Semantic Adaptation of Multimedia Documents

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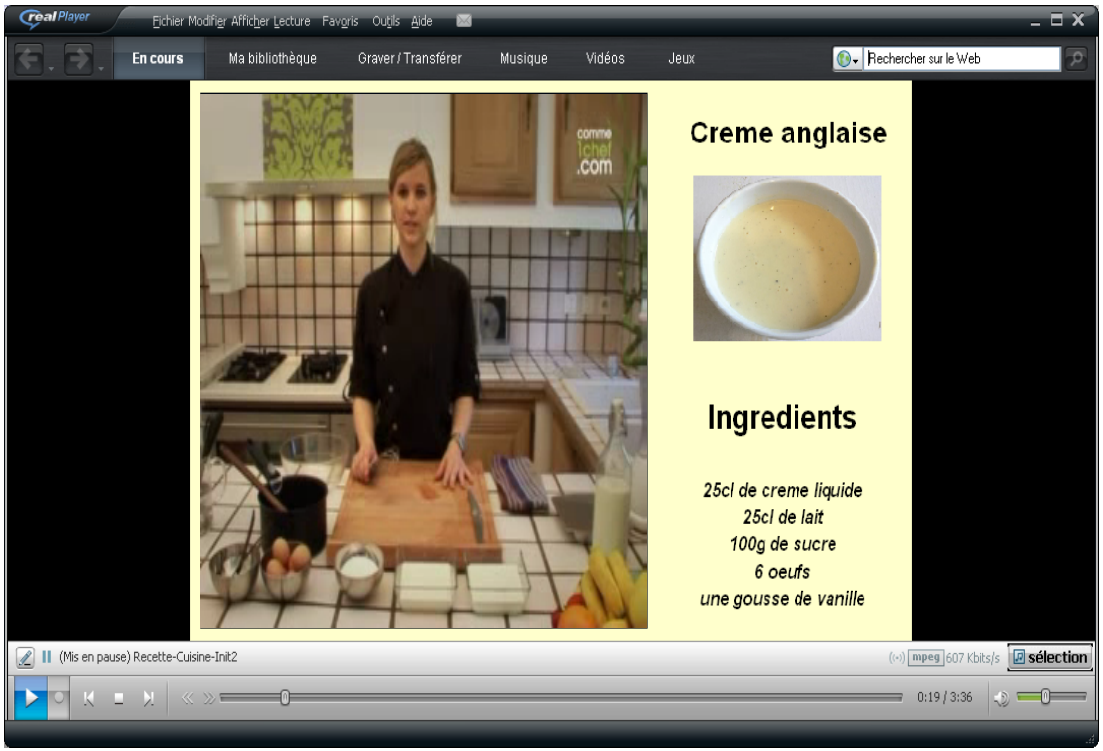
A multimedia document



Composed of objects

- Text
- Image
- Audio
- Video

Assembled by an author

- Temporal dimension
- Spatial dimension
- Hypermedia dimension

Multimedia document adaptation

Multimedia document adaptation

Profile$_1$

Profile$_2$

Profile$_3$

Multimedia document adaptation

Adaptation

$Profile_1$

$Profile_2$

$Profile_3$

Outline

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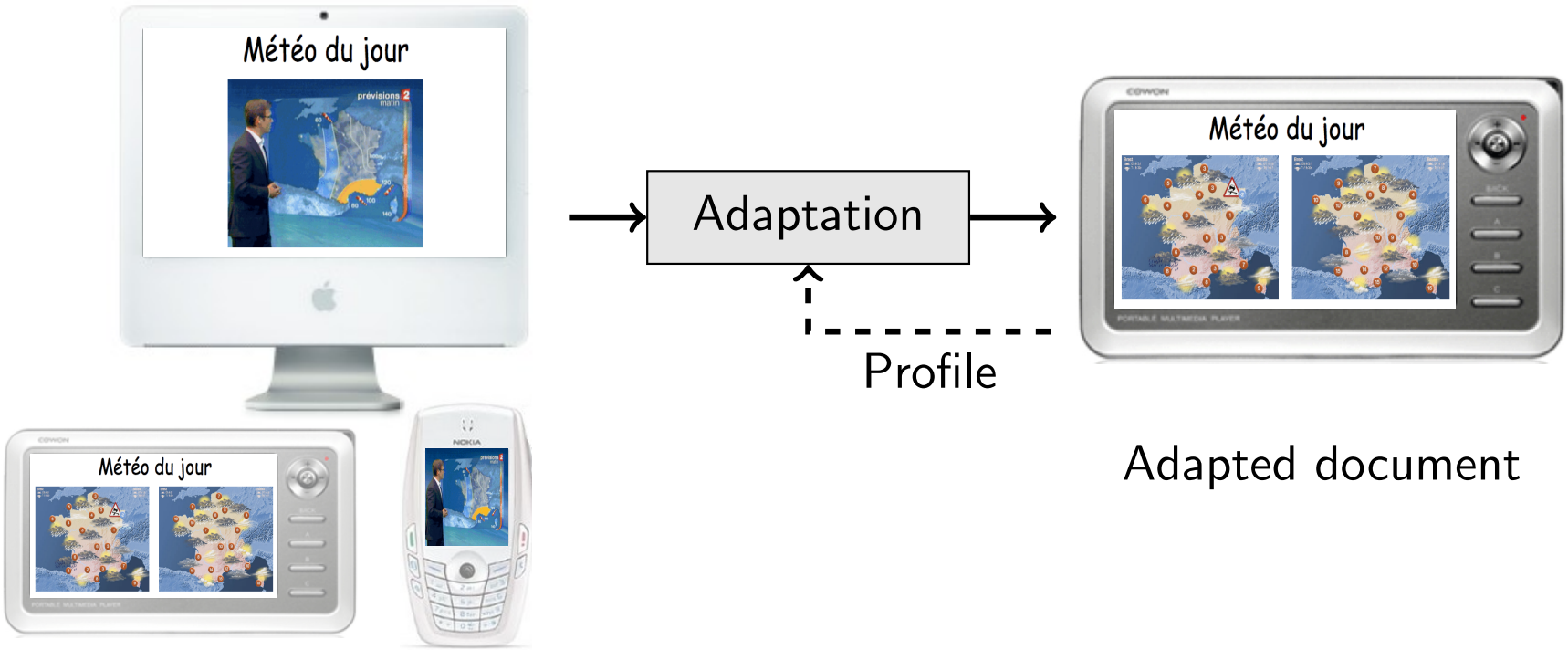
Current adaptation techniques

- Specification of alternatives
  - based on target profiles



Initial document

Adapted document

Current adaptation techniques

- Specification of alternatives
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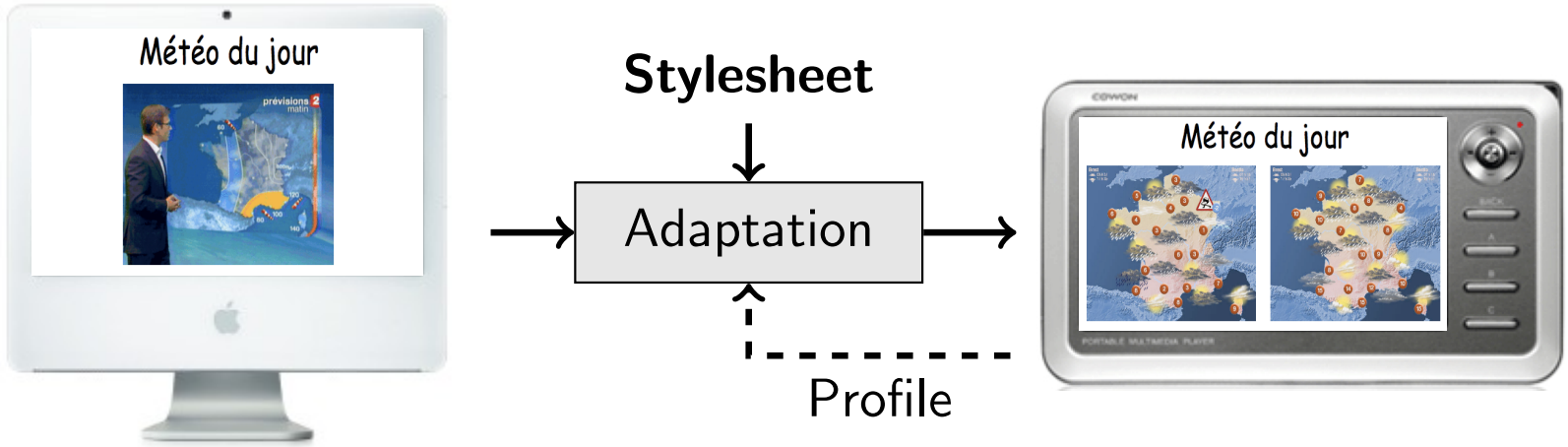
  - based on content



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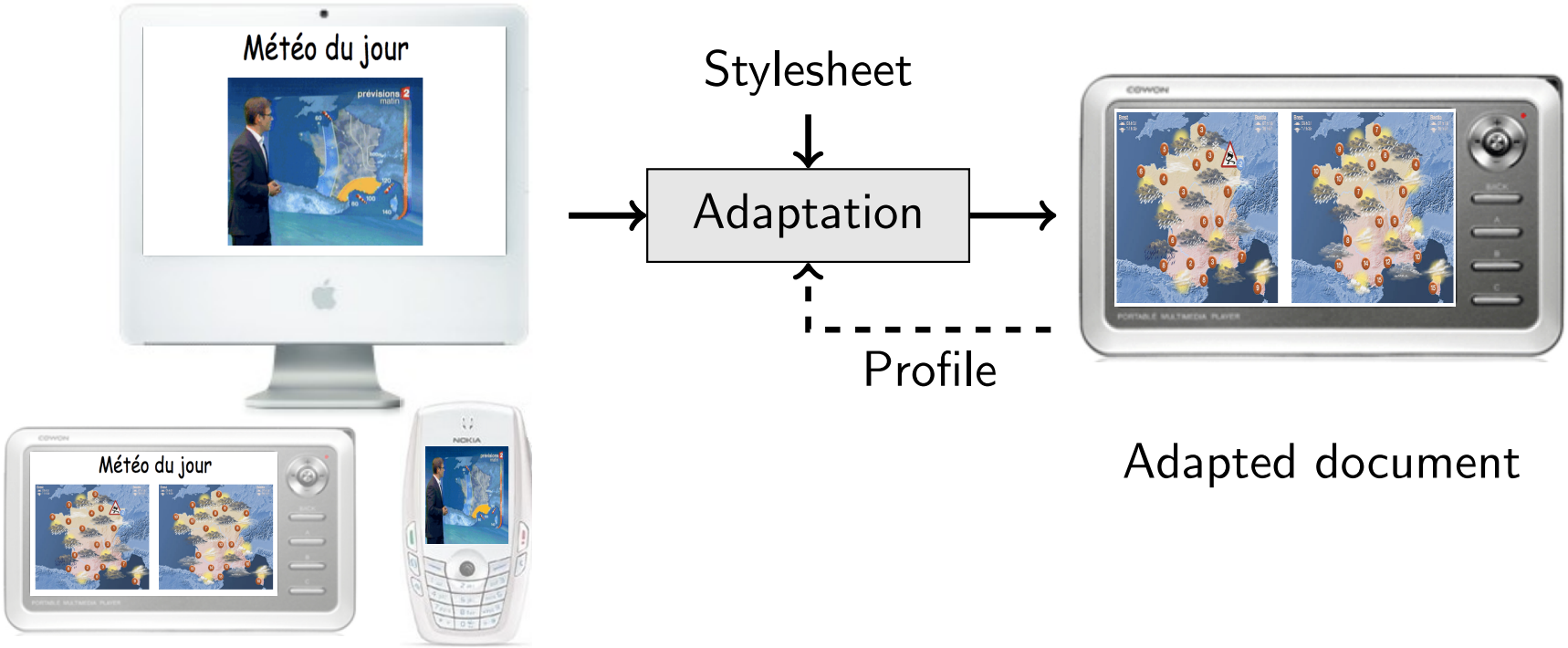
  - both approaches



Initial document

Adapted document

Current adaptation techniques

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Initial document

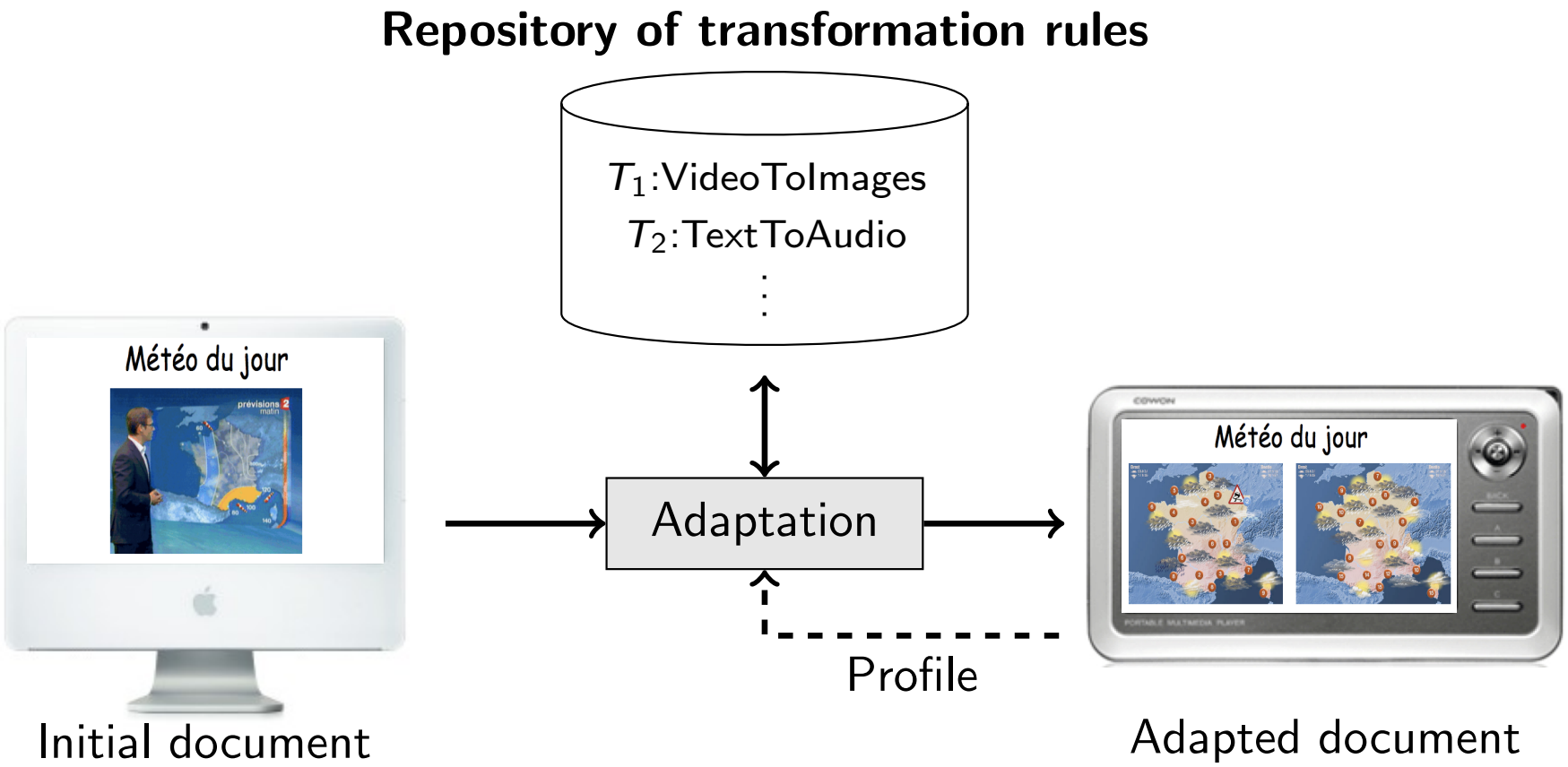
Stylesheet

Adaptation

Hard to predict target profiles

Current adaptation techniques

- Specification of alternatives
  - based on target profiles
  - based on content
  - both approaches
- Specification of transformation rules



Current adaptation techniques

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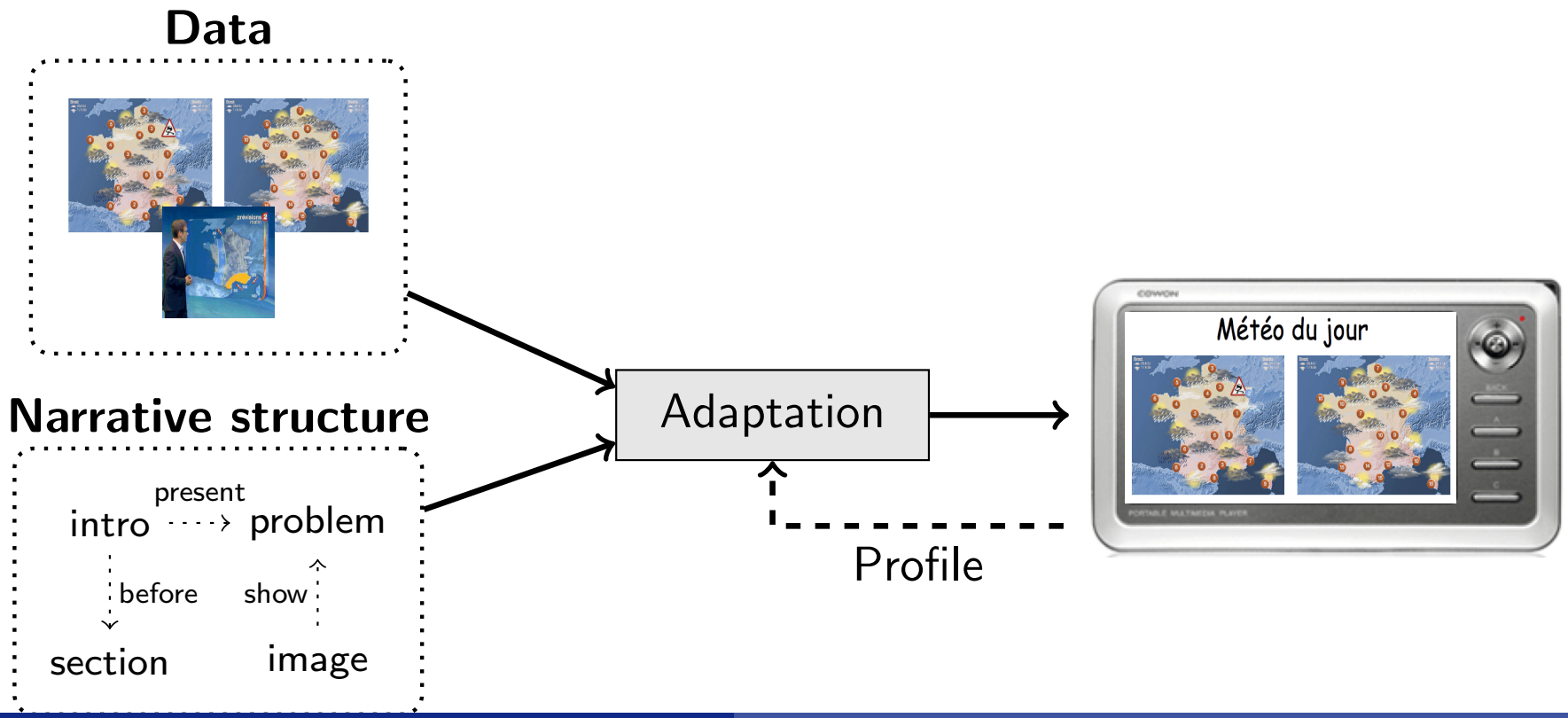
- Specification of transformation rules
- Specification of abstract models



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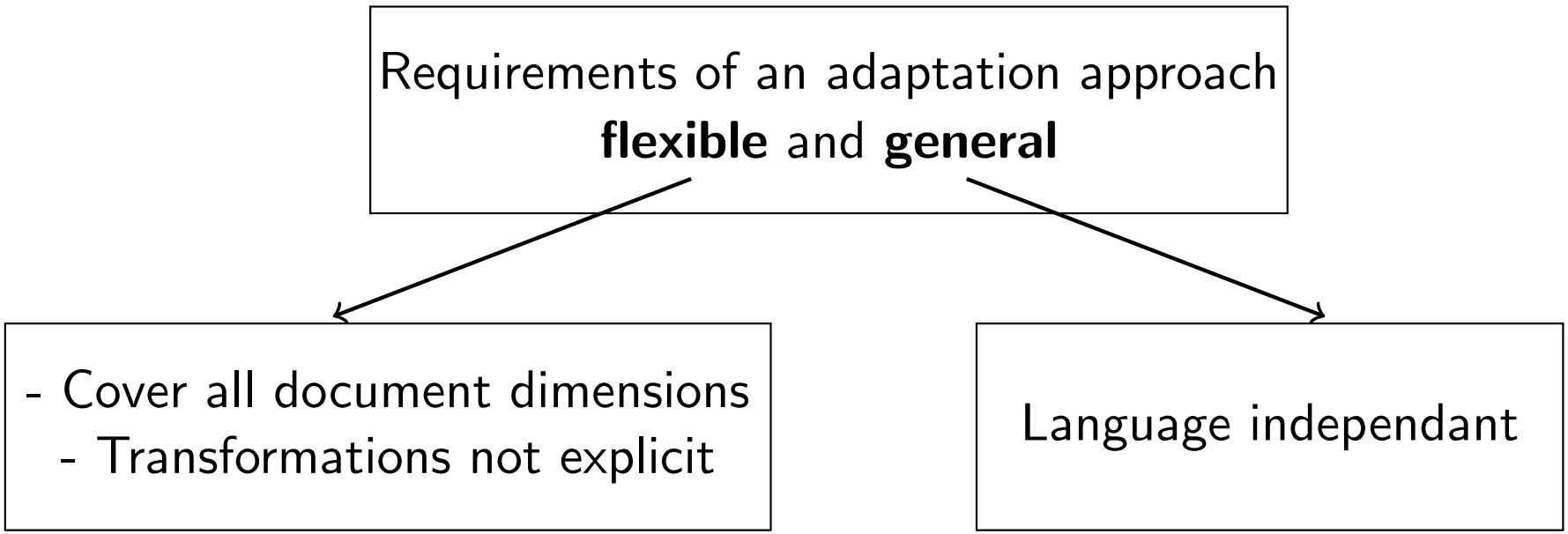

Adaptation quality

"The basic assumption is that content transformation activities should be provided as non-destructive operations." (DocEng'08)

$\Rightarrow$ One approach is to measure the adaptation transformations

Different kind of metrics:

- Measuring the discourse evolution
- Measuring the composition degradation
- Measuring the content transformation

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Different kind of metrics:

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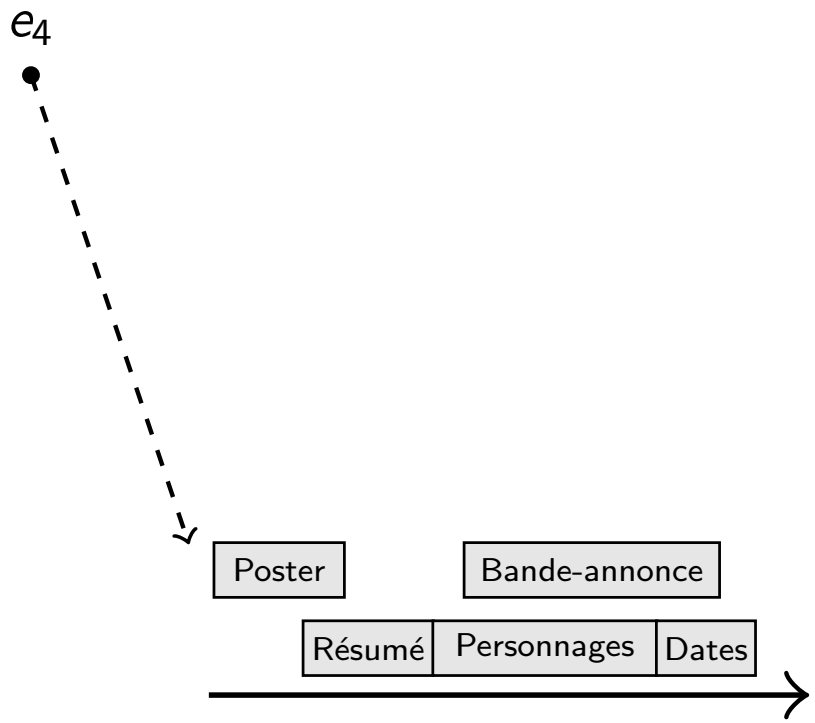
Semantic adaptation of multimedia documents

An execution is considered as a set of objects

Objects may be composed temporally



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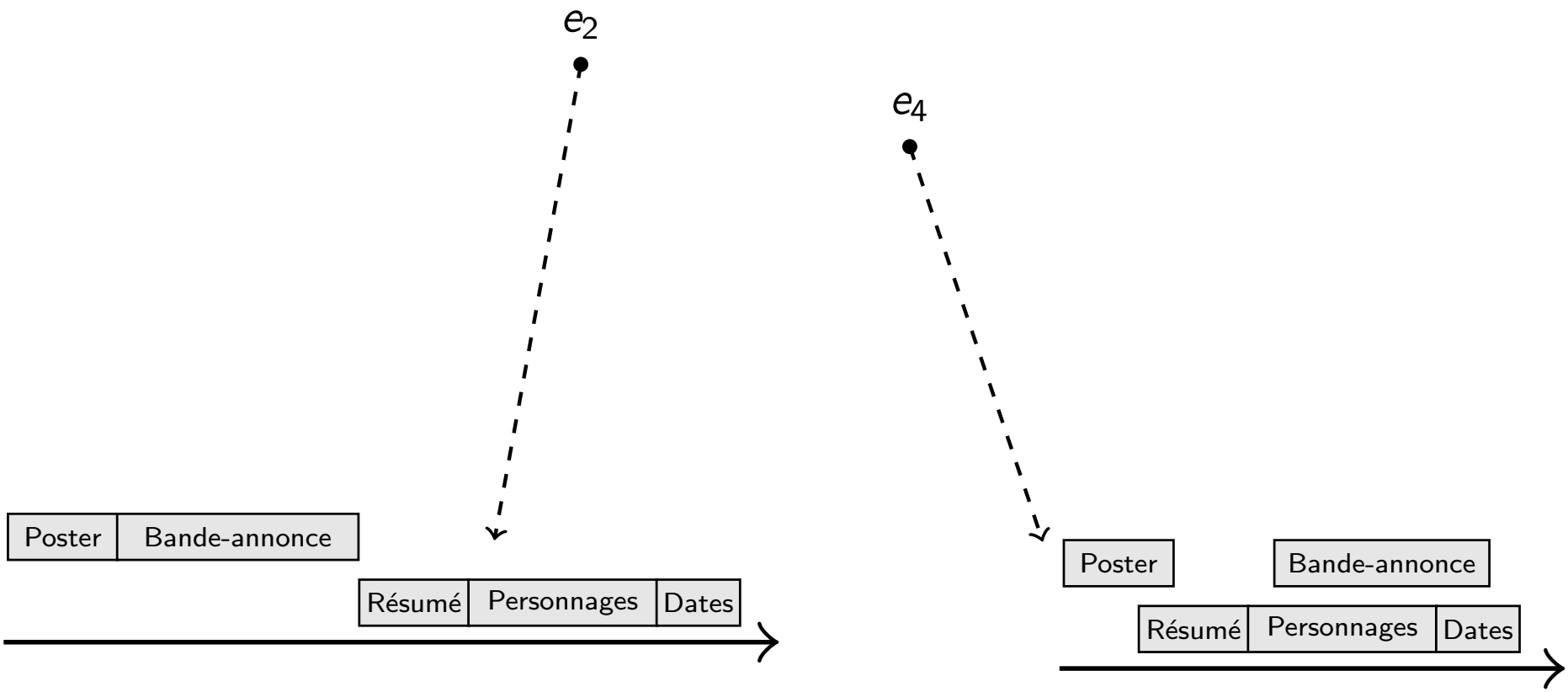
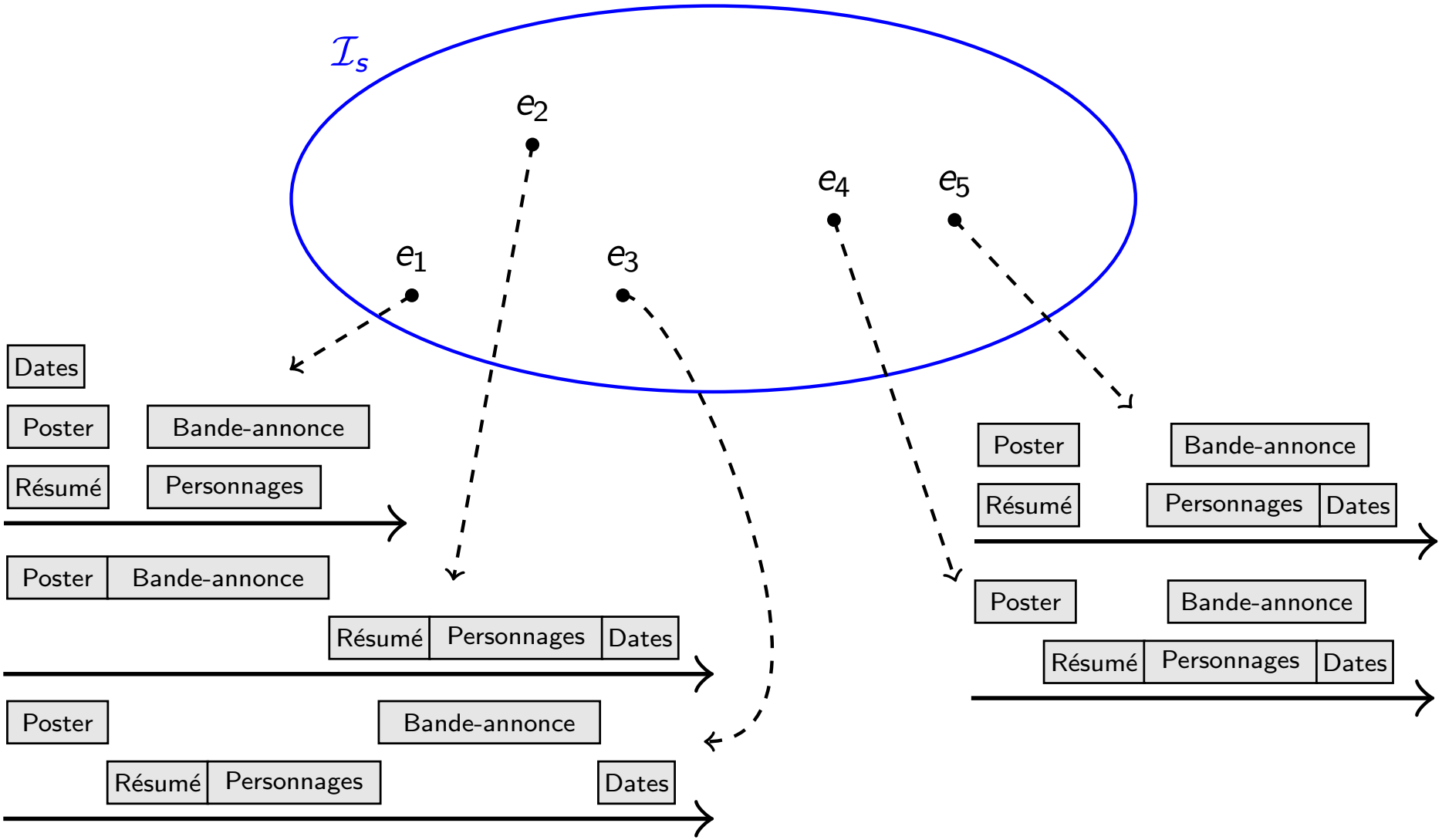


Semantic adaptation of multimedia documents

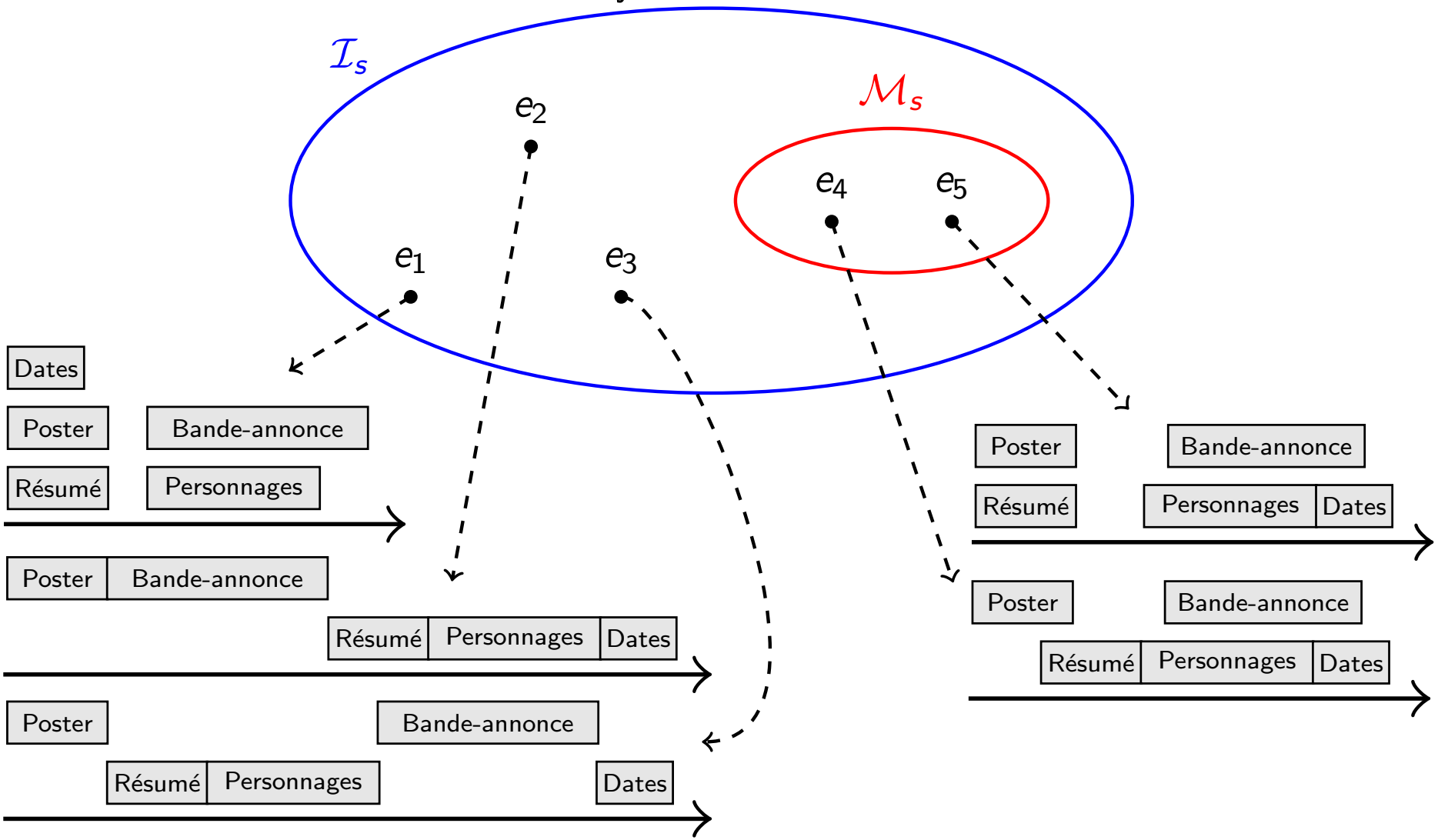
A document can be interpreted as a set of executions



Semantic adaptation of multimedia documents

A document can be interpreted as a set of executions

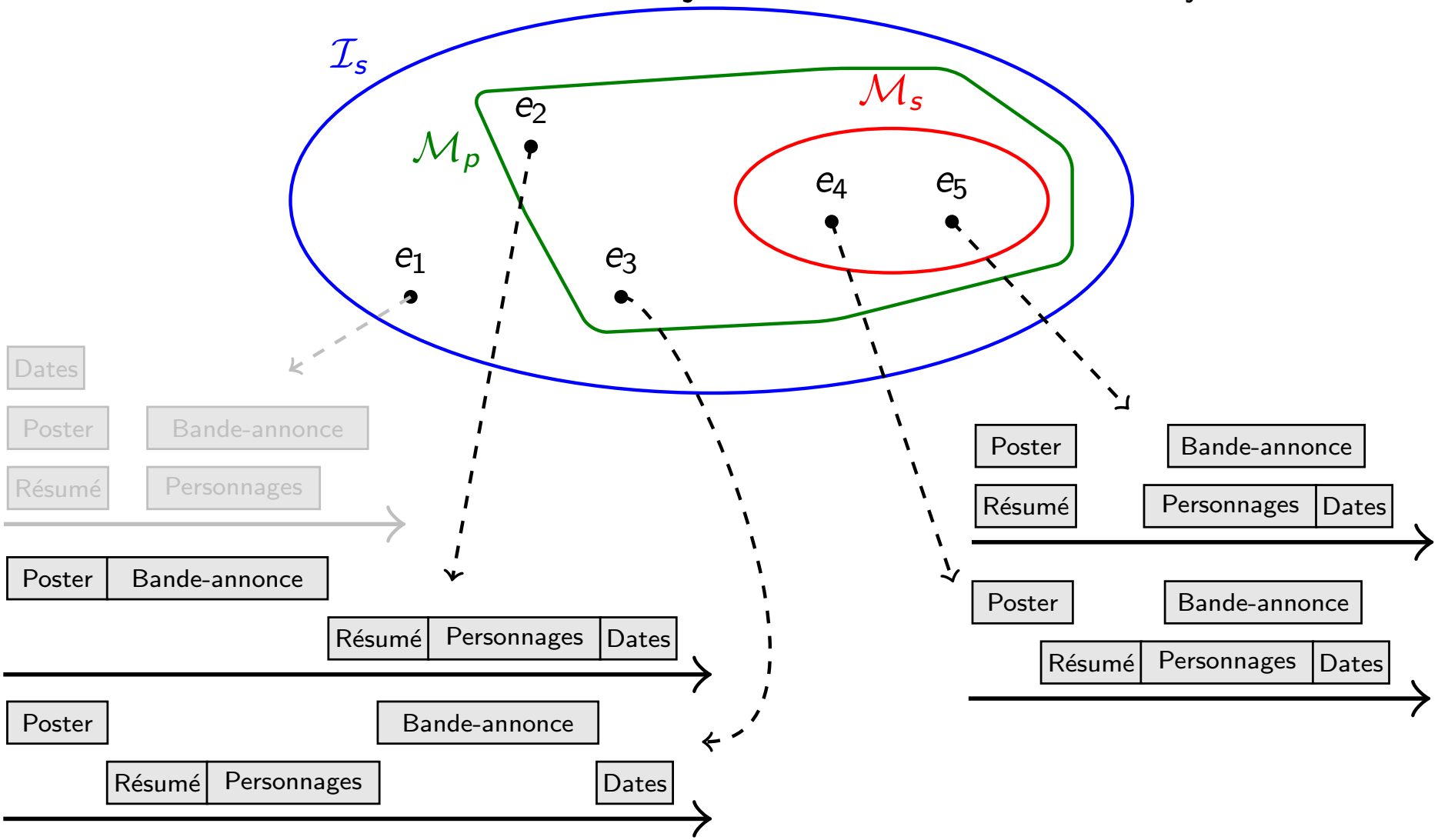
Some satisfy the author intention



Semantic adaptation of multimedia documents

The target device accepts only some executions

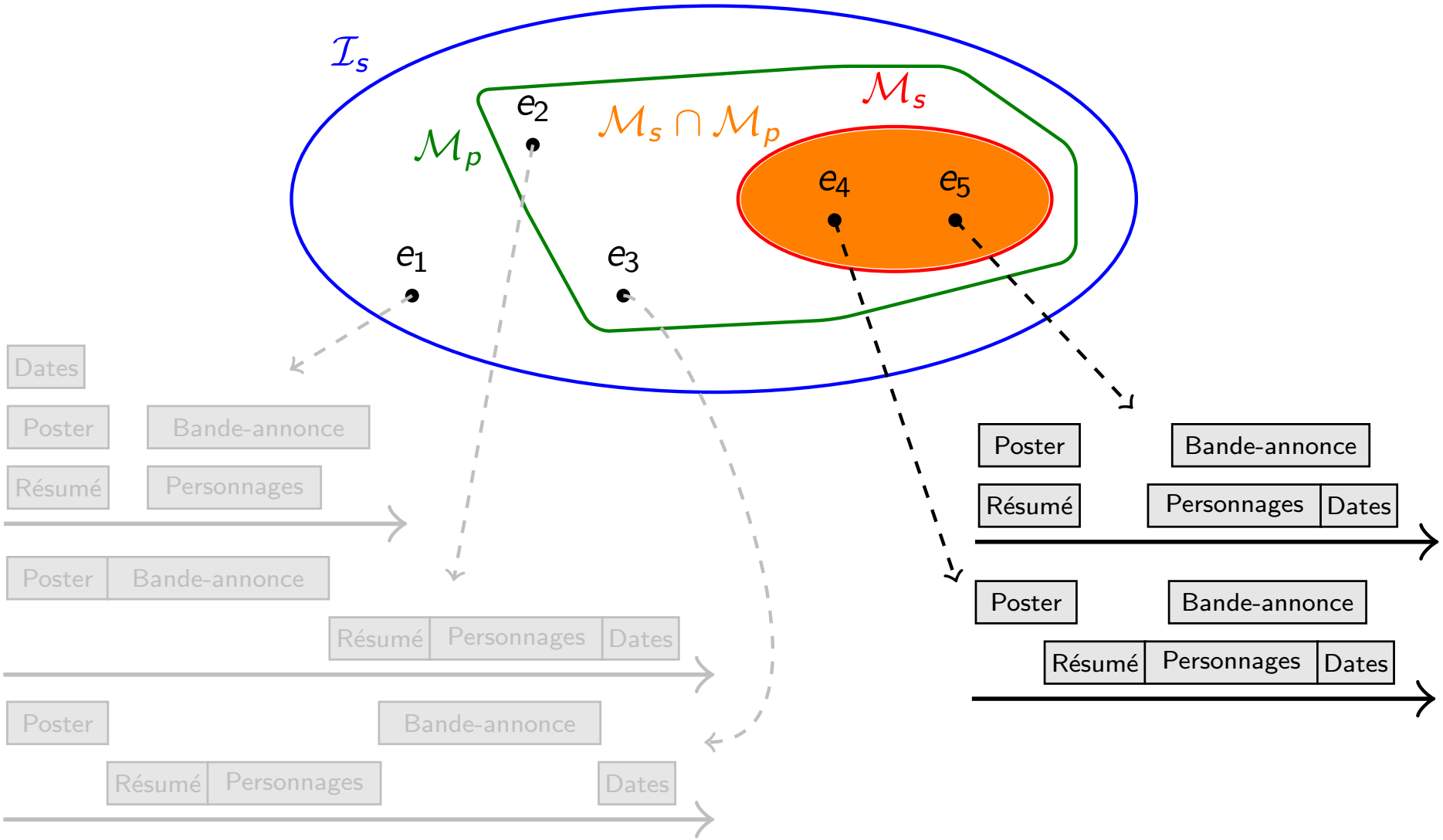
Profile: no more than 2 objects executed simultaneously



Semantic adaptation of multimedia documents

Adapting amounts to find possible initial executions ($\mathcal{M}_s \cap \mathcal{M}_p$)

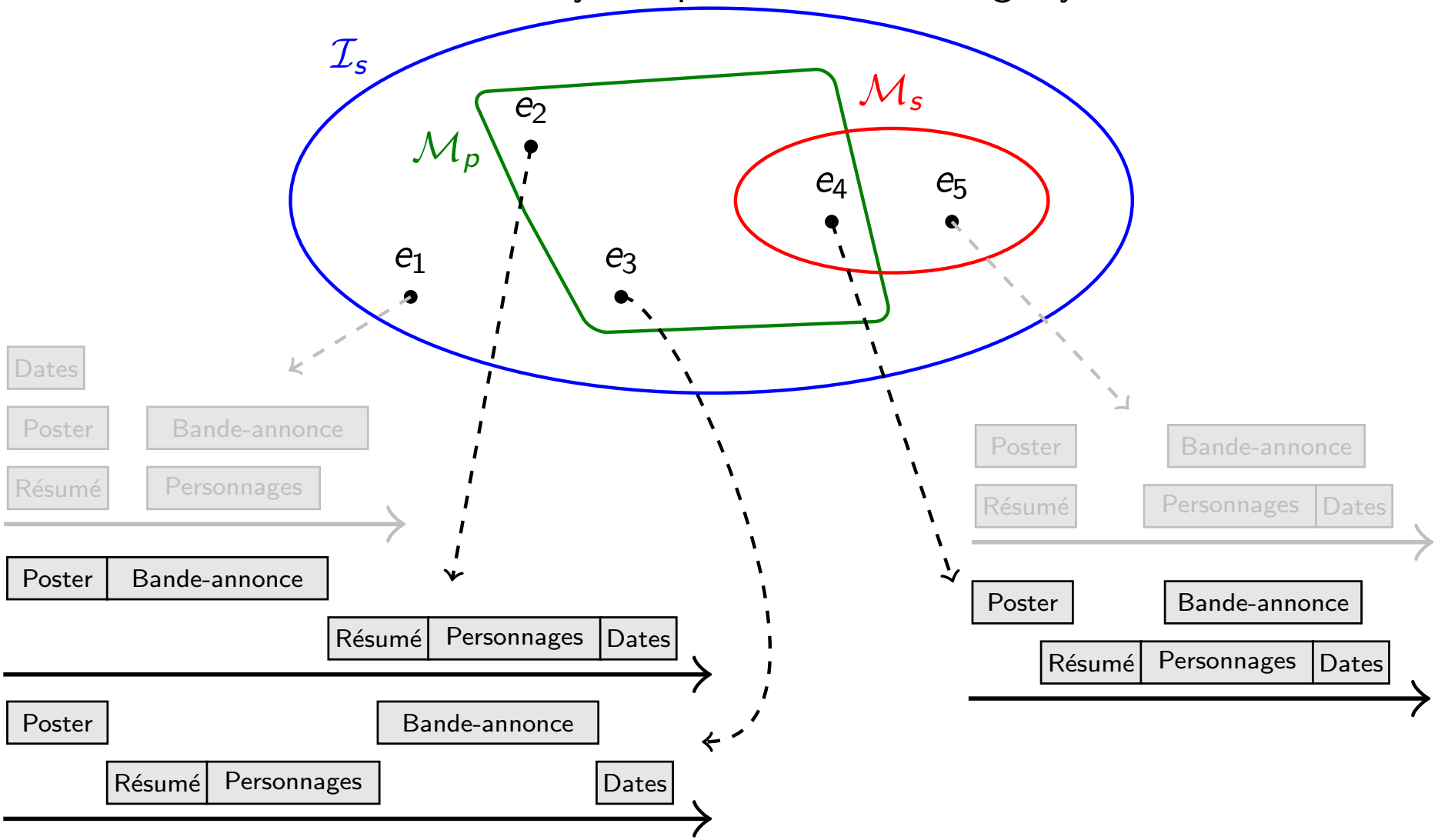
Here, no adaptation is needed



Semantic adaptation of multimedia documents

Other profiles can be considered

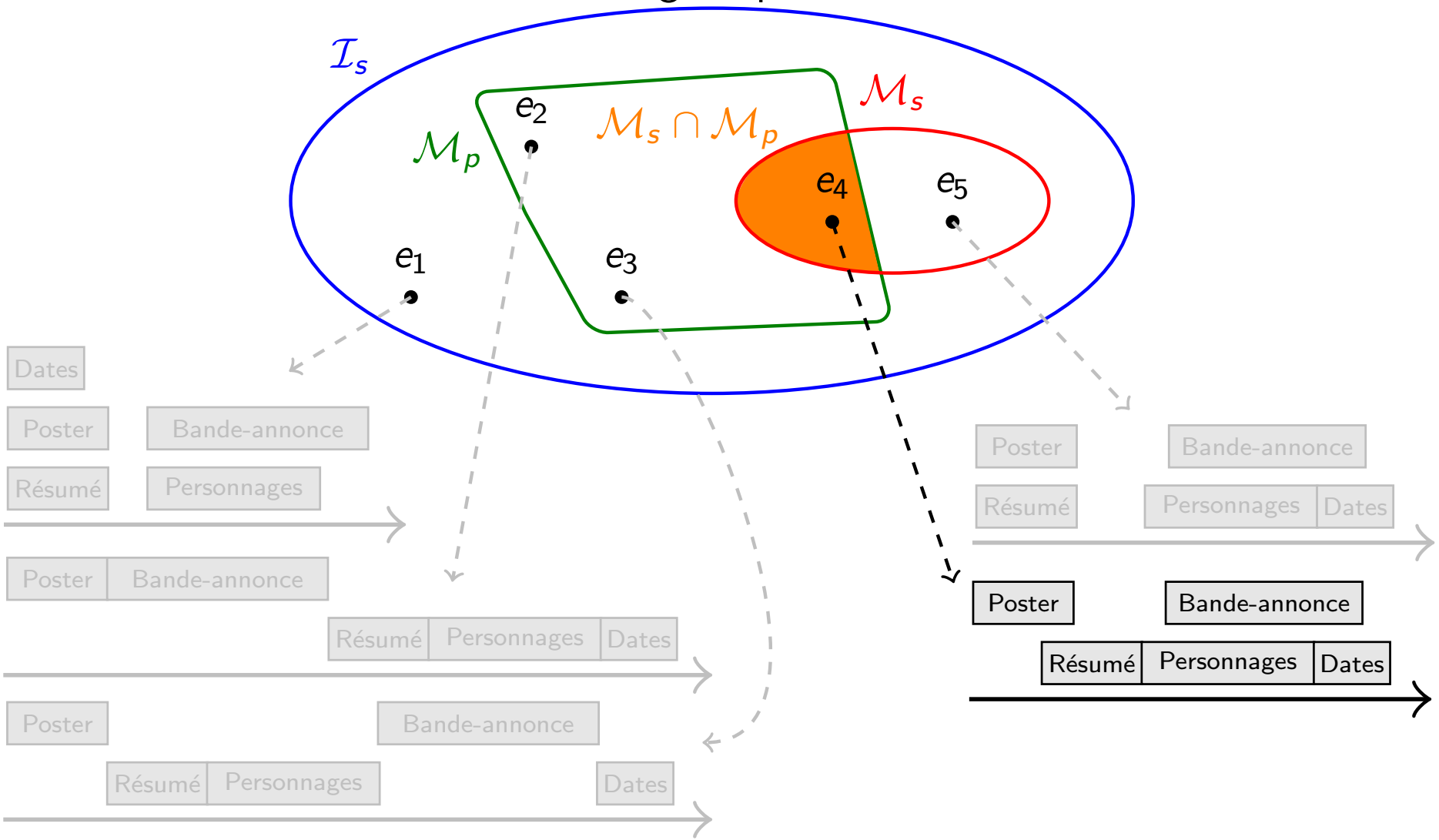
Profile: satisfy the presentation contiguity



Semantic adaptation of multimedia documents

The adaptation selects some possible initial executions

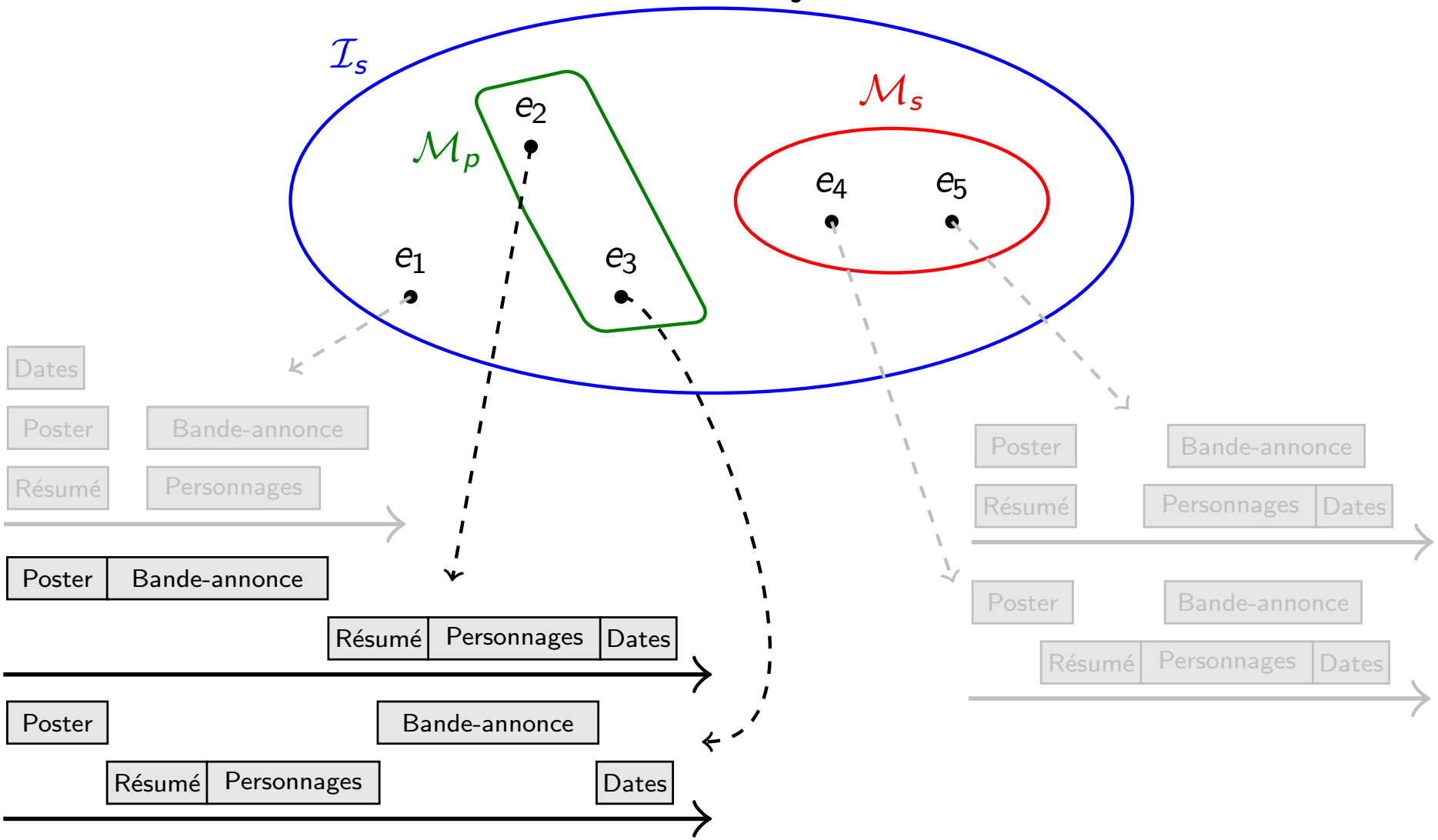
Refining adaptation



Semantic adaptation of multimedia documents

In other cases, no initial execution can be possible

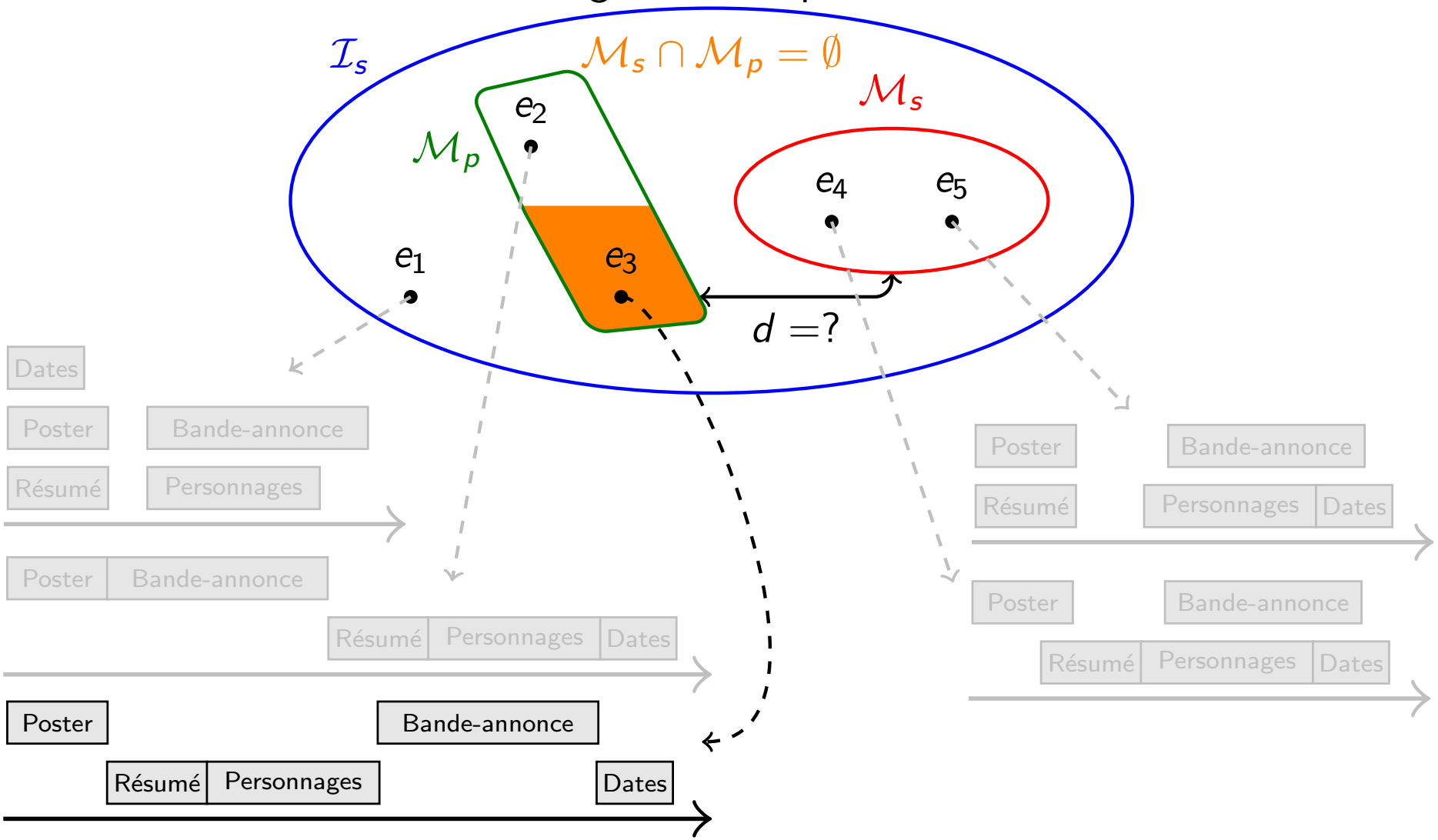
Profile: execute one objets at a time



Semantic adaptation of multimedia documents

The adaptation selects some executions close to initial ones

Transgressive adaptation



Our contribution

Bridge the gap between theory and application

- **Consider all multimedia document dimensions**
  - Temporal dimension
  - Spatial dimension
  - Hypermedia dimension
- **Consider the combination of all dimensions**
  - Adapting the spatio-temporal and hypermedia dimension
- **Consider standard multimedia documents**
  - Adapting SMIL documents
- **Consider media adaptation**

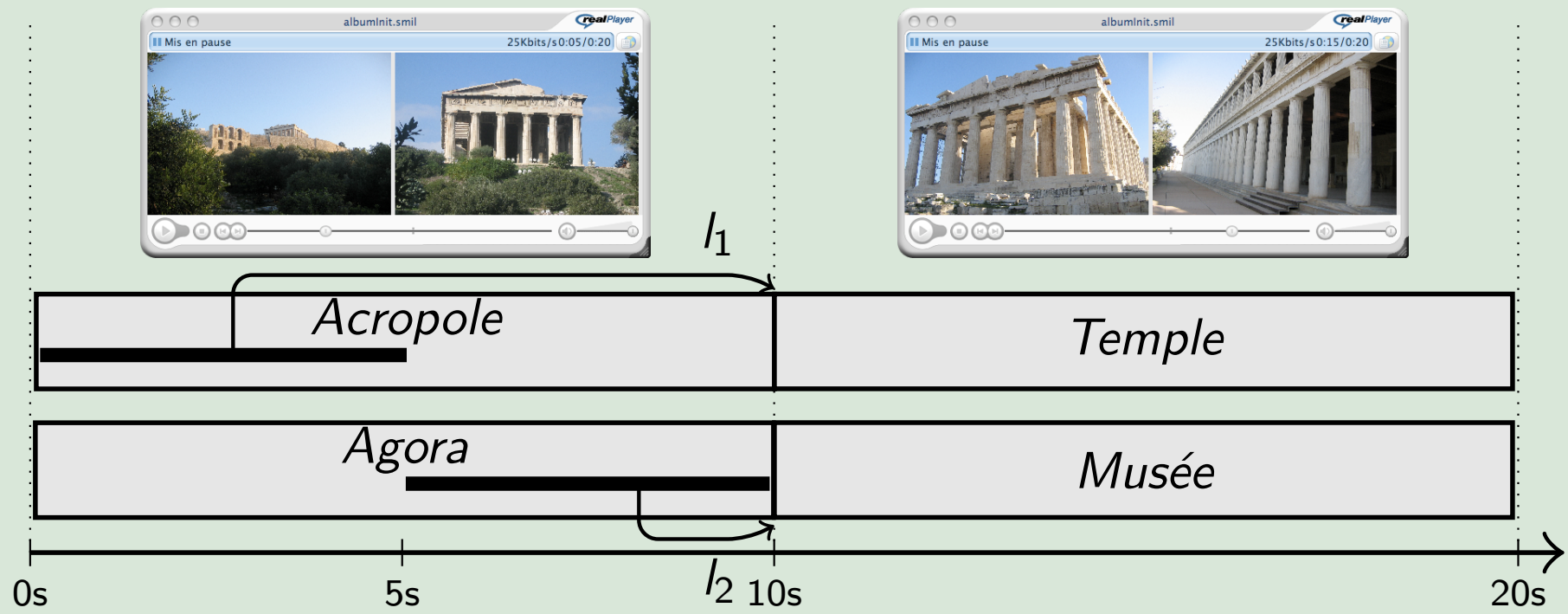
Tables des matières

Multimedia document specification

Definition (Multimedia document specification)

A multimedia document specification $s = \langle O, C \rangle$ is composed of a set of objects O and a set of relations (or constraints) C between the elements of O.

Example (Spatio-temporal and hypermedia specification)

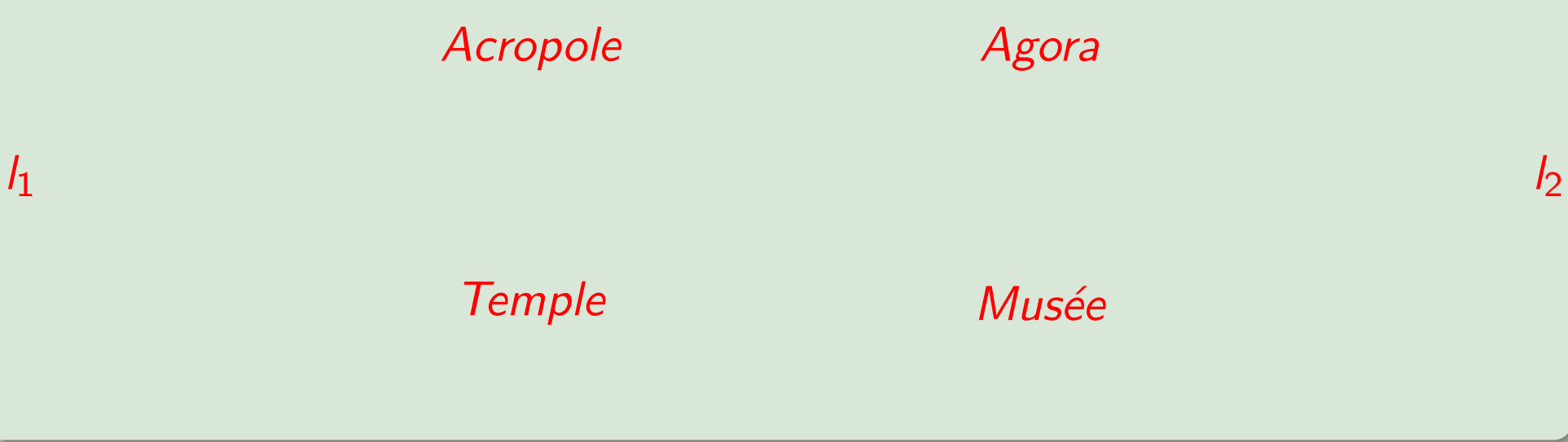


Multimedia document specification

Definition (Relation graph)

A multimedia document specification $s = \langle O, C \rangle$ can be represented with a relation graph: O is the set of nodes and edges are labeled by elements from C.

Example (Spatio-temporal and hypermedia relation graph)



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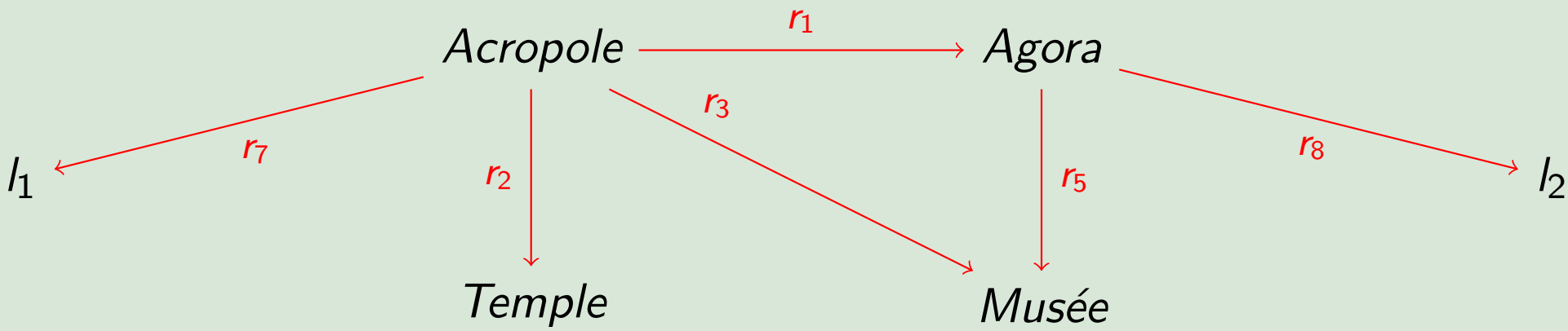

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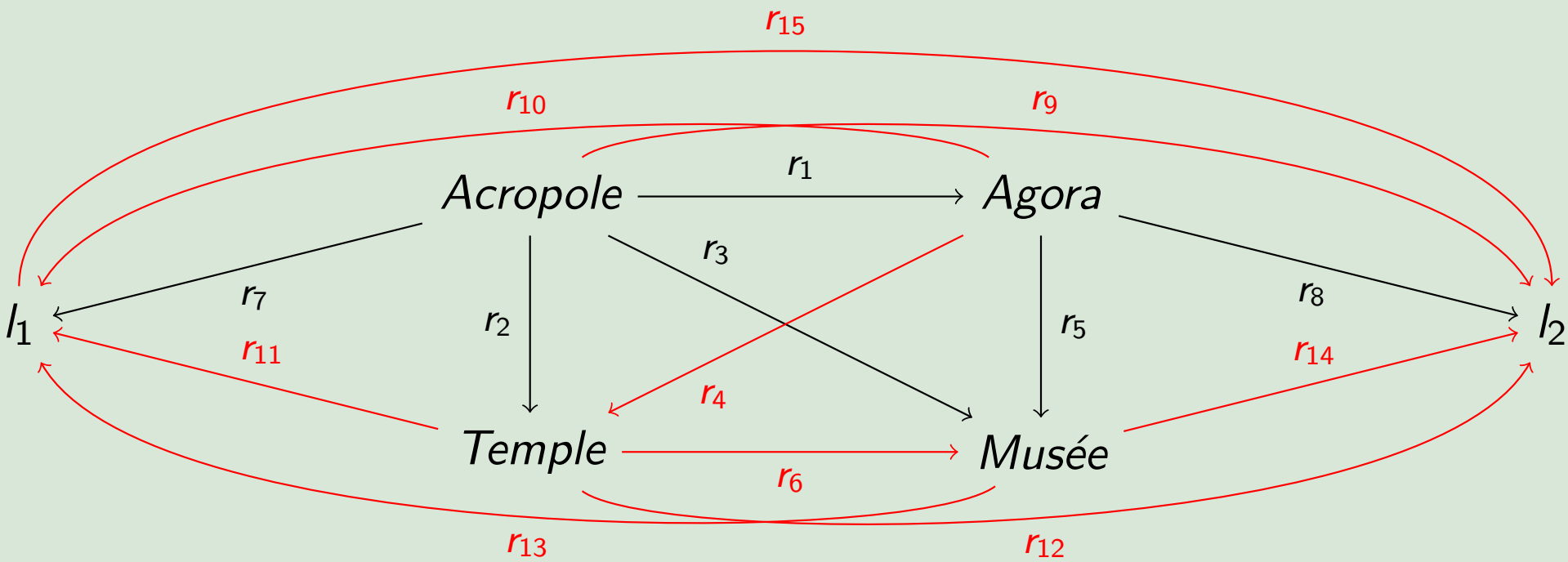
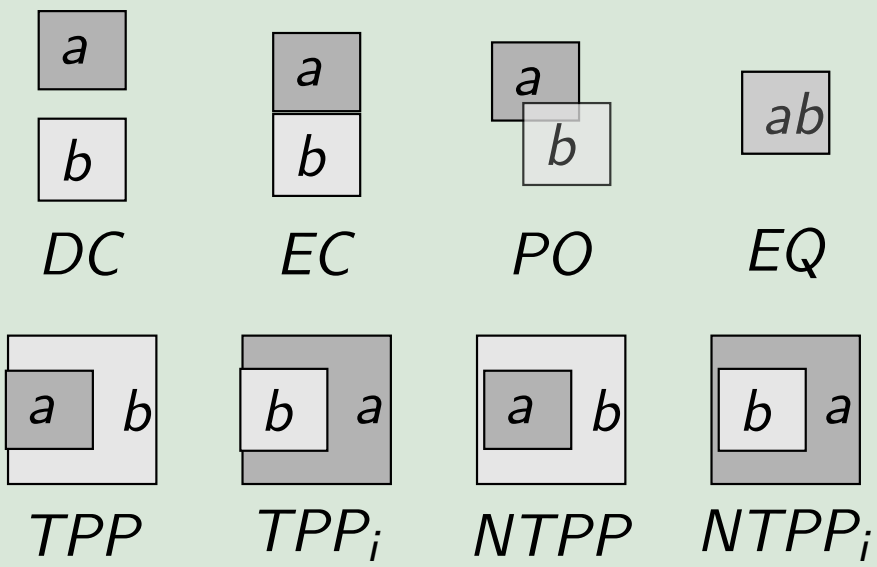


Spatio-temporal and hypermedia specification

Definition (Spatio-temporal relation)

A spatio-temporal relation $r = \langle r_s, r_t \rangle$ is composed of a spatial relation r_s and a temporal relation r_t.

RCC8 spatial representation



Allen temporal representation

x r y	x / y	y r^{-1} x
before (b)	— —	(bi) after
meets (m)	——	(mi) met-by
during (d)	——	(di) contains
overlaps (o)	——	(oi) overlapped-by
starts (s)	——	(si) started-by
finishes (f)	——	(fi) finished-by
equals (e)	=	(e)

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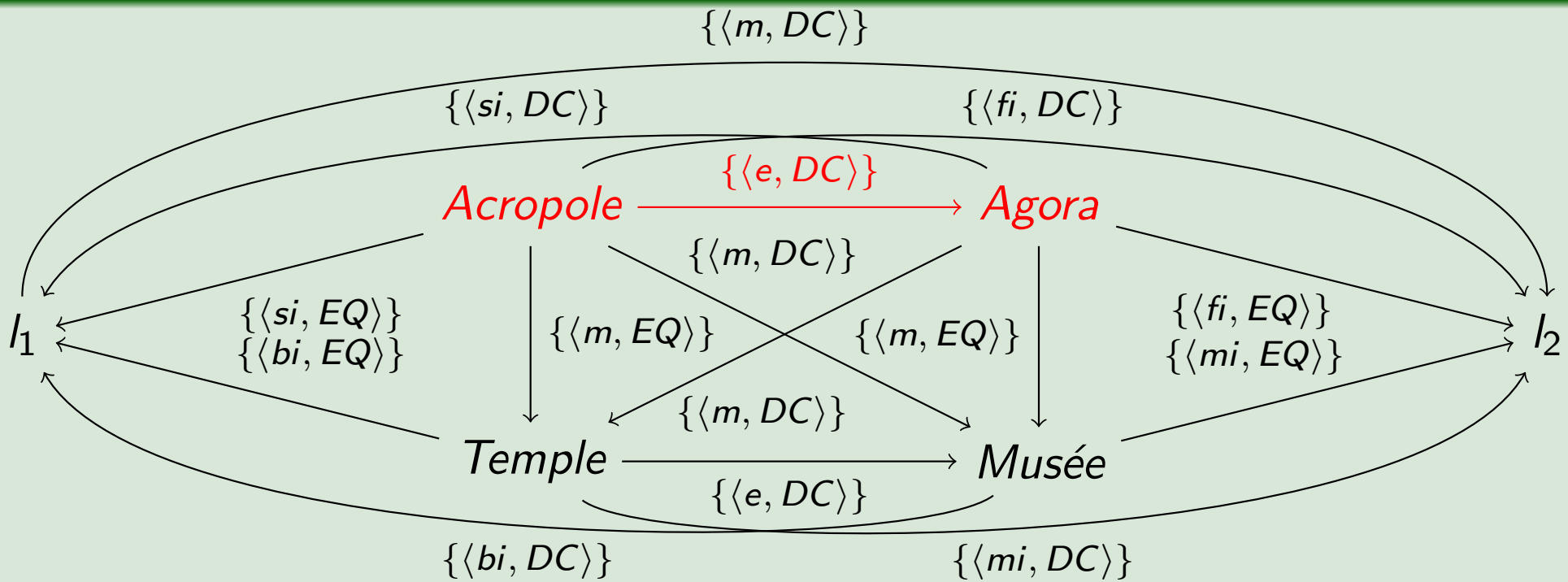

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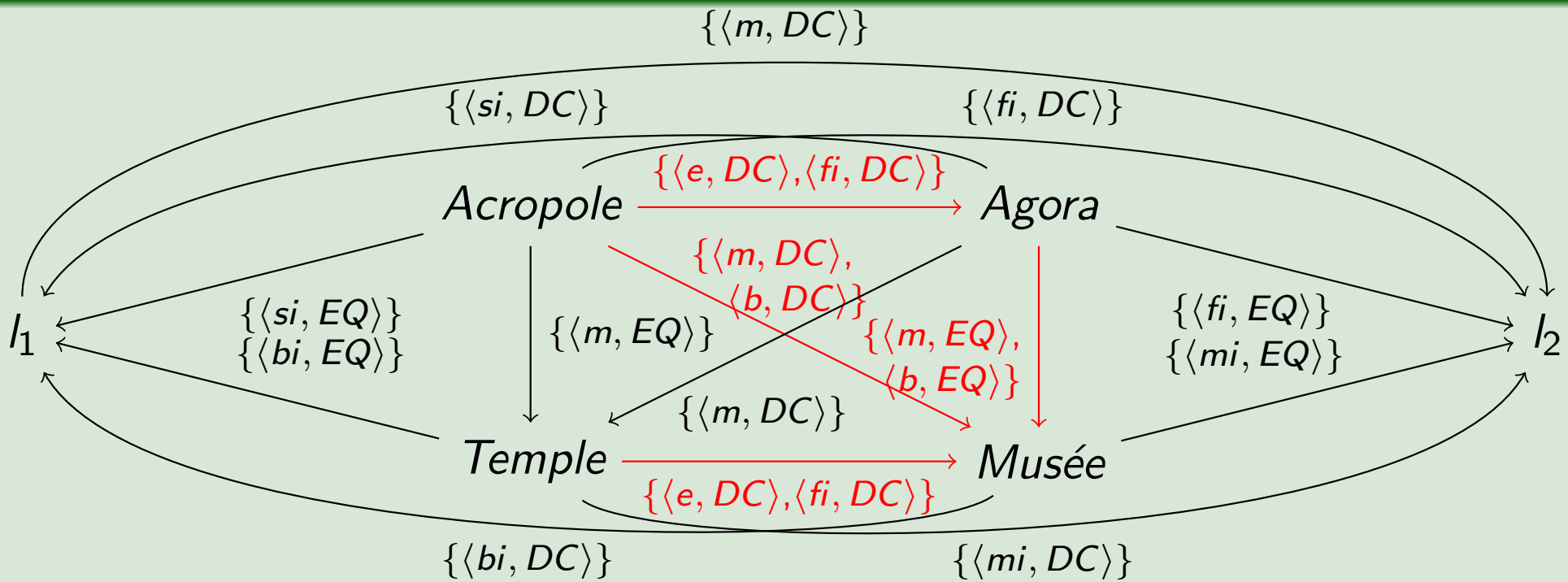
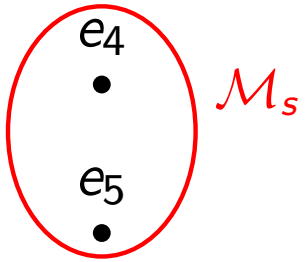


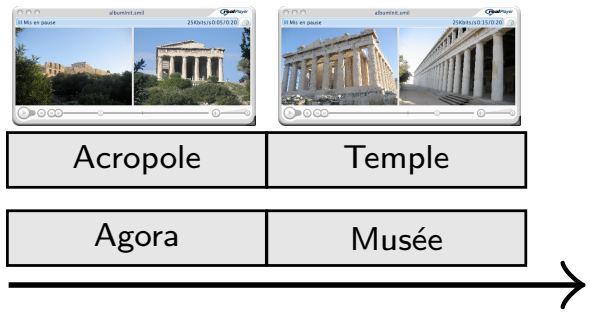
Outline

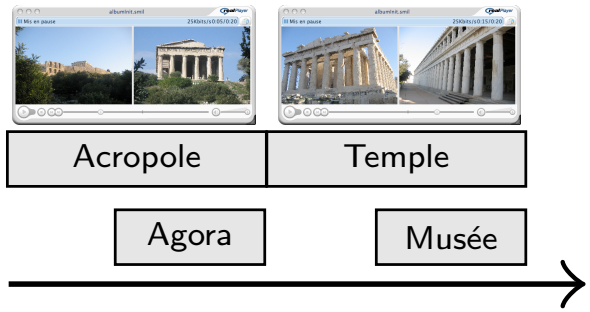
Transgressive adaptation

Profile

no simultaneous executions
no side by side objects







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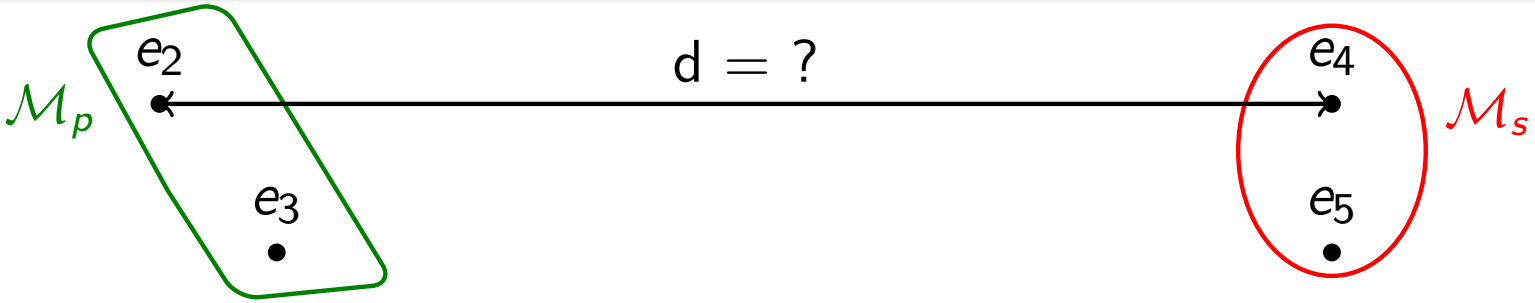
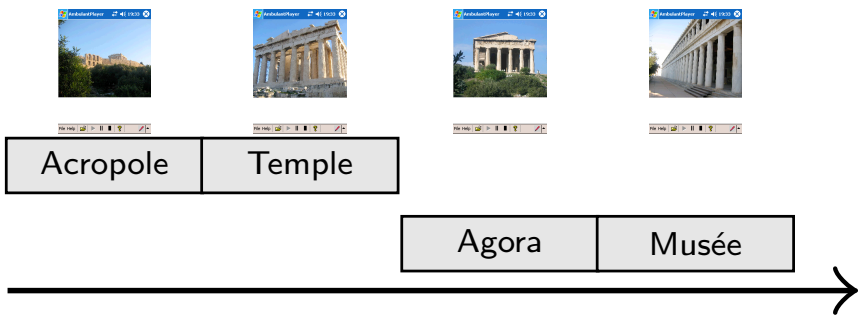
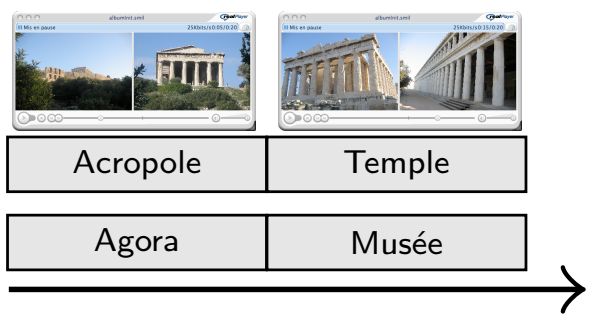
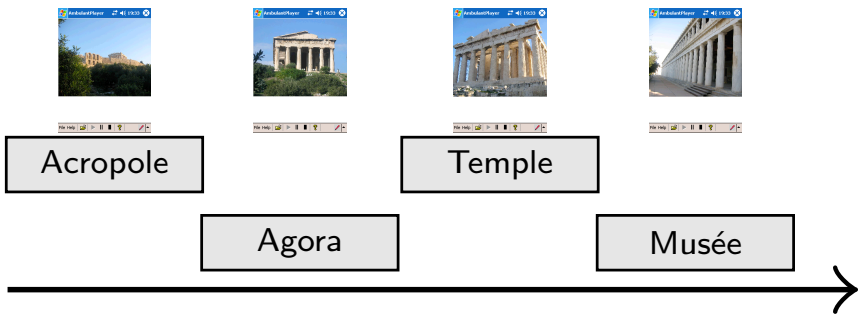
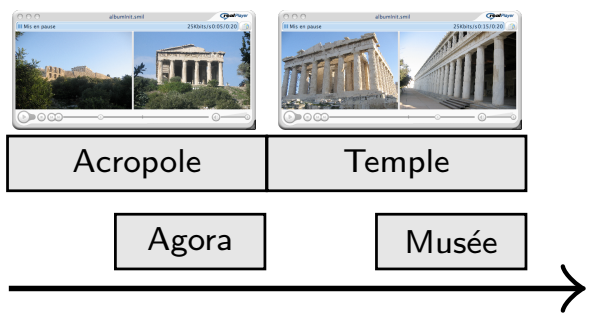




d = ?







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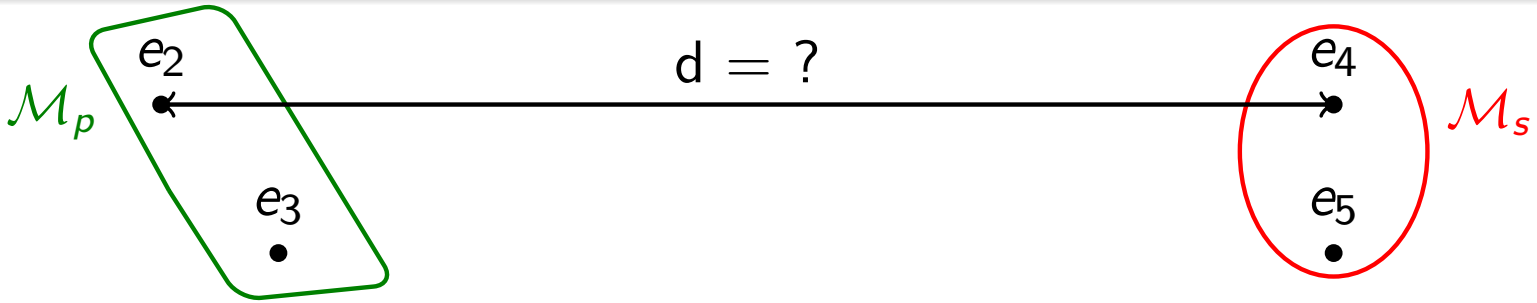

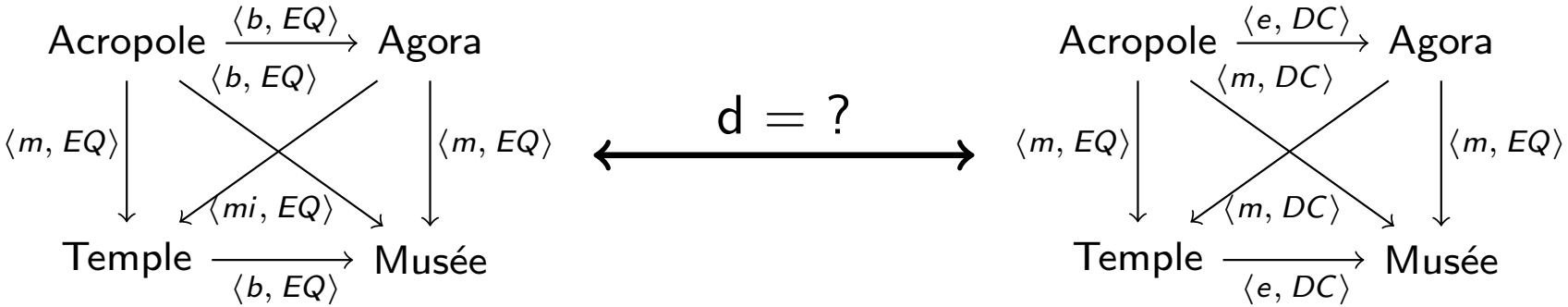

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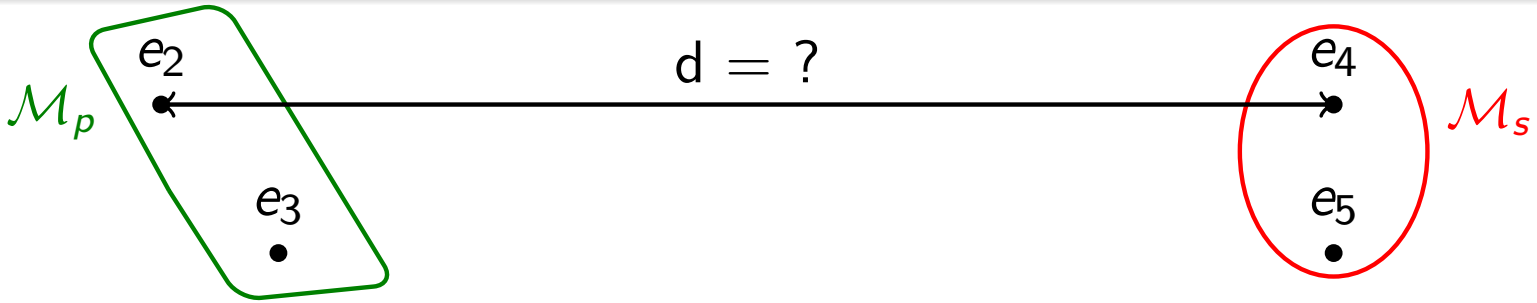
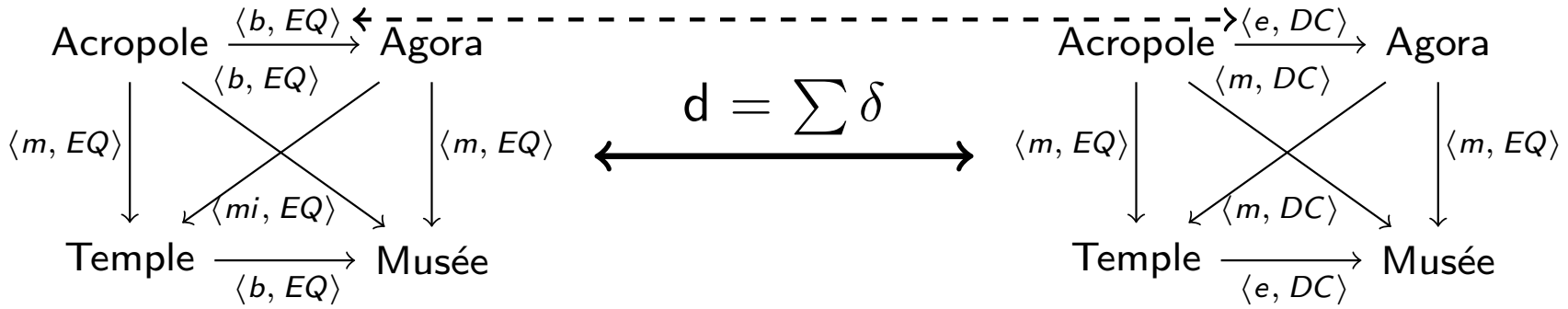
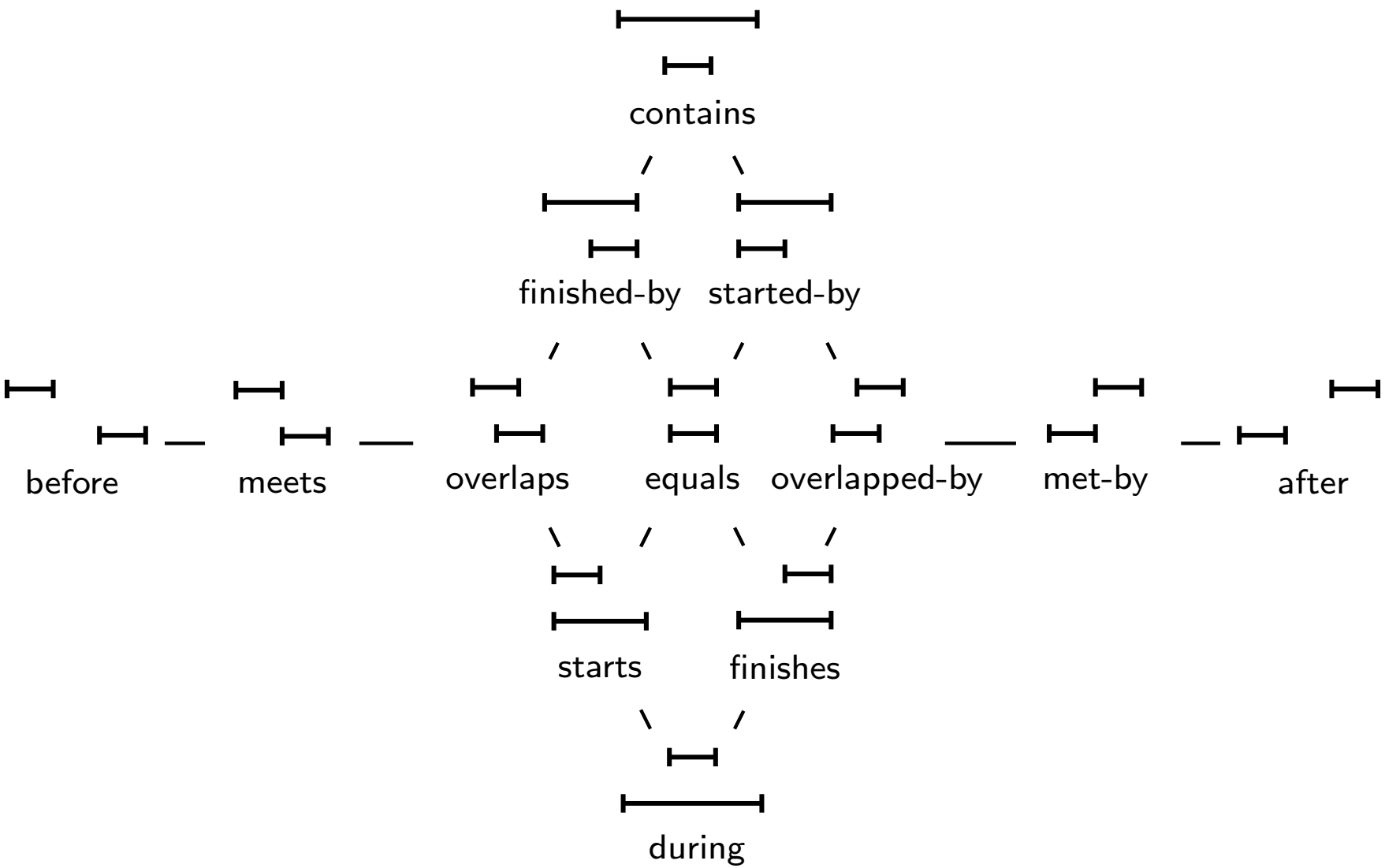


$\delta = ?$



Allen neighborhood graph



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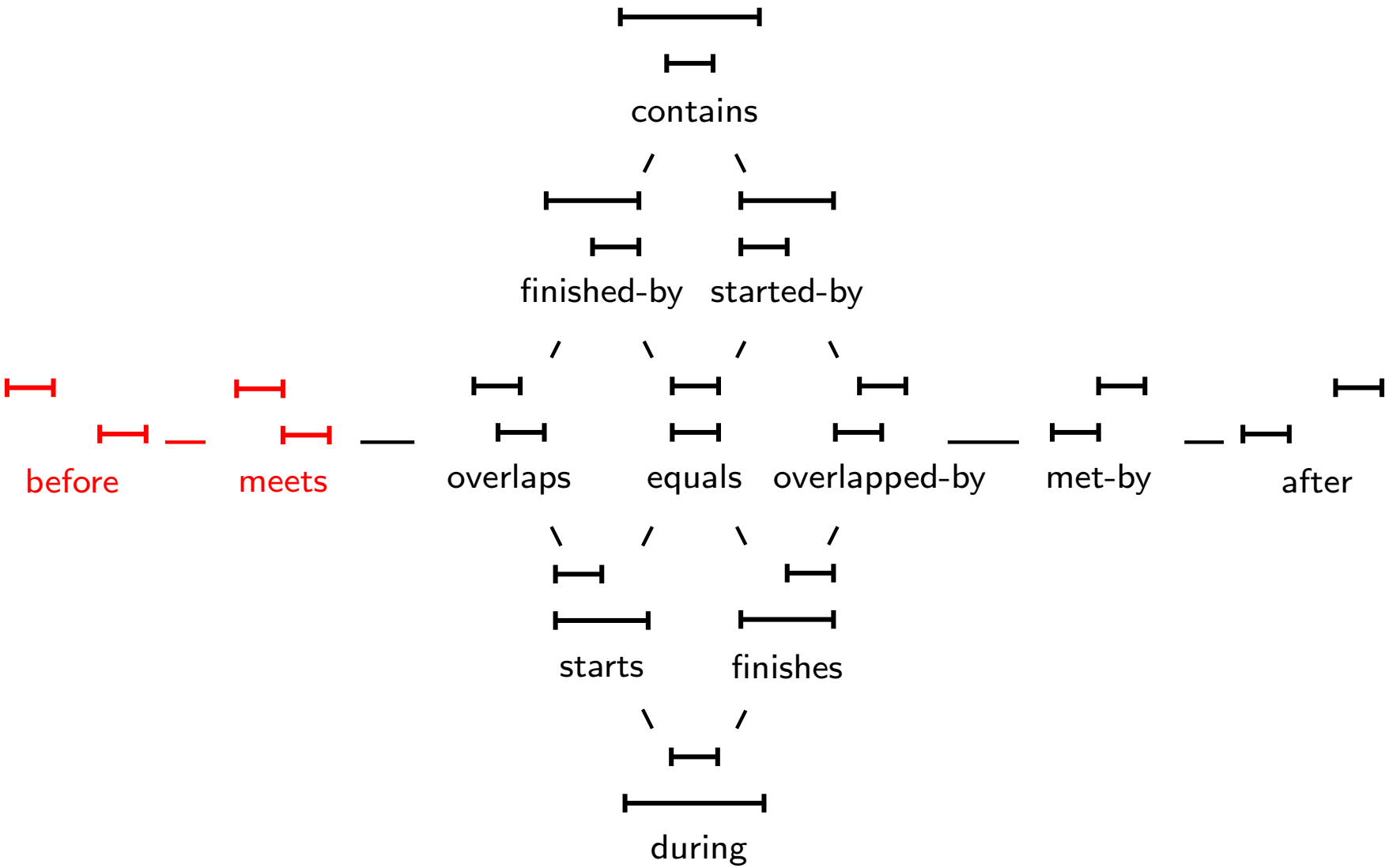

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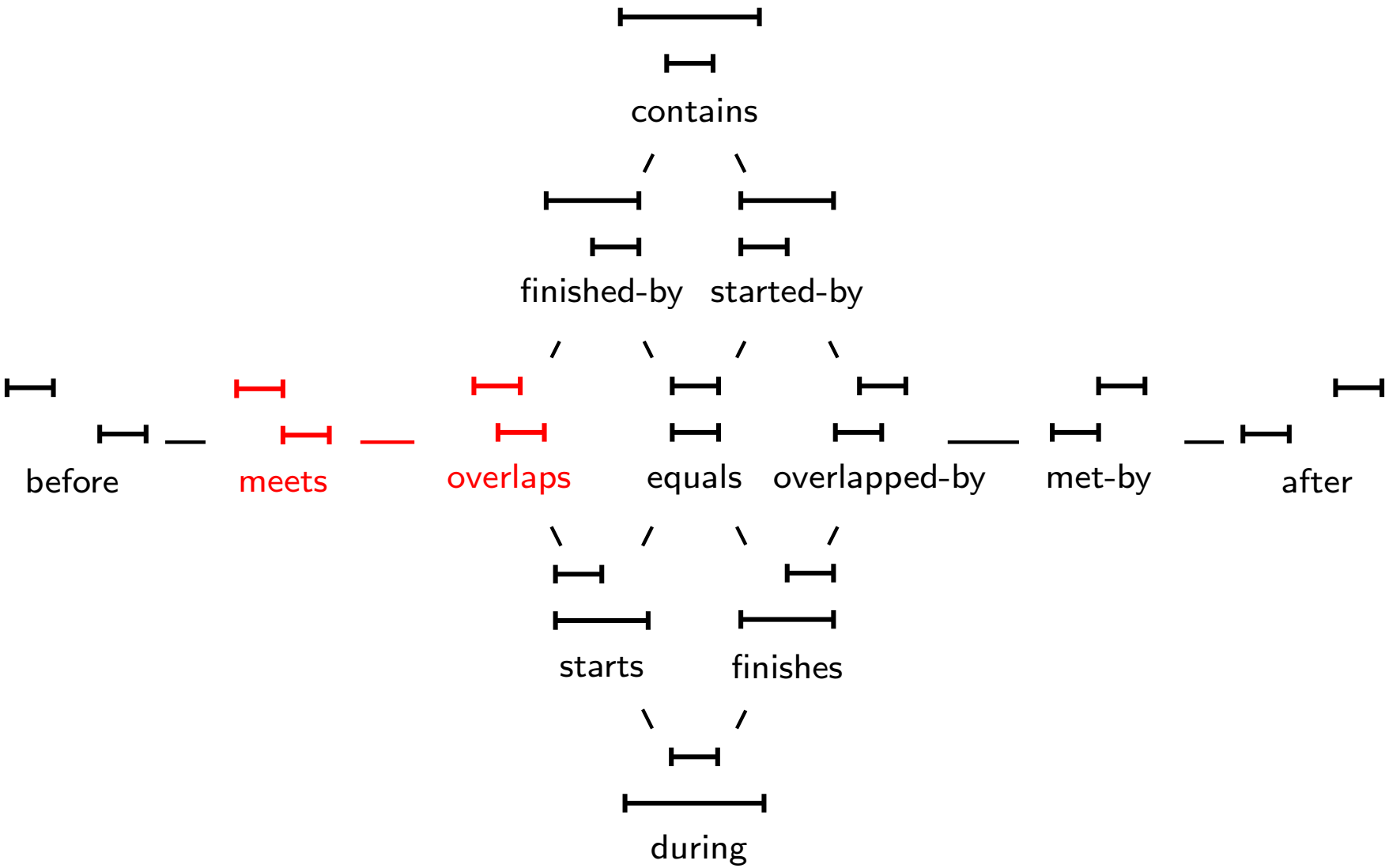

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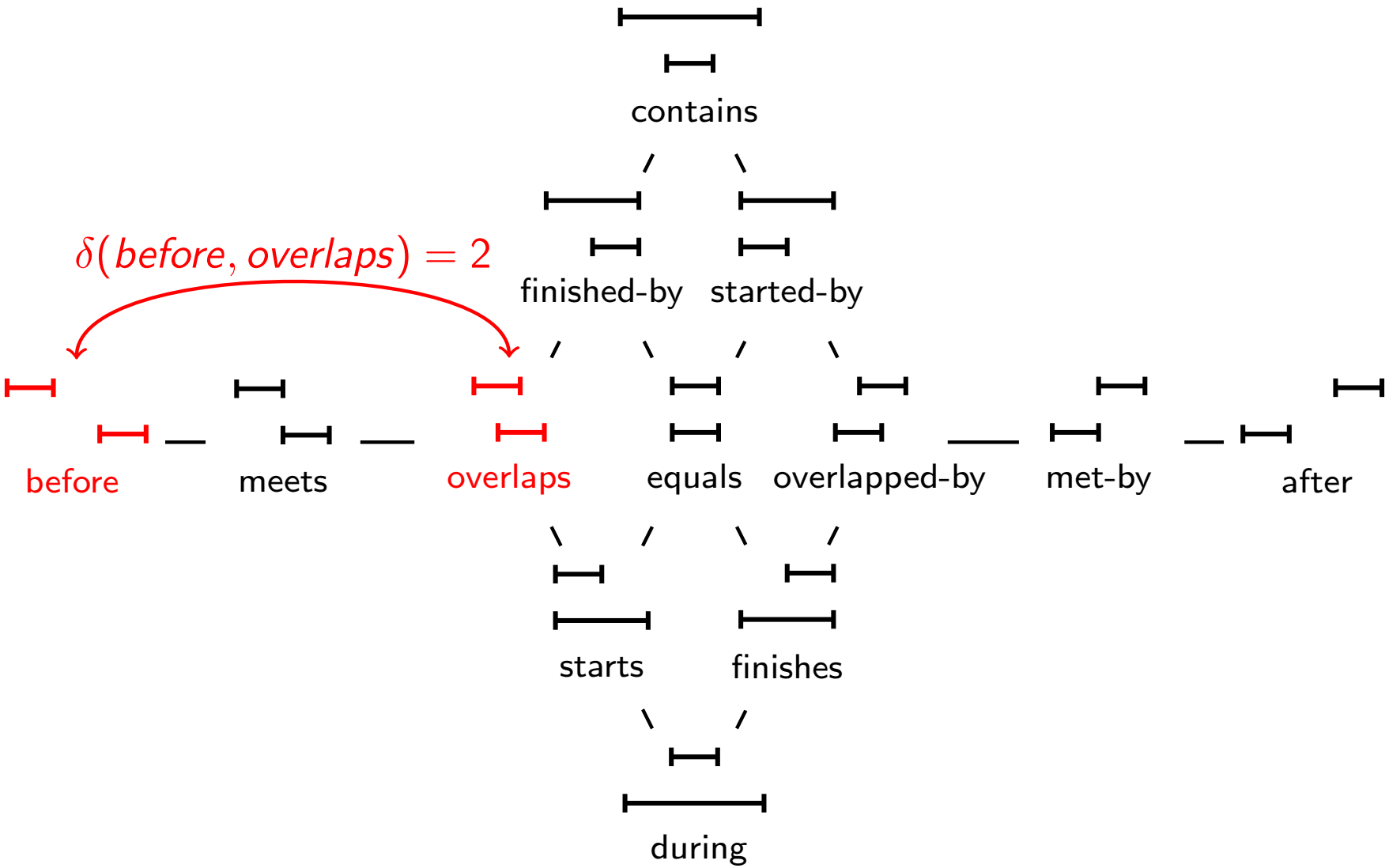
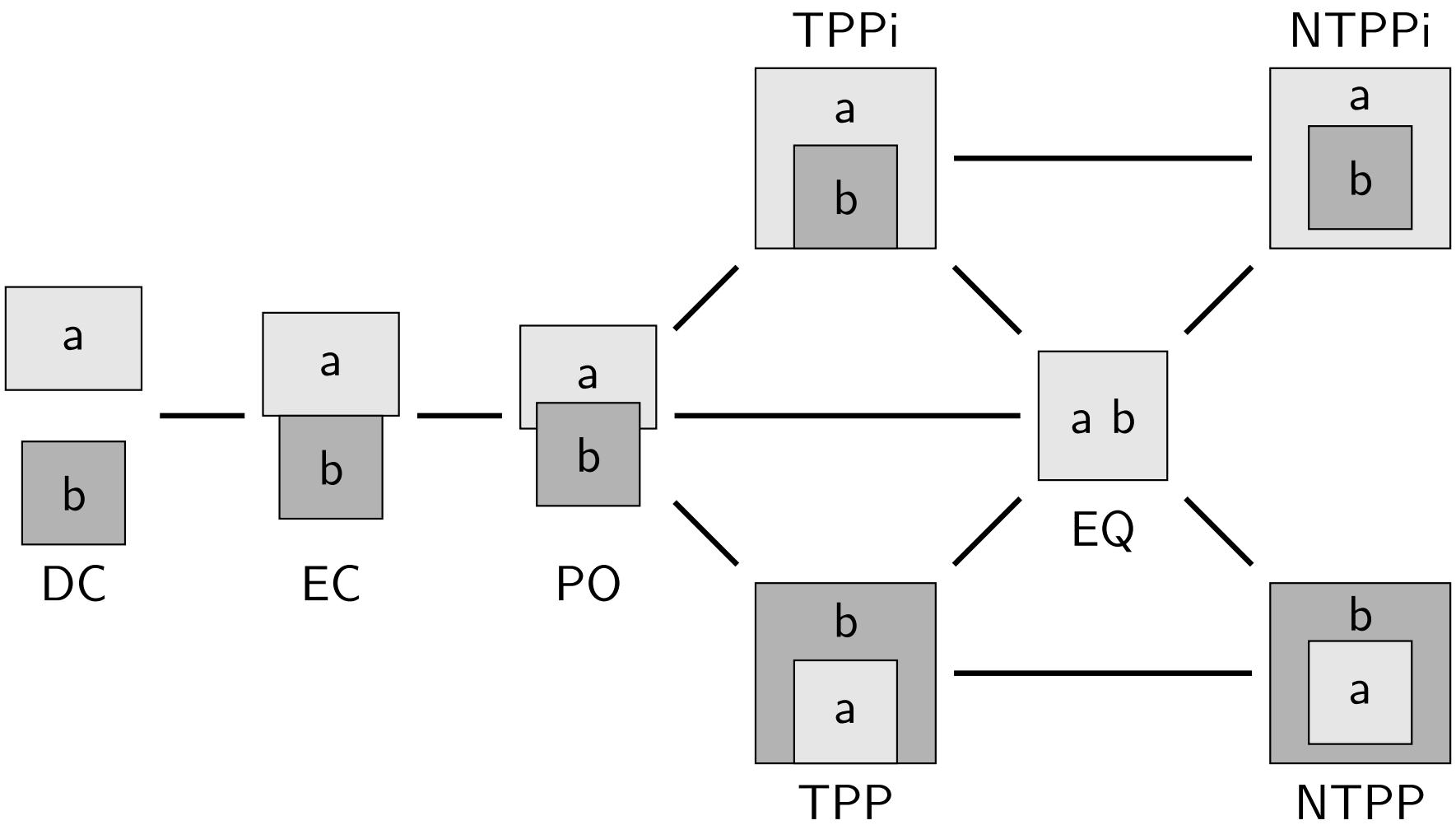


RCC8 neighborhood graph



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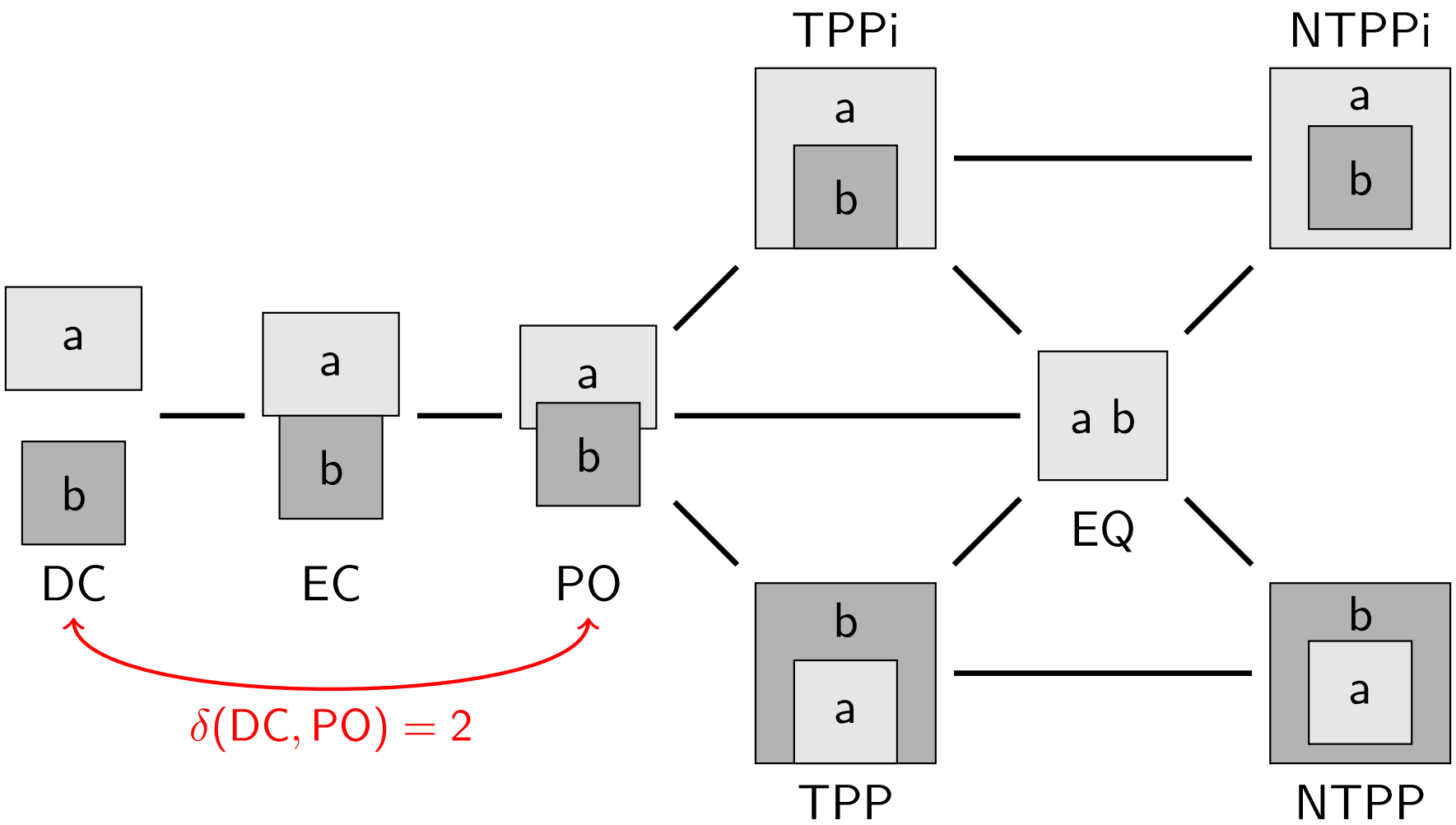


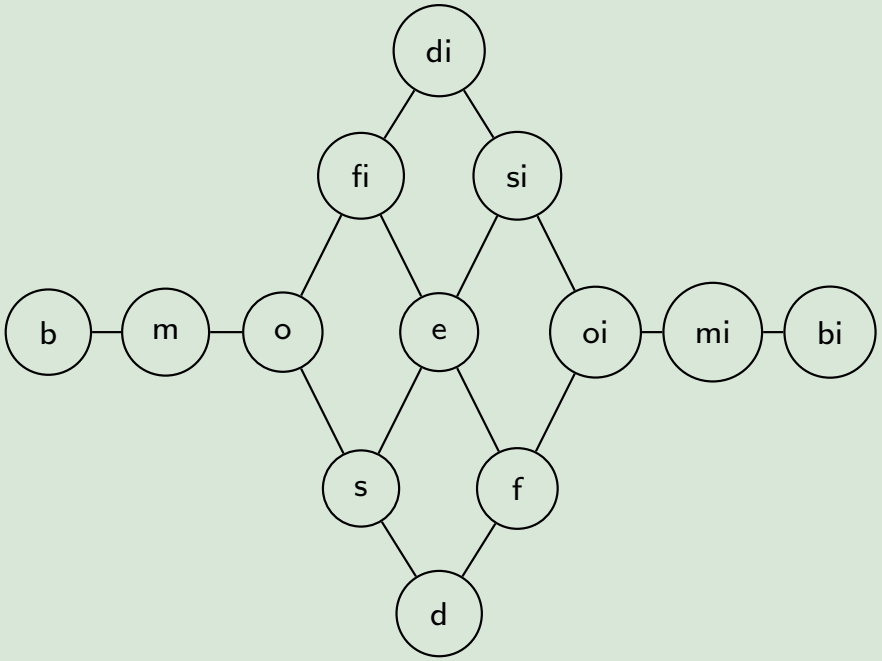
Spatio-temporal neighborhood

Definition (Distance between spatio-temporal relations)

The distance between spatio-temporal relations is based on the graph product of the temporal and spatial neighborhood graphs.

Example (Distance between spatio-temporal relations)

Allen neighborhood graph



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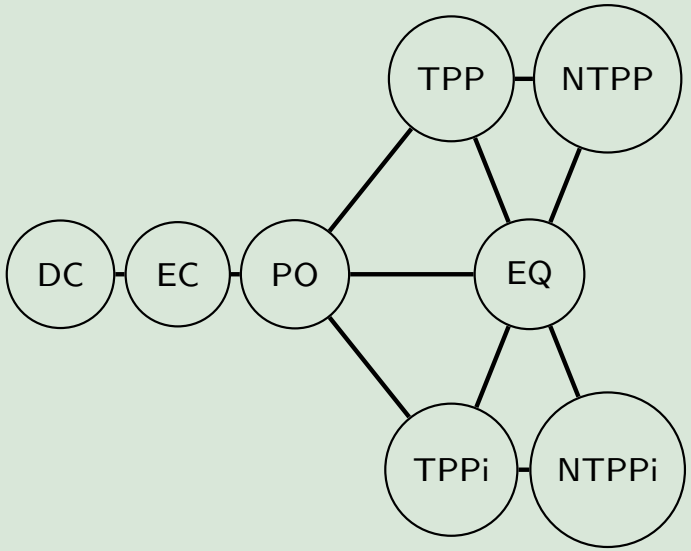

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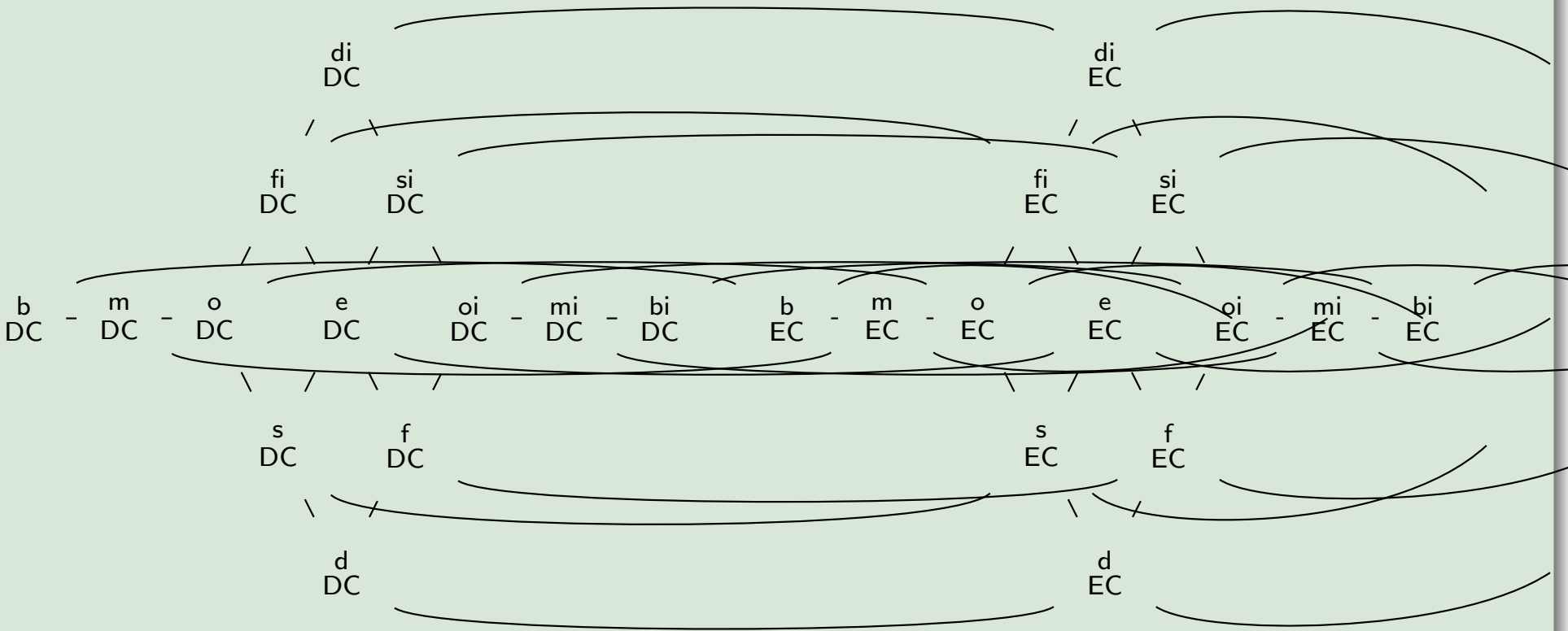

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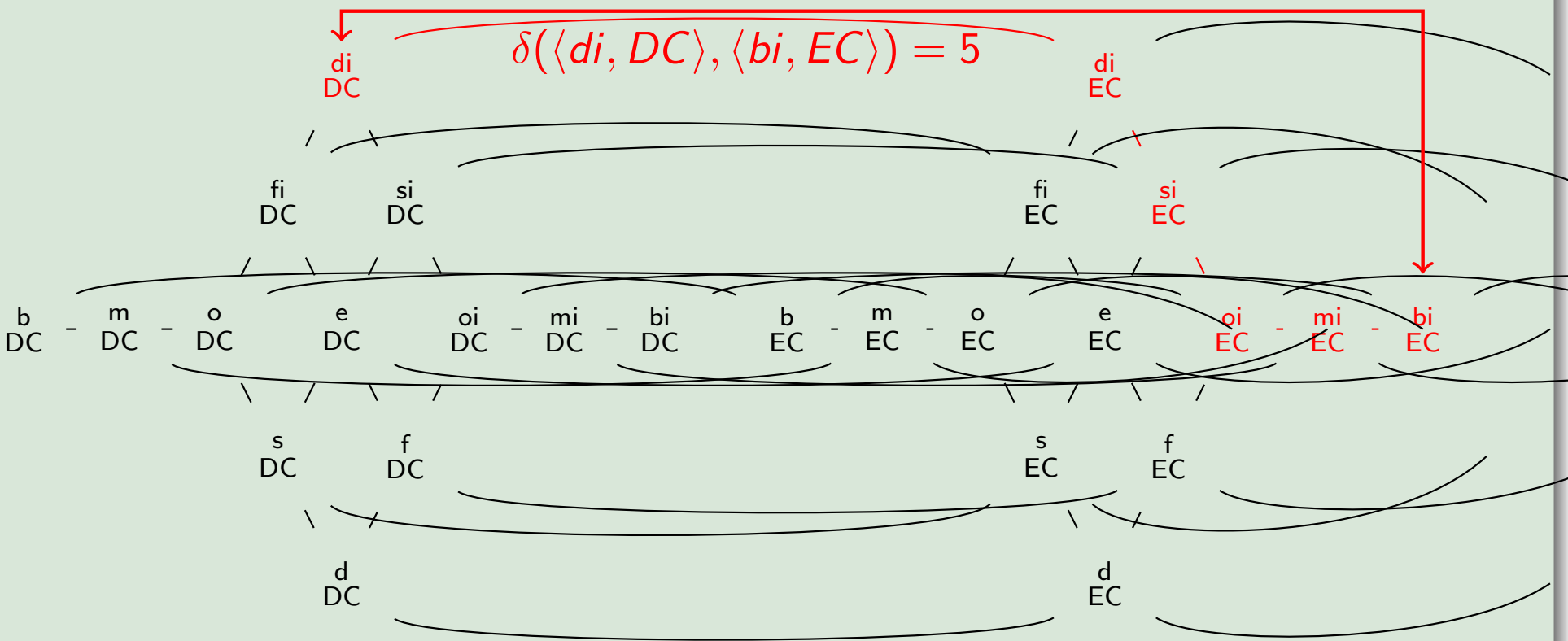


Spatio-temporal neighborhood

Property (Distance between spatio-temporal relations)

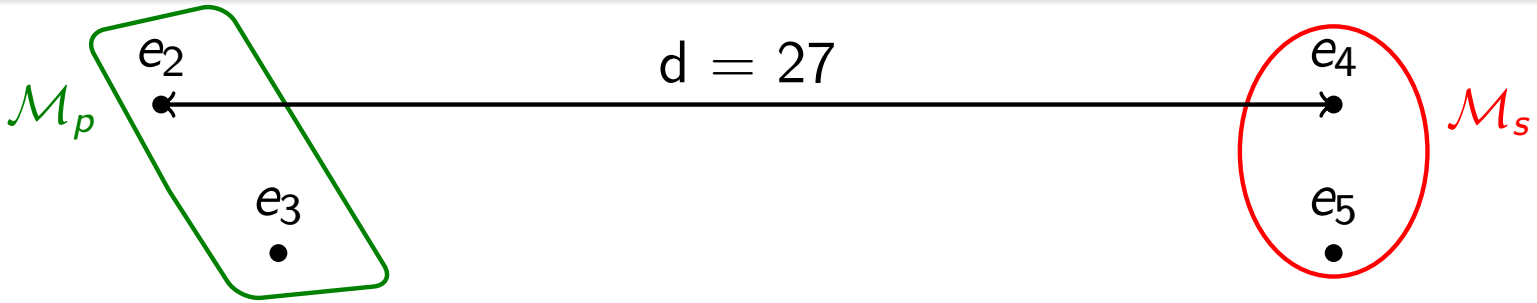
Suppose two spatio-temporal relations $r_1 = \langle r_t^1, r_s^1 \rangle$ et $r_2 = \langle r_t^2, r_s^2 \rangle$ and two neighborhood graphs with one temporal N_t^X and the other one spatial $N_s^{X'}$.

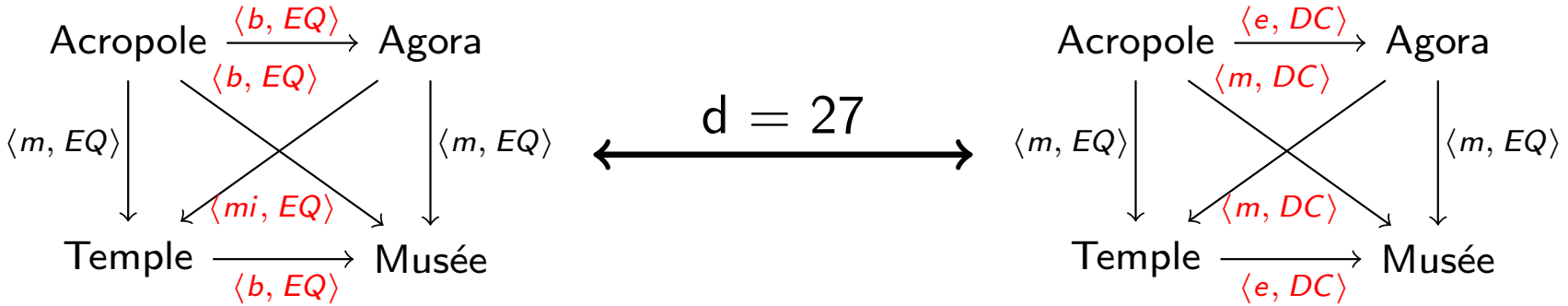
The conceptual distance $\delta(r_1, r_2)$ is equal to the sum of $\delta(r_t^1, r_t^2)$ in N_t^X and $\delta(r_s^1, r_s^2)$ in $N_s^{X'}$.

Example (Distance between spatio-temporal relations)

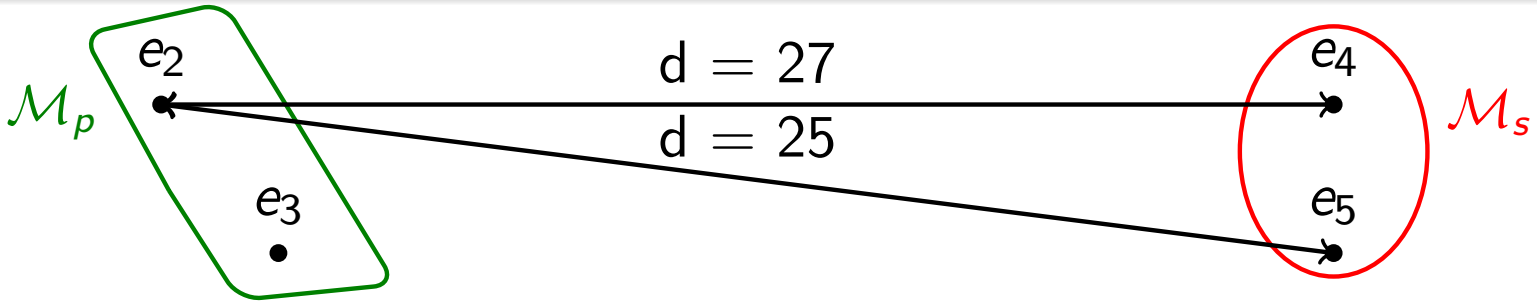
$$\delta(\langle di, DC \rangle, \langle bi, EC \rangle) = \delta(di, bi) + \delta(DC, EC) = 4 + 1 = 5$$

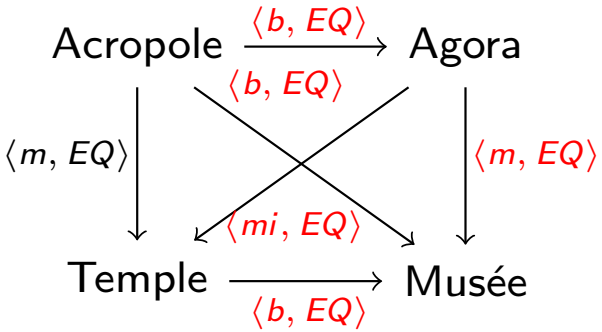
Computation of adapted solutions

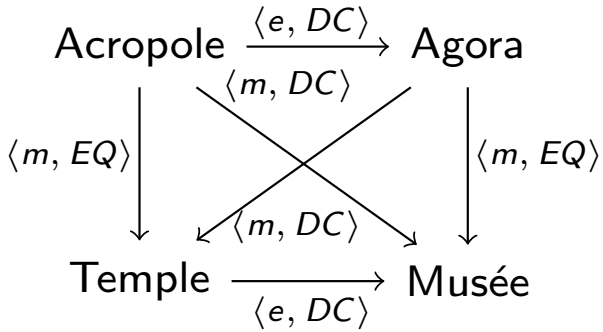




Computation of adapted solutions







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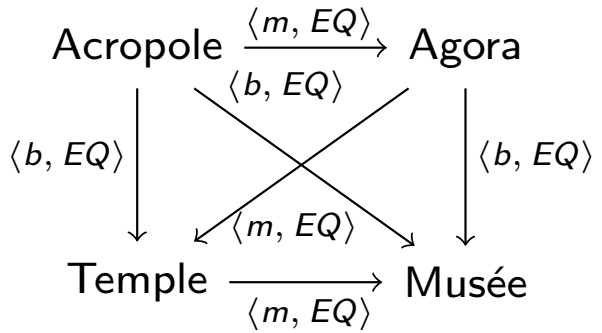
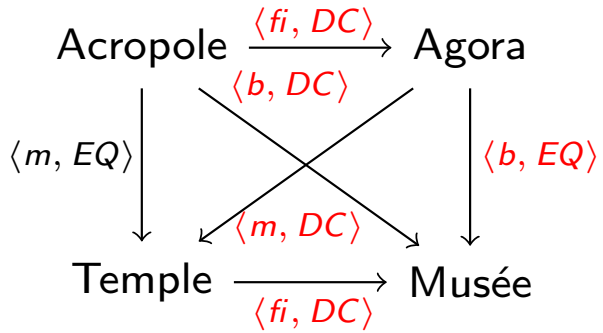
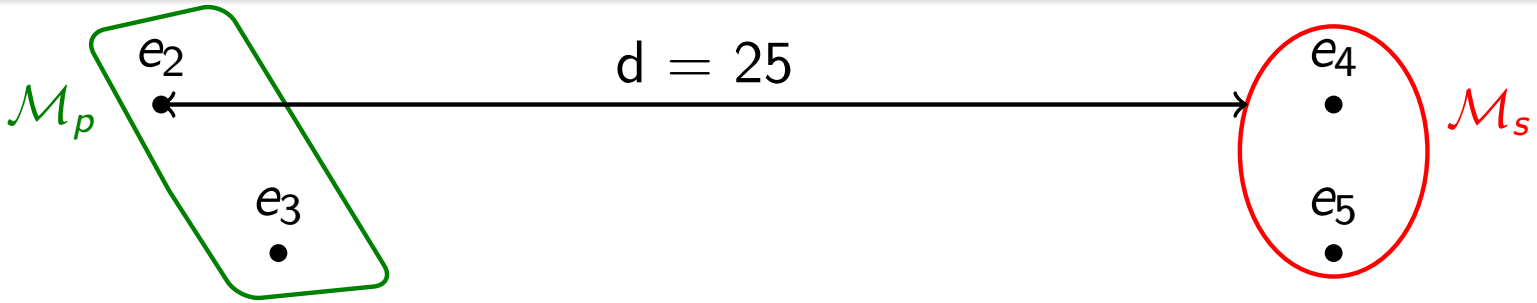
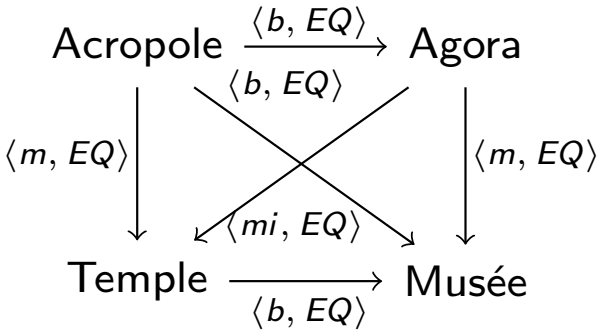
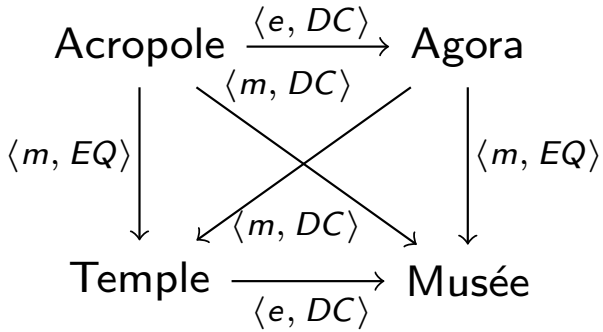


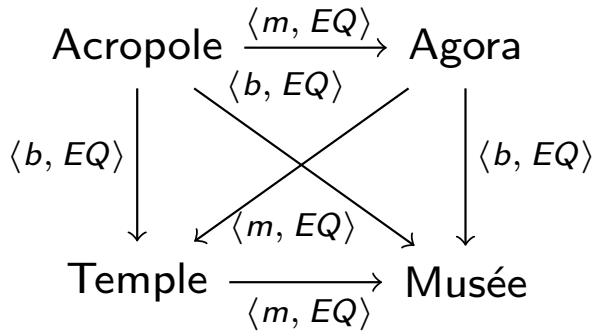


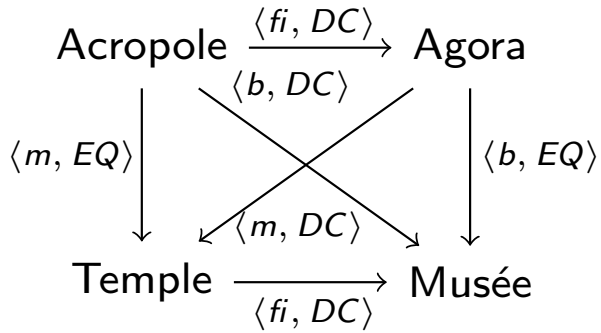
Computation of adapted solutions



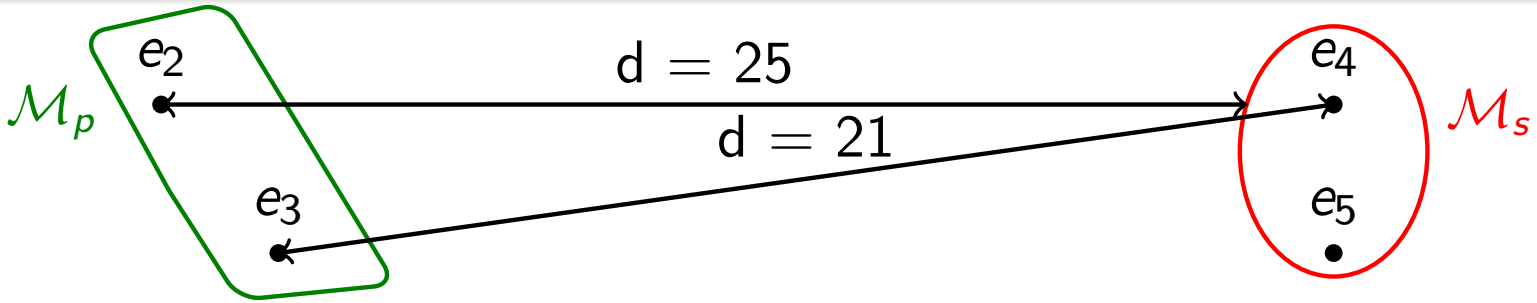


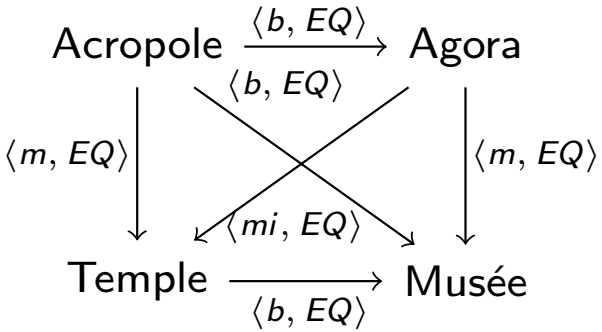


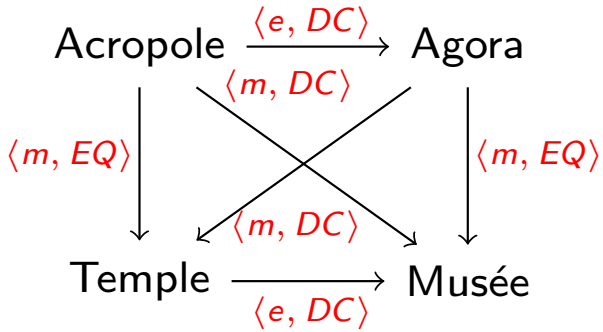




Computation of adapted solutions







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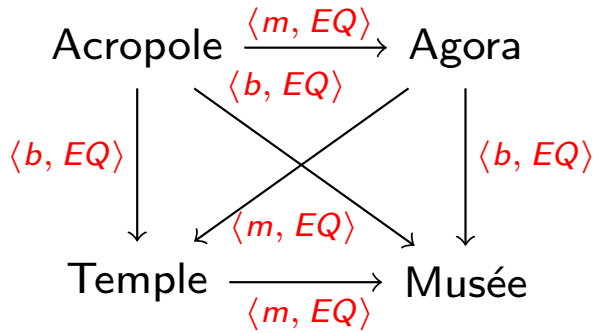
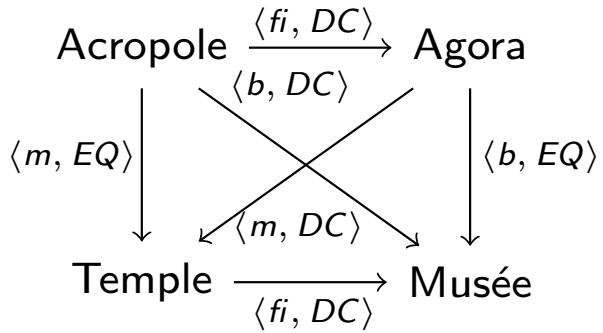
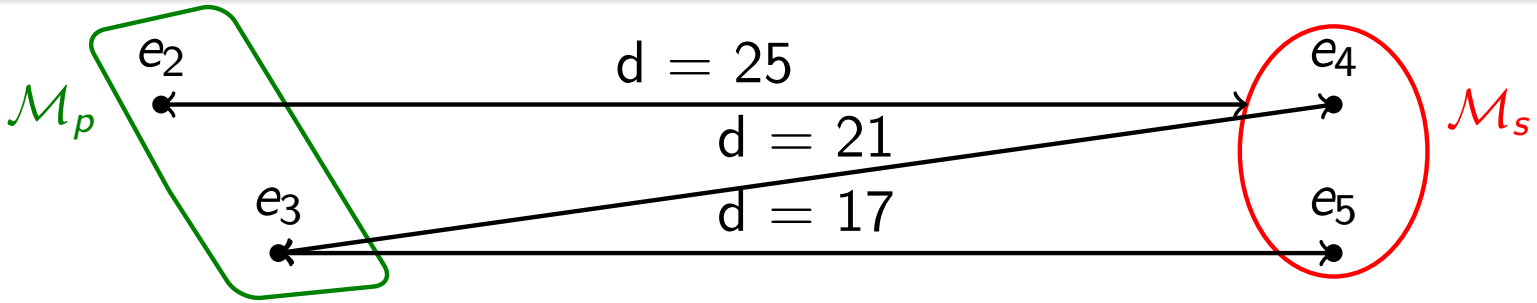
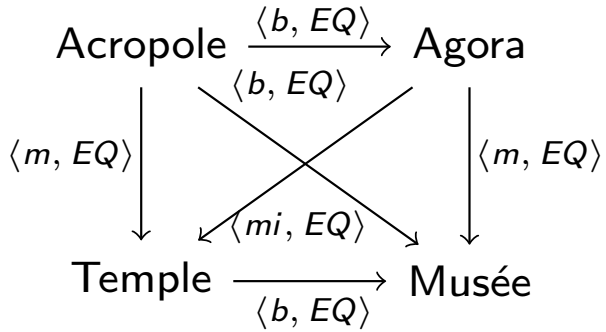
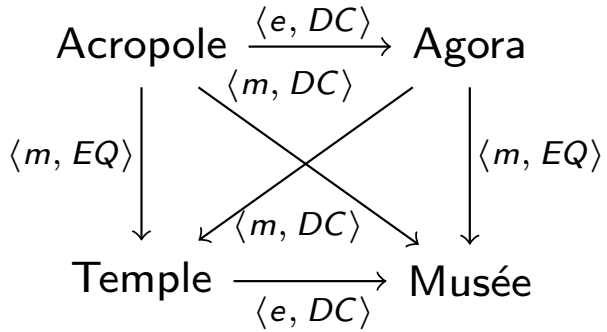


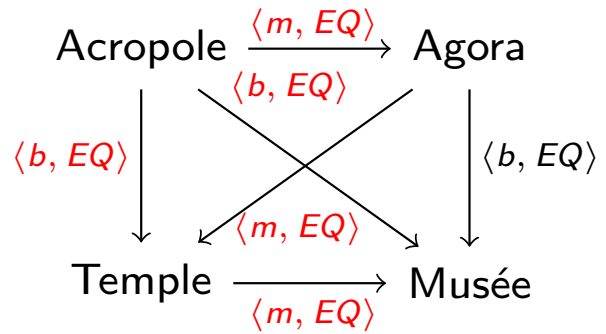


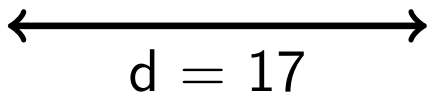
Computation of adapted solutions

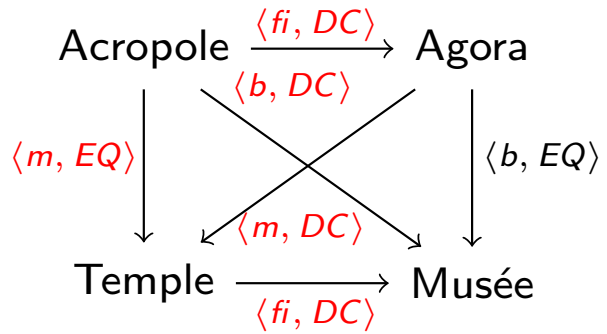




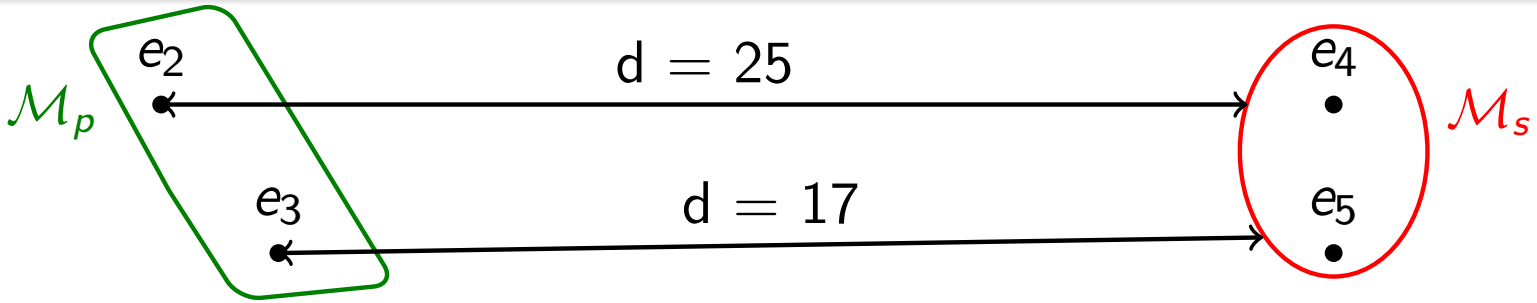


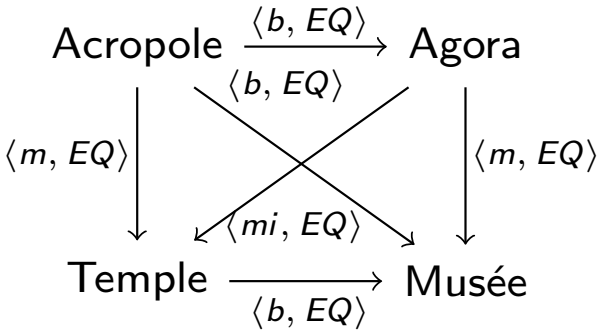


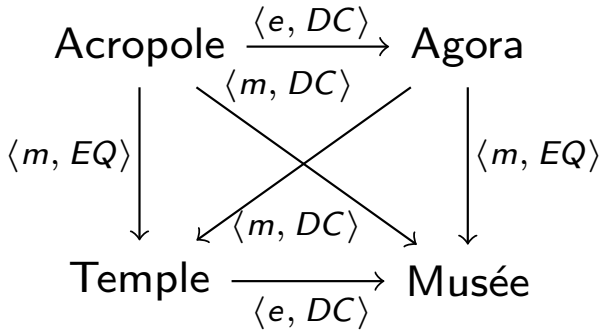


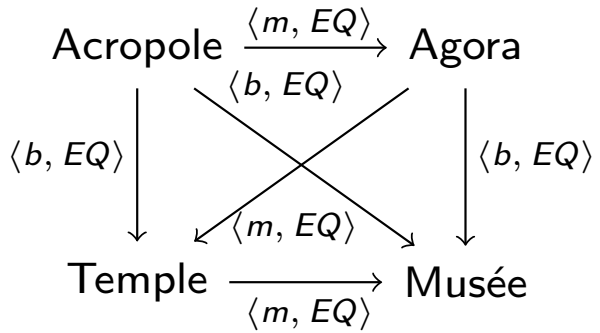


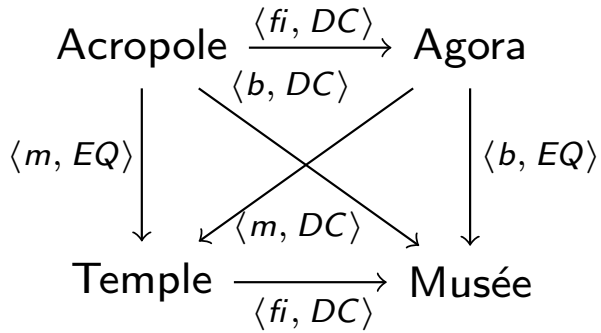
Computation of adapted solutions



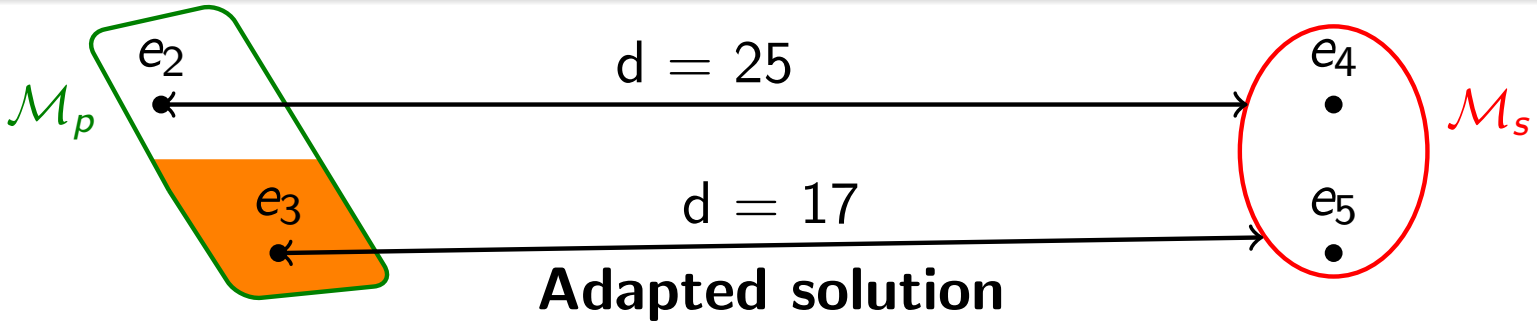


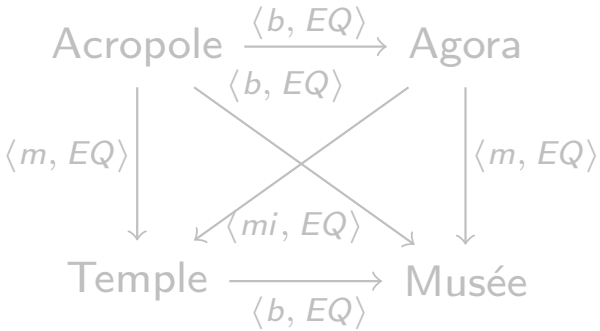


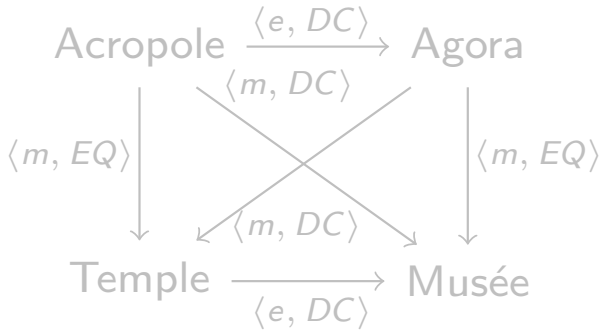


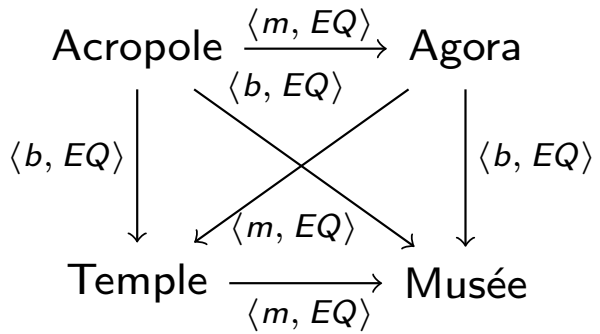


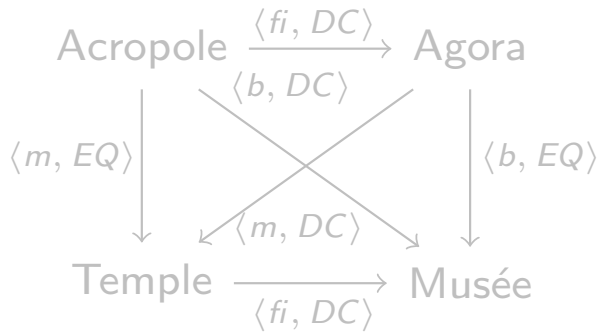
Computation of adapted solutions



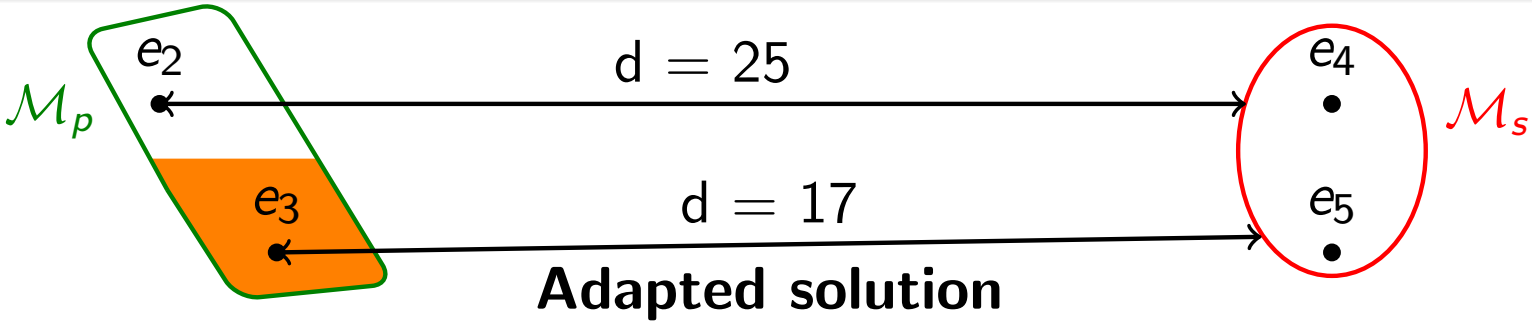


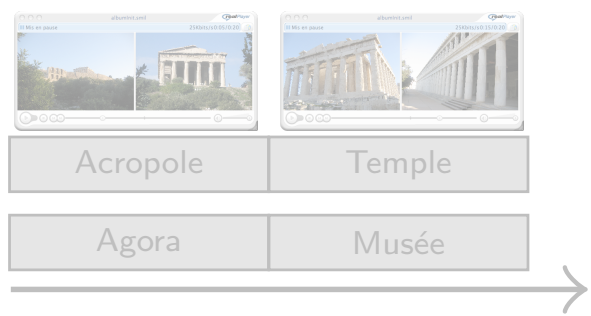


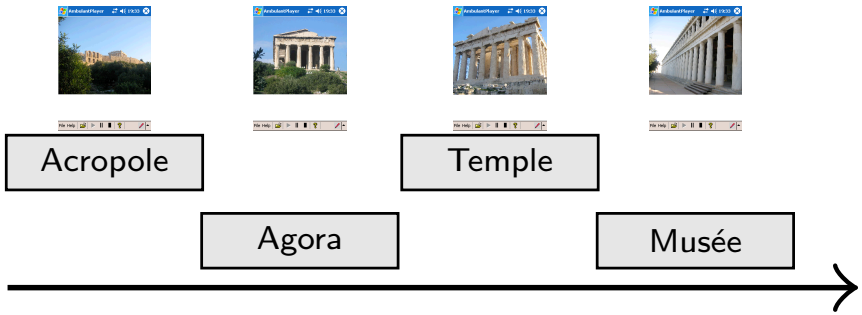


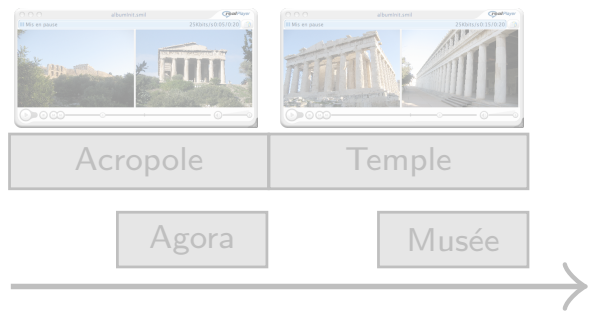


Computation of adapted solutions









Adaptation algorithm

In : An initial matrix $I_{i,j}$ and a matrix with possible relations $P_{i,j}$.
Out : A set of adapted matrix solutions.

PathConsistency(P);
If P does not contain an empty relation then
    Select a relation in $P_{i,j}$ and
    decomposed $P_{i,j}$ in $r_1, \ldots, r_k$;
    If $P_{i,j}$ can't be decomposed then
        $tmp \leftarrow d(I, P)$;
        If $(tmp < Min)$ then
            $Min \leftarrow tmp; \mathcal{S} \leftarrow \{P\}$;
        If $(tmp = Min)$ then
            $\mathcal{S} \leftarrow \mathcal{S} \cup \{P\}$;
    Otherwise for each r_l $(1 \leq l \leq k)$ do
        $P_{i,j} \leftarrow r_l$;
        If $(d(I, P) \leq Min)$ then
            Adaptation(I,P);

Adaptation algorithm

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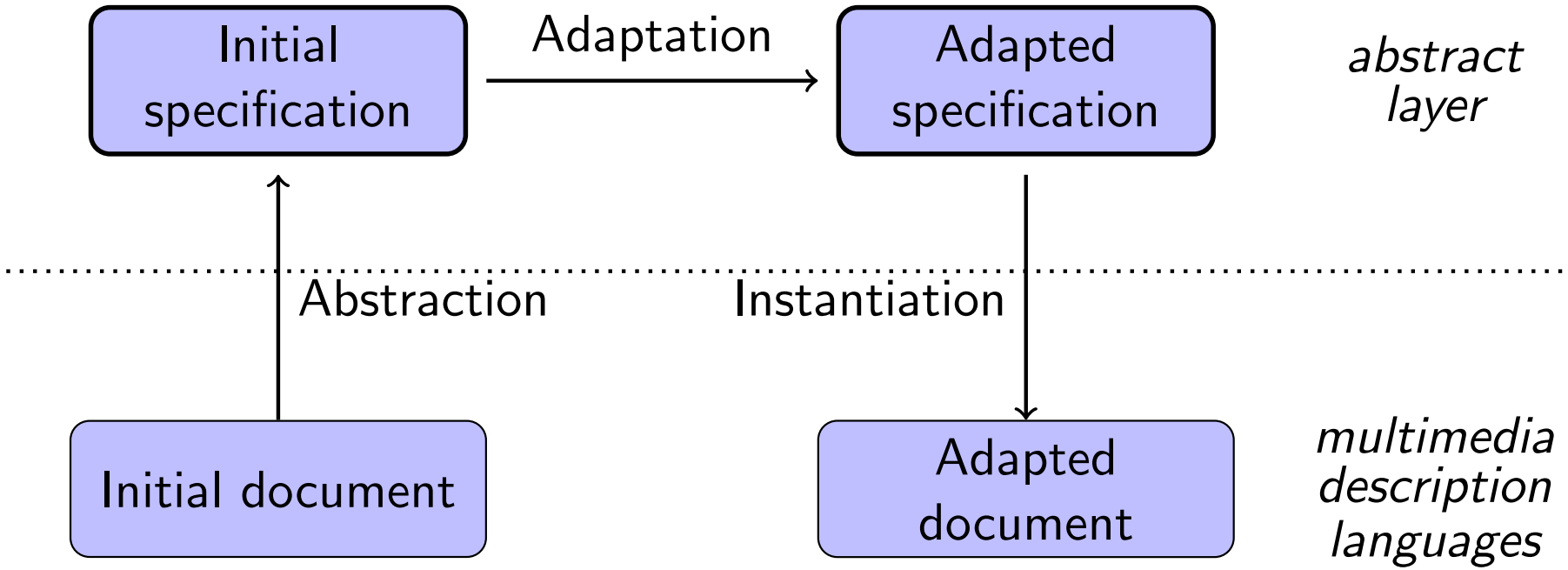
        If $(d(I, P) \leq Min)$ then
            Adaptation(I,P);

Outline

General strategy



Outline

Adaptation quality

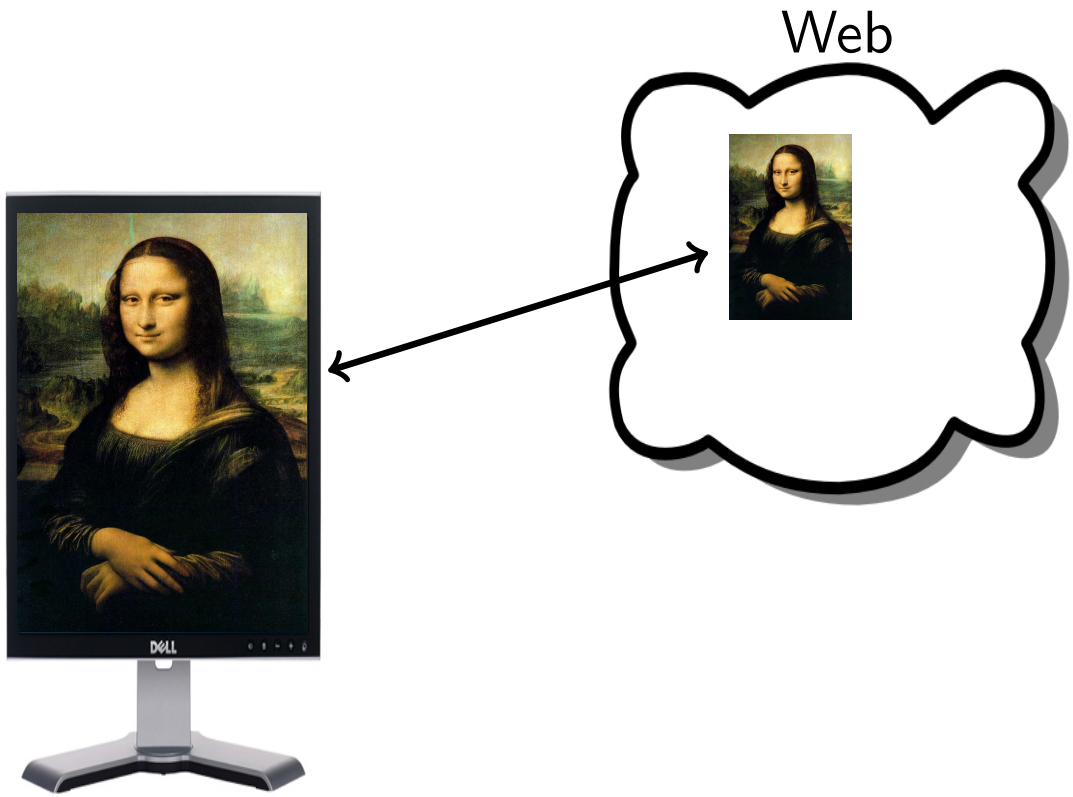
"The basic assumption is that content transformation activities should be provided as non-destructive operations."

$\Rightarrow$ One approach is to measure the adaptation transformations

Different kind of metrics:

- Measuring the discourse evolution
- Measuring the composition degradation
- Measuring the content transformation

Semantic media adaptation

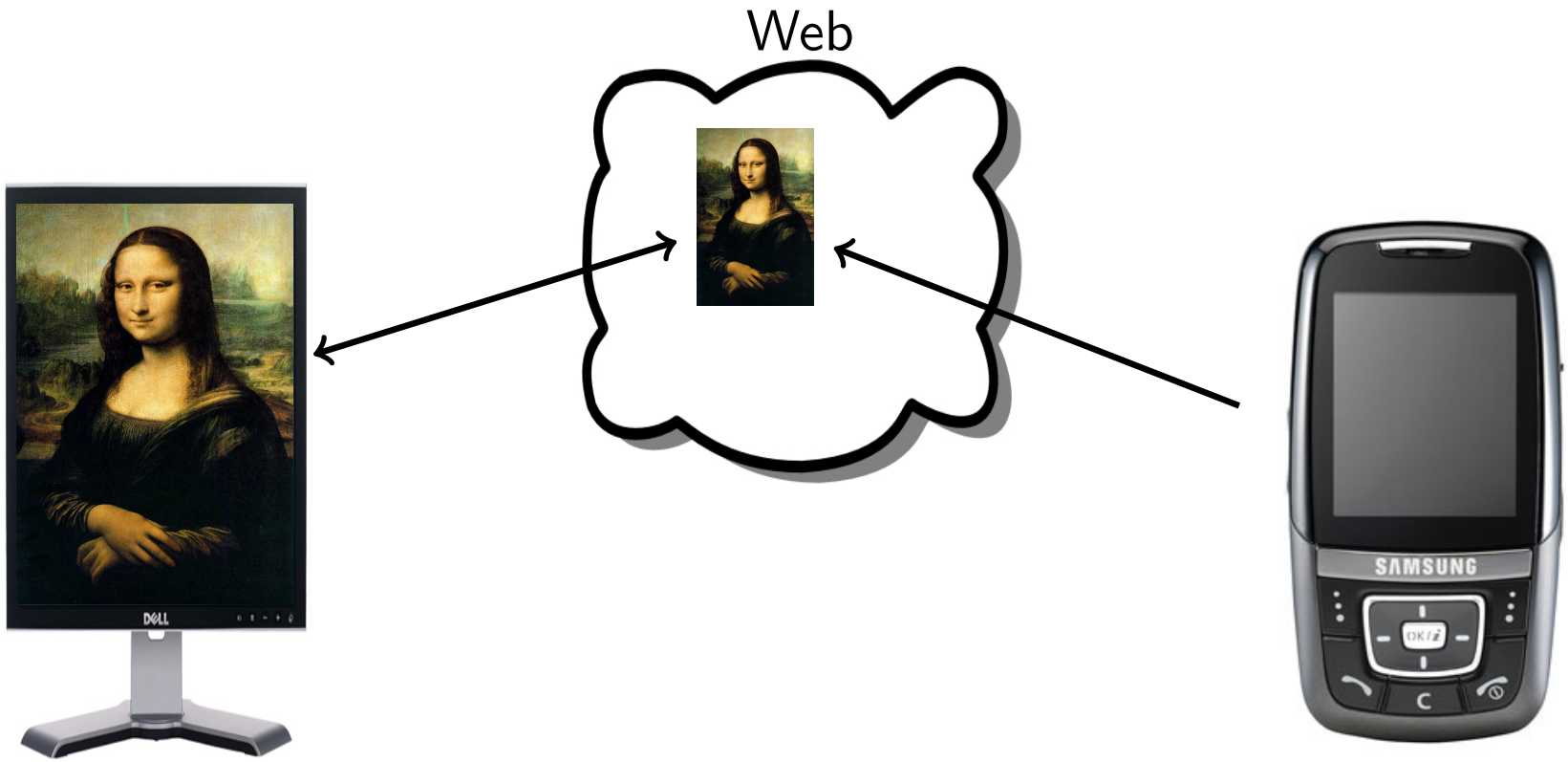


Mona Lisa Image

PNG format

560 x 864

Semantic media adaptation

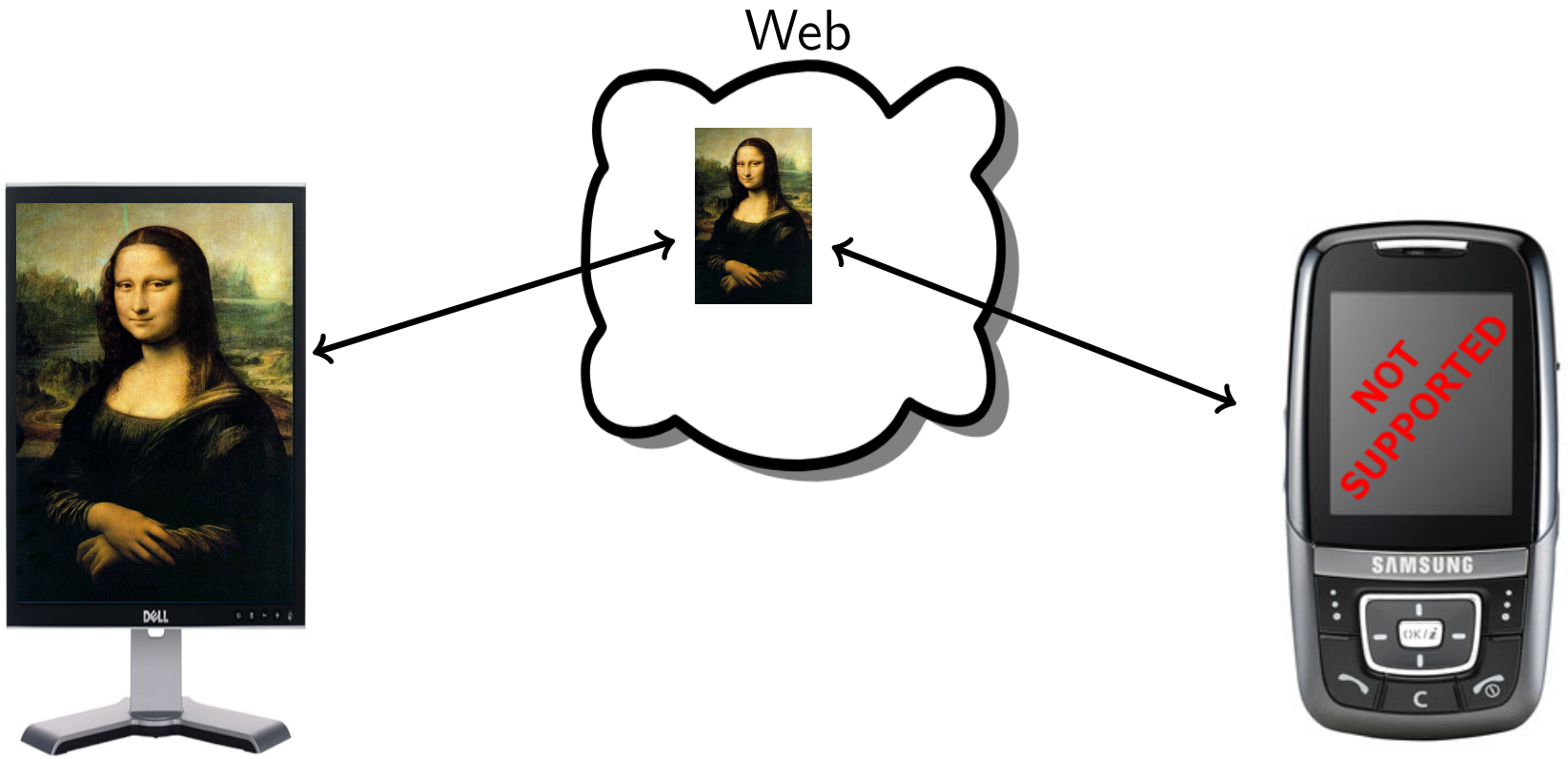


Mona Lisa Image

PNG format

560 x 864

Semantic media adaptation



Mona Lisa Image

PNG format

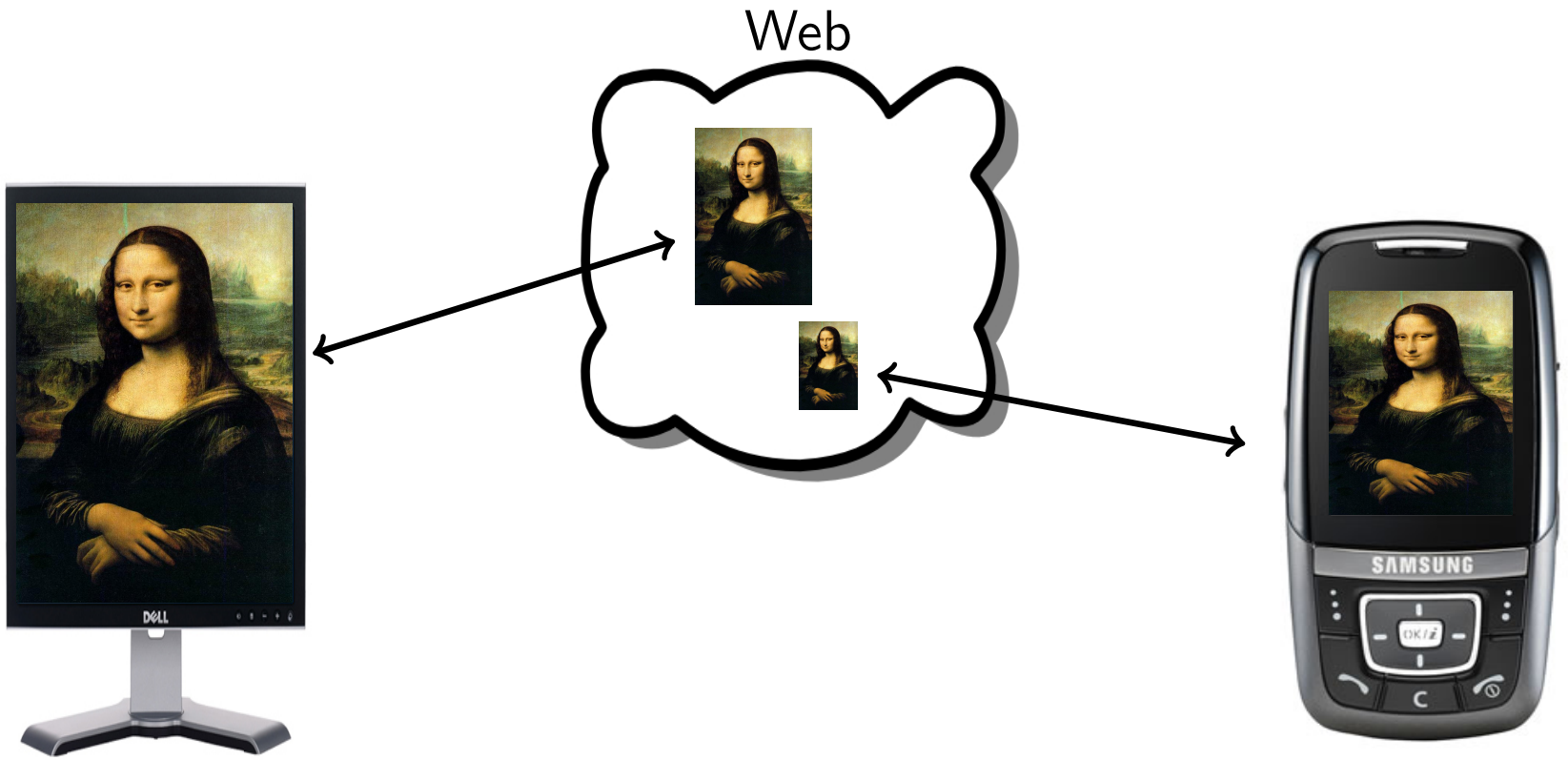
560 x 864

Profile

Format = {JPG,BMP,3GP}

Max resolution = 400 x 600

Semantic media adaptation



Mona Lisa Image

PNG format

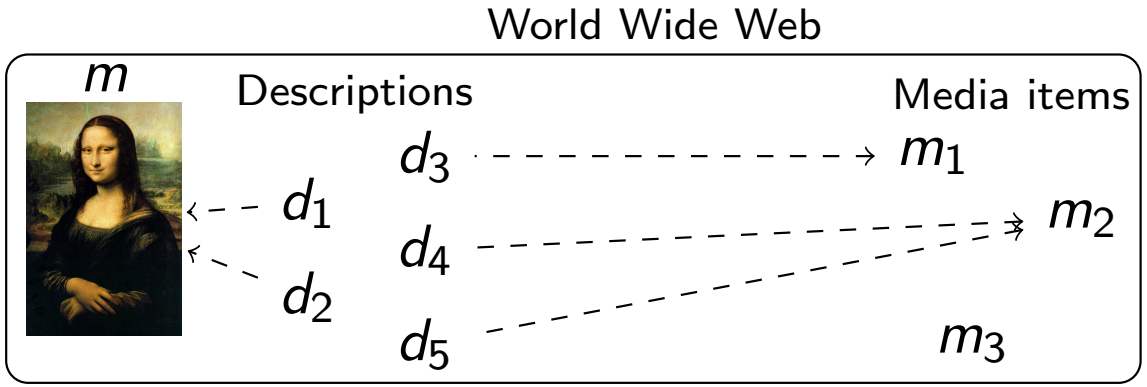
560 x 864

Mona Lisa Image

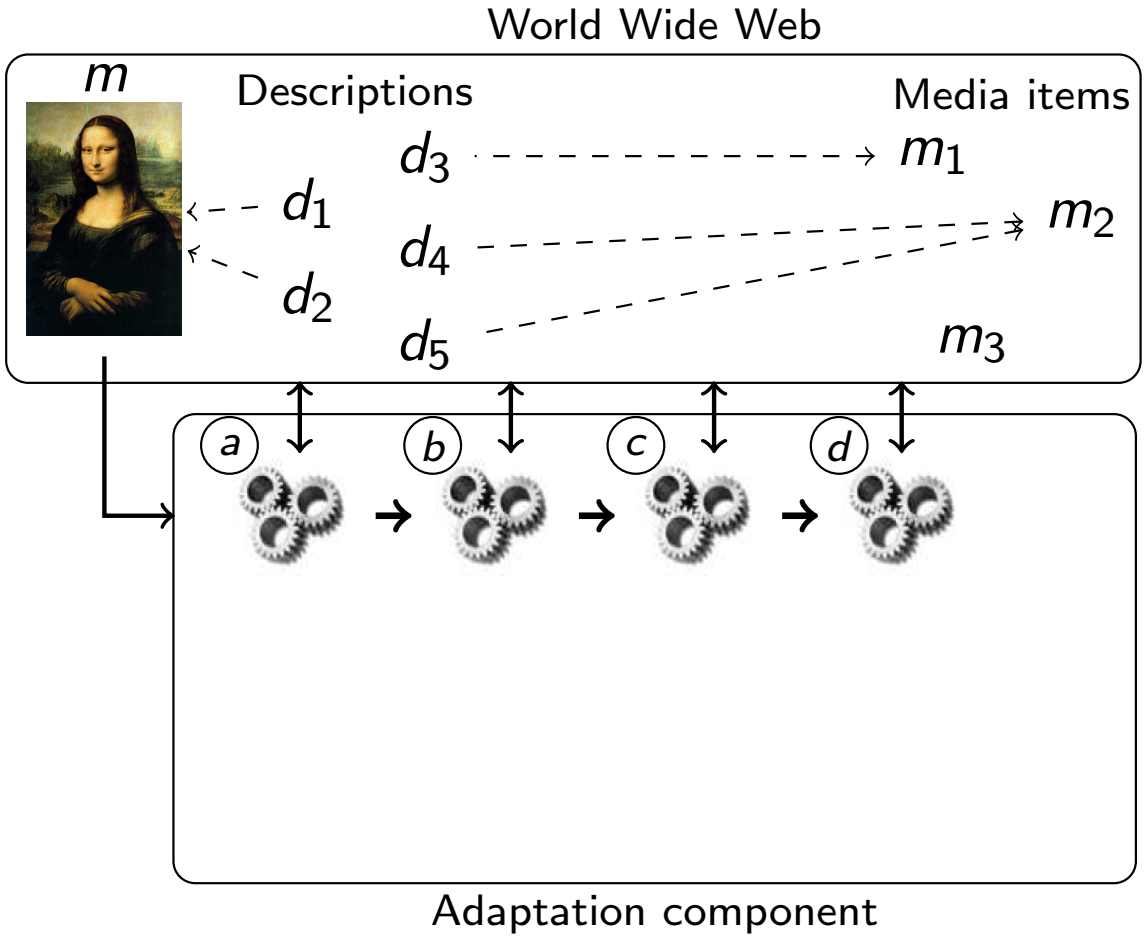
JPG format

386 x 600

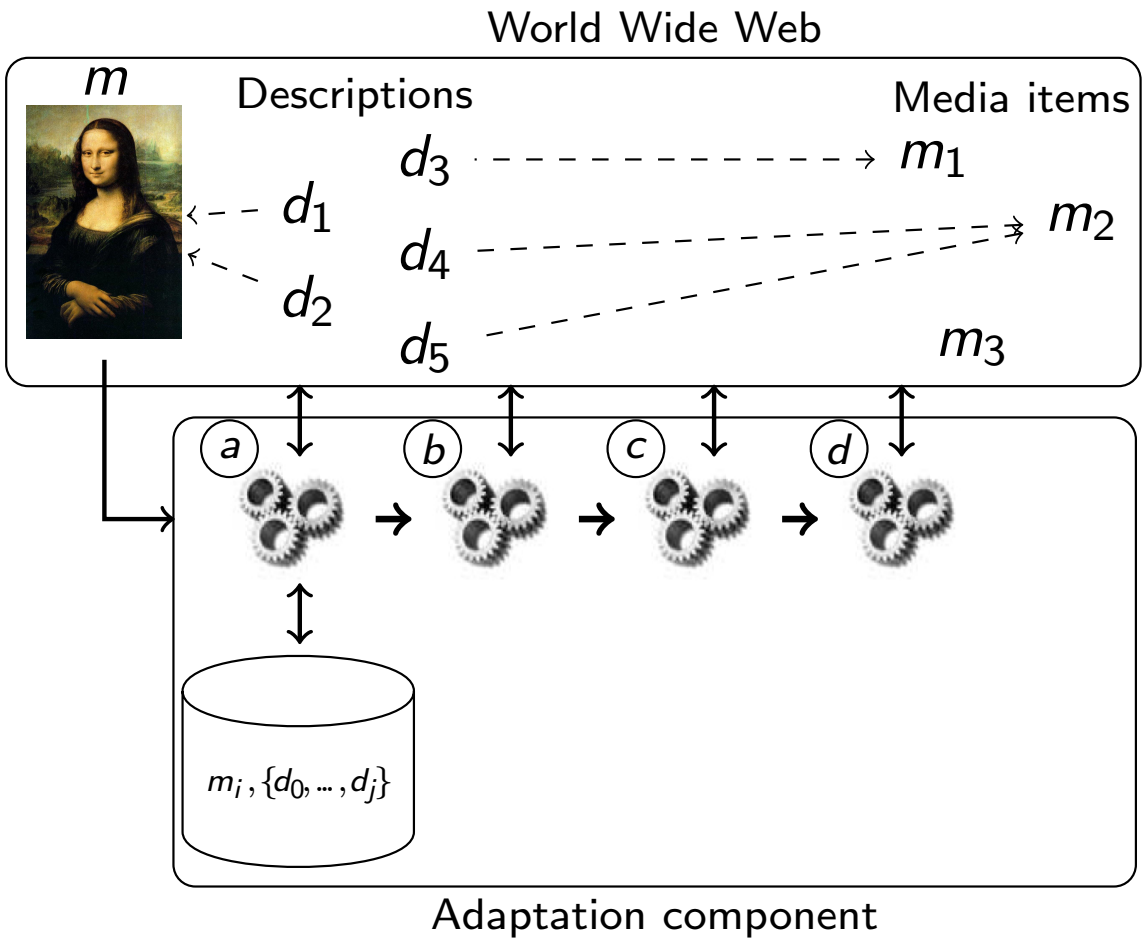
Software architecture



Software architecture



Software architecture



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d_1	height: "864" width: "560" format: PNG
d_2	title: "Mona Lisa" author: "Da Vinci"

m_1

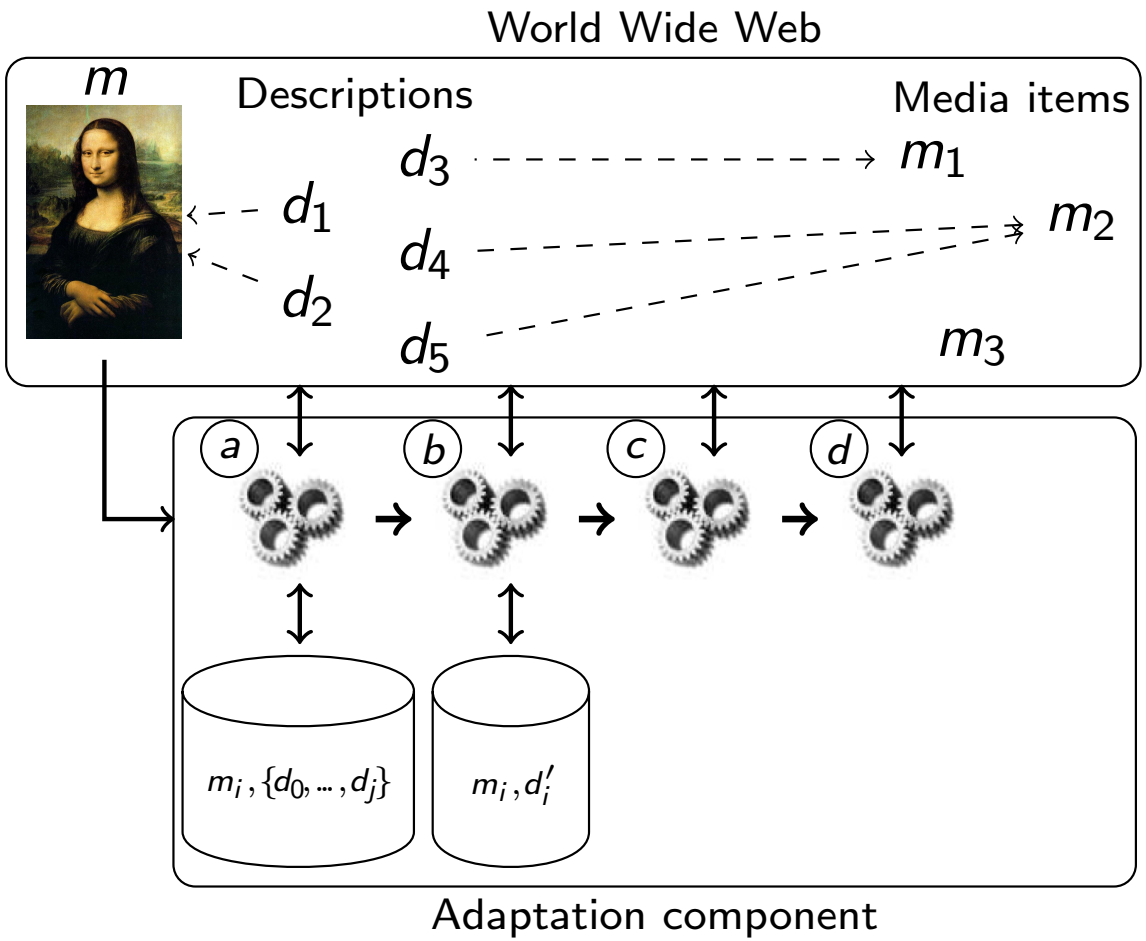
d_3	date: "17/12/2007" title: "Mona Lisa" format: PNG

m_2

d_4	height: "600" width: "386" format: JPG
d_5	title: "Mona Lisa" author: "Da Vinci"

ⓐ: Description association

Software architecture



m

d'

height: "864"
width: "560"
format: PNG
title: "Mona Lisa"
author: "Da Vinci"

m_1

d'_1

date: "17/12/2007"
title: "Mona Lisa"
format: PNG

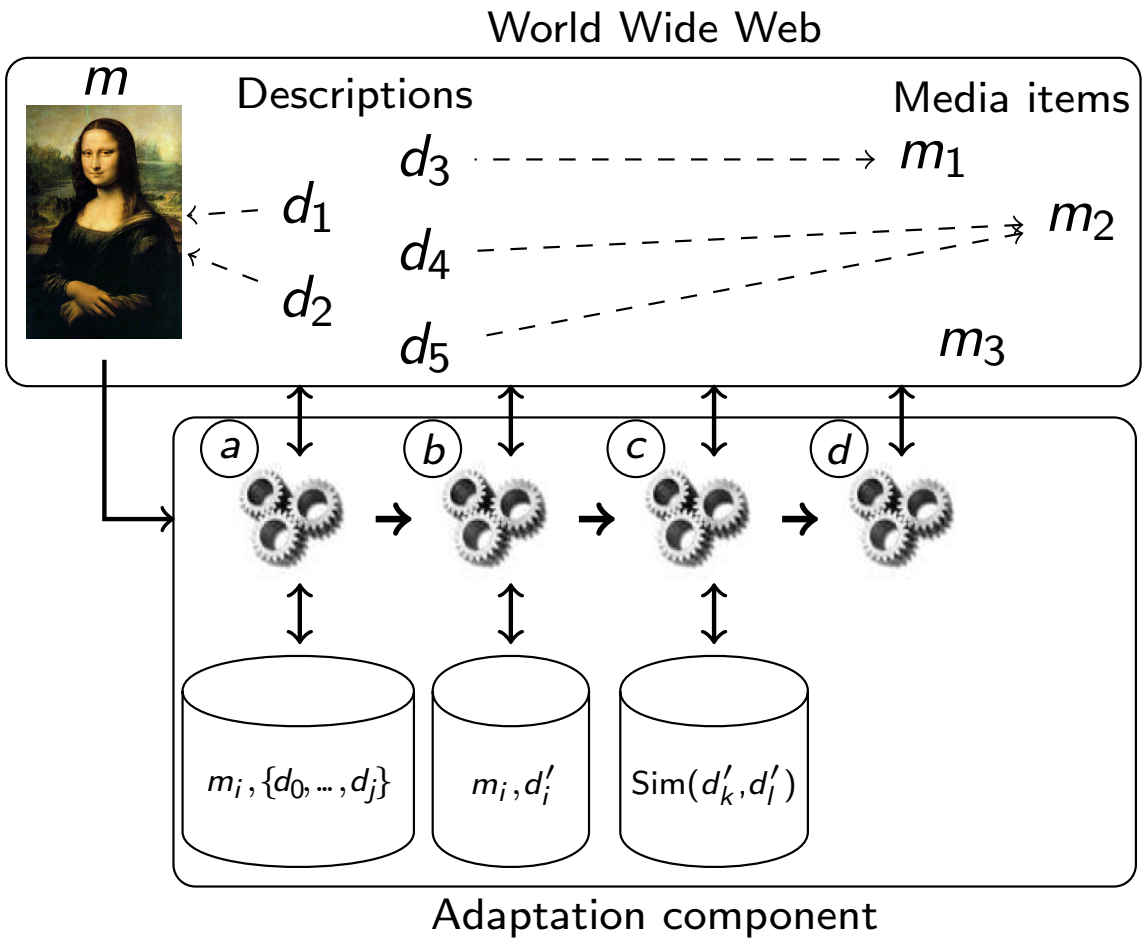
m_2

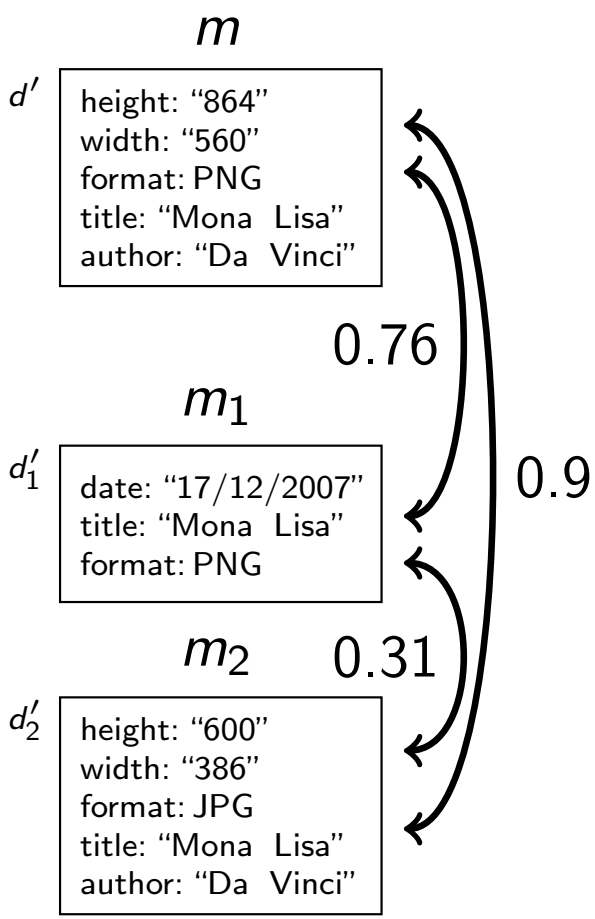
d'_2

height: "600"
width: "386"
format: JPG
title: "Mona Lisa"
author: "Da Vinci"

ⓑ: Description aggregation

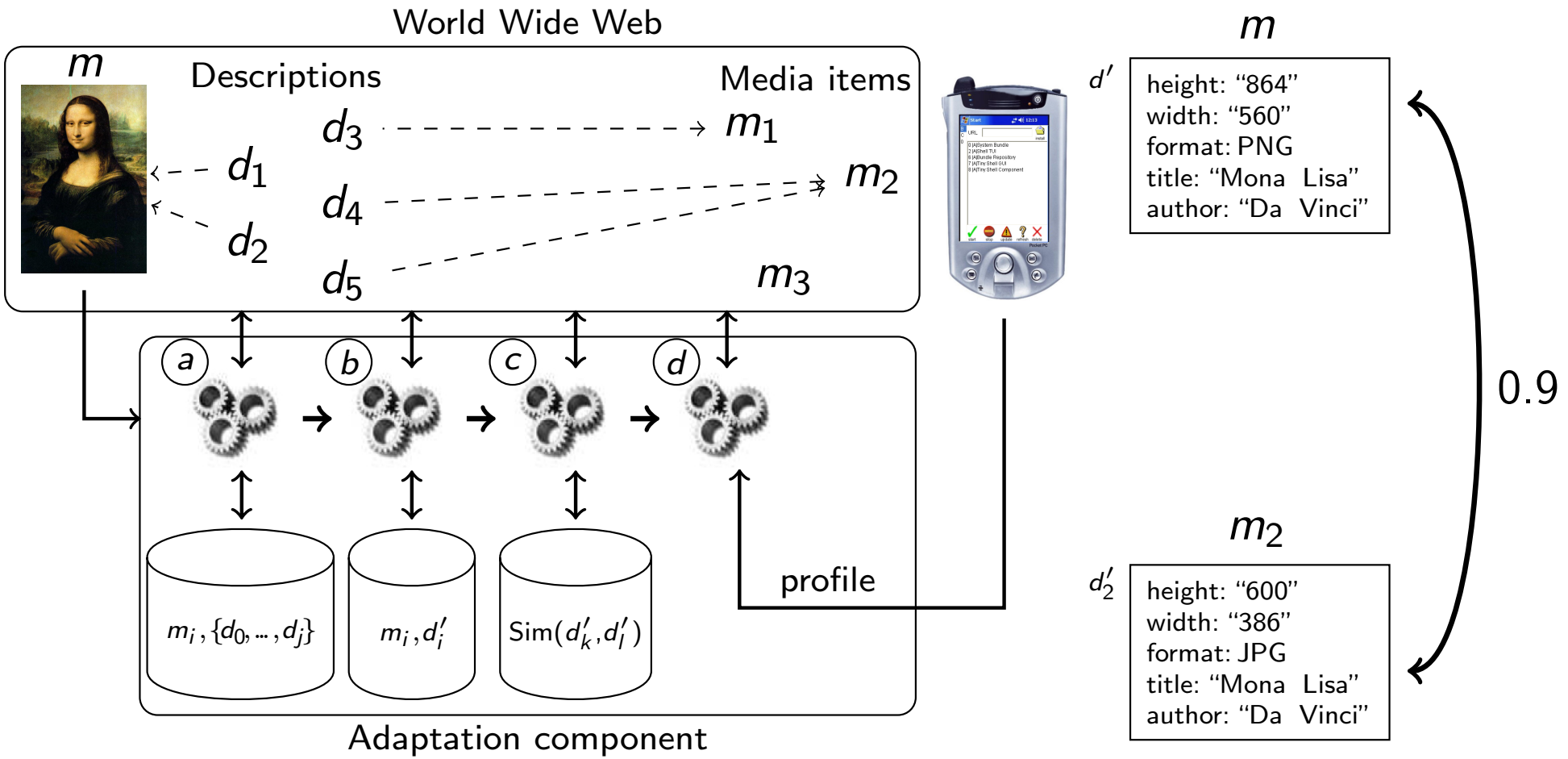
Software architecture





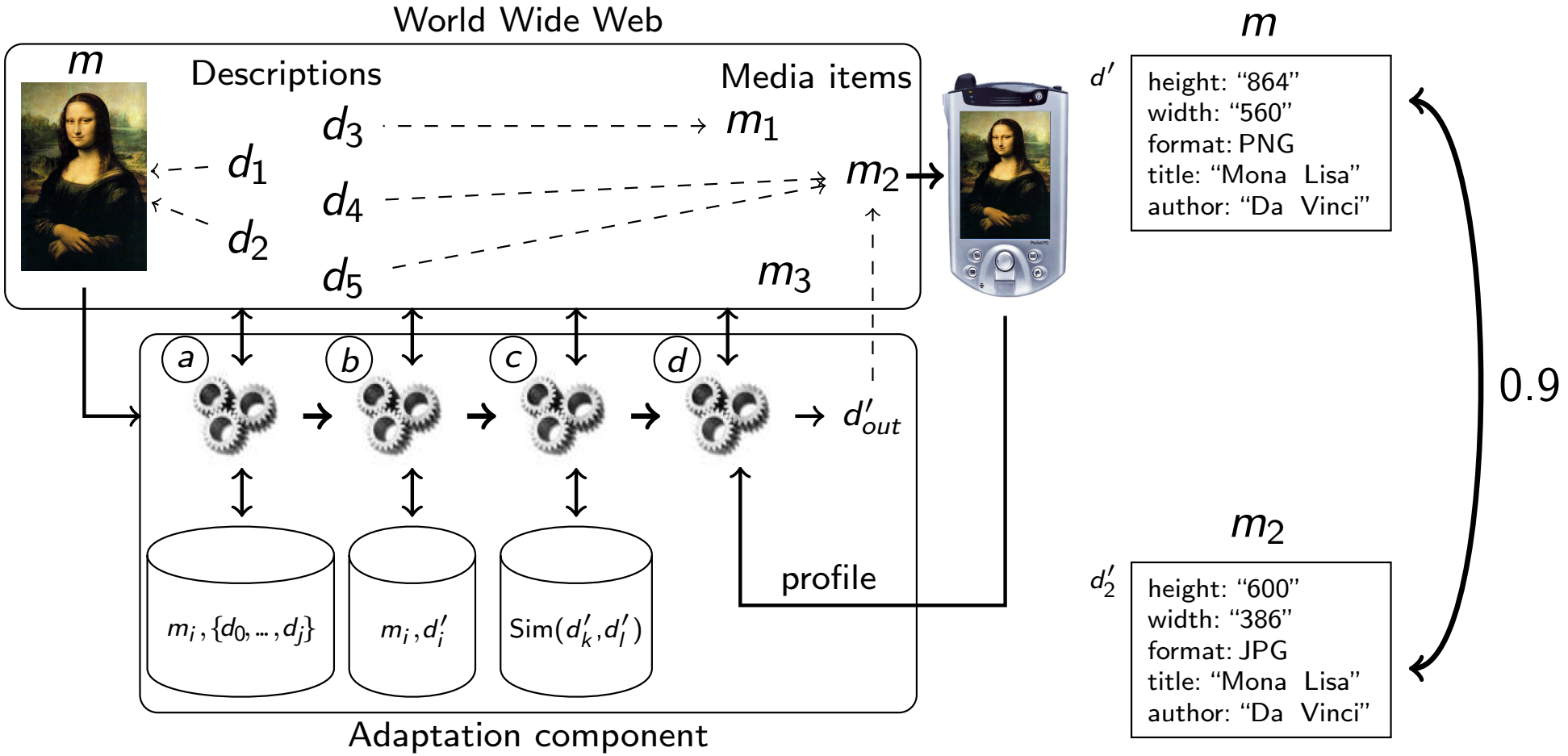
ⓒ: Description similarity

Software architecture

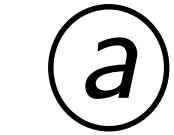


ⓓ: Description selection

Software architecture

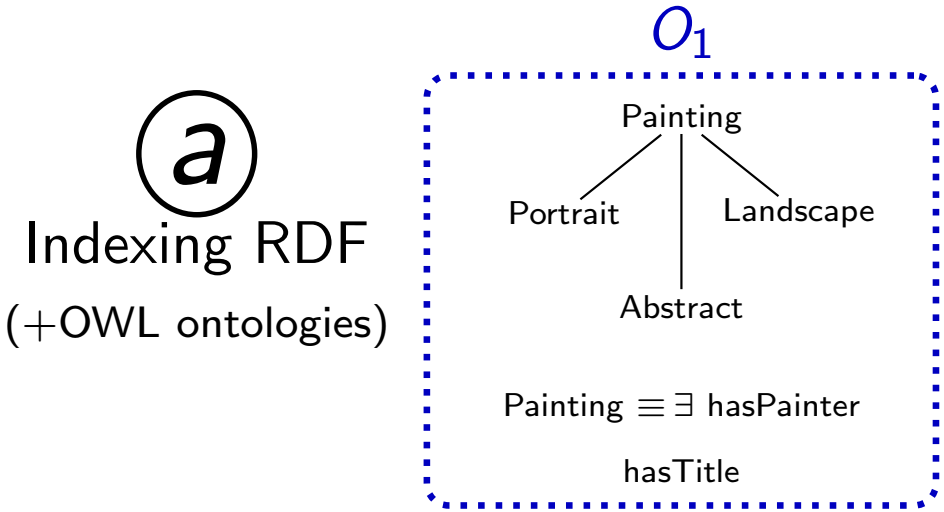


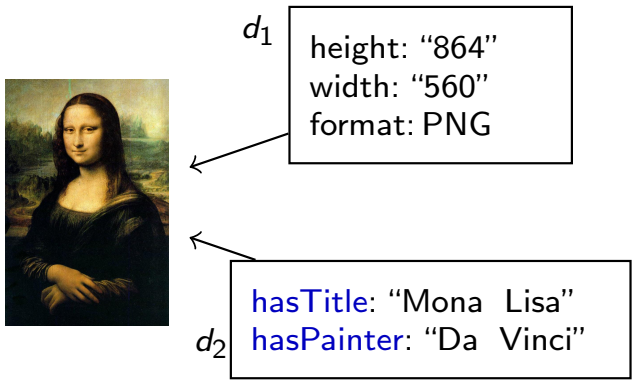
Media adaptation using Semantic Web technologies



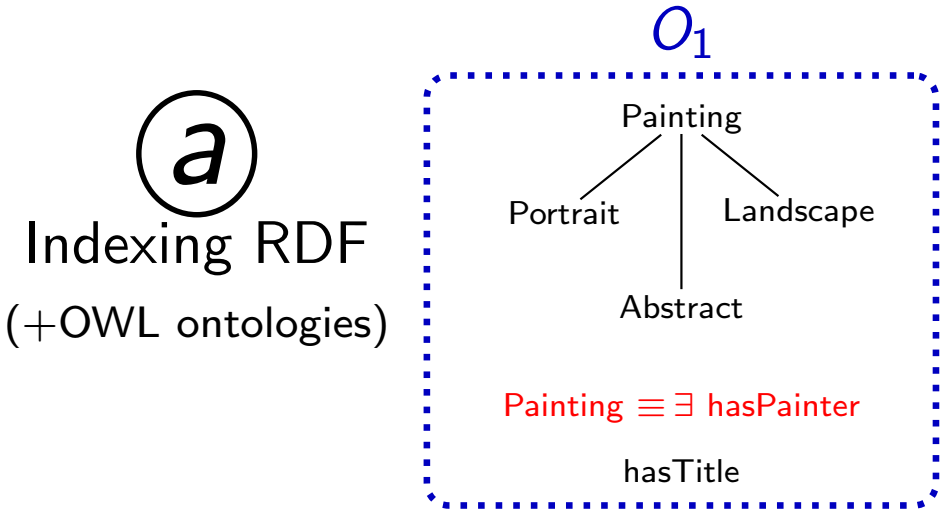
Indexing

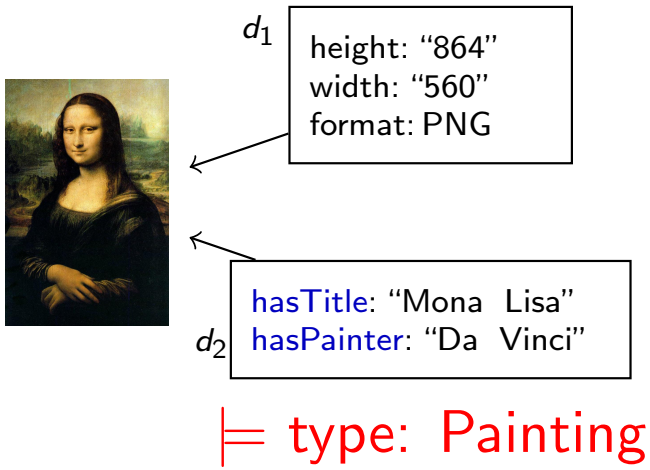
Media adaptation using Semantic Web technologies





Media adaptation using Semantic Web technologies

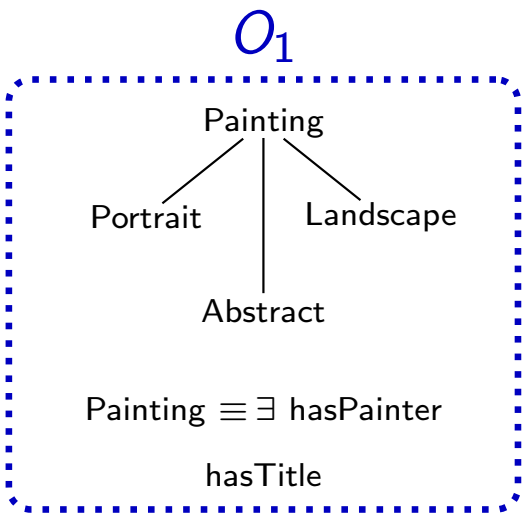


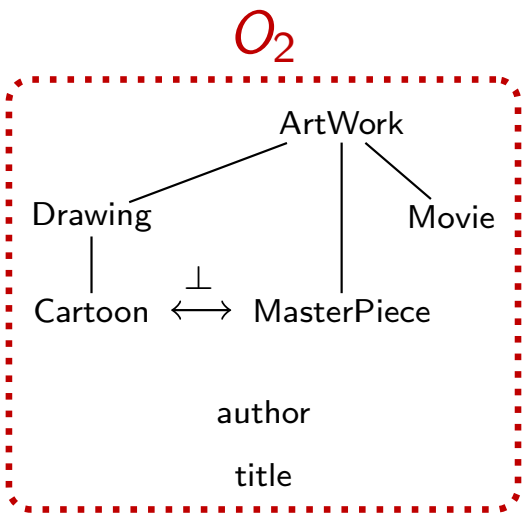


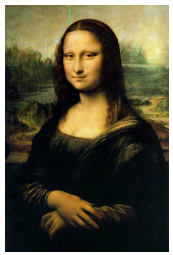
Media adaptation using Semantic Web technologies

Indexing RDF

(+OWL ontologies)



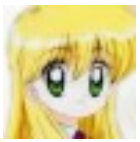




d_1
height: "864"
width: "560"
format: PNG

d_2
hasTitle: "Mona Lisa"
hasPainter: "Da Vinci"

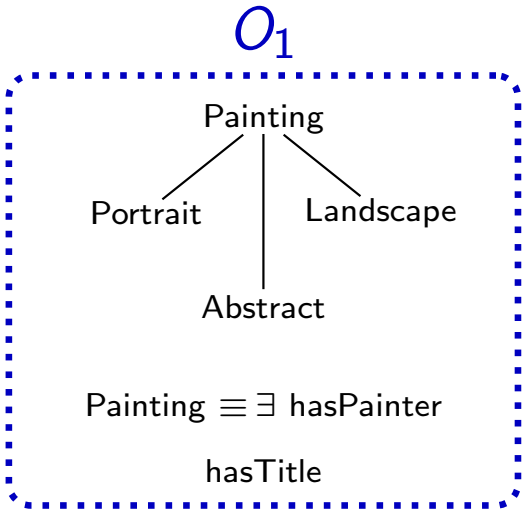
d_3
type: Cartoon
author: "Sato"
format: JPG

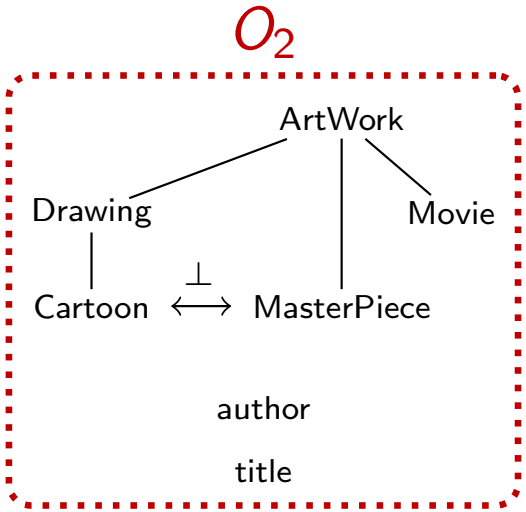


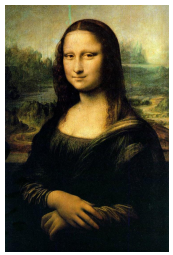
Media adaptation using Semantic Web technologies

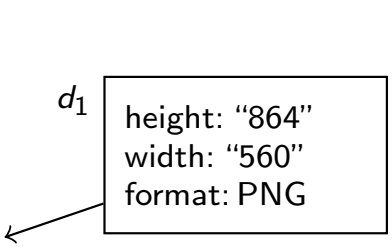
Indexing RDF

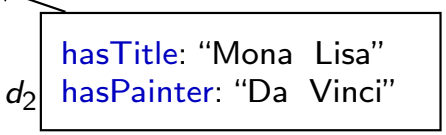
(+OWL ontologies)

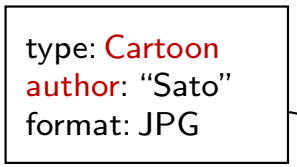


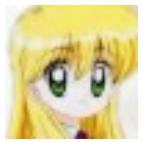


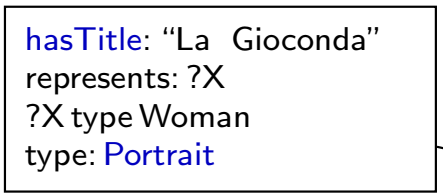




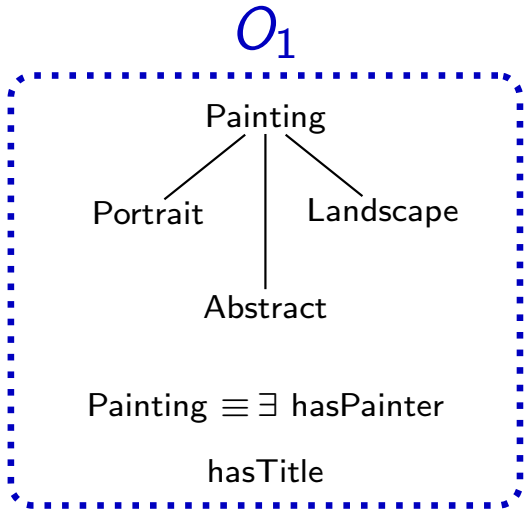


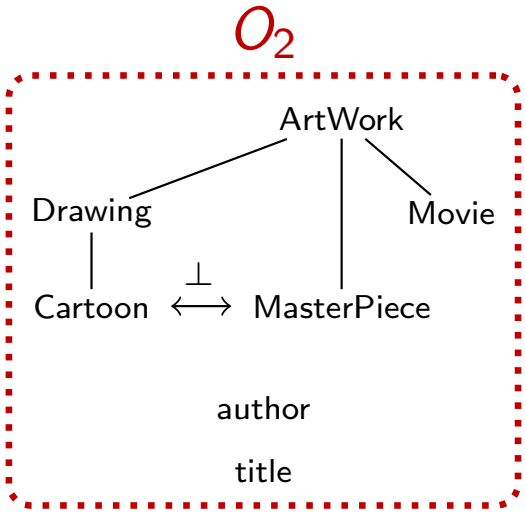


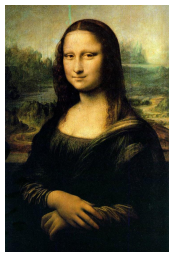




Media adaptation using Semantic Web technologies

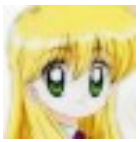






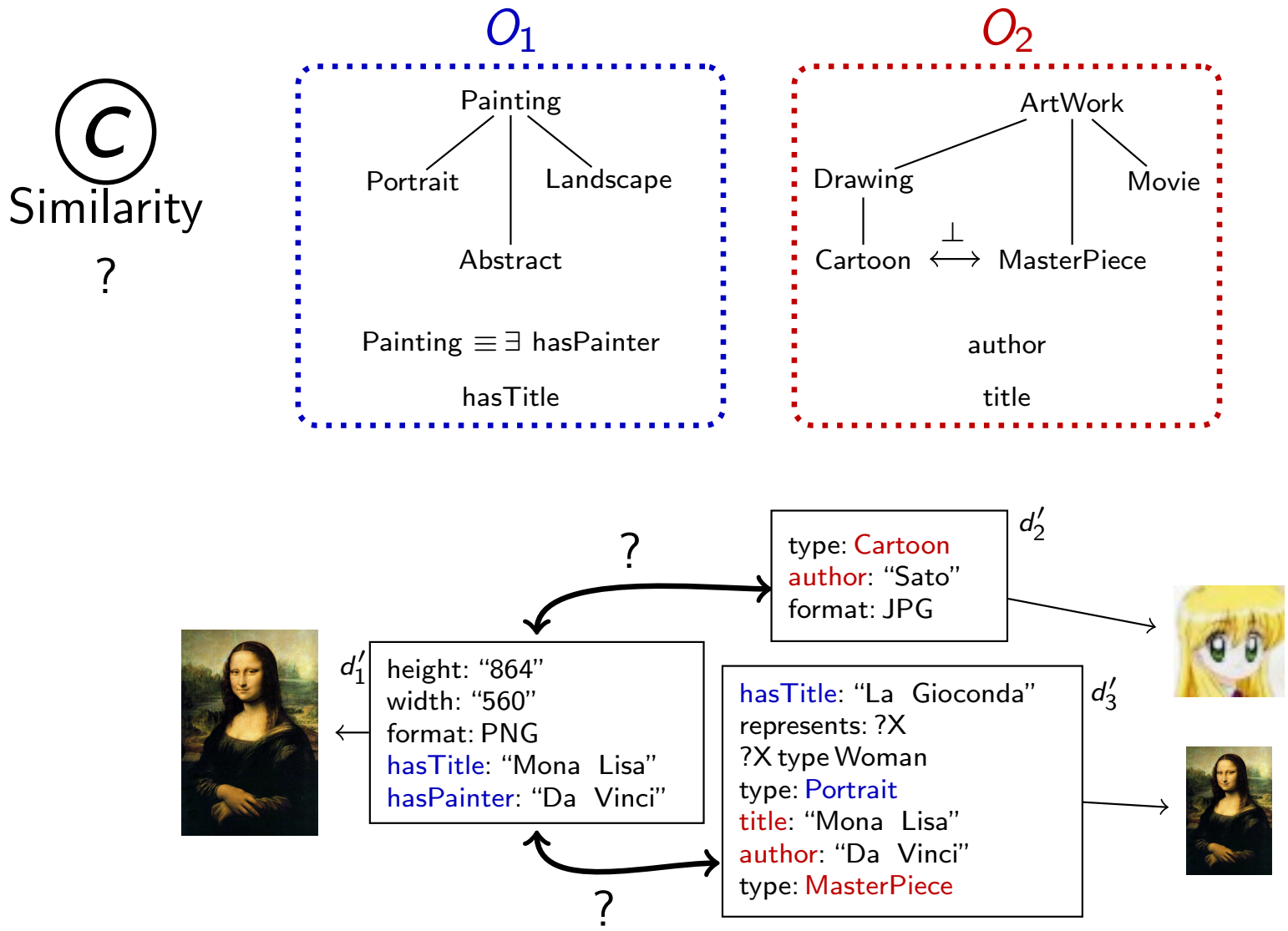
d'_1
height: "864"
width: "560"
format: PNG
hasTitle: "Mona Lisa"
hasPainter: "Da Vinci"

d'_2
type: Cartoon
author: "Sato"
format: JPG

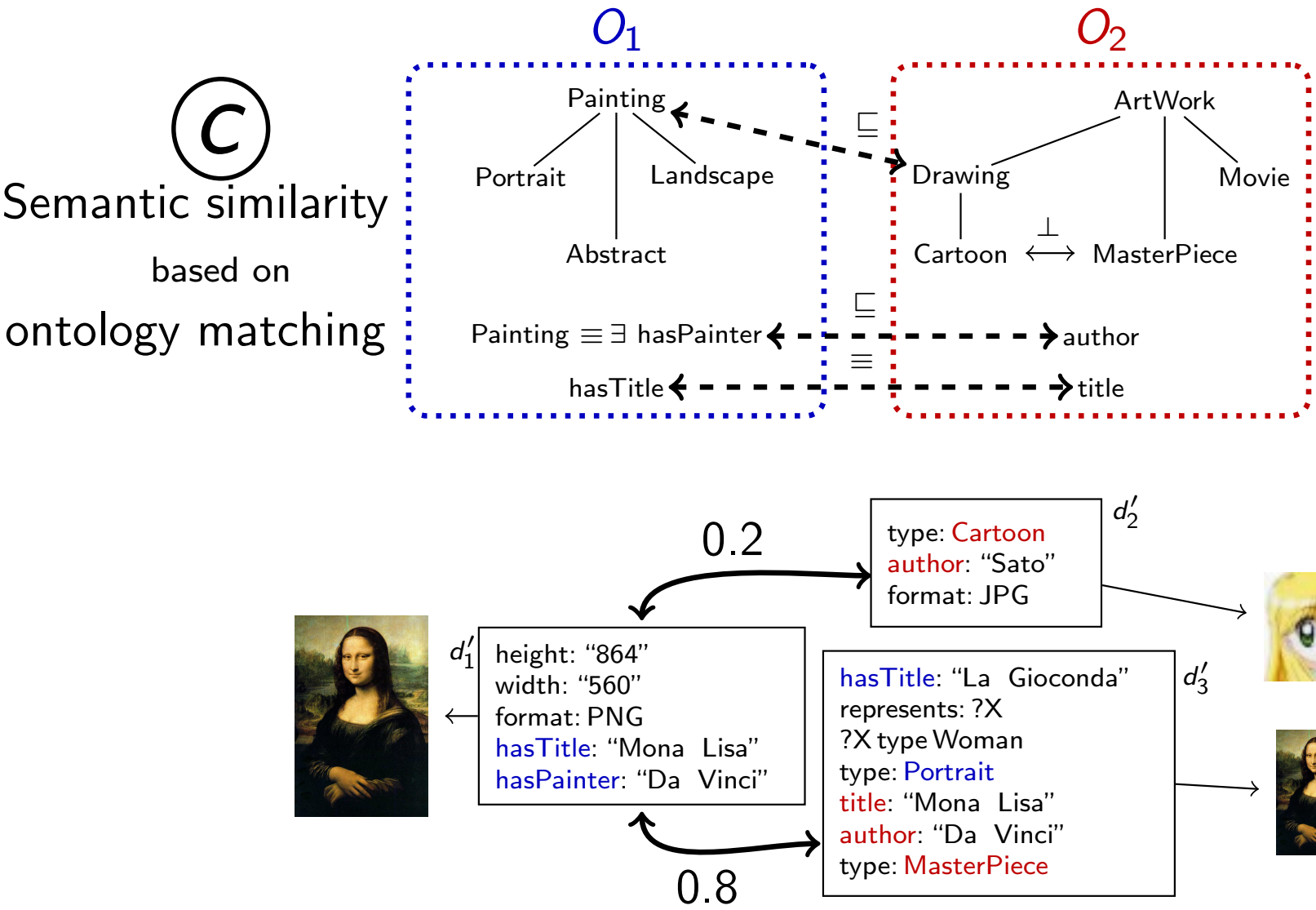


d'_3
hasTitle: "La Gioconda"
represents: ?X
?X type Woman
type: Portrait
title: "Mona Lisa"
author: "Da Vinci"
type: MasterPiece

Media adaptation using Semantic Web technologies

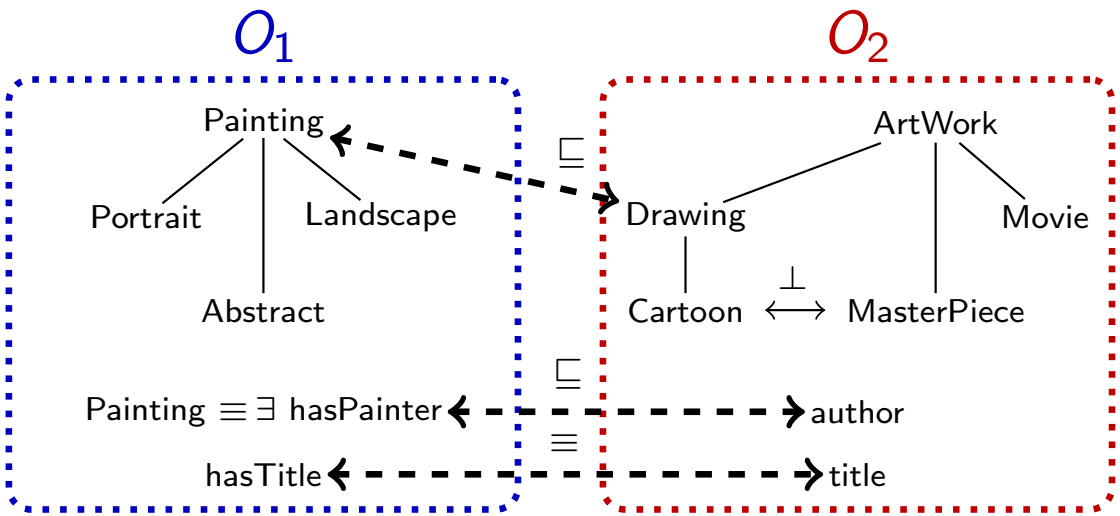


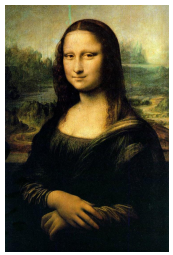
Media adaptation using Semantic Web technologies



Media adaptation using Semantic Web technologies

Semantic filtering
(e.g., only masterpieces)





d'_1
height: "864"
width: "560"
format: PNG
hasTitle: "Mona Lisa"
hasPainter: "Da Vinci"

0.8

d'_3
hasTitle: "La Gioconda"
represents: ?X
?X type Woman
type: Portrait
title: "Mona Lisa"
author: "Da Vinci"
type: MasterPiece

Conclusion

Application of the semantic adaptation approach

- **Adaptation of all multimedia document dimensions**
  - temporal, spatial and hypermedia
  - spatio-temporal and hypermedia
- **Development of a SMIL adaptation strategy**
- **Implementation of a SMIL adaptation prototype**
- **Semantic media adaptation based on Semantic Web technologies**

Discussion about the adaptation quality

"The basic assumption is that content transformation activities should be provided as non-destructive operations." (DocEng'08)

$\Rightarrow$ One approach is to measure the adaptation transformations

Different kind of metrics:

- Measuring the discourse evolution
- Measuring the composition degradation
- Measuring the content transformation

How is it possible to mix all distances ?