

Computational Modeling of Musical Expression

Perspectives, Datasets, Analysis and Generation

Outline

- Perspectives
- Analysis
 - Hands-on Part I
- Generation
 - Hands-on Part II
- Conclusions

Part I

Perspectives

COMPOSER  **PERFORMER**  **LISTENER**

COMPOSER  **PERFORMER**  **LISTENER**

expression?

► What is Musical Expression?

“Expressiveness:

1. refers to the effect of auditory parameters of music performance (loudness, intensity, phrasing, tempo, frequency spectrum, etc.) – covering acoustic, psychoacoustic, and/or musical factors
2. refers to the variation of auditory parameters away from a prototypical performance, but within stylistic constraints (e.g. too much variation is unacceptable, and does not fall within the gamut of expressiveness)
3. is used in the intransitive sense of the verb (no emotion or mood or feeling is necessarily being expressed; rather the music performance sounds “expressive” to differing degrees).”

–Fabian et al. [2014]

“In this tutorial we focus on **how** musical expression is transmitted
and *not* on **what** is being transmitted”

–*Someone really clever?*

Performers “manipulate the sound properties, including frequency (**pitch**), **time**, **amplitude**, and **timbre** (harmonic spectrum) above and beyond the pitch and duration categories that are determined by composers.”

These manipulations define the term “musical expression” which is partially achieved by altering the variables for stress, rhythm, accent, and intensity contour.

–Palmer and Hutchins [2006]

While a significant part of the performer's aim is to communicate the composer's intentions, nevertheless, **performers** bring their **personal, cultural, and historical viewpoints** to the fore when subjectively understanding expression.

-Fabian [2014]

Uncertainty remains with respect to whether "the expressive deviations measured are due to deliberate expressive strategies, music structure, motor noise, imprecision of the performer, or even measurement errors."

Langner and [2003]

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“the expressive deviations measured are due to
deliberate **expressive strategies**, music **structure**,
motor **noise**, **imprecision** of the performer, or even
measurement **errors**.”

—Langner and Goebel [2003]

- ▶ Can you hear musical expression?

- ▶ Can you hear musical expression?

Recording of a mechanical (deadpan) performance

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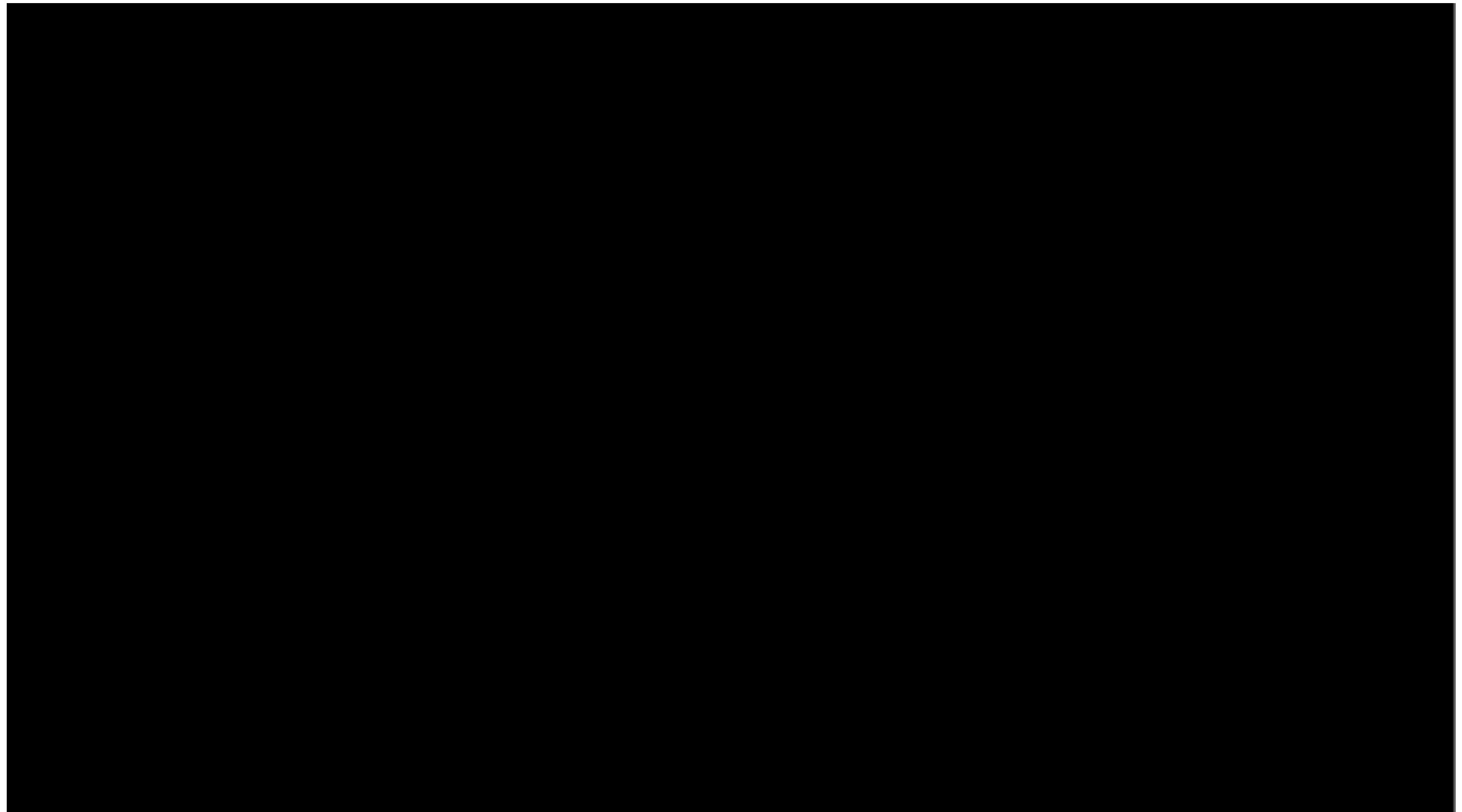
Recording of a mechanical (deadpan) performance

Video performance

- ▶ Can you hear musical expression?

Recording of a mechanical (deadpan) performance

Video performance



Different interpretations of the same piece

Different interpretations of the same piece



- ▶ Do people care about musical expression?

► Do people care about musical expression?



Michael Lee. 4 years ago

The problem with this recording is clear enough: Its not Mozart! This is not what he wrote. Interpretation has boundaries and Gould has consciously transgressed them.



5



REPLY

Hide replies ^



organman52 1 year ago

He was a twisted psychopath - and his followers are the same.

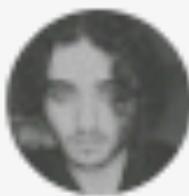


2



REPLY

► Do people care about musical expression?



Ufuk Sarp Selçok 4 years ago

I really don't understand how people can find this interpretation bad. This is the only one that I liked. Without Gould's interpretation, I wouldn't even like this piece. I think you guys should loosen up a bit.

32 REPLY

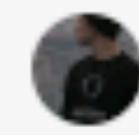
[▲ Hide replies](#)



organman52 1 year ago

How utterly PATHETIC.

1 REPLY



Tornik 1 year ago (edited)

"How utterly PATHETIC."

With a personal insult to a person you don't even know, about their opinion on a piece of music, you are the only one looking pathetic here.

10 REPLY

► Do people care about musical expression?



You're 100% right 1 year ago (edited)

Gould had a lot of respect for Mozart. His main criticisms were reserved for the later works by Mozart.

Again, a player's opinion of a composer has no bearing on his/her performance. You guys are just being biased as fuck and can't appreciate this light humorous playing by Gould. Only the best can match this attention to detail

[Read more](#)



2



[REPLY](#)



organman52 1 year ago

All rational people know EXACTLY what GHOUL is doing. And trust me - this is not the piece Mozart created. It is the DISTORTION this twisted mother fucker decided to torture educated listeners with. AS SICK AS IT GETS.



1



[REPLY](#)



Nerdelbaum Frink 9 months ago

Lol you're mad



1



[REPLY](#)

► Do people care about musical expression?



Asa Yagami 1 year ago

Of all versions, I love this the most

4 REPLY

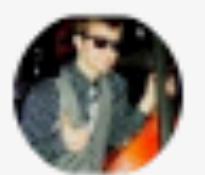


pianopera 4 years ago

Gould's bizarre affectation turns Mozart's music into a brilliant travesty.

18 REPLY

View 2 replies



Jeff Little 6 years ago

No, man...you guys don't get it. You're both wrong. I am absolutely CONVINCED that Mozart would have LOVED this. I don't care what ANYONE says.

5 REPLY

► Do people care about musical expression?

trappa skunk 5 months ago

Only Glenn Gould could take a sonata usually played like a school exercise and turn it into a raucous bacchanal! Barenboim's version could literally put you to sleep, Gould's will wake you up!

1 like 2 REPLY

John C. 9 years ago

now this is the right speed!!

1 like REPLY

► Do people care about musical expression?



organman52 3 years ago

There is absolutely no sense of pulse in this hideous 'interpretation.'



5



REPLY

[View reply](#) ▾



Asa Yagami 1 year ago

luv it!!!!!!



3

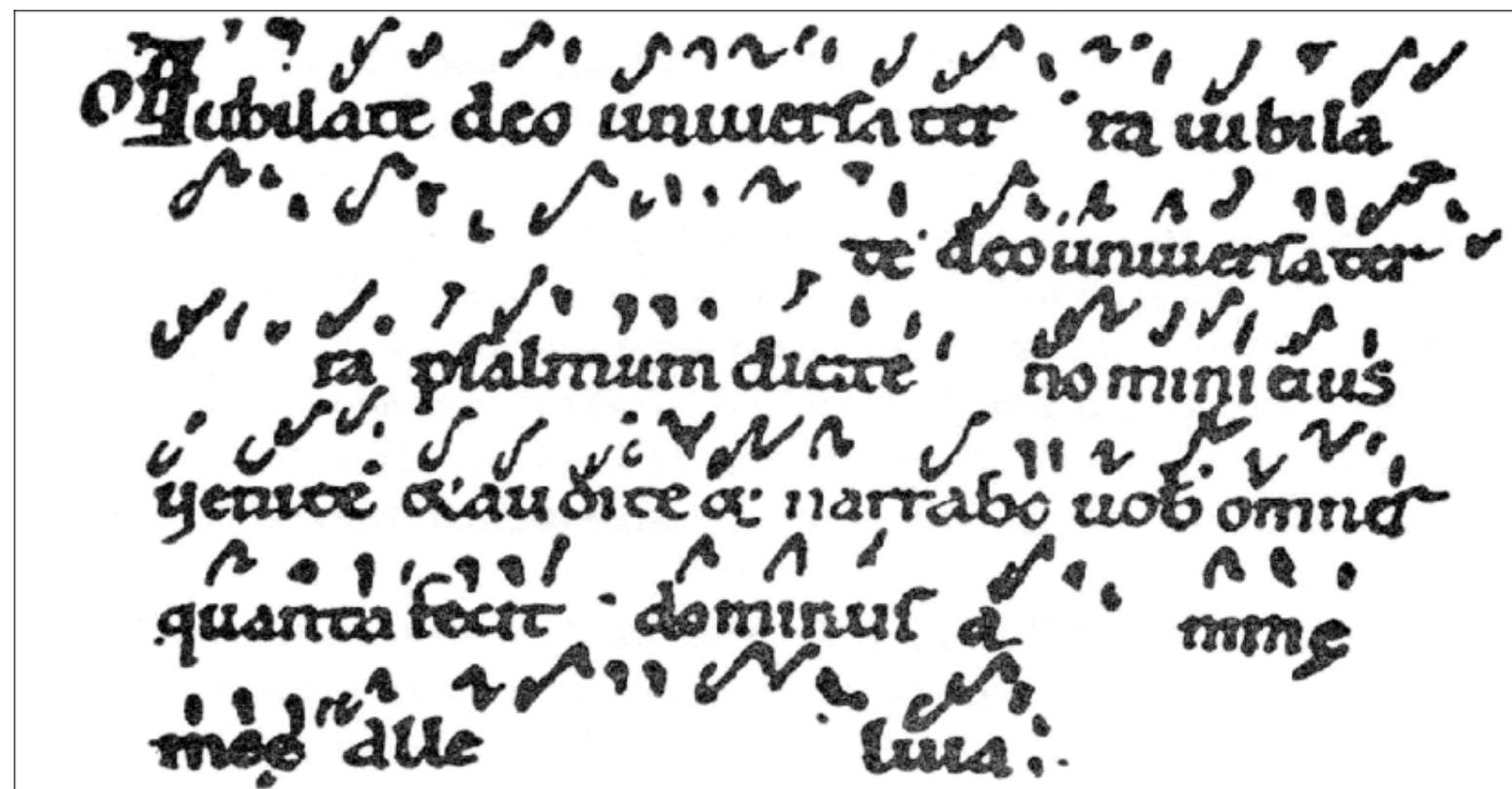


REPLY

- ▶ Do people care about musical expression?

► Communicating expressiveness: score

Neumatic notation (7th to 14th century)



Qui suicit helmoden. qfuit hær. qfuit ihu.
 Qui suicit helgezer. qfuit loty. qfuit mathad.
 Qui suicit lew. qfuit symdon. qfuit ludre.
 Qui suicit loseph. qfuit lonce. qfuit helgeci.
 Qui suicit mela. qfuit memna. qfuit meduia.
 Qui suicit noreham. qfuit dd. qfuit lessé.
 Qui suicit oled. qfuit boos. qfuit salmon.

▶ Communicating expressiveness: score

Specified dynamics for the first time in score (1597)

Sonata pian e forte from the *Sacrae symphoniae*

Giovanni Gabrieli (1554-1612)

-Sadie [1998]



- ▶ Communicating expressiveness: score

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- Symbolic representation of a musical composition



▶ Communicating expressiveness: score

- Symbolic representation of a musical composition
- It does not only contain notes, but also other elements that provide syntactic and semantic context to the music:



▶ Communicating expressiveness: score

- Symbolic representation of a musical composition
- It does not only contain notes, but also other elements that provide syntactic and semantic context to the music:
 - Time signatures: metrical hierarchy



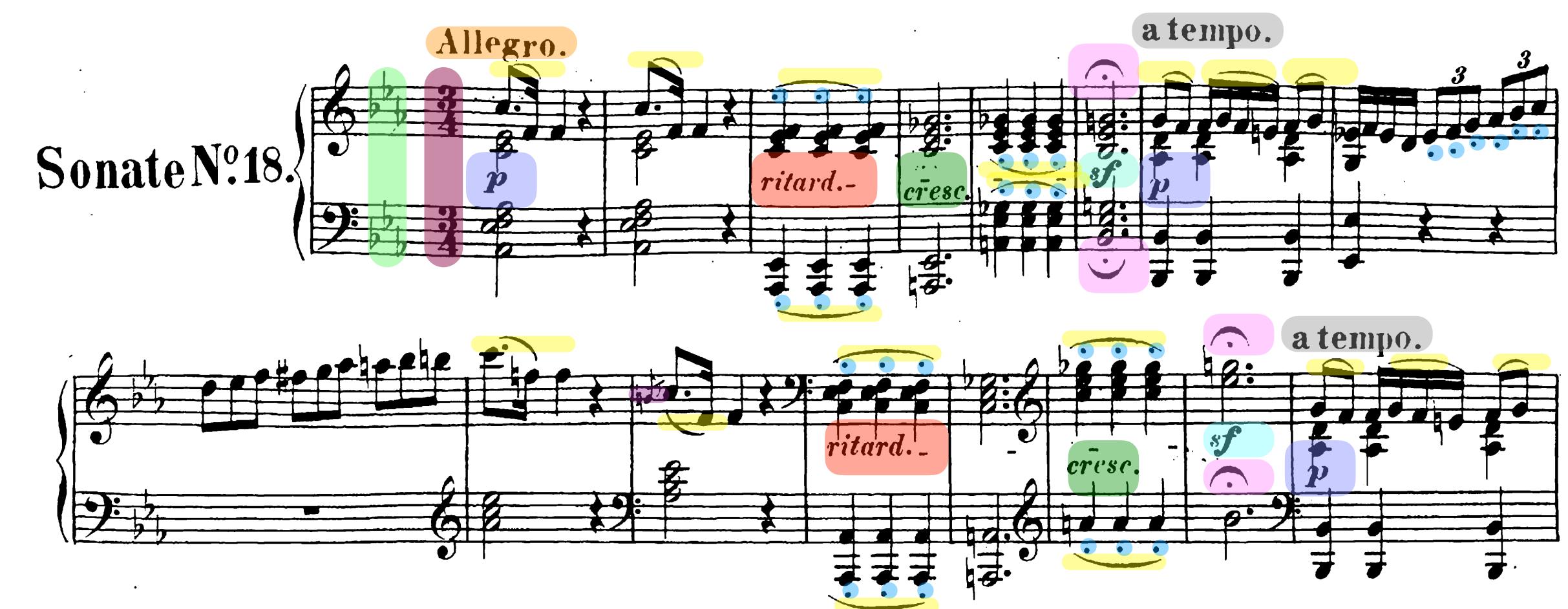
▶ Communicating expressiveness: score

- Symbolic representation of a musical composition
- It does not only contain notes, but also other elements that provide syntactic and semantic context to the music:
 - Time signatures: metrical hierarchy
 - Key signature: tonal hierarchy



▶ Communicating expressiveness: score

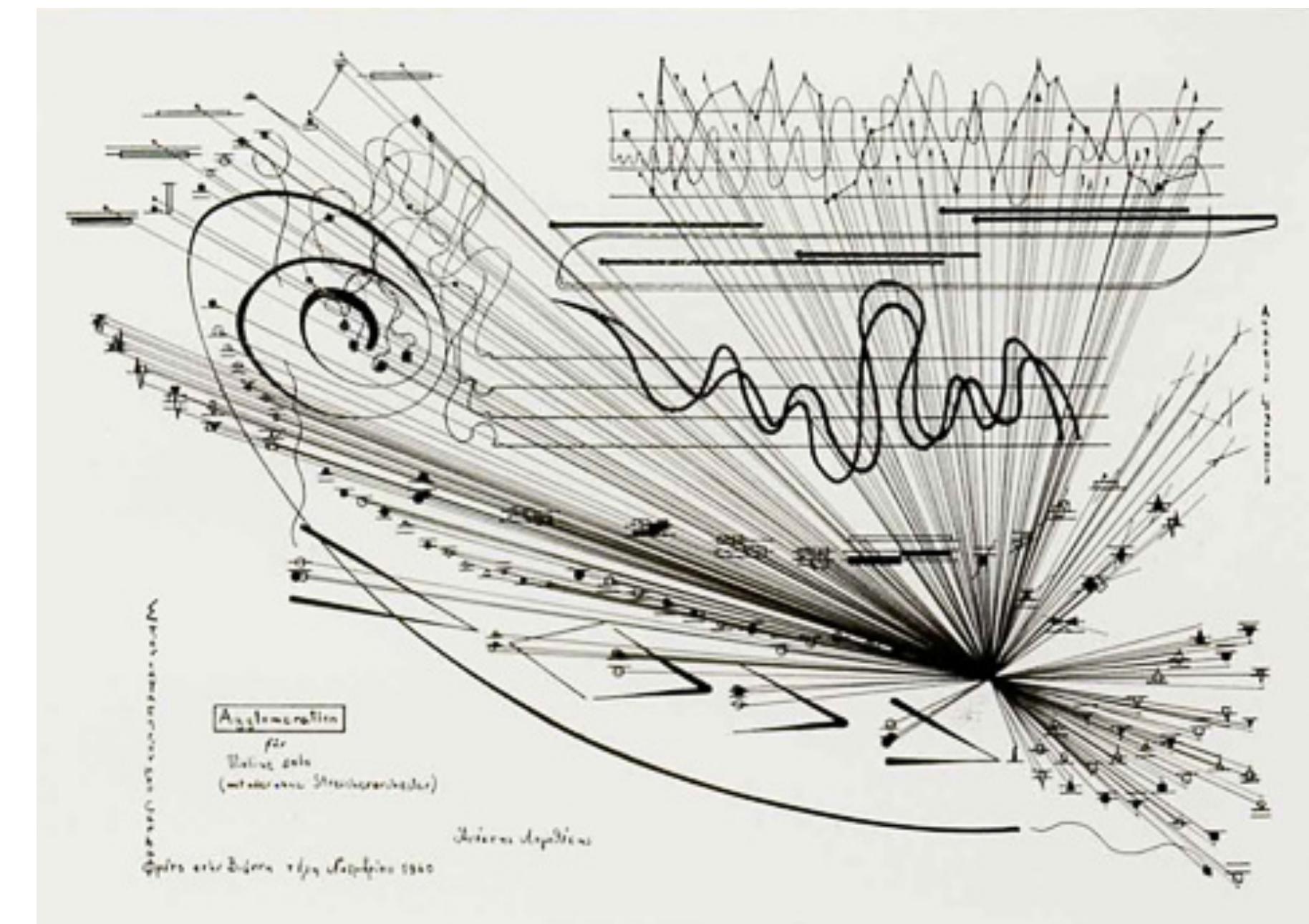
- Symbolic representation of a musical composition
- It does not only contain notes, but also other elements that provide syntactic and semantic context to the music:
 - Time signatures: metrical hierarchy
 - Key signature: tonal hierarchy
 - Dynamics markings, articulation markings...



▶ Communicating expressiveness: score

Logothetis (1921-1994)

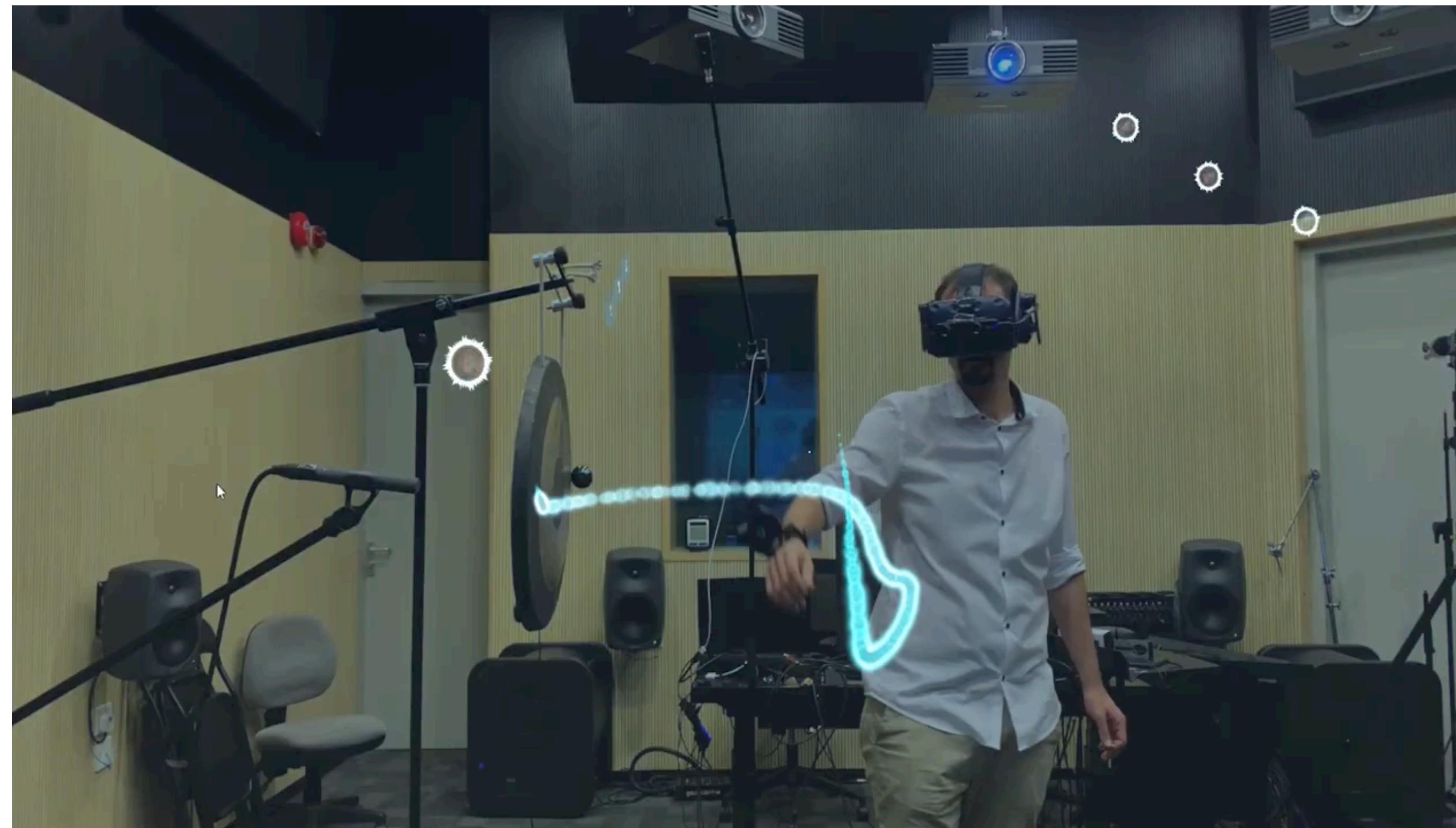
- = quiet-loud and short
- = quiet loud quiet (duration corresponds to the optic)
- ▲ = quiet loud
- = quiet and long
- = loud and short
- = loud quiet loud
- = change of timbre (without pitch assessment)
- ★ = sound rich in overtones
- ~~ = vibrato (fading out)
- ==== = tremolo, flutter-tonguing



- ▶ Communicating expressiveness: score

LINEAR

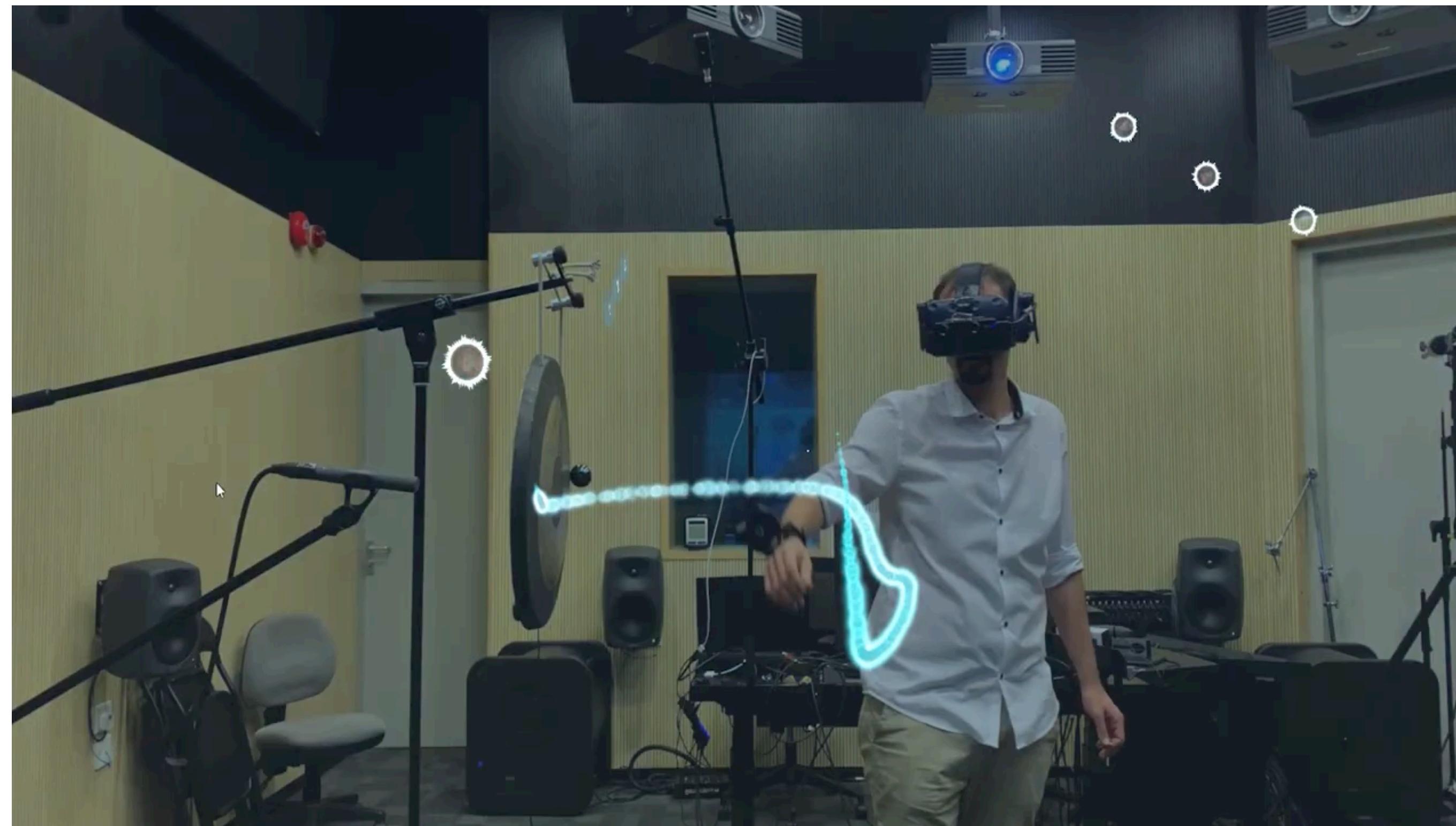
(Live-generated Interface and Notation environment for Augmented reality)

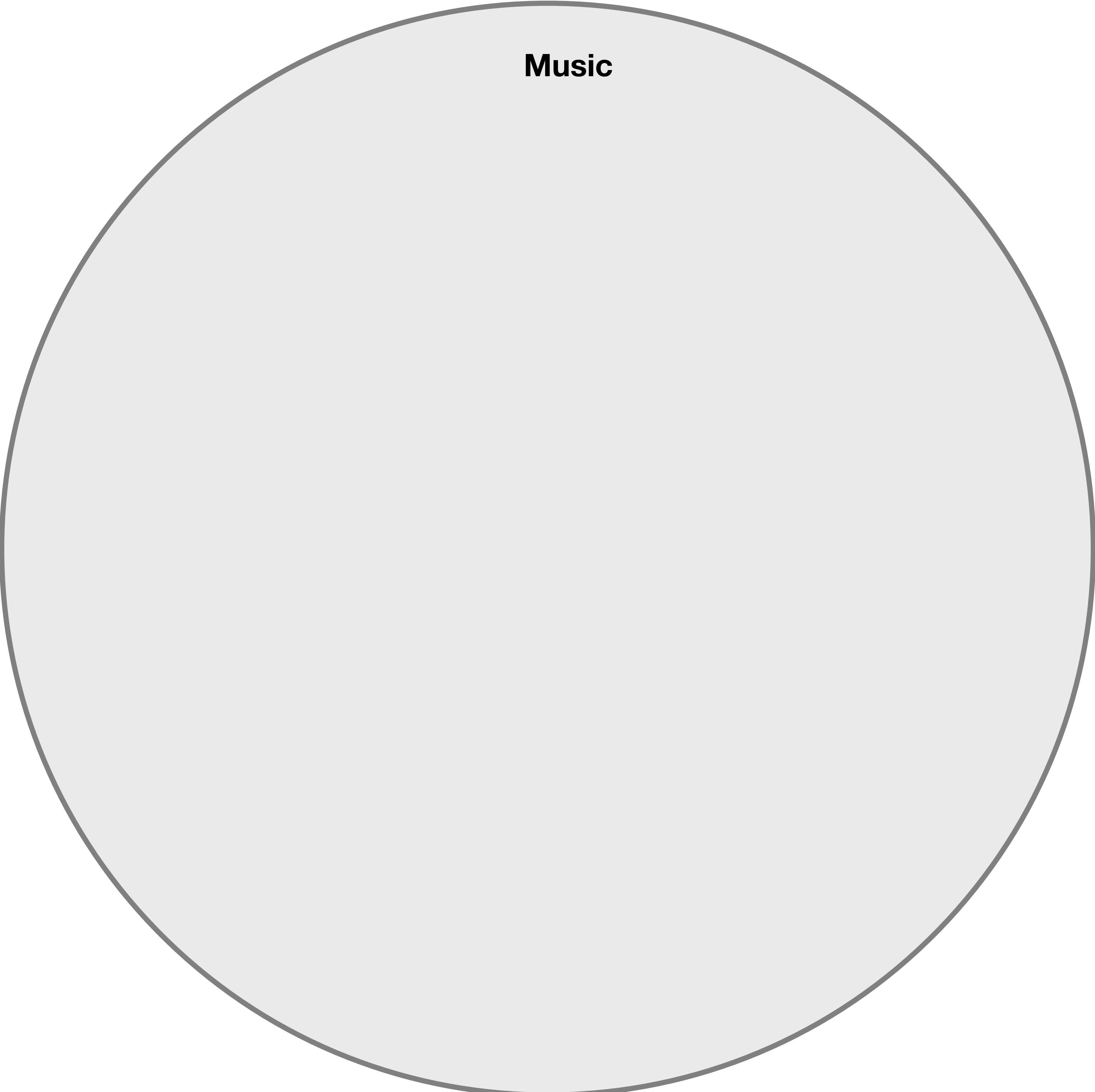


- ▶ Communicating expressiveness: score

LINEAR

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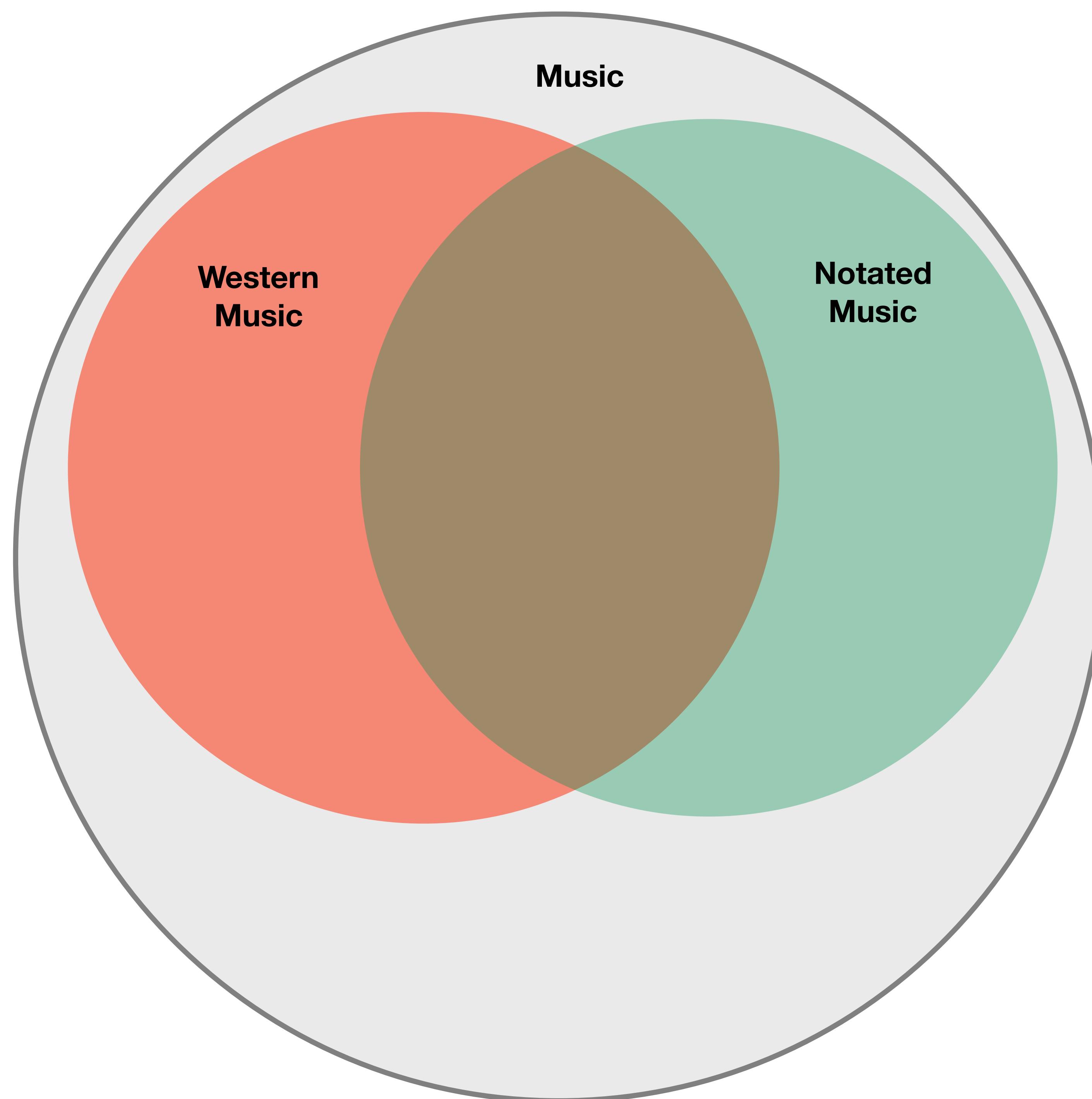


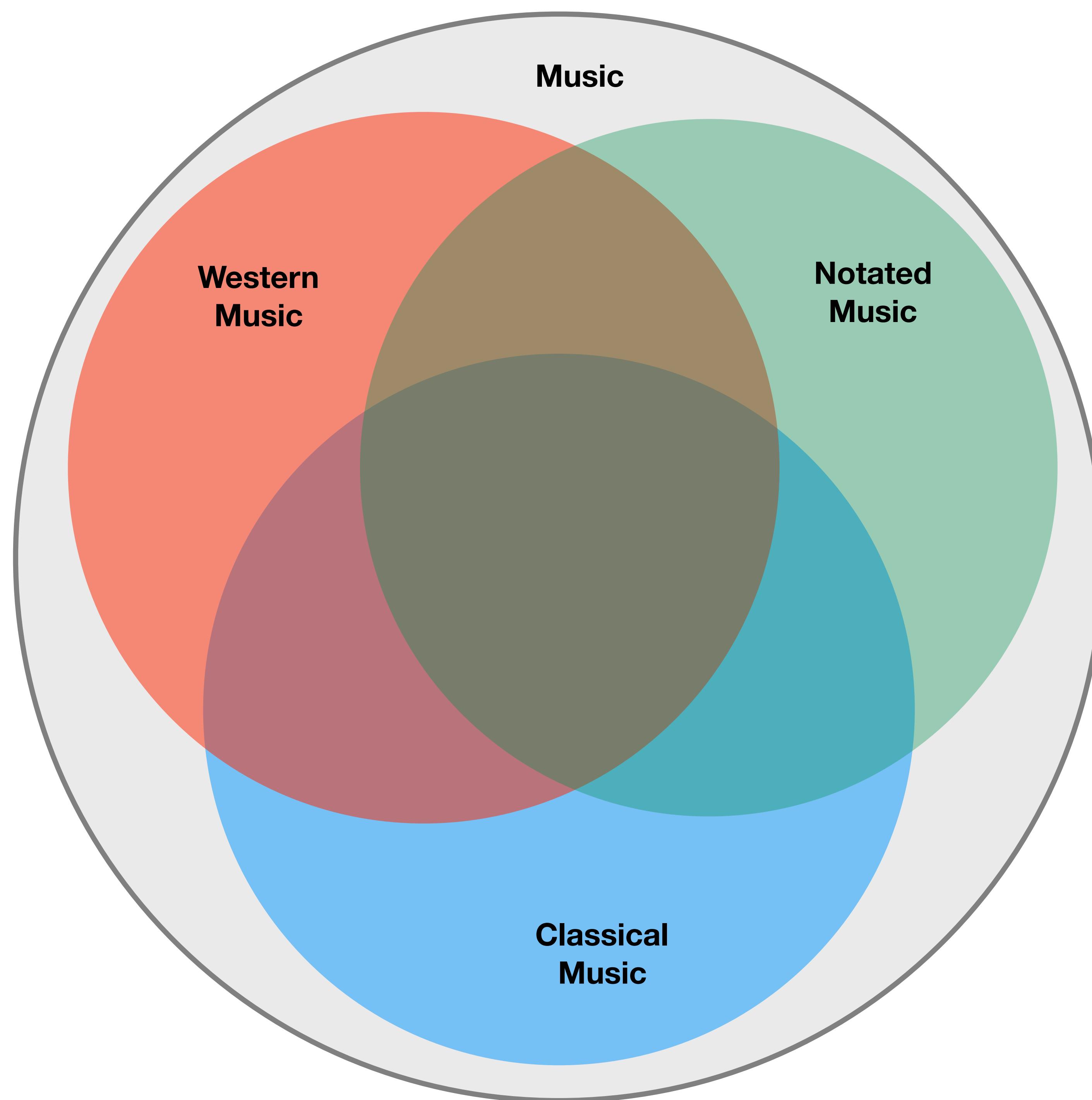


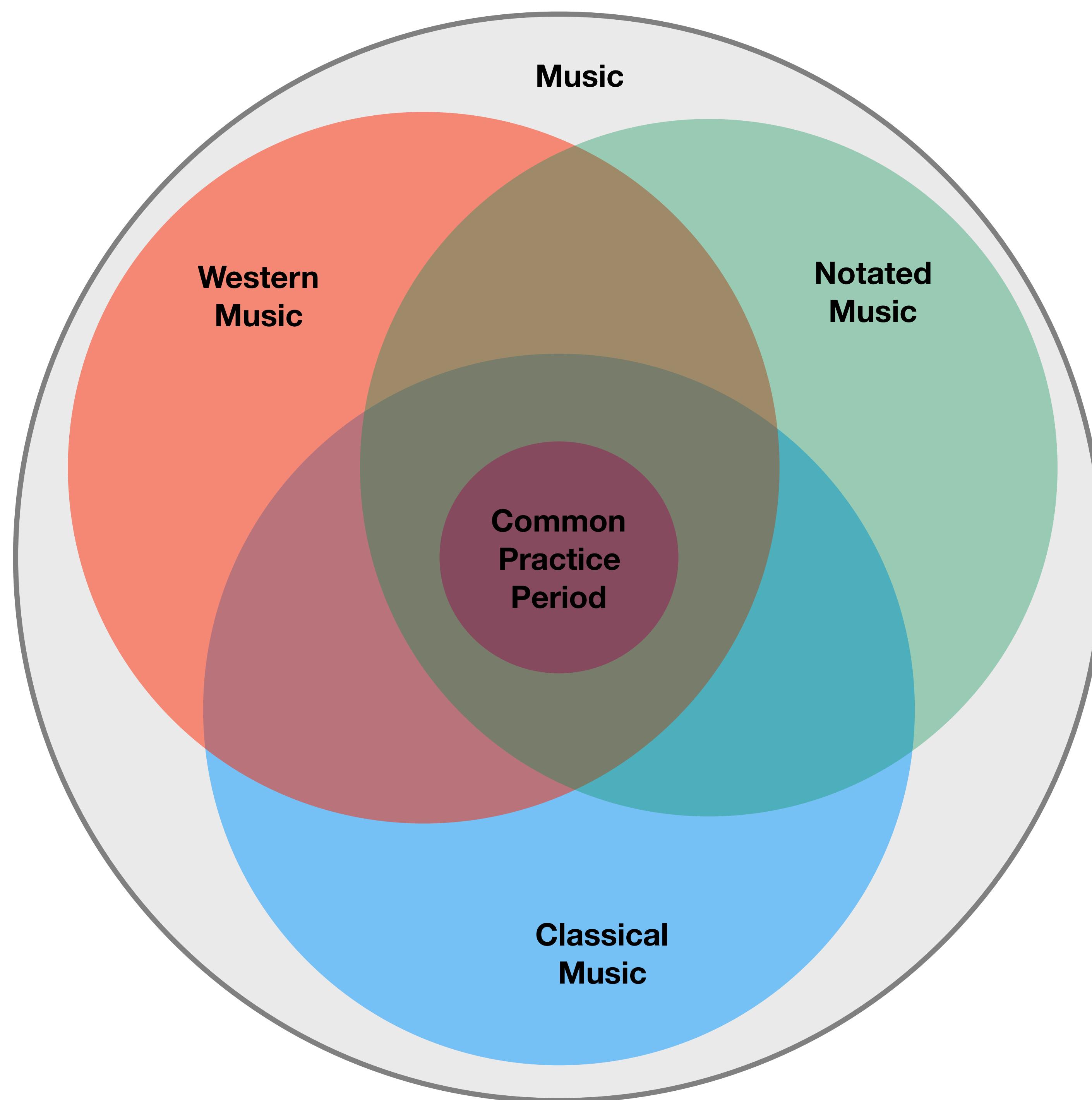
Music

Music

**Western
Music**







► Related communities

- Performance Studies Network ([PSN](#)) - Part of Centre for Musical Performance as Creative Practice ([CMPCP](#))
[[mailing list](#)] [[upcoming conference](#)]
- Technologies for Music Notation and Representation ([TENOR](#))
[[upcoming conference](#)]
- The International Symposium on Performance Science ([ISPS](#))
[[upcoming conference](#)]

Part II

Analysis

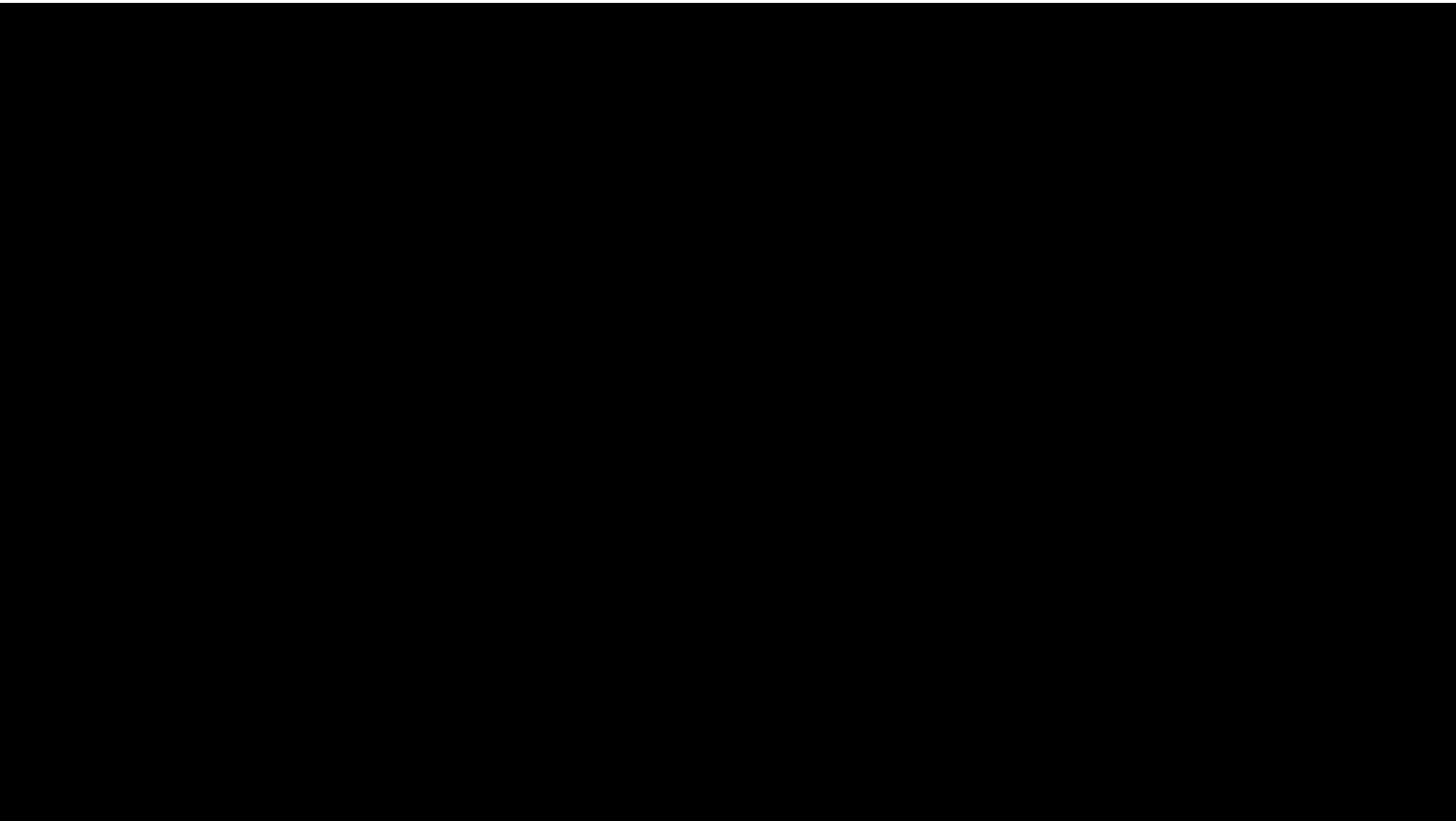
- ▶ Measuring differences in expression

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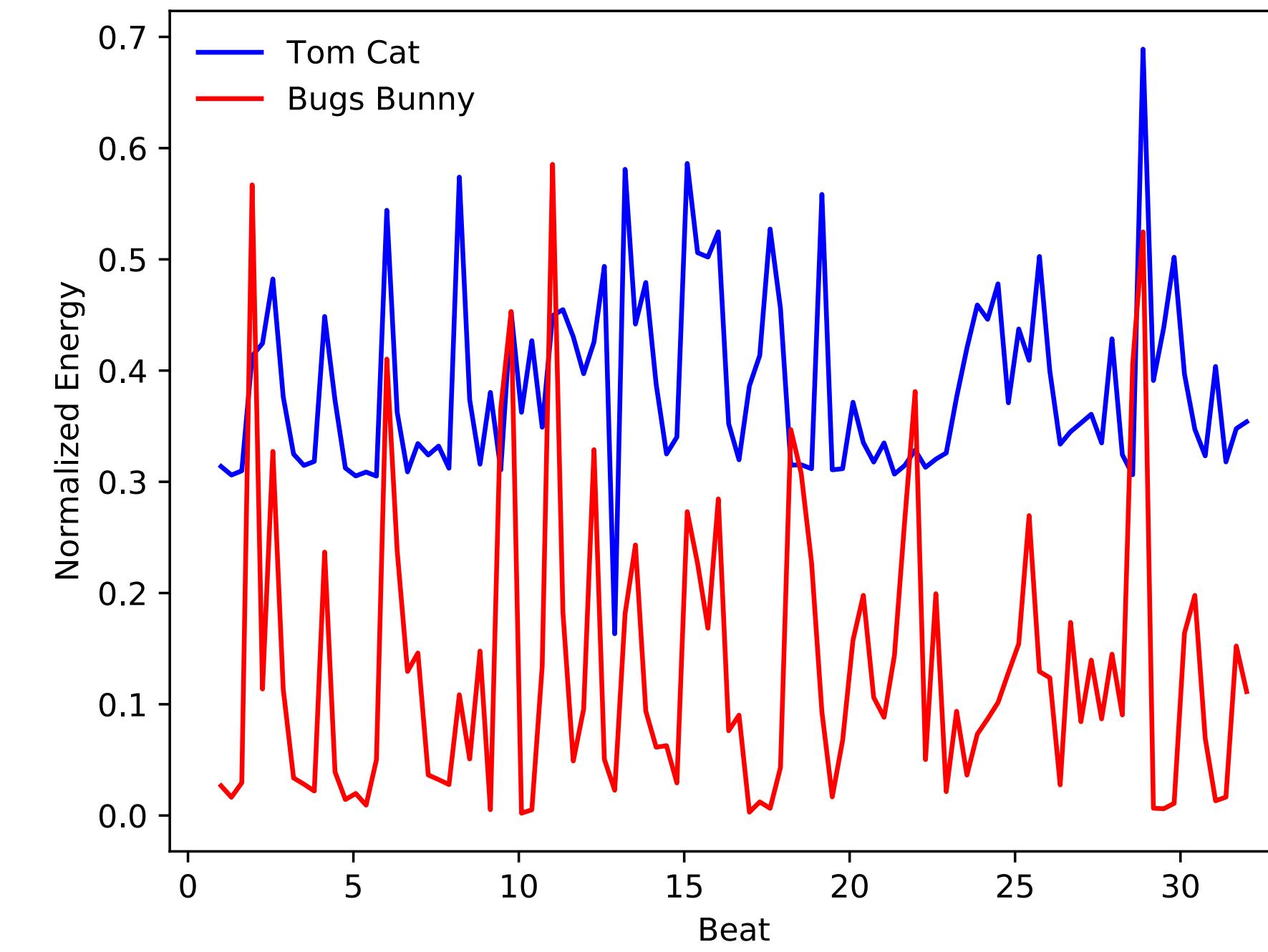
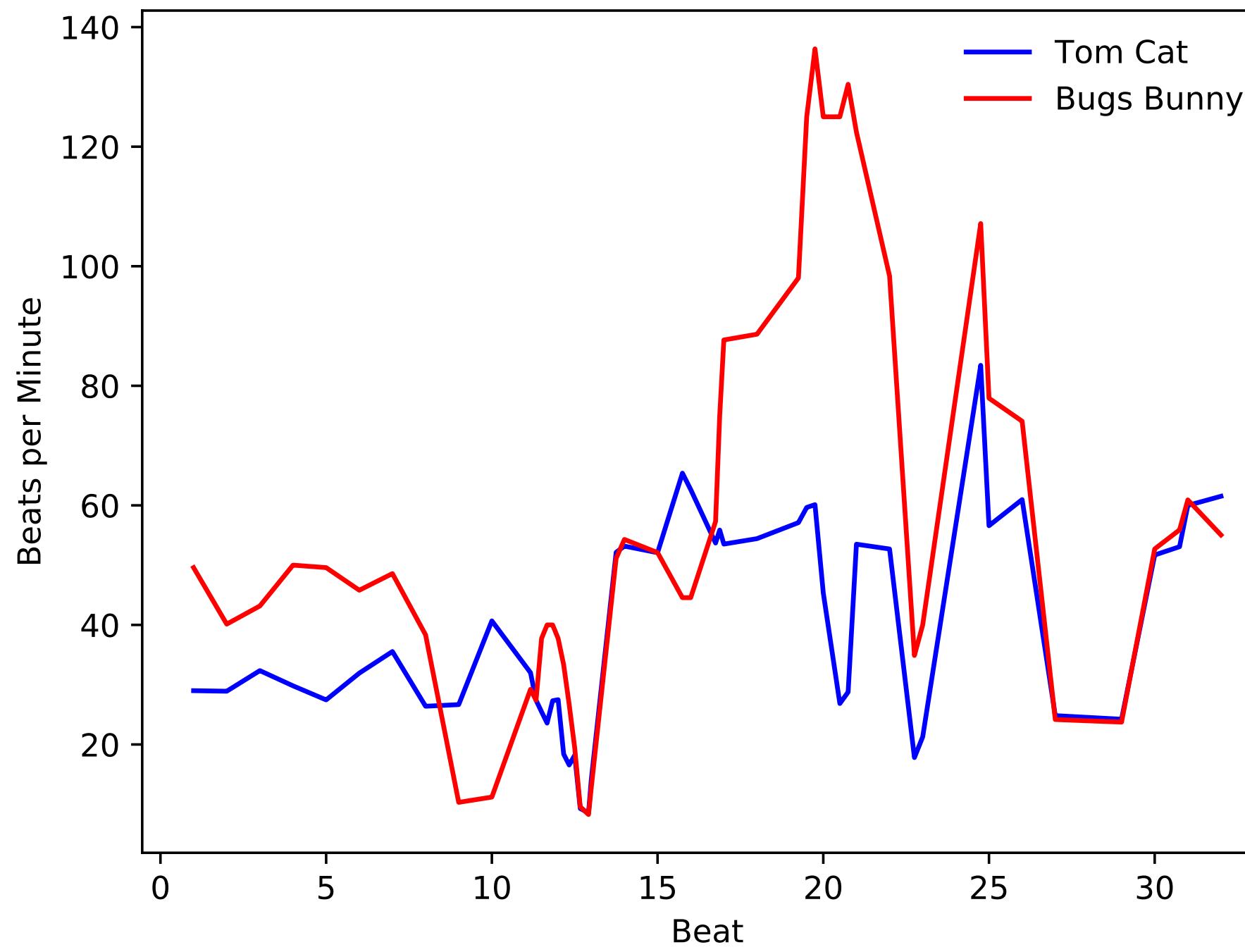
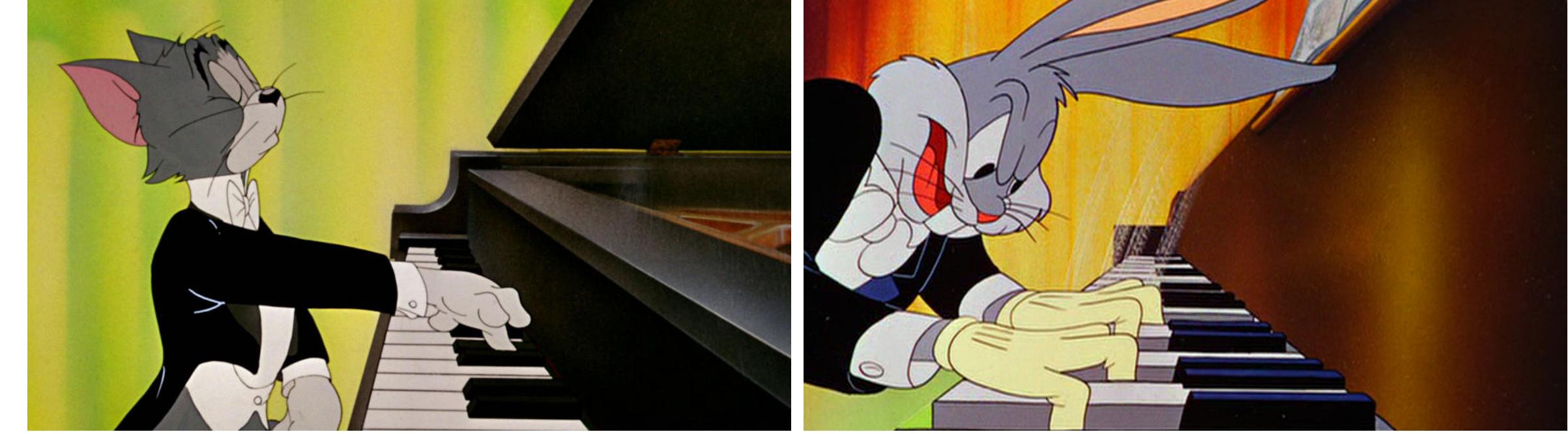
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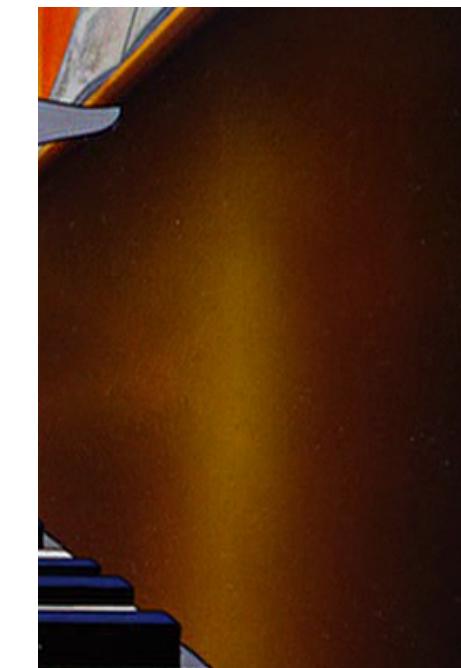
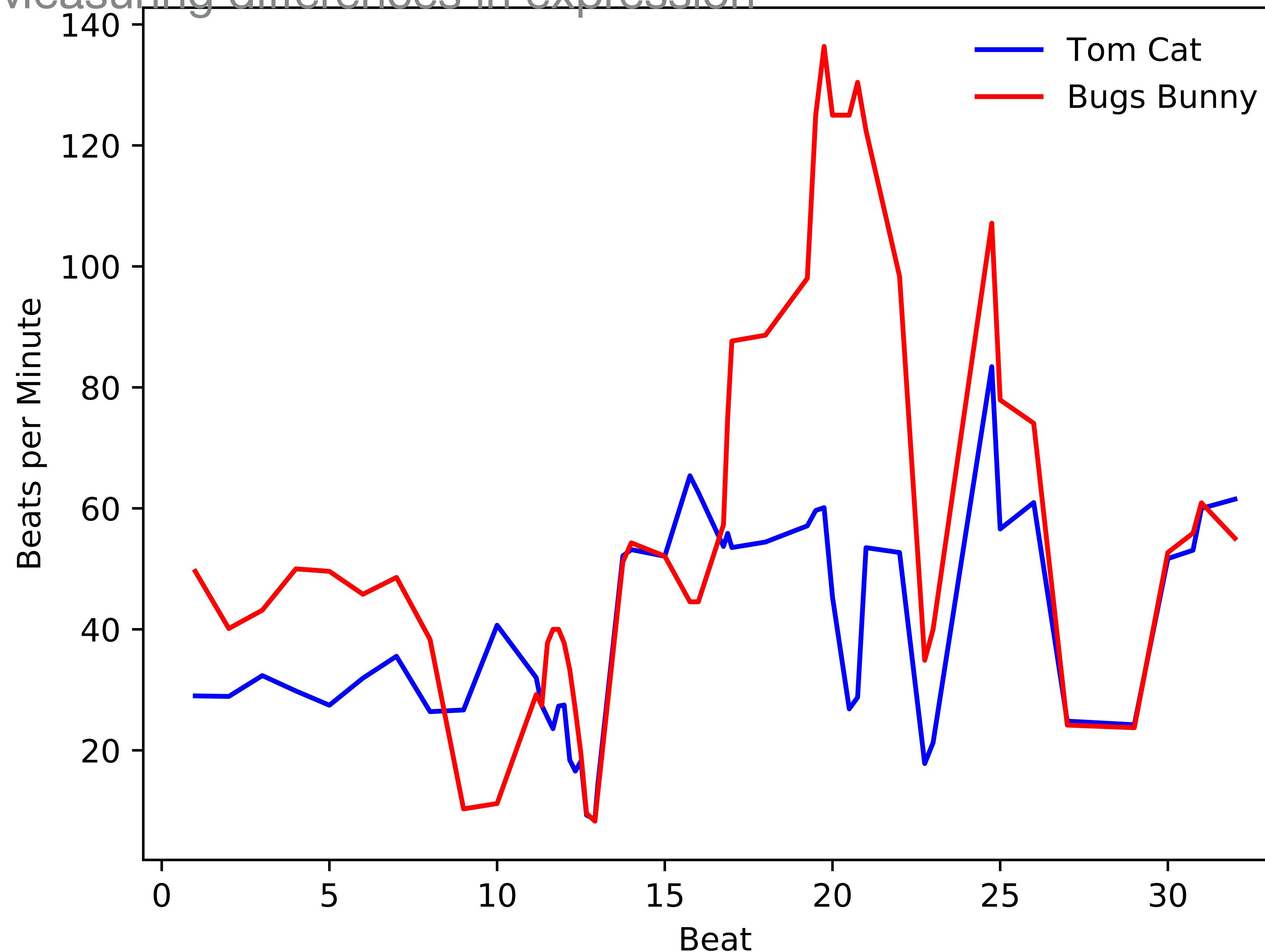


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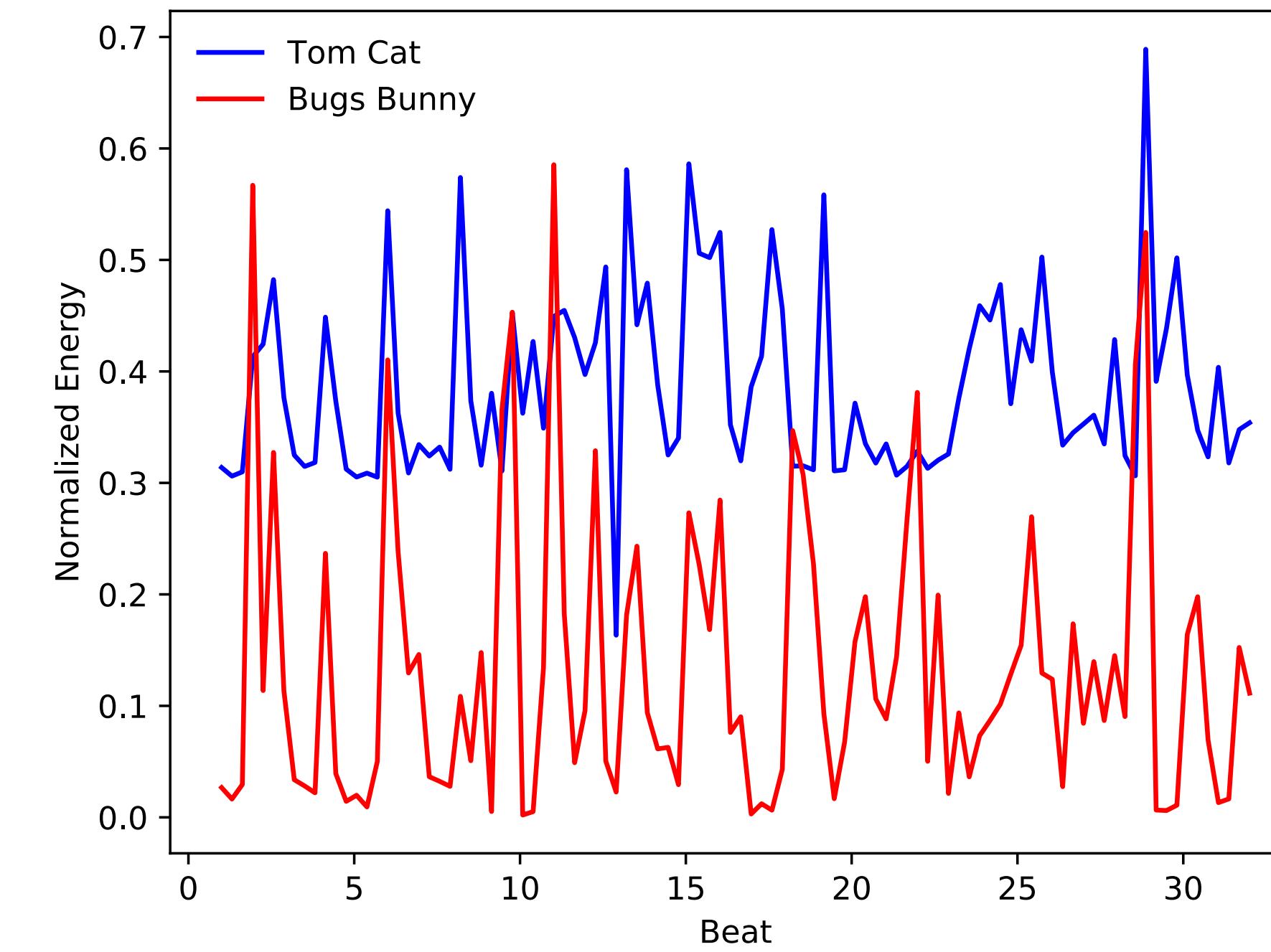
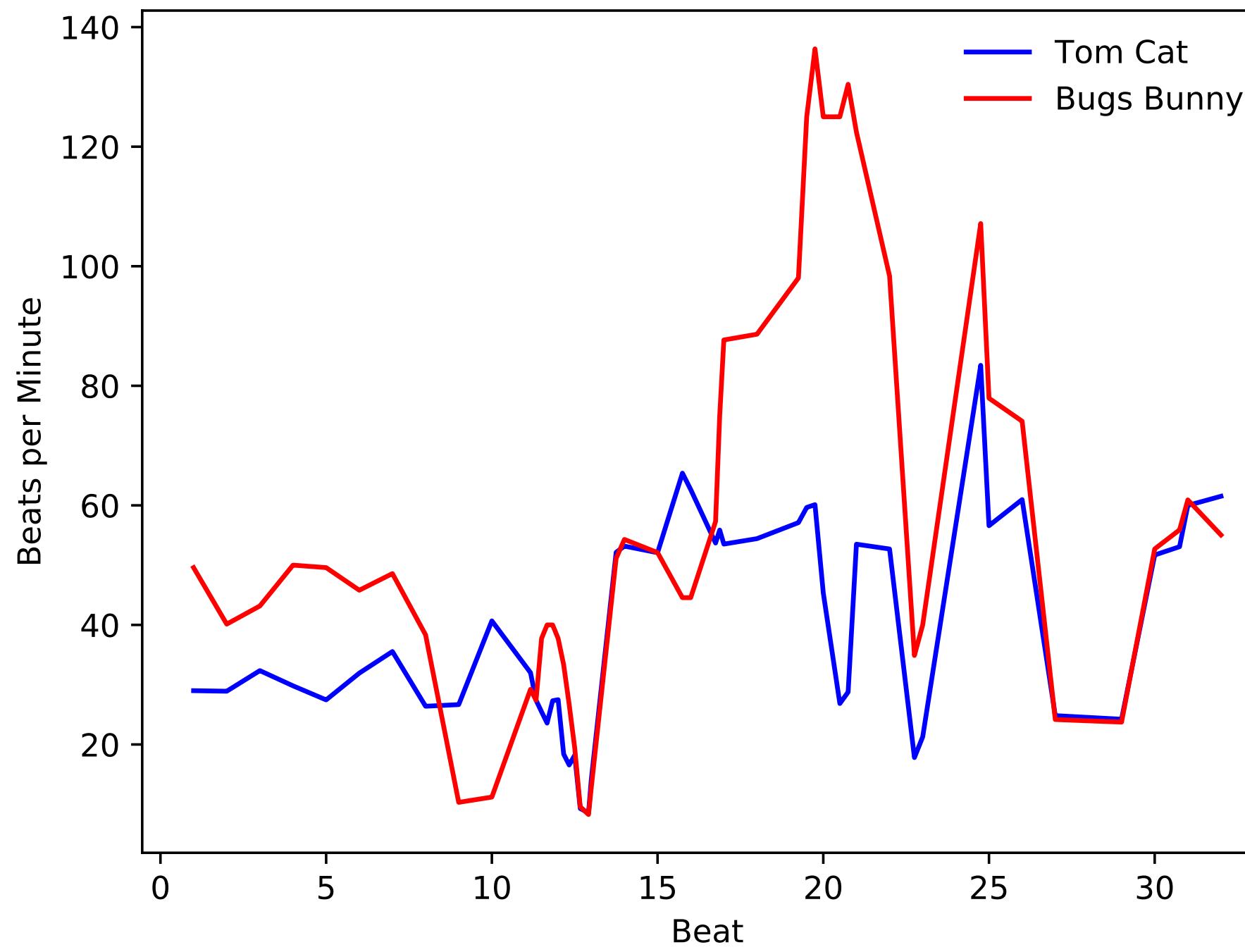
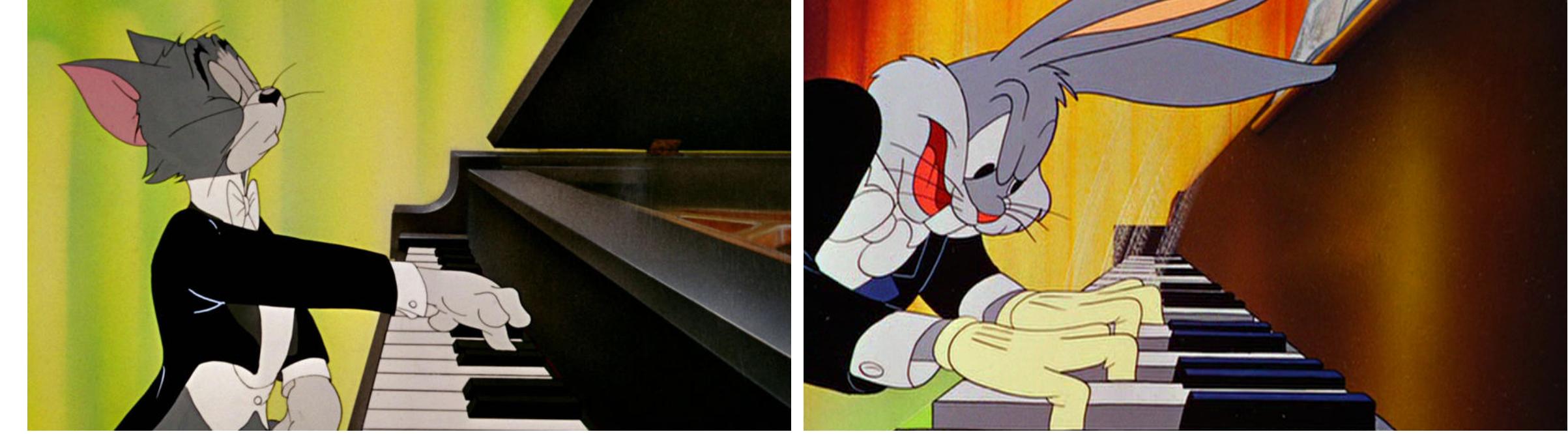
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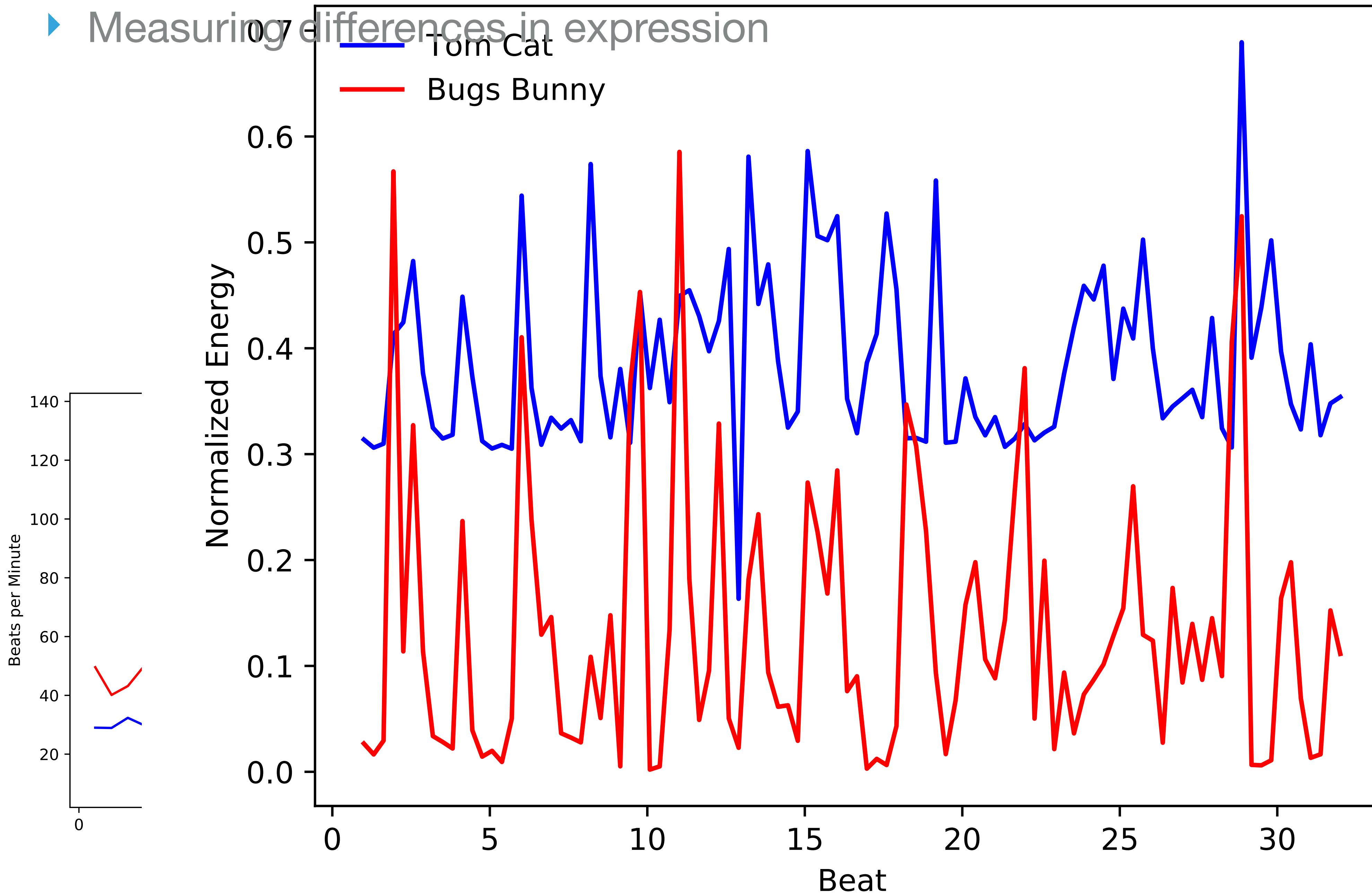
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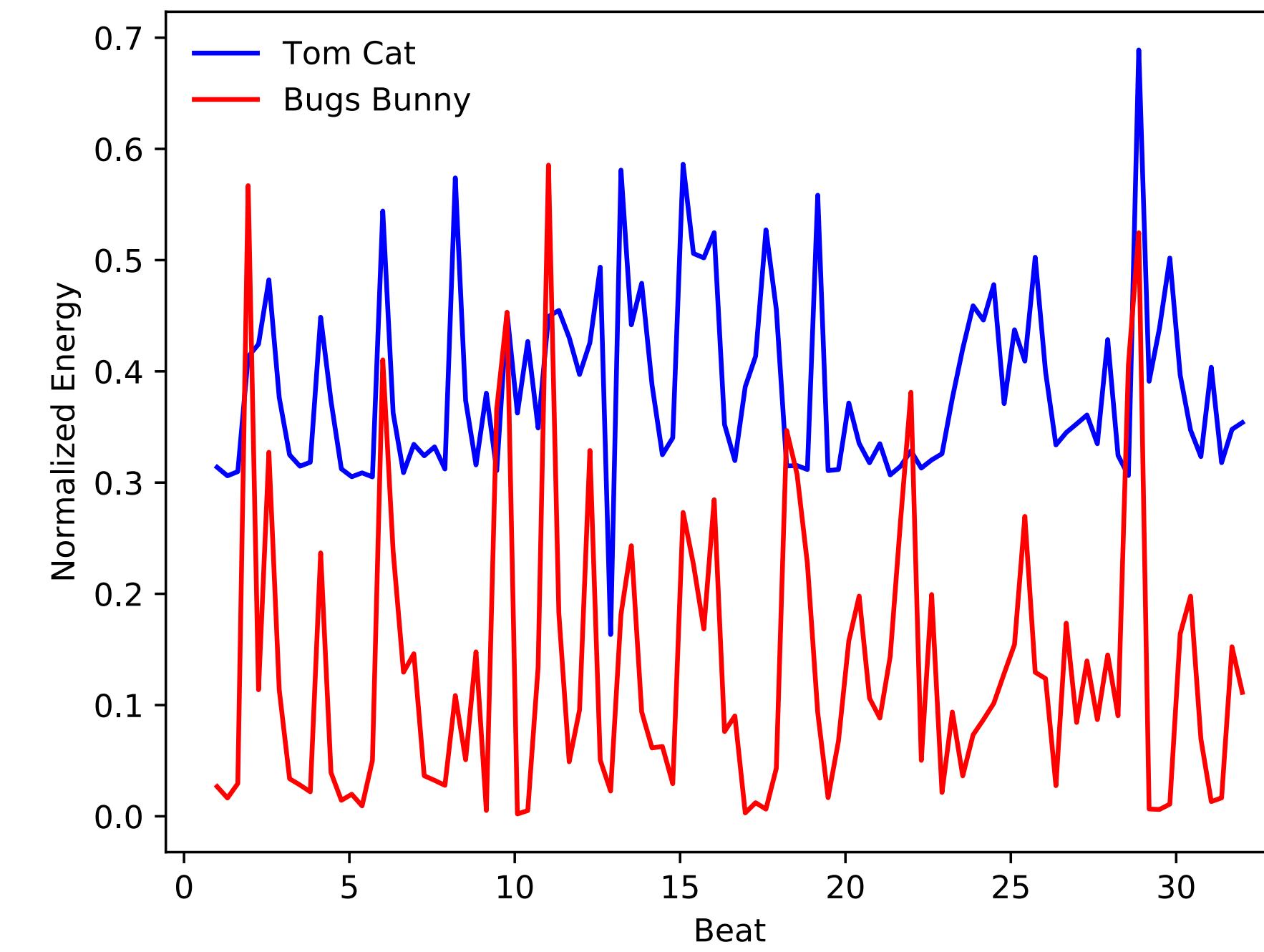
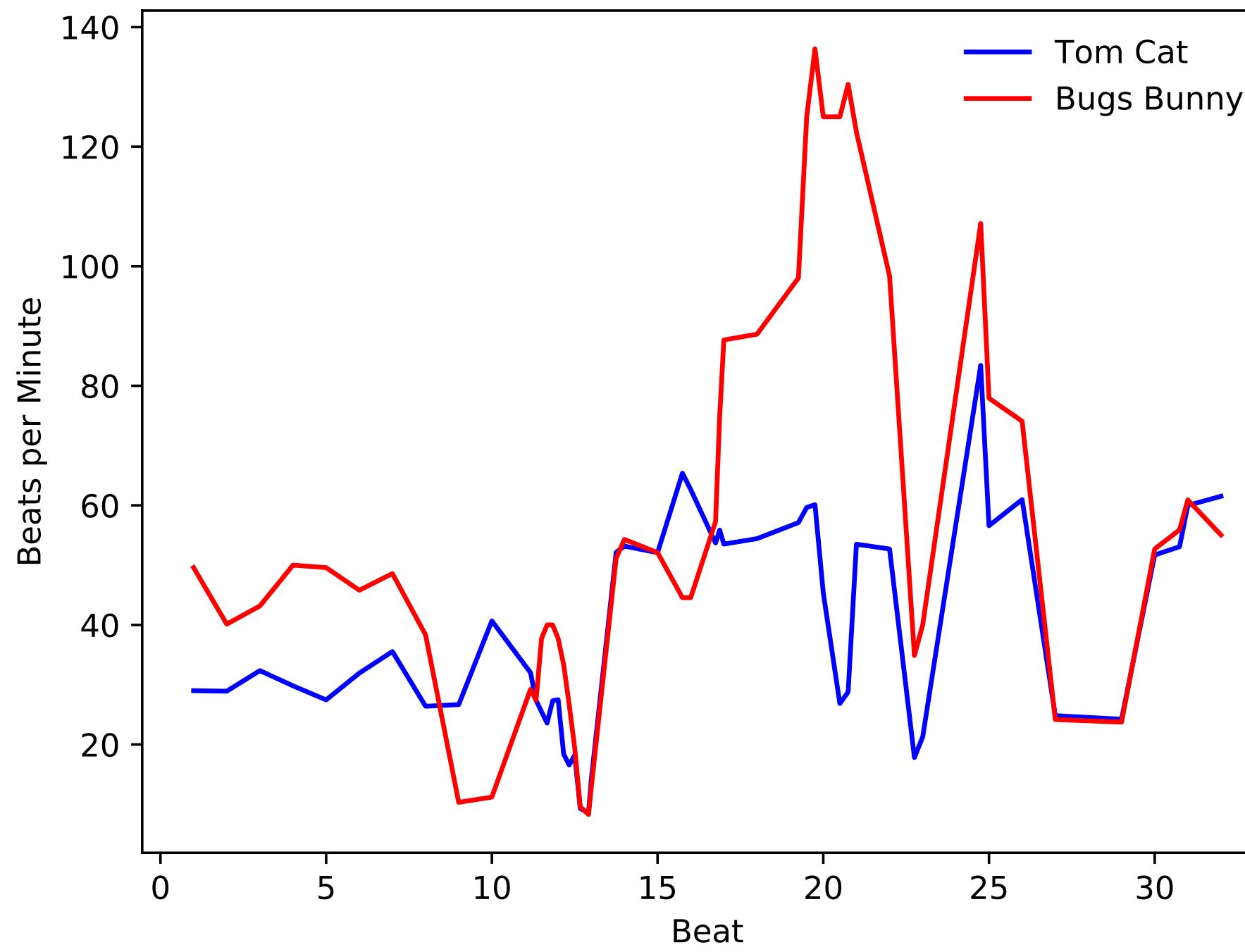
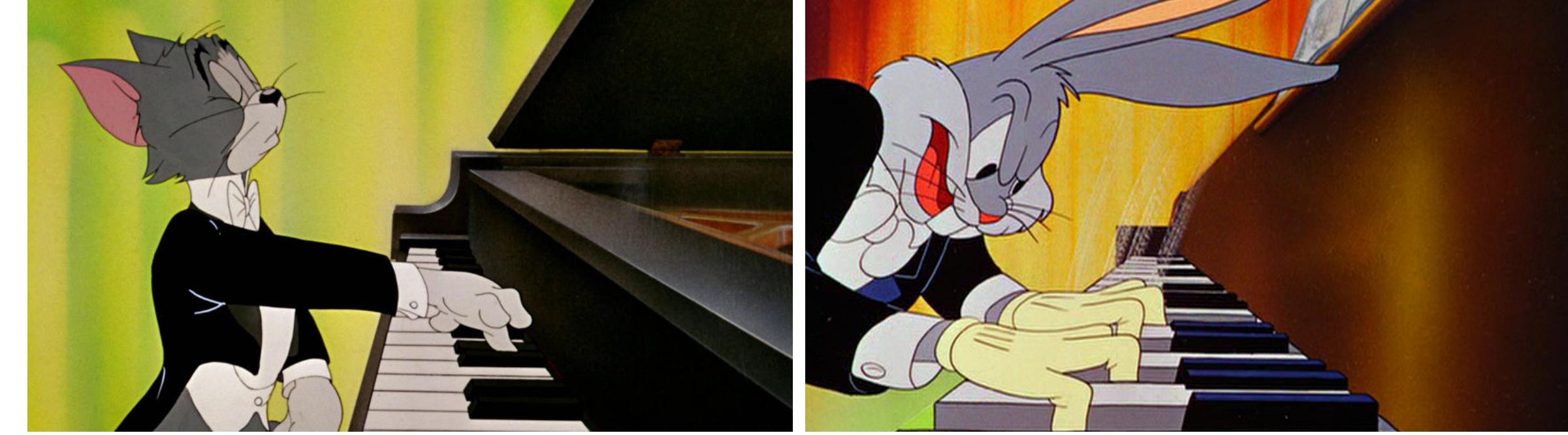
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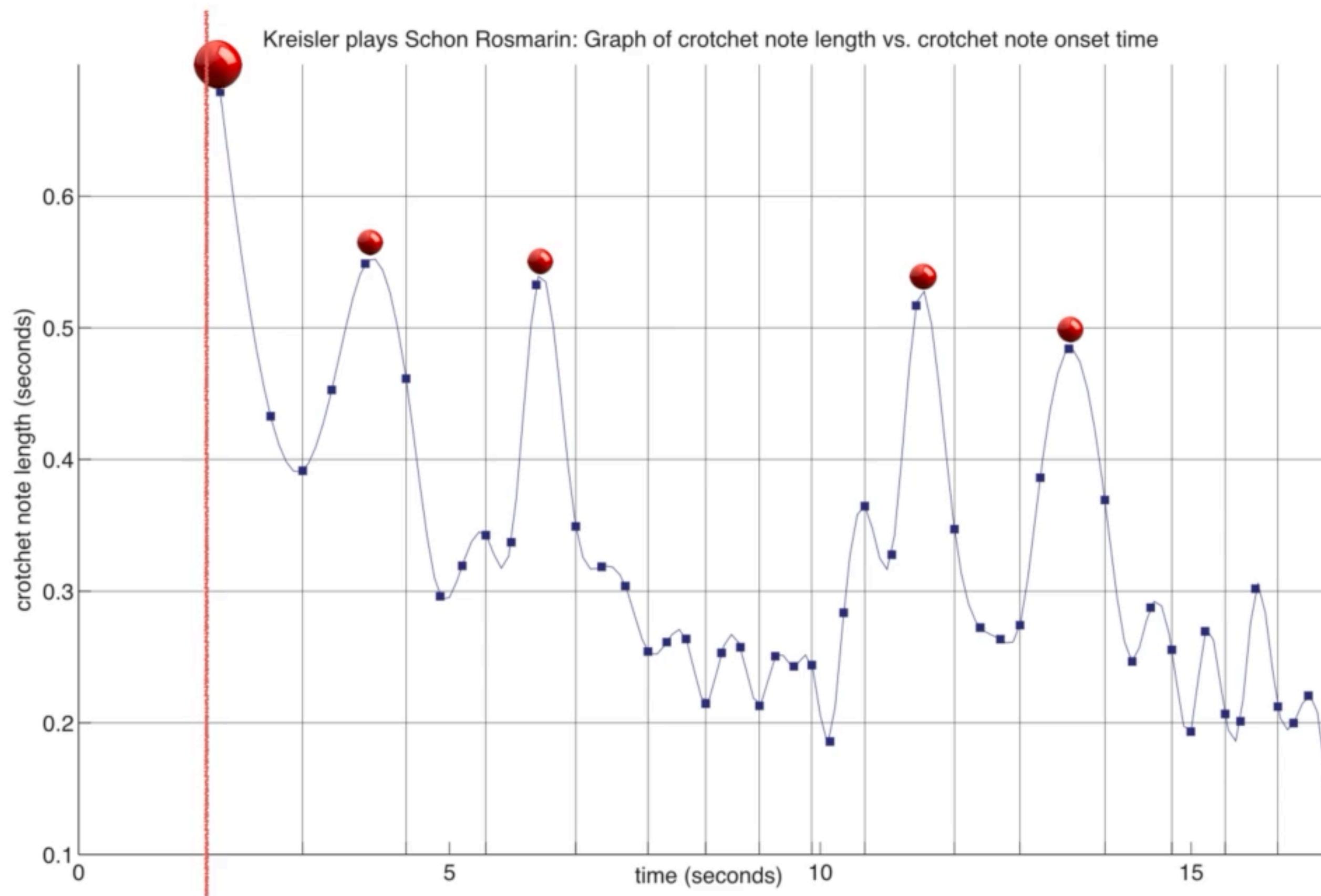
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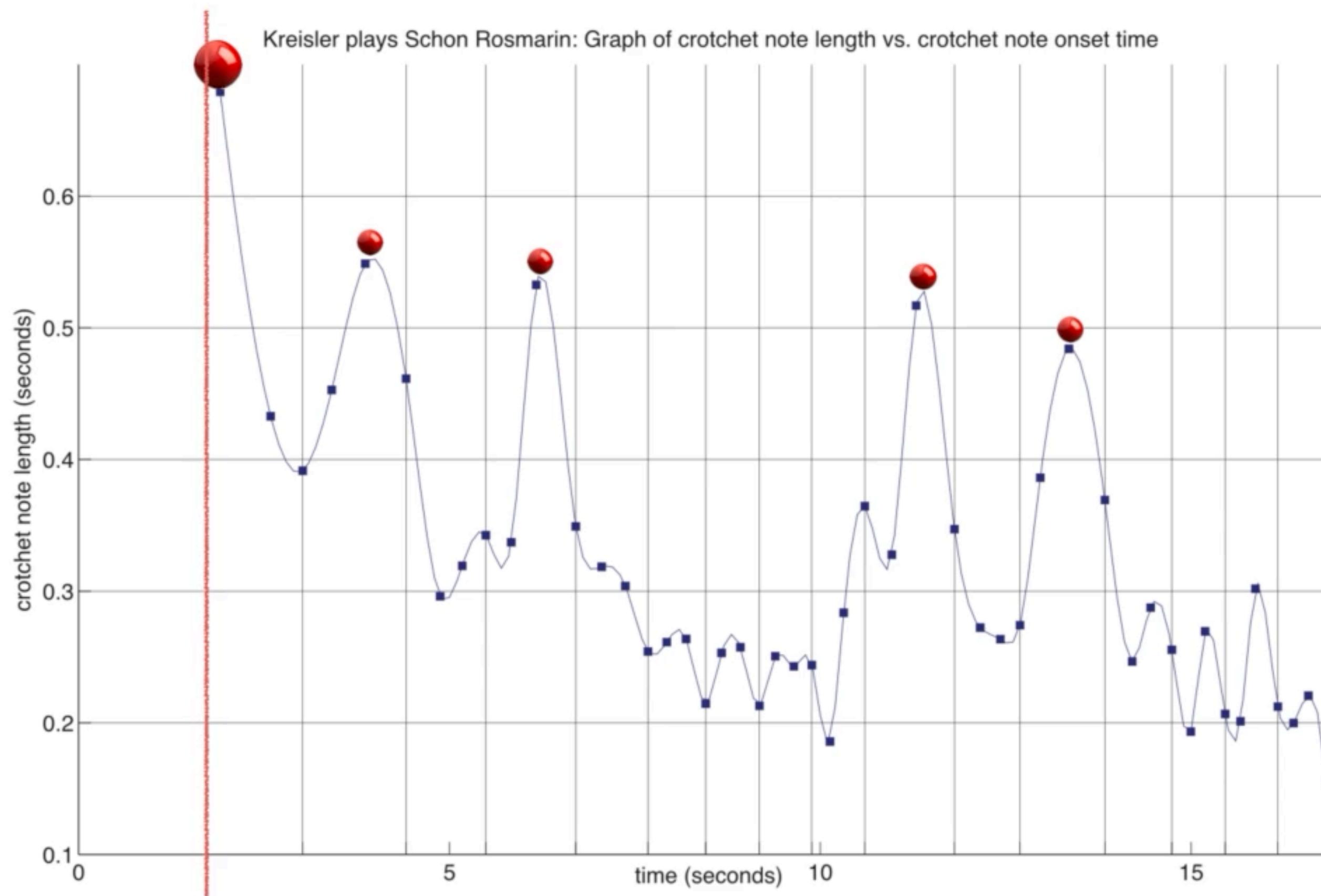
▶ Measuring differences in expression



Tipping point [Chew 2015]

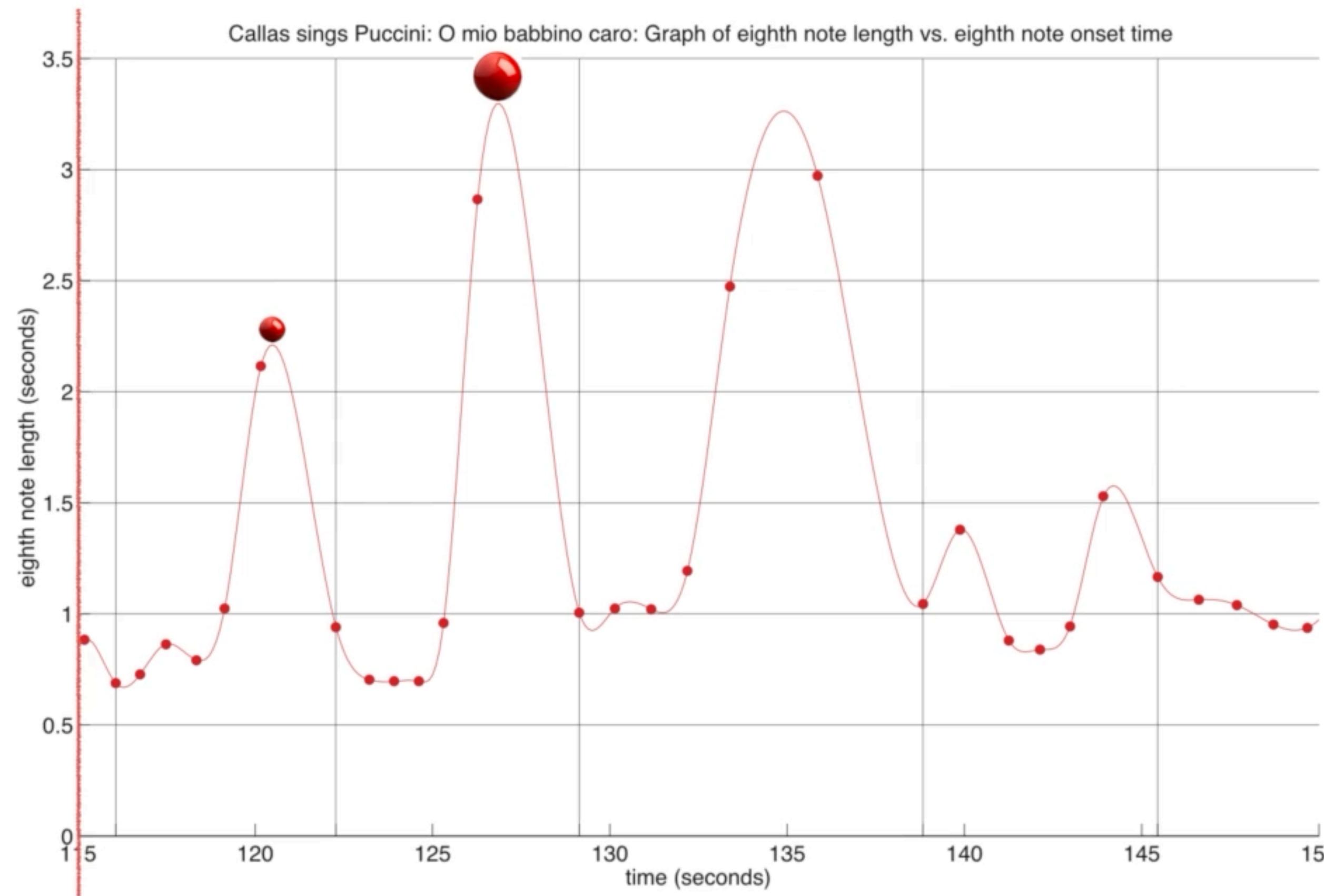


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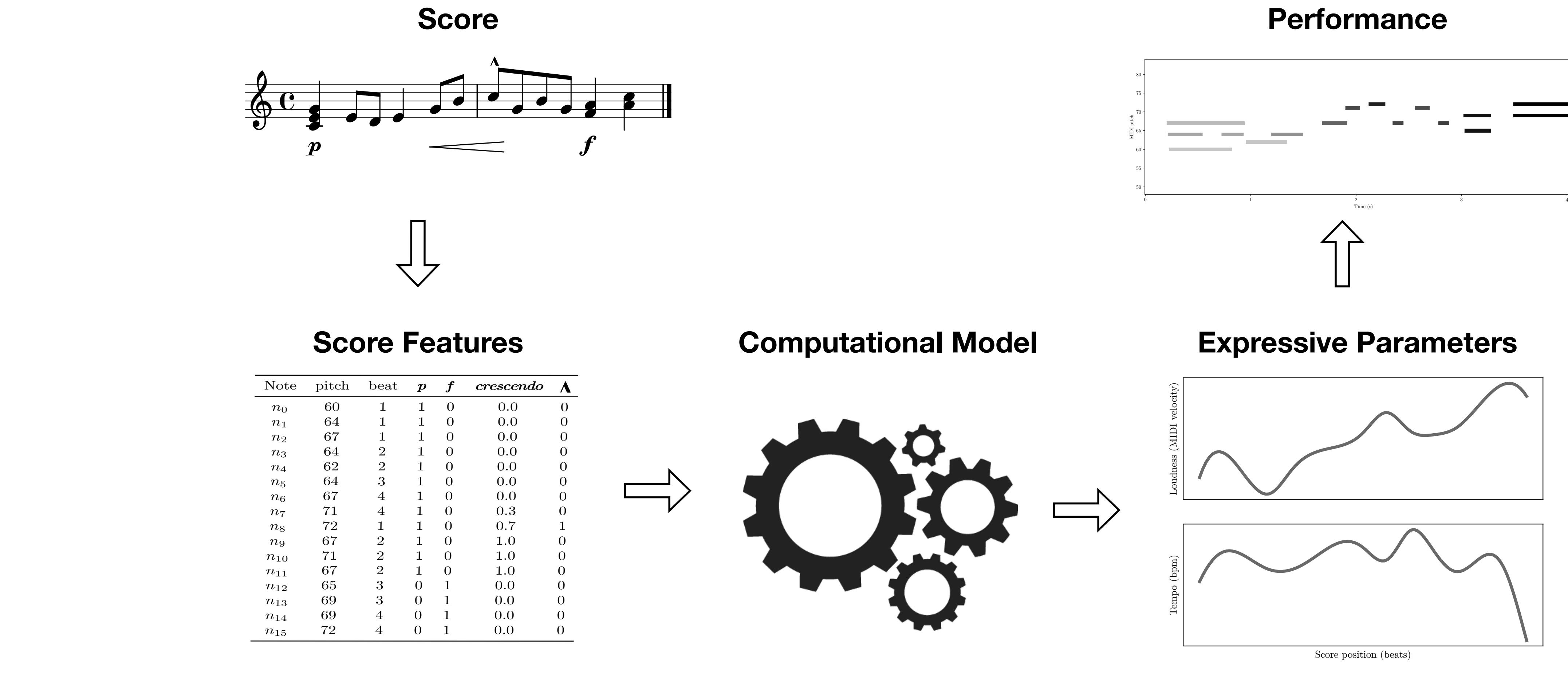
Performance worm



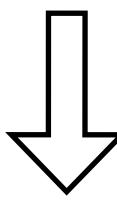
Performance worm



► Components of a computational model of expression

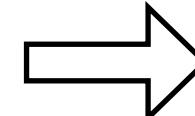


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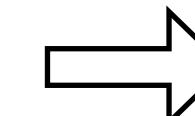
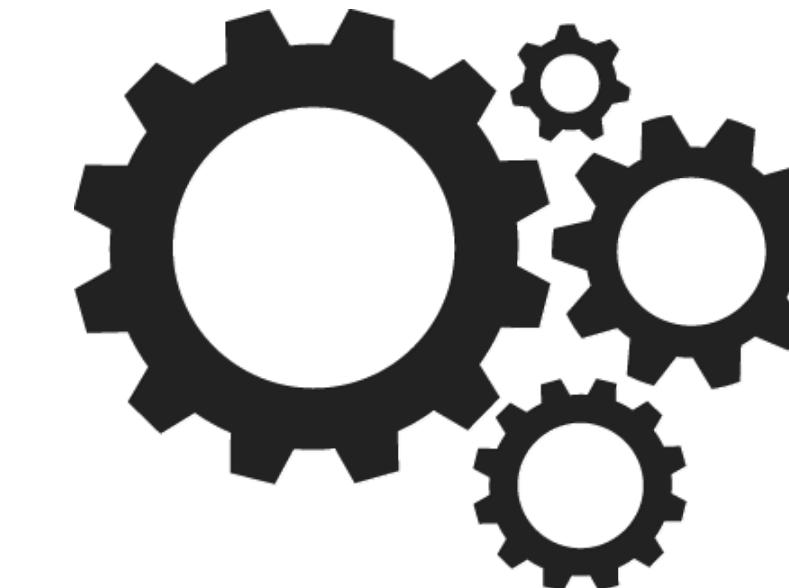


Score Features

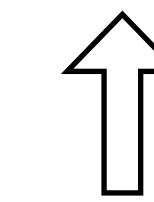
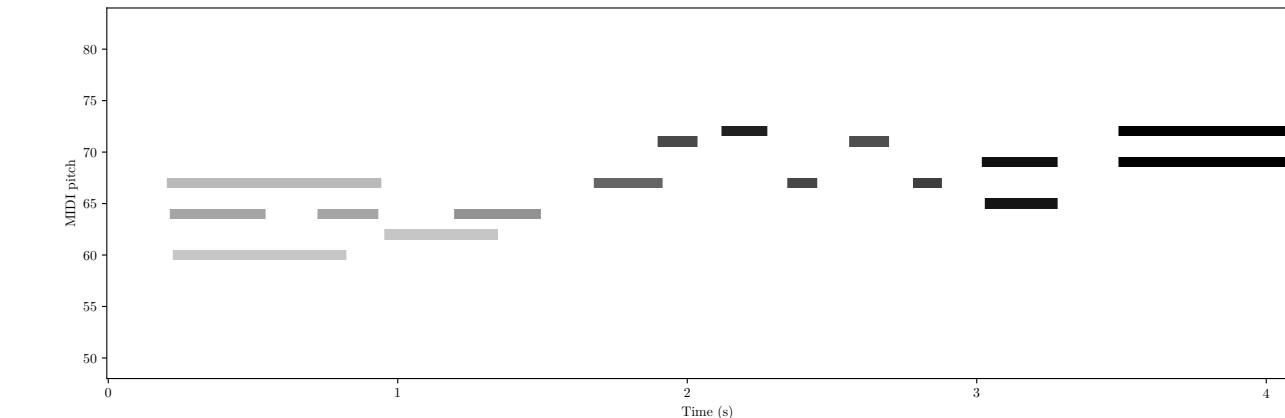
Note	pitch	beat	<i>p</i>	<i>f</i>	crescendo	Λ
n_0	60	1	1	0	0.0	0
n_1	64	1	1	0	0.0	0
n_2	67	1	1	0	0.0	0
n_3	64	2	1	0	0.0	0
n_4	62	2	1	0	0.0	0
n_5	64	3	1	0	0.0	0
n_6	67	4	1	0	0.0	0
n_7	71	4	1	0	0.3	0
n_8	72	1	1	0	0.7	1
n_9	67	2	1	0	1.0	0
n_{10}	71	2	1	0	1.0	0
n_{11}	67	2	1	0	1.0	0
n_{12}	65	3	0	1	0.0	0
n_{13}	69	3	0	1	0.0	0
n_{14}	69	4	0	1	0.0	0
n_{15}	72	4	0	1	0.0	0



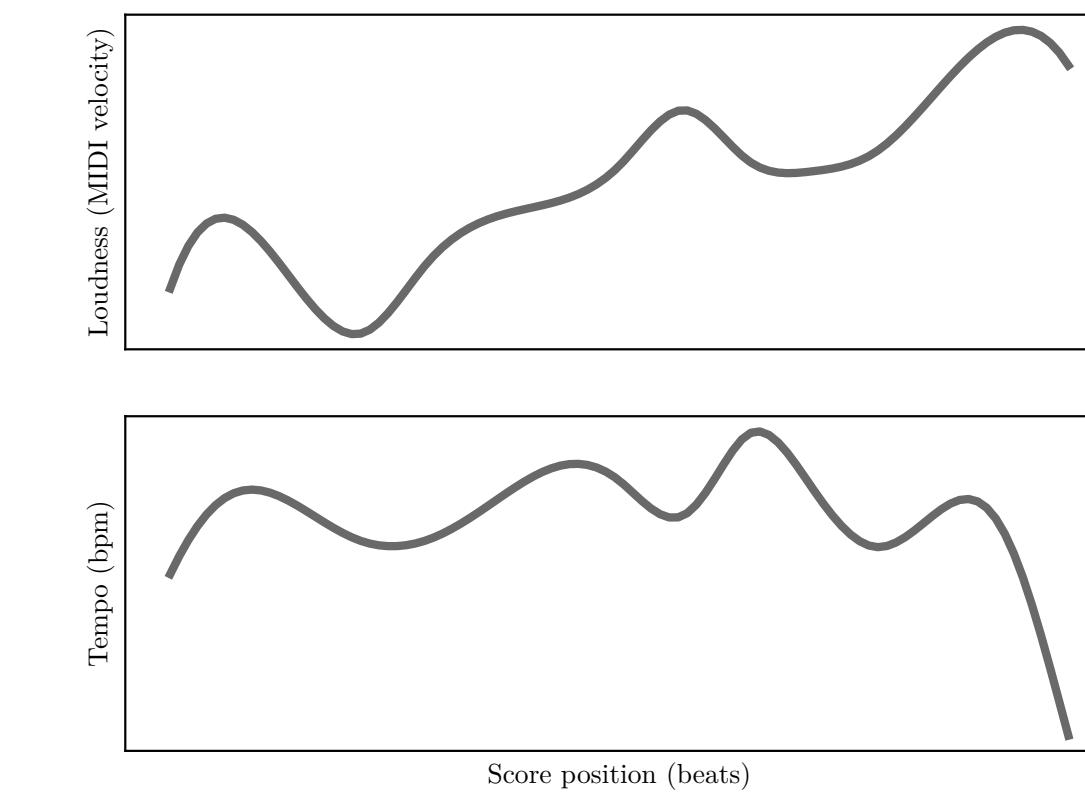
Computational Model



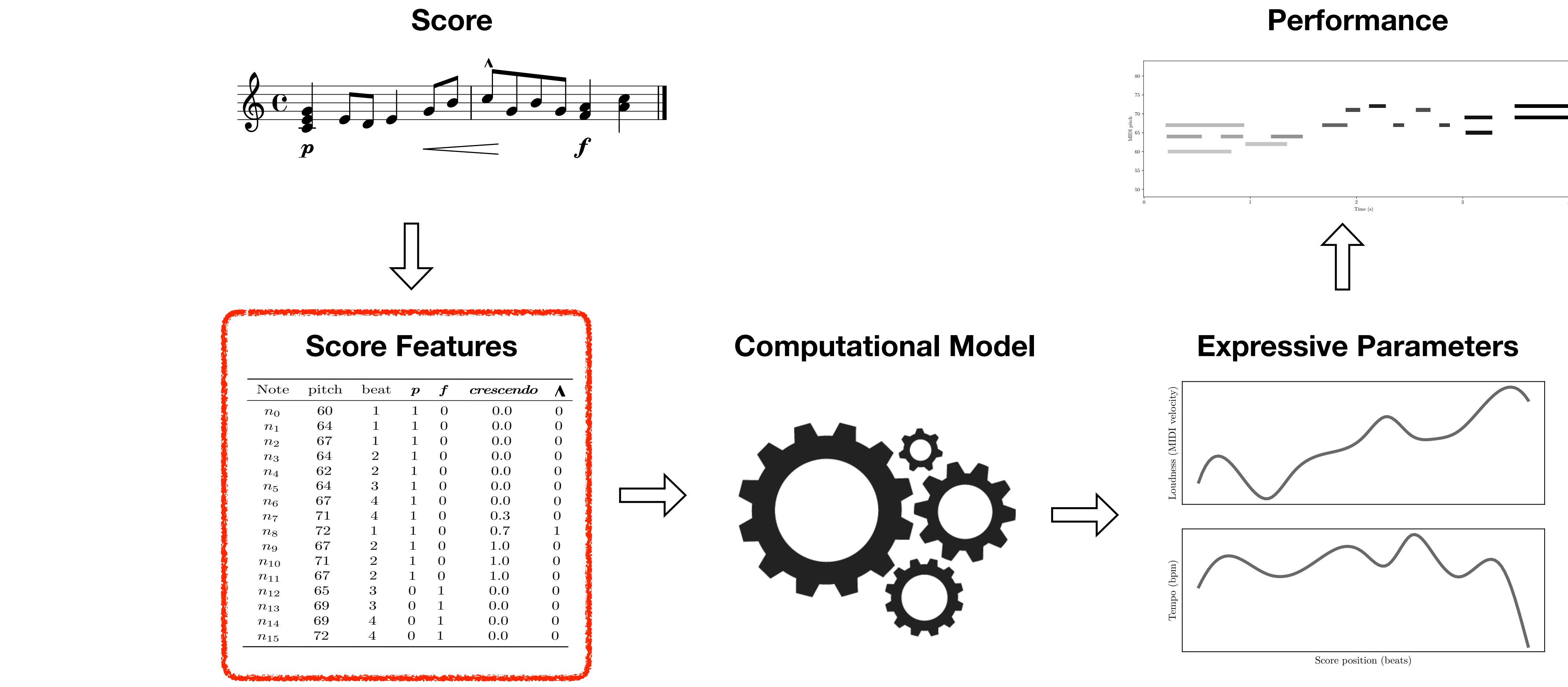
Performance



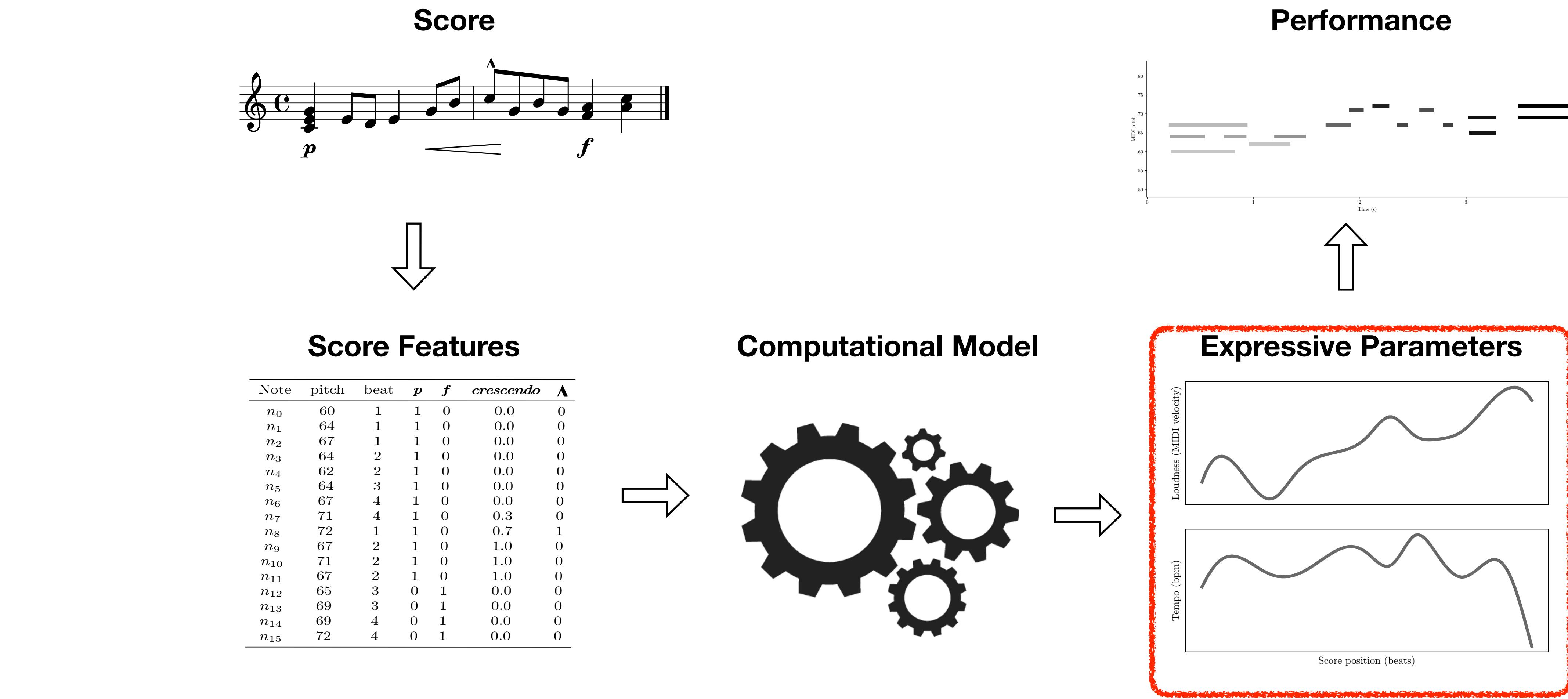
Expressive Parameters



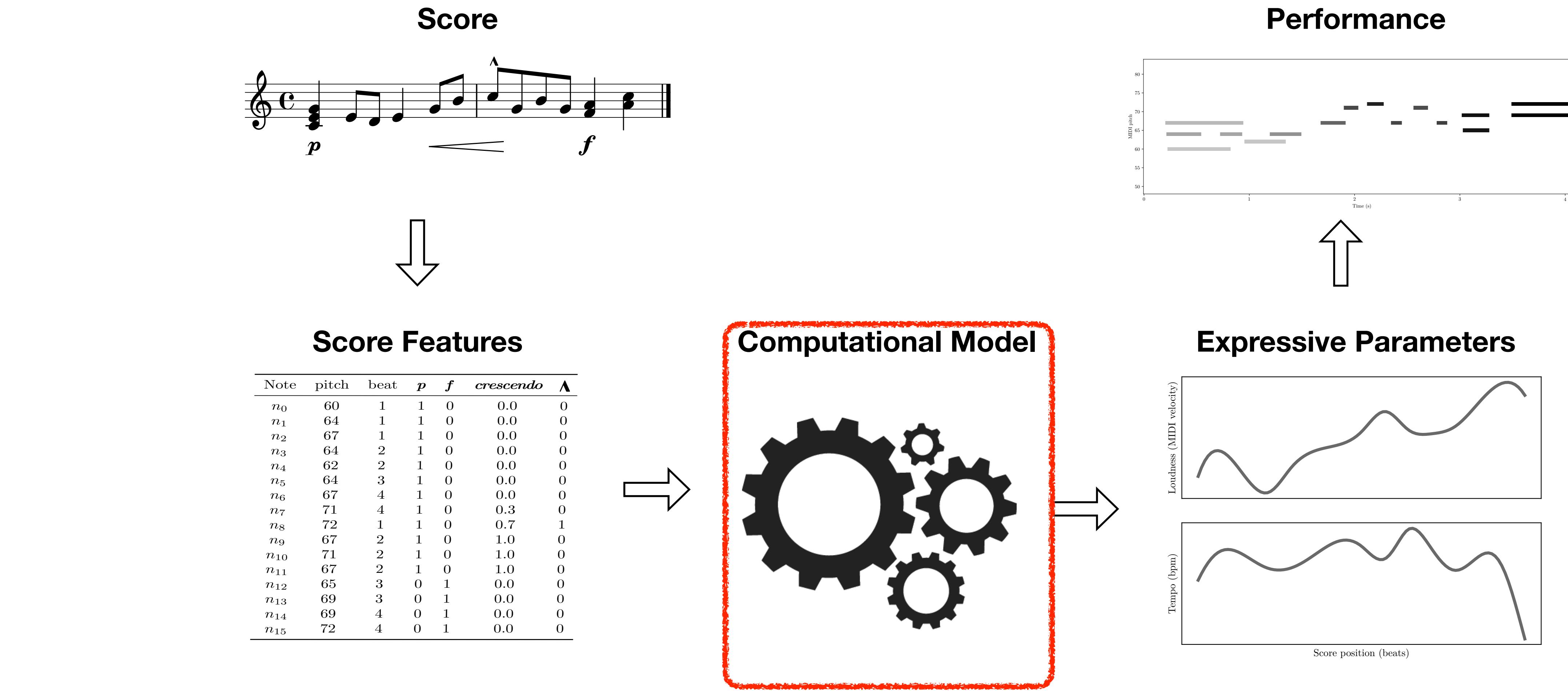
▶ Components of a computational model of expression



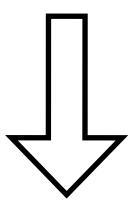
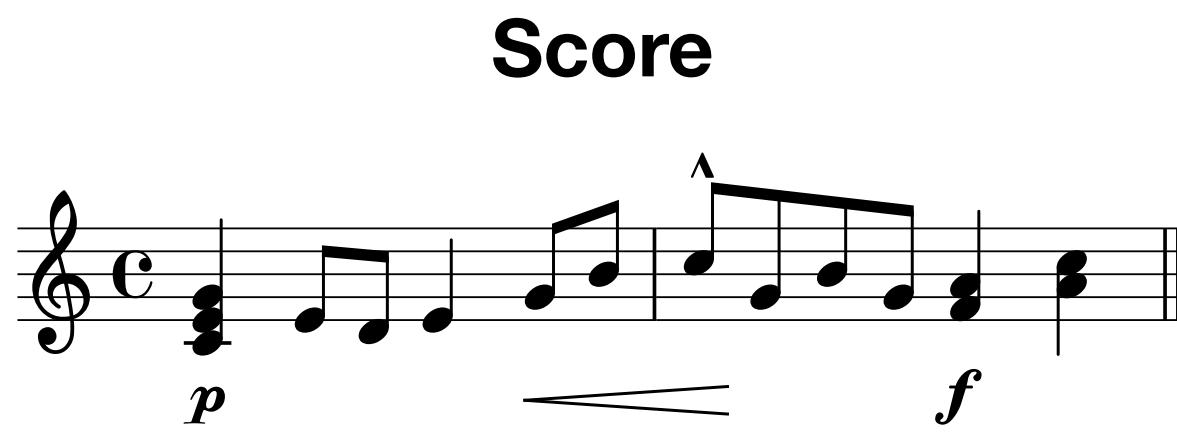
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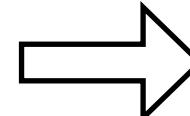


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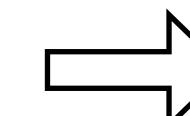
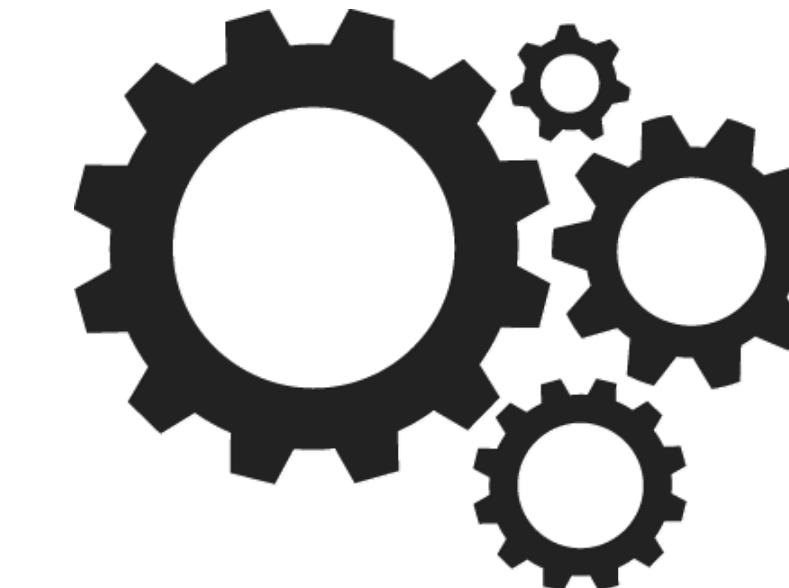


Score Features

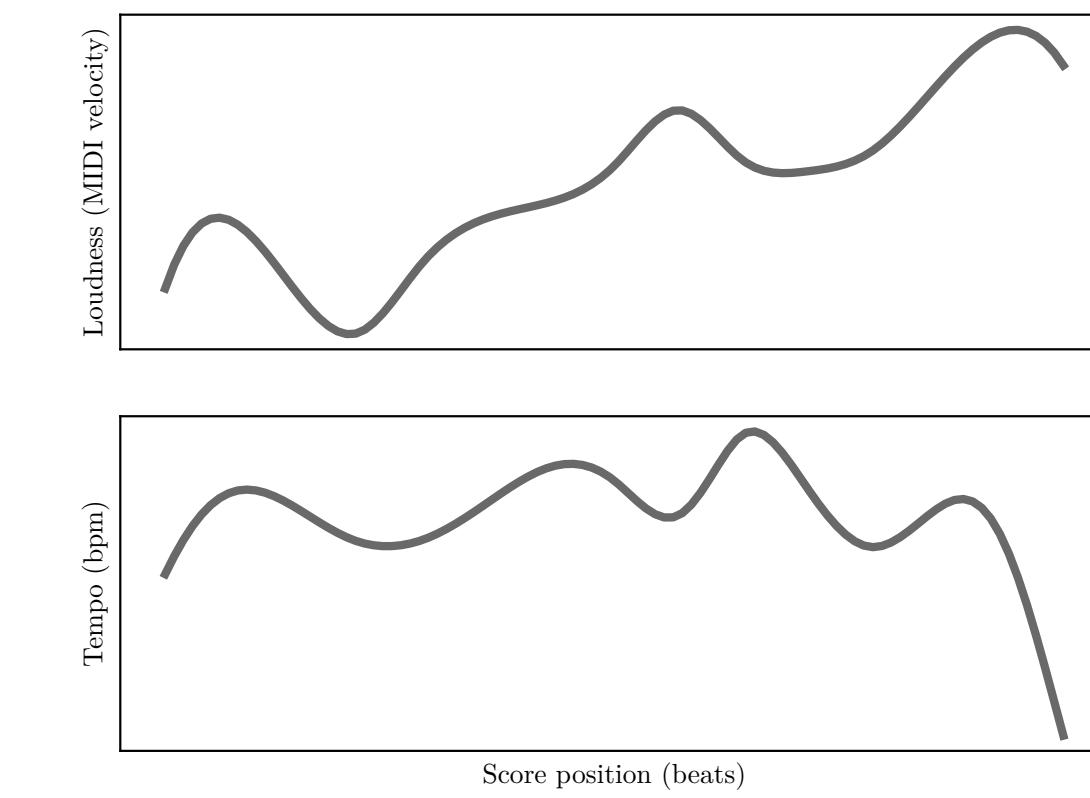
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n_{15}	72	4	0	1	0.0	0



Computational Model



Expressive Parameters



Performance representation model: Decomposing a performance into score and expression

- For predictive modelling of musical expression we want to describe the performance in a way that is independent of the score.

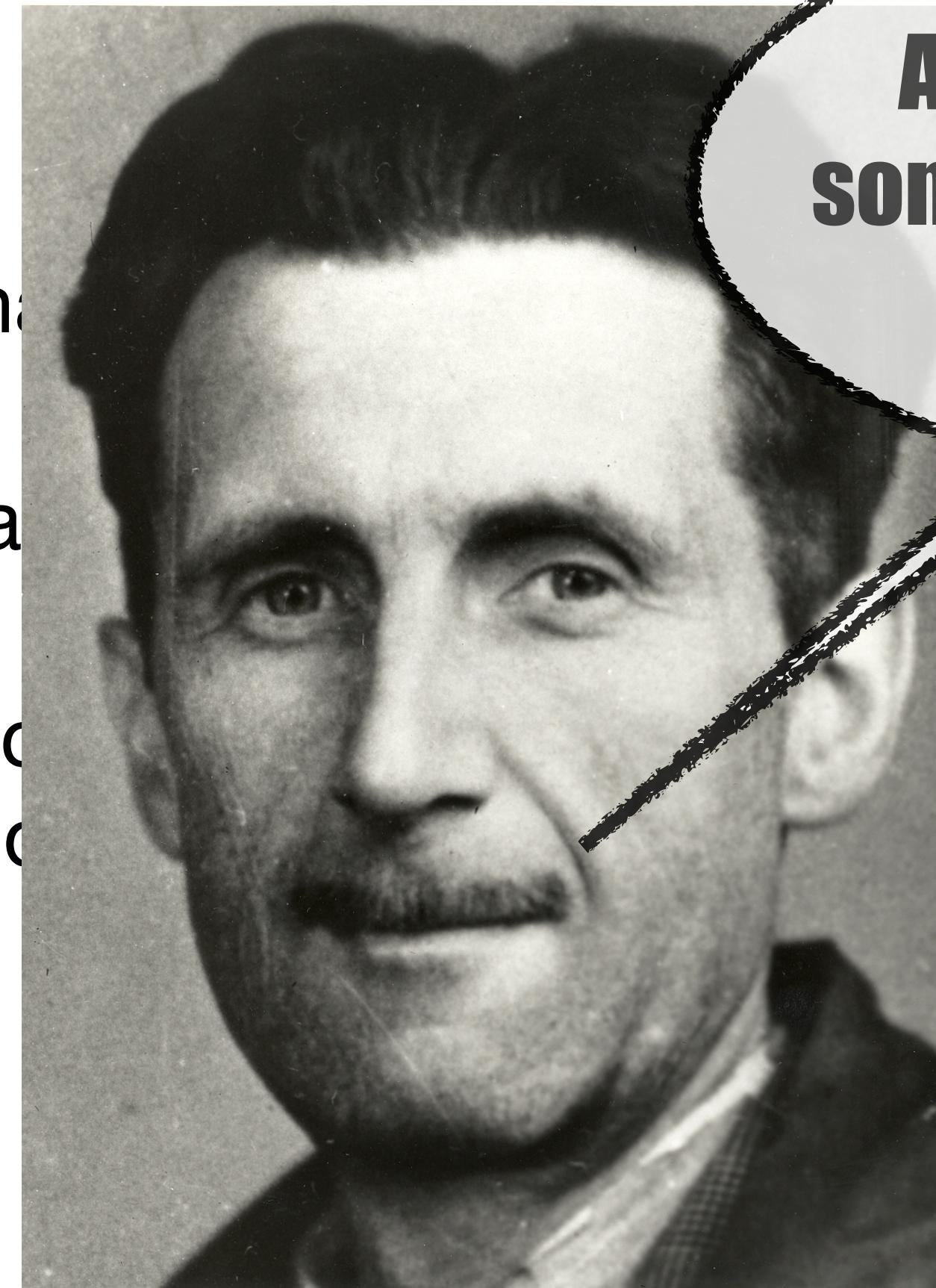
```
# conceptually:  
performance = score + expression  
expression = performance - score  
  
# formally:  
expression = f(score, performance) # encoder  
performance = g(score, expression) # decoder  
  
# we want:  
assert performance == g(score, f(score, performance))
```

▶ A note on evaluation

- Can we use the squared error to compute the loss of predicted expression values?
- Reasons to do so:
 - Theoretical: Commonalities in performance (Repp, 1992, 1994)
 - Pragmatic: It is time and resource consuming to evaluate models with human judgment
 - BUT: Loss functions such as squared error with respect to a human performance are not necessarily a reliable indicator of musical quality

► A note on evaluation

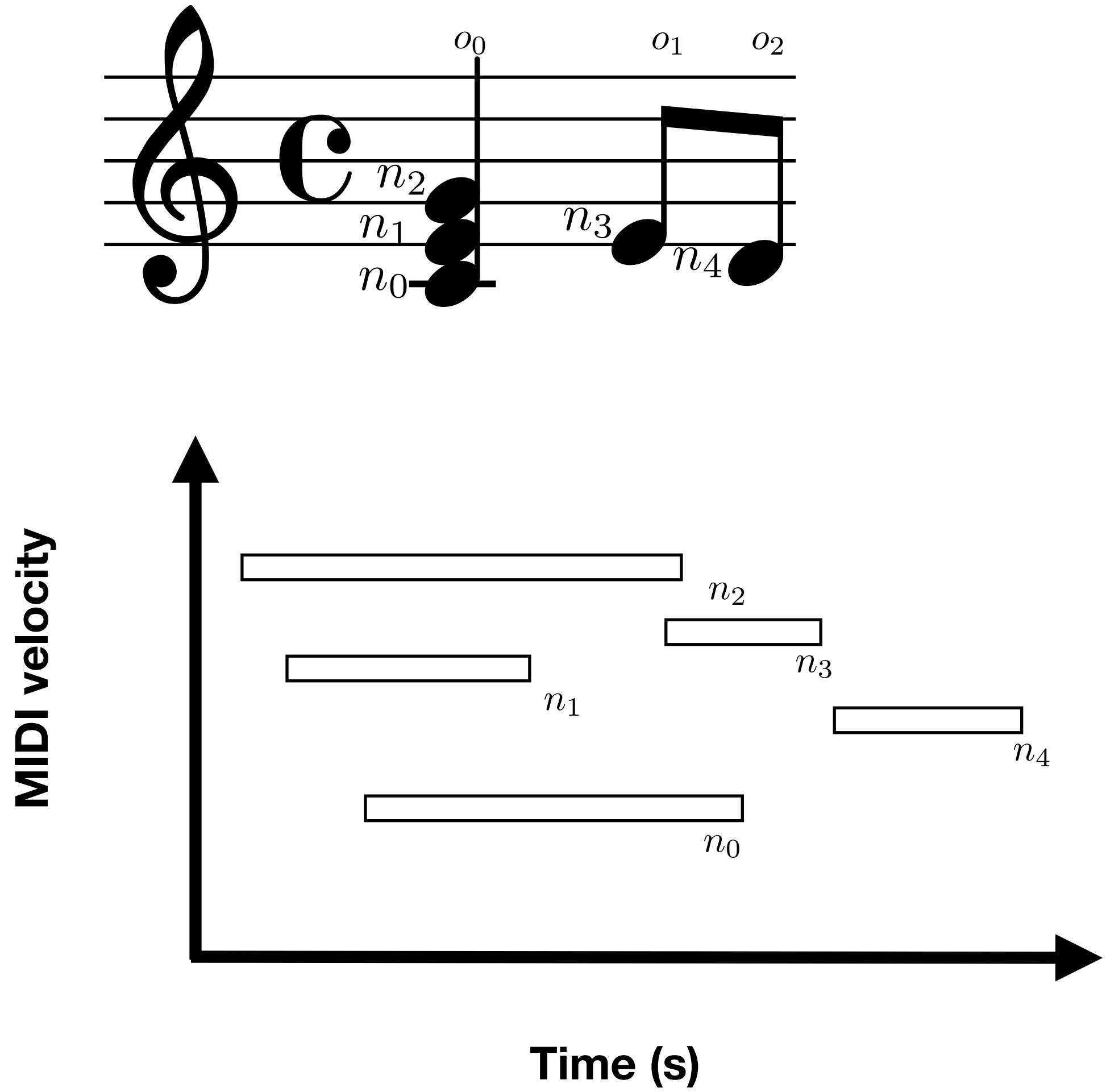
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- Reasons to do so:
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 - Pragmatic: It is time and cost efficient to evaluate models with human judgment
 - BUT: Loss functions such as squared error with respect to a human performance are not necessarily a reliable indicator of quality



All errors are equal, but
some errors are more equal
than others!

► Performance representation model

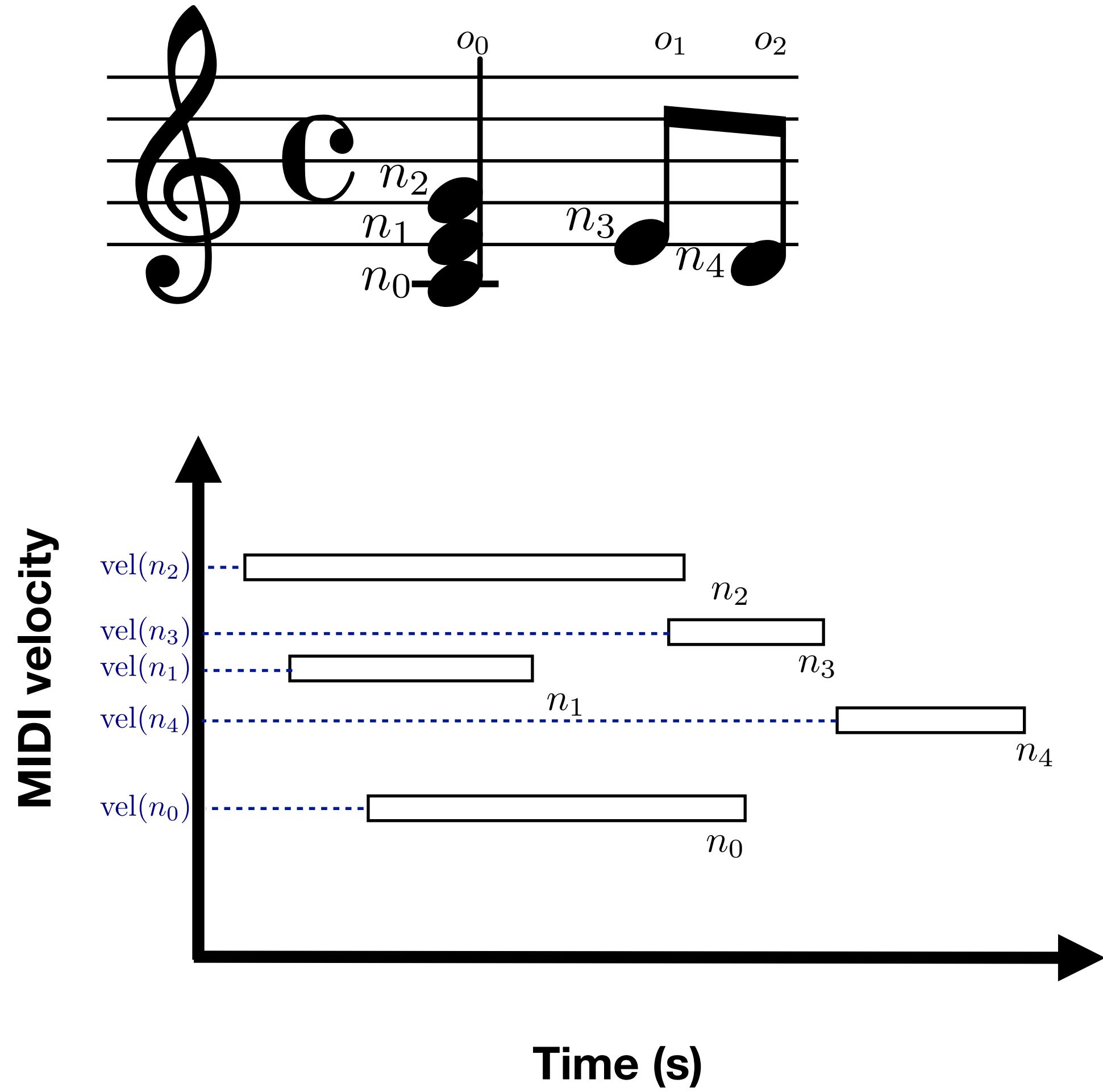
Expressive Parameters:



► Performance representation model

Expressive Parameters:

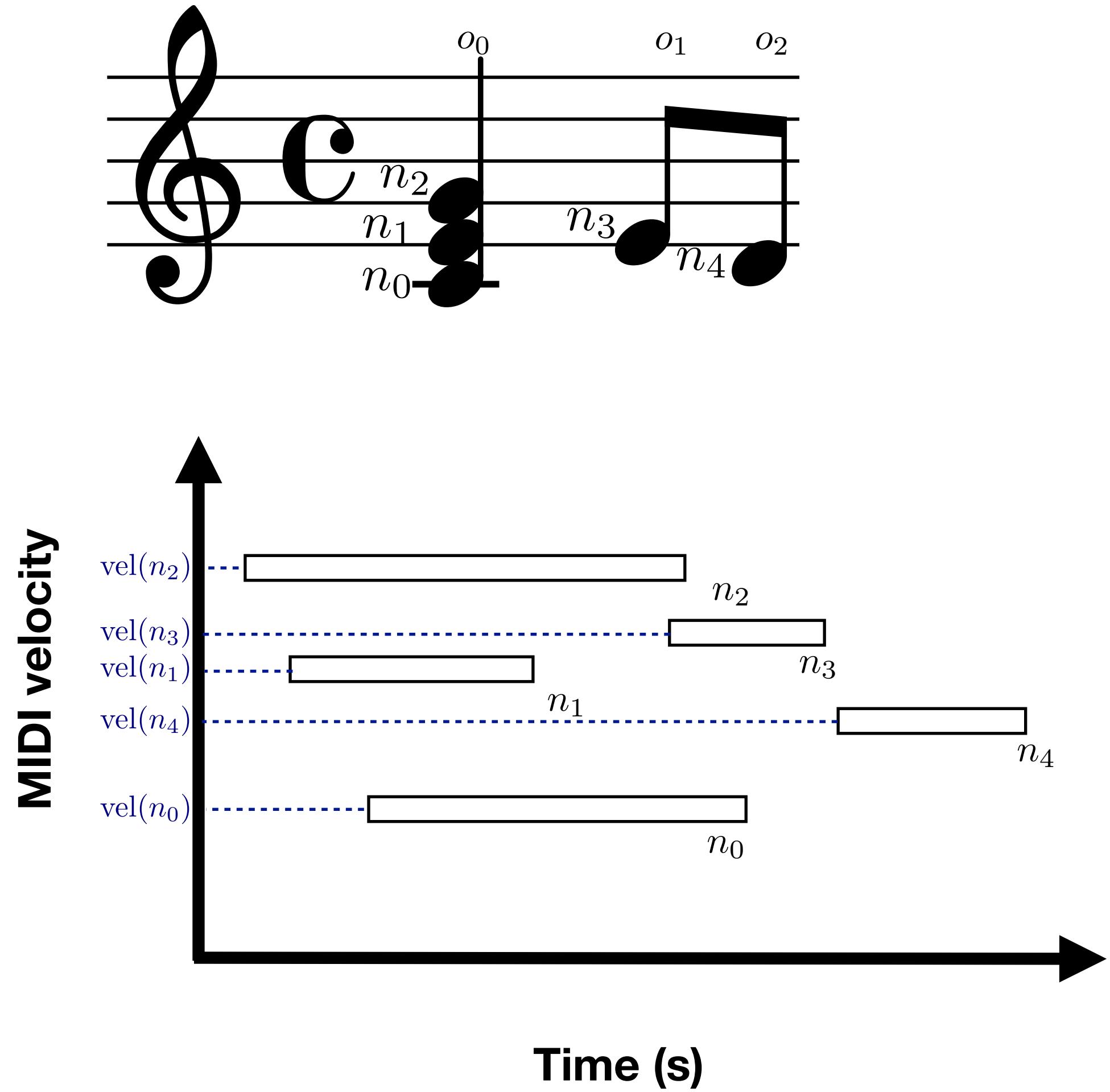
Dynamics: MIDI velocity



► Performance representation model

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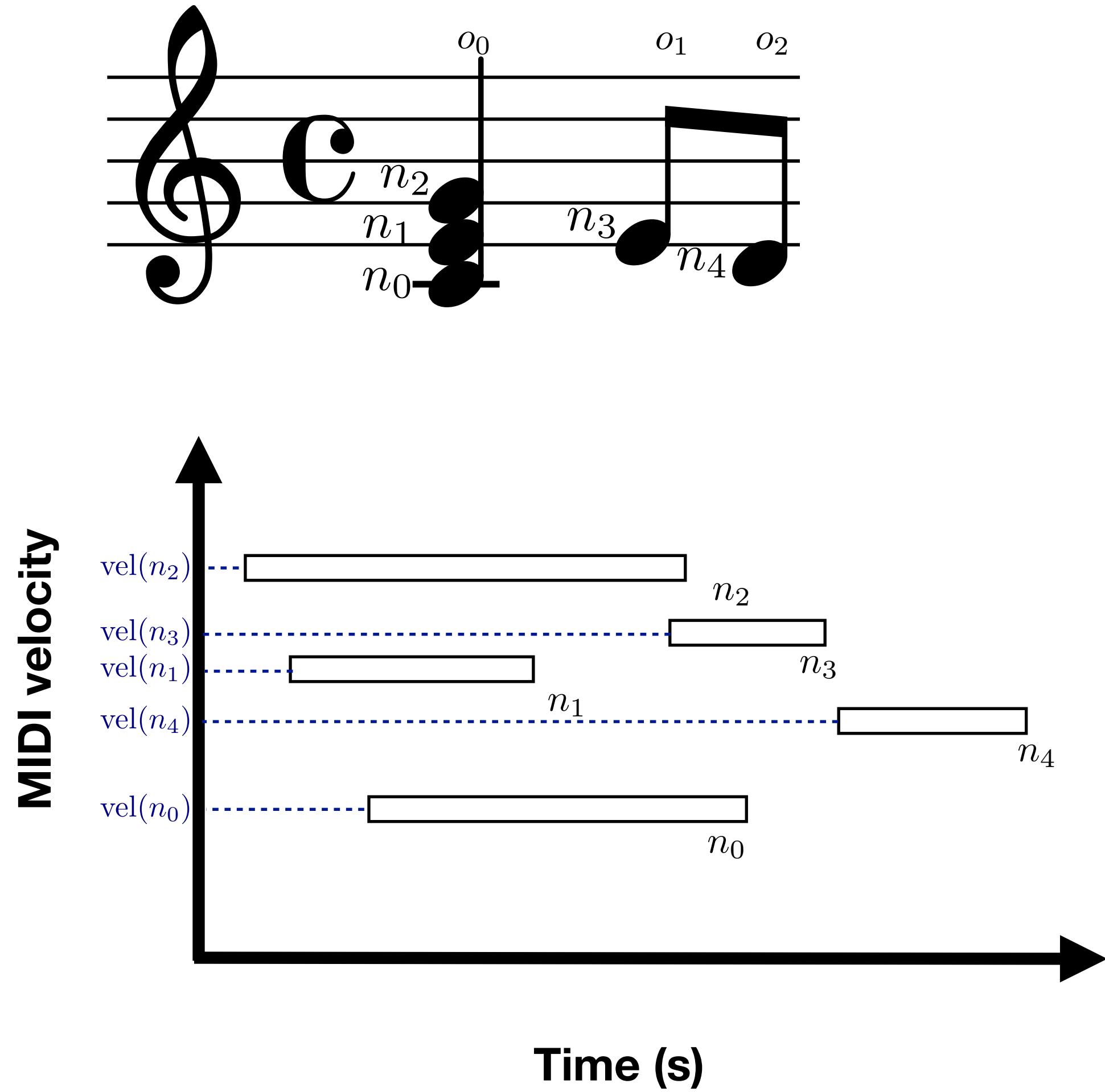
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► Performance representation model

Expressive Parameters:

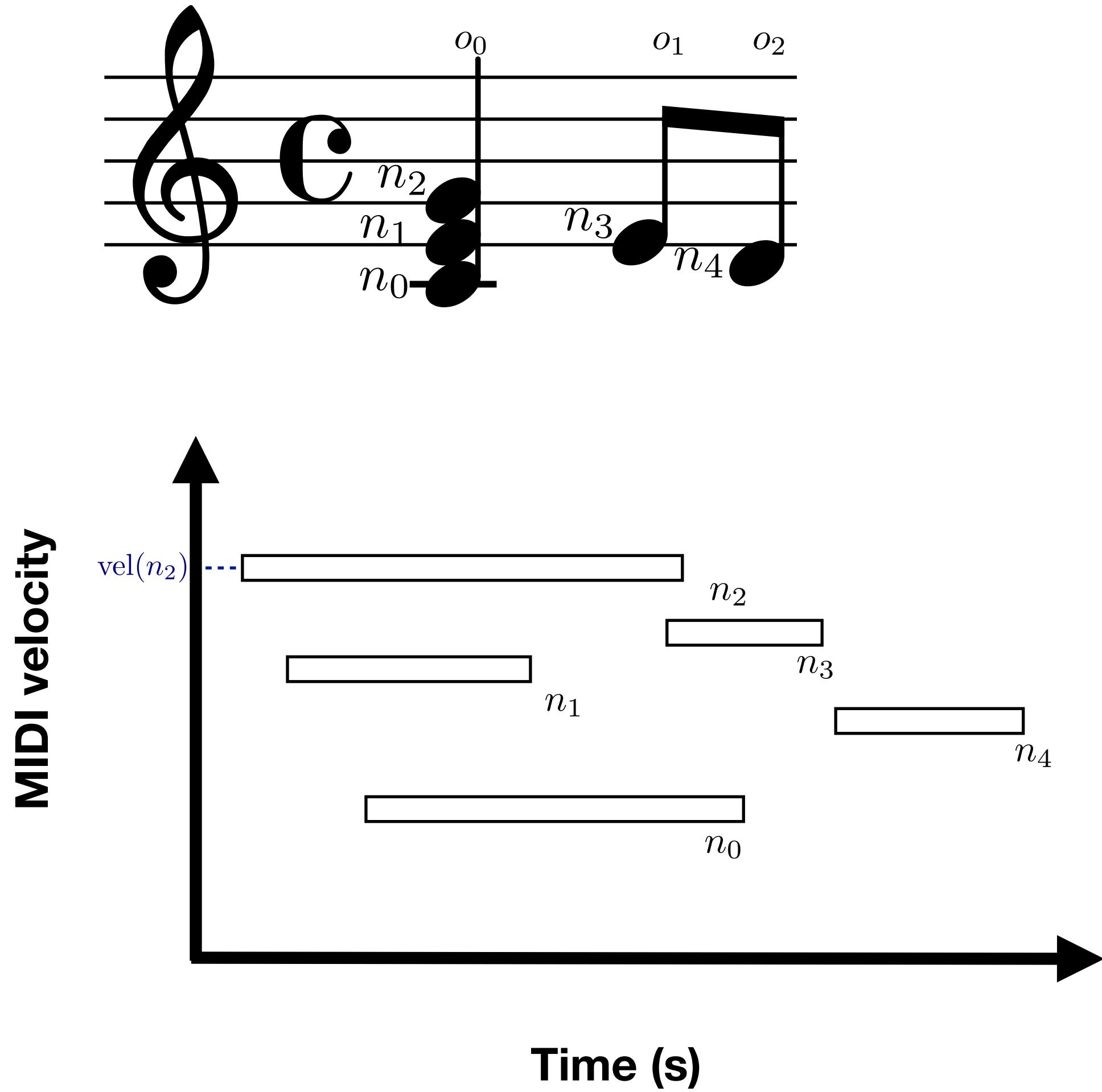
Dynamics: MIDI velocity



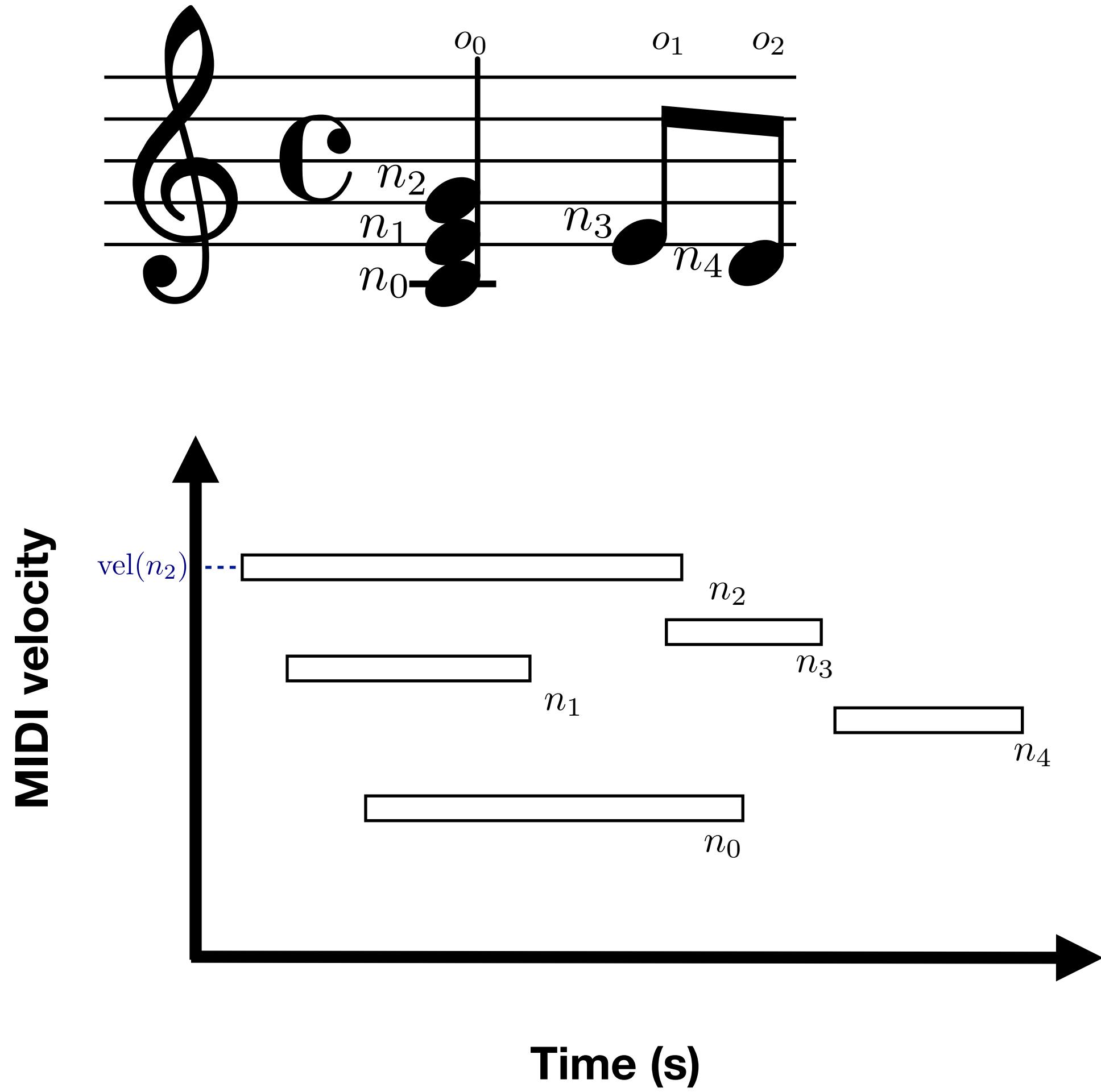
► Performance representation model

Expressive Parameters:

Dynamics: MIDI velocity



► Performance representation model

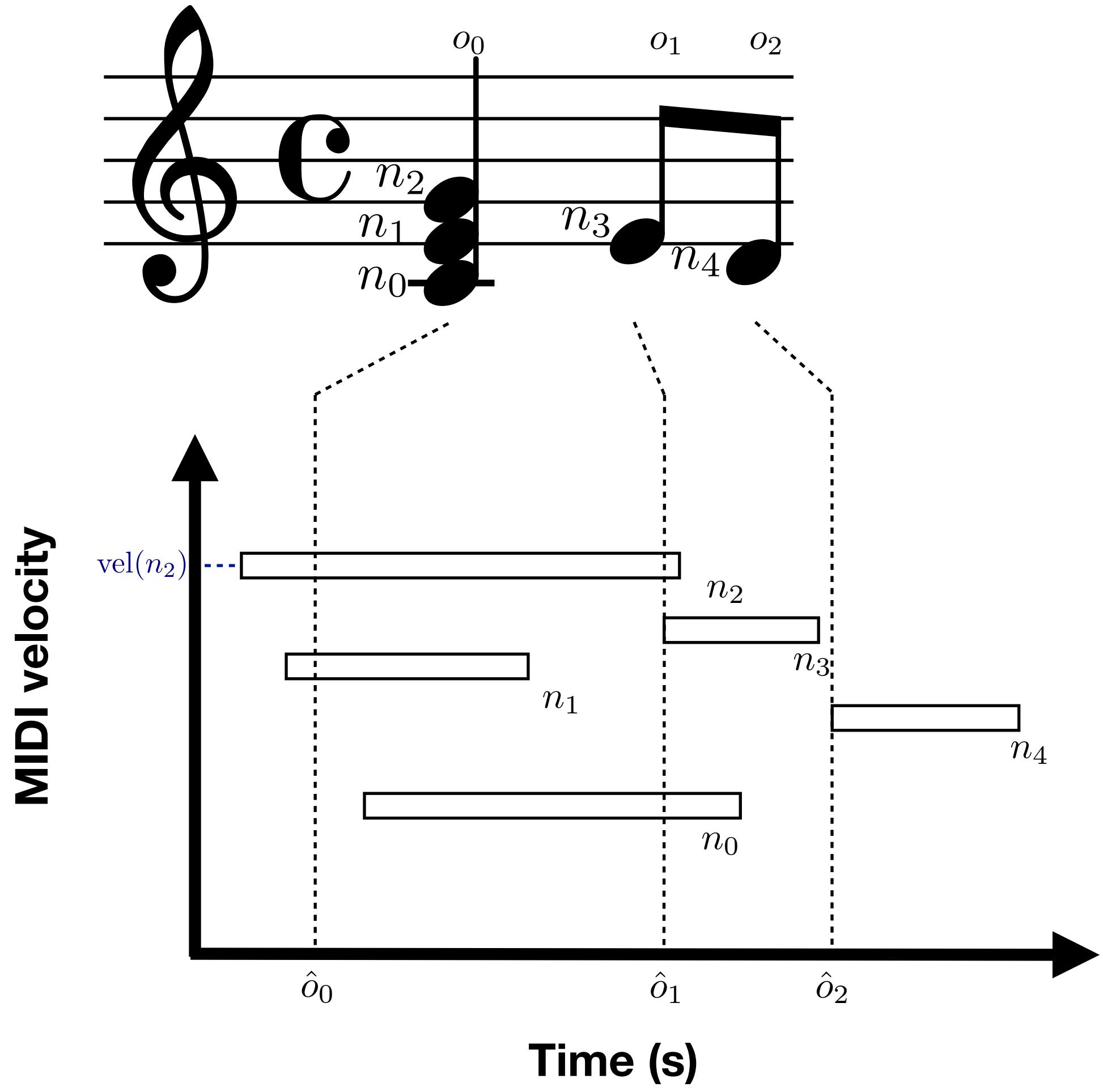


Expressive Parameters:

Dynamics: MIDI velocity

Timing

► Performance representation model

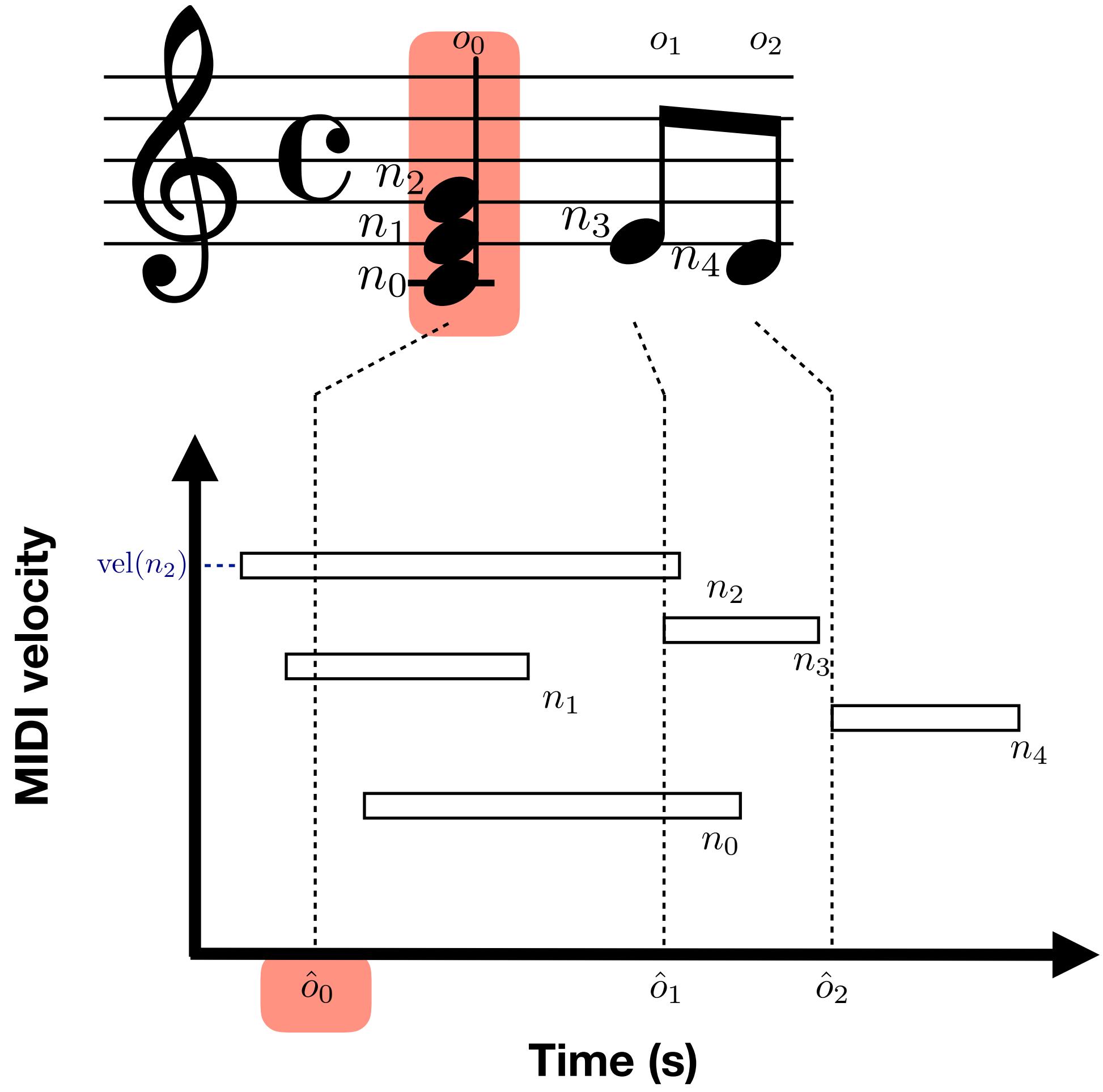


Expressive Parameters:

Dynamics: MIDI velocity

Timing

► Performance representation model

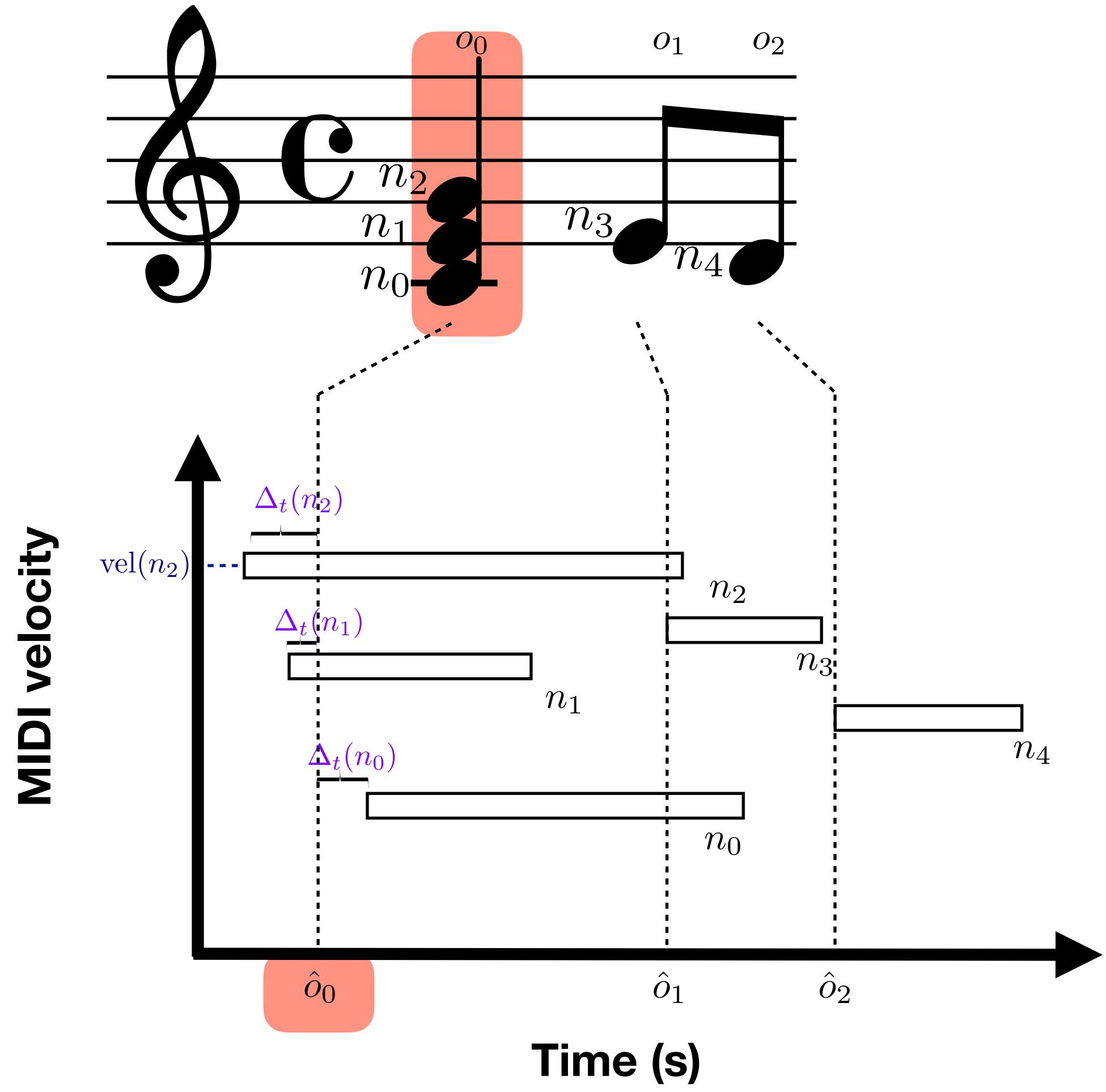


Expressive Parameters:

Dynamics: MIDI velocity

Timing

► Performance representation model

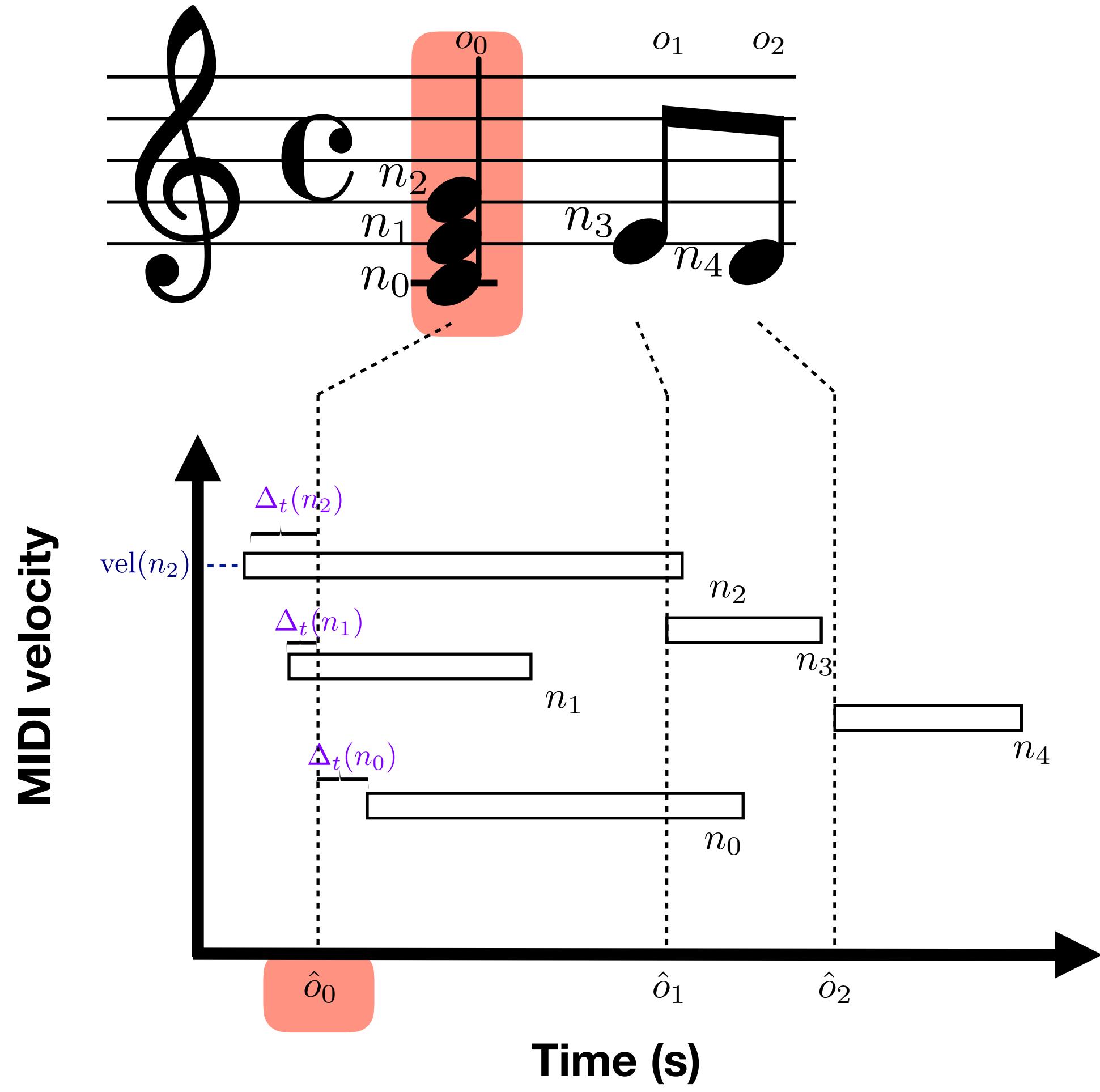


Expressive Parameters:

Dynamics: MIDI velocity

Timing

► Performance representation model

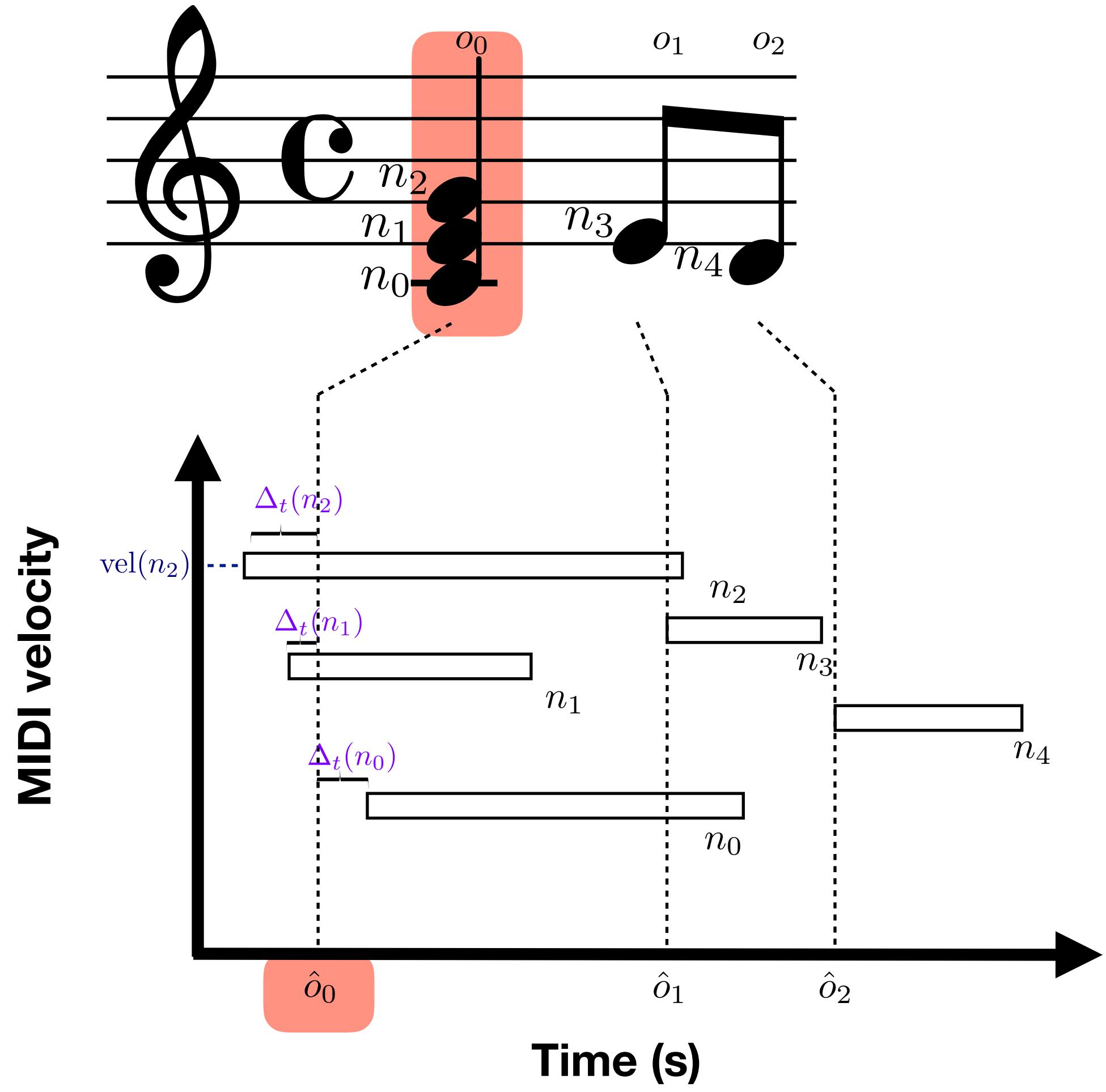


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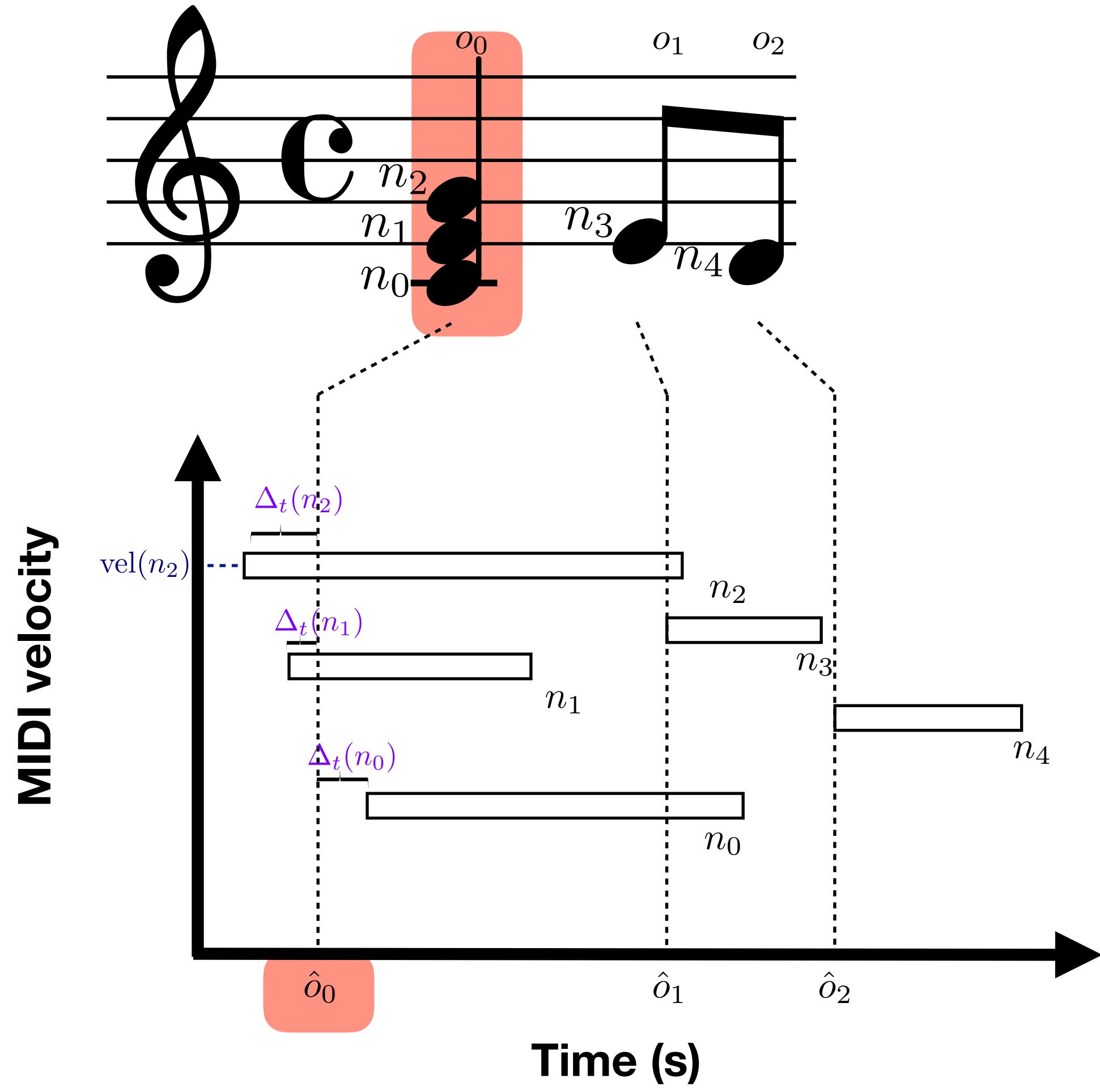


Expressive Parameters:

Dynamics: MIDI velocity

Timing

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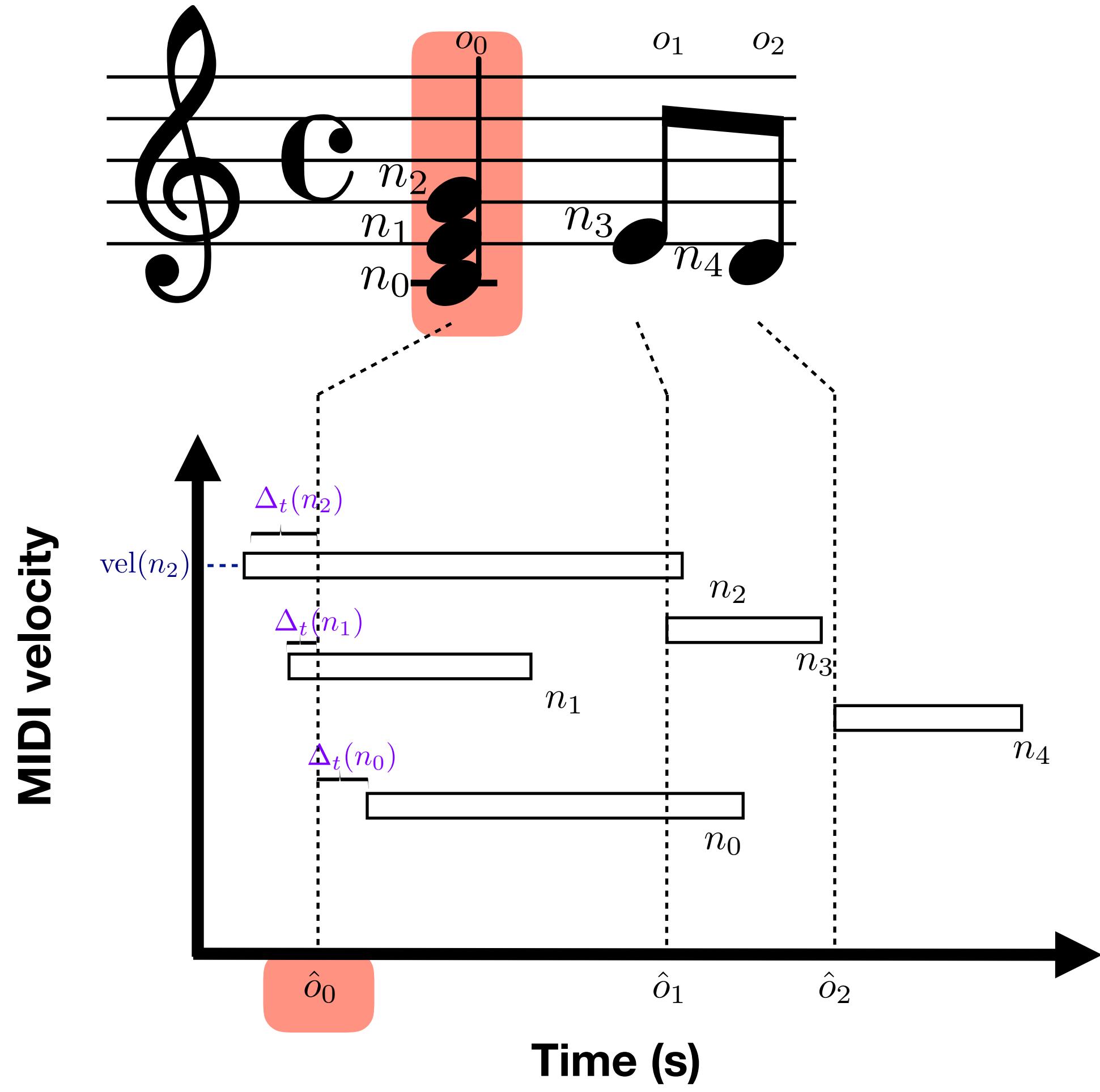


Expressive Parameters:

Dynamics: MIDI velocity

Timing

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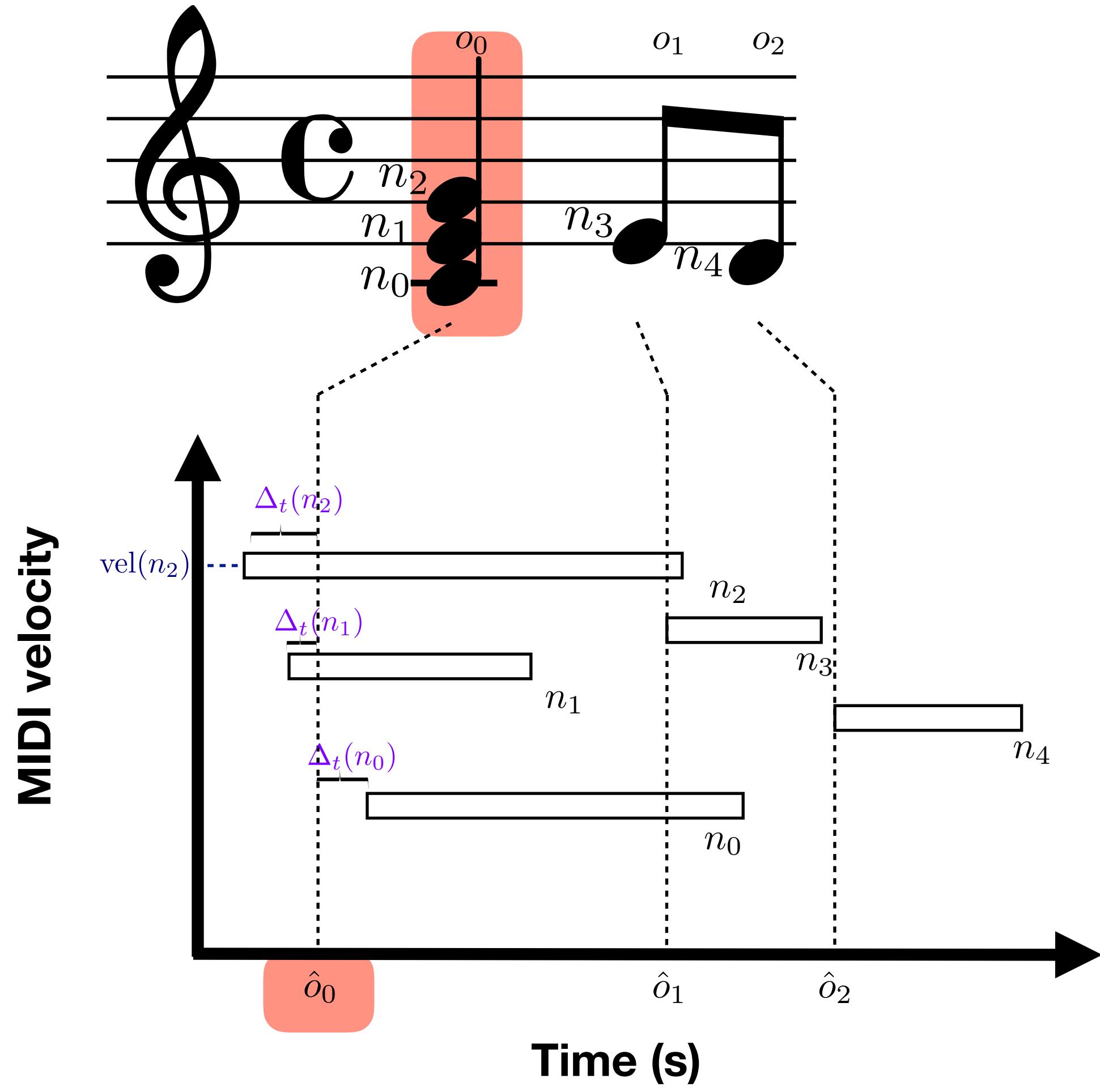


Expressive Parameters:

Dynamics: MIDI velocity

Timing

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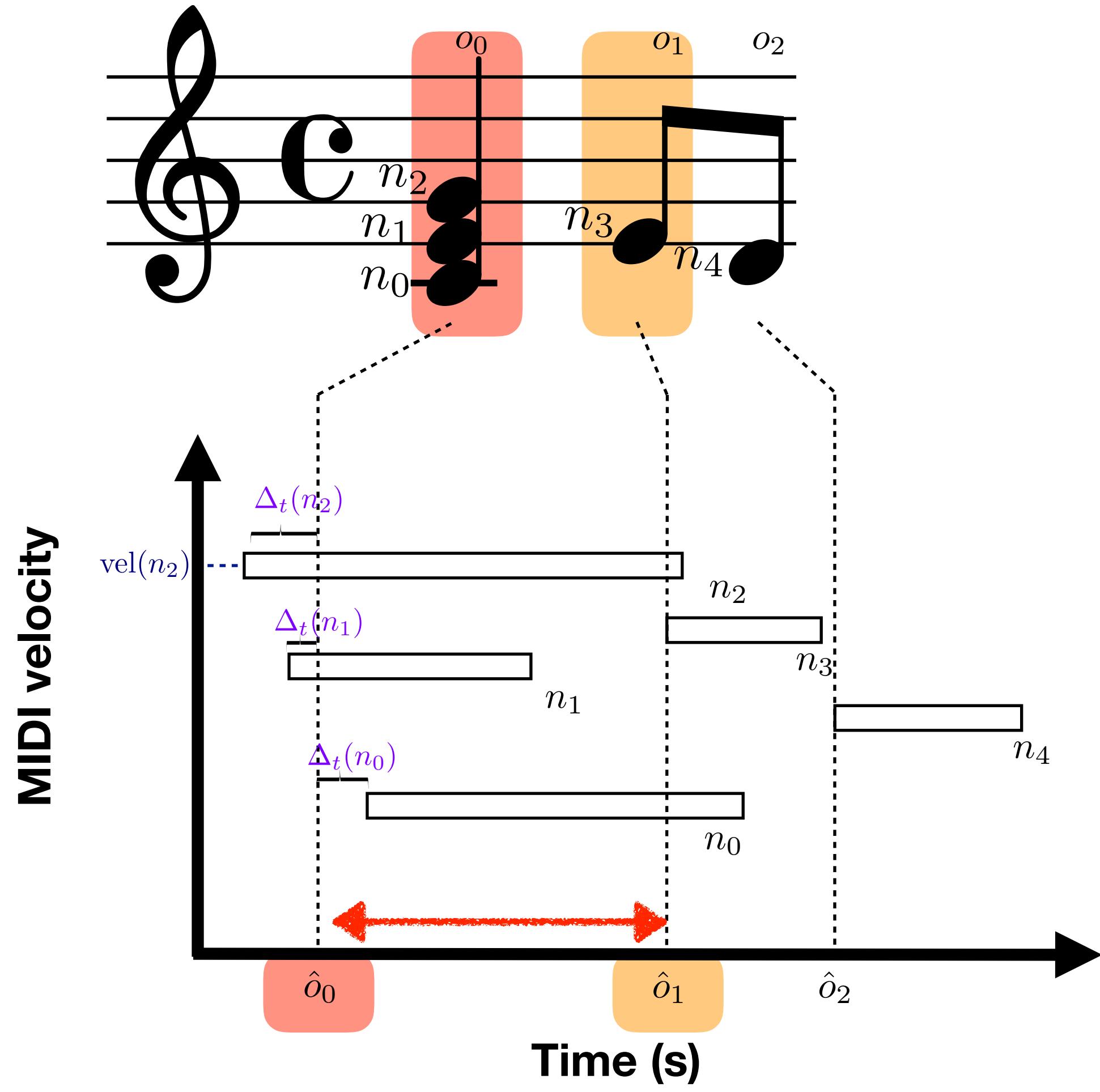
Expressive Parameters:

Dynamics: MIDI velocity

Timing

Tempo: Beat period

► Performance representation model



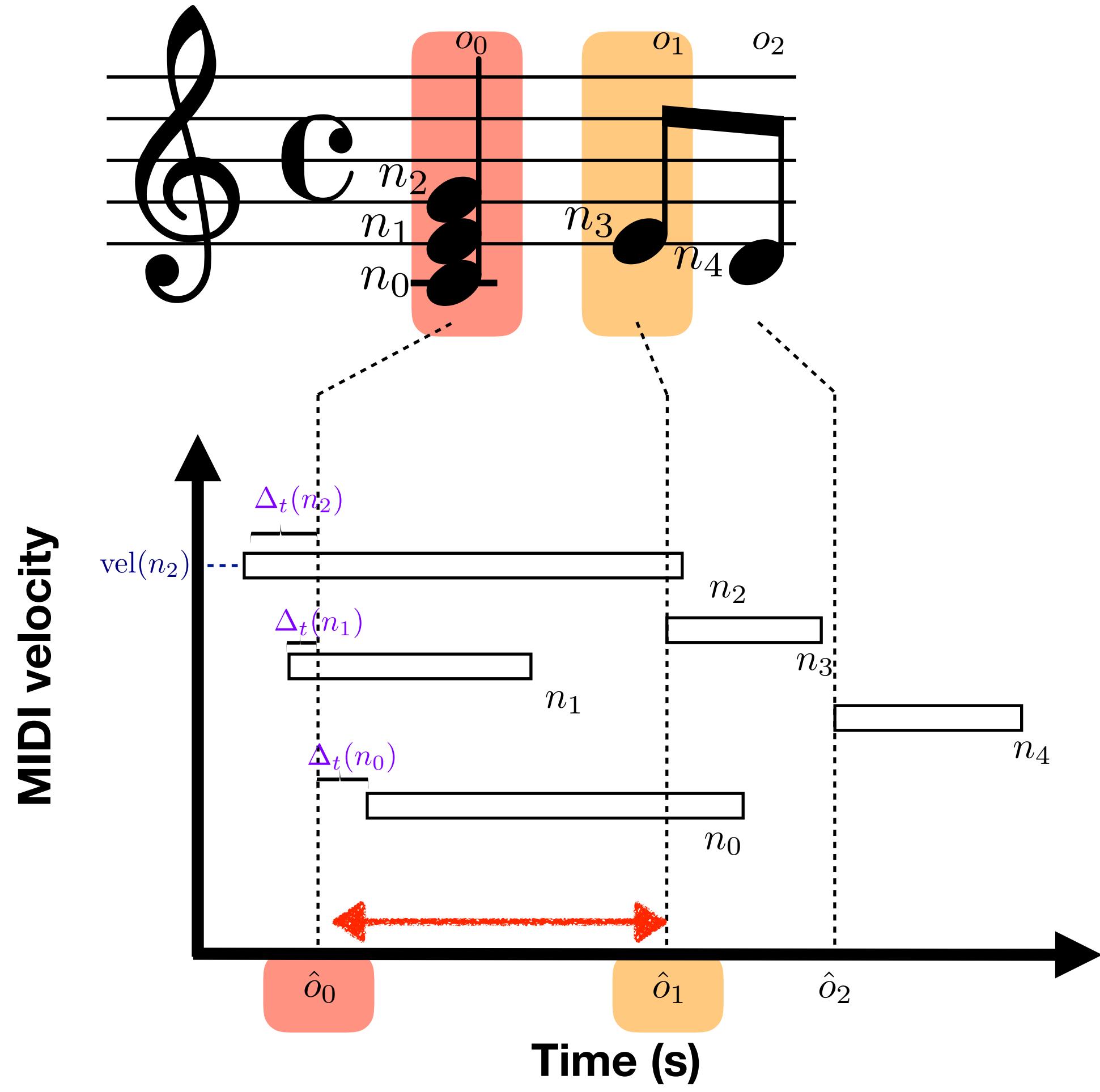
Expressive Parameters:

Dynamics: MIDI velocity

Timing

Tempo: Beat period

► Performance representation model



Expressive Parameters:

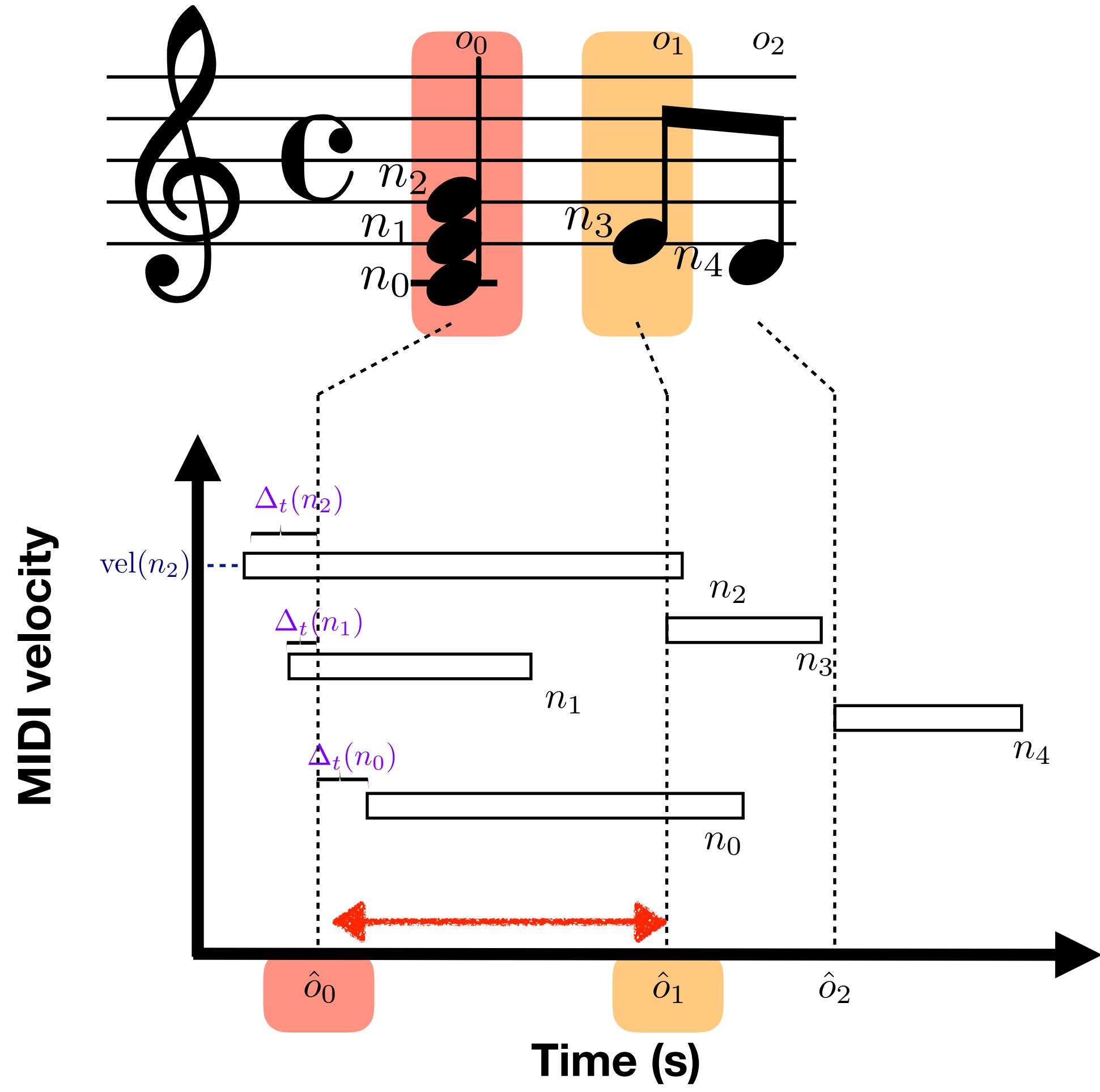
Dynamics: MIDI velocity

Timing

Tempo: Beat period

$$bp(o_0) = \frac{\text{red double-headed arrow}}{1 \text{ beat}}$$

► Performance representation model



Expressive Parameters:

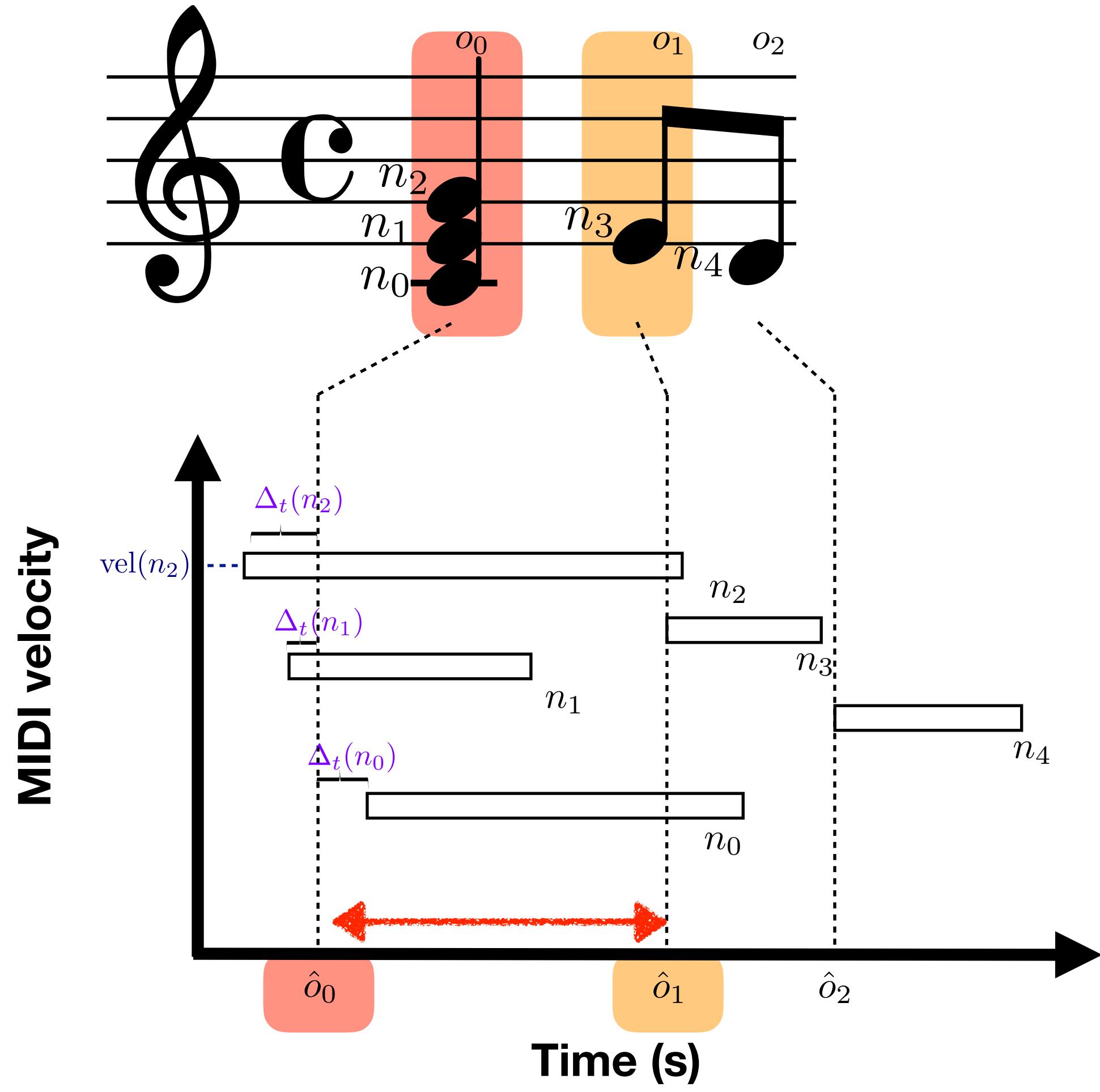
Dynamics: MIDI velocity

Timing

Tempo: Beat period

$$bp(o_0) = \frac{IOI_0^{perf}}{1 \text{ beat}}$$

► Performance representation model



Expressive Parameters:

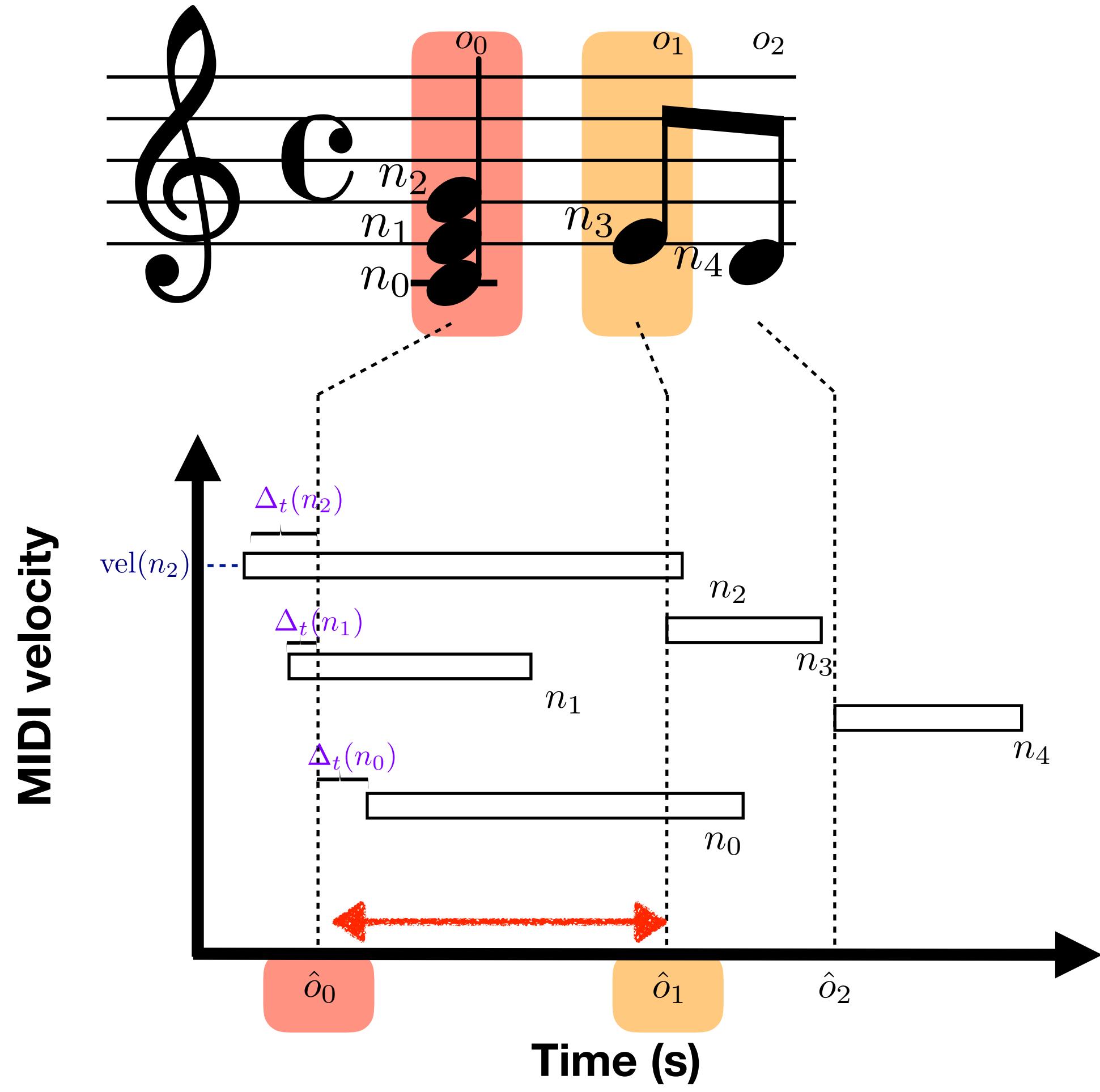
Dynamics: MIDI velocity

Timing

Tempo: Beat period

$$bp(o_0) = \frac{IOI_0^{perf}}{IOI_0^{score}}$$

► Performance representation model



Expressive Parameters:

Dynamics: MIDI velocity

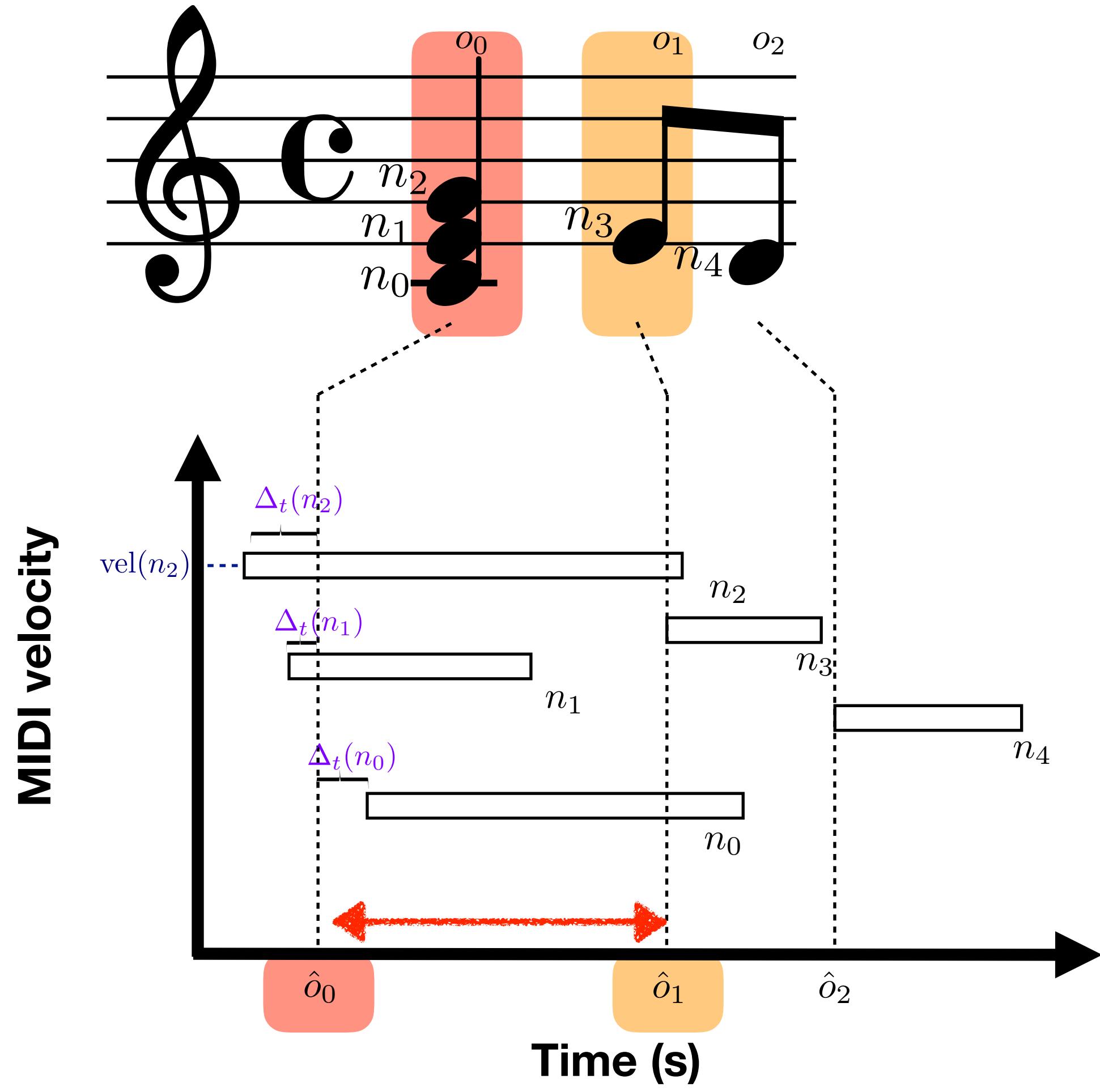
Timing

Tempo: Beat period

$$bp(o_0) = \frac{IOI_0^{perf}}{IOI_0^{score}}$$

$$bp(n_0) = bp(n_1) = bp(n_2)$$

► Performance representation model



Expressive Parameters:

Dynamics: MIDI velocity

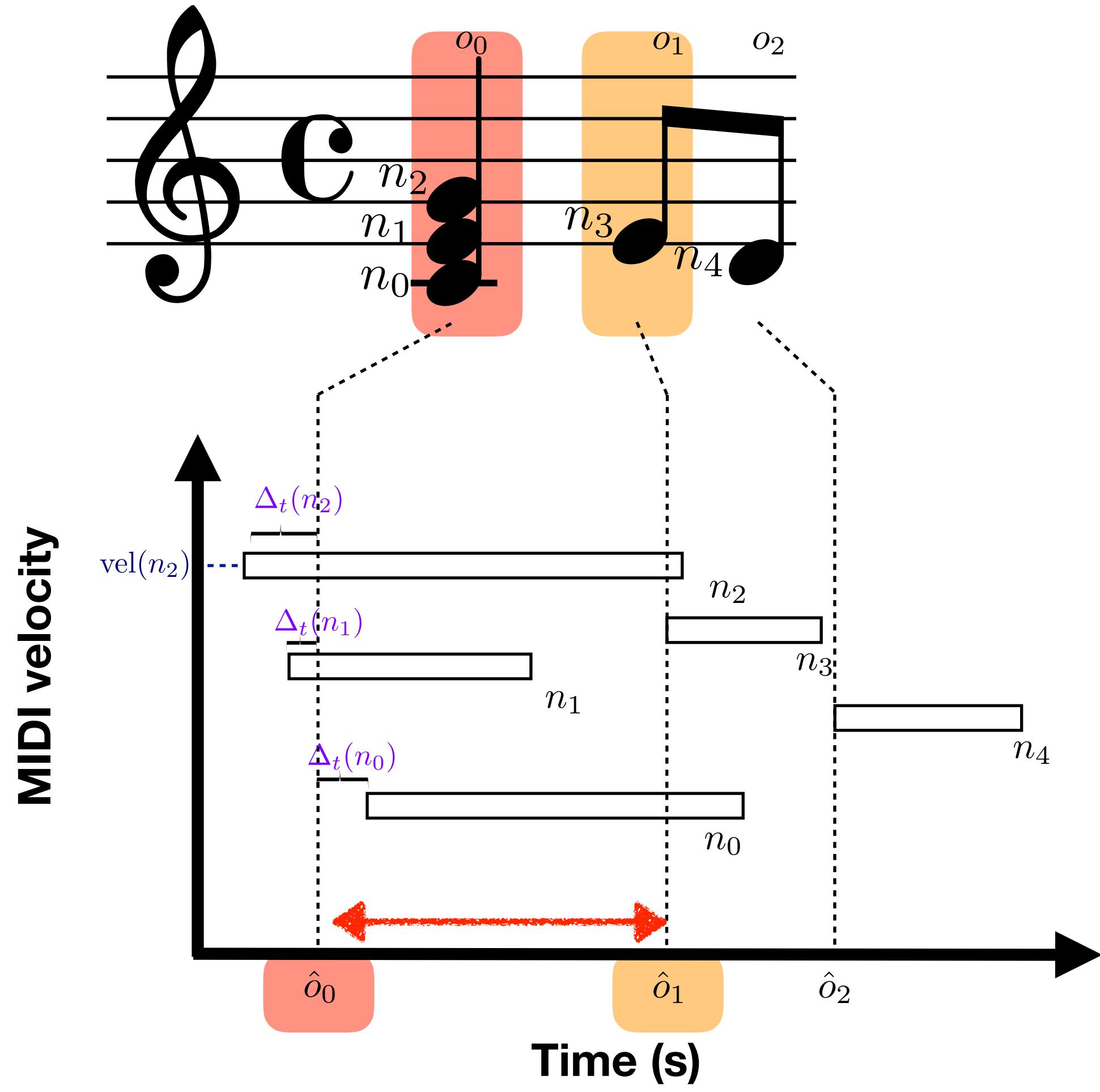
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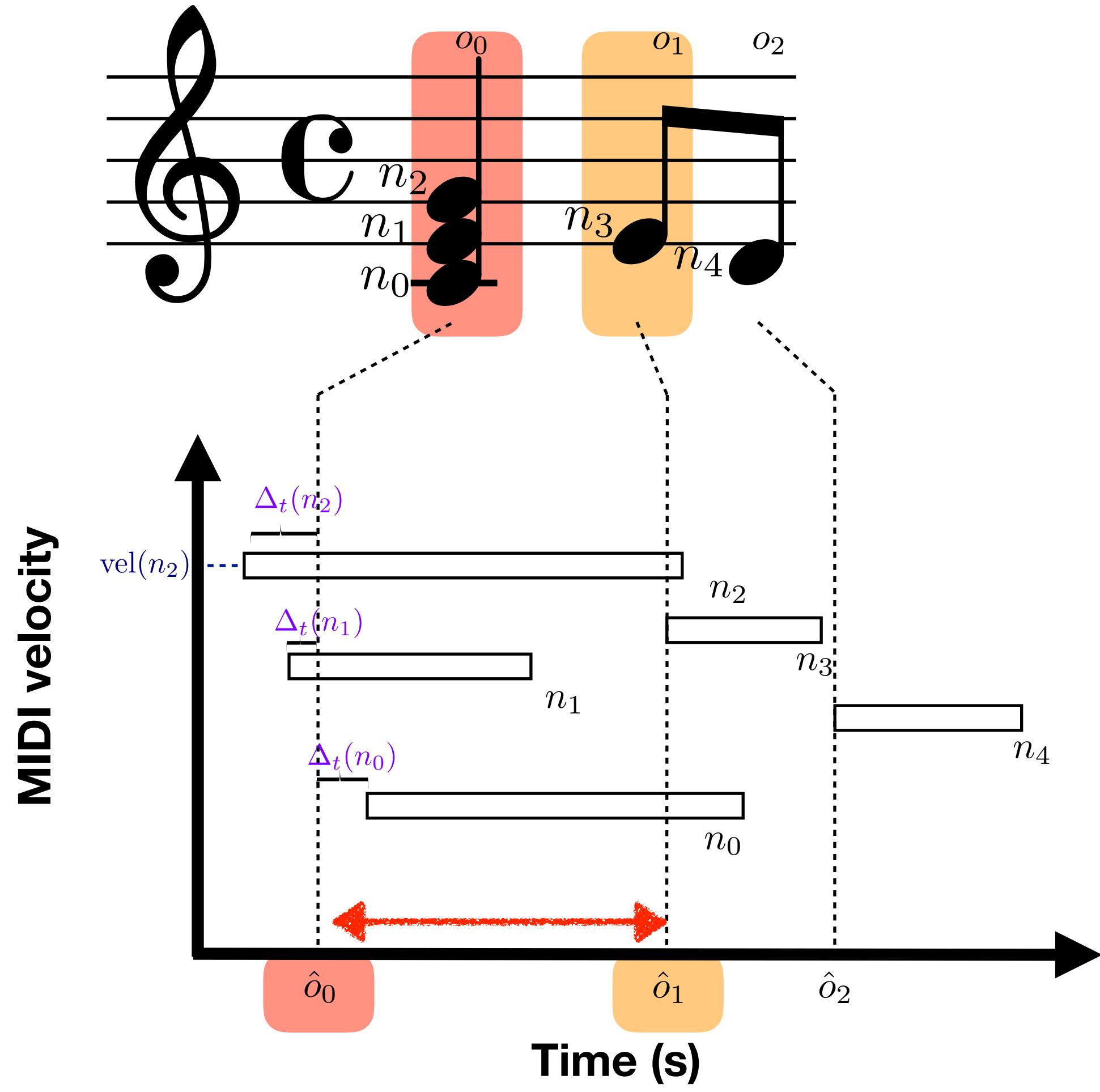
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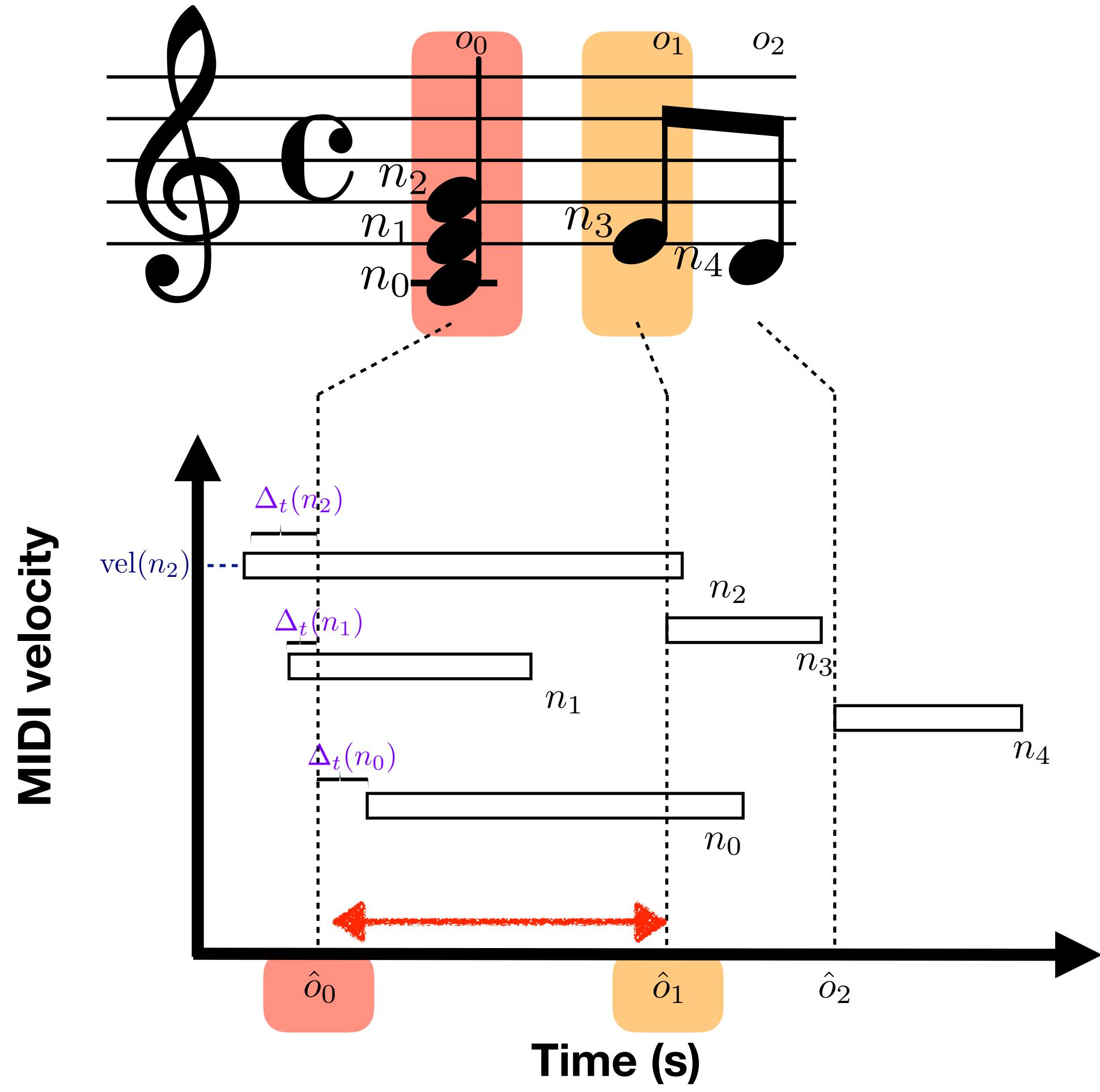
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► Performance representation model



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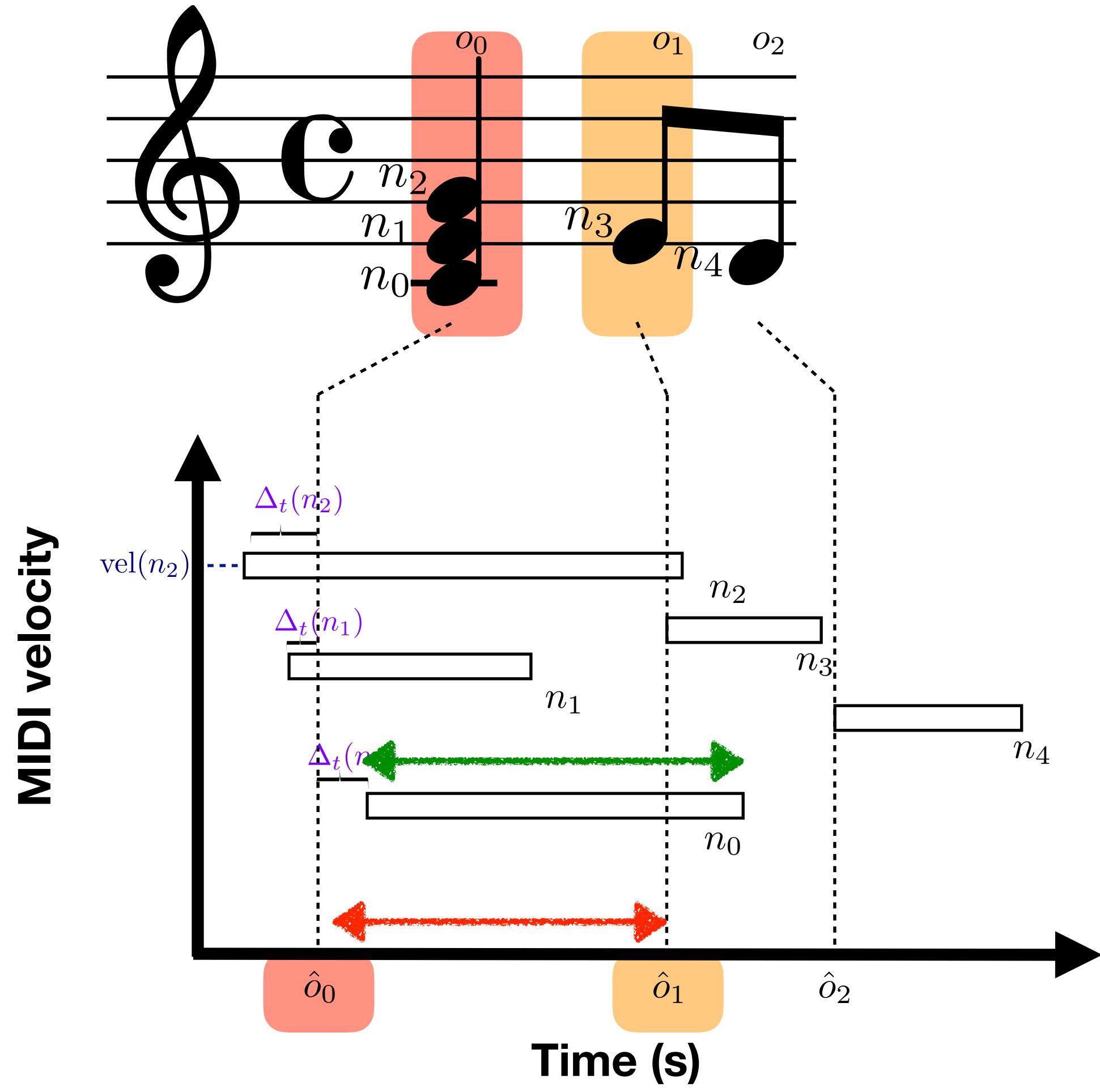
Timing

Tempo: Beat period

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► Performance representation model



Expressive Parameters:

Dynamics: MIDI velocity

Timing

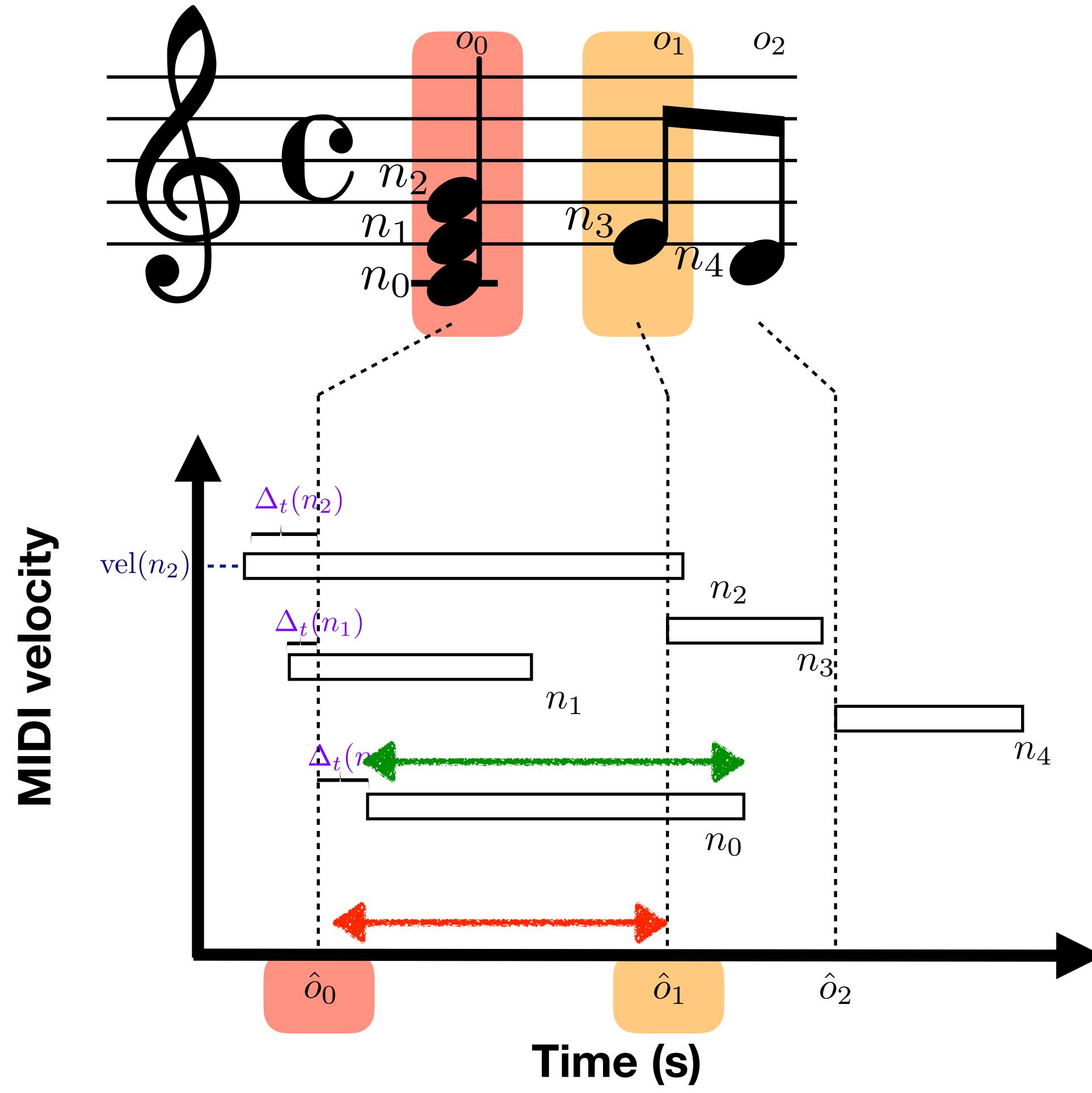
Tempo: Beat period

$$bp(o_0) = \frac{IOI_0^{perf}}{IOI_0^{score}}$$

$$bp(n_0) = bp(n_1) = bp(n_2)$$

Articulation: Articulation ratio

► Performance representation model



Expressive Parameters:

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Timing

Tempo: Beat period

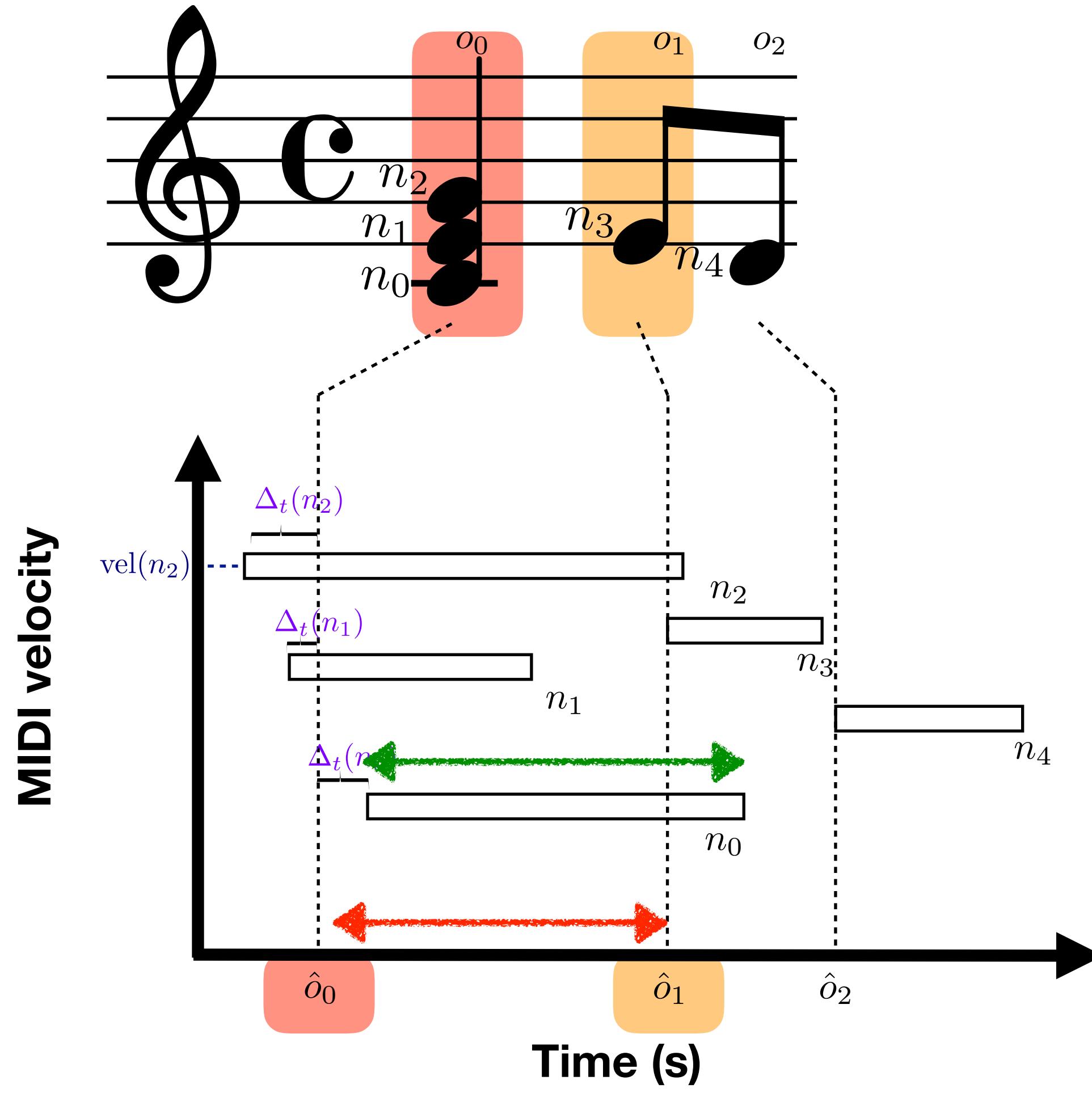
$$bp(o_0) = \frac{IOI_0^{perf}}{IOI_0^{score}}$$

$$bp(n_0) = bp(n_1) = bp(n_2)$$

Articulation: Articulation ratio

$$art(n_0) = \frac{\text{green double-headed arrow}}{1 \text{ beat} \times bp(n_0)}$$

► Performance representation model



Expressive Parameters:

Dynamics: MIDI velocity

Timing

Tempo: Beat period

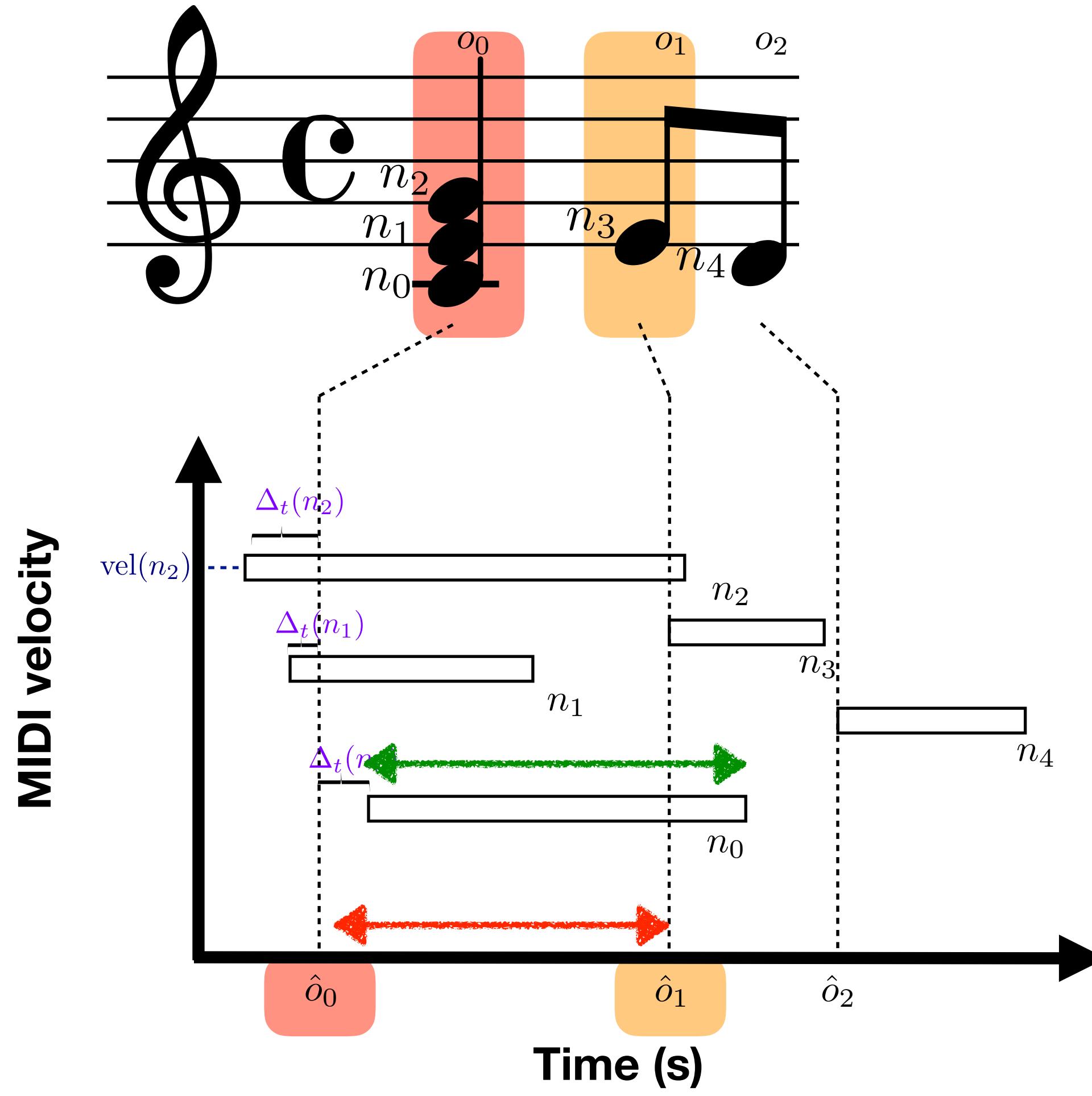
$$\text{bp}(o_0) = \frac{\text{IOI}_0^{\text{perf}}}{\text{IOI}_0^{\text{score}}}$$

$$\text{bp}(n_0) = \text{bp}(n_1) = \text{bp}(n_2)$$

Articulation: Articulation ratio

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► Performance representation model



Expressive Parameters:

Dynamics: MIDI velocity

Timing

Tempo: Beat period

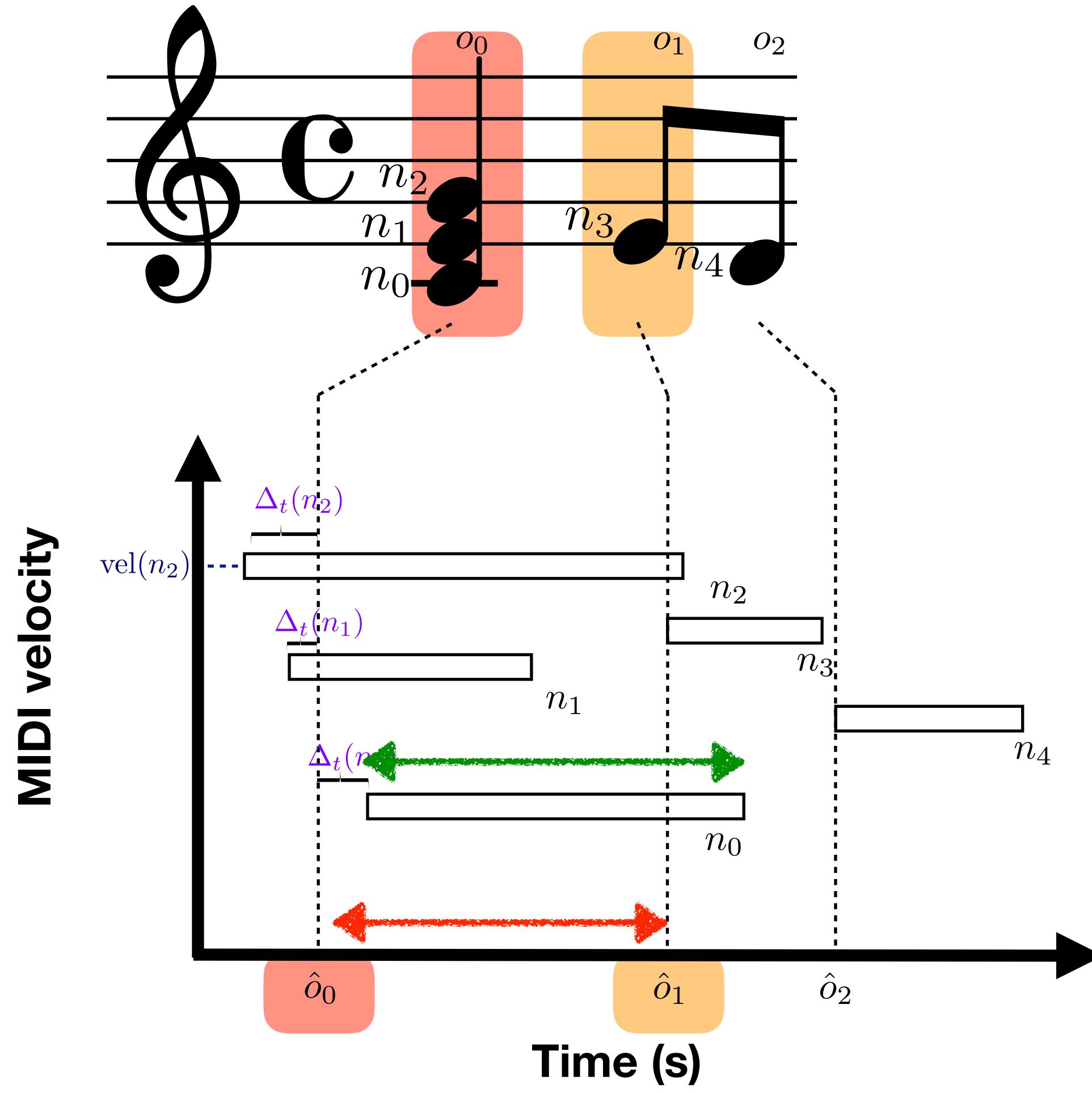
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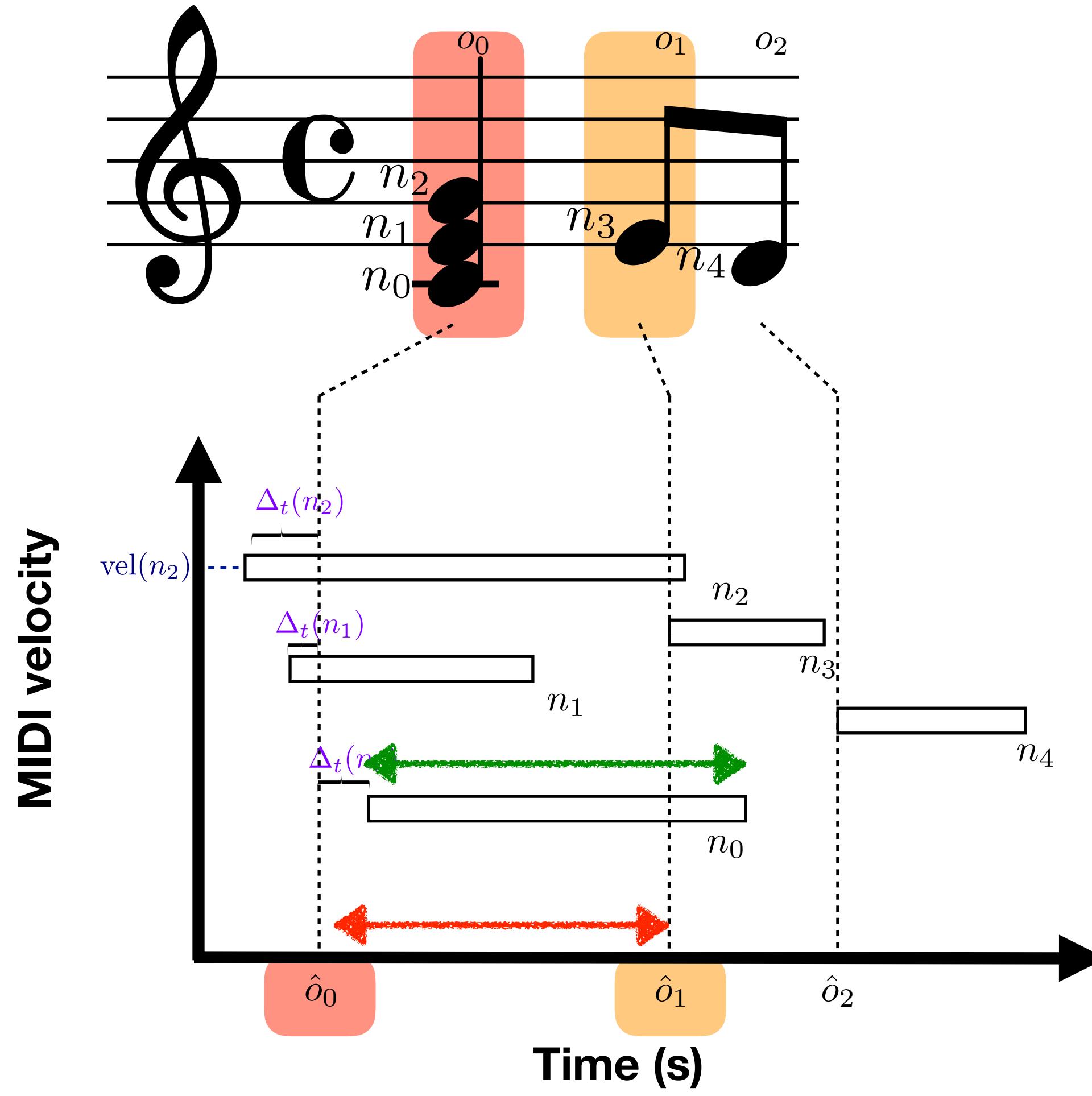
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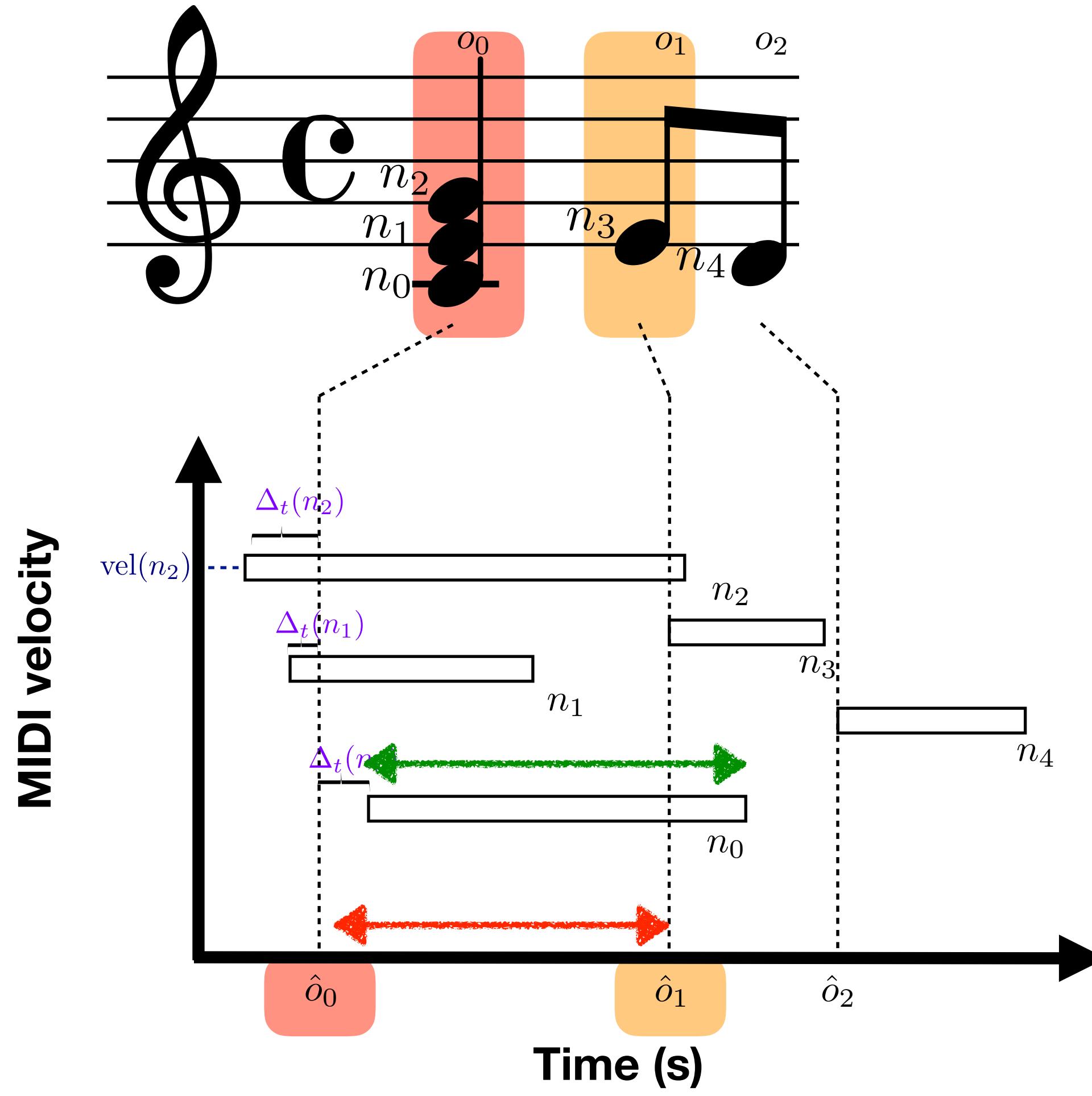
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Expressive Parameters:

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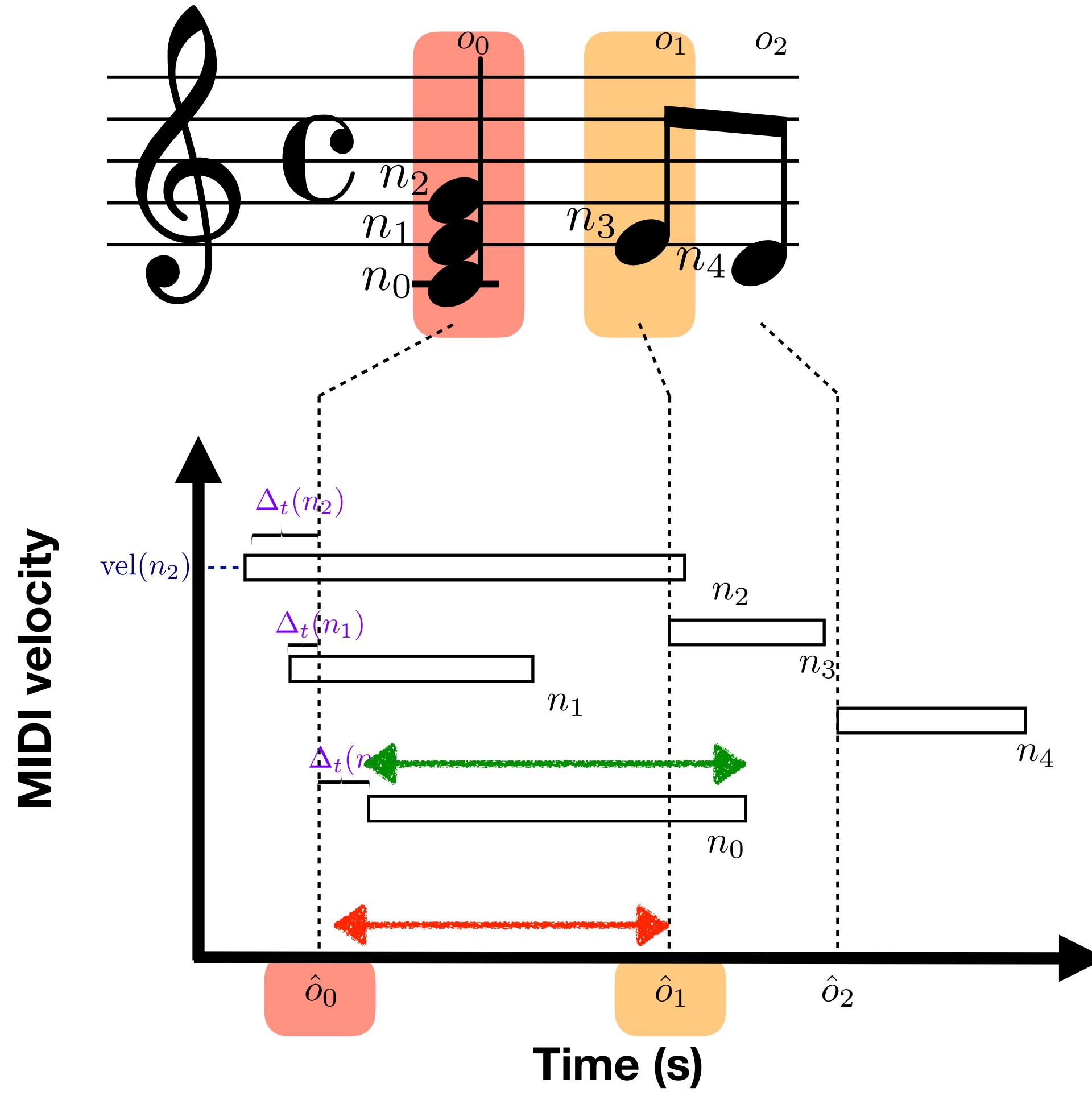
$$\text{bp}(o_0) = \frac{\text{IOI}_0^{\text{perf}}}{\text{IOI}_0^{\text{score}}}$$

$$\text{bp}(n_0) = \text{bp}(n_1) = \text{bp}(n_2)$$

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► Performance representation model



Expressive Parameters:

Dynamics: MIDI velocity

Timing

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► Datasets

Dataset	Performer	Pieces	Genre & Epoch	Multiple Performances different performer	same performer	Source	Score Alignment	Publicly Available?
PIANO								
Repp Repp (1996)	Advanced students	4	Classical: 1830–1920	yes	yes	computer-controlled piano	note-wise	no
Vienna 4x22 Goebl (1999)	Advanced students & professionals	4	Classical: 1780–1840	yes	no	computer-controlled piano	note-wise	Yes
Batik/Mozart Widmer and Tobudic (2002)	Professional	30+	Classical: 1750–1800	no	no	computer-controlled piano	note-wise	no
Magaloff/Chopin Flossmann et al. (2010)	World-renowned	150+	Classical: 1800–1850	no	no	computer-controlled piano	note-wise	no
Zeilinger/Beethoven Cancino-Chacón et al. (2017)	Professional	15+	Classical: 1790–1830	no	no	computer-controlled piano	note-wise	no
Mazurka Sapp (2007)	World-renowned	45+	Classical: 1800–1850	yes	some	audio recordings	onset-wise	Yes
CrestMuse PEDB Hashida et al. (2008, 2017)	World-renowned & professionals	40+	Classical: 1700–1900	no	yes	audio recordings and computer-controlled piano	note-wise	Yes
Maestro Simon et al. (2017)	Professional	900+	Classical: 1700–2000	yes	no	computer-controlled piano	none	Yes
Xia Xia and Dannenberg (2015)	Advanced Students (duets)	3	Popular: 1800–1990	yes	yes	computer-controlled piano	note-wise	Yes
OTHER								
RCO/Symphonic Grachten et al. (2017)	World-renowned (orchestra)	20+	Classical: 1800–1900	yes	no	audio recordings	onset-wise	no
Marchini Marchini et al. (2014)	Professional (string quartet)	1	Classical: 1790–1800	no	yes	audio recordings	onset-wise	no

Hands-on Part I

MazurkaBL

- 2000 selected recordings from the CHARM Mazurka dataset. It contains score-aligned loudness, beat, and expressive marking data

Link to jupyter notebook: <https://bit.ly/34s4LrU>

Alternatively: setup using git

1. `git clone https://github.com/katkost/MazurkaBL.git`
2. in `/MazurkaBL`: `pip install -r requirements.txt`
3. in `/MazurkaBL/scripts`: `jupyter notebook`
4. in browser window select file: `ismir_tutorial.ipynb`

Part III

Generation

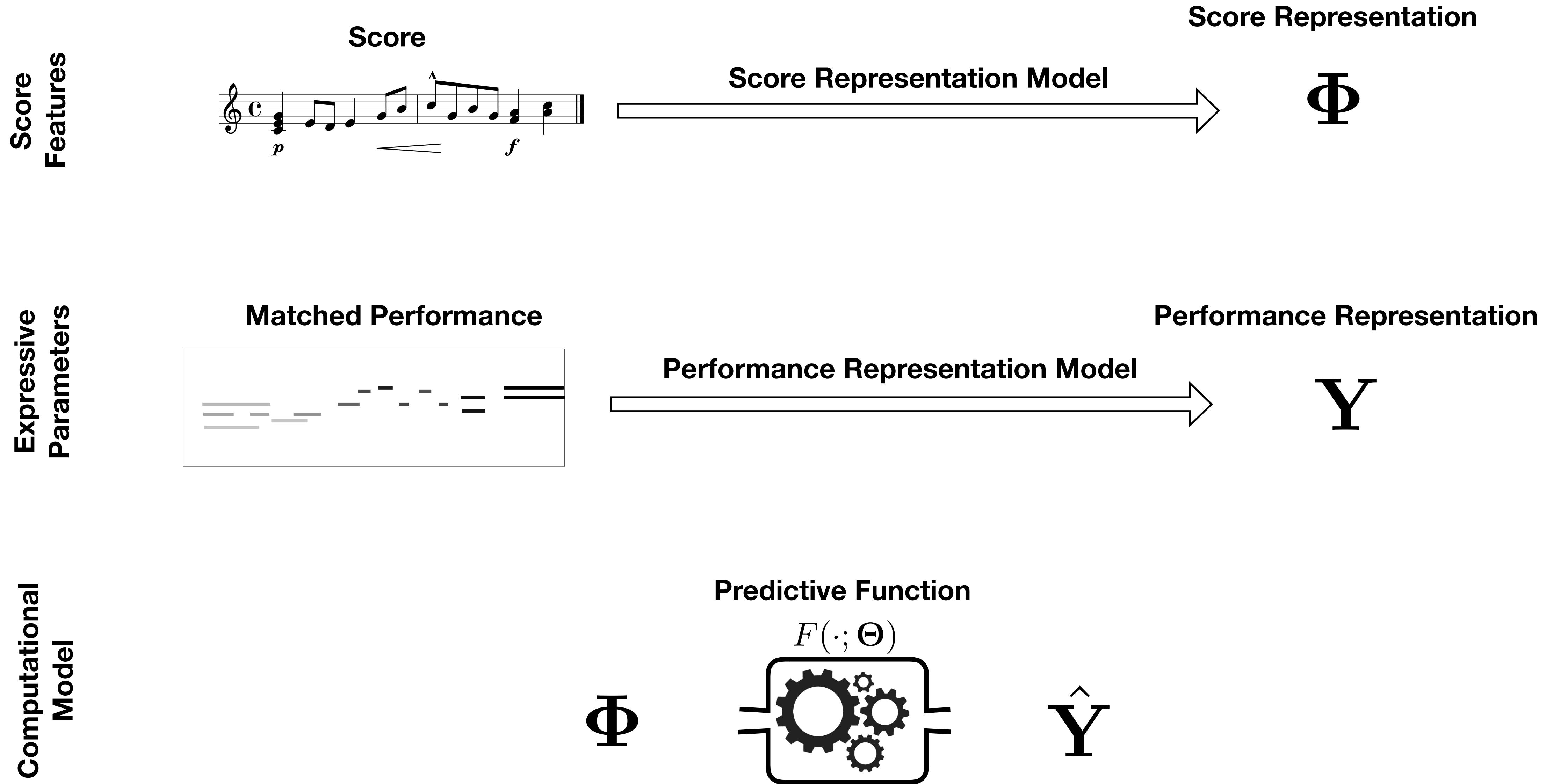
Methods for Generation

System	Computational Model	Expressive Parameters	Score Features
KTH <small>Sundberg et al. (1983); Friberg et al. (2006)</small>	Rule-based	<ul style="list-style-type: none"> • Tempo • Dynamics: MIDI velocity • Articulation 	<ul style="list-style-type: none"> • Rules for each aspect of expression
ESP <small>Grindlay and Helmbold (2006)</small>	Hierarchical HMMs	<ul style="list-style-type: none"> • Tempo: log IBI ratio and its first difference. • Dynamics: MIDI velocity 	<ul style="list-style-type: none"> • Low-level: melodic interval. • High-level: metrical hierarchies and phrase structure (annotated)
NAIST <small>Teramura et al. (2008)</small>	Gaussian Processes	<ul style="list-style-type: none"> • Dynamics: MIDI velocity, • Timing: onset deviations (bpm) • Articulation: offset deviations (bpm) 	<ul style="list-style-type: none"> • Low-level: pitch, duration, dynamics markings. • High-level: time signature, melody, relative pitch.
YQX <small>Flossmann et al. (2011)</small>	DBNs (+ learned articulation rules from Widmer (2003))	<ul style="list-style-type: none"> • Tempo: low frequency components of the log-IOI. • Timing: high-frequency components of log-IOI. • Articulation: duration ratio • Dynamics: log-MIDI velocity. 	<ul style="list-style-type: none"> • Low-level: Pitch, contour. • High-level: Narmour's IR features, harmonic consonance
Gu & Raphael <small>Gu and Raphael (2012)</small>	Switching Kalman Filter	<ul style="list-style-type: none"> • Tempo: IOI • Dynamics: MIDI velocity 	<ul style="list-style-type: none"> • Low-level: position in the score
Polyhymnia <small>Kim et al. (2013)</small>	3 CRFs modeling the highest and lowest voices (m) and a harmony model (h) for the inner voices (+ rules for dynamics markings and ornaments from statistical analysis)	<ul style="list-style-type: none"> • Tempo: log IBI ratio (m) • Timing: onset deviations • Articulation: note-wise duration ratio (m, h). • Dynamics: log MIDI velocity ratio (m, h). 	<ul style="list-style-type: none"> • Low-level: pitch (m), duration (m,h), interval to outer voices (h) • High-level: metrical strength (m)
Laminae <small>Okumura et al. (2014)</small>	Performance cases modeled by Gaussian distributions and Tree-based clustering + first order Markov model.	<p>Voice-wise first differences of</p> <ul style="list-style-type: none"> • Tempo: ave. bpm per beat • Timing: onset deviations (bpm) • Articulation: duration ratio • Dynamics: MIDI velocity 	<ul style="list-style-type: none"> • Low-level: pitch class, octave, dynamics markings • High-level: phrasing, voice (human annotated)

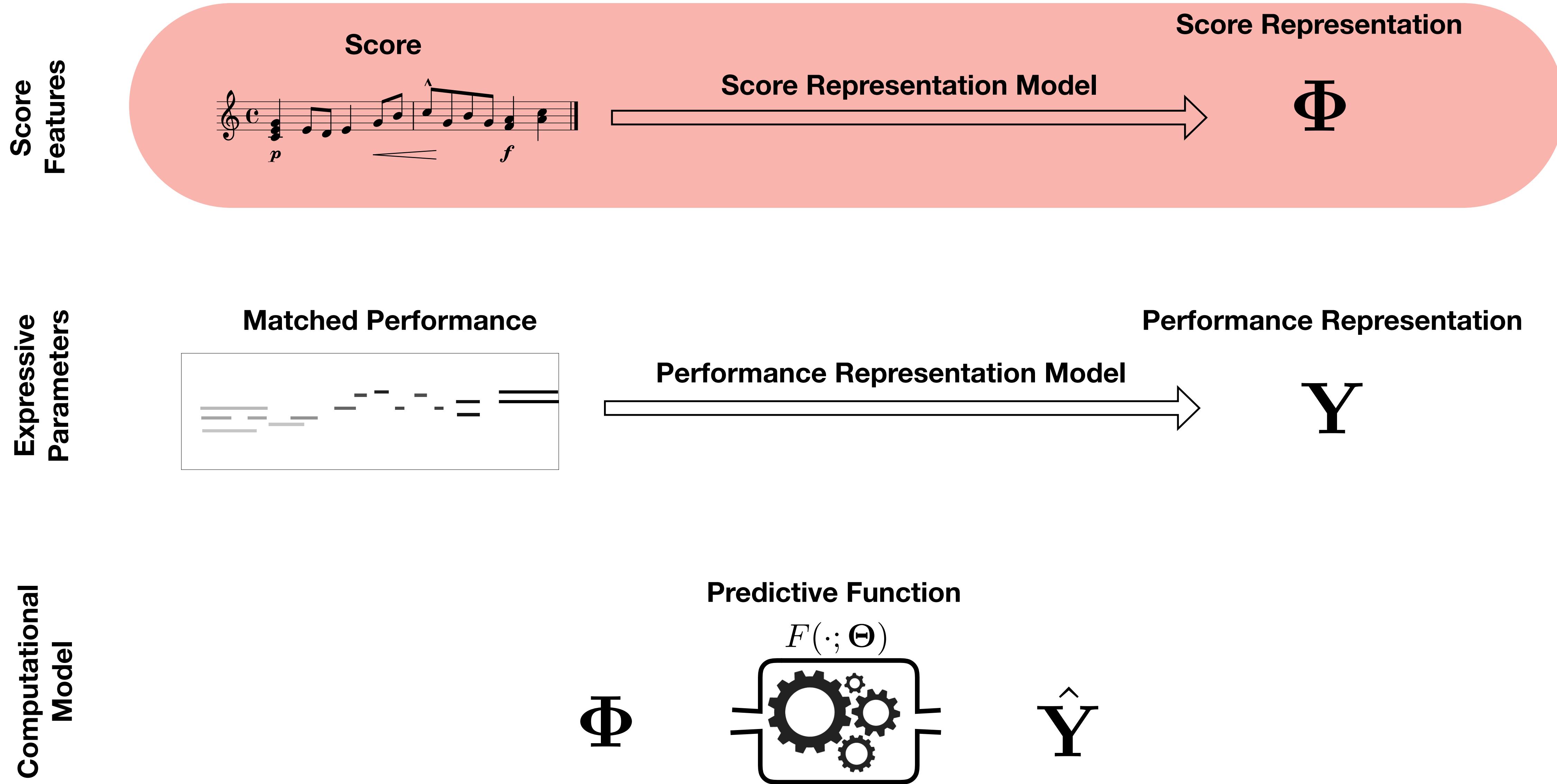
Methods for Generation

System	Computational Model	Expressive Parameters	Score Features
Bresin <small>Bresin (1998)</small>	FFNNs	<ul style="list-style-type: none"> • Tempo: IOI • Articulation: performed duration • Dynamics: change in loudness 	<ul style="list-style-type: none"> • Low-level: pitch, duration, melodic interval • High-level: encodings of conditions for KTH rules, like leap articulation, melodic charge, articulation repetition
Unsupervised RBM <small>van Herwaarden et al. (2014); Grachten and Krebs (2014)</small>	RBM (features) + Linear Models	<ul style="list-style-type: none"> • Dynamics: MIDI velocity 	<ul style="list-style-type: none"> • Low-level: note-centered piano-roll, MIDI-velocity history
Giraldo & Ramírez <small>Giraldo and Ramírez (2016)</small>	<ul style="list-style-type: none"> • Ornamentation (classification): FFNNs, decision trees, SVMs, k-NN • Timing, Articulation and Dynamics (regression): FFNNs, regression trees, SVMs, k-NN 	<ul style="list-style-type: none"> • Timing: onset deviation • Articulation: duration ratio • Dynamics: energy ratio • Ornamentation 	<ul style="list-style-type: none"> • Low-level: pitch, duration, position in bar • High-level: Narmour's IR features, key, metrical position, phrase position
Basis Mixer <small>Grachten and Widmer (2012); Cancino Chacón and Grachten (2016)</small>	<ul style="list-style-type: none"> • Onset-wise model: RNNs • Note-wise: models FFNNs <p>Models can be either deterministic NNs or probabilistic GMDNs</p>	<ul style="list-style-type: none"> • Tempo: log-IBI (onsetwise) • Timing: Onset deviations (notewise) • Articulation log-duration (notewise) • Dynamics: MIDI velocity trend (onsetwise) and deviations (onsetwise) 	<p>Encoding of score aspects through basis functions.</p> <ul style="list-style-type: none"> • Low-level: pitch, duration, dynamics and articulation markings, position in bar • High-level: tonal tension, harmonic analysis
VirutosoNet <small>Jeong et al. (2019)</small>	<ul style="list-style-type: none"> • Hierarchical-RNN 	<ul style="list-style-type: none"> • Tempo: log-IBI (onsetwise) • Timing • Articulation/Pedal • Dynamics: MIDI velocity 	<ul style="list-style-type: none"> • pitch, duration of note, tempo and dynamic markings, etc

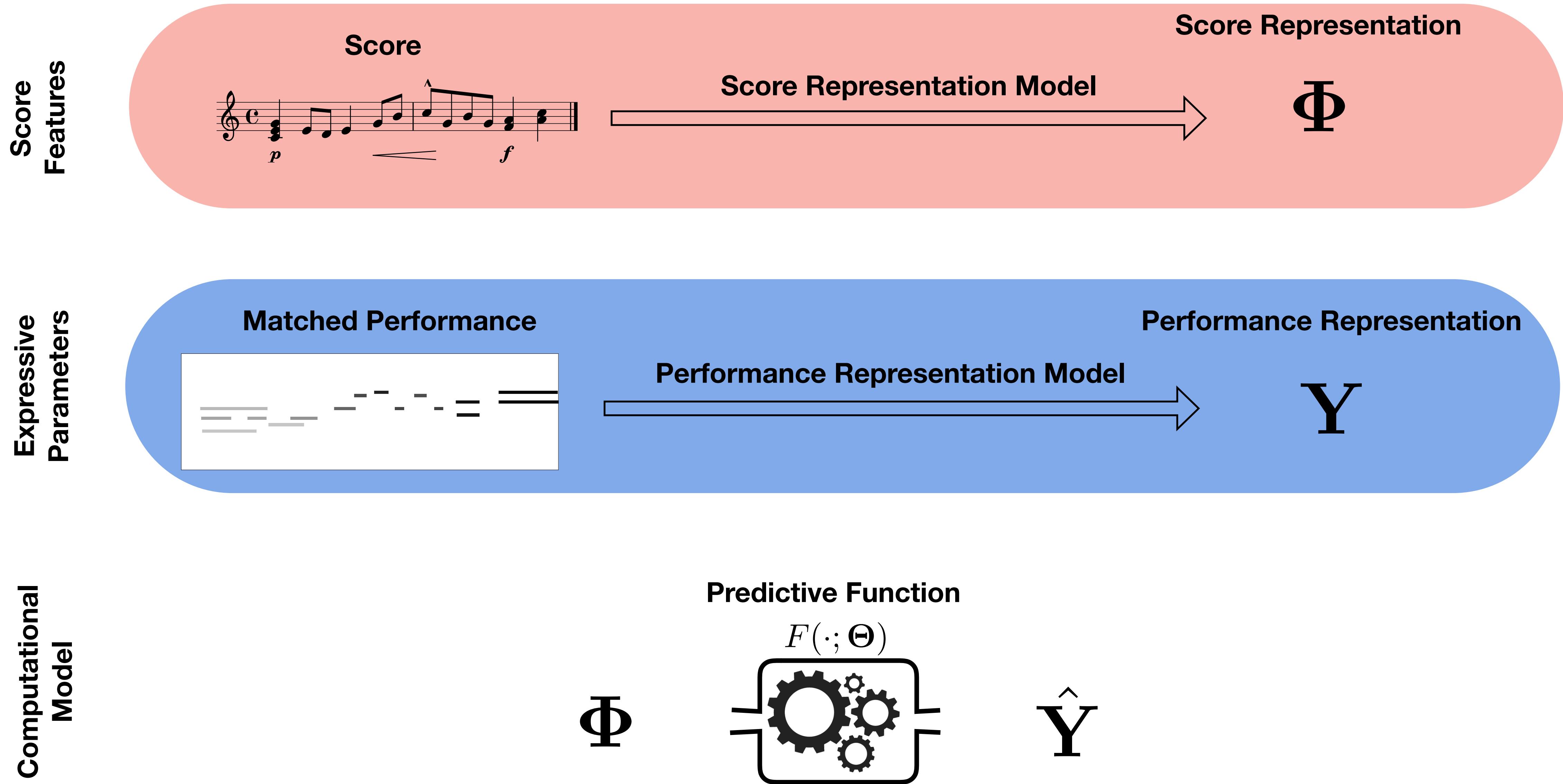
▶ Components of BMs



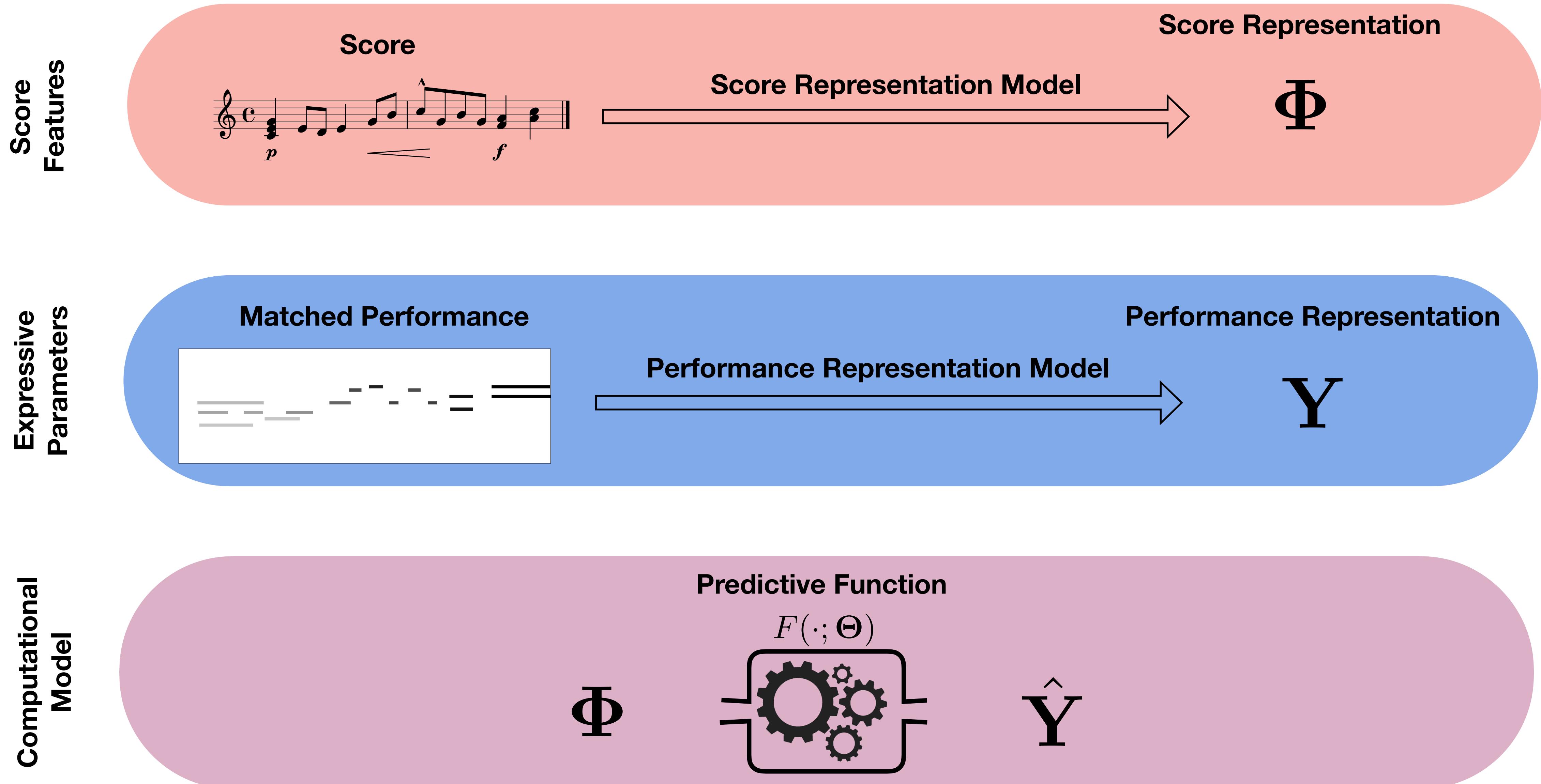
▶ Components of BMs



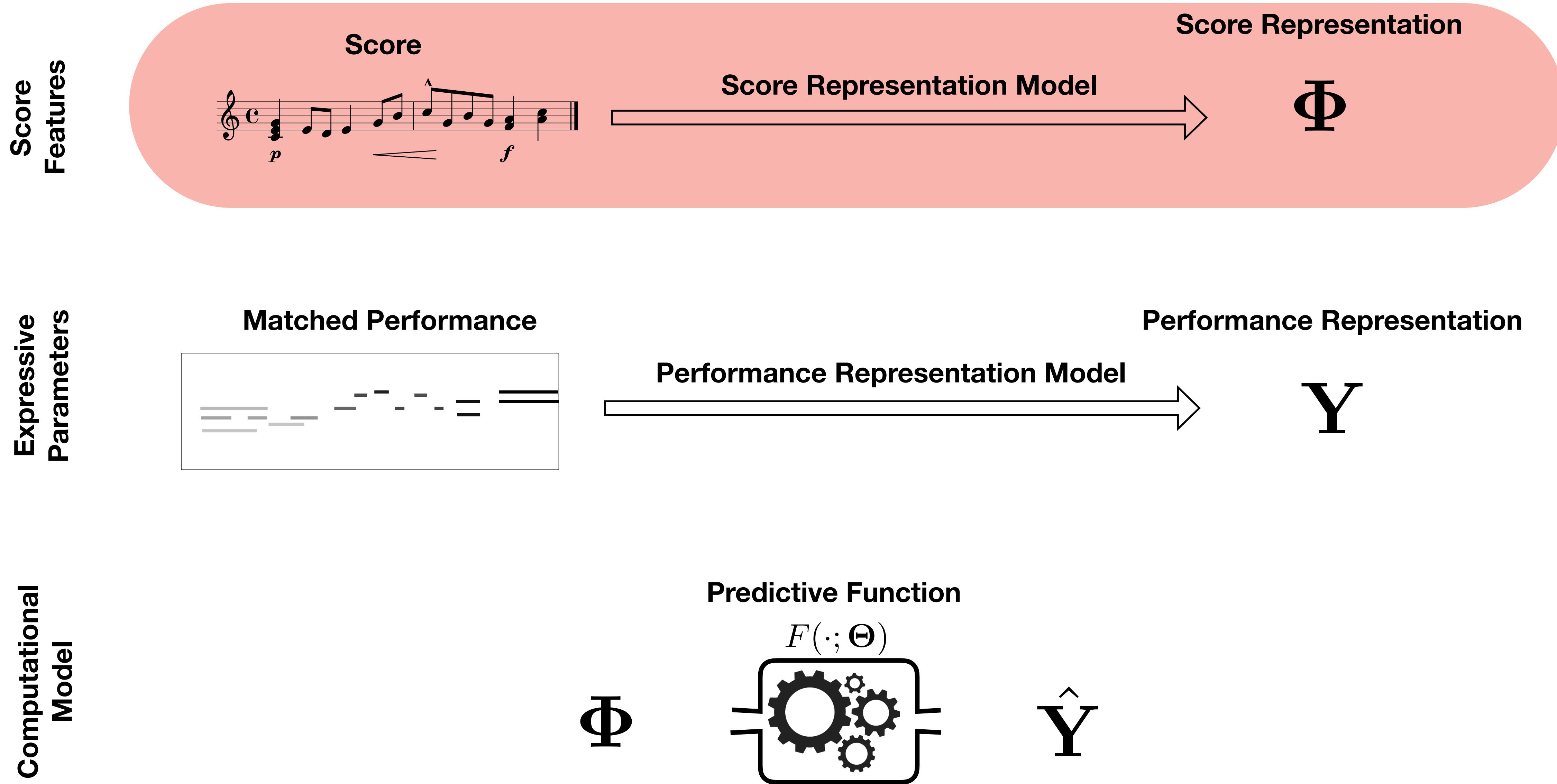
► Components of BMs



► Components of BMs



▶ Components of BMs



Hands-on Part II

Link to jupyter notebook: <https://bit.ly/2WFL90A>



Alternatively run the notebooks locally:

1. git clone <https://github.com/mgrachten/basismixer-notebooks.git>
2. cd ./basismixer-notebooks
3. conda env create -f environment.yml # or environment_macos.yml
4. jupyter notebook



Trois Nocturnes.

À M^{me} Camille Pleyel.

F. Chopin, Op.9.

1

Nocturne.

Larghetto.

$\text{♩} = 116$.

— IOI Bi-directional Recurrent
Non-linear Basis Model

1
Nocturne.

Larghetto.

$\text{♩} = 116$.

p *espress.*

z *z*

fz p

smorz.

p

legatiss.

37

Trois Nocturnes.

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F. Chopin, Op.9.

1

Nocturne.

Larghetto.

$\text{♩} = 116$.

— IOI Bi-directional Recurrent
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Part V

Conclusions

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Defining expressiveness is not a trivial task



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Once you have a definition,
defining the sub-aspects is also hard



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defining the sub-aspects is also hard



Conclusions

The digital age has opened the possibility to study musical expression using empirical research

Conclusions

Empirical performance research:

- has given light into a number of principles on how to model/create performance
- has enriched more computational aspects in areas such as emotion studies / structure analysis etc.



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► Future work

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- **Dataset creation:**
 - Data-driven methods require large amounts of data

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 - Data-driven methods require large amounts of data
- **Expressive Parameters:**
 - Investigate the effects of the choice of expressive parameters
 - Performance representations that are cognitively motivated

► Future directions

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- **Better models of music understanding:**
 - Models and features that capture the long term semantic and emotive relationships that appear in music

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- **Better models of music understanding:**
 - Models and features that capture the long term semantic and emotive relationships that appear in music
- **Evaluation:**
 - Better criteria for evaluating different models, and comparing their performance to that of humans (other than reconstruction error)
 - More efforts towards establishing venues for systematic evaluation and comparison, like the RenCon competition. (Maybe a MIREX competition? 😊)

How does the notion of musical expression apply to non-classical music?

- Empirical research on musical expression has traditionally focused on western classical music
- Other musical practices do not always fit well into current performance research paradigms

[Dorottya Fabian, Renee Timmers, and Emery Schubert (2014) *Expressiveness in music performance: Empirical approaches across styles and cultures*, Oxford Scholarship Online]



Reverend Greasehound 4 years ago

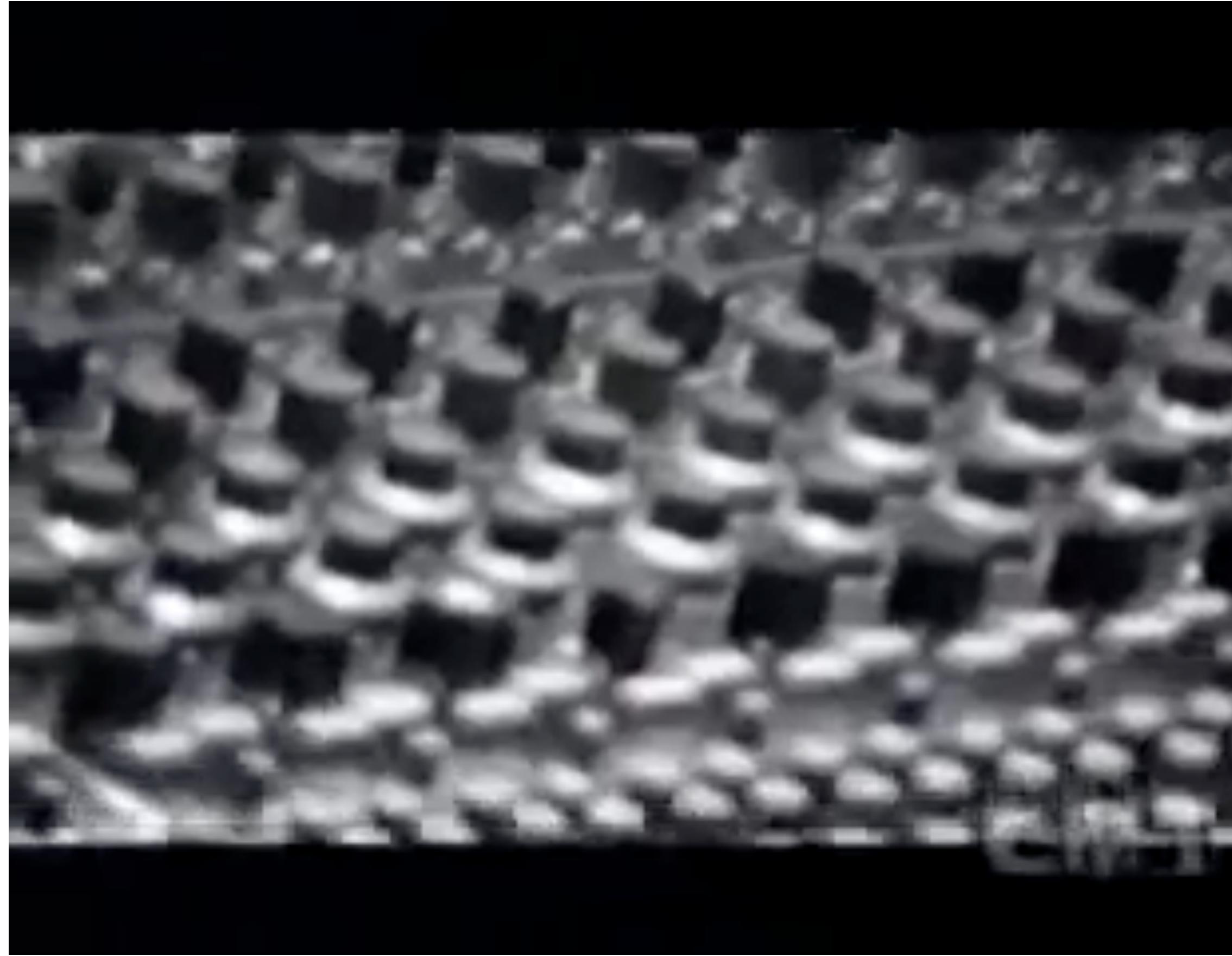
I've always liked the original by Soundgarden, but Johnny's covers always sort of gave the songs deeper meaning. Something about his cold voice and somber performances that really give the lyrics themselves their due.



29



REPLY



Reverend Greasehound 4 years ago

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I've always liked the original by Soundgarden, but Johnny's covers always sort of gave the songs deeper meaning. Something about his cold voice and somber performances that really give the lyrics themselves their due.

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Thank you!

Acknowledgments

This work has been partially funded by the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme, grant agreement No. 670035 (project “Con Espressione”).



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