Musical Artificial Intelligence / Basic Principles + Machine Learning in Max

Eli Stine \ Oberlin Con \ February 2024

Who I Am / What I Love

_Composer, Programmer, Media Designer, Educator

_Things I Love:

Electroacoustic Music, Spatial Audio, Film/XR Sound Design,

Interactive Media, Computer Graphics

Code for this Talk

Entirely optional

Requires Max 8 (demo is just fine)

No/minimal coding experience required

github.com/estine/mlinmax

Musical AI: Talk Structure / Contents

_(Personal) History + Definitions

_Linear Regression + Supervised/Unsupervised Learning

_Deep Learning

_Musical Examples + Thoughts

What is Machine Learning (ML)?

Def.: Broad definition: we want a computer to learn how to emulate, or model, some data or process

Implementation: given an input, we want to build a model that gives us the correct output for that input

Some useful terminology that will show up: features, training, classification, unsupervised/supervised/deep learning

My Entry + Interests

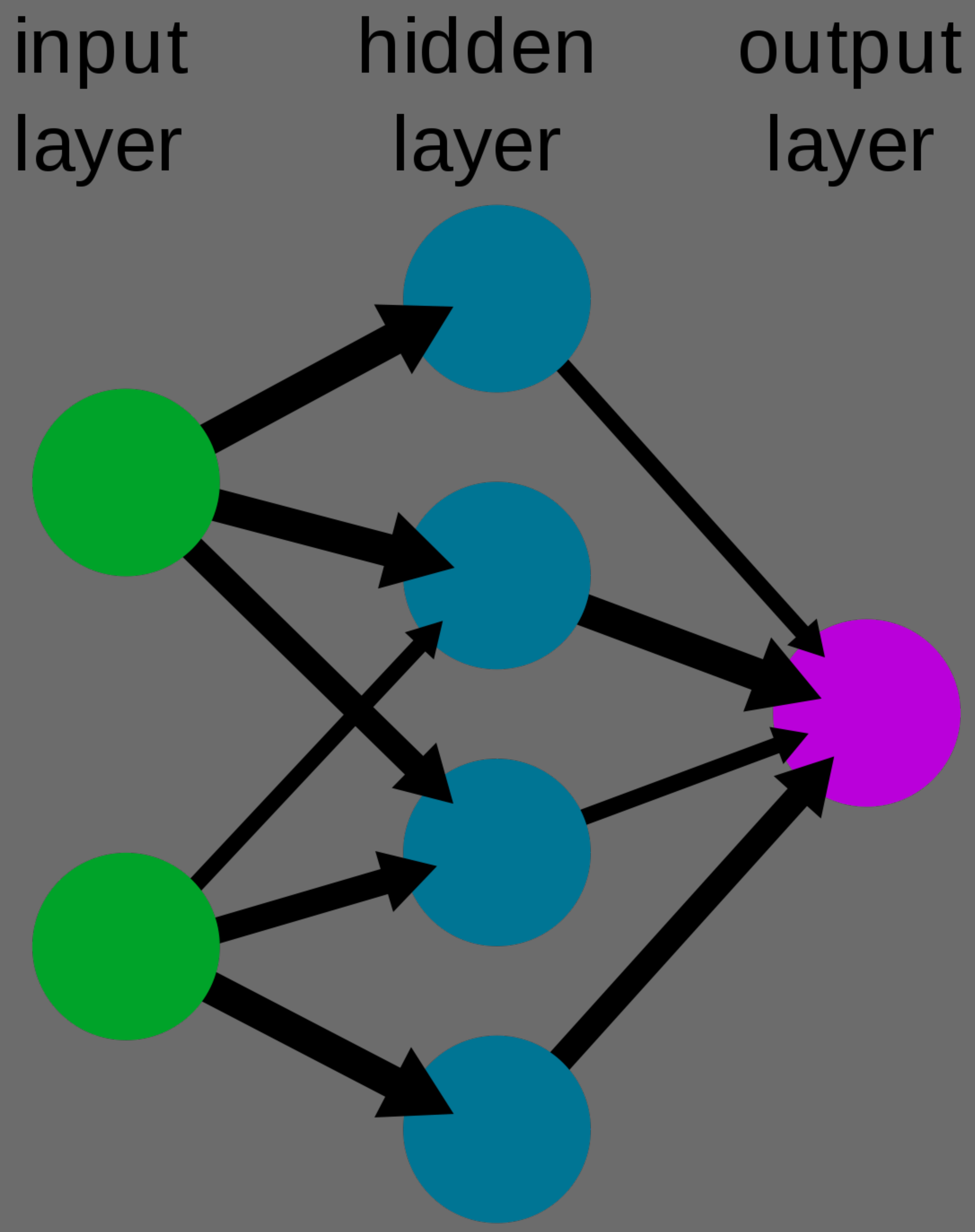
_Harvestworks ⇨Neural Networks / AI Class ⇨Markov Models

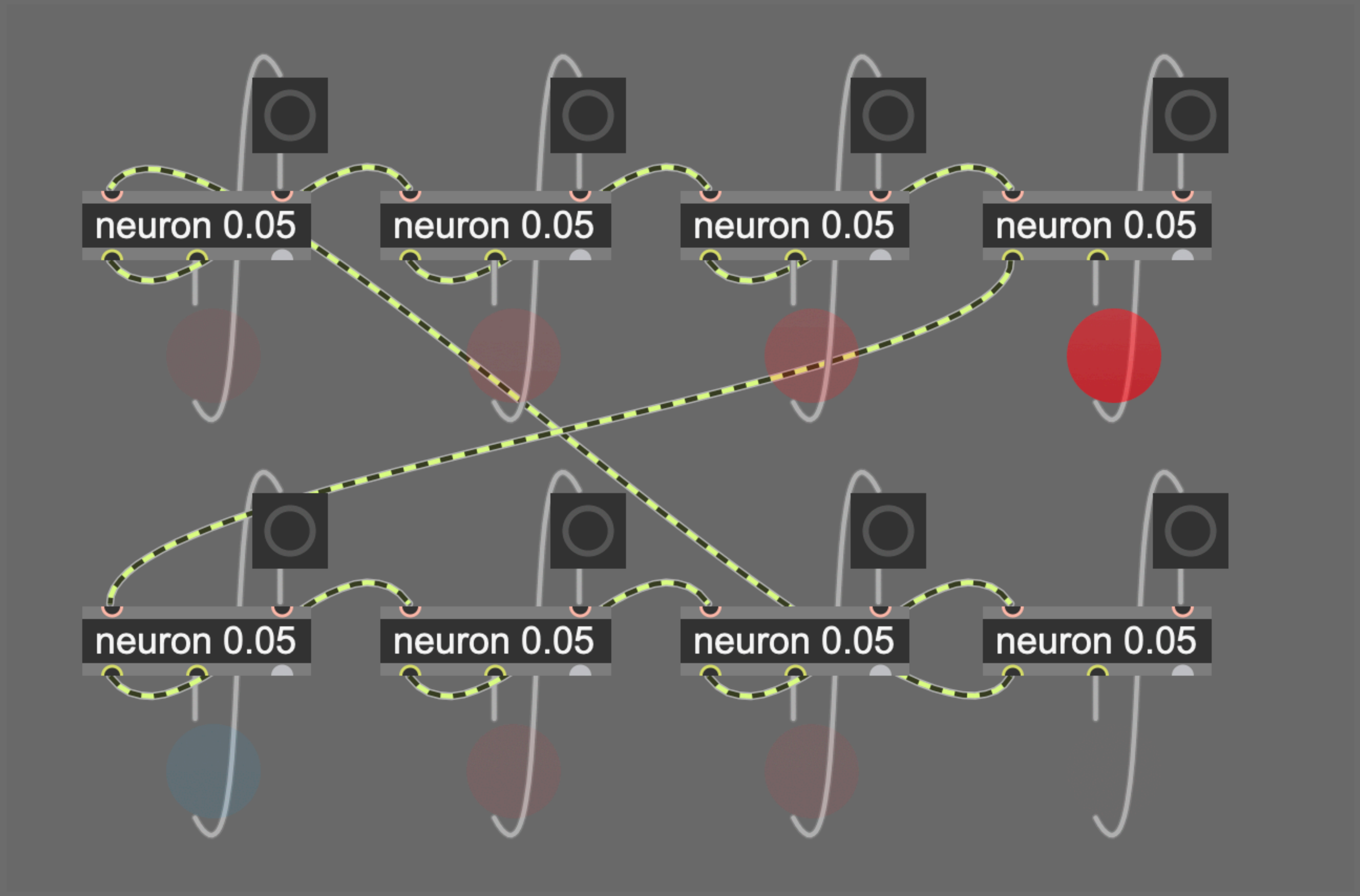
_Fascination with modeling nuanced and fragile natural/organic/chaotic systems using a completely discrete and stable tool (Digital Computer)

_Renewed cultural interest in audio AI/generation systems
⇨ more engagement/funds/development in tools, etc.

A quick divergence: Neural Networks

A simple neural network





Max patch with a set of neurons that are triggered by, and generate, audio

Musical Machine Learning: Some Historical Context

_***Musical Dice Game*** *(compose a minuet from random numbers)*	*~1750s*
_***Dreaming of Computer Music*** *- Ada Lovelace*	*1843*
_***ILLIAC Suite*** *(computer-composed string quartet) - Lejaren Hiller*	*1958*
_***Computer Music*** *- Max Mathews*	*~1960s*
_***Voyager System*** *(real-time digital improvisation) - George Lewis*	*1986*
_***Experiments in Musical Intelligence*** *(style matching) - David Cope*	*1991*
_***Deep Learning*** *(modern ML revolution) - Geoffrey Hinton*	*2016*

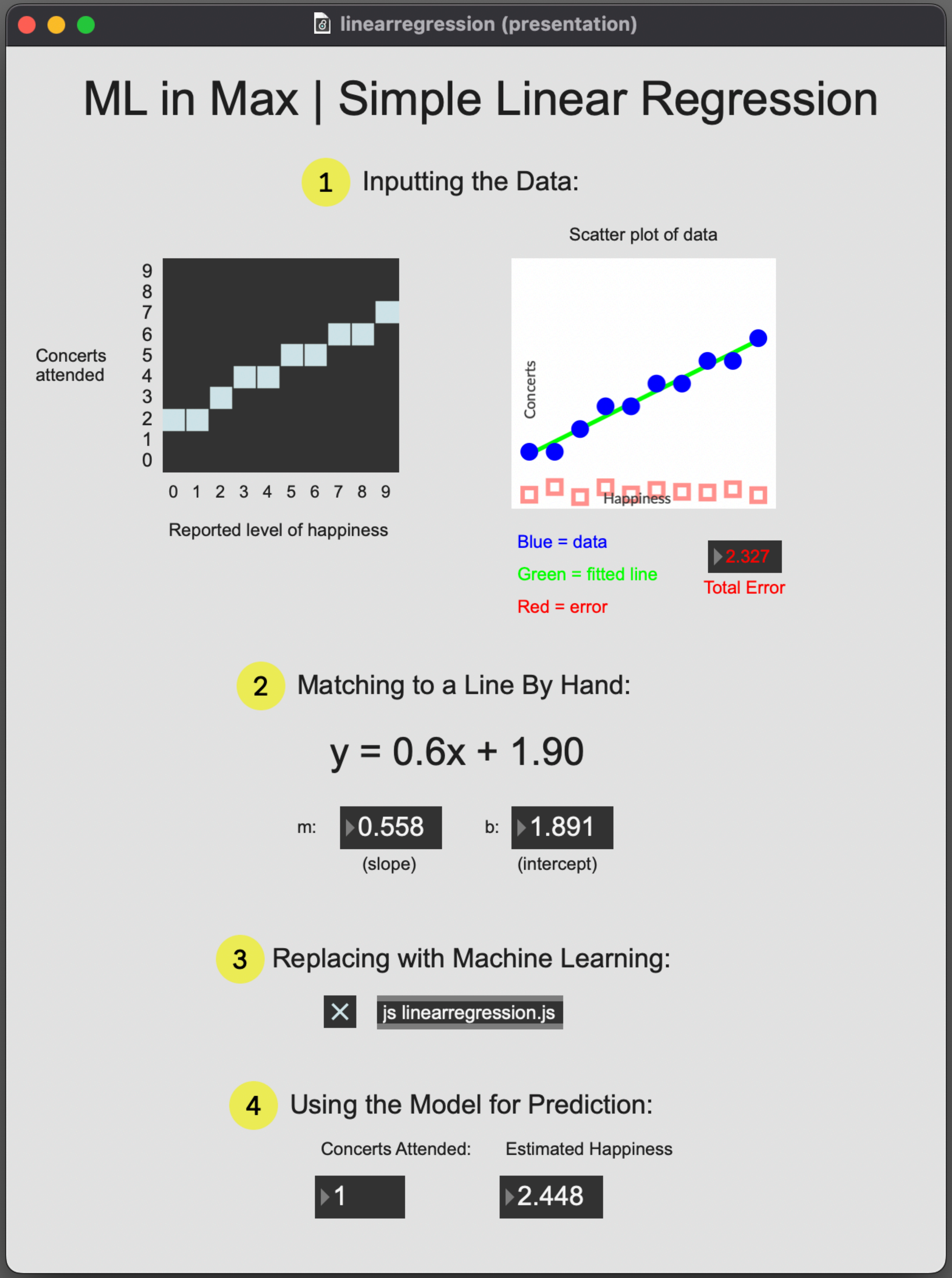
Raw vs. Symbolic Musical AI

Def.: Music may be defined in many ways, but a common formal distinction in musical AI systems is made between generative systems that are

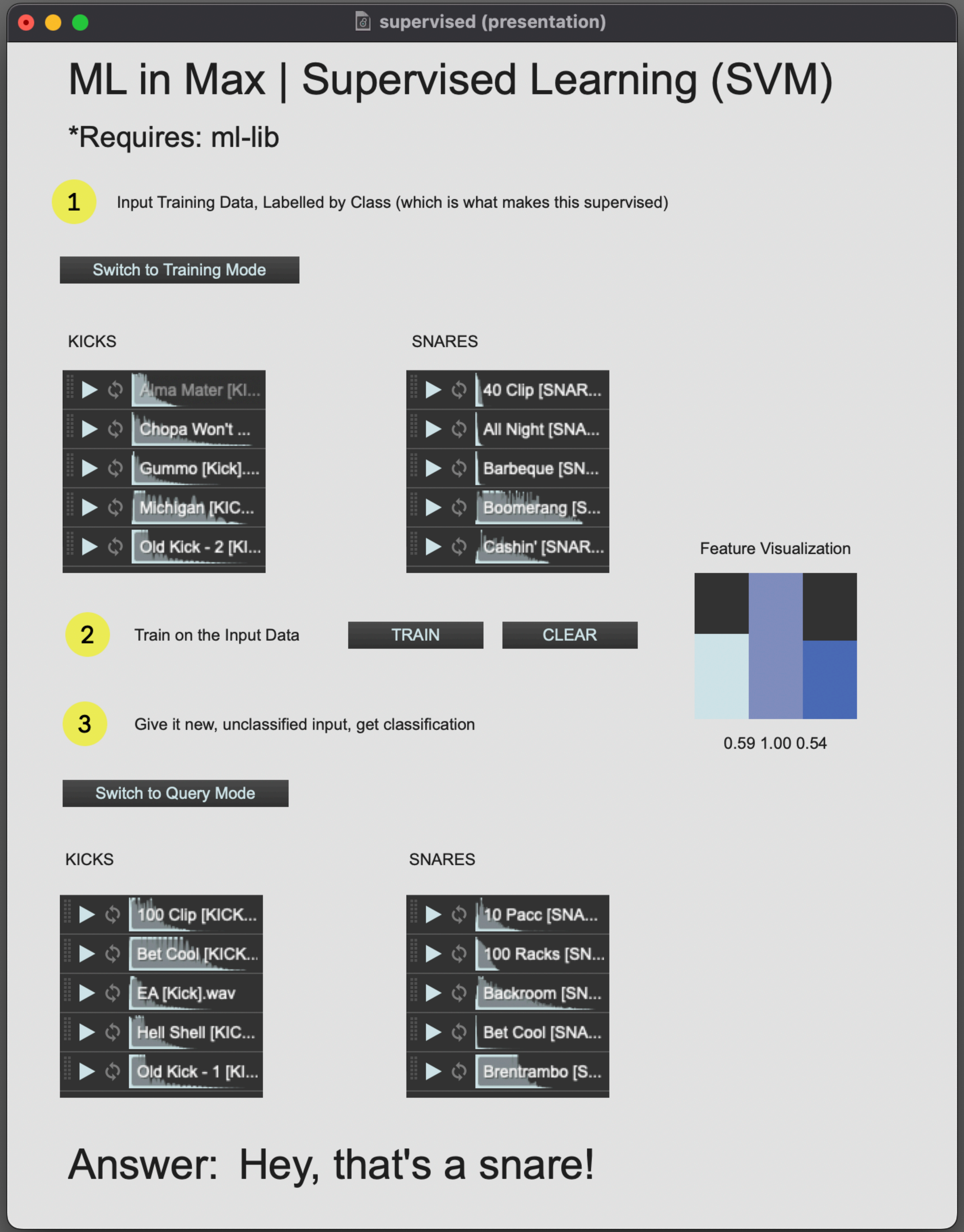
***symbolic** (note-based) or*
***raw** (digital audio sampled-based)*

***Symbolic** task: generate notes in fugue in the style of Bach*
***Raw** task: generate digital audio samples at 44.1kHz, 16 bit*

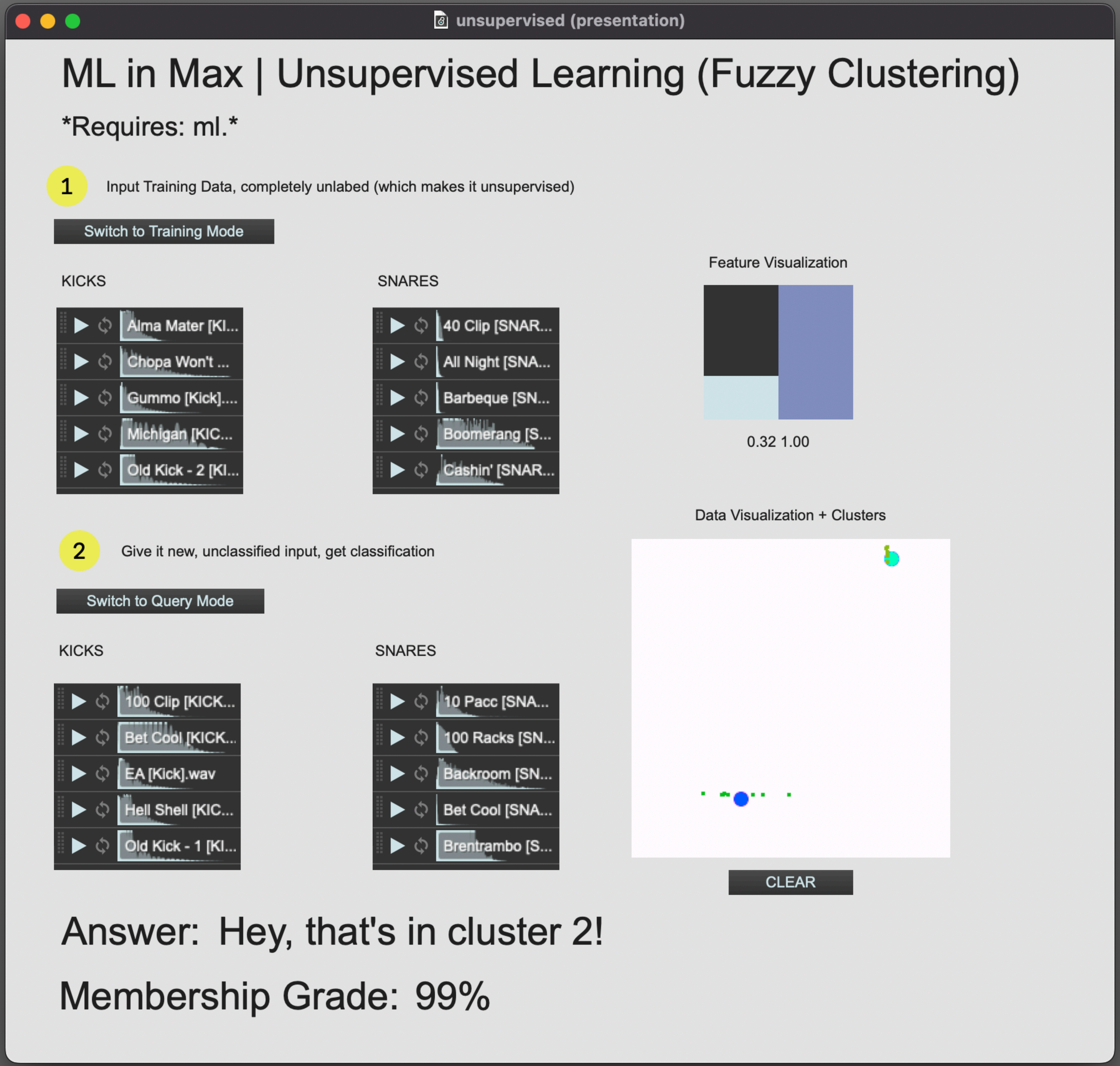
Simple Linear Regression



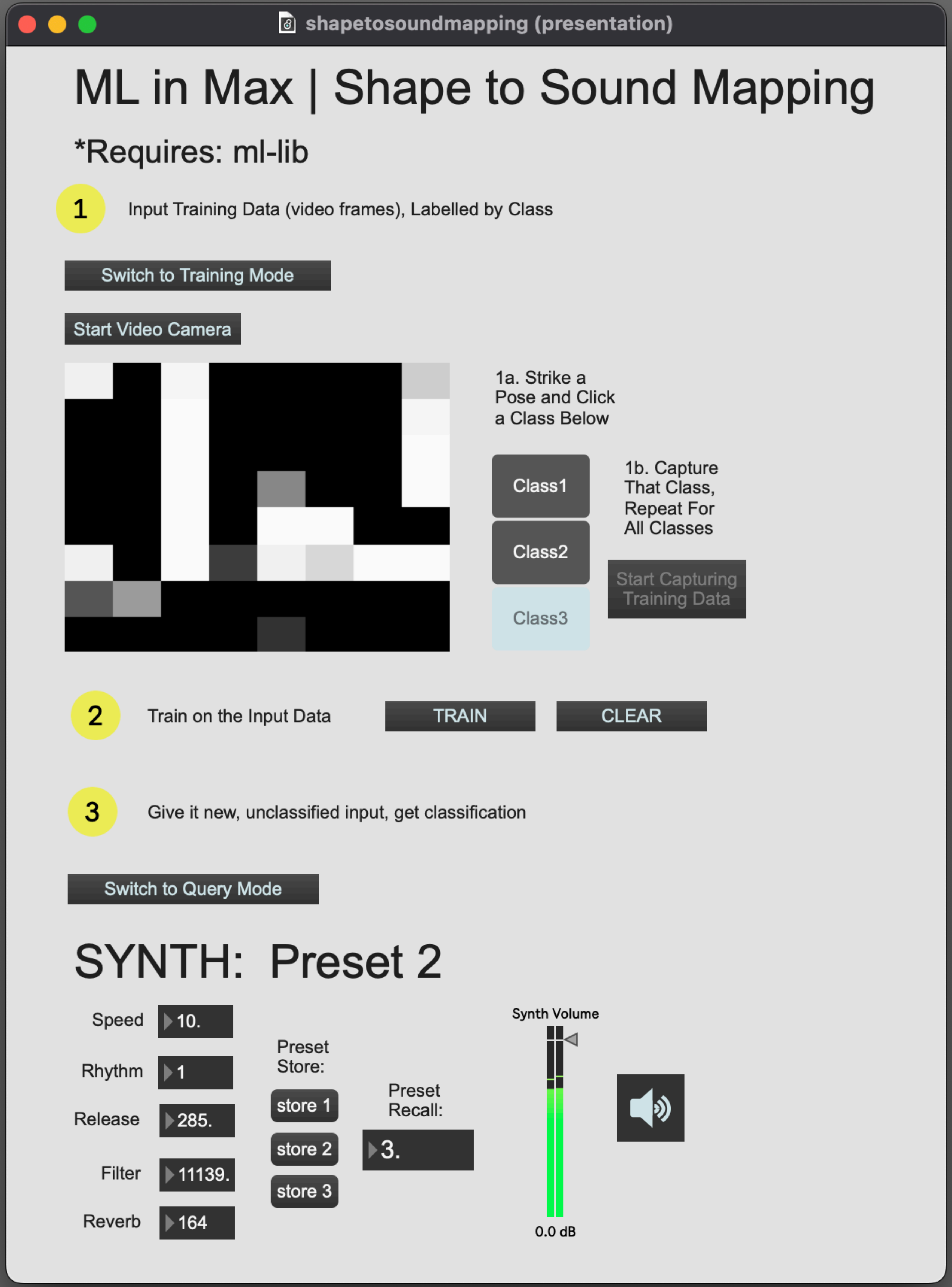
Supervised Learning



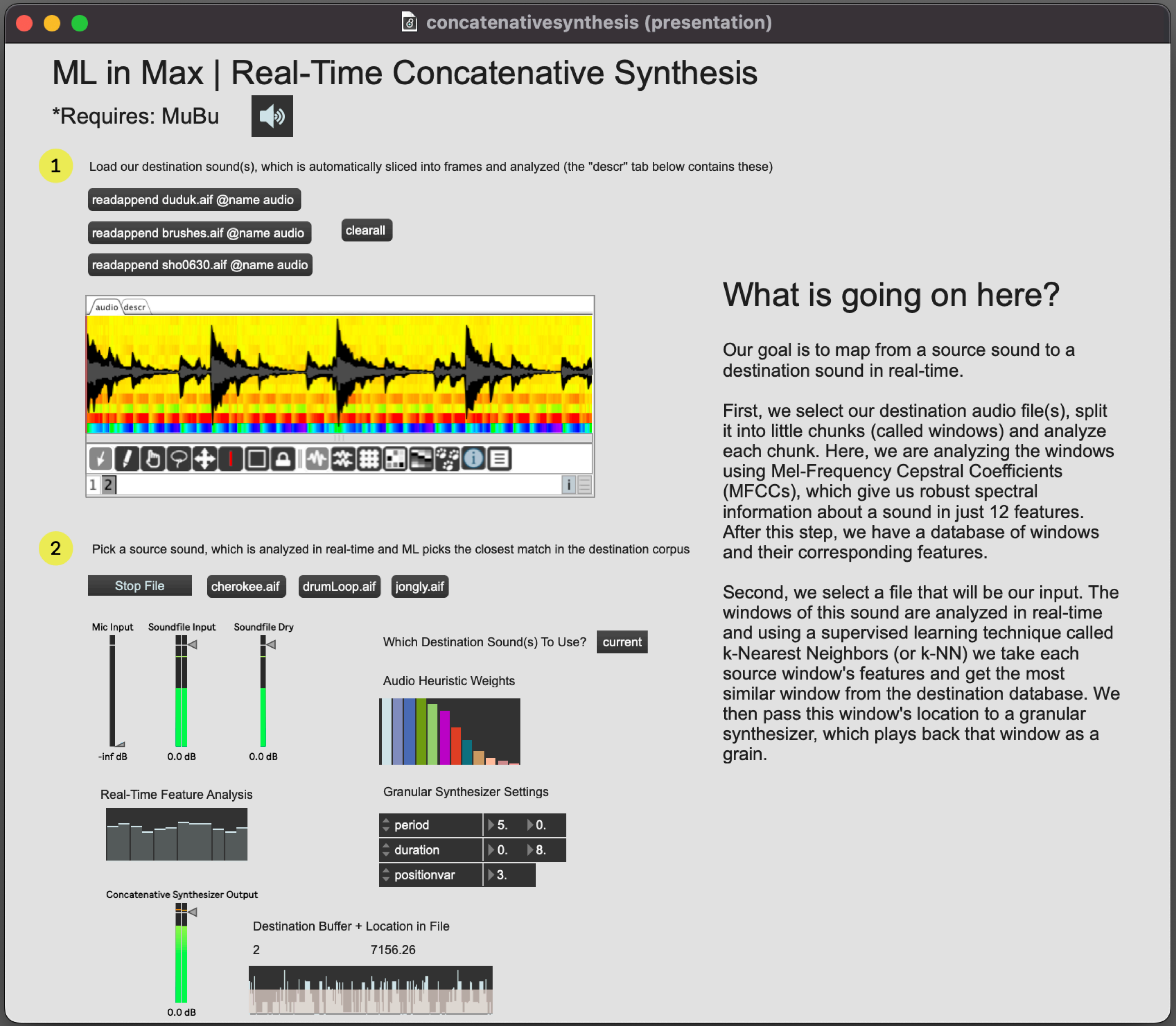
Unsupervised Learning



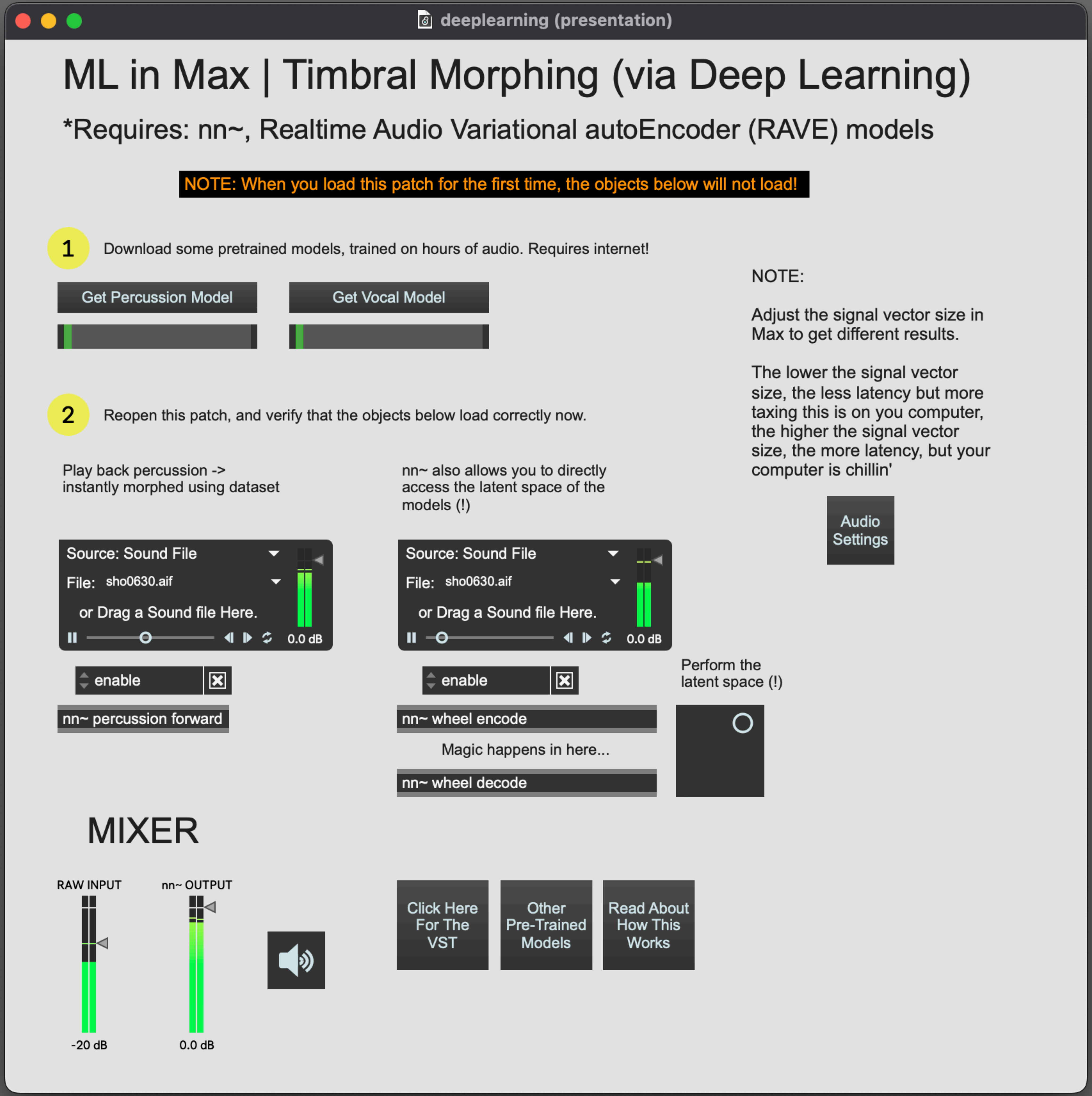
Musical Example: Shape to Sound Mapping



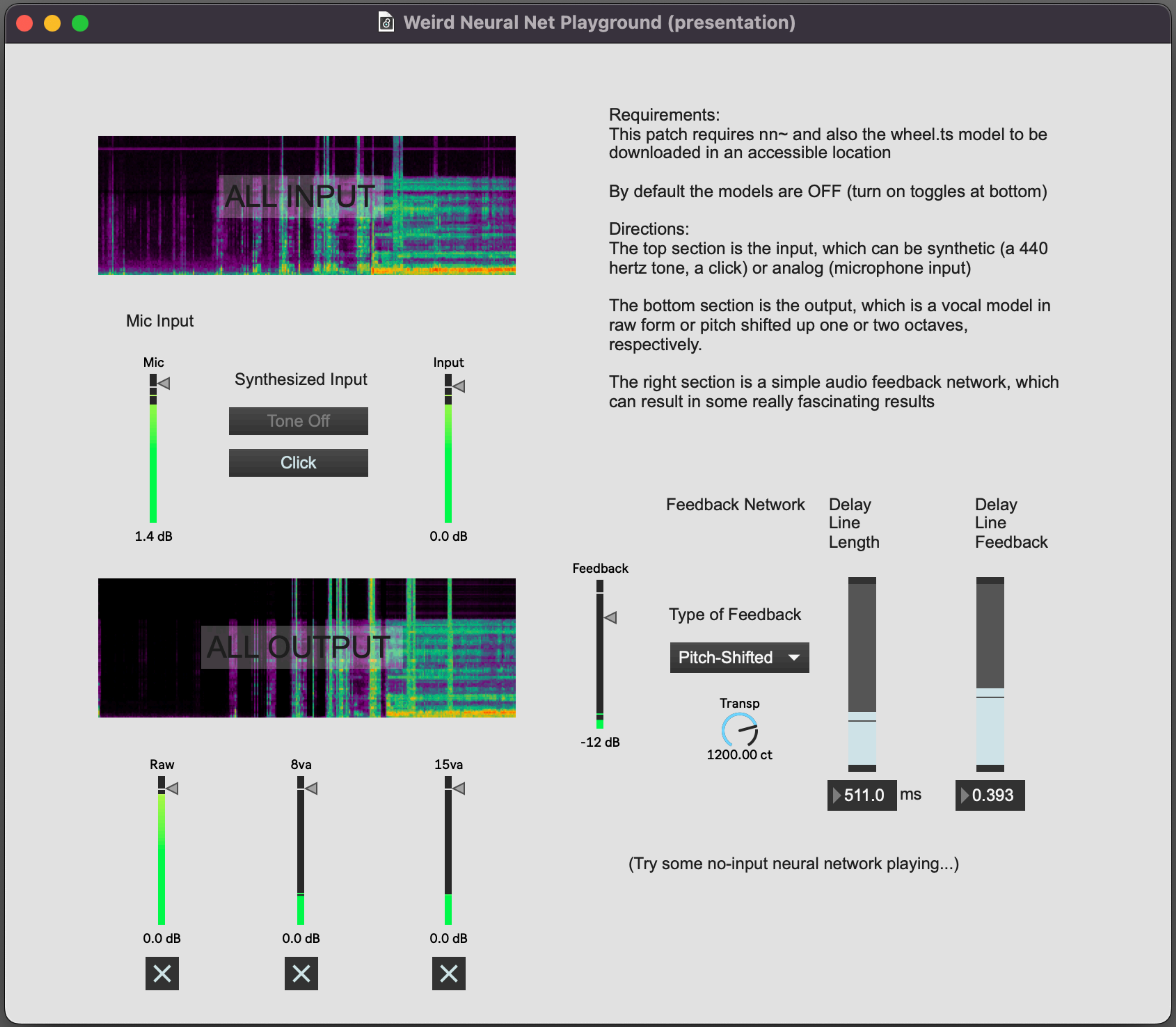
Musical Example: Real-Time Concatenative Synthesis



Musical Example: Timbral Morphing (via Deep Learning)



No-Input Raw Generative Audio



Thoughts on Musical AI/Generative Audio Systems

_*Creative Friction*

_*Originality + Ownership*

_*Access + Ethics*

_*How does a music technology-focused artist navigate this?*

Resources

_MusicLM: https://google-research.github.io/seanet/musiclm/examples/

_DDSP: https://magenta.tensorflow.org/ddsp-vst

_Mawf: https://mawf.io/

_Neutone by Qosmo: https://neutone.space/

_Wavenet: https://deepmind.google/technologies/wavenet/

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