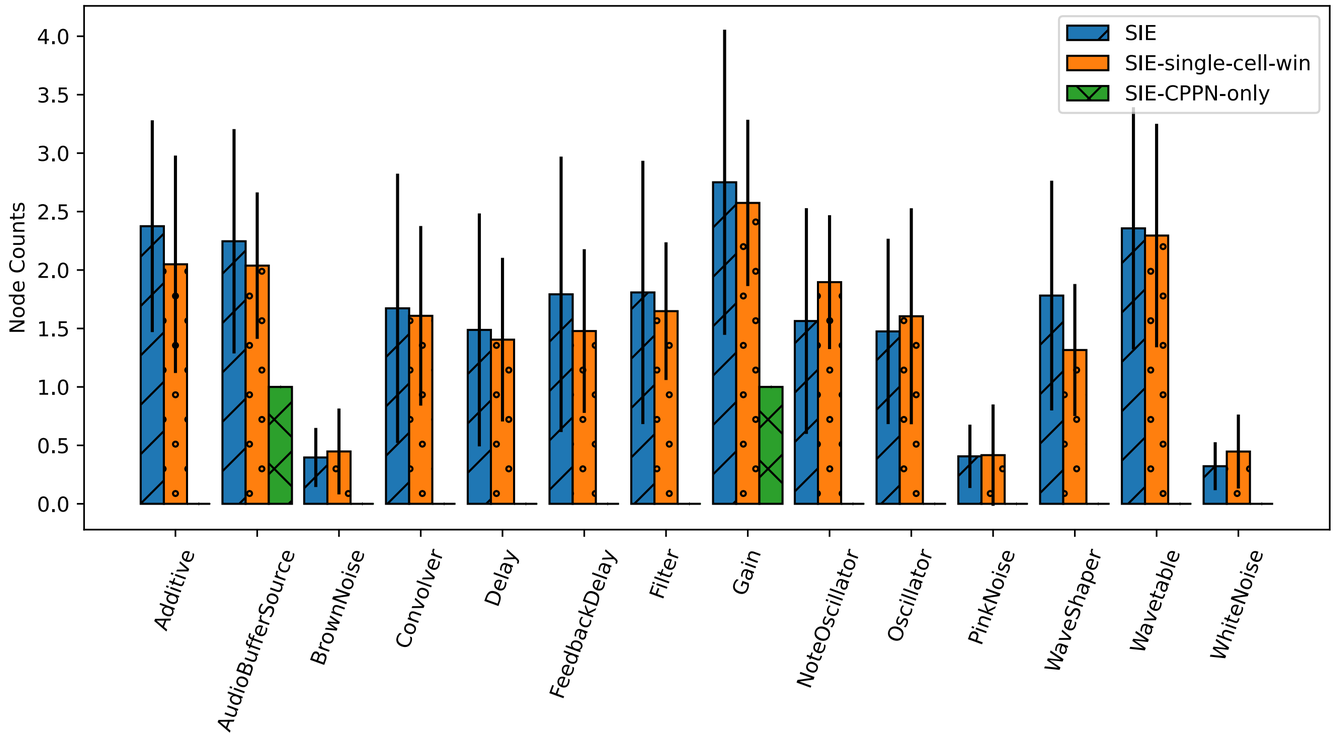
Results

Genome Complexity

- Uniform set of CPPN activation functions
- Custom wavetable and additive synthesis DSP nodes prominent
- CPPN only genomes with higher CPPN node count
  - Compensating for the lack of DSP?



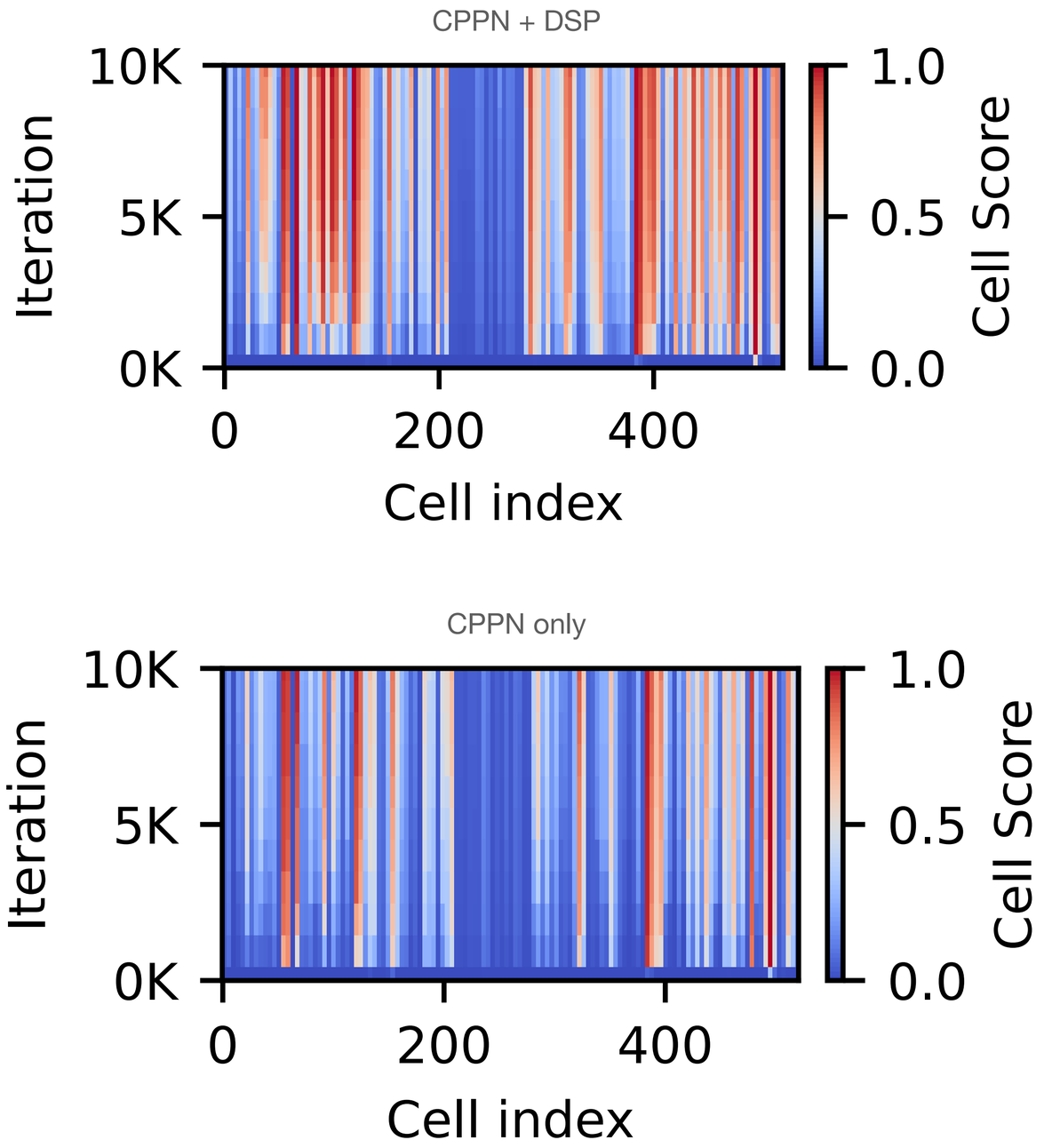




Results

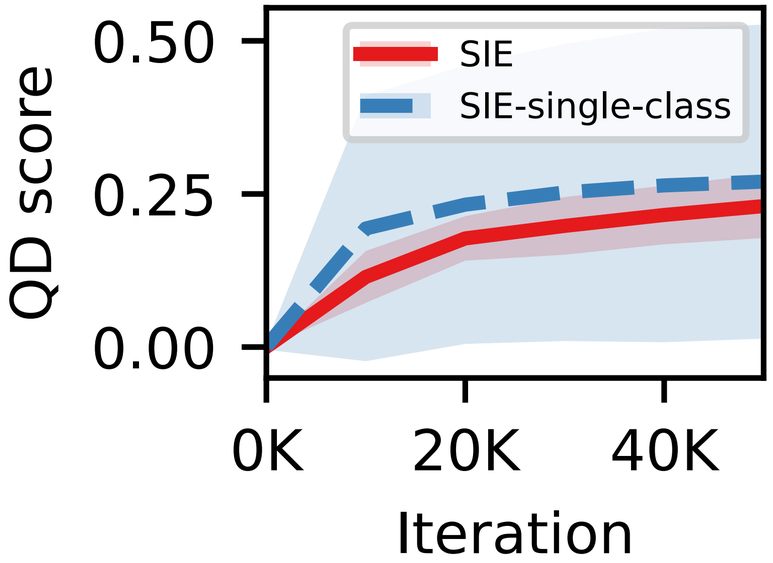
Performance Against Pre-trained Reward Signals

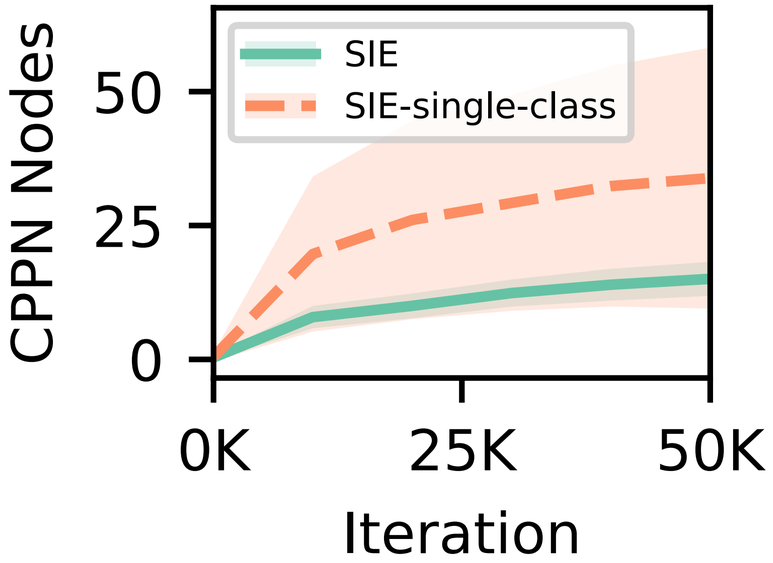
- High scores across most classes
- CPPN + DSP higher overall
- Synthesiser struggles with scoring high on musical classes
  - Understandably?

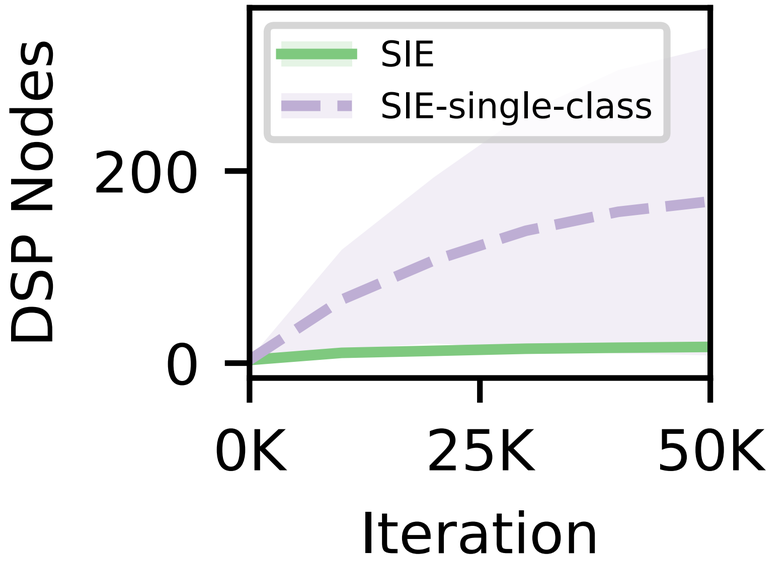


21.7±3.6
goal switches

63.2% of the 34.3±4.5 mean new champions per class







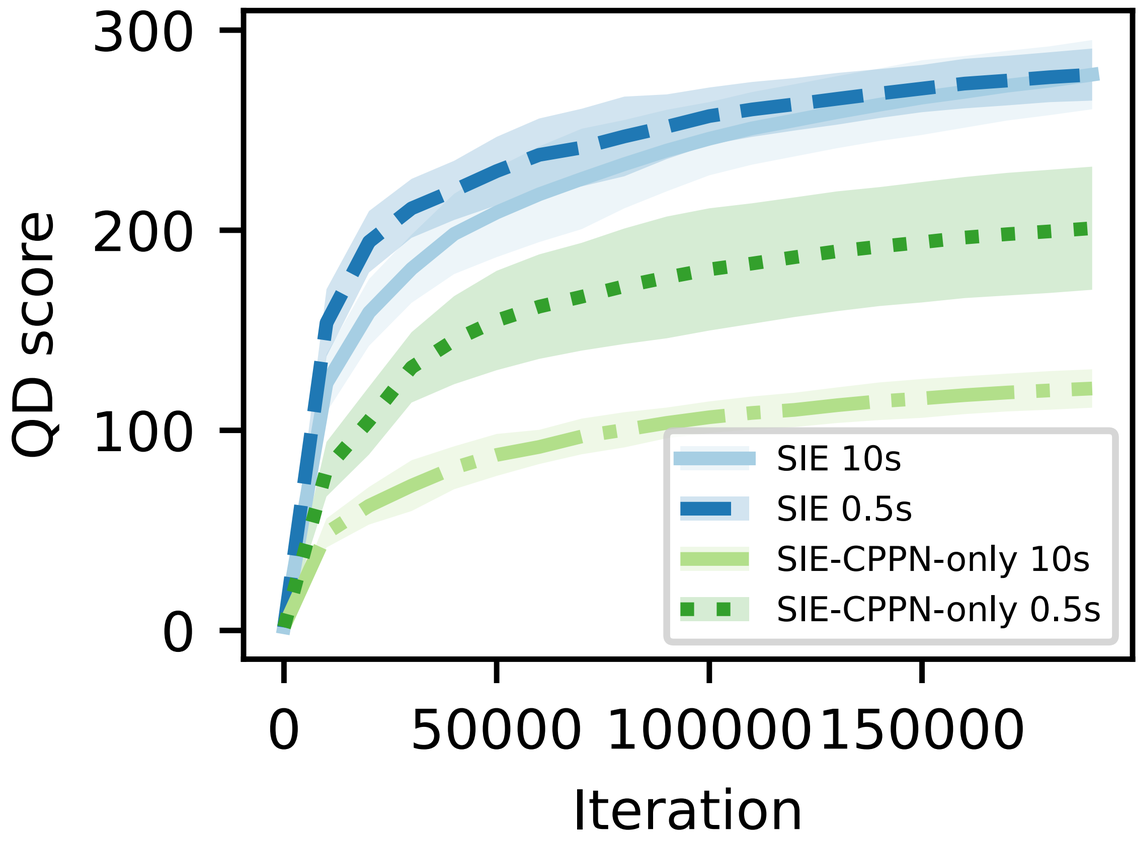
Abandoning Diversity

Similar performance at the cost of significantly higher complexity

Results

Temporal Pattern Revelation and Classifier Characteristics

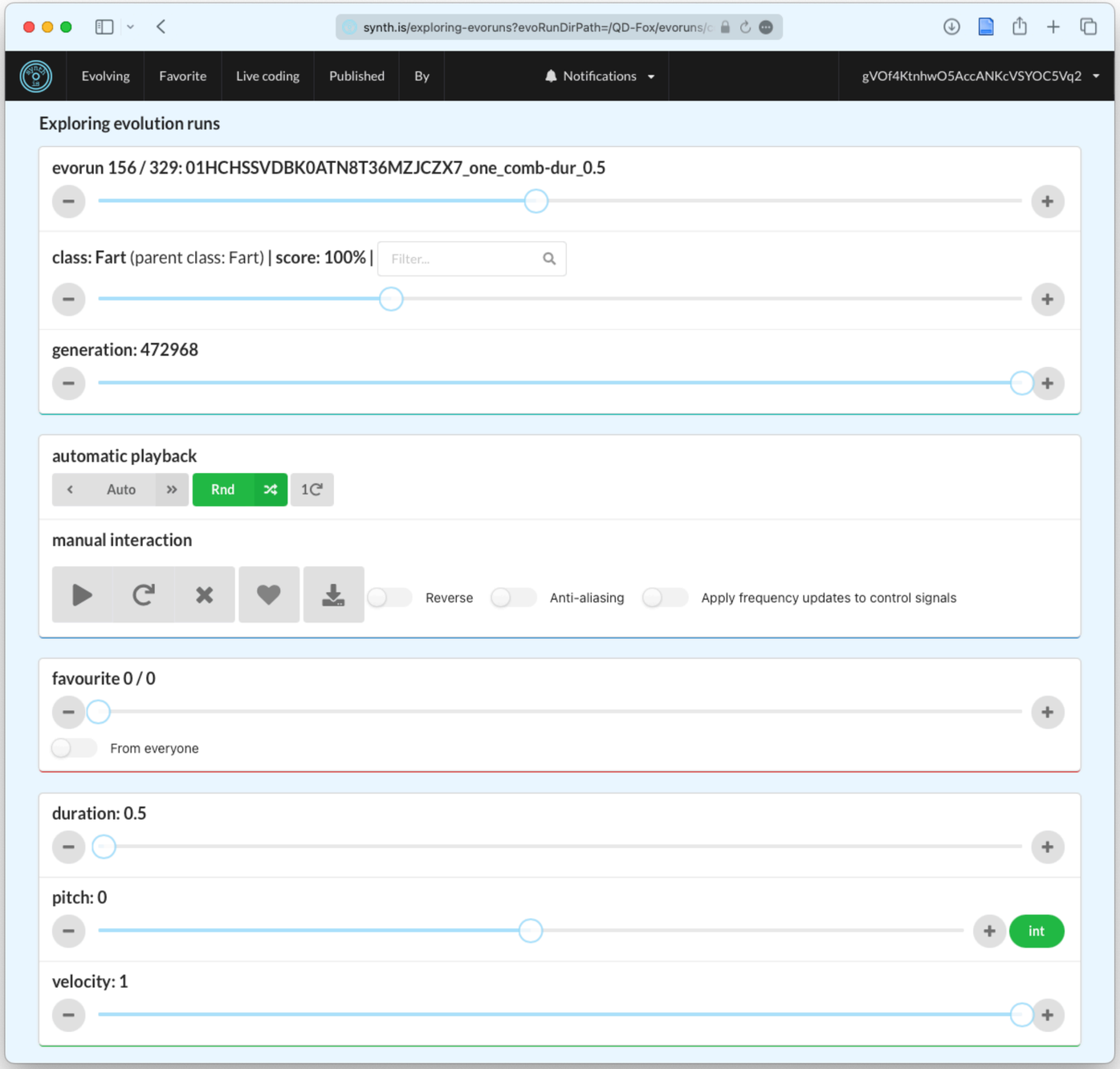
- Longer time for sounds to develop doesn't benefit CPPN-only sounds
  - Lack of DSP more apparent?
- CPPN + DSP duration agnostic



Sound Objects and their Application

Evoruns Explorer

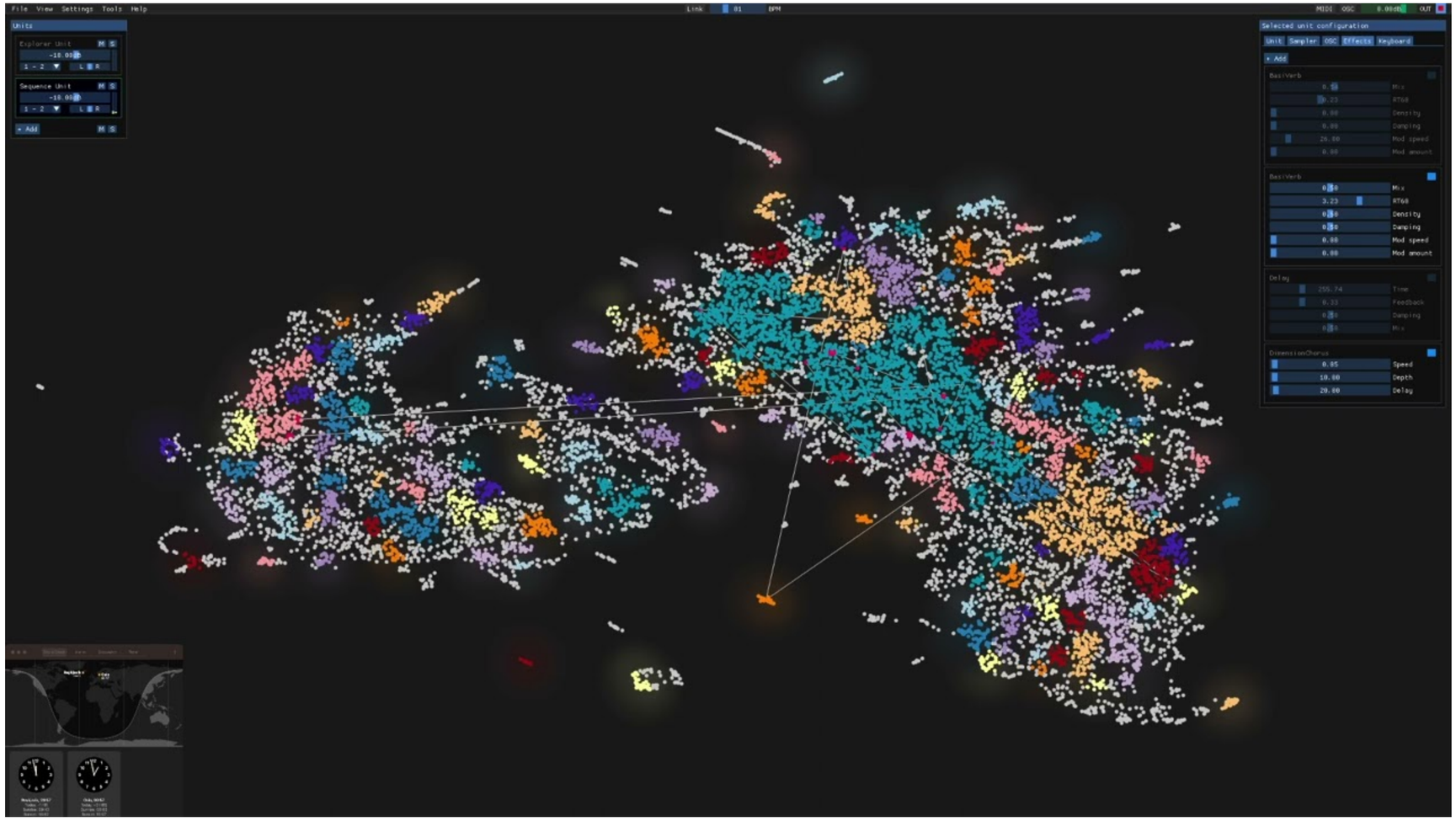
- Scrub through evolutionary runs, classes and generations



Sound Objects and their Application

Evolutionary Sequences

- Live-stream playlist:

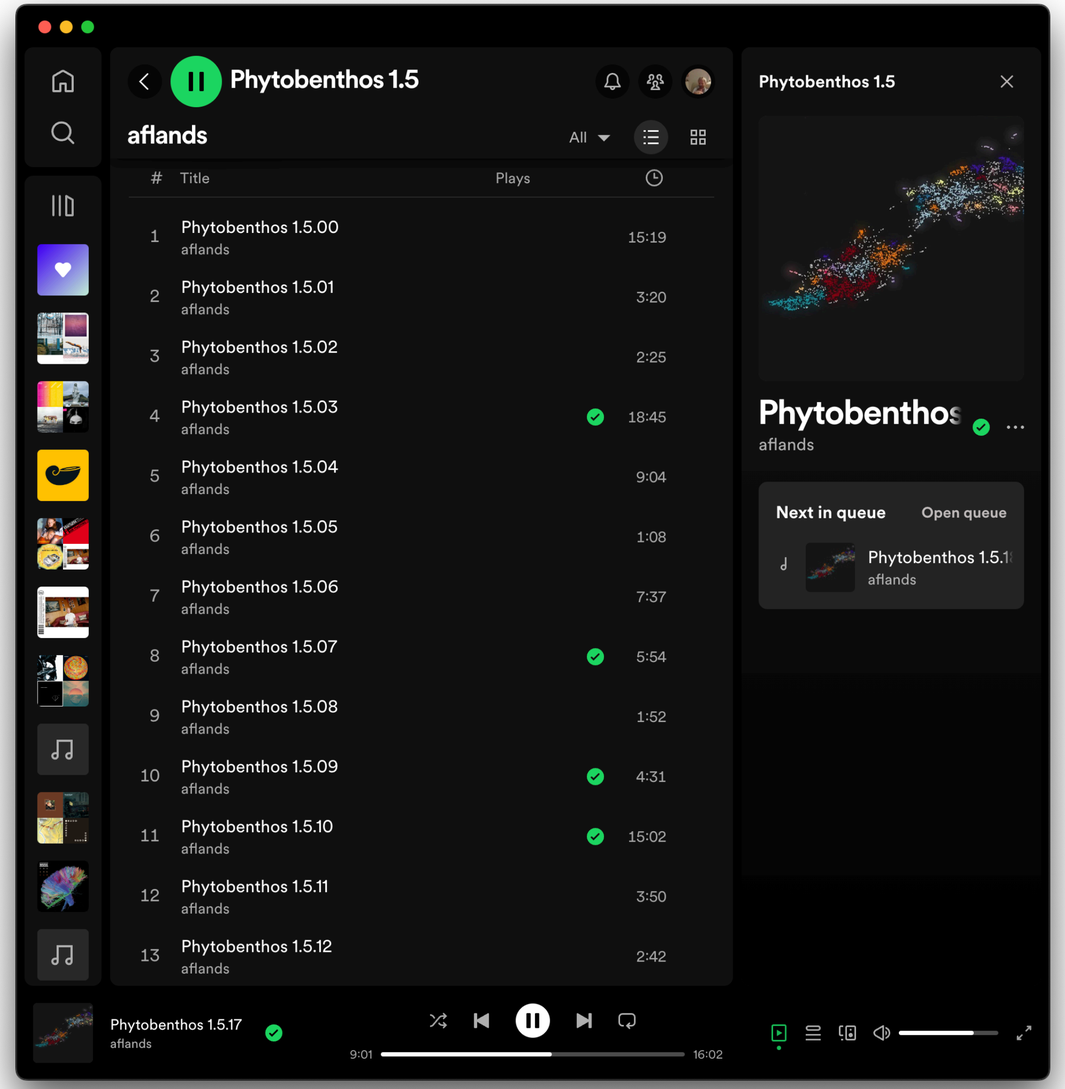


Sound Objects and their Application

Evolutionary Sequences

- Some of this stuff is actually on main-streaming services (WIP):

- IndieWeb publication planned

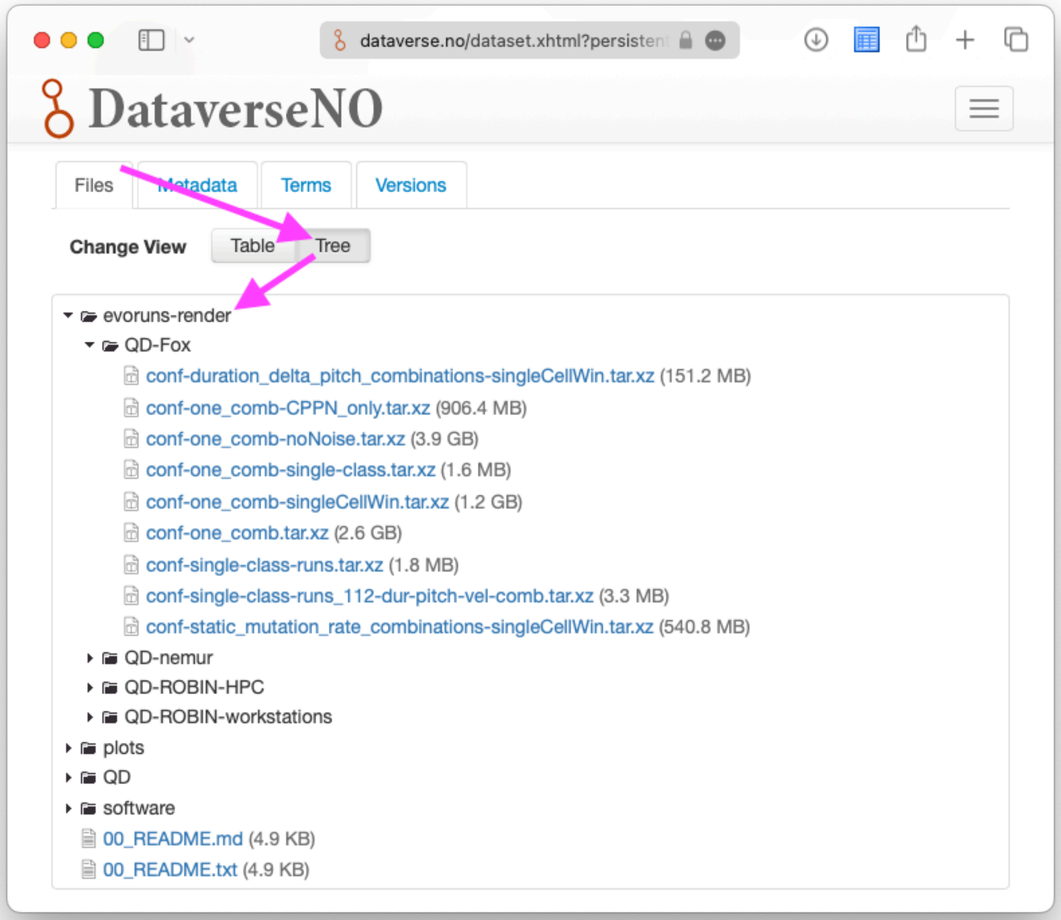


Sound Objects and their Application

meat machines vs *silicone* machines

- in: 💪 *organising sound*

- mail results to: bthj@uio.no



con clu si on

Evoruns Explorer

Silicon Machine Composer

For Meat Machine Composers

- Applying diversity-promoting algorithms with classifier reward signals is a viable approach for sound discovery
- The sound synthesis approach employed achieved high confidence from a DNN classifier
- Diverse and innovative sound objects were generated, suggesting further explorations in this system
- Expanding the behaviour space beyond predefined classes using dimensionality reduction and clustering algorithms is worth exploring
- Leveraging human intuition can lead to semantically meaningful diversity in the search space
- Our system is a tool for discovering interesting sound objects, facilitating the creation of further sonic art
- Our method encourages a bottom-up process of exploration, reflecting the evolutionary path of human development
- This instrument promotes exploratory discovery and the development of human abilities through technology.