Musical Style Modification as an Optimization Problem

Frank Zalkow
AudioLabs
frank.zalkow@audiolabs-erlangen.de

Stephan Brand
SAP SE
stephan.brand@sap.com

Benjamin Graf
SAP SE
benjamin.graf@sap.com

International Computer Music Conference, Utrecht, September 13, 2016

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2. Data corpus
3. Local search within neighborhood
4. Objective functions
5. Results

Introduction and Overview

Motivation

- Origin of project

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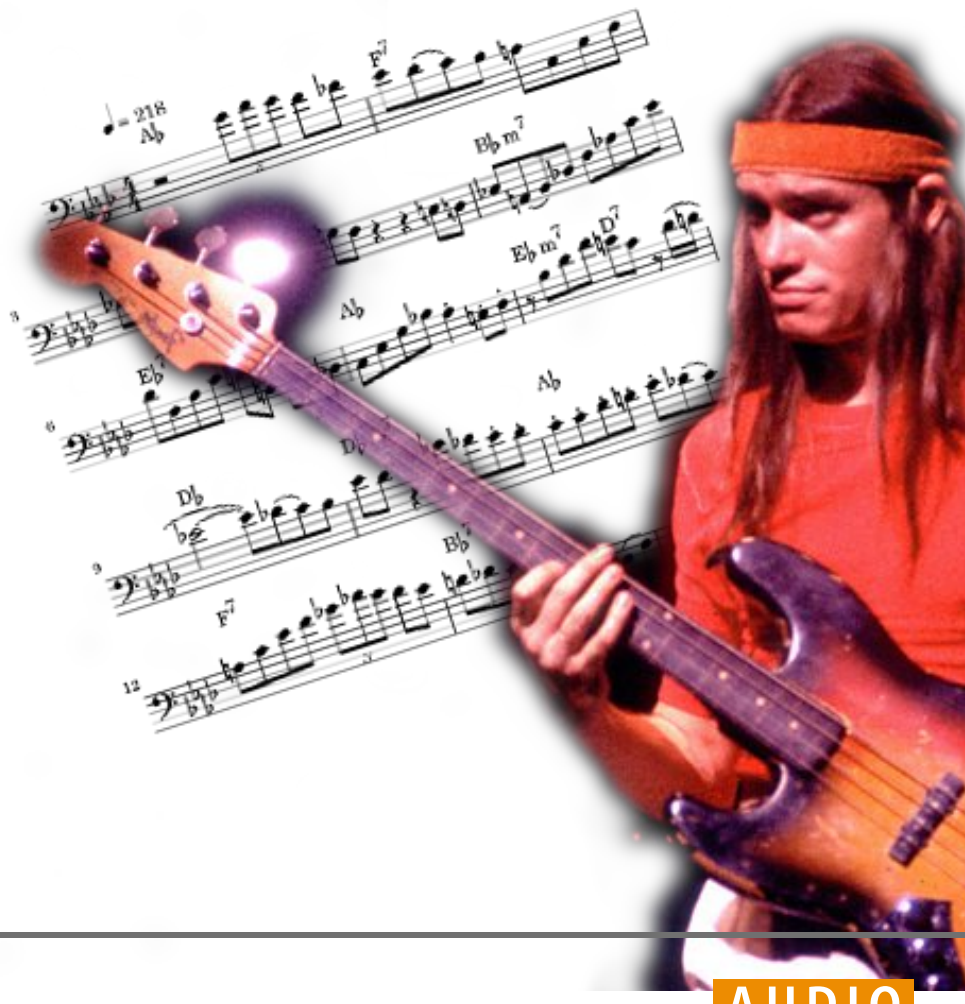

Frank Zalkow, Stephan Brand, Benjamin Graf

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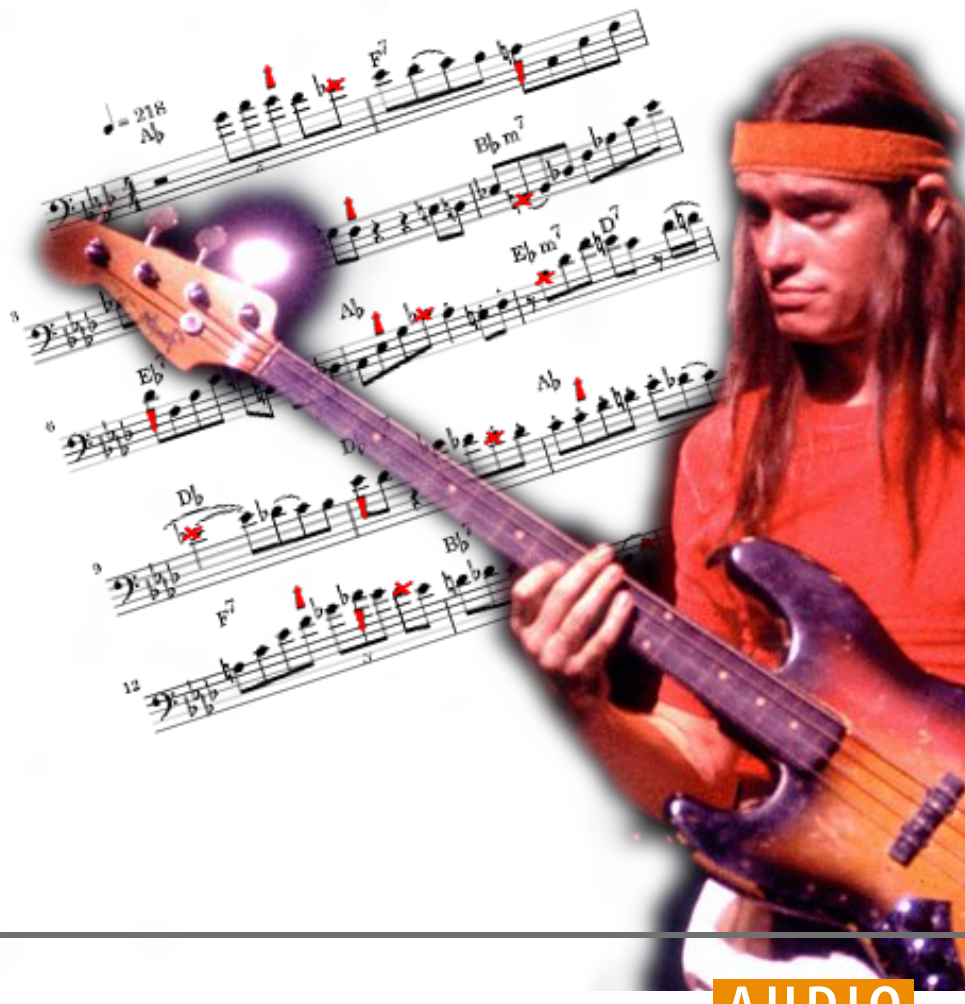

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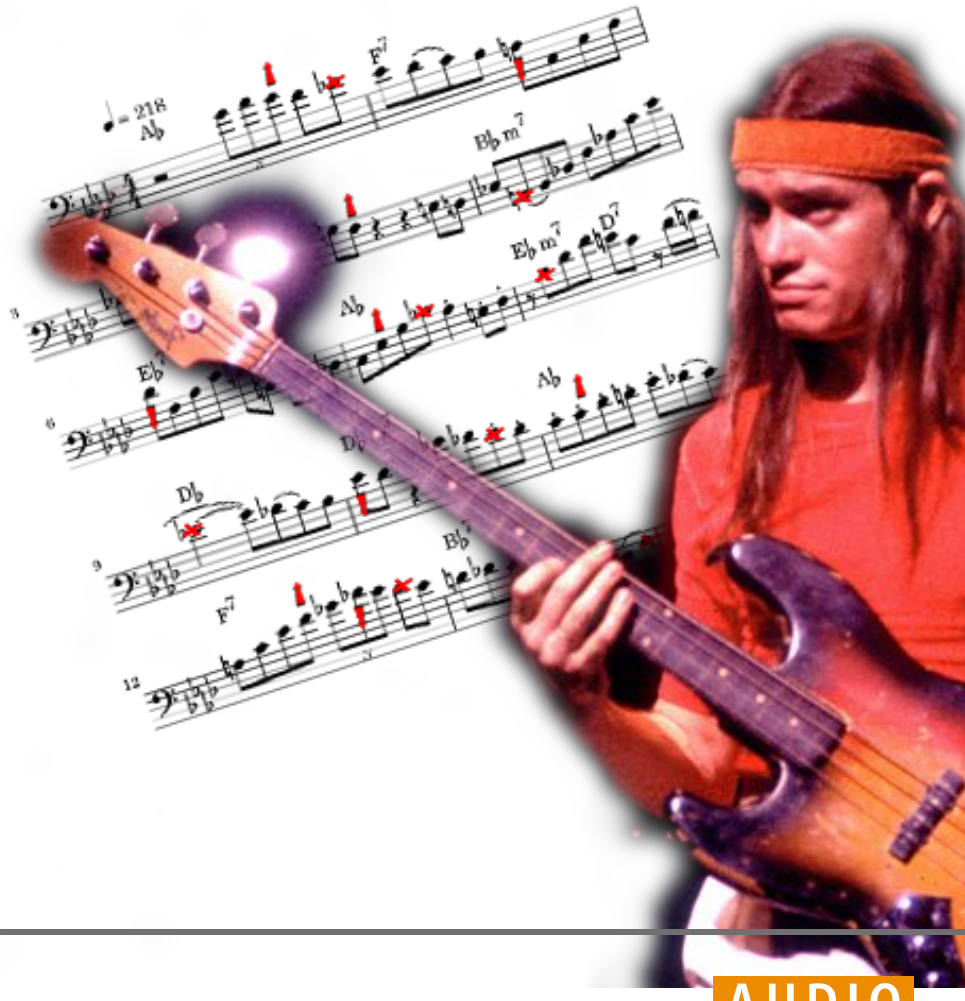
- Musical style modification
- Applications



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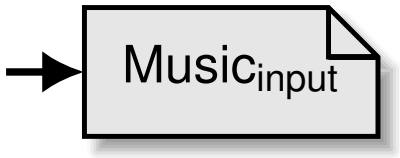

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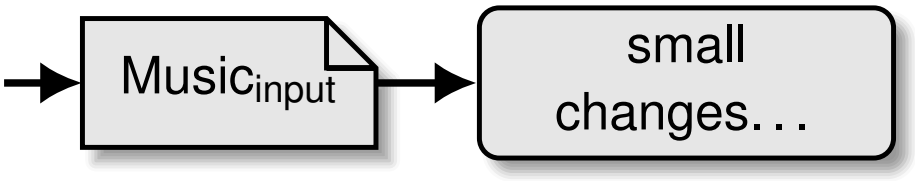

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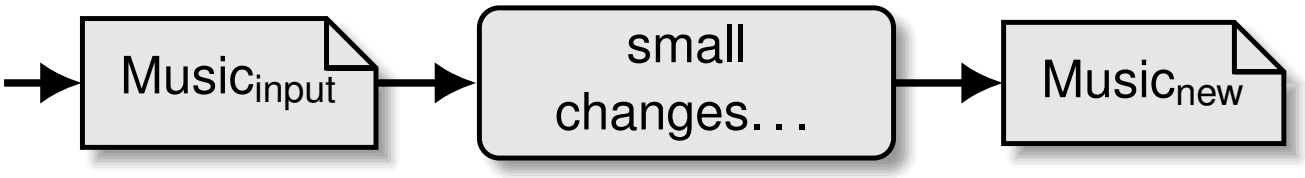

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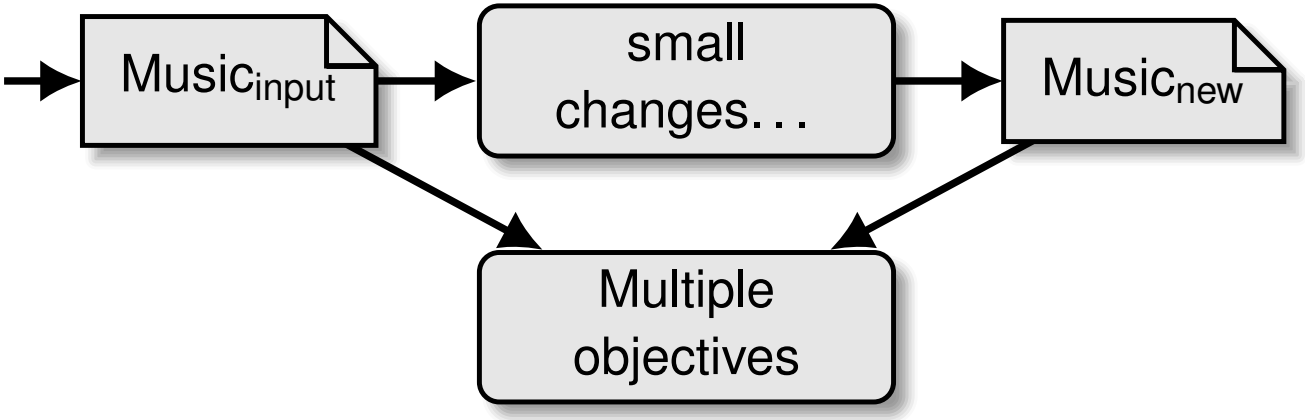

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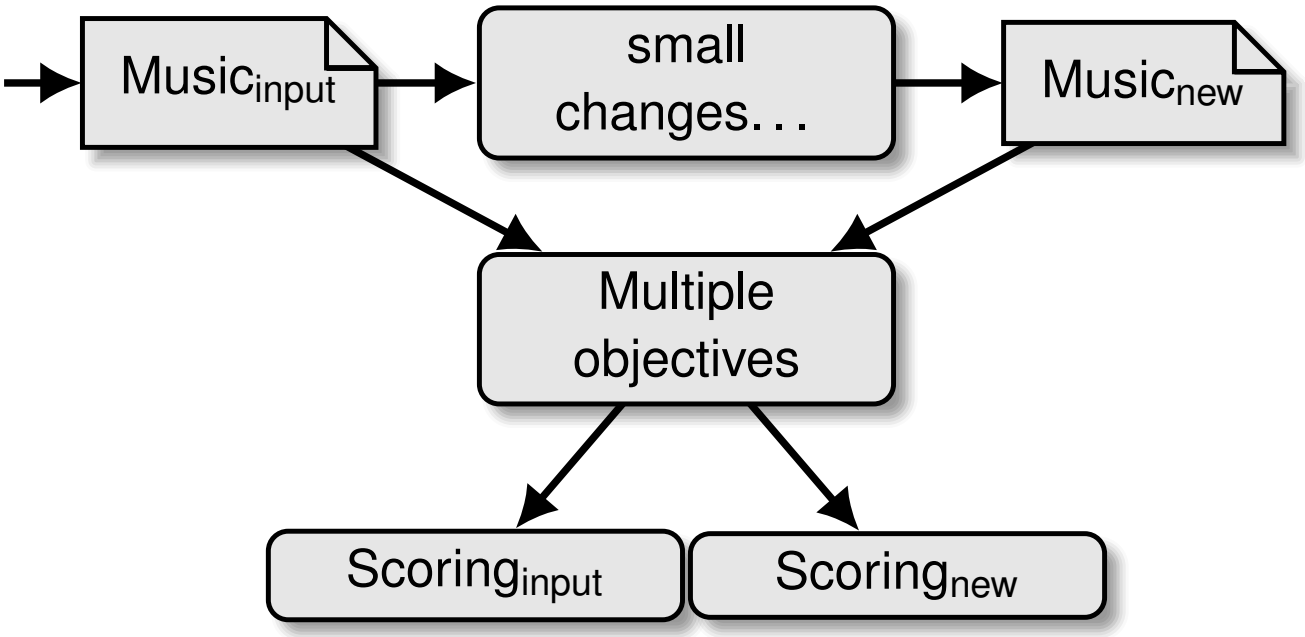

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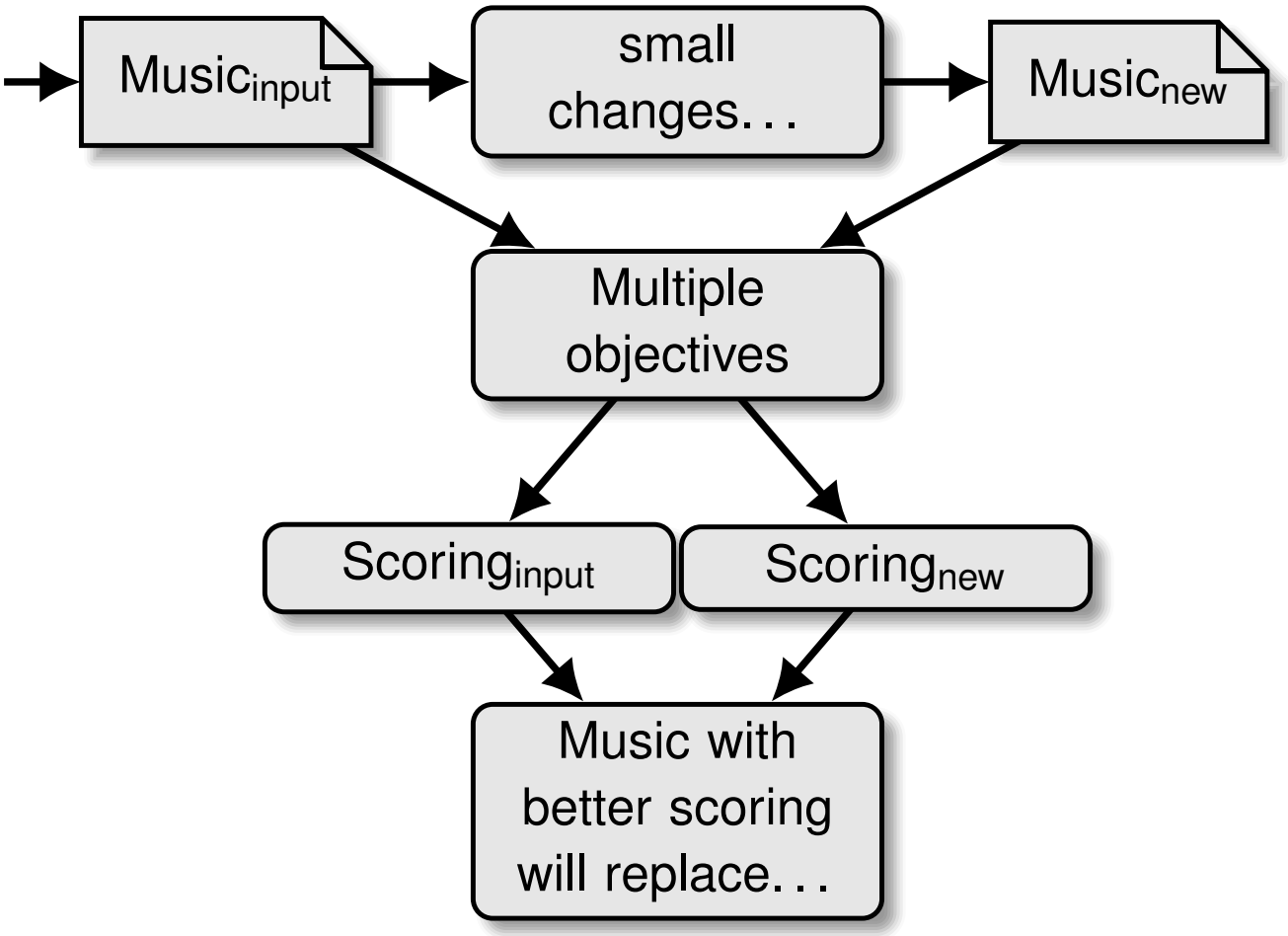

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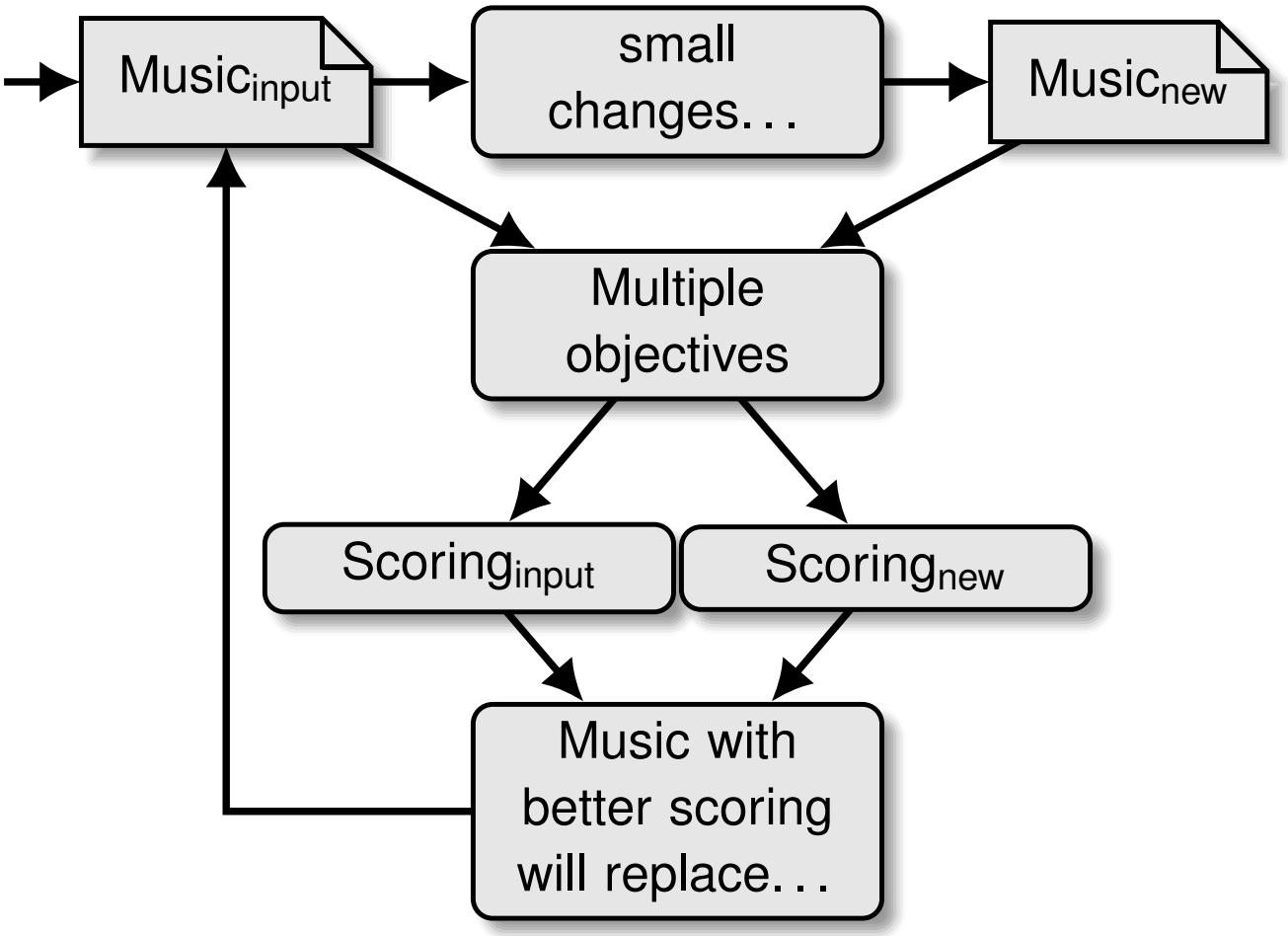

Content

Data corpus

Pieces

Jaco Pastorius [Malone, 2002]	Victor Wooten [Wooten, 2003]

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J. Pastorius: *Havona*	R. Noble: *Cherokee (Indian Love Song)*
W. Shorter: *Port Of Entry*	V. Wooten: *Classical Thumb*
J. Pastorius: *Punk Jazz*	J. Lennon and P. McCartney: *Norwegian Wood (This Bird Has Flown)*
J. Pastorius: *Slang*	V. Wooten: *Sex in a Pan*
H. Mancini: *The Days of Wine and Roses*	B. Fleck: *Sinister Minister*
J. Pastorius: *(Used To Be A) Cha Cha*	V. Wooten and B. Fleck: *Stomping Grounds*

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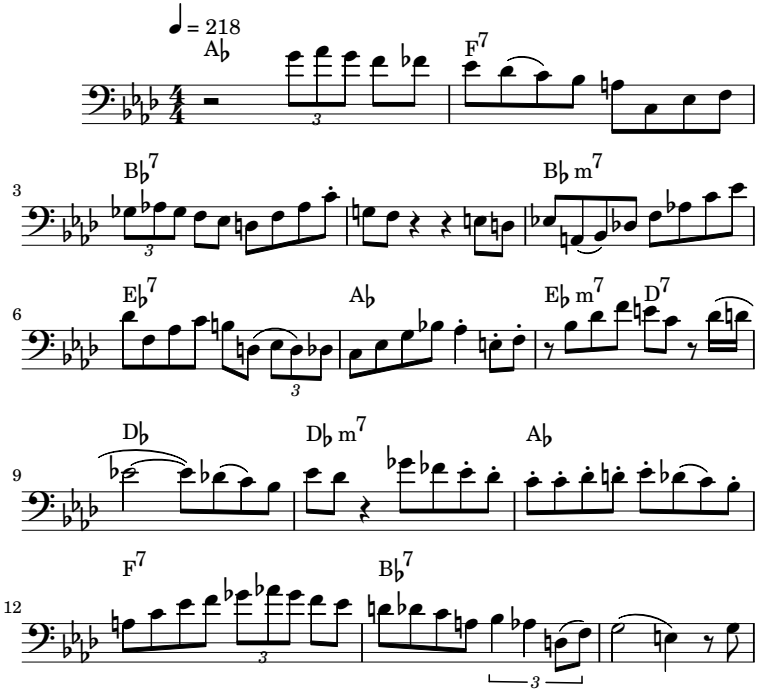
2227.5 quarter length total	3642.75 quarter length total

Data corpus

Pieces – Examples

Jaco Pastorius [Malone, 2002]	Victor Wooten [Wooten, 2003]

Donna Lee



Audio from J. Pastorius: *Jaco Pastorius*, Epic 1976.

Data corpus

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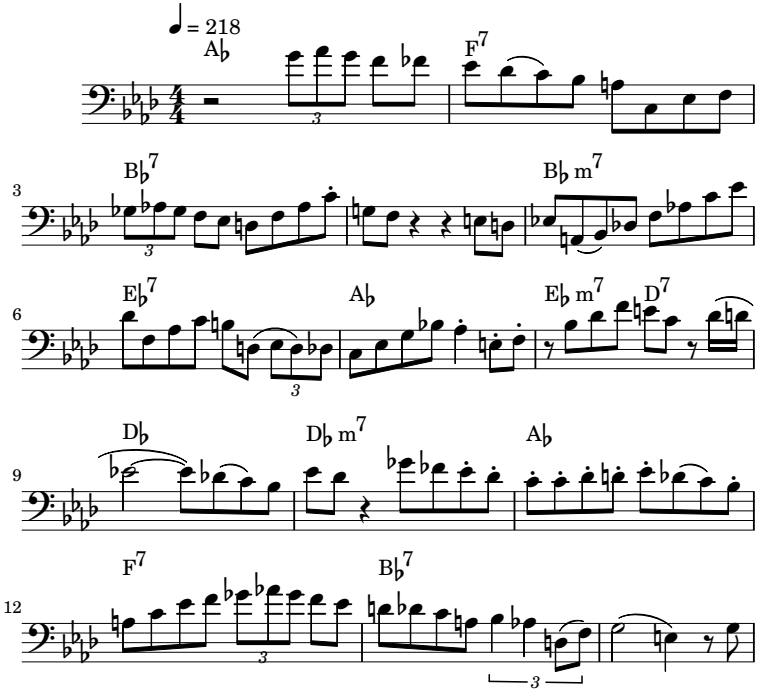

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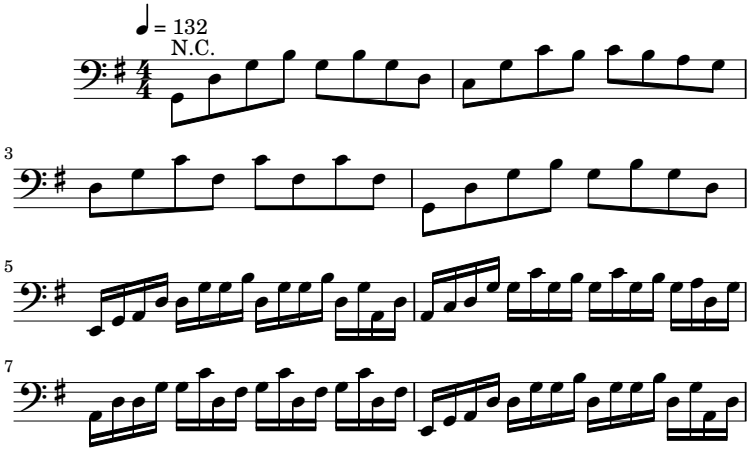
Classical Thumb



Audio from V. Wooten: *A Show of Hands*, Compass 1996.

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Local search within neighborhood

Note events: $N = (n_1, n_2, \ldots, n_I)$ where $n_i = (p_i, d_i)$

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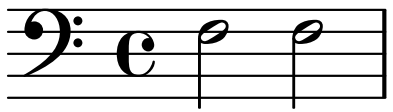

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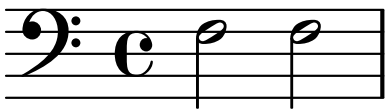

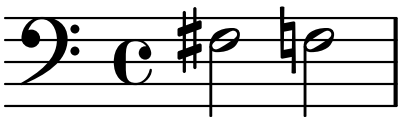

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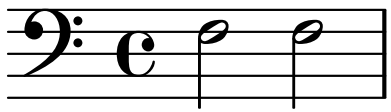
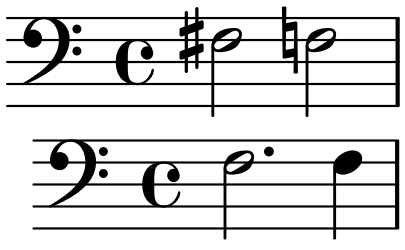


- Changing the pitch p_i
- Changing the duration of two notes d_{i_1} and d_{i_2}



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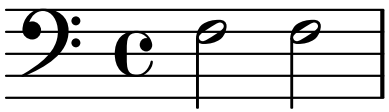
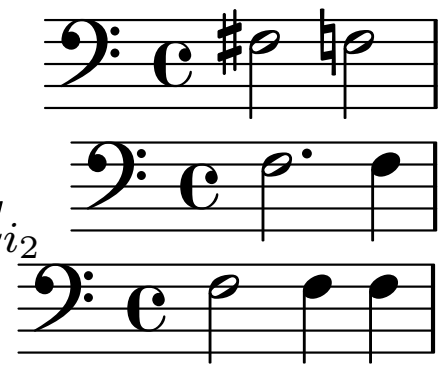


- Changing the pitch p_i
- Changing the duration of two notes d_{i_1} and d_{i_2}
- Dividing n_i into multiple notes



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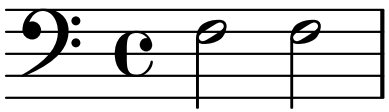
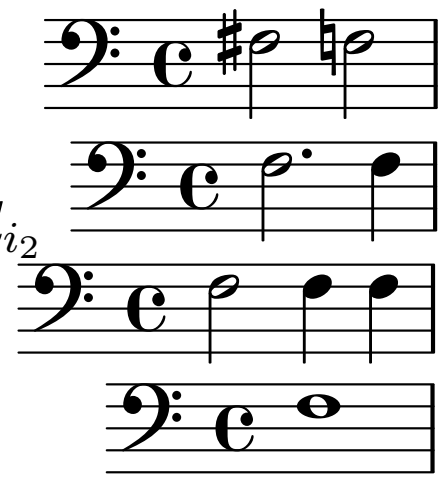


- Changing the pitch p_i
- Changing the duration of two notes d_{i_1} and d_{i_2}
- Dividing n_i into multiple notes
- Joining n_i and n_{i+1} into single note



Content

Objective functions
Feature classification

- Windowing (overlapping segments of 2–12 quarter lengths)

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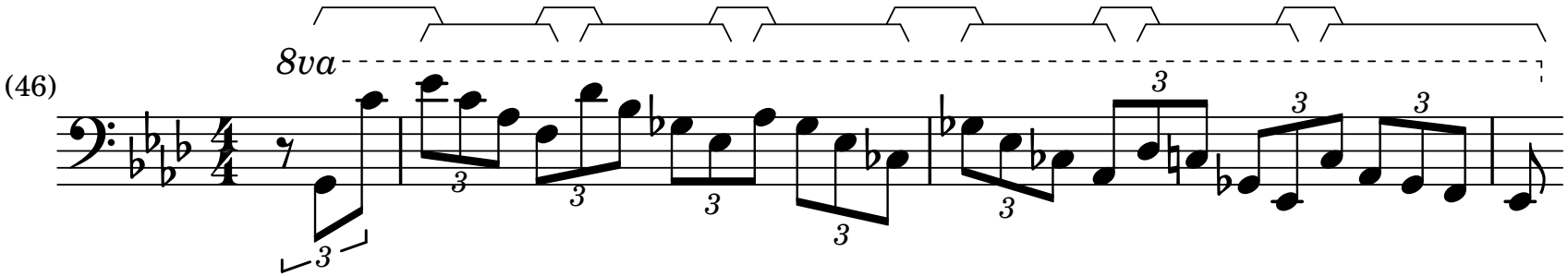
- 324 of music21's feature extractors [Cuthbert et al., 2011] as well as 86 customly designed ones
- Gradient Tree Boosting [Hastie et al., 2009], outputting probability

Objective functions

Feature classification

Example of customly designed features:



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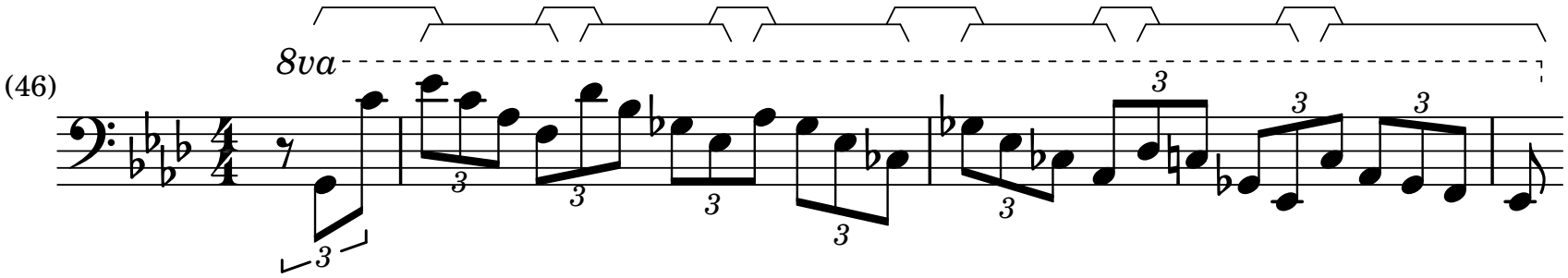

$$f_{\mathrm{Jaco}} = \frac{f_{\mathrm{Len}}}{b} \bmod 1 \text{ where } \frac{a}{b} = f_{\mathrm{Dur}},$$
$$\gcd(a, b) = 1$$

Objective functions

Feature classification

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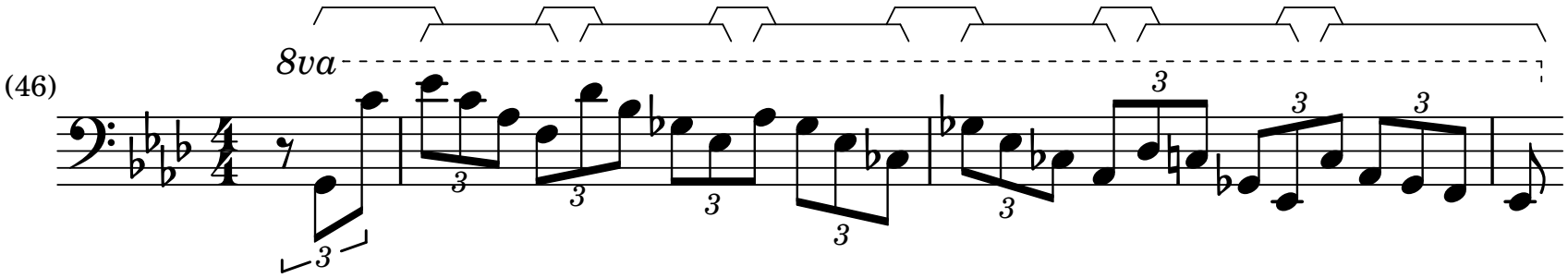

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$$\gcd(a, b) = 1$$

$f_{\mathrm{Len}} = 4$ and $f_{\mathrm{Dur}} = 1/3$, so $f_{\mathrm{Jaco}} = 4/3 \bmod 1 = 1/3$

Objective functions

Markov probability

- Separate Markov chains for durations and pitches

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- Separate Markov chains per chord symbol type

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Ratio of example/counter-example Markov probability

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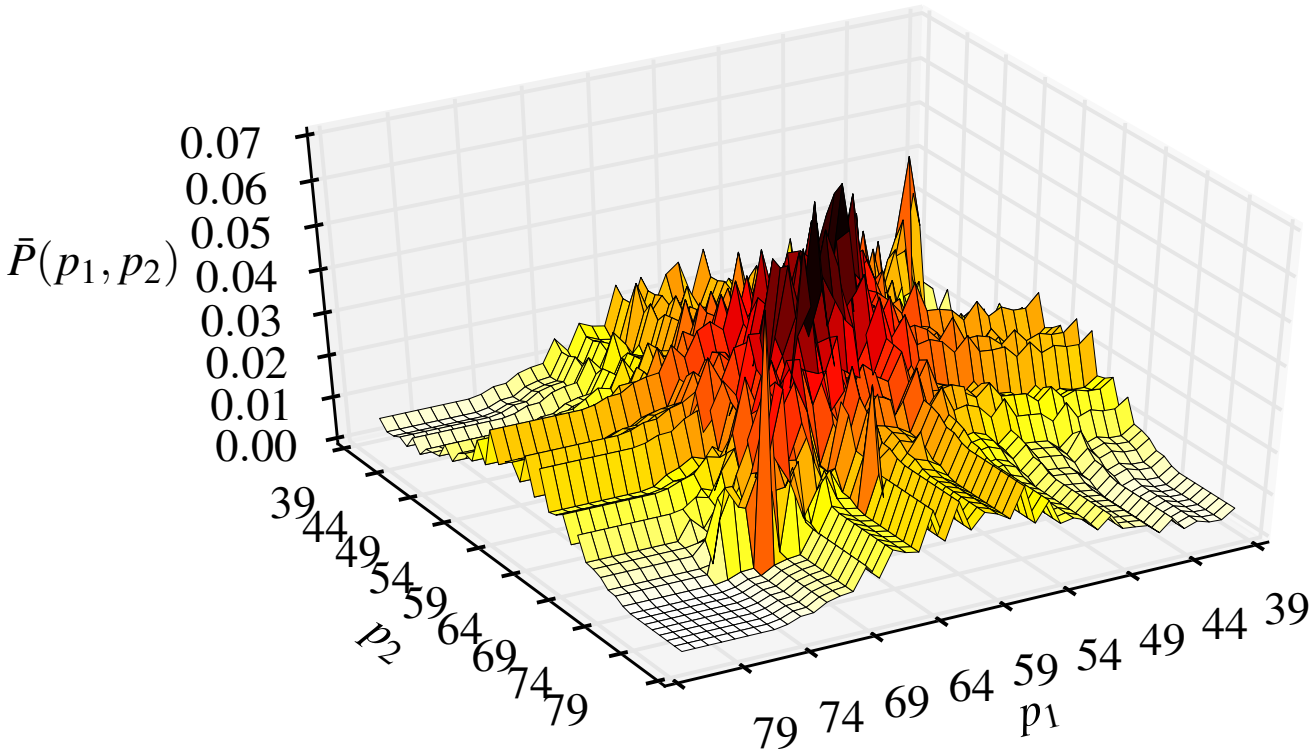

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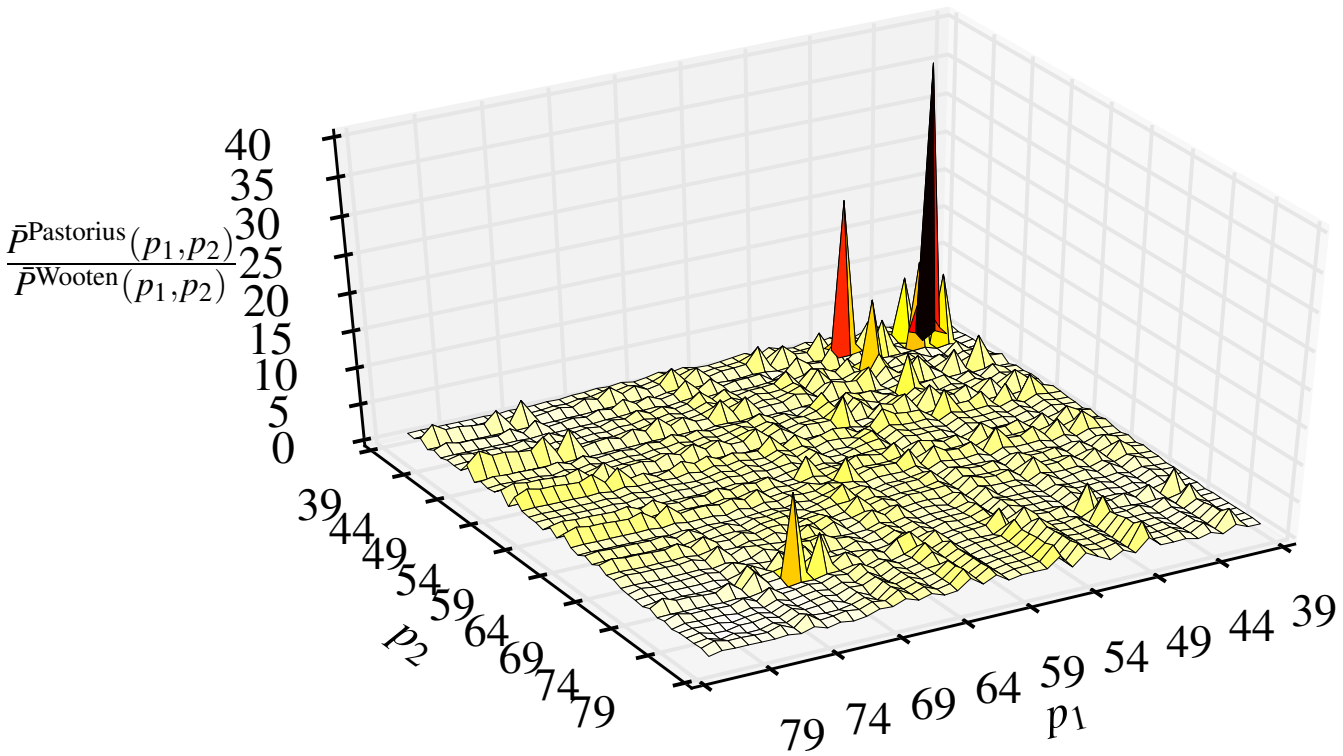
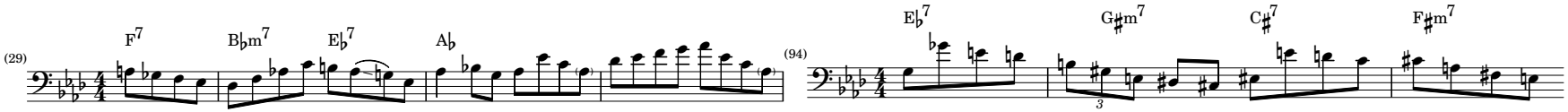


Objective functions

Time correlations for chord-repetitions



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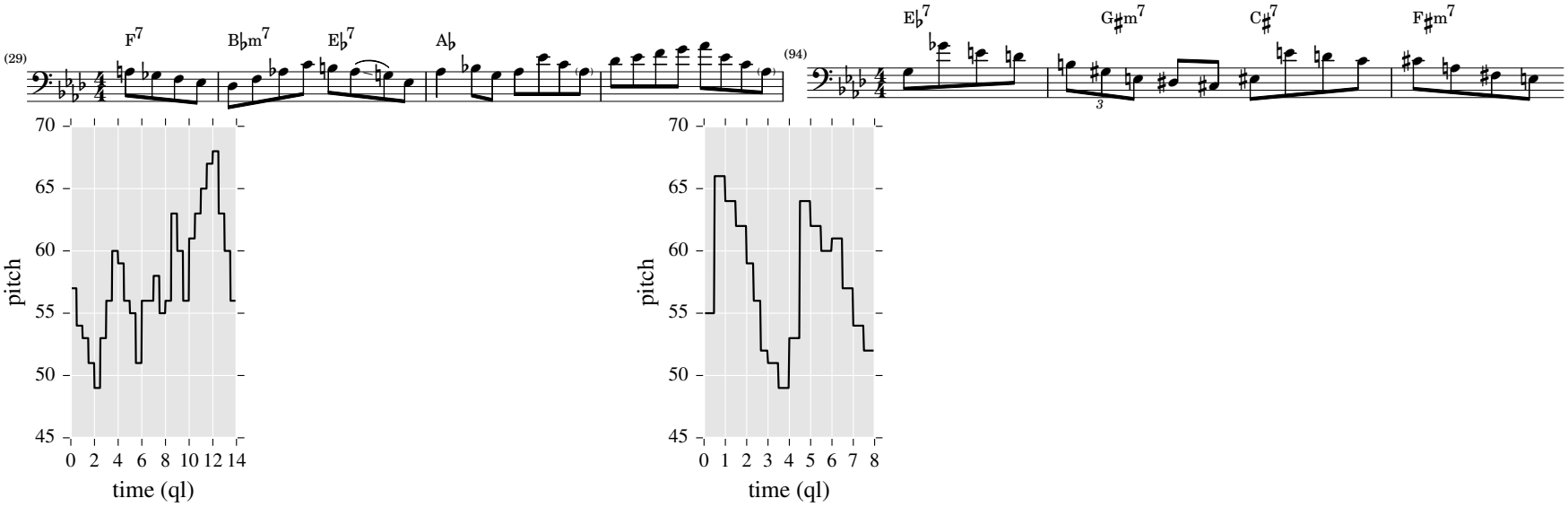

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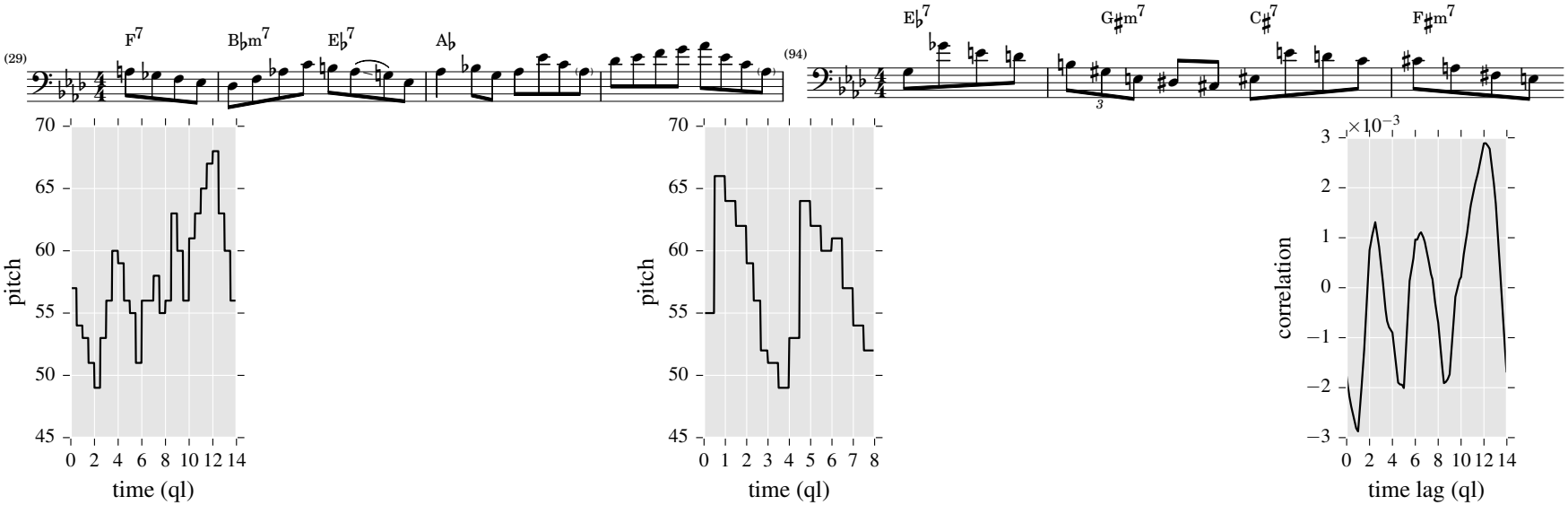

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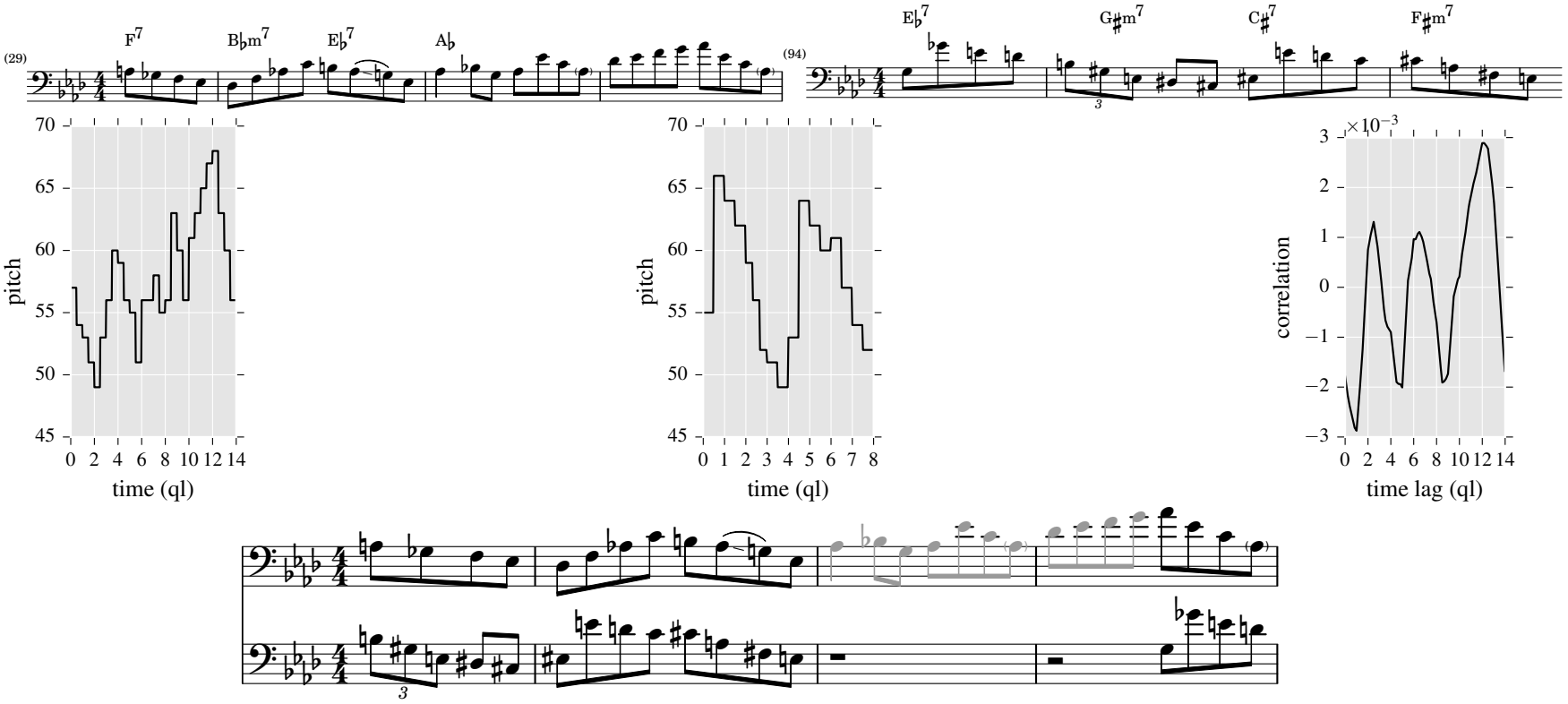

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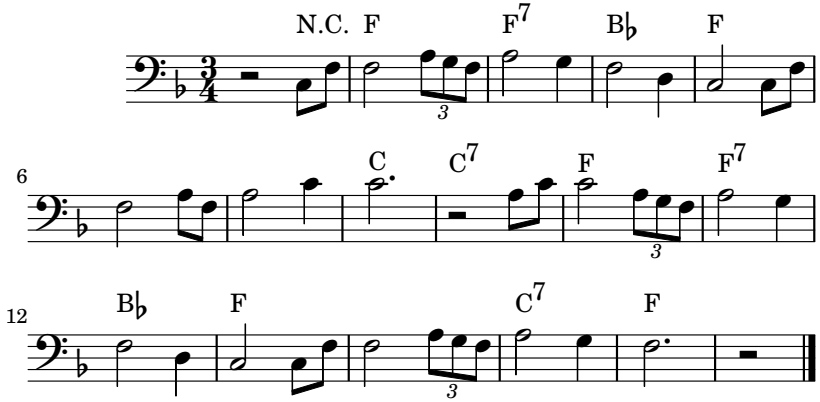
Results

Problem of evaluation

Results

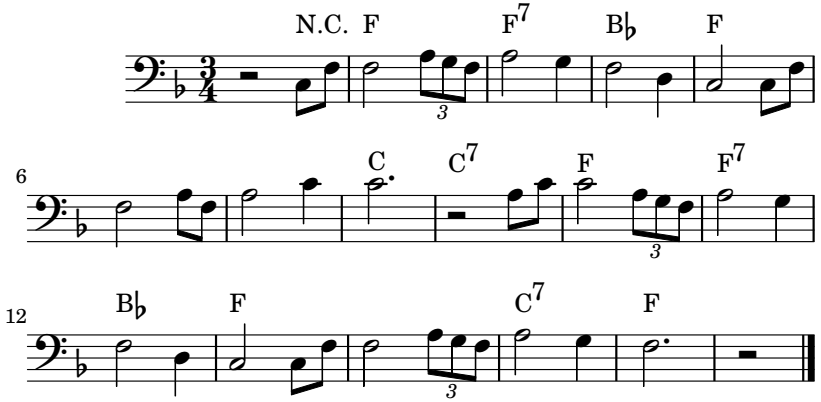
Example

Original



iteration 0

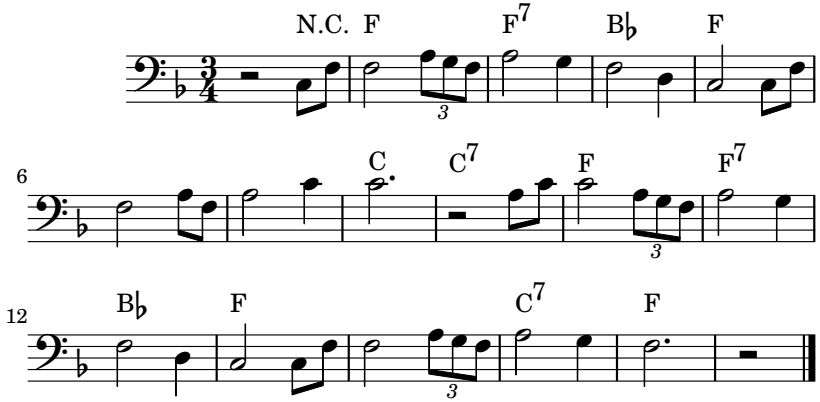
(0 accepted changes, target style Pastorius)



Results

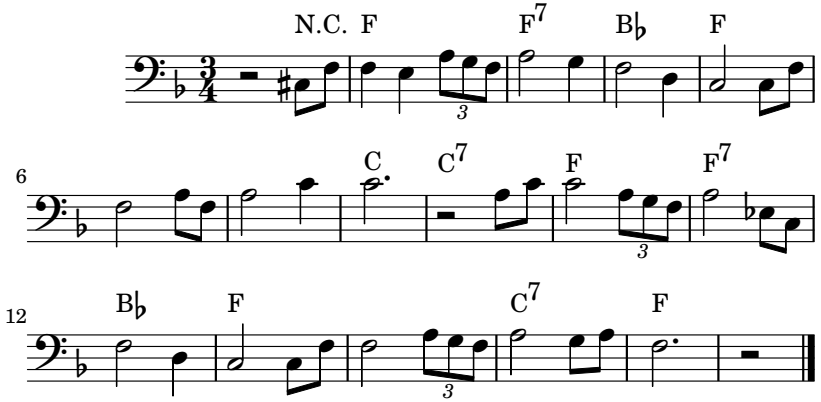
Example

Original



iteration 140

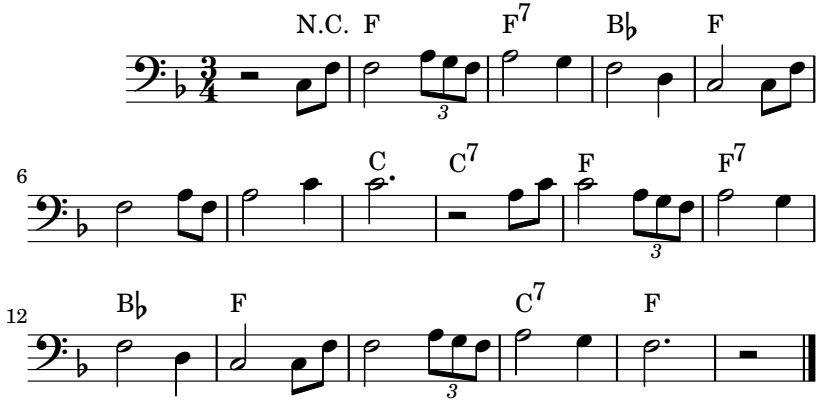
(5 accepted changes, target style Pastorius)



Results

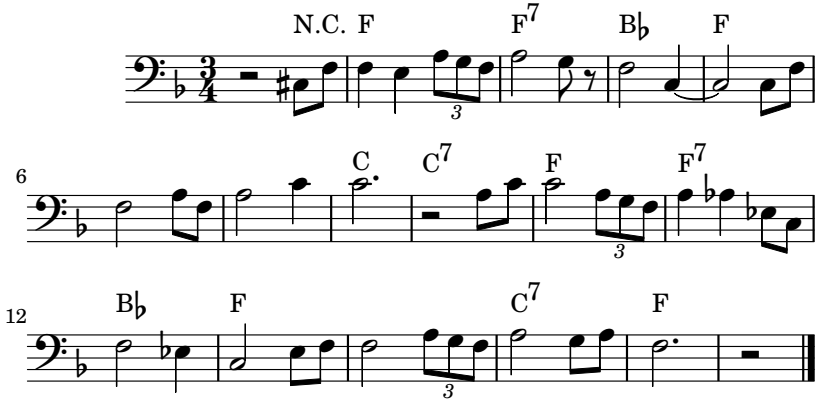
Example

Original



iteration 644

(10 accepted changes, target style Pastorius)



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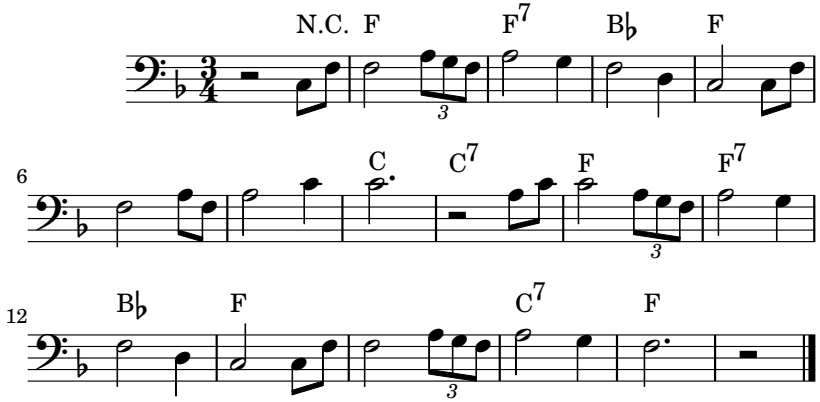
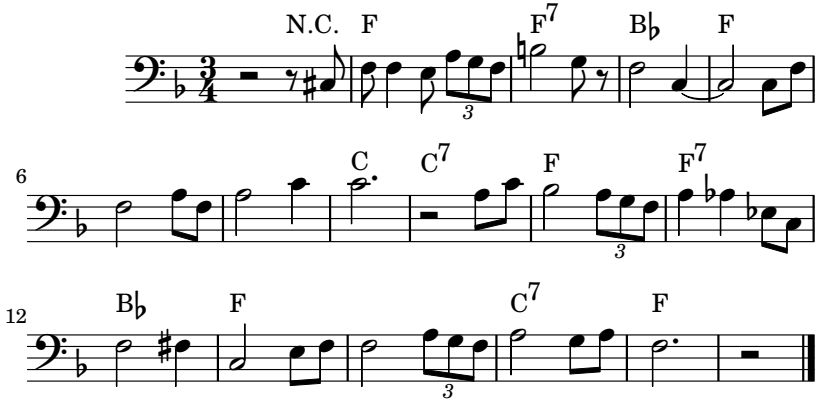


iteration 2058

(14 accepted changes, target style Pastorius)



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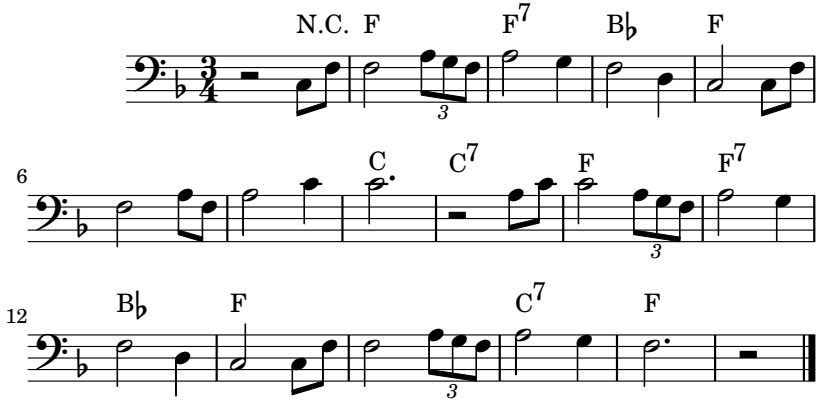
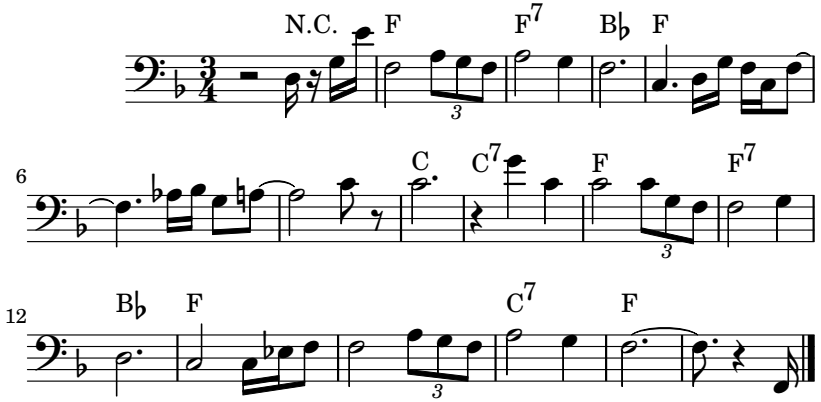


iteration 1776

(24 accepted changes, target style Wooten)



Results
Recap

- Method for musical style modification

Results
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- Method for musical style modification
- Local optimization is great for this task

Results
Recap

- Method for musical style modification
- Local optimization is great for this task
- Hard to evaluate

References

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