

Pedagogy



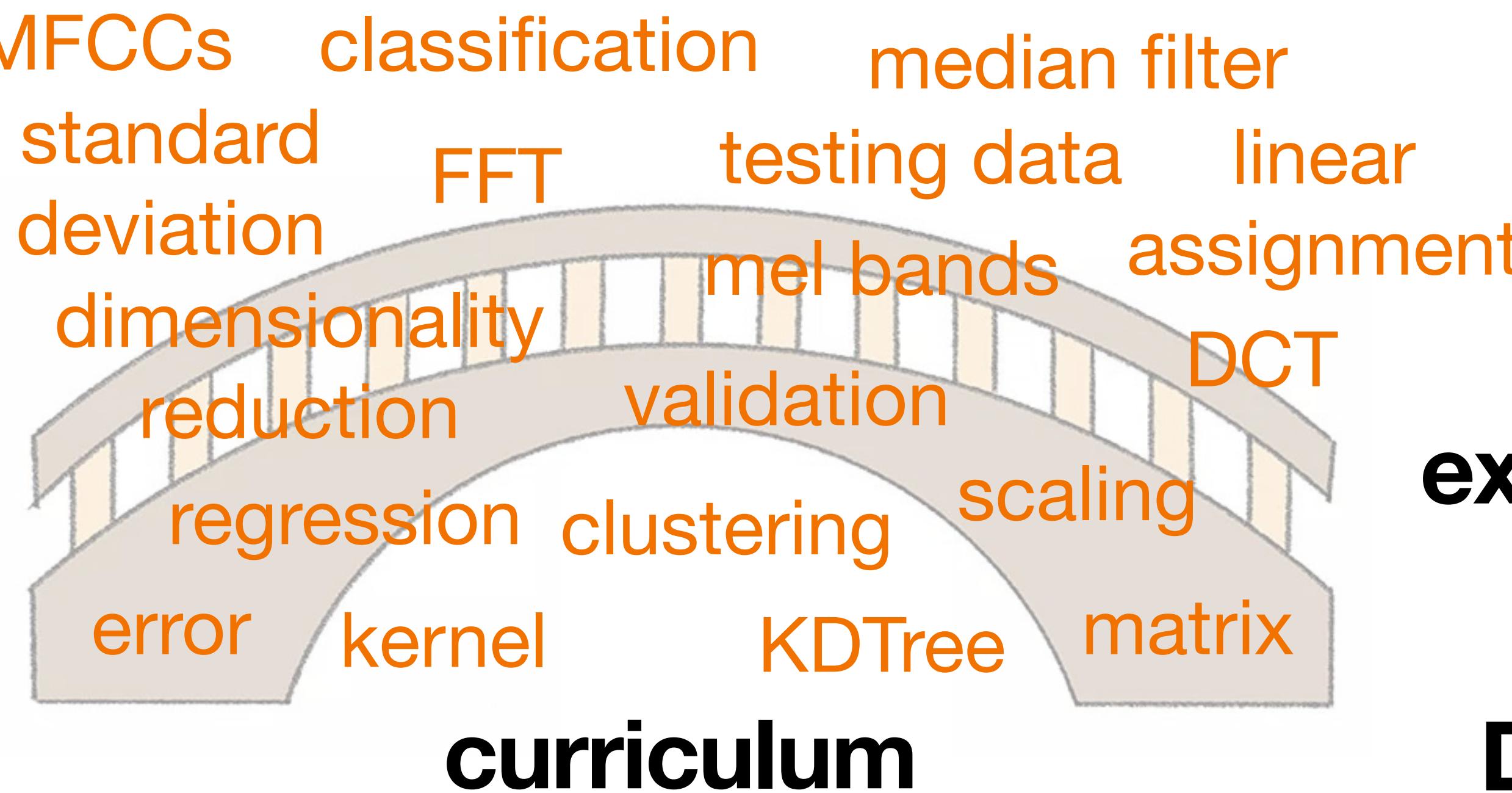
Pedagogical Goals

- “enable techno-fluent musicians to use machine listening and machine learning in their creative practices”
- Just “providing the tools” is not enough...
- Make the tools Accessible, Inviting, Learnable, Musical, Inspiring, Expressive
- Build Intuition (Musical Intuition <→ Statistical Intuition)
- Apply knowledge of Machine Learning & AI in broader society

Our Learners

- “Techno-fluent” Musicians
- >= 1 semester of computer music (Max, SuperCollider, or Pure Data)

**Techno-fluent
Musicians**



**Musically
expressive uses
of Machine
Learning &
Data Science**

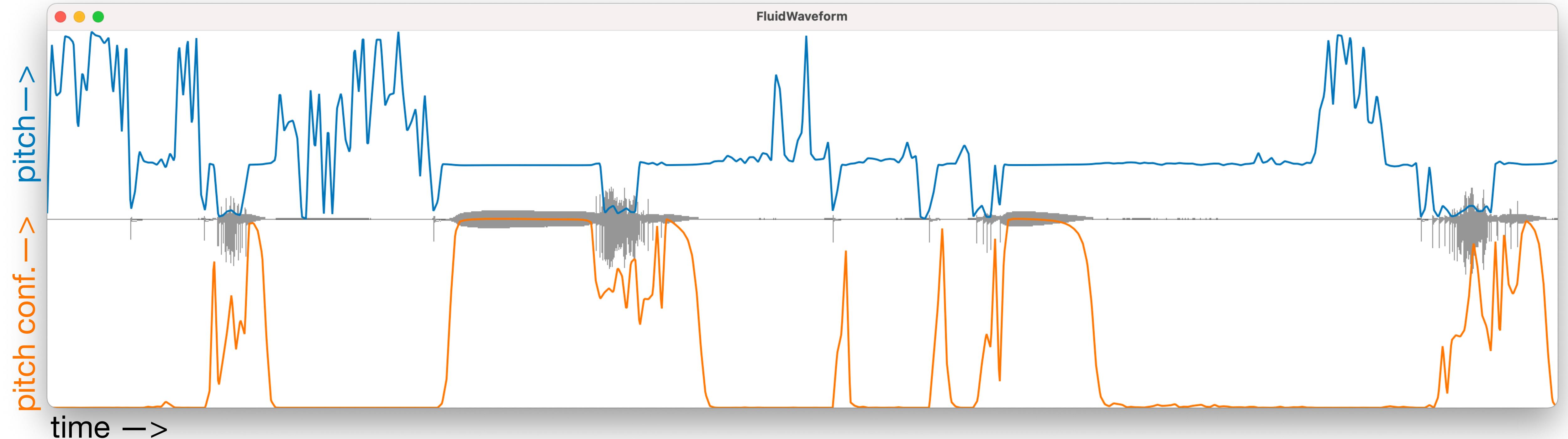
Challenges for Learners

& Pedagogical Approaches



Metaphor of Machine “Listening”

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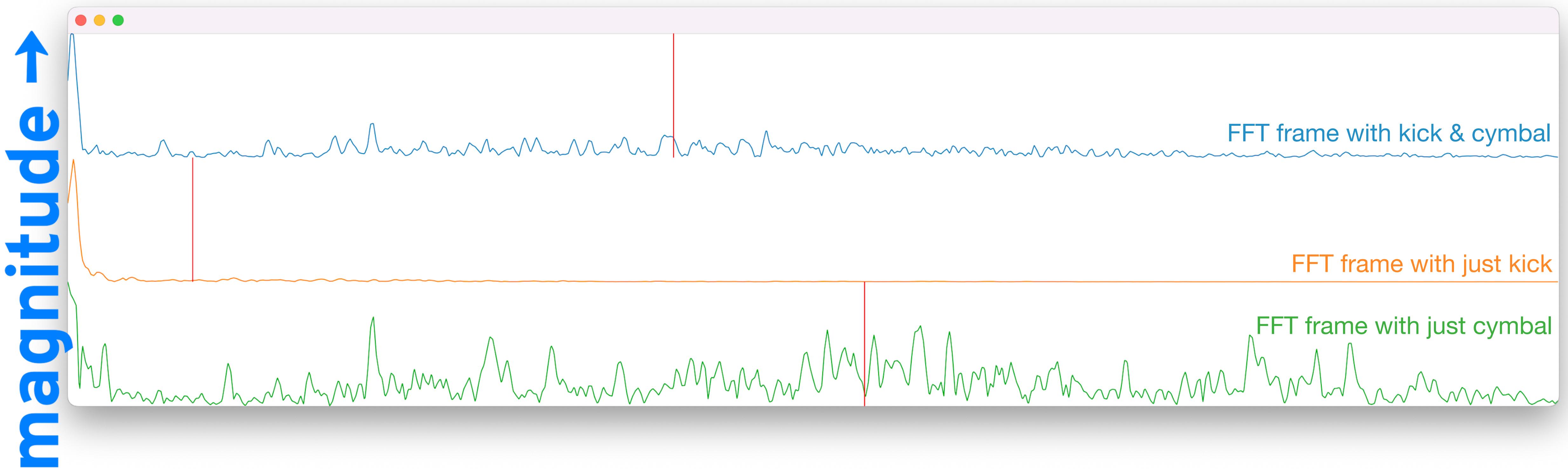


Metaphor of Machine “Listening”

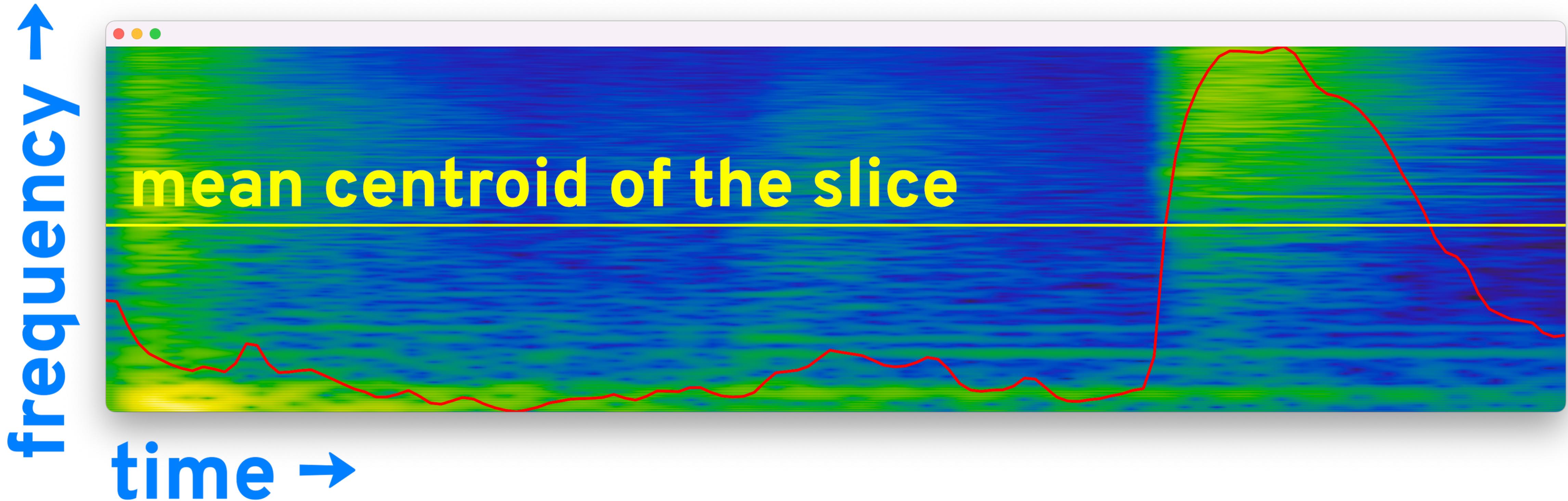
- Audio descriptors & Statistical measures
- Humans do multi-modal listening that
 - rapidly switches modes
 - weights perception according to different criteria

Statistics: spectral centroid

frequency →



Statistics: mean spectral centroid



*color = magnitude

Managing Data (buffer as data container)

FFT frames (time): →

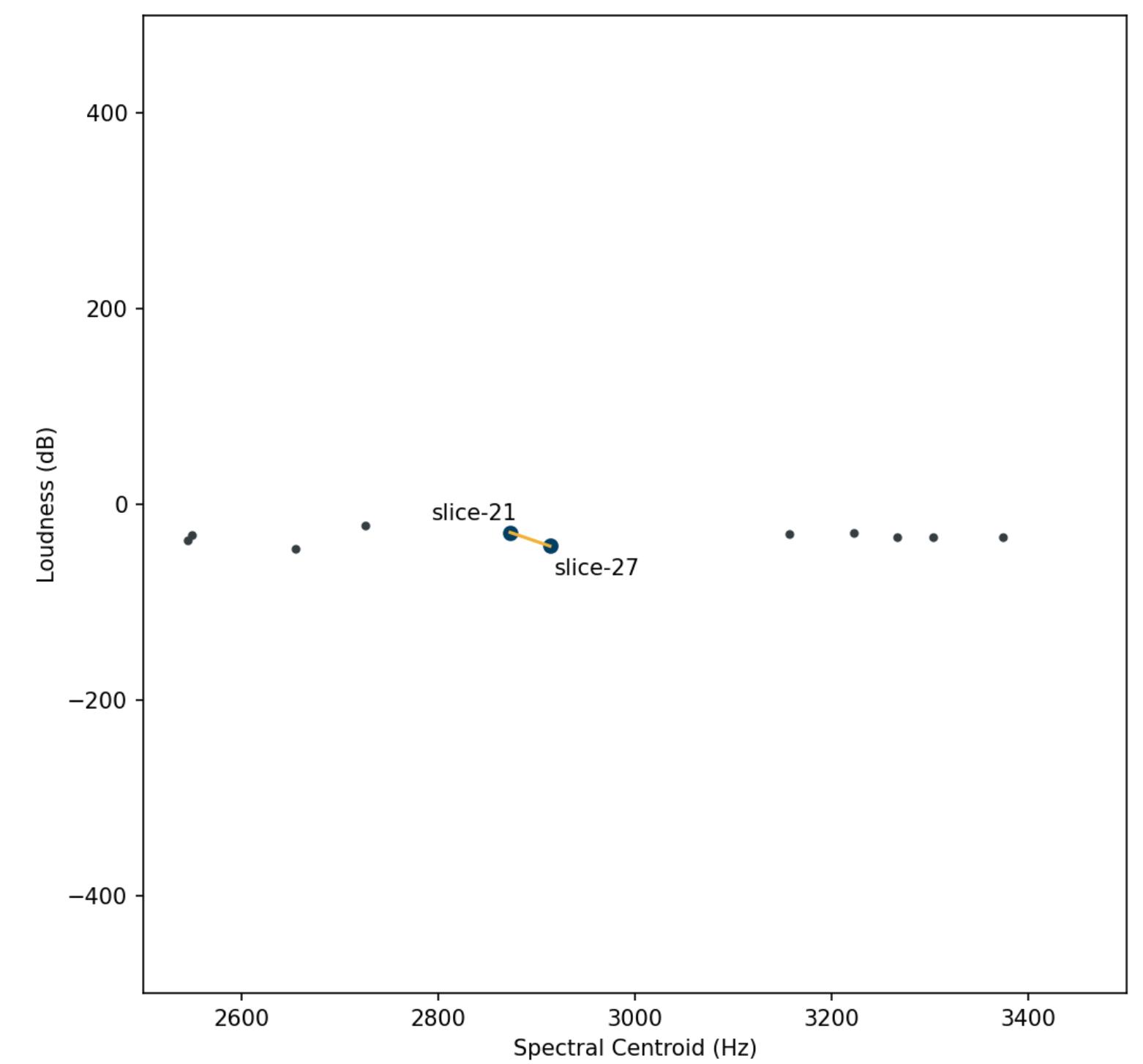
chan: 0	frame: 0	1	2	3	4	5	6	7...
analysis feature →	mfcc 0	mfcc 0	mfcc 0	mfcc 0	mfcc 0	mfcc 0	mfcc 0	...
1	mfcc 1	mfcc 1	mfcc 1	mfcc 1	mfcc 1	mfcc 1	mfcc 1	...
2	mfcc 2	mfcc 2	mfcc 2	mfcc 2	mfcc 2	mfcc 2	mfcc 2	...
3	mfcc 3	mfcc 3	mfcc 3	mfcc 3	mfcc 3	mfcc 3	mfcc 3	...
4	mfcc 4	mfcc 4	mfcc 4	mfcc 4	mfcc 4	mfcc 4	mfcc 4	...
5	mfcc 5	mfcc 5	mfcc 5	mfcc 5	mfcc 5	mfcc 5	mfcc 5	...

interface redesign to *hide* buffers (in Max)



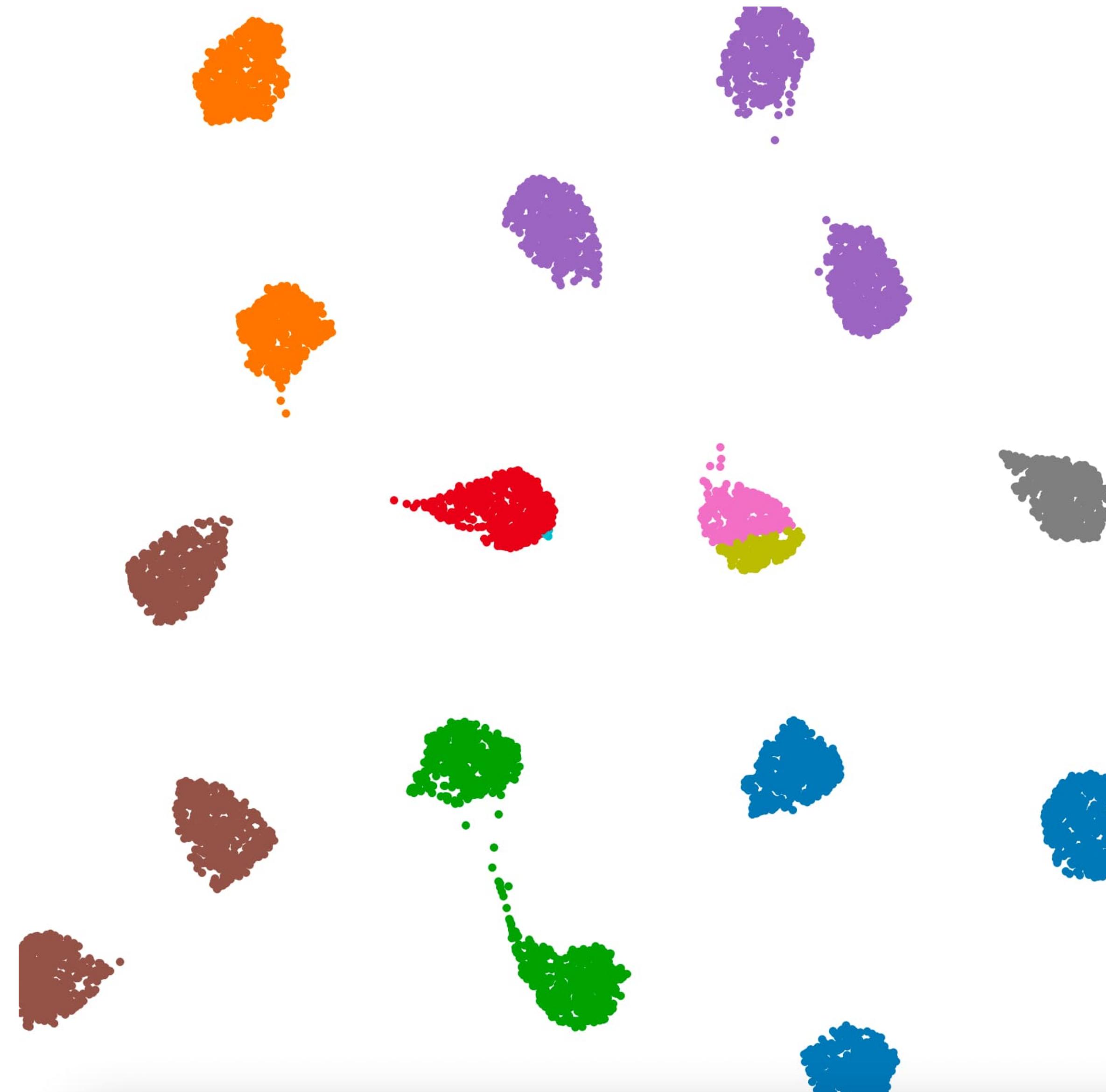
Proximity as Similarity

- What does it mean for two sounds to be “similar”?
- Computers compare numerically & measure distance
- Human assumptions of similarity (1 vs. 12 semitones)
- Logarithmic vs. Linear scales
- Mismatched Ranges & Scaling (1 dB ?= 1 Hz)



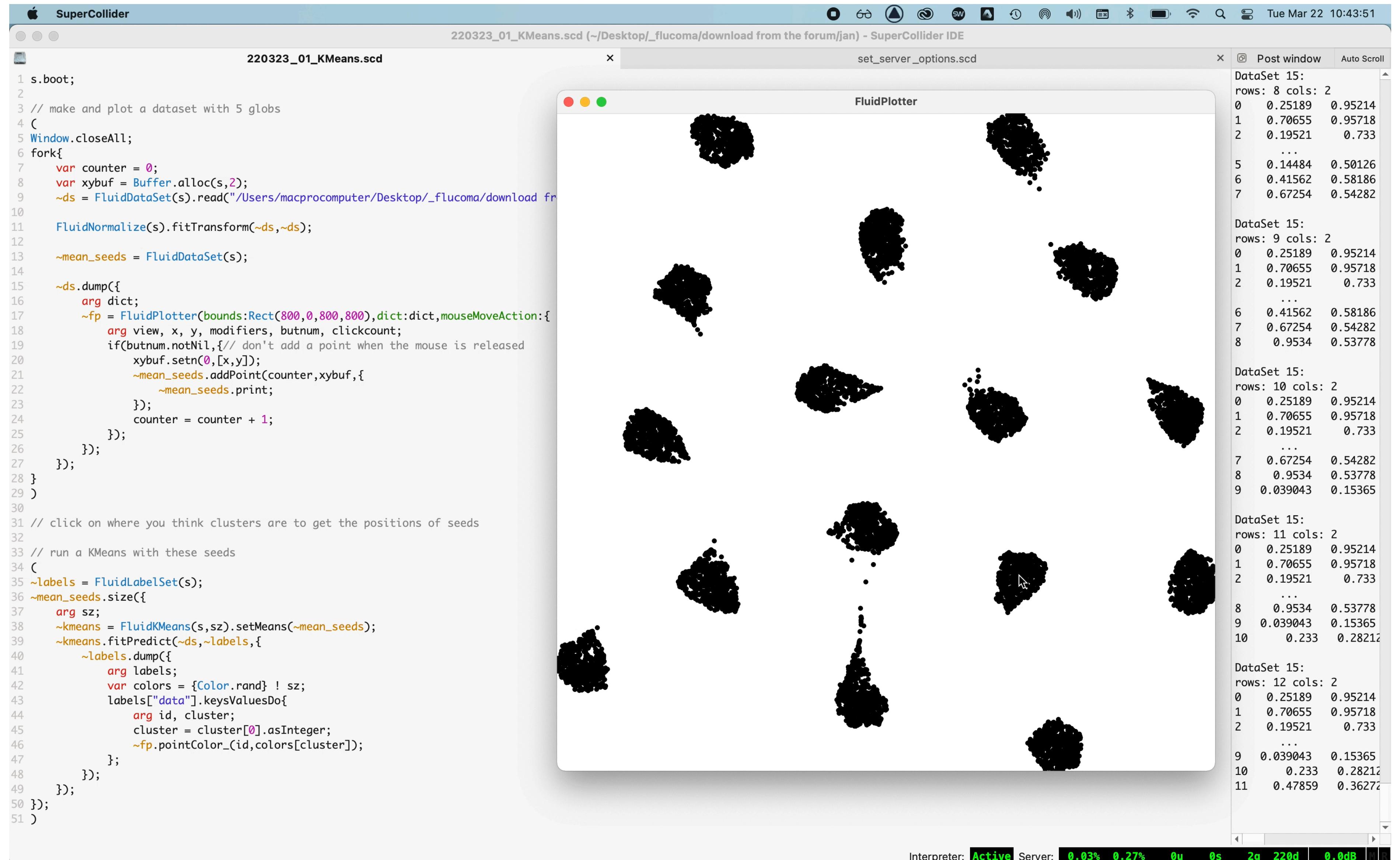
Human Perception vs Machine Perception

- Clustering
- Putting a “human-in-the-loop”



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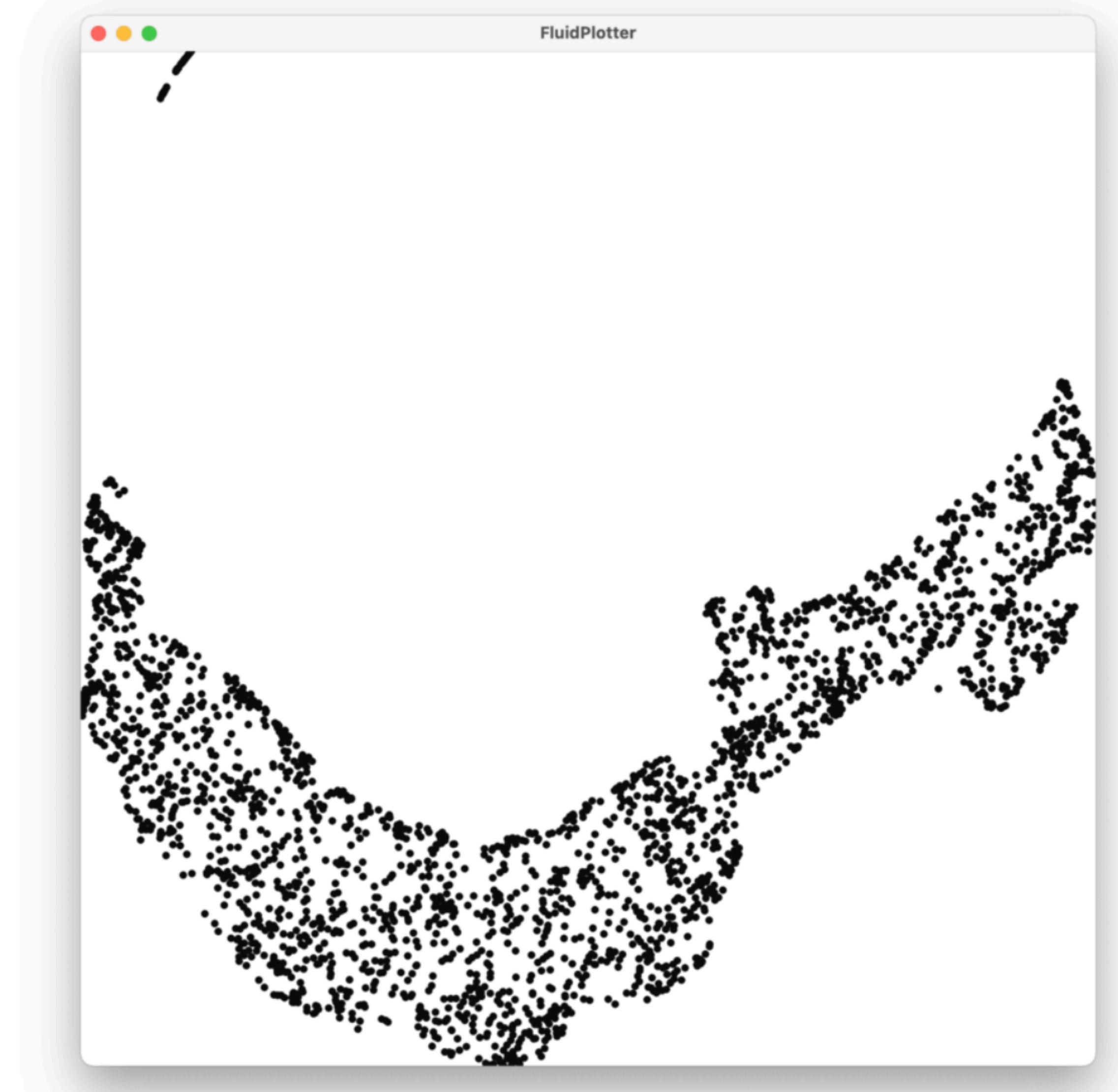


Outliers

- But, what *is* an outlier?
- Or, do I want to use these “outliers”?

Might they be interesting? ↵

Outliers are not always problematic. They may be musically more relevant than the other points in the dataset. For example, if one were to [analyse and plot](#) a folder containing a whole bunch of snare drum hits, many of the snare hits might be very similar and form a cluster of data points. What might be more *musically* interesting is to look for the snare hits that have unique characteristics and stand out when compared to the majority? Another way of considering this is to ask what snare hits are *significantly different* from the majority of the data points in the dataset?



A plot with outlier candidates in the upper left section.

The data that created this plot is a [UMAP](#) reduction of [MFCC](#) analyses from the sound file below.

Hoping that ML Performs Magic

- Dreaming big and asking “How can this work?...”
 - Instead of “Could this work?”
- Resistance to lots of trial-and-error in building & testing pipelines

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***Knowing when to use
Machine Learning***

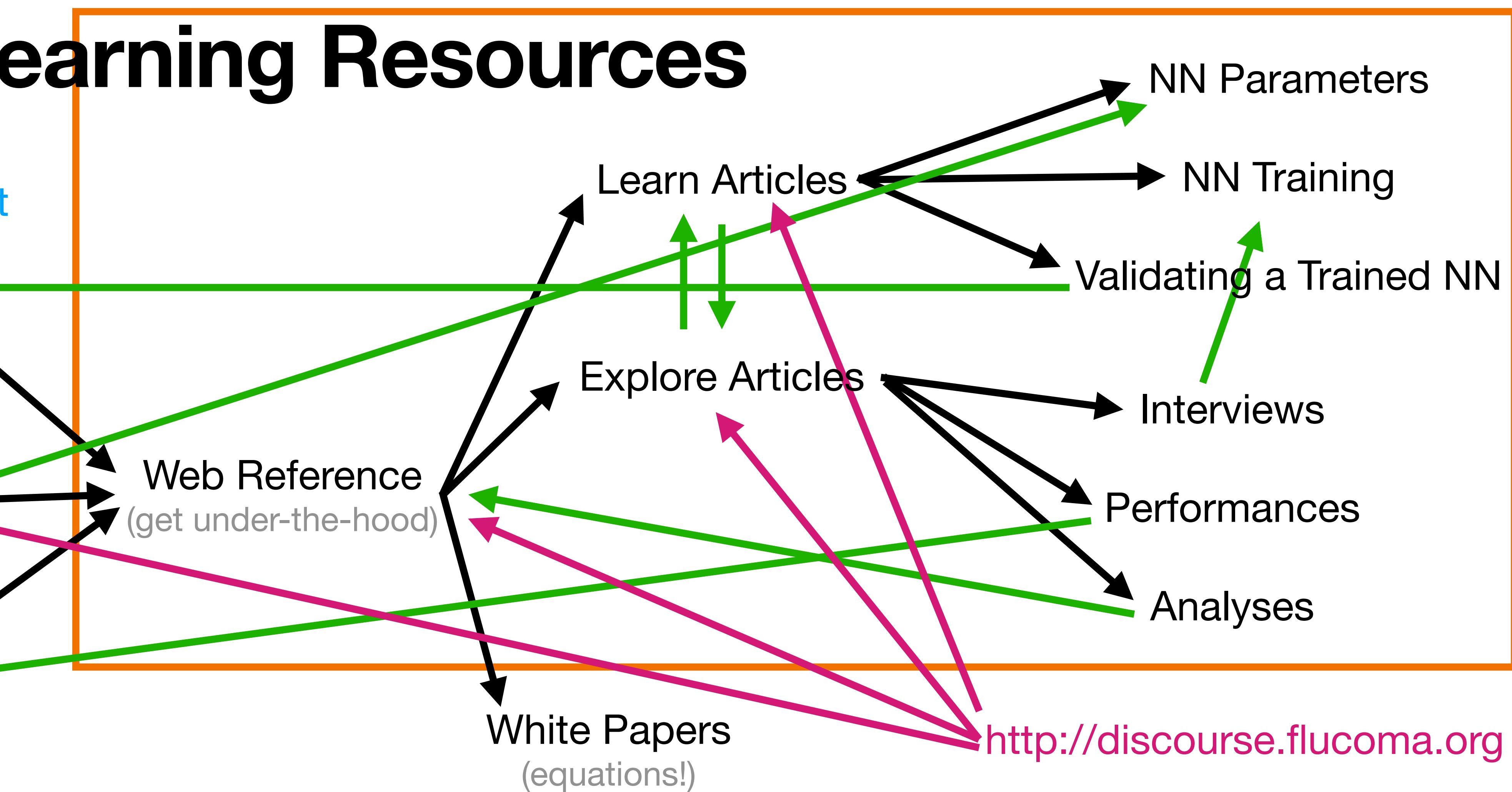
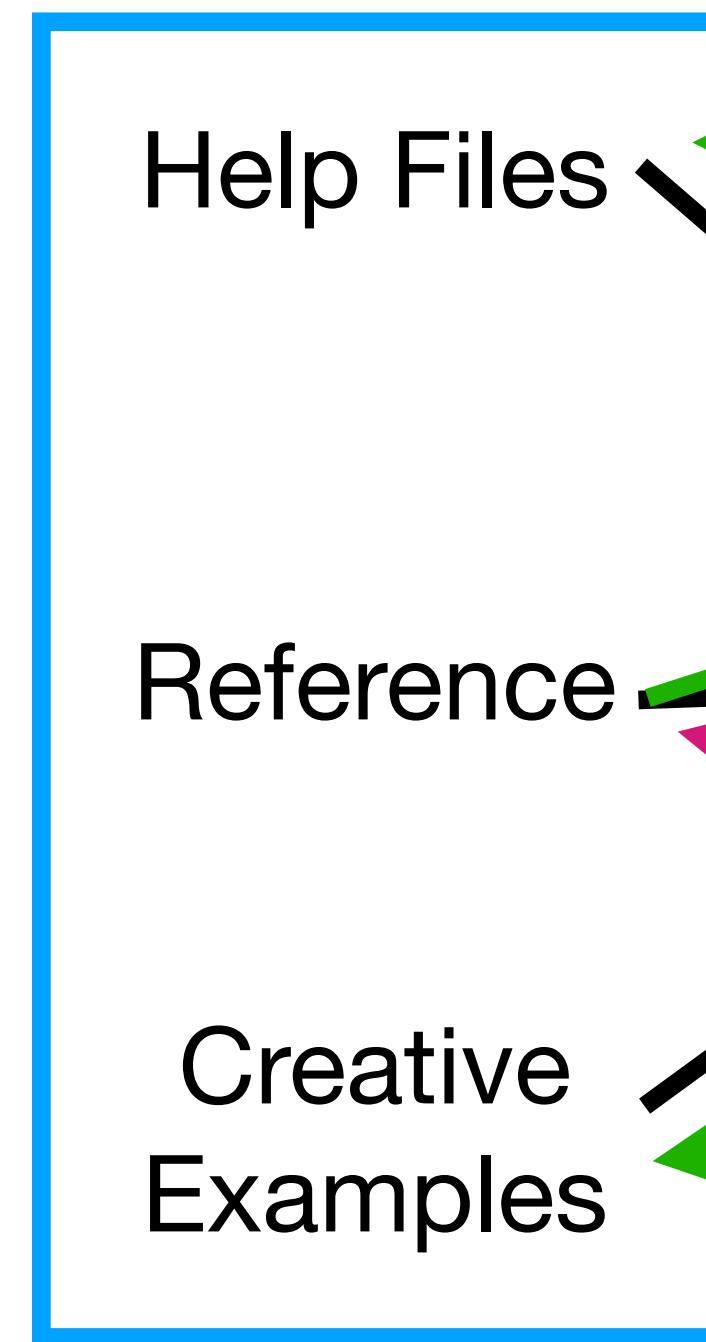


Assuming that ML Performs Magic

- Disclaimer: *If it sounds good keep it.*
- And...is it doing what you think it is doing?
- **Validation** can:
 - Offer ways to improve our system to get even closer to our desired outcome.
 - Reveal our assumptions and/or misunderstandings about the data, providing opportunities to deepen our knowledge.
 - Reveal nuances in the system and/or data that might offer more paths of exploration and creativity.

Tiered Learning Resources

In the Creative Coding Environment



Allows learners to pursue knowledge as far as they deem appropriate to feed their creative practice in a given moment.

What they *need* to know *when* they need to know it. Granularity of Pedagogy.

Stay focused on a creative idea, not overwhelmed by the deep rabbit hole or steep learning curve.

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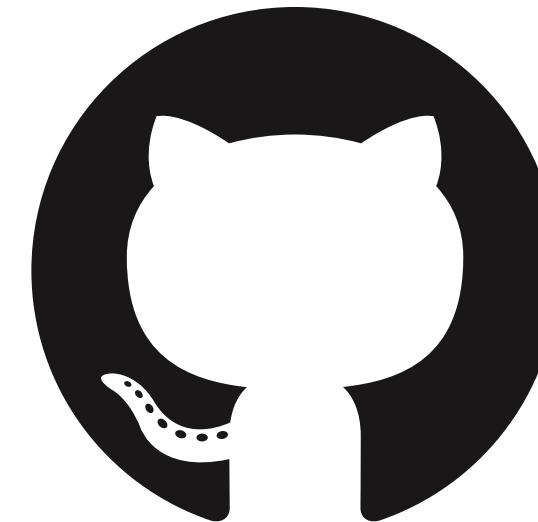
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tutorials
performances

