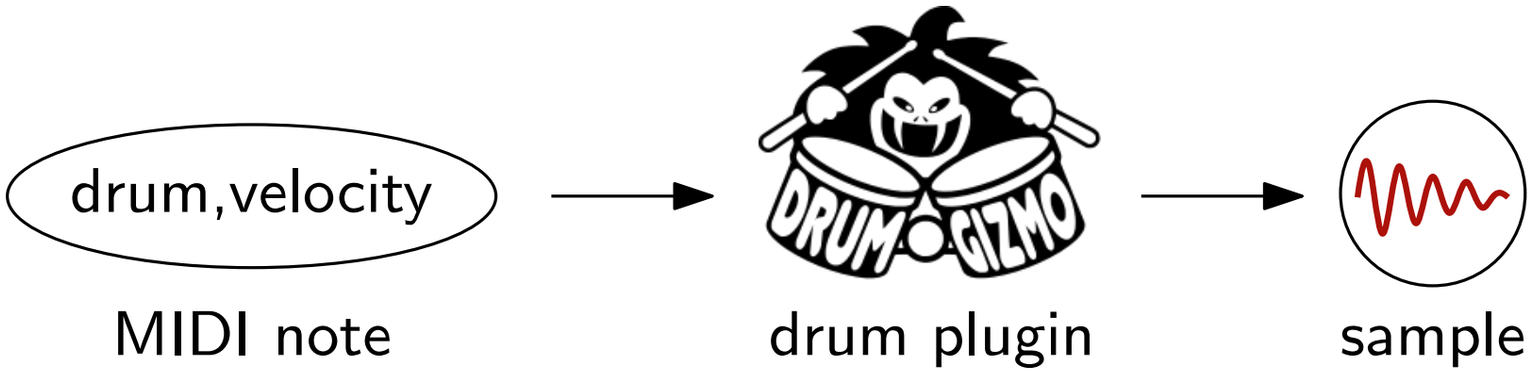
On Choosing Best Samples for Virtual Drums

André Nusser & Bent Bisballe Nyeng

Motivation

How to select samples?



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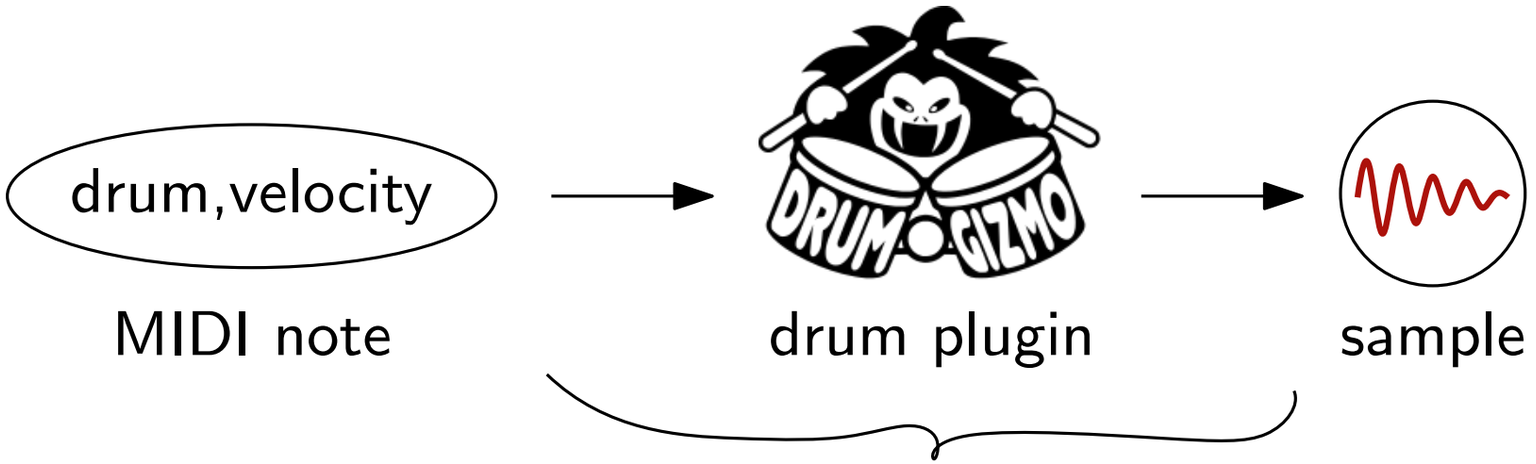

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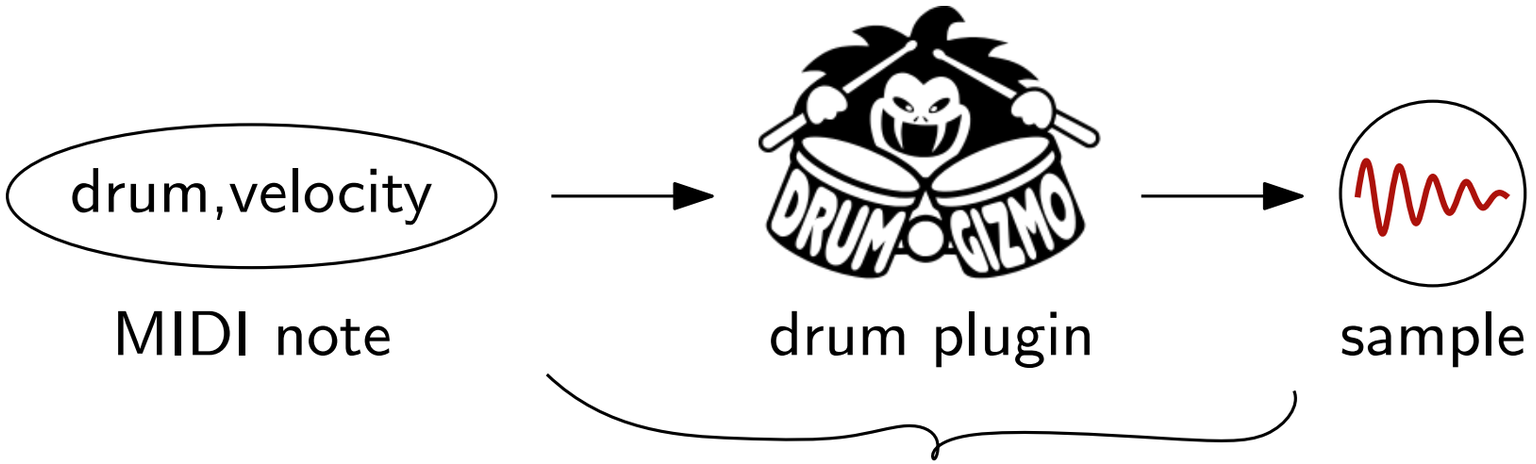
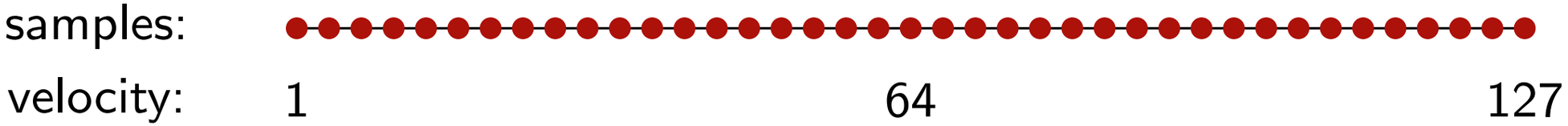


Naive Solution:



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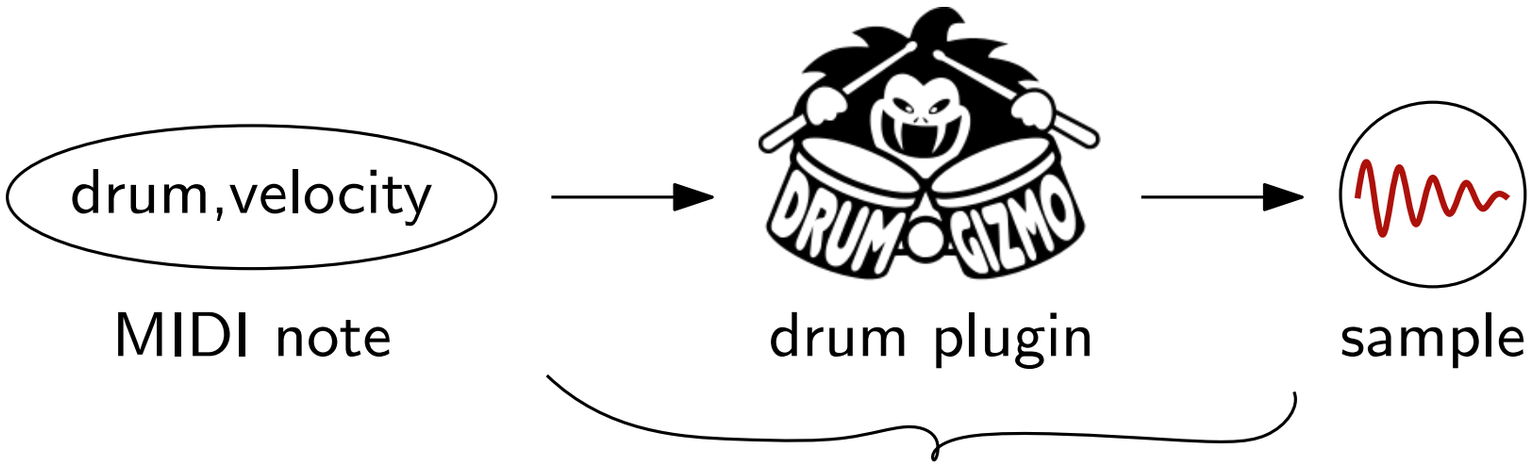
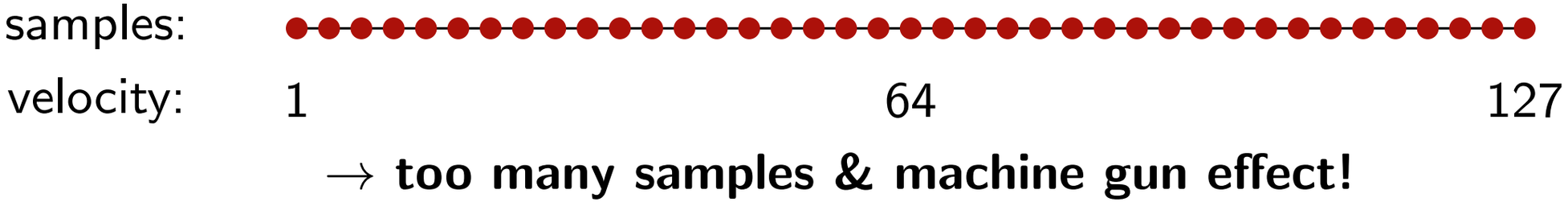


what happens here??

Naive Solution:

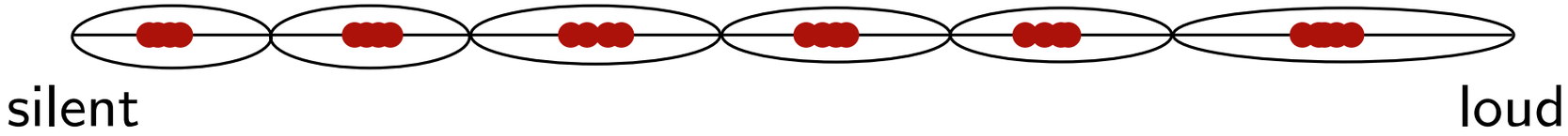


$\rightarrow$ **too many samples & machine gun effect!**

Motivation

Other Selection Methods

Round Robin:



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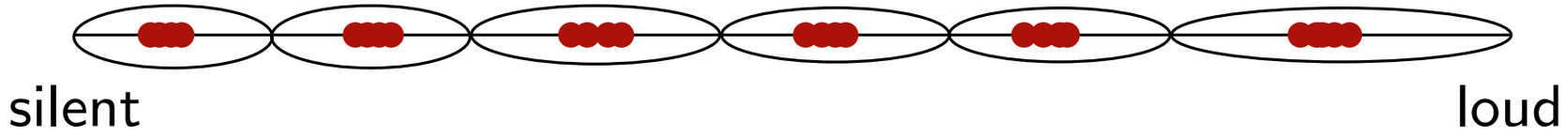
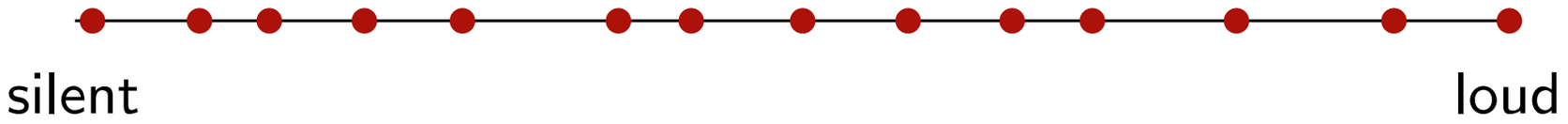


Continuous Velocities:



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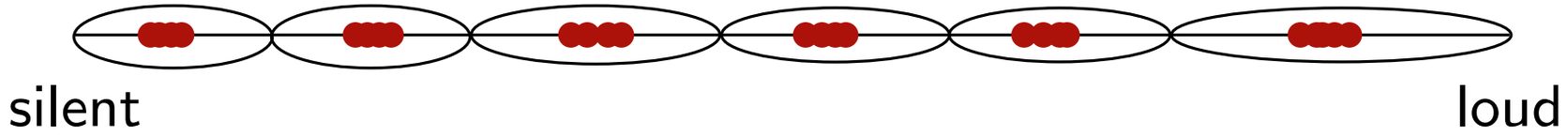

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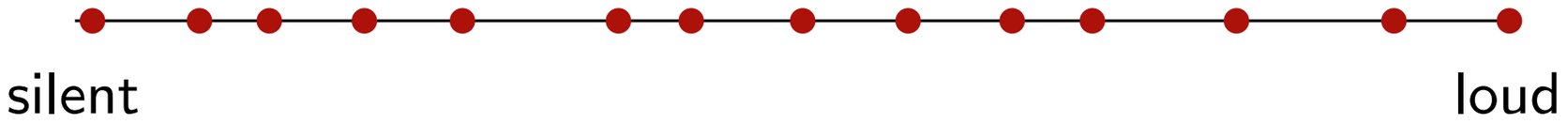


→ **Remainder: How to select samples in this setting?**

Motivation

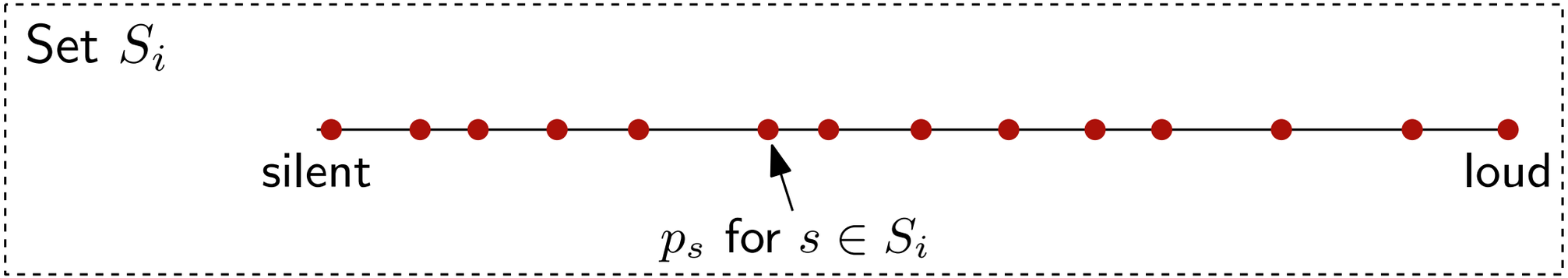
Why continuous velocities?

- sampling a drum kit is easier
- no staircase effect
- no scaling samples
- more flexible

Setting

Data:

Instrument $i \in I$:



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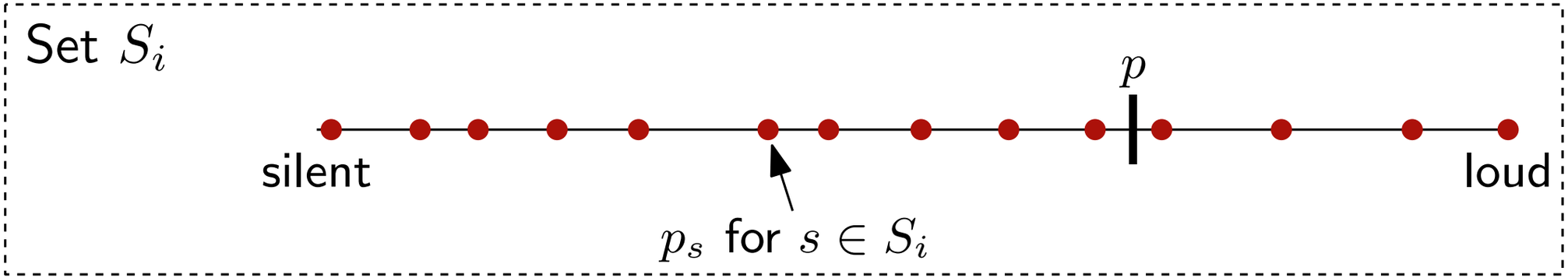

Requests: $(i, p) \in I \times \mathbb{R}^+$

Answer: best sample from S_i for the power value p

Setting

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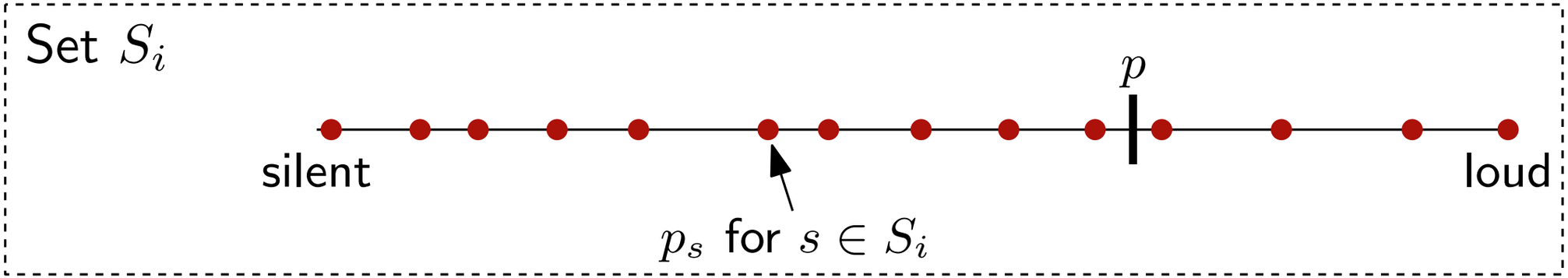


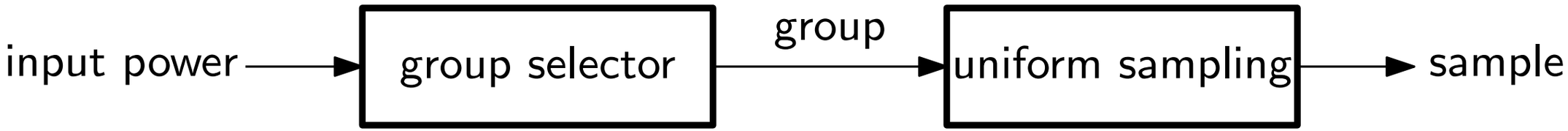
Requests: $(i, p) \in I \times \mathbb{R}^+$

Answer: best sample from S_i for the power value p

$\rightarrow$ **What is the best sample?**

Previous Approaches in DrumGizmo

Approach I: Velocity Groups



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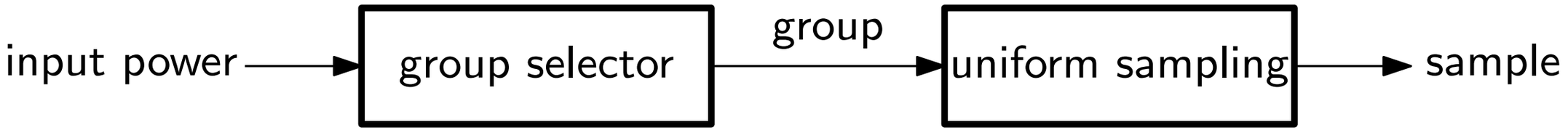
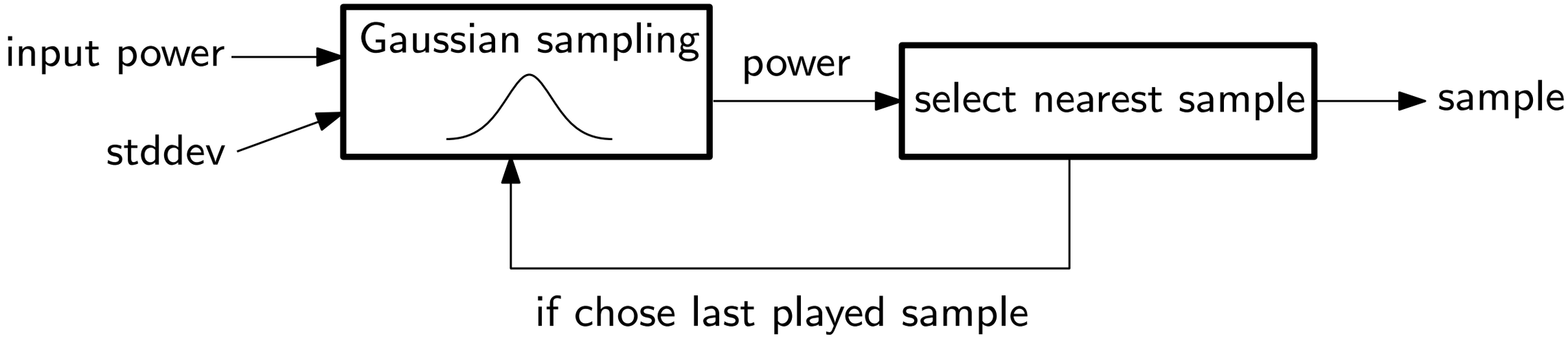


Issues:

- Staircase effect
- More work to create a drum kit

Previous Approaches in DrumGizmo

Approach II: Sampling from Normal Distribution



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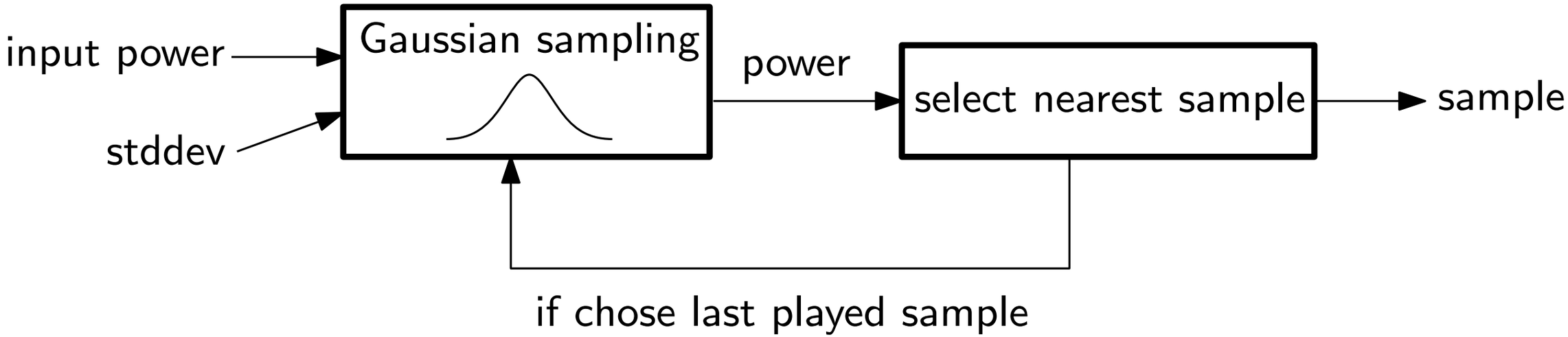

Issues:

- Possible machine gun effect
- Does not use full potential of data set:
- No notion of time

Requirements of Sample Selection Algorithm

1) Closeness

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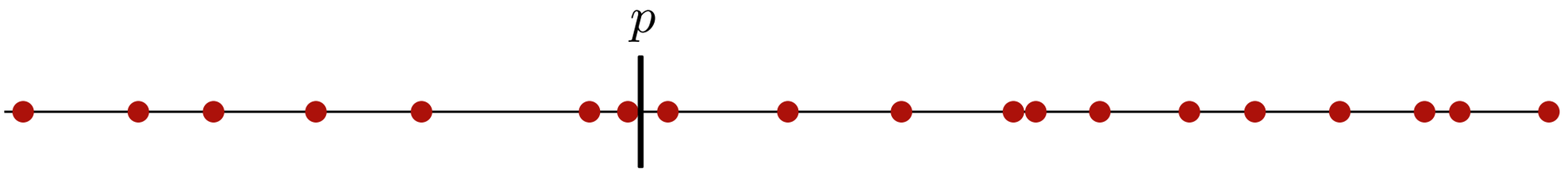

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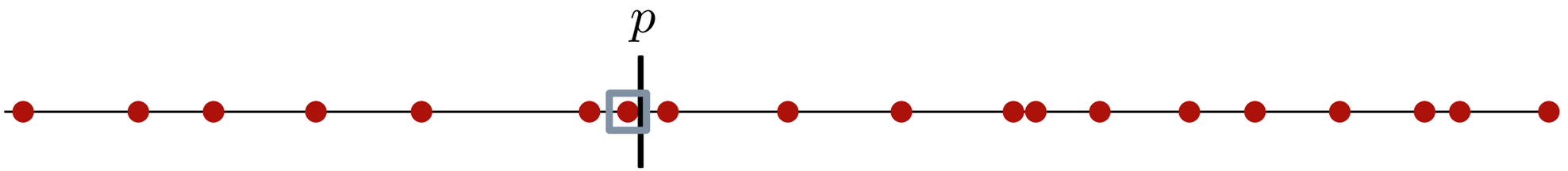

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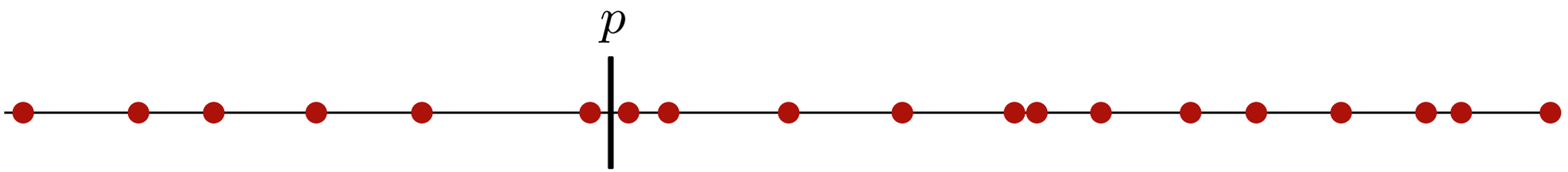

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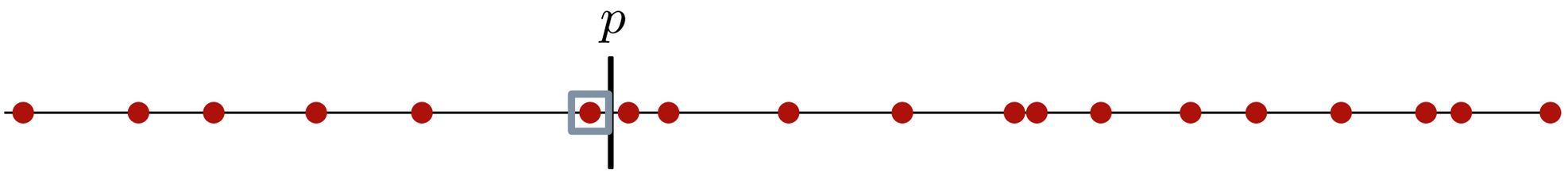

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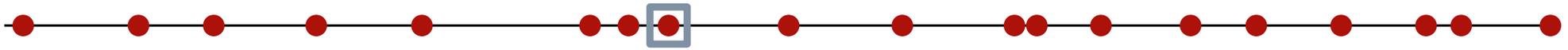

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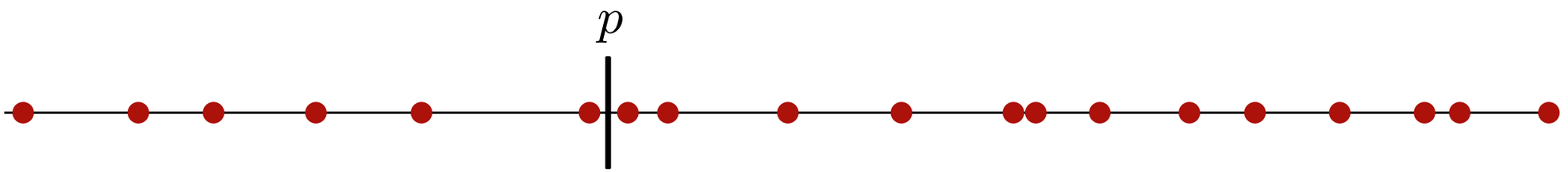

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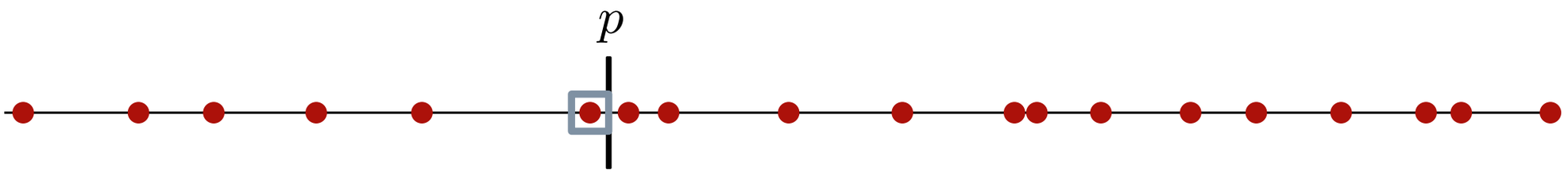

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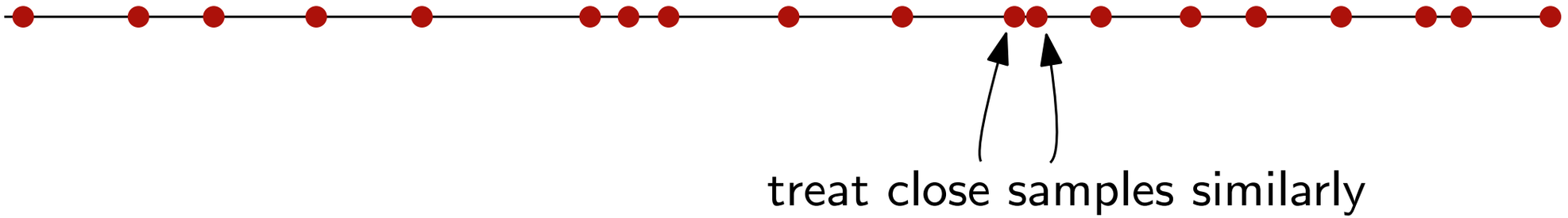

1) Closeness
2) Diversity
3) Randomization
4) Locality

Our Solution

Idea: Quantify all requirements and create function to be optimized

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$\rightarrow$ on request power p at time point t:
for each sample $s \in S$ compute score $f(s, t)$ ← "the lower the better"

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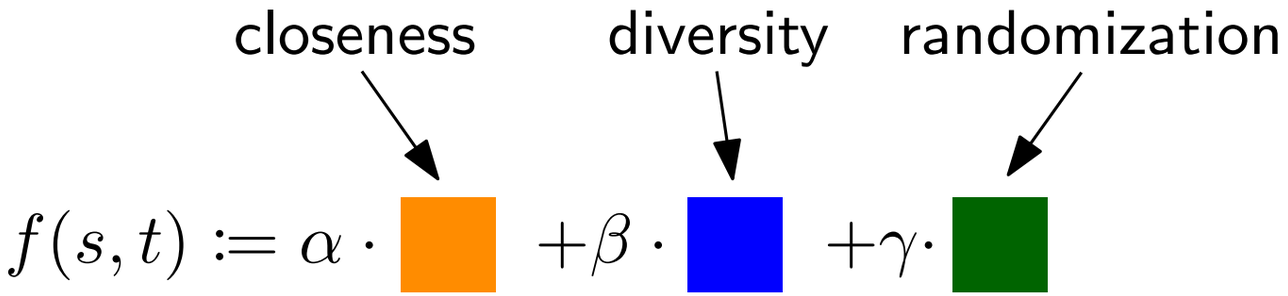

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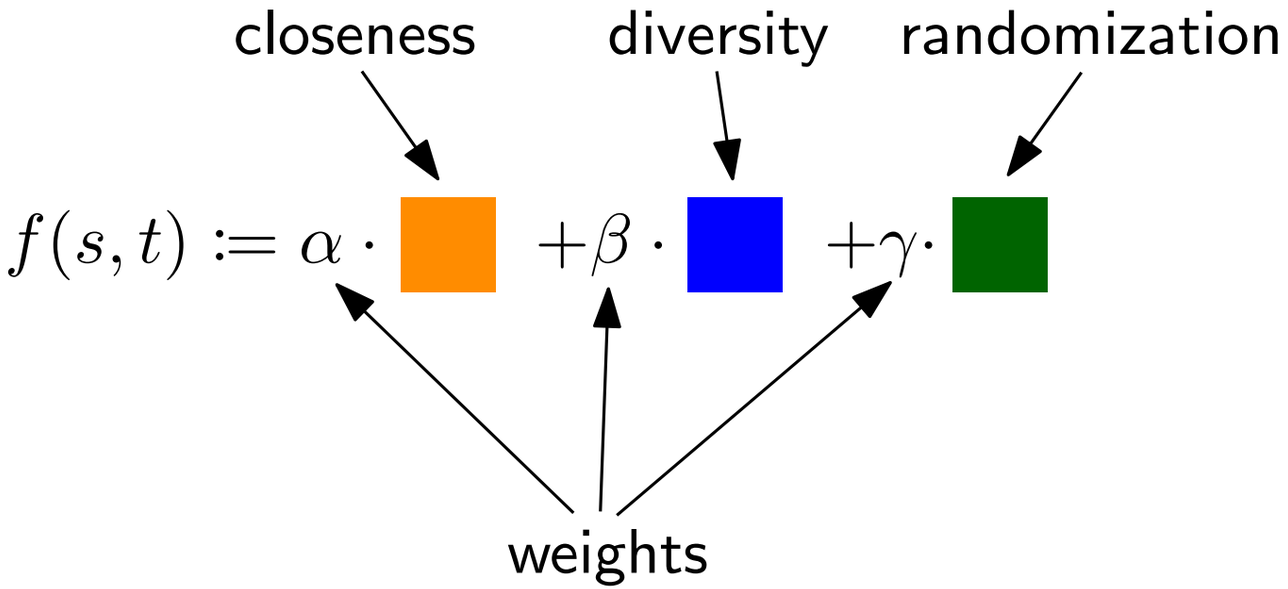

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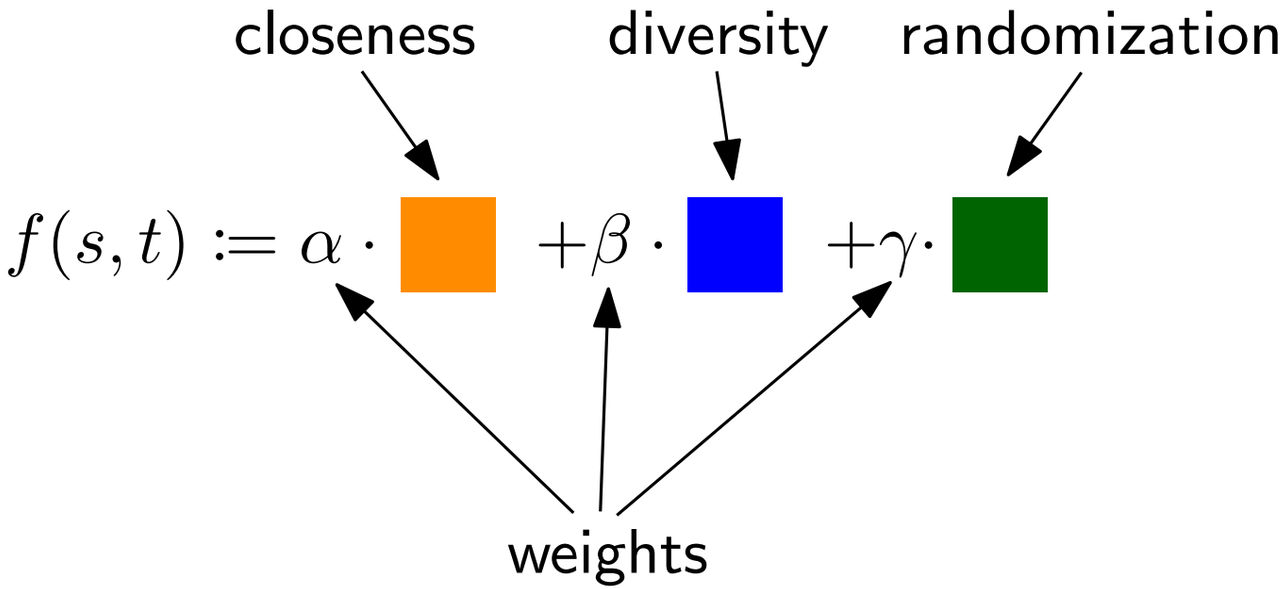

$= \left(\frac{p - p_s}{p_{\max} - p_{\min}} \right)^2$

$= \left(1 + \frac{t - t_s}{S}\right)^{-1}$

$= r(s,t)$

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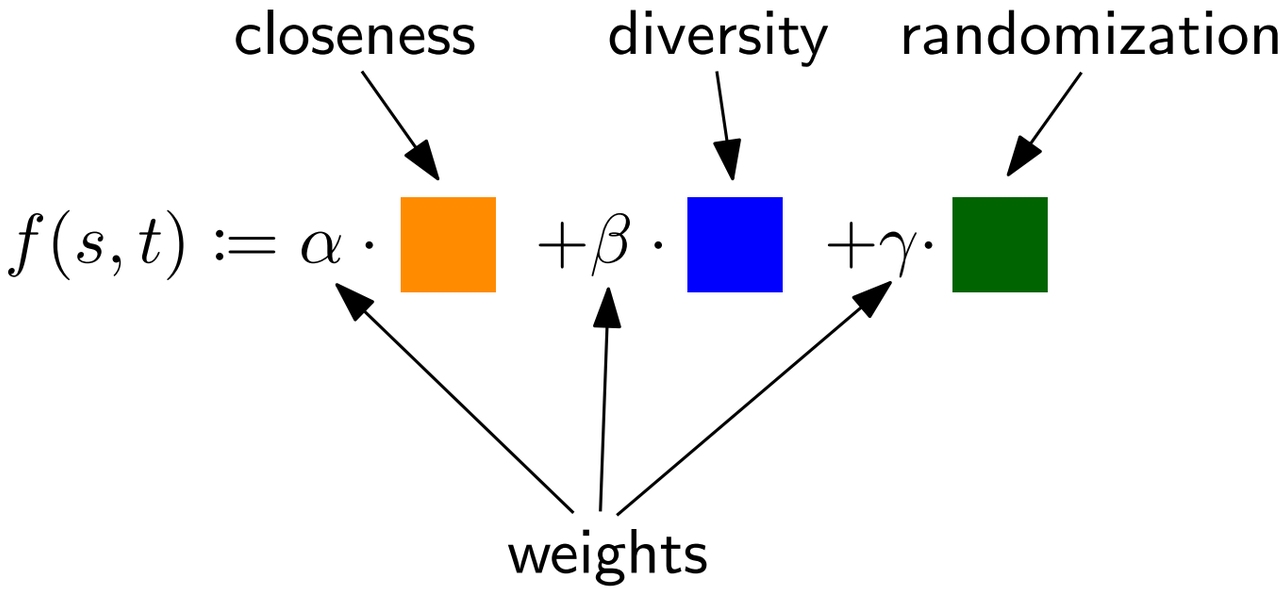

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→ **Are the requirements fulfilled?**

Our Solution

“Algorithm”

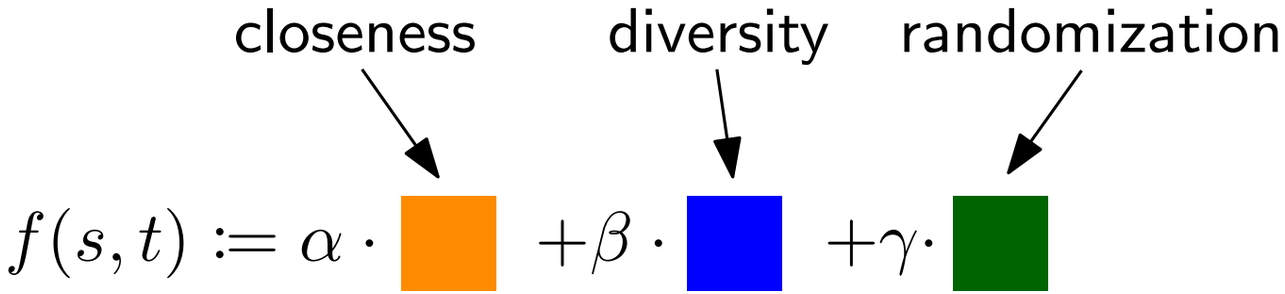
Input: Requested power p, instrument i, current time step t, parameters α, β, γ, and values t_s which are the time points sample s was played the last time

Output: Sample s

return $\arg\min_{s \in S_i} \alpha \cdot \left(\frac{p - p_s}{p_{\max} - p_{\min}} \right)^2 + \beta \cdot \left(1 + \frac{t - t_s}{S}\right)^{-1} + \gamma \cdot r(s, t)$

Emulation

Three Extreme Cases



Choose closest sample: $\alpha = 1$ and $\beta = \gamma = 0$

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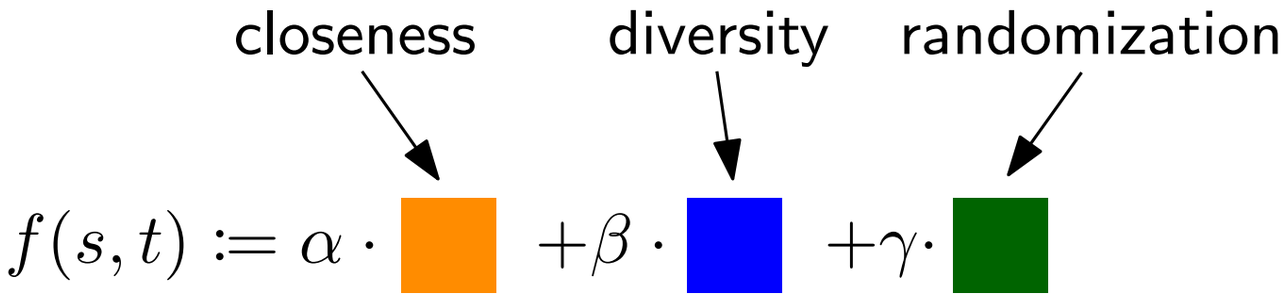
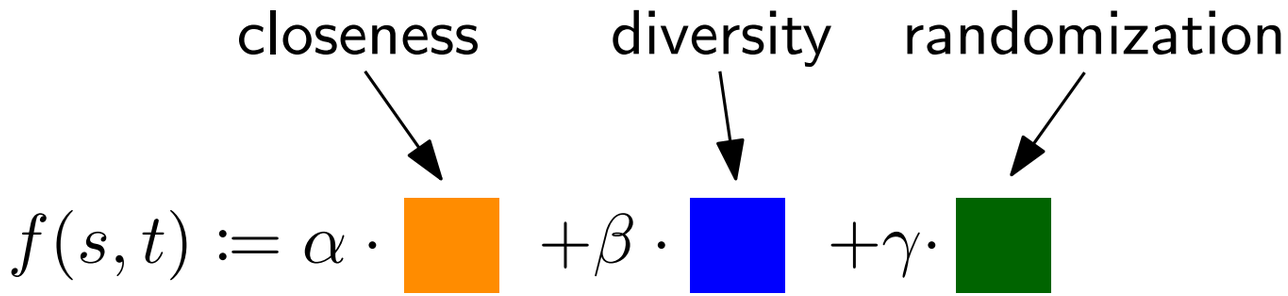


Choose closest sample: $\alpha = 1$ and $\beta = \gamma = 0$

Choose oldest: $\beta = 1$ and $\alpha = \gamma = 0$

Emulation

Three Extreme Cases



Choose closest sample: $\alpha = 1$ and $\beta = \gamma = 0$

Choose oldest: $\beta = 1$ and $\alpha = \gamma = 0$

Choose randomly: $\gamma = 1$ and $\alpha = \beta = 0$

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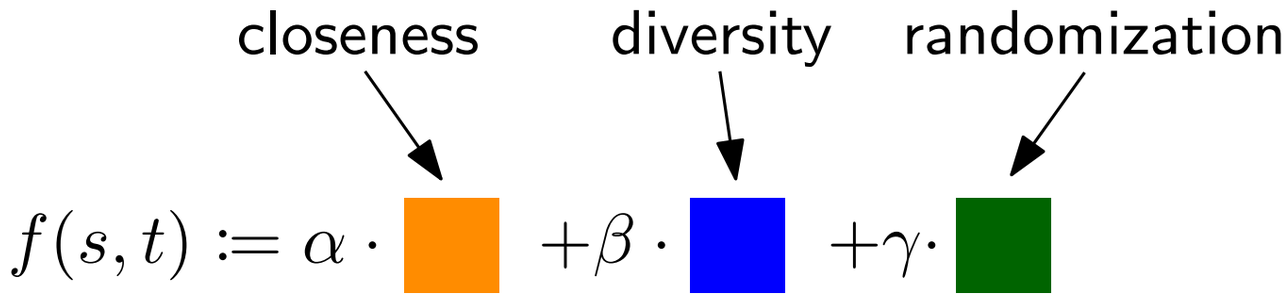
Round Robin



Prepare drum kit: Samples in same group have same power values

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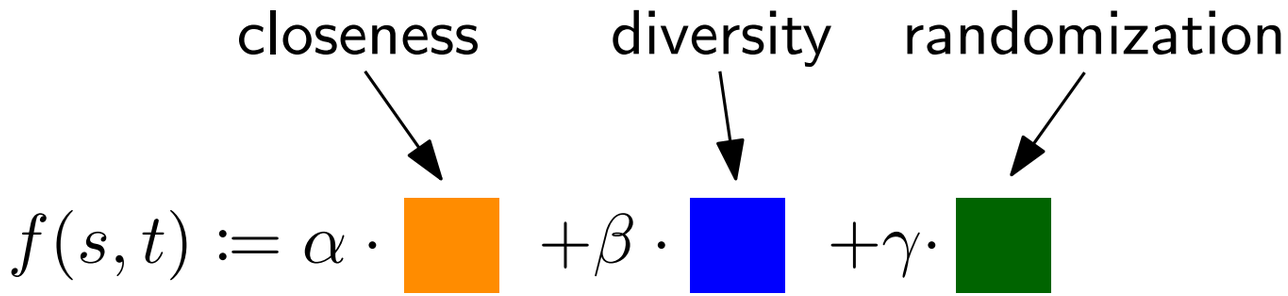


Prepare drum kit: Samples in same group have same power values

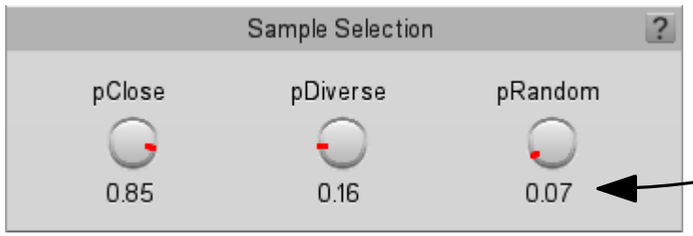
First choose closest: $\alpha =$ "large"

Then choose oldest: $\beta =$ "small"

And randomize a bit: $\gamma =$ "a bit smaller"

Implementation

- Introduced in DrumGizmo (in a preliminary form) in July 2019
- Simple controls:



values are not α, β, γ but some scaled version!

- Two improvement releases after user feedback

Experiments

Setting

Data:

- Crocell drum kit snare
- 98 samples (i.e., also power values)

Experiments:

- Repeatedly play same note
- Sweep MDI velocities several times

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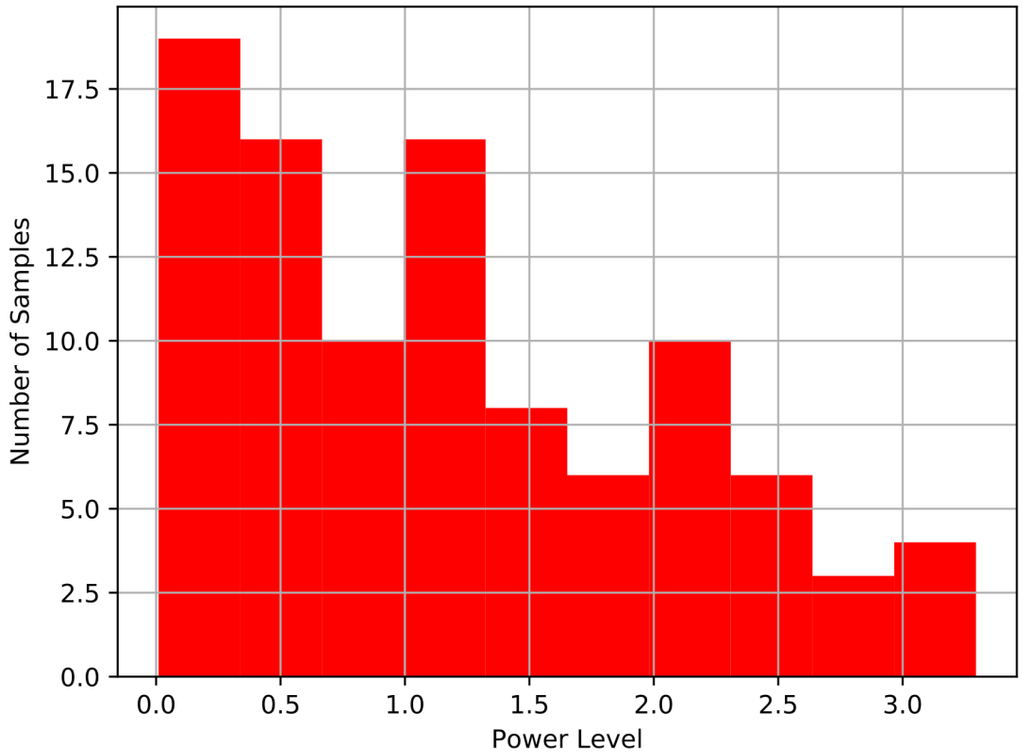
Crocell Kit Power Level Distribution:



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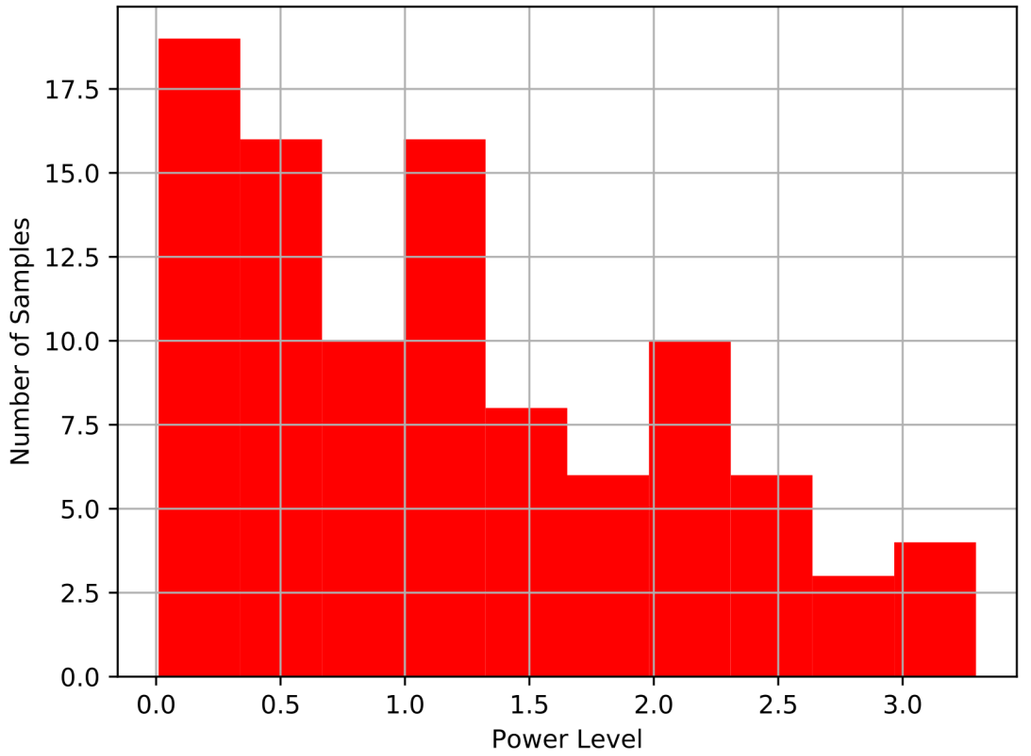
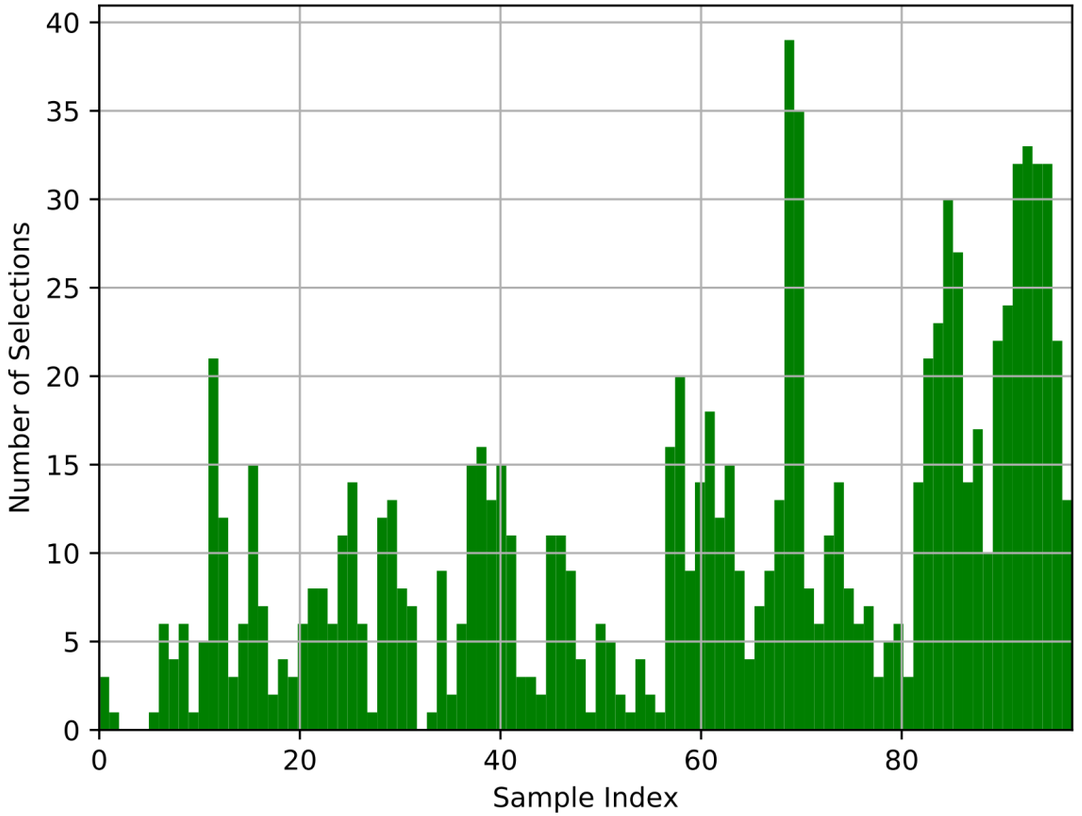


Why not sound tests?

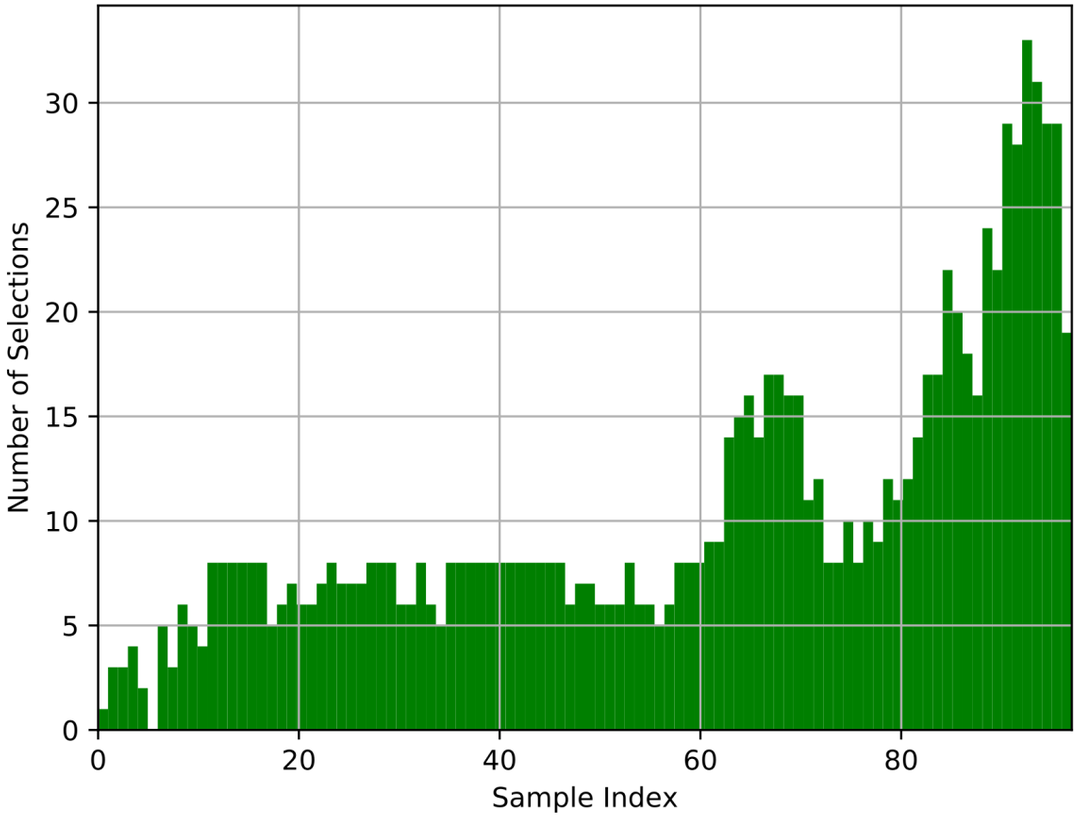
Experiments

Sweep

Old:



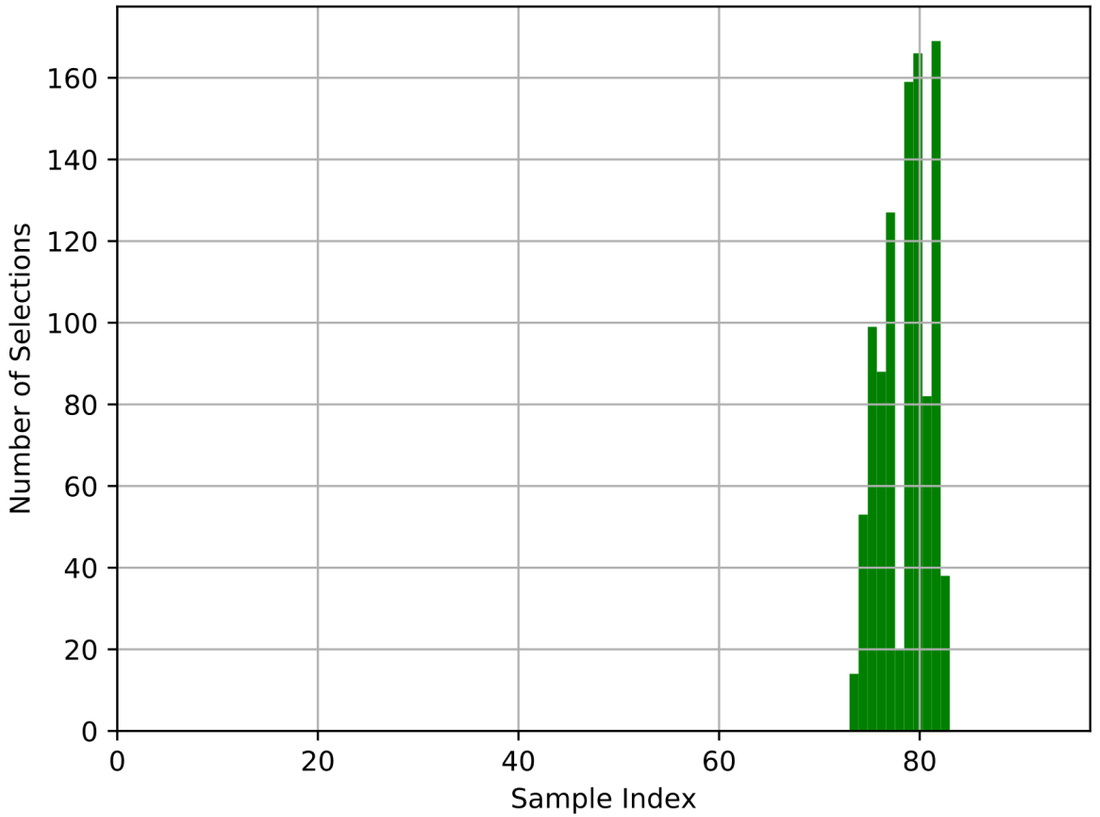
New:



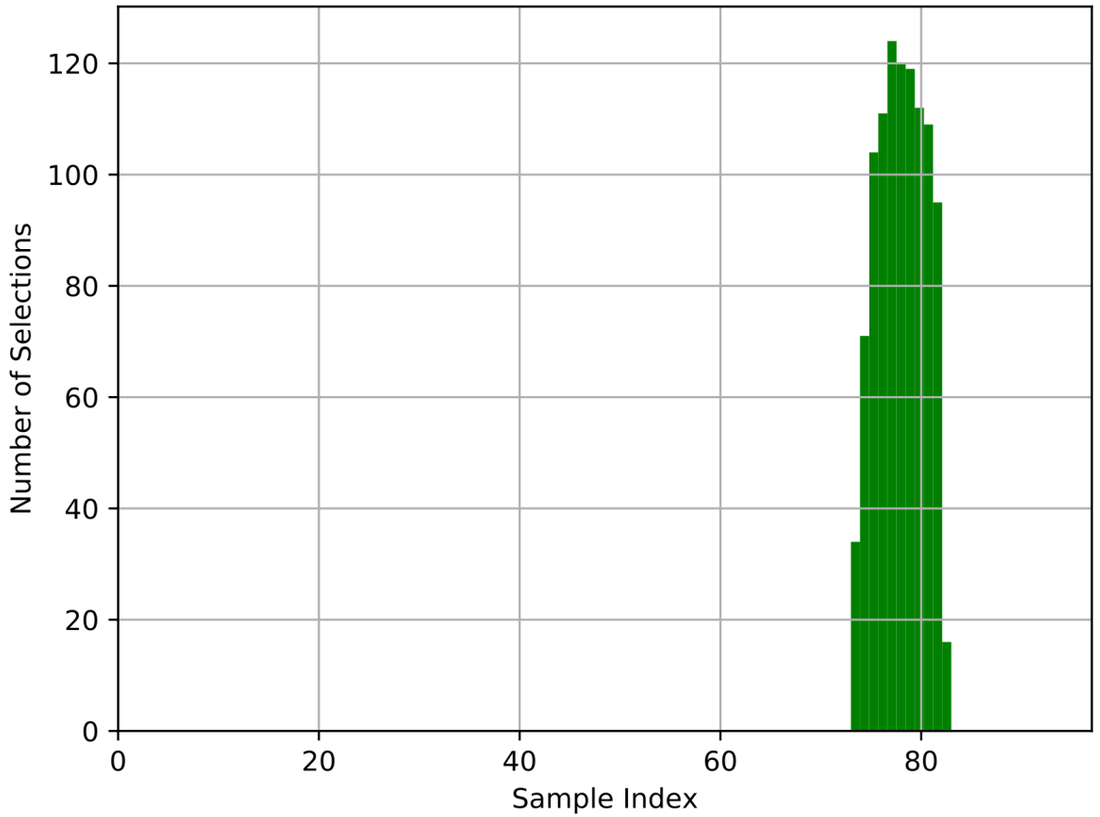
Experiments

Dense Sampling: MIDI Velocity 80

Old:



New:



Experiments

Sparse Sampling: MIDI Velocity 112

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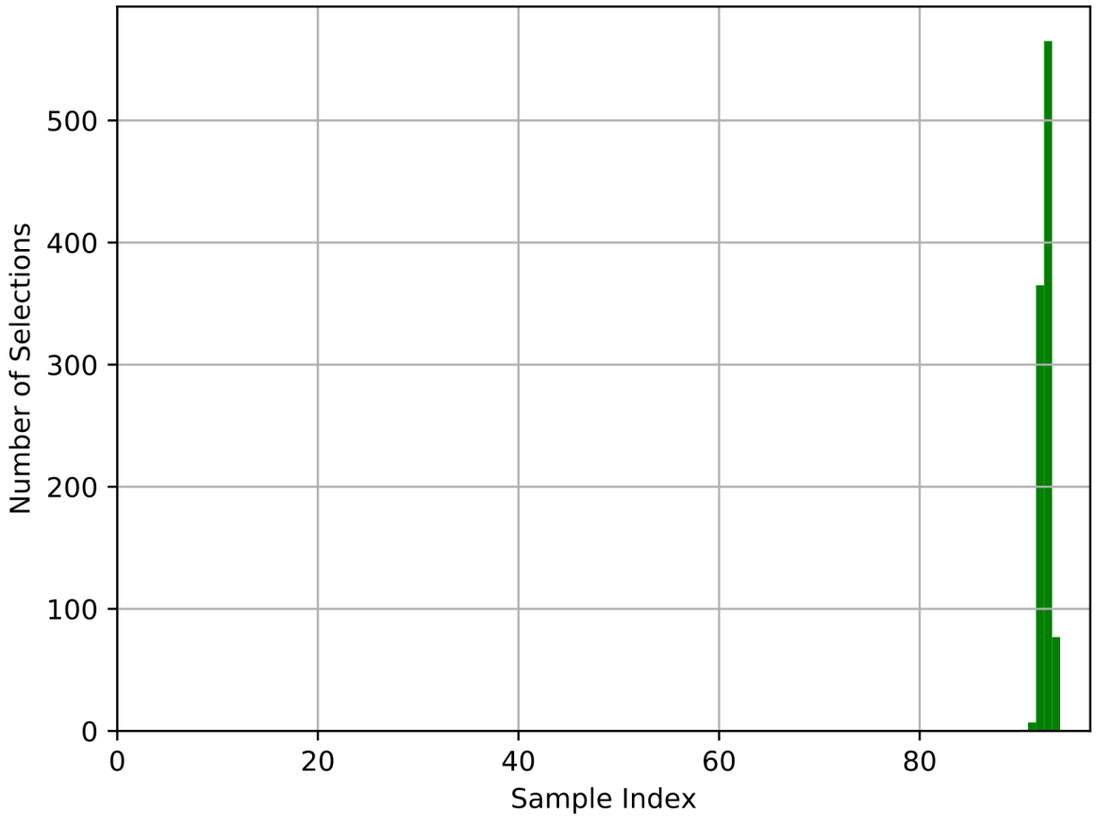

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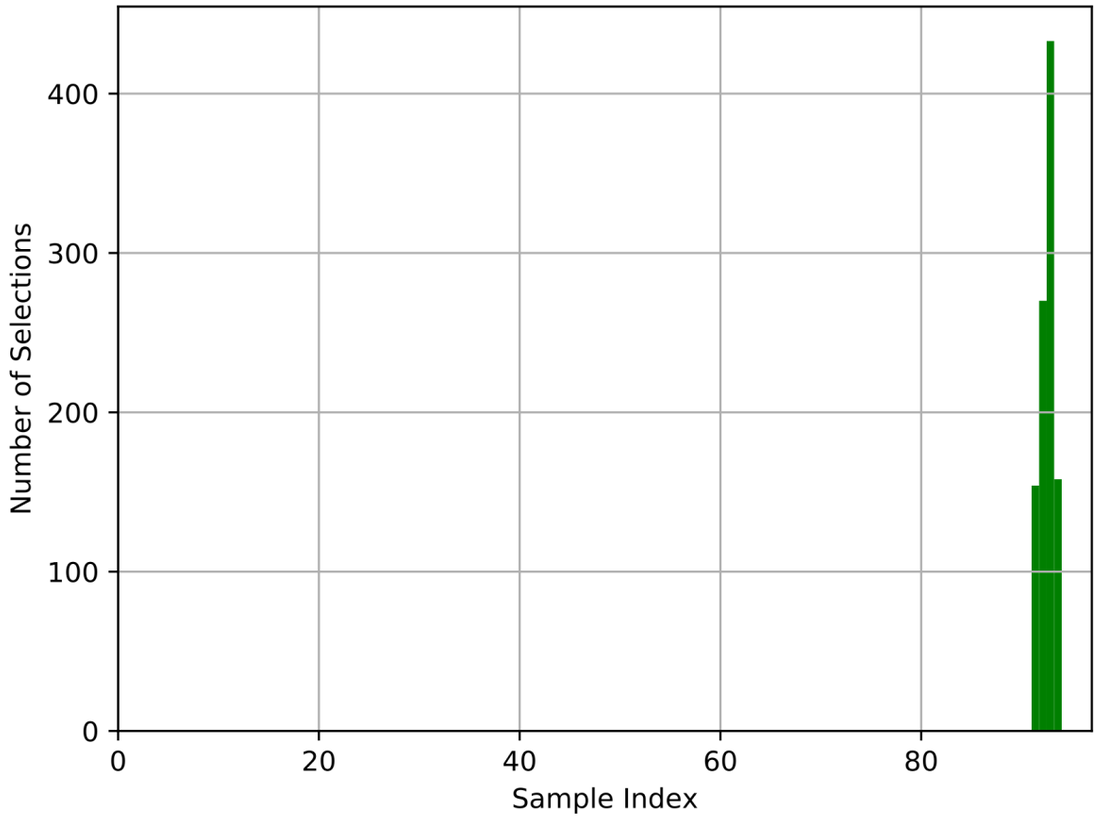

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User Feedback

- First Example:
  - **Issue:** Fast notes on sparsely sampled cymbal
  - **Solution:** Change diversity term from quadratic to linear

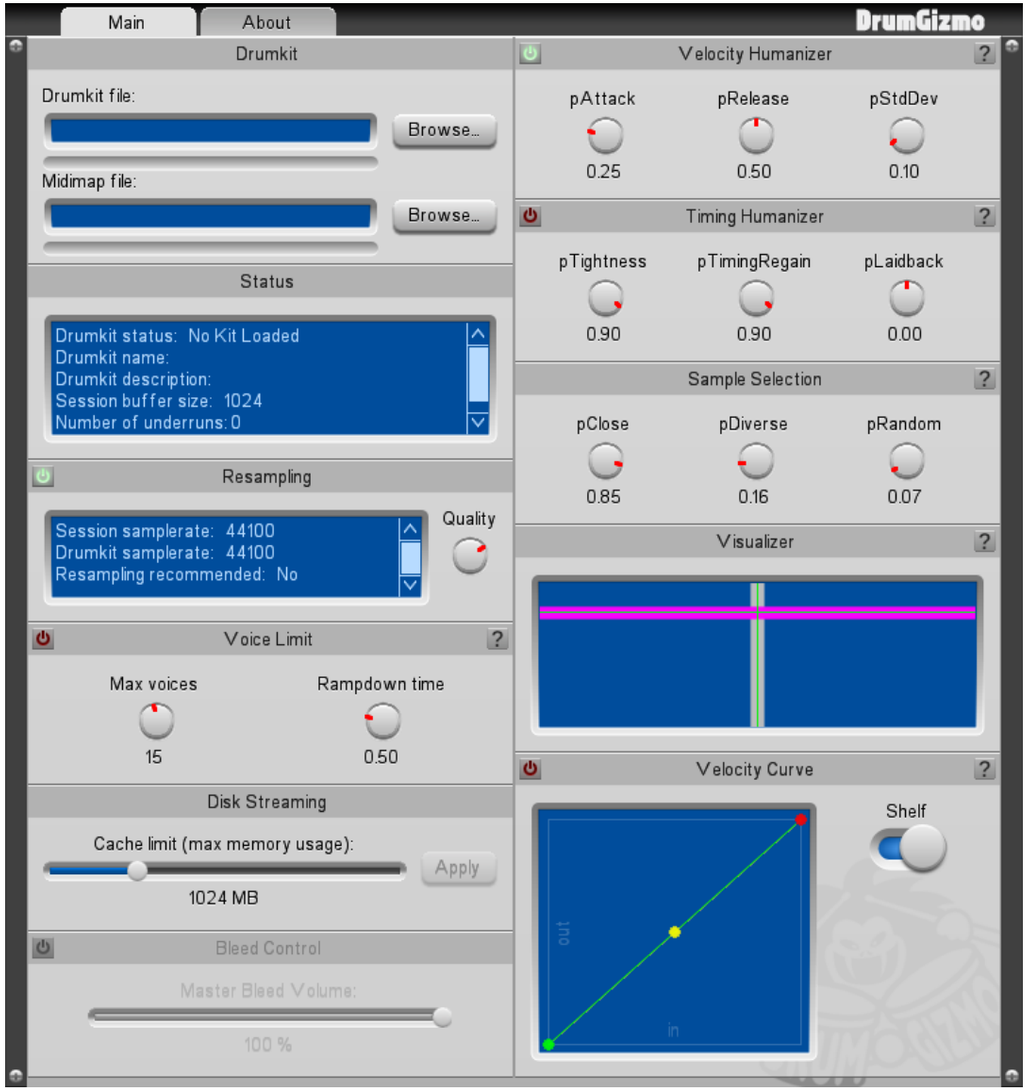
Experiments

User Feedback

- First Example:
  - **Issue:** Fast notes on sparsely sampled cymbal
  - **Solution:** Change diversity term from quadratic to linear
- Second Example:
  - **Issue:** Suboptimal performance on certain drum kit
  - **Quick Solution:** Change default parameters
  - **Long-Term Solution:** Each drum kit provides its parameters

Final Remarks

New Release!



Thanks for your attention!

www.drumgizmo.org