Guider / composer l’improvisation musicale homme-machine avec des scénarios temporels

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Équipe Représentations Musicales

PhD Thesis (May 2016)
Directors: M. Chemillier, G. Assayag

ImproteK system

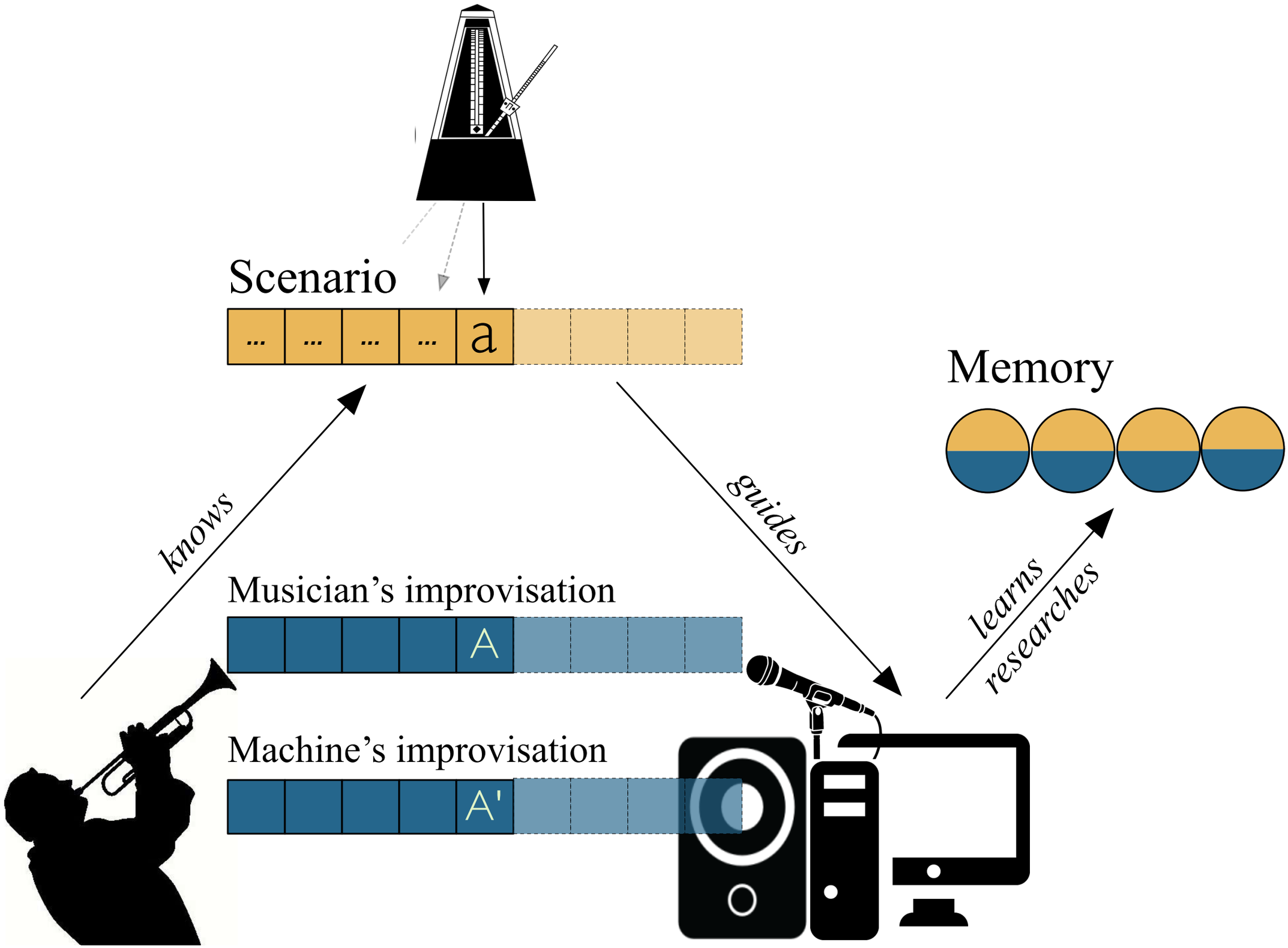
Take advantage both:
of the prior knowledge of a temporal structure
of the live environment

Use a guiding **scenario** and learned **memory** scheme

Introduce **anticipatory behaviors** in the music generation processes

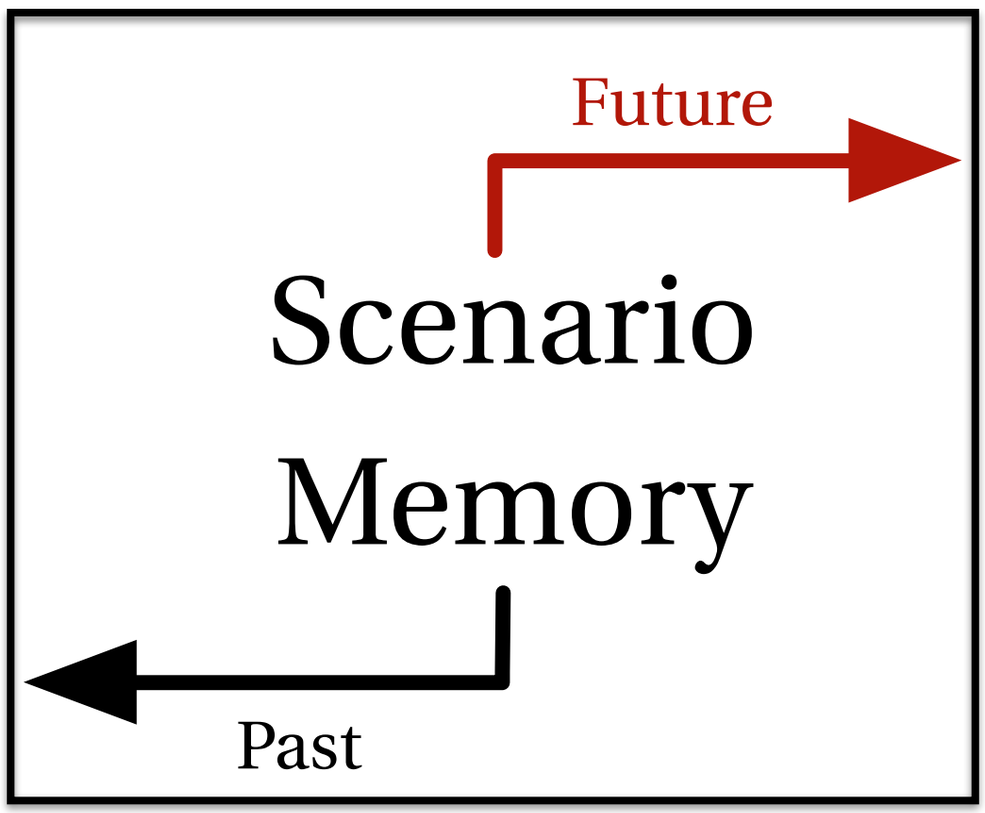
Combine **planning** and **reactivity**

Concentrate on **pulsed music and idiomatic** improvisation

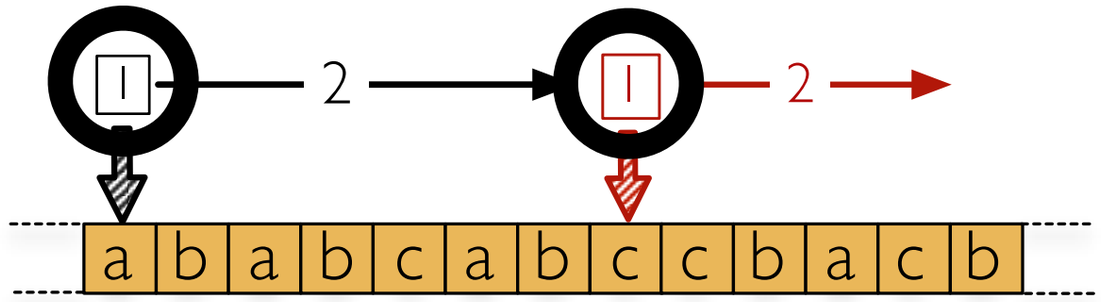


Nika, Chemillier, Assayag, Computer-Aided Composition of Musical Processes, *ACM Computers in Enternainment*, 2016 (in press).

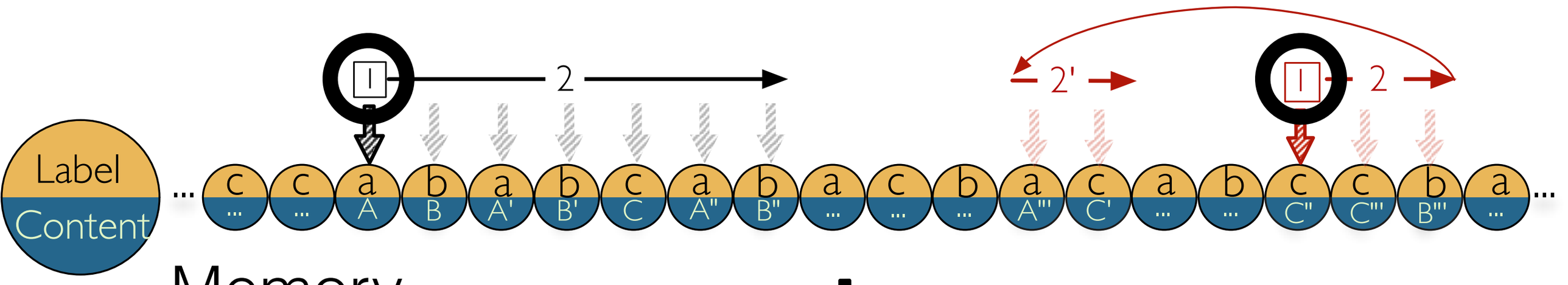
2. Generation model



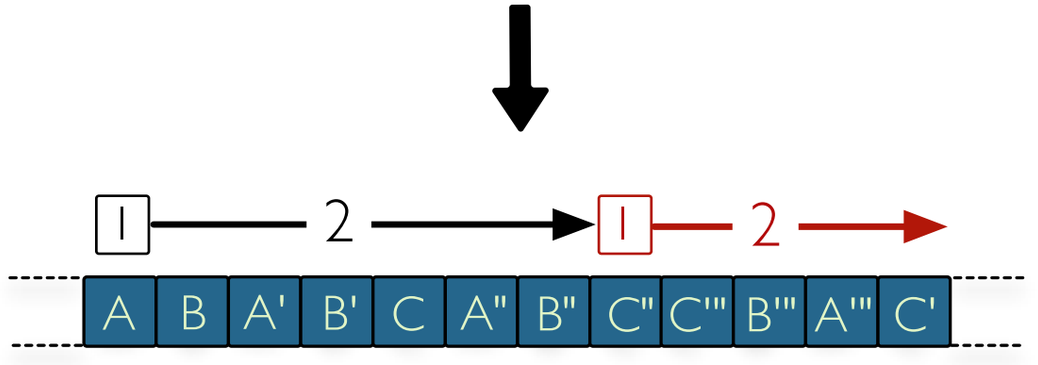
Introducing temporal structures in music generation processes



Scenario



Memory

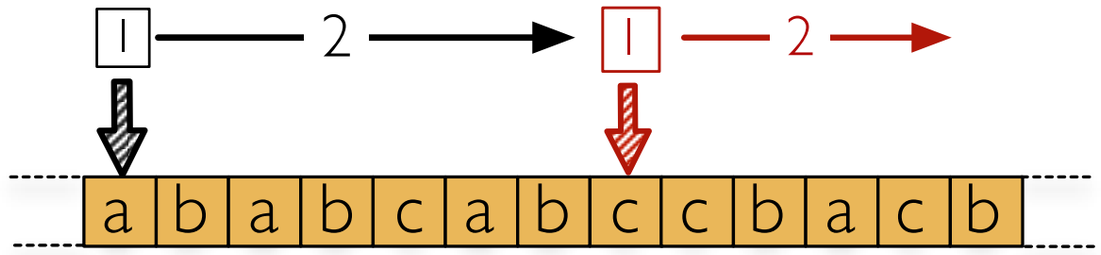


Machine improvisation

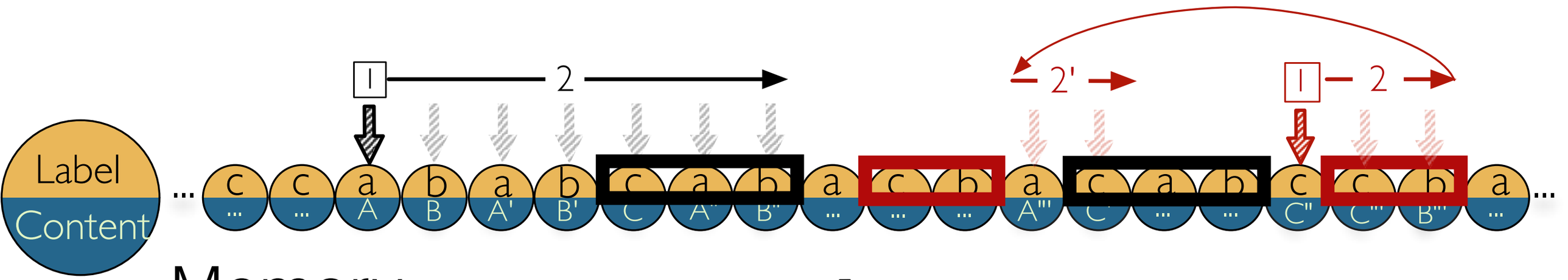
Algorithmic approach (1) I I

Continuity with the future of the scenario

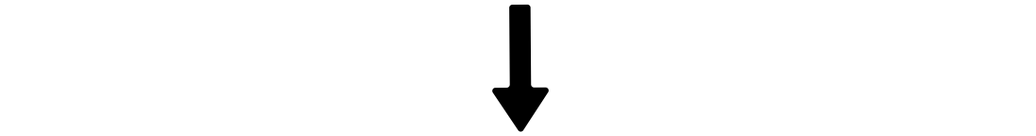
Find a prefix of the current suffix of the scenario in the memory.

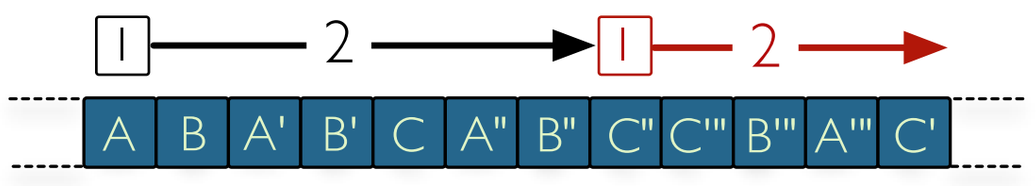


Scenario



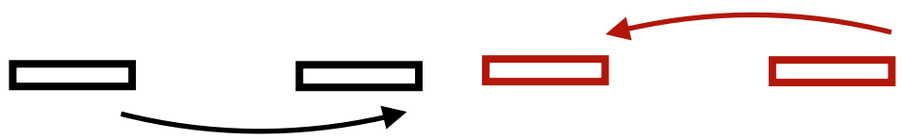
Memory





Machine improvisation

Algorithmic approach (2)



Continuity with the past of the memory

Musical memory learned in a Factor Oracle automaton (Crochemore et al.) —> Suffix links

index T T'

. . . . **a b c** w x . . . . . **a b c** y z . . . .

*Scenario (**S**)*

Research phase $\phi_n = S_T$:

- Store the positions and the lengths of the prefixes of S_T found in ***M***

. . . . . a b c w x . . . a b . . . . a b c . .

*Memory (**M**)* | *length = 5* | *2* | *3*

- Store B_T (computed during the research)

Later, research phase $\phi_m = S_{T'}$:

- Using B_T —> length of the common prefix between S_T and $S_{T'}$: ***LCP(m,n)=3***

- Prefixes of $S_{T'}$ in ***M***: partial results obtained from research phase $\phi_n = S_T$:

mismatch mismatch ?

. . . . . a b c **w** x . . . a b **.** . . . a b c **?** .

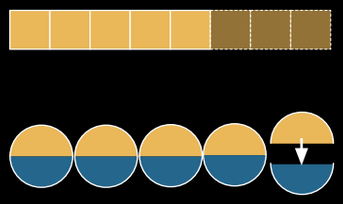
*Memory (**M**)*

length = 5	*2*	*3*
LCP(m,n)=3 < 5	***LCP(m,n)=3 > 2***	***LCP(m,n)=3***
Results ϕ_m: Prefix of $S_{T'}$ in ***M*** length = 3	Prefix of $S_{T'}$ in ***M*** length = 2	Prefix of $S_{T'}$ in ***M***, length = ***?*** —> research on a shorter suffix: $S_{T'+LCP(m,n)}$

Nika, Guiding human-computer music improvisation: introducing authoring and control with temporal scenarios, *PhD Thesis - Paris 6*, 2016.

Conformity / Scenario - Digression / Memory

Rent party
Rémi Fox (saxophone), Jérôme Nika (ImproteK),
Repetitions for a performance at Montreux Jazz Festival 2015.

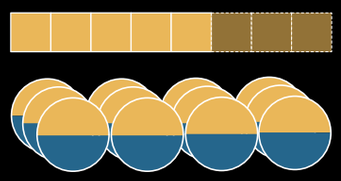


Scenario: simple chord progression
II: Cm7 Bb7 I AbMaj7 Bb7 :II (*Rent party,* Booker T. Jones)
Memory: live audio segmented and labeled online —> same chord progression

1 voice

Hybridization

The Man I Love - "Three Ladies" project
Hervé Sellin (piano), Georges Bloch (ImproteK)

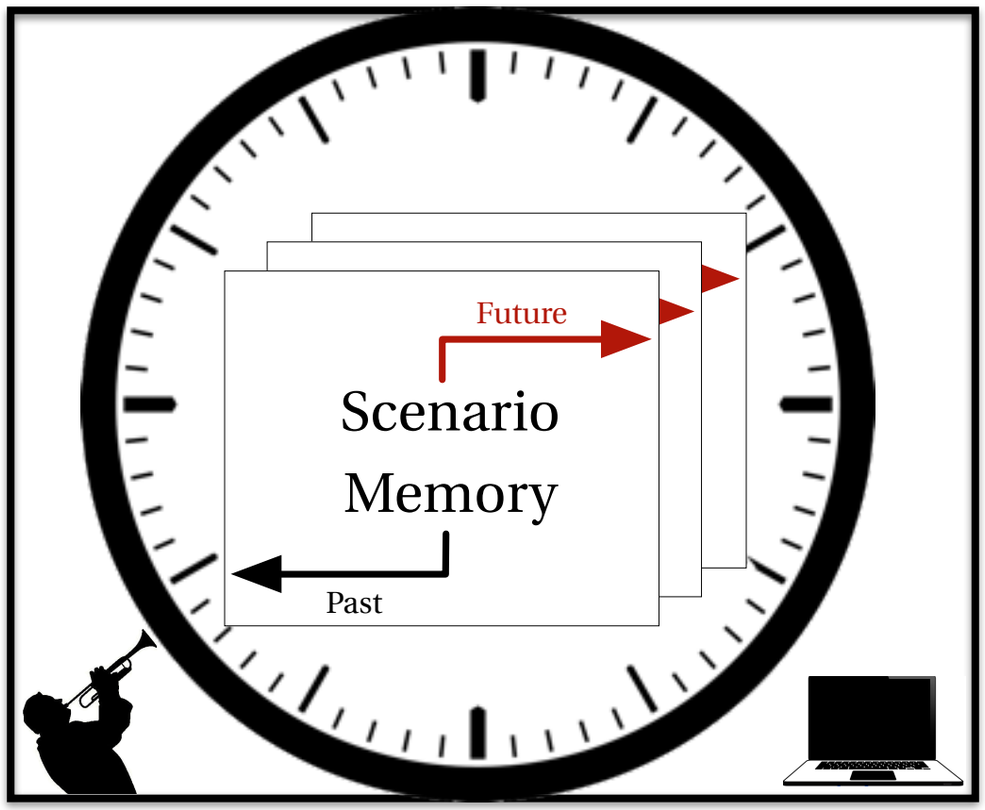


Scenario: Chord progression: *The Man I Love*

Memory: **Billie Holiday** singing *The Man I Love*,
Edith Piaf singing *Mon dieu* and *Milord*,
Elisabeth Schwarzkopf singing *Mi tradì quell'alma ingrata* (Mozart, Don Giovanni),
and *Tu che del gel sei cinta* (Puccini, Turandot).

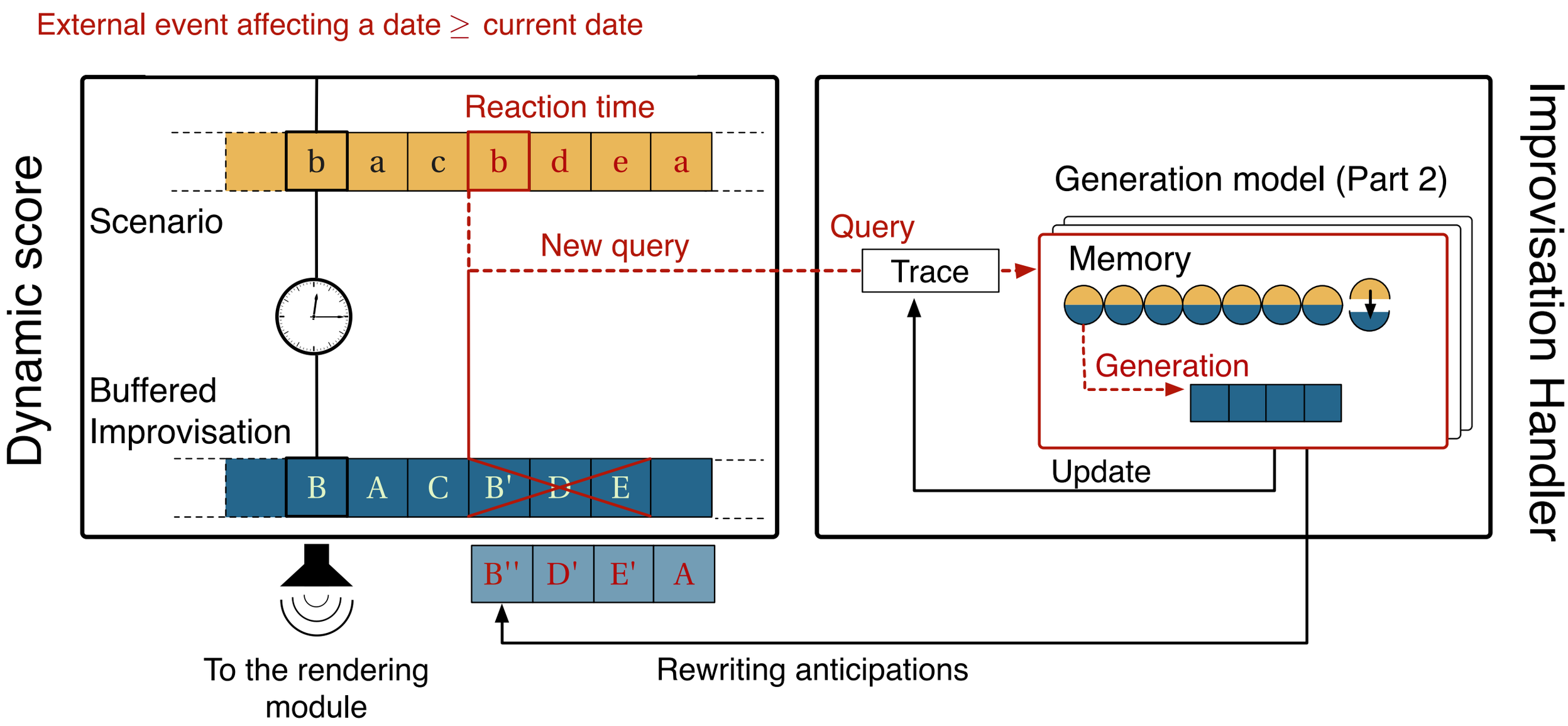
| 3 different voices

3. Architecture



Combining long-term planning and reactivity

Guided improvisation modeled as dynamic calls to an offline model



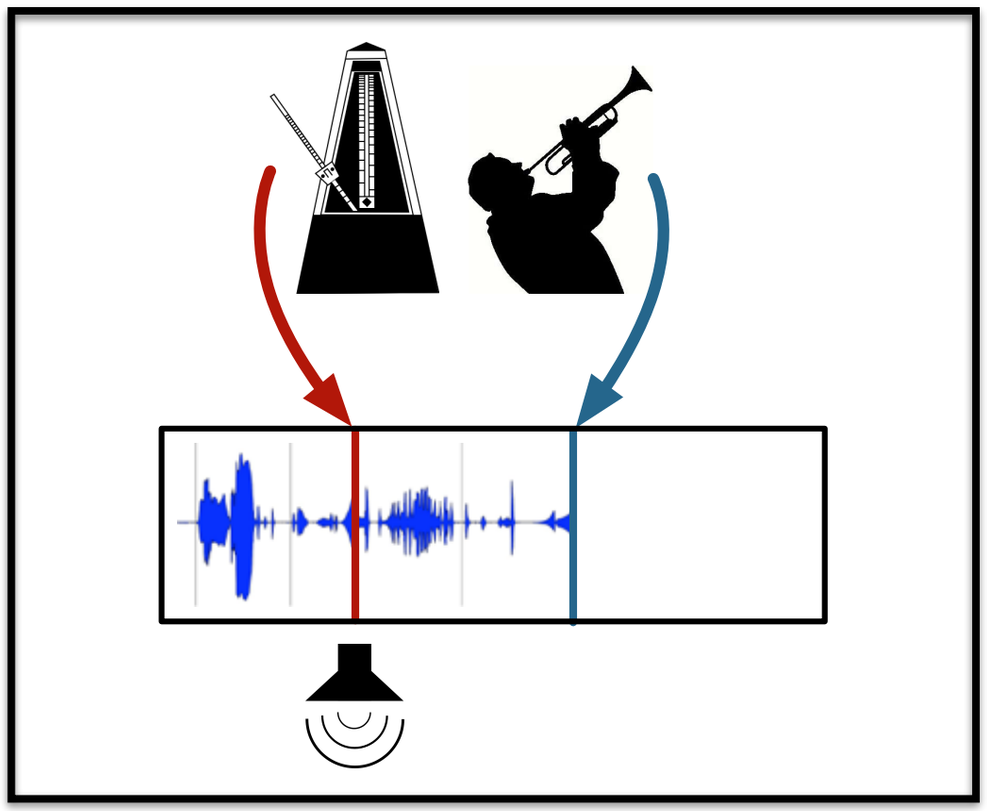
External events —> Reaction —> Modification of reactive inputs —> Query —> Rewriting anticipations

Generic framework:

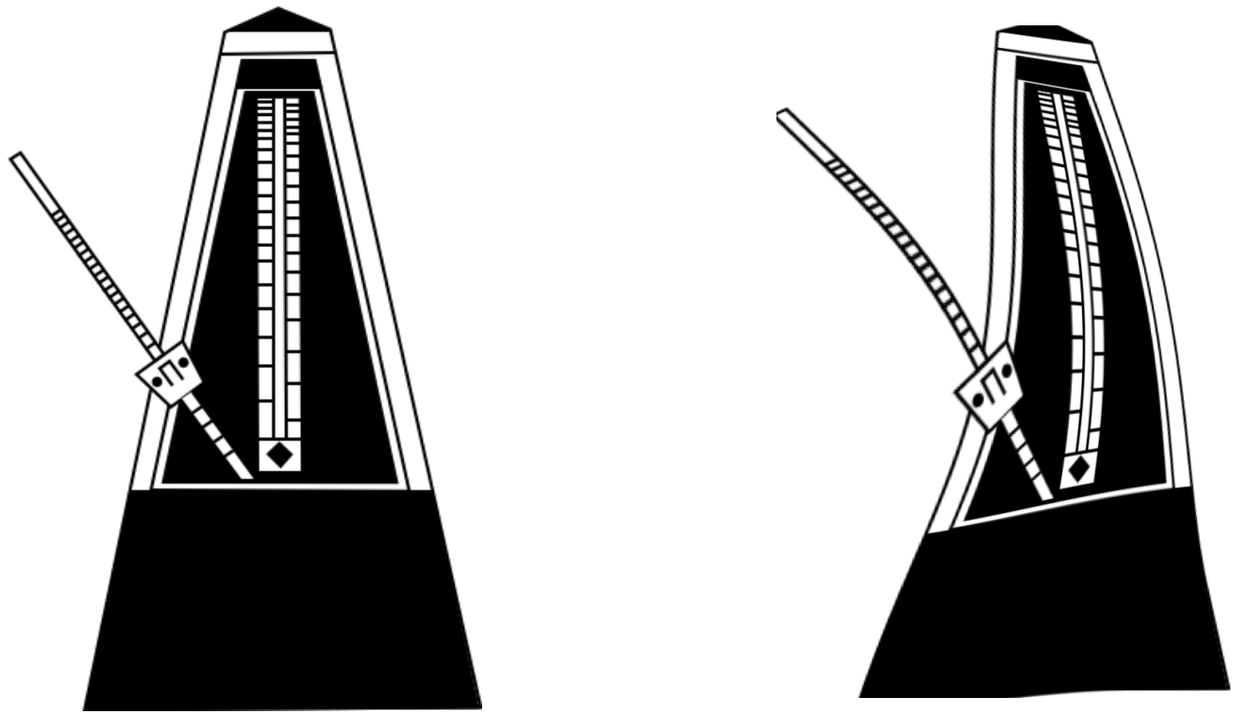
- External events: operator controlling the system, composed reactivity rules, external listening module…
- Reactive inputs: scenario itself or secondary parameters.

Nika, Bouche, Bresson, Chemillier, Assayag, GuidGuied improvisation as dynamic calls to an offline model, *Sound and Music Computing conference*, 2016.

4. Playing with (the sound of) the musicians

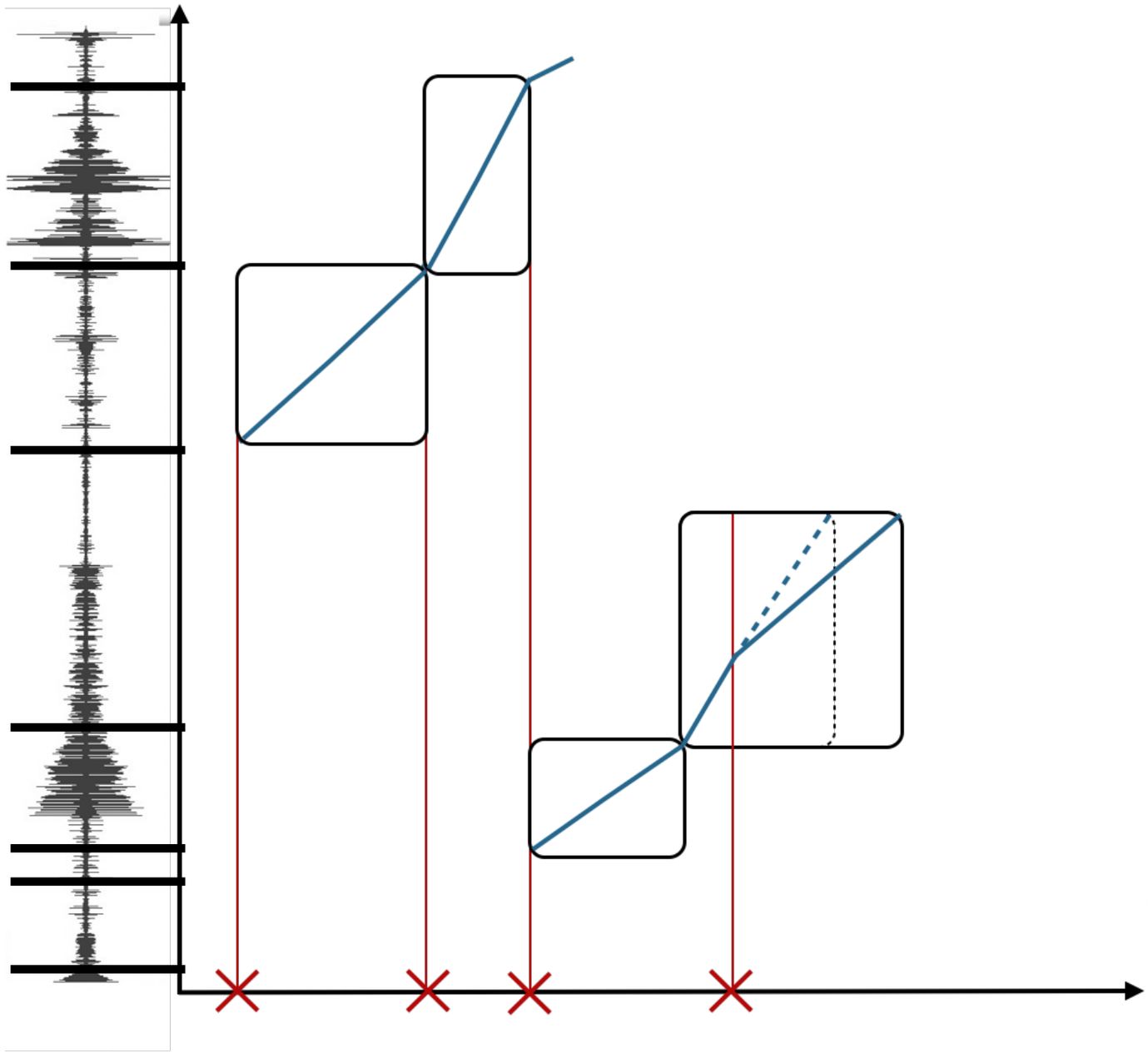


Recording, sequencing, synchronizing, rendering



Synchronizing the rendering of dynamically **evolving sequences** generated from **live inputs** with an external **non-metronomic beat source**

Audio memory
(being recorded, segmented, labeled)

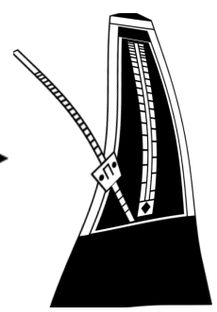


Performance time

New beat, tempo estimation

Predicted duration of a beat

Temporal variable Antescofo

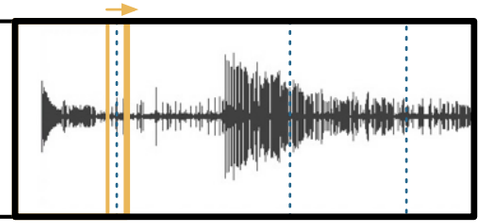


External non-metronomic beat source

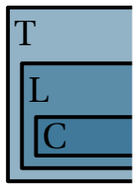
Synchronized rendering
=
Tempo estimation (temporal variable Antescofo) + Phase vocoder

Continuity:

The temporal variable T is updated, and the new event to play is contiguous to the previous one.



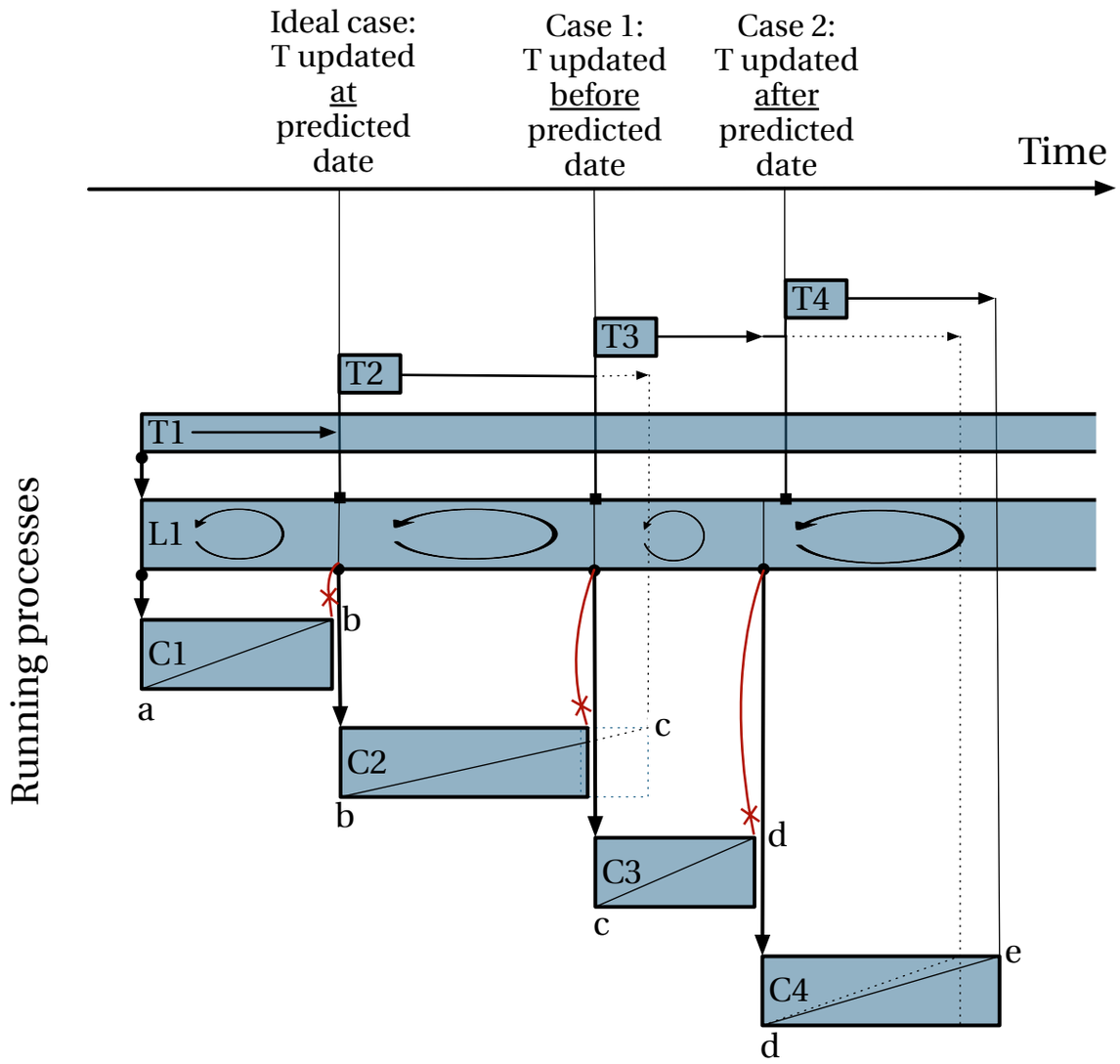
Hierarchy

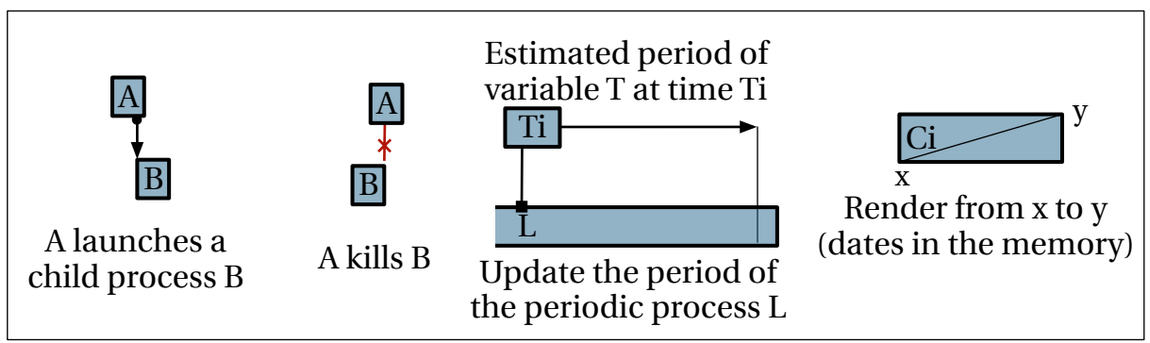


Reactive process listening to the updates of T

Synchronisation loop process

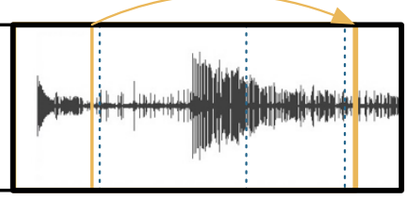
Control / rendering process



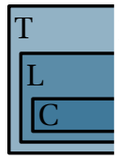


Discontinuity:

The temporal variable T is updated, and the new event to play is not contiguous to the previous one.



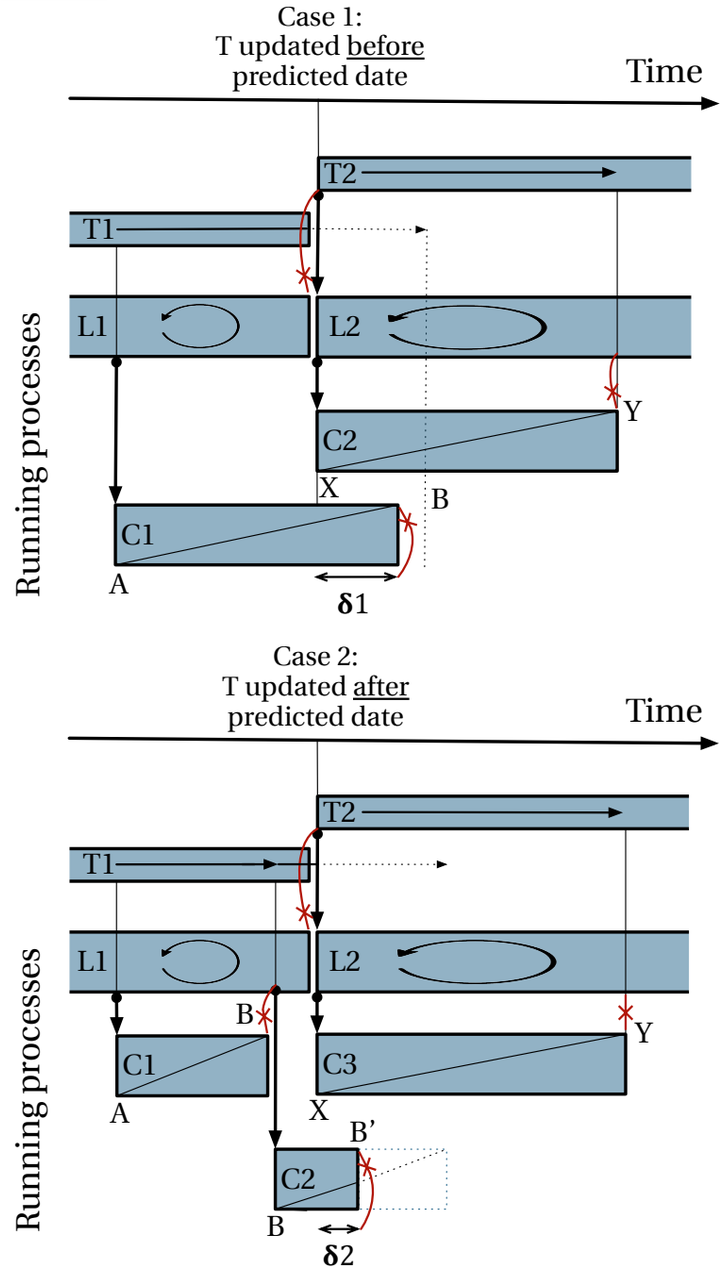
Hierarchy

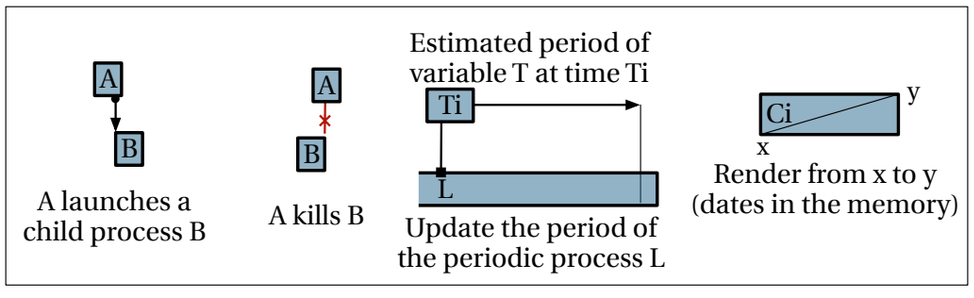


Reactive process listening to the updates of T

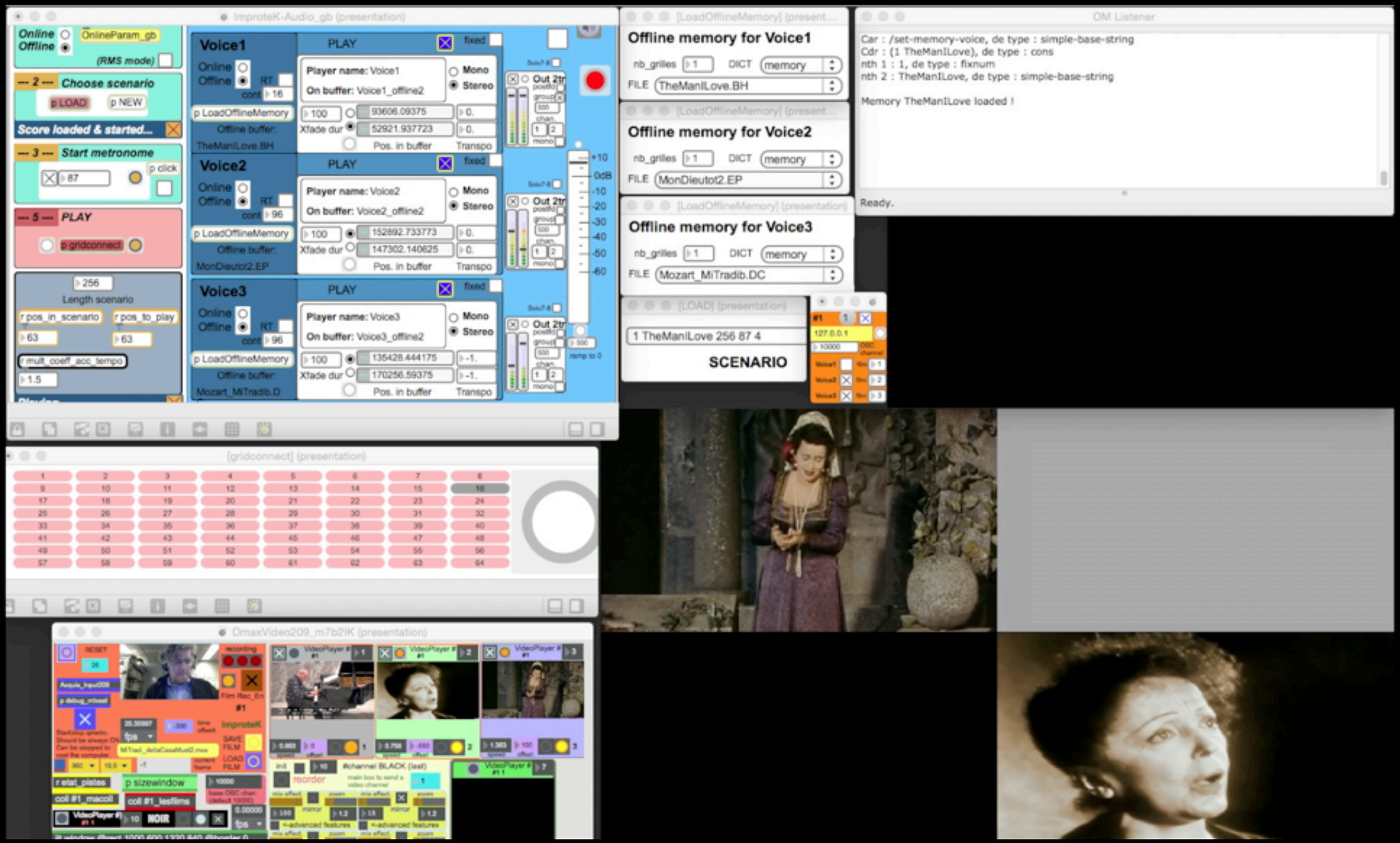
Synchronisation loop process

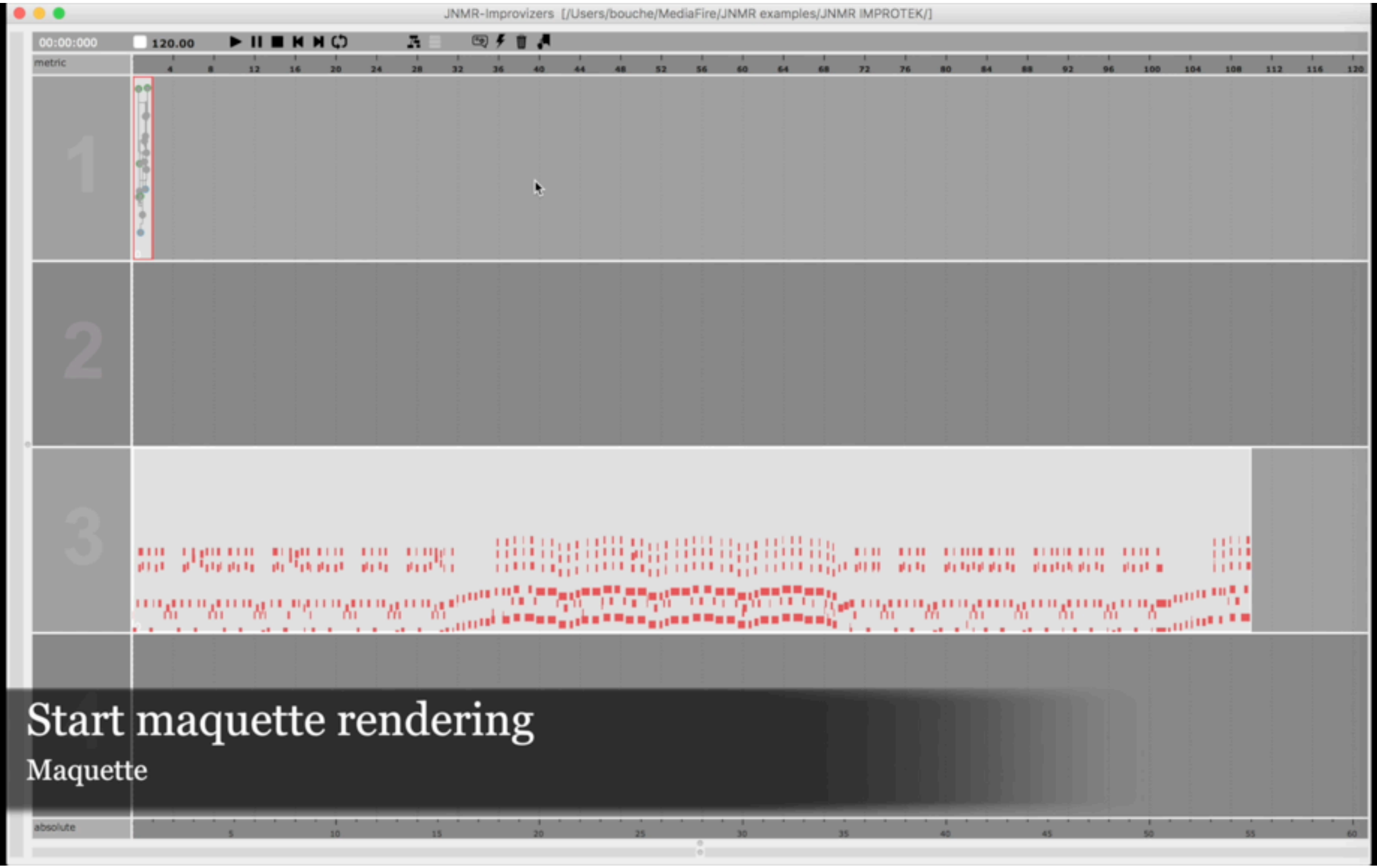
Control / rendering process





Adaptive multimedia recorder / sequencer / renderer

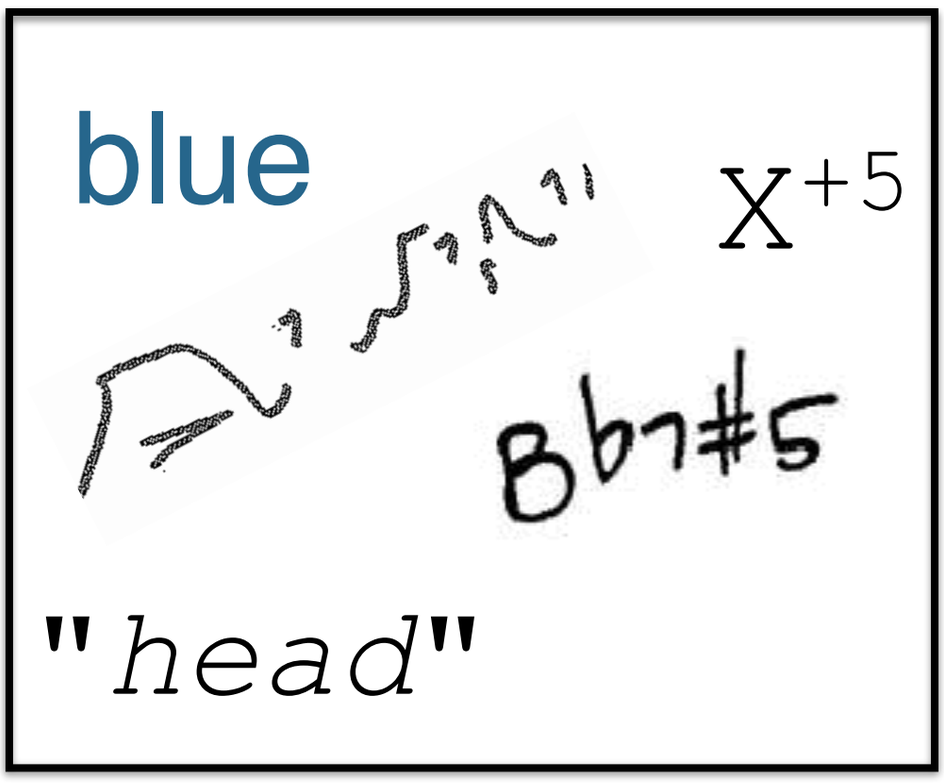




Used as an application case to design the *new scheduling / rendering engine of OpenMusic*
(Bouche, Bresson, Projet EFFICACe)

Example from Bouche, Nika, Chechile, Bresson, Computer-Aided Composition of Musical Processes, *Journal of New Music Research*, 2016.

5. Scenarios, scenarii…

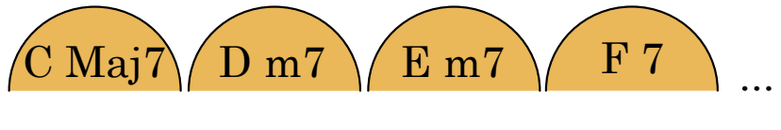


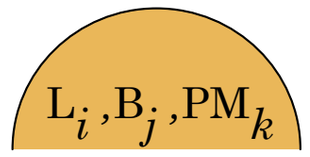
Genericity and "meta-composition"

Idiomatic alphabet (example)	Content-based alphabet (example)

Idiomatic alphabet (example)	Content-based alphabet (example)

1-Define an alphabet



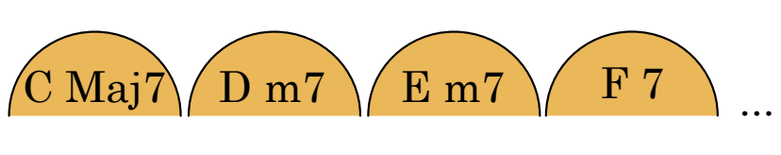


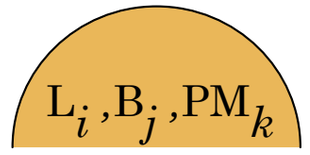
Loudness class i
Brightness class j
Playing Mode k

Nika, Chemillier, Assayag, Computer-Aided Composition of Musical Processes, *ACM Computers in Enternainment*, 2016 (in press).

Idiomatic alphabet (example)	Content-based alphabet (example)

1-Define an alphabet





Loudness class i
Brightness class j
Playing Mode k

2-Define (possibly different) equivalences to compare:

- events in M

- labels in M / in S

Nika, Chemillier, Assayag, Computer-Aided Composition of Musical Processes, *ACM Computers in Enternainment*, 2016 (in press).

Idiomatic alphabet (example)	Content-based alphabet (example)

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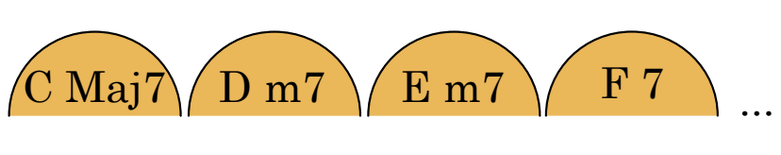

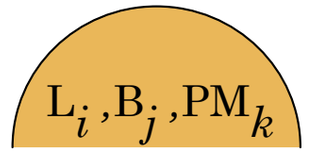

Loudness class i
Brightness class j
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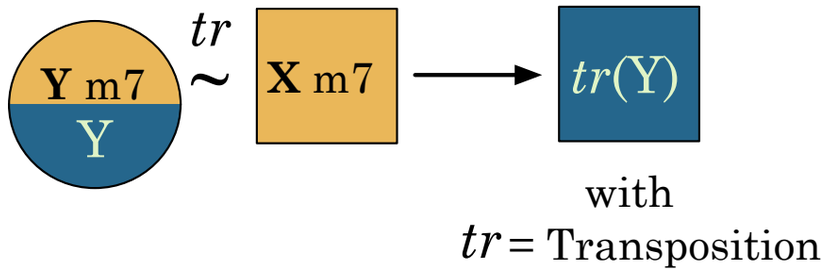
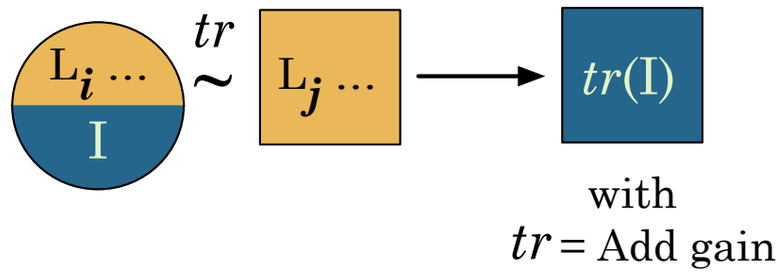
3-Define associated transformations for the contents



with
tr = Transposition



with
tr = Add gain

Nika, Chemillier, Assayag, Computer-Aided Composition of Musical Processes, *ACM Computers in Enternainment*, 2016 (in press).

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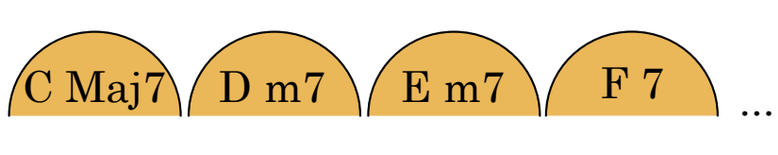

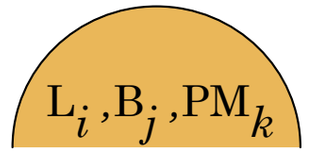

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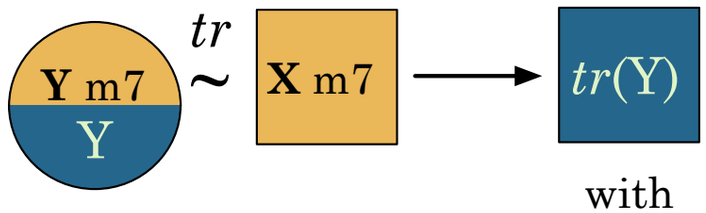

with
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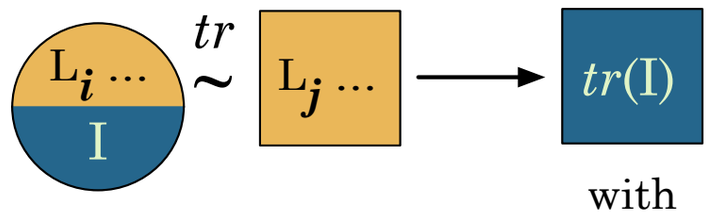
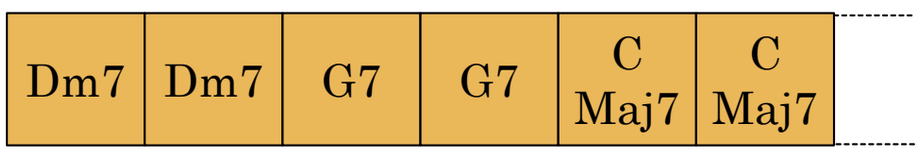
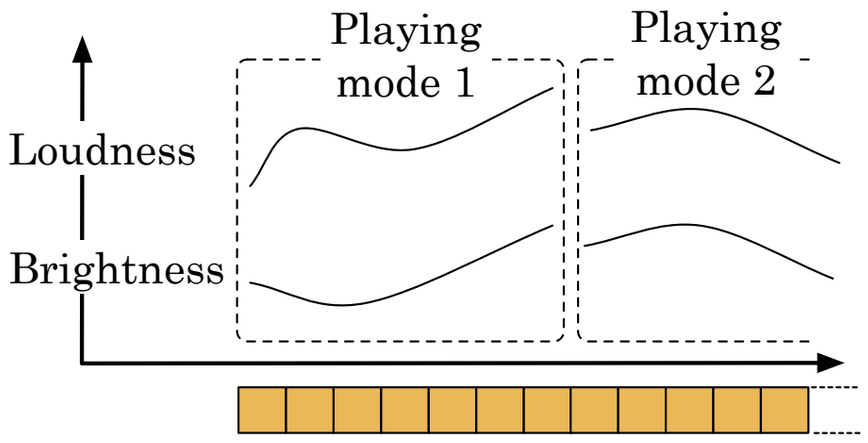


with
tr = Add gain

4-Compose a fixed or dynamic scenario



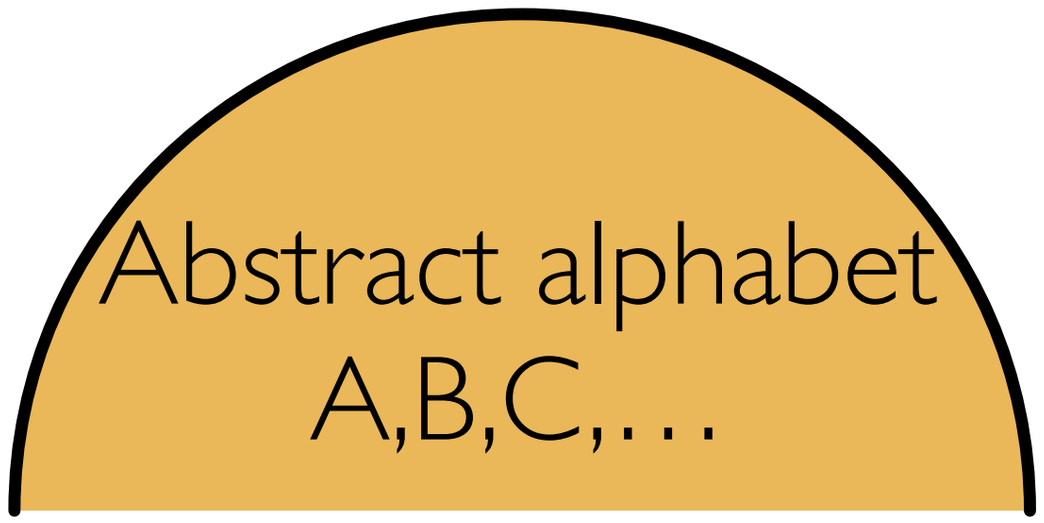


Scenario example 3:

Composed form using an abstract alphabet

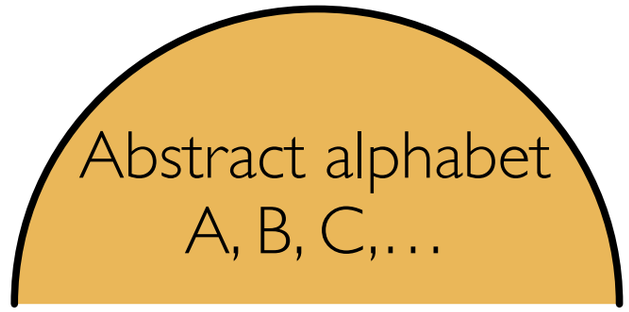
Alphabet

=

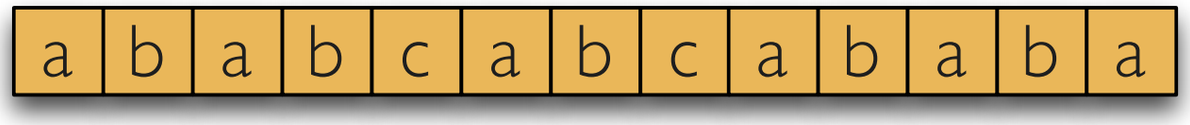


Scenario example 3:

Composed form using an abstract alphabet



Scenario



=

$$||: A_1\ B_1\ B_2\ A_1\ B_2 :||$$

with:

$A_1 = ||\ \mathrm{X}\ |\ \mathrm{X}^{+5}\ |\ \mathrm{X}^{-2}\ |\ \mathrm{X}^{+3}\ ||$

$A_2 = ||\ \mathrm{X}\ |\ \mathrm{X}\ |\ \mathrm{X}^{+5}\ |\ \mathrm{X}^{+5}\ |\ \mathrm{X}^{-2}\ |\ \mathrm{X}^{-2}\ |\ \mathrm{X}^{+3}\ |\ \mathrm{X}^{+3}\ ||$

$B_1 = ||\ \mathrm{Y\ Z}\ |\ \mathrm{Z}^{+5}\ \mathrm{X}^{+3}\ |\ \mathrm{Y\ X}^{+5}\ |\ \mathrm{Z}^{+5}\ \mathrm{X}^{+3}\ |\ \mathrm{Y\ X}^{-4}\ |\ \mathrm{Y}^{+3}\ |\ \mathrm{Z}^{-5}\ \mathrm{Z}\ |\ \mathrm{Z}^{+5}\ \mathrm{X}^{+3}\ ||$

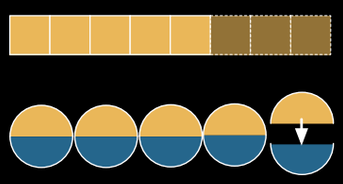
$B_2 = ||\ \mathrm{Y\ Z}\ |\ \mathrm{Z}^{+5}\ \mathrm{X}^{+3}\ |\ \mathrm{Y\ X}^{+5}\ |\ \mathrm{Z}^{+5}\ \mathrm{X}^{+3}\ |\ \mathrm{Y\ X}^{-4}\ |\ \mathrm{Y}^{+3}\ |\ \mathrm{Z}^{-5}\ \mathrm{Z}\ |\ \mathrm{Z}^{+5}/\mathrm{X}^{+3}\ \mathrm{Y}\ ||$

2 voices: *solo* and *accompaniment*

Constraints for the *accompaniment* voice: memory restricted to the occurrences of A1 and first measures of B1 to get a repetitive but evolving result

Scenario example 3: Composed form using an abstract alphabet

Generative improvisation #1
Rémi Fox (saxophone), Jérôme Nika (ImproteK),
Repetitions for a performance at Montreux Jazz Festival 2015.

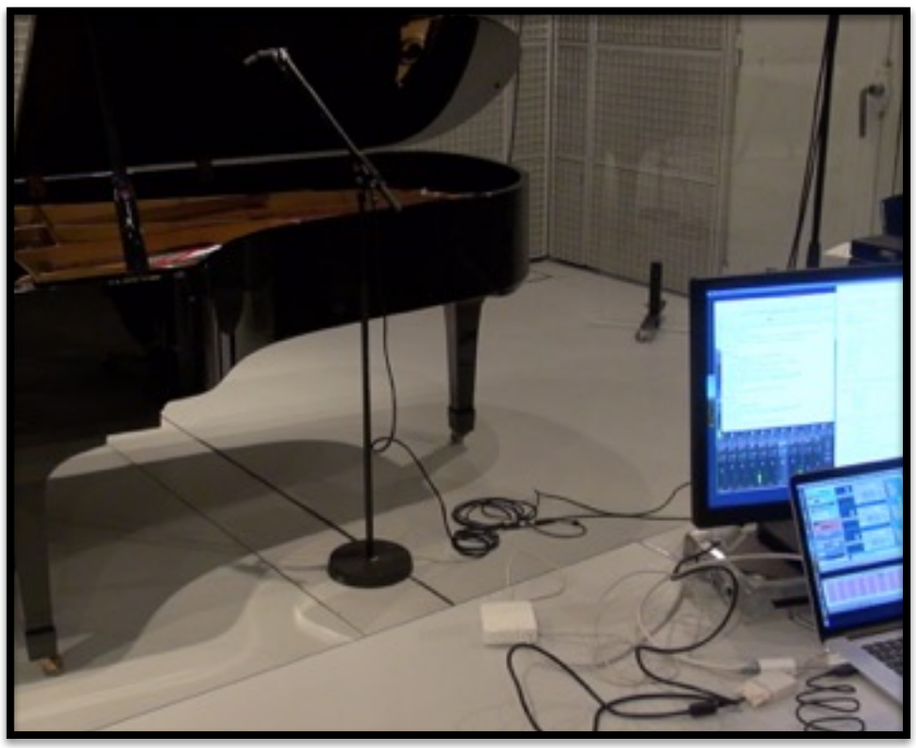


Scenario: Composed form using an abstract alphabet

Memory: Live audio recorded, segmented, and labeled online

3 different voices

6. Method and validation



Collaborations with expert musicians
"Let the music(ians) (pl/s)ay"

Performances with ImproteK since 2013

MONTREUX Jazz Festival

pietre che cantano
festival internazionale

Centre
BEAT GENERATION Pompidou

LES [rencontres] INATTENDUES
musiques et philosophies

TOURNAI JAZZ festival 6 & 7 février 2015

ETHNOMUSIKA

Last concert

Benoît Delbecq

Jozef Dumoulin

Ashley Slater

Gilbert Nouno
(using ImproteK)

"*The rhythm the rhythm*
and your memory in my head three years after"

Scenarios: texts by writers from the beat generation

BEAT GENERATION Centre Pompidou

En présence de William S. Burroughs - Secret Heroes
Grande Salle Centre Pompidou, June 22.

Bernard Lubat

Hervé Sellin

Rémi Fox

Jovino Santos Neto

Charles Kely

Kilema

Michelle Agnes Magalhaes

Louis Mazetier

Benoît Delbecq

Jozef Dumoulin

Ashley Slater

Musical focuses of the collaborations

Bernard Lubat and ''La Compagnie Lubat'': ''*Jazzed-up song*'', *jazz, scat, and free improvisation.*
Long-term collaboration to design the first models and prototypes: recombining and phrasing; downstream controls; reduction and multiplication; ''hybridization''; rhythm, synchronization, groove.

Jovino Santos Neto: *Brazilian music and jazz.*
improvisation using an online musical memory; harmonization, arrangement; ''hybridization''; rhythmic phrasing.

Kilema, Velonjoro, and Charles Kely: *Marovany zither and jazz*.
Contrametricity; rhythmic articulation.

Louis Mazetier*: Stride piano.*
Mixing offline and online memory; scenario defined on an alphabet describing harmony and macrostructure; secondary generation parameters.

Michelle Agnes Magalhaes: *Composed contemporary improvisation.*
Improvisation using an online musical memory; non-idiomatic composed improvisation; content-based alphabet; scenario: discretized multimodal profile of audio descriptors.

Rémi Fox: *Funk, jazz, and structured ''generative improvisation''.*
Improvisation using an online musical memory; interface and controls: duet between a musician and an operator; rhythm, synchronization, groove; definition of an alphabet, a scenario and constraints.

Hervé Sellin: *Jazz and ''deconstruction of the idiom''.*
''Hybridization''; mixing offline and online memory; improvisation plans; ''music-driven'' vs. ''event-driven'' interactions; video improvisation.

Benoît Delbecq: *Structured improvisation.*
Improvisation using an online musical memory; interface and controls: duet between a musician and an operator; rhythm, synchronization, groove; definition of an alphabet, a scenario and constraints.

Approach: methodology and validation

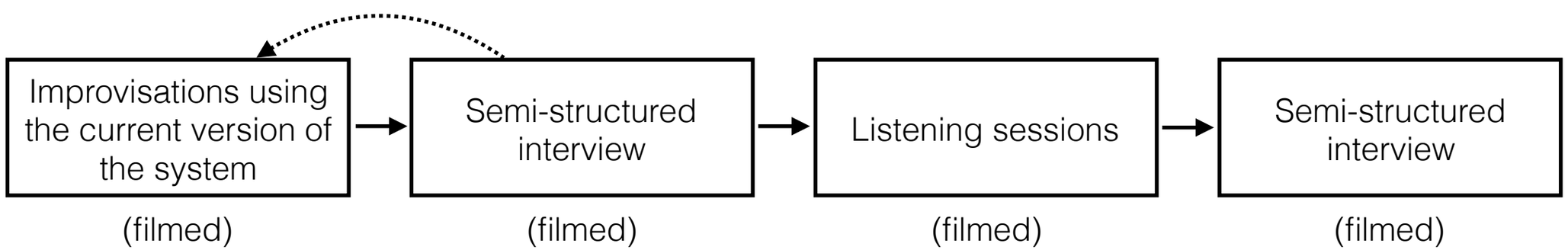
- **Intense fieldwork** with Marc Chemillier (EHESS), ethnomusical approach.

- "Participant observation": **numerous interactions with musicians** fully integrated to the **incremental development** of the models and architectures.

- **Step-by-step validation** of the successive versions of the models and architectures with musicians:
  - Through **work sessions, residences, performances**.
  - **Gathering assessments** from experts of the concerned idioms to **validate and / or refine the scientific and technical choices**.

- **Filmed listening sessions and interviews** (hours of video): 2 objectives
  - Get some information to understand the musician's conception of improvisation and **motivate the following development steps**.
  - **Validation** of the successive versions of the models.

Outline of a work session with an expert musician:



Chemillier, Nika, «Etrangement musical », les jugements de goûts de Bernard Lubat sur le logiciel ImproteK , *Cahiers d'ethnomusicologie*, 2016.
Nika, Guiding human-computer music improvisation: introducing authoring and control with temporal scenarios, *PhD Thesis - Paris 6*, 2016.

Some considerations from listening sessions and interviews



- Validation
  - *"Groove", "It does not play mechanically".*
  - *"A real dialog", "Two musicians playing together".*
  - Going from *simulation* to *stimulation.*
    - *"Here, I played something that is not usual for me".*
  - Anticipatory behavior
    - *"Inspiring 'music-driven' reactions instead of only 'event-driven' reactions".*
  - Hybridization:
    - *"There are some strange areas, the notes are strangers to the harmony, but in a great way."*
  - Composed scenarios: (not so) paradoxical interest of the scenario:
    - *"Since the system knows the structure I can improvise freely".*
  - Depending on the projects and the musicians, validation: *"sounds human" / " 'machinic' virtuosity"*
    - Reflects different expectations regarding the system and human-computer improvisation in general.

- Limitations & suggestions
  - Difficulty to develop a musical narration over several occurrences of the scenario.
    - "*A real saxophonist would never do that, insisting that much on the first phrase."*
      - Interface / Controls ? Reactive listening ? Planning at a higher level ?
  - Hybridization using an offline memory: select the corpus carefully !
    - *"Undesired patchwork", "It sits on the fence"*.
  - Working on structure *and sound* with the scenario ?
  - Current implementation dedicated to pulsed improvisation.

Some conclusions from the listening sessions and interviews

Some conclusions from the listening sessions and interviews

Work in progress…

- Merge the paradigms "free" / "reactive" / "scenario"

  (Omax / Somax / ImproteK)

- Combine scenarios and reactive listening

  Initiated by A. Chemla—Romeu-Santos' Master thesis (2015). *Supervision: G. Assayag, J. Nika.*

- Automatic discovery and short-term inference of scenarios

  Initiated by Théis Bazin's Master's thesis (2016). *Supervision: P. Esling, J. Nika.*

  - Anticipatory behaviors / *predicted* short-term structures

- Vertical chaining of agents working on different alphabets

- Enhance the possibilities regarding music composition