

Spatio-temporal proximities for multimedia document adaptation

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AIMSA'06



A multimedia document example

Spatio-temporal dimension

Temporal dimension

Name

Results

Speech



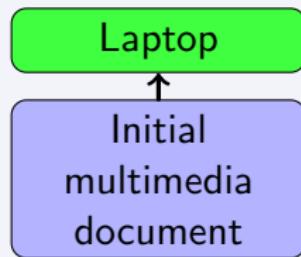
Spatial dimension

Match

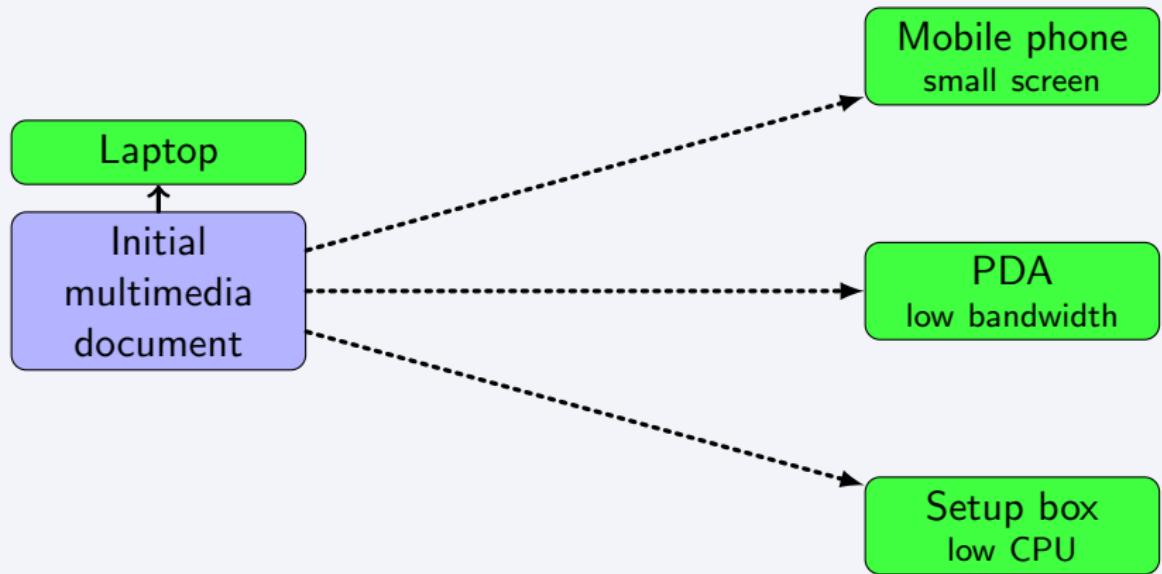
Results

Name

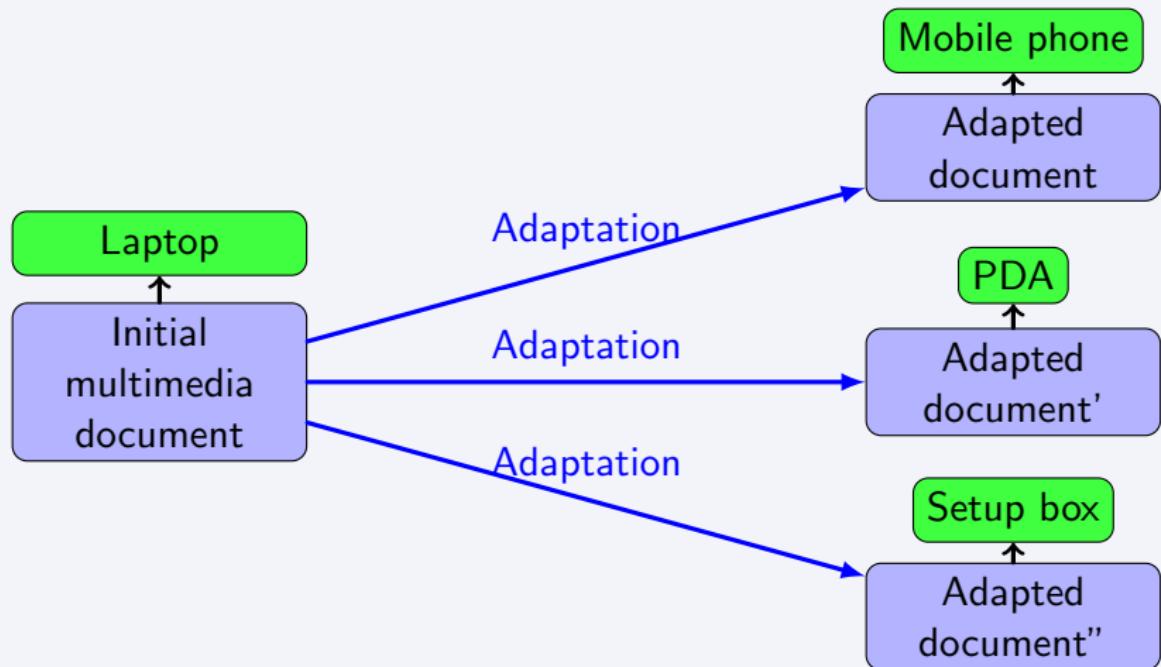
Multimedia document adaptation



Multimedia document adaptation



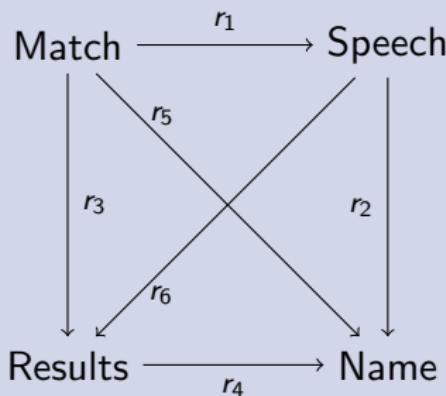
Multimedia document adaptation



Our general semantic adaptation approach

- Specify semantic relations between multimedia objects.

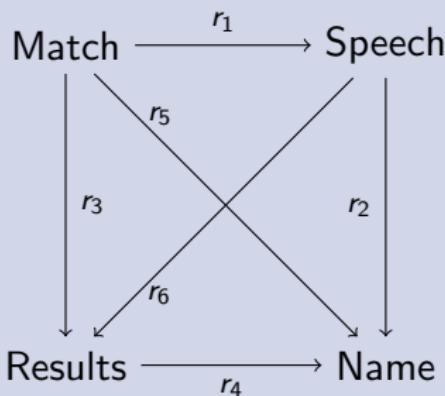
Initial relation graph



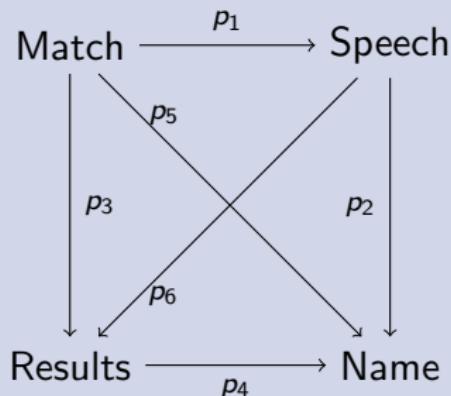
Our general semantic adaptation approach

- Specify semantic relations between multimedia objects.
- Identify the possible relations according to the profile.

Initial relation graph



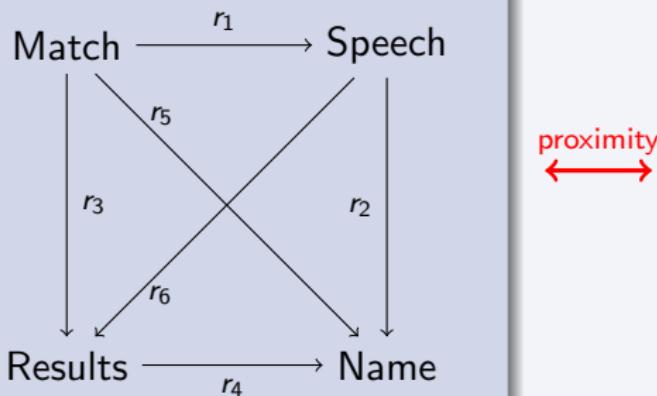
Possible relation graph



Our general semantic adaptation approach

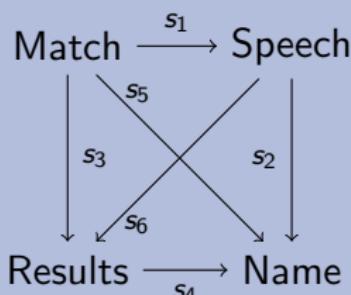
- Specify semantic relations between multimedia objects.
- Identify the possible relations according to the profile.
- Compute adapted solutions close to the initial document.

Initial relation graph



Possible relation graph

Adapted solution



What is new in this paper ?

- Mix several dimensions (temporal and spatial).
- Define spatio-temporal distances between multimedia documents.
- Identify different proximity metrics according to multimedia object properties.

Outline

1 Spatio-temporal proximities

- Specify a qualitative spatio-temporal representation
- Define spatio-temporal proximities

2 The case of animated documents

3 Refining the spatio-temporal proximities

4 Conclusion

Outline

1 Spatio-temporal proximities

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3 Refining the spatio-temporal proximities

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Specify a spatio-temporal representation

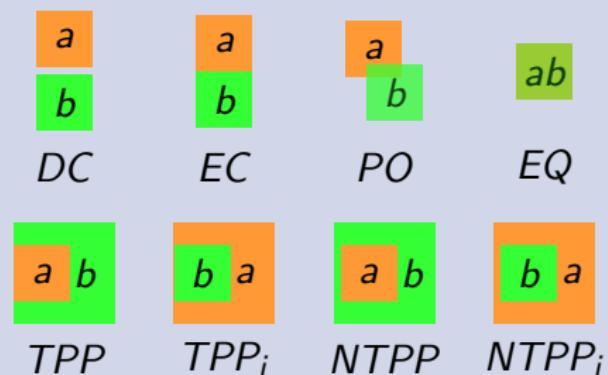
Definition (Spatio-temporal relation)

A spatio-temporal relation is a pair $\langle r_T, r_S \rangle$ where r_T is a temporal relation over the set \mathcal{T} and r_S is a spatial relation over the set \mathcal{S} .

\mathcal{T} = Allen interval algebra

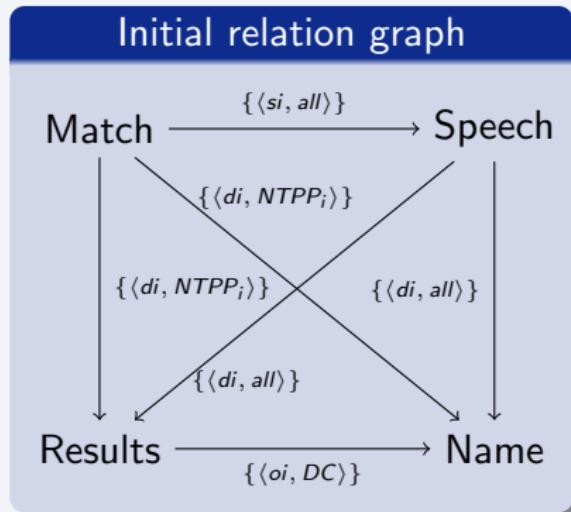
$x \, r \, y$	x / y	$y \, r^{-1} \, x$
before (b)	— —	(bi) after
meets (m)	— —	(mi) met-by
during (d)	— —	(di) contains
overlaps (o)	— —	(oi) overlapped-by
starts (s)	— —	(si) started-by
finishes (f)	— —	(fi) finished-by
equals (e)	=	(e)

\mathcal{S} = RCC8



Example

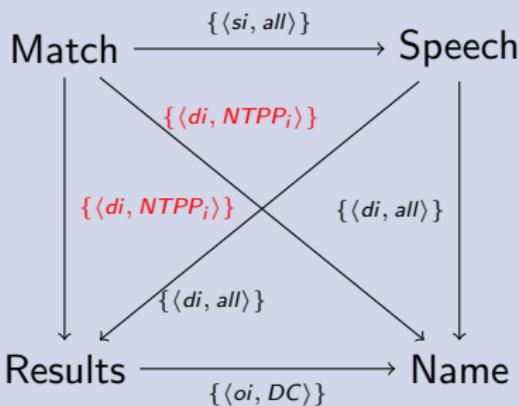
- Specify semantic relations between multimedia objects.



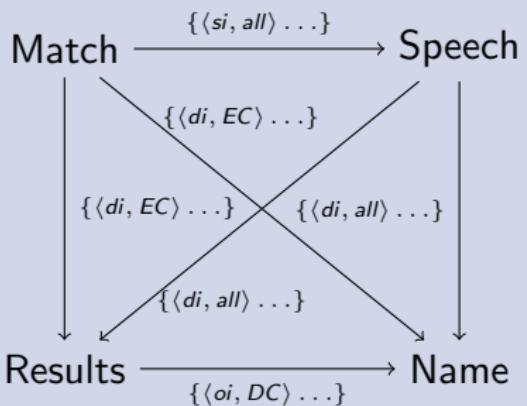
Example

- Specify semantic relations between multimedia objects.
- Identify the possible relations according to the profile:
 - Overlapping visible objects are impossible at a time.

Initial relation graph



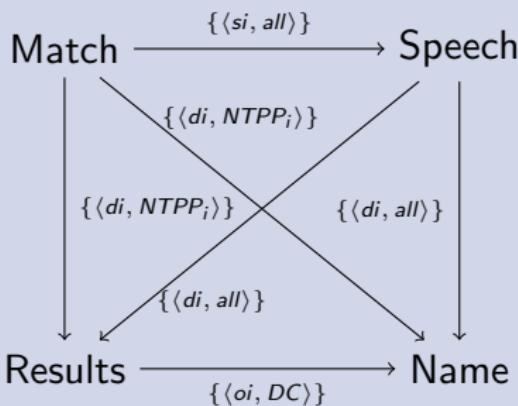
Possible relation graph



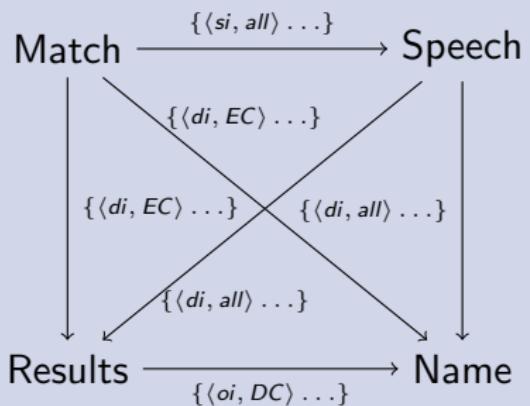
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- Compute adapted solutions close to the initial document.

Initial relation graph

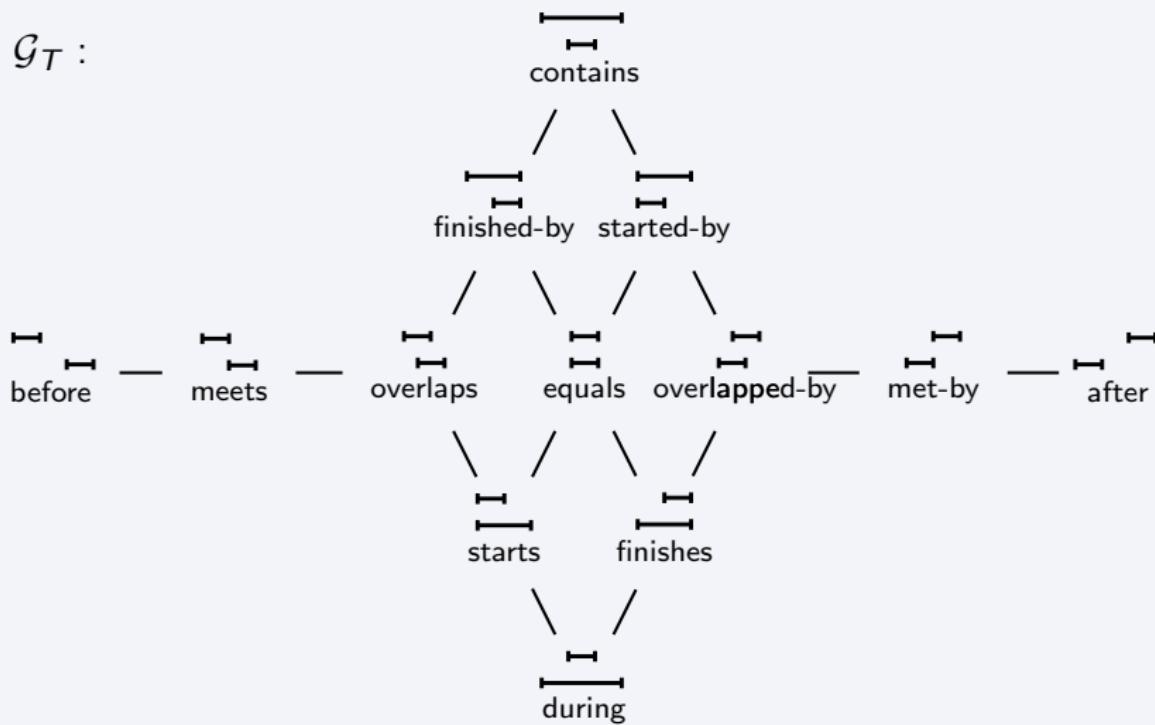


Possible relation graph



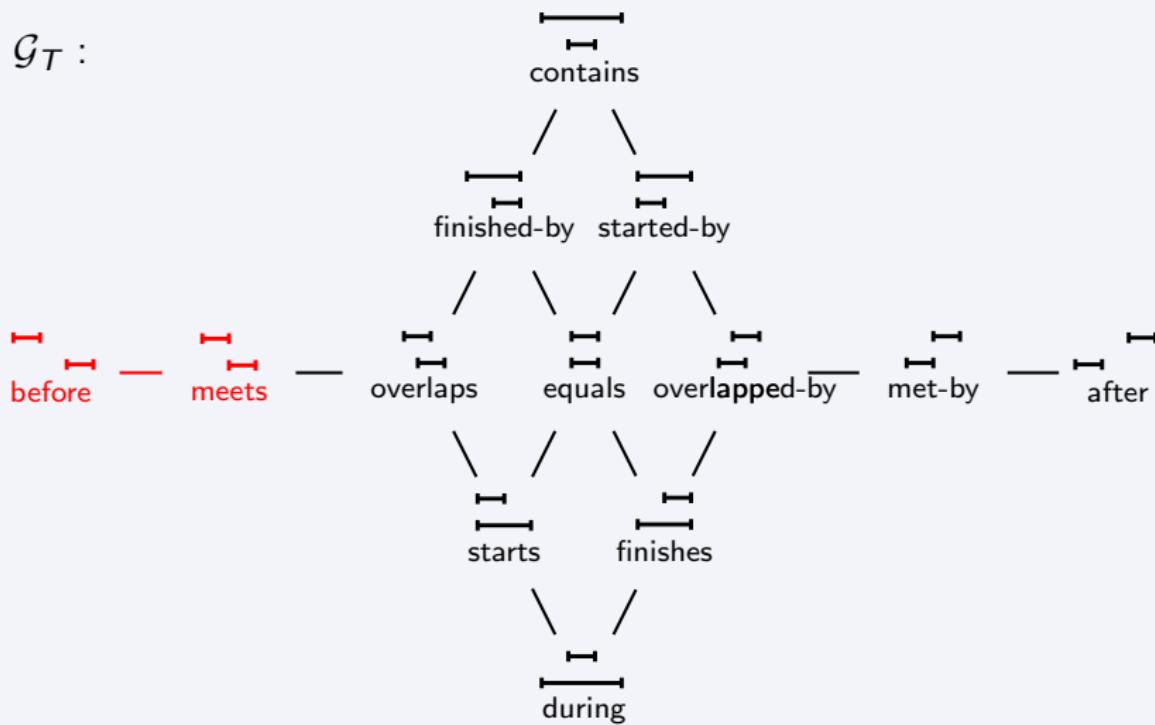
Temporal proximities

$\mathcal{G}_T :$



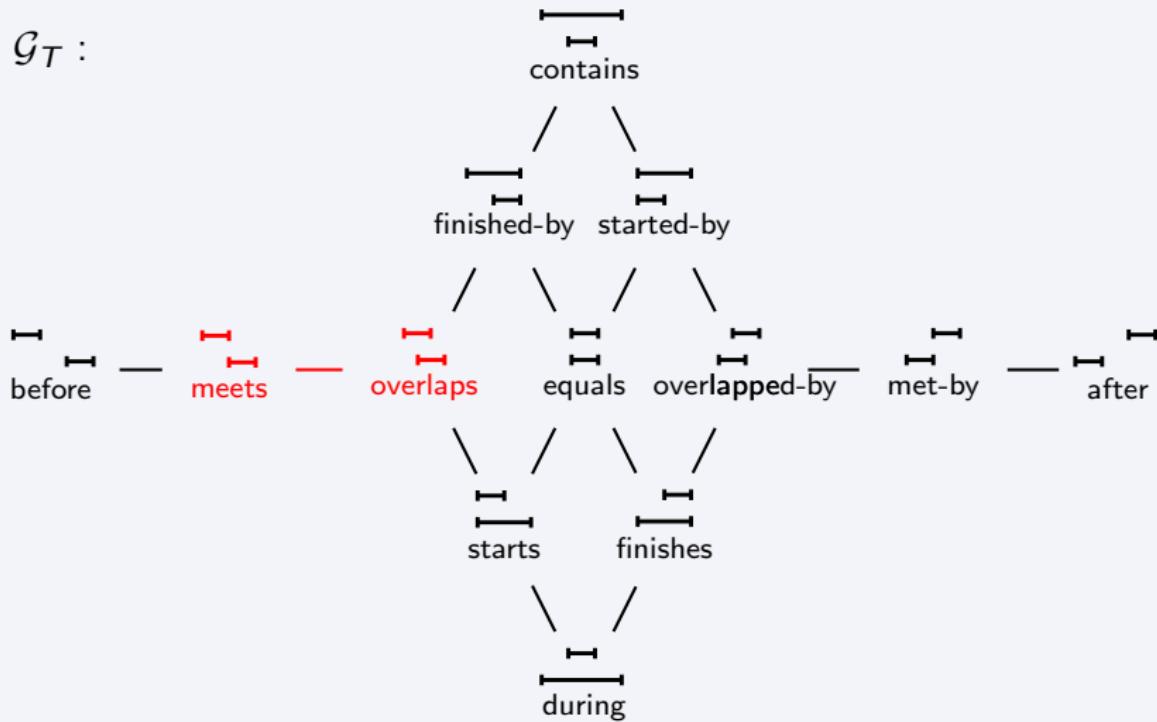
Temporal proximities

$\mathcal{G}_T :$



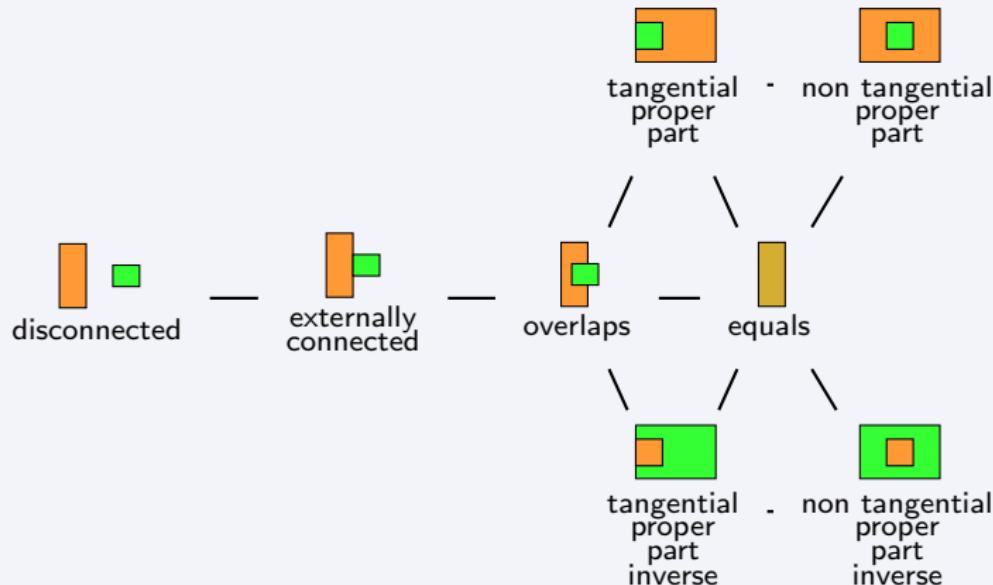
Temporal proximities

$\mathcal{G}_T :$



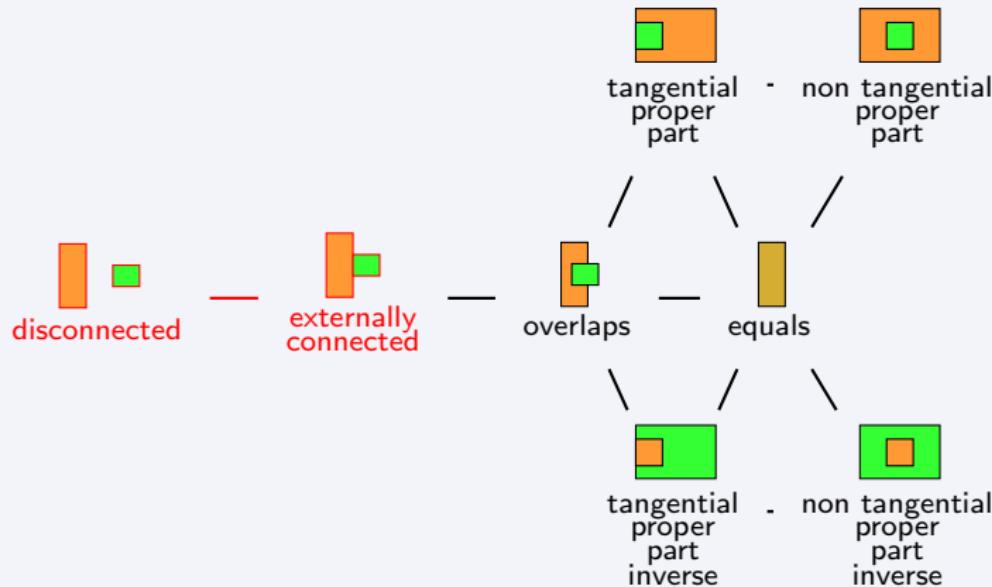
Spatial proximities

$\mathcal{G}_S :$

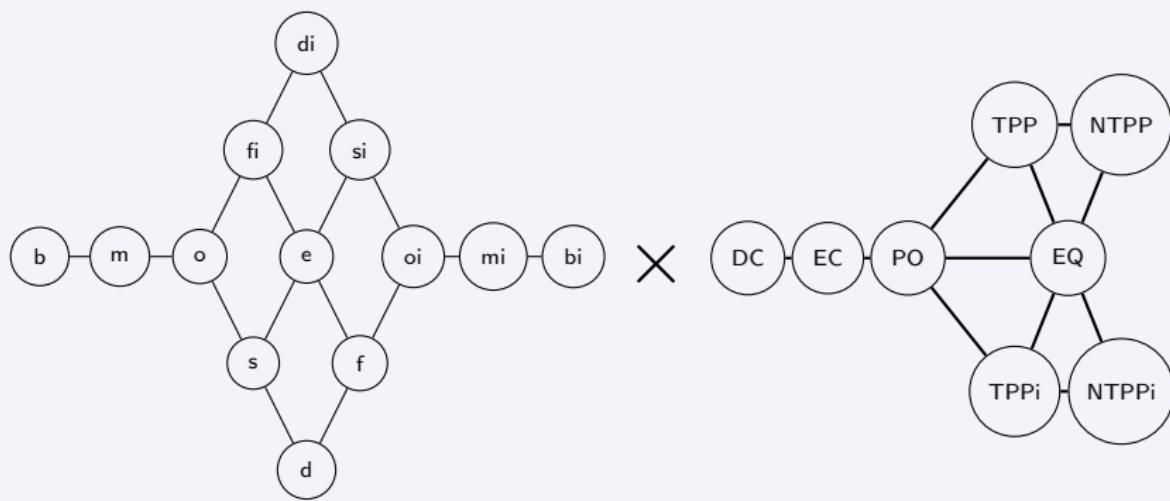


Spatial proximities

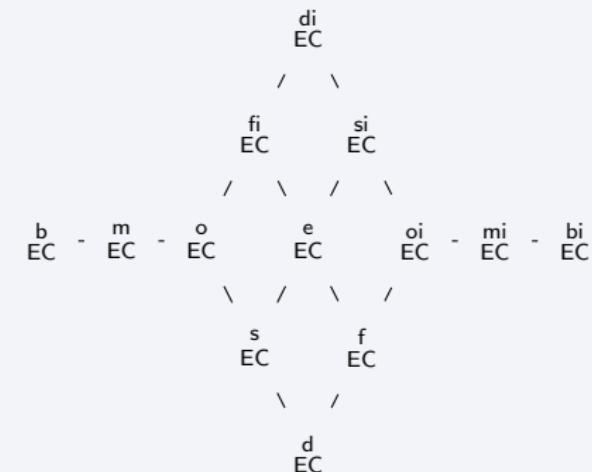
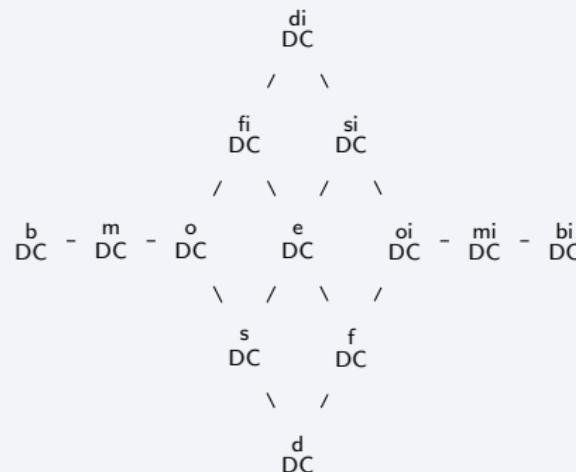
$\mathcal{G}_S :$



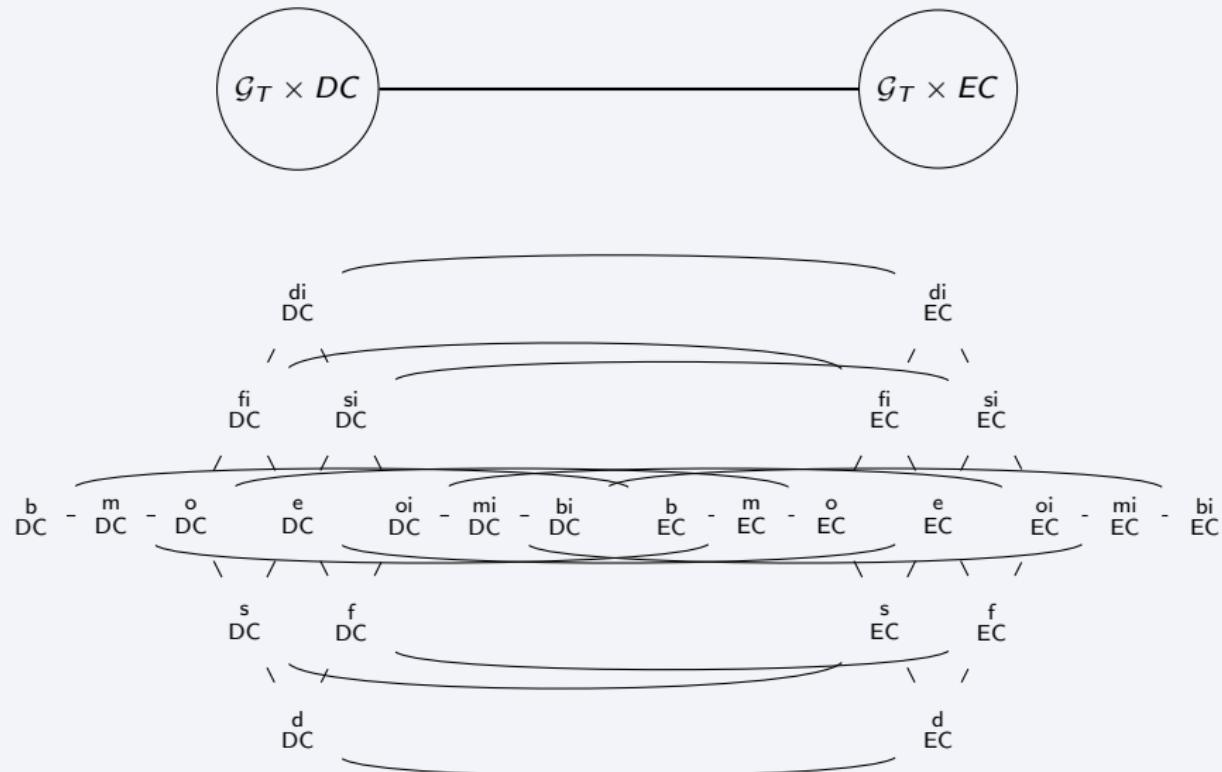
Spatio-temporal proximities

 \mathcal{G}_T \mathcal{G}_S 

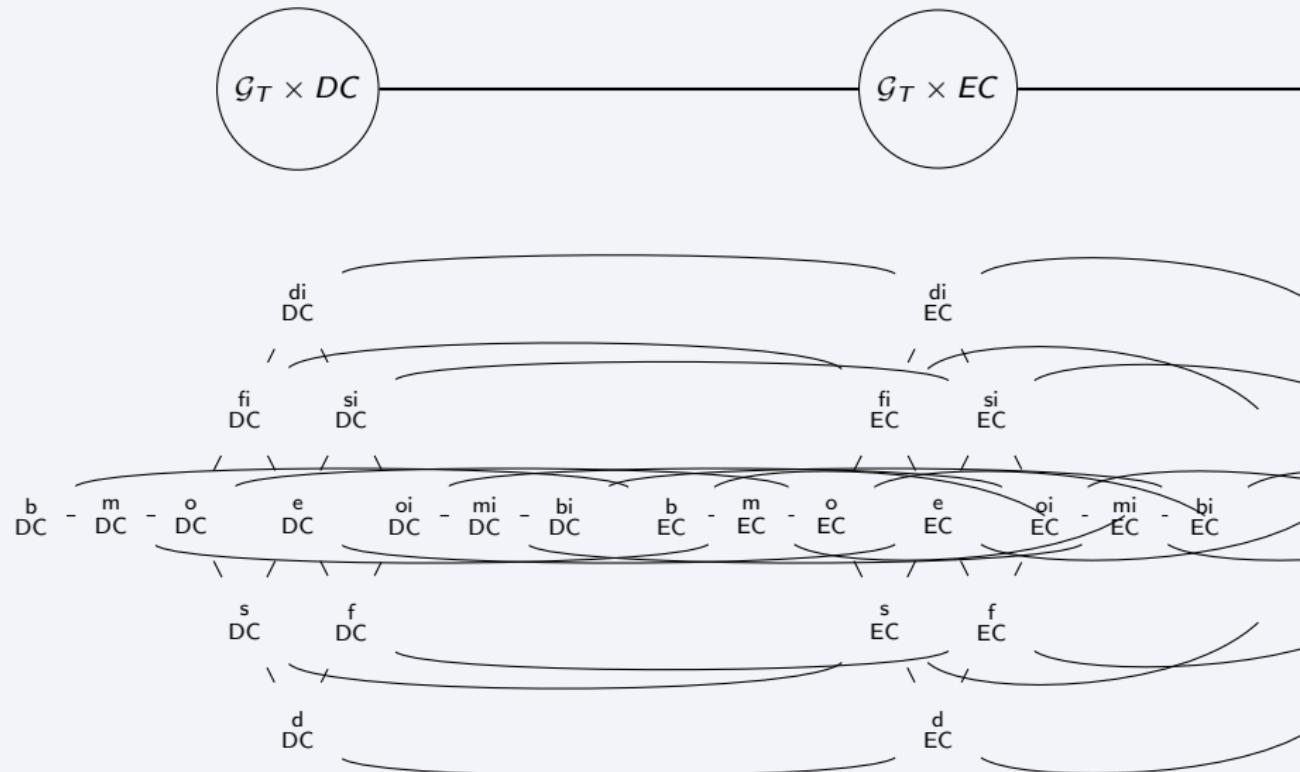
Spatio-temporal proximities



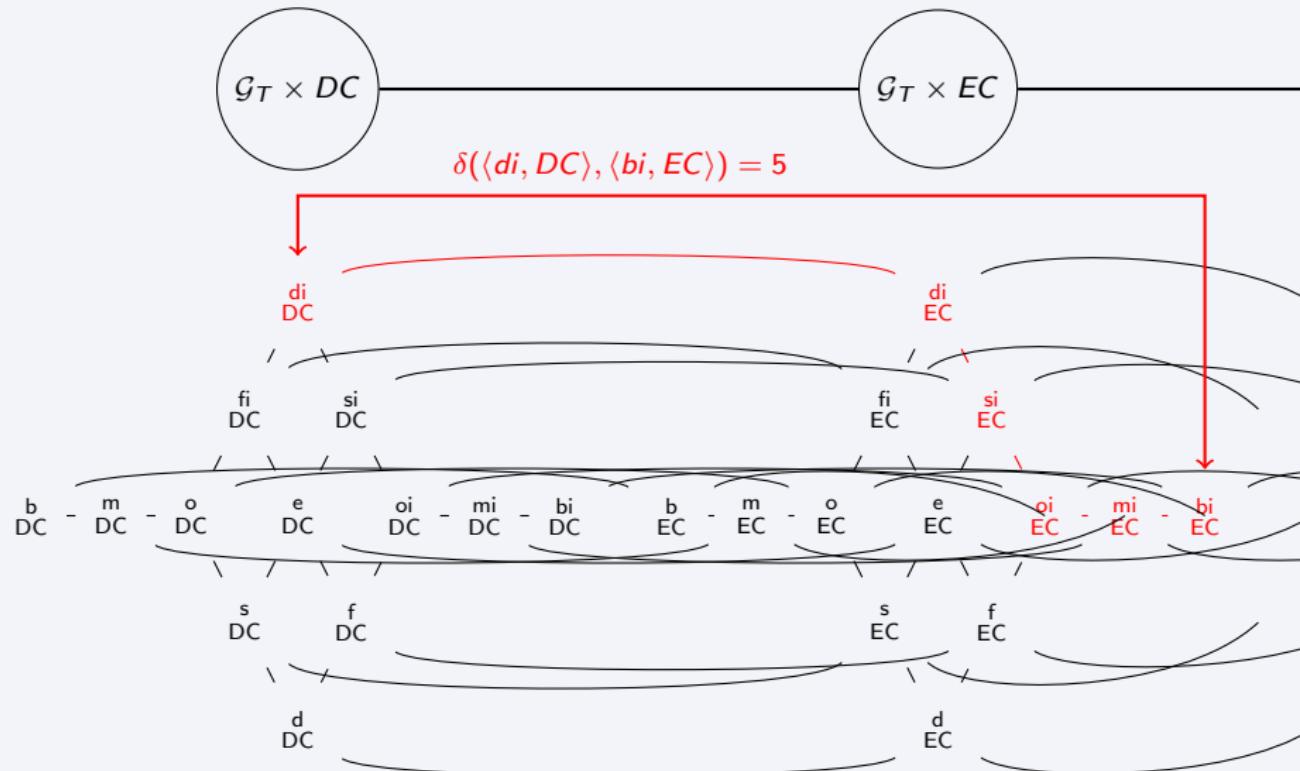
Spatio-temporal proximities



Spatio-temporal proximities



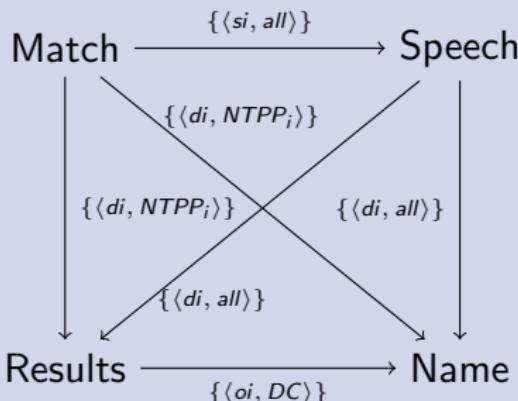
Spatio-temporal proximities



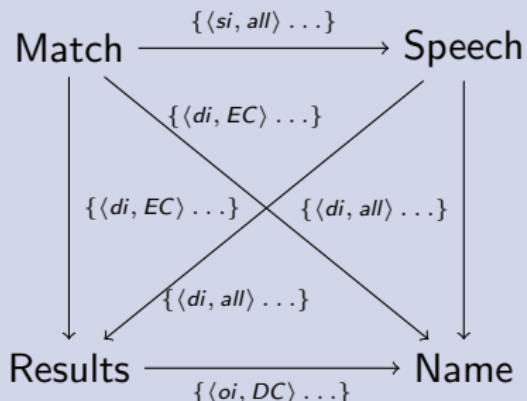
Example

- Compute adapted solutions close to the initial document.

Initial relation graph



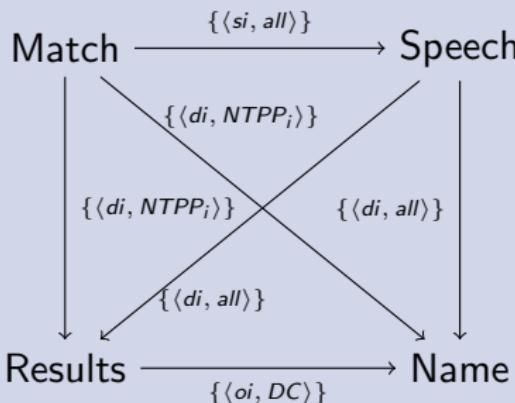
Possible relation graph



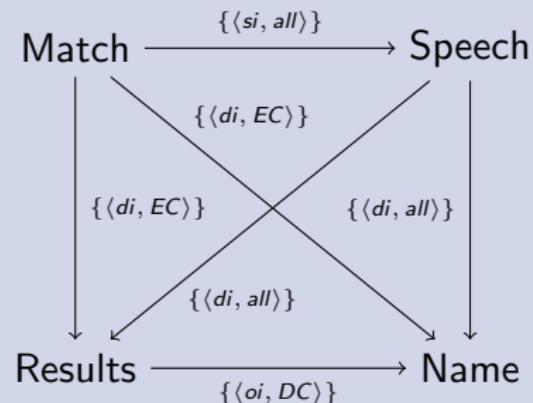
Example

- Compute adapted solutions close to the initial document.
 - Generate consistent possible relation graphs.

Initial relation graph



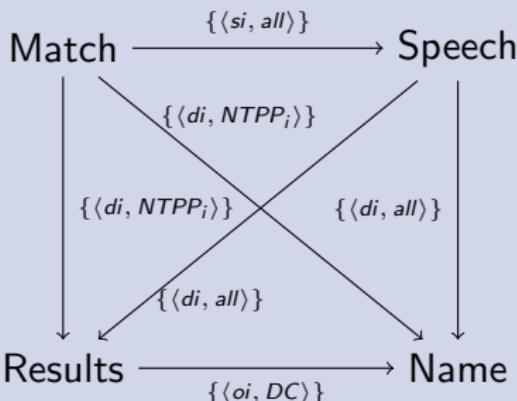
Consistent possible relation graph



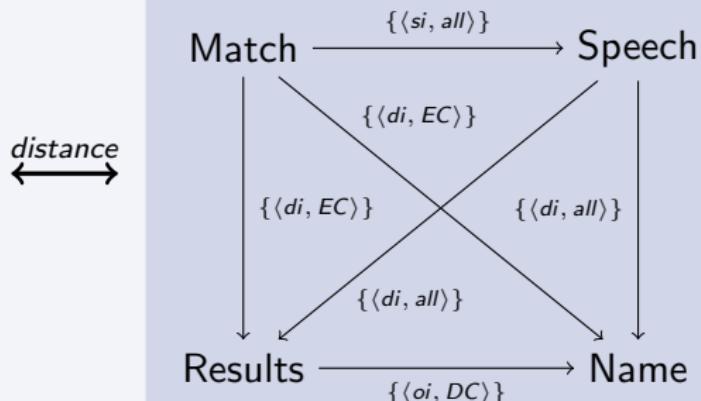
Example

- Compute adapted solutions close to the initial document.
 - Generate consistent possible relation graphs.
 - $distance = \sum_{i=1}^n \delta(r_i, p_i)$.

Initial relation graph



Consistent possible relation graph

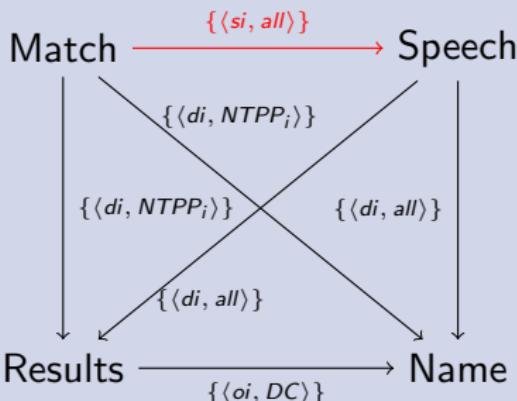


$distance$

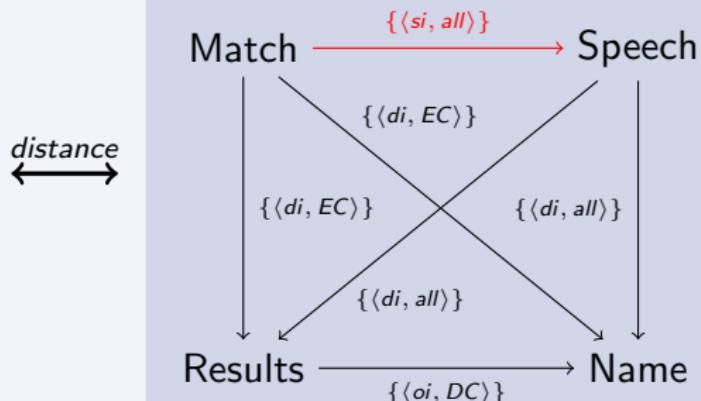
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Initial relation graph



Consistent possible relation graph



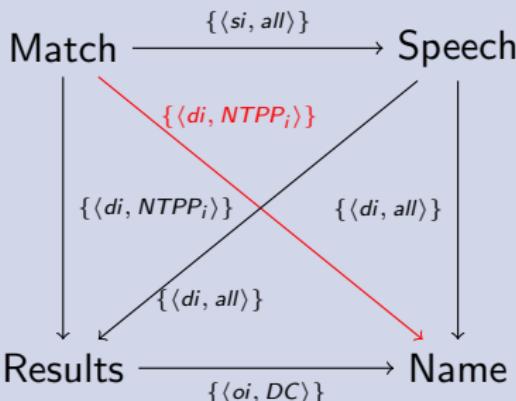
$distance$

$$distance = 0$$

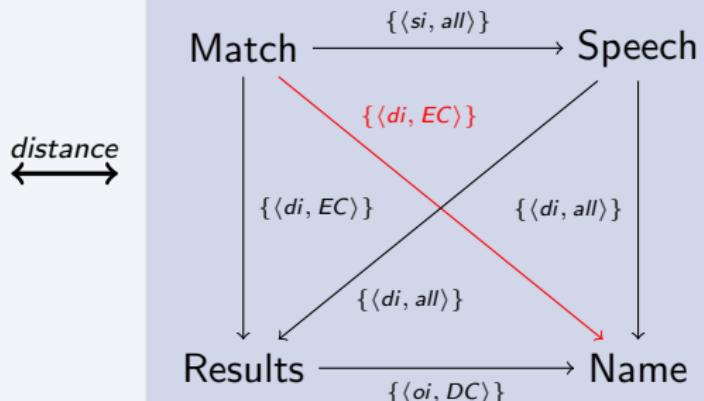
Example

- Compute adapted solutions close to the initial document.
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Initial relation graph



Consistent possible relation graph

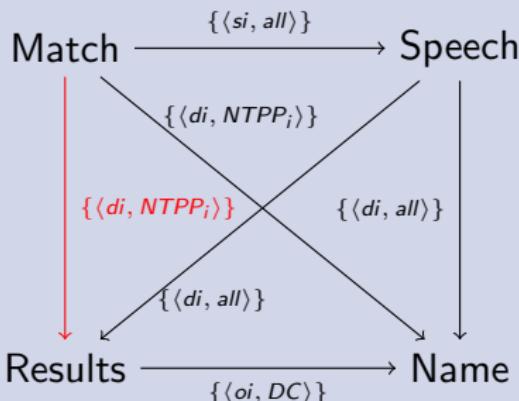


$$distance = 0 + 3$$

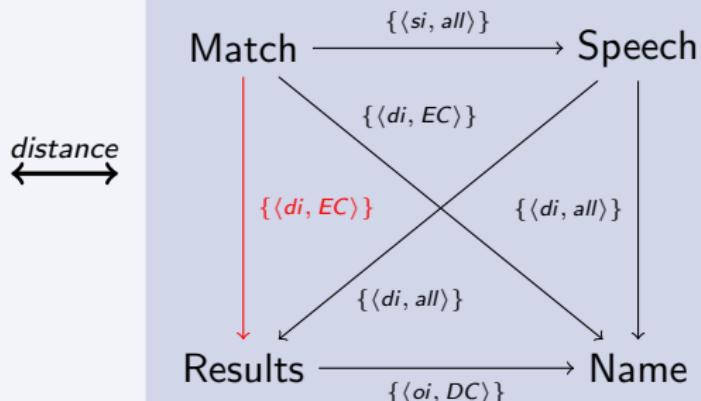
Example

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Initial relation graph



Consistent possible relation graph



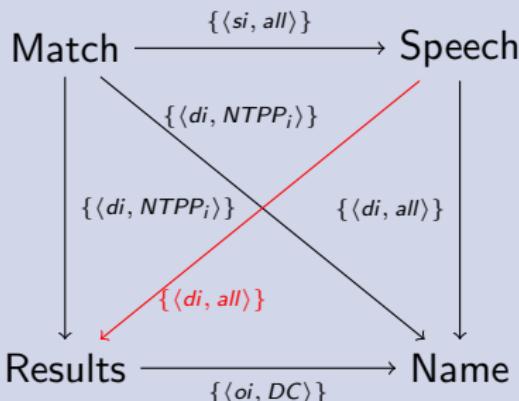
$distance$

$$distance = 0 + 3 + 3$$

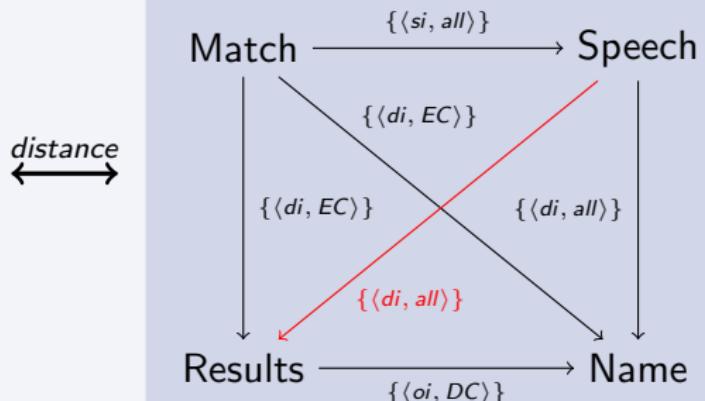
Example

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Initial relation graph



Consistent possible relation graph

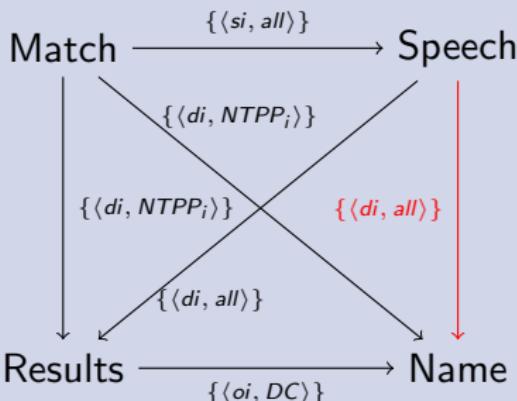


$$distance = 0 + 3 + 3 + 0$$

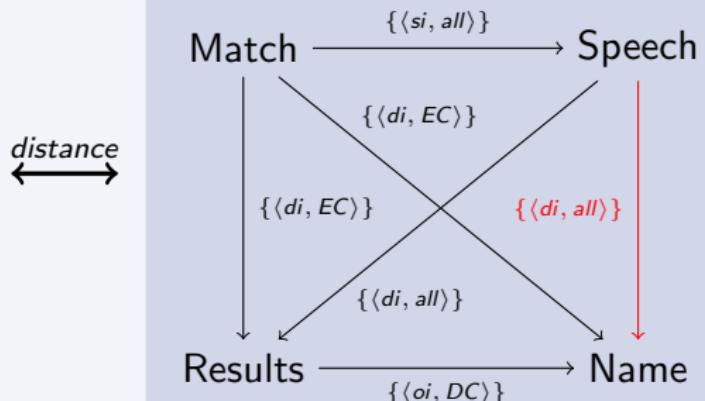
Example

- Compute adapted solutions close to the initial document.
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Initial relation graph



Consistent possible relation graph



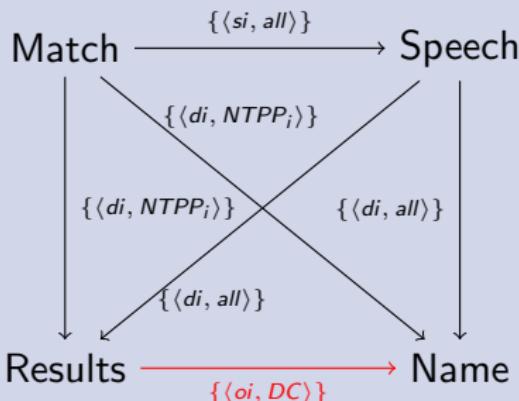
$distance$

$$distance = 0 + 3 + 3 + 0 + 0$$

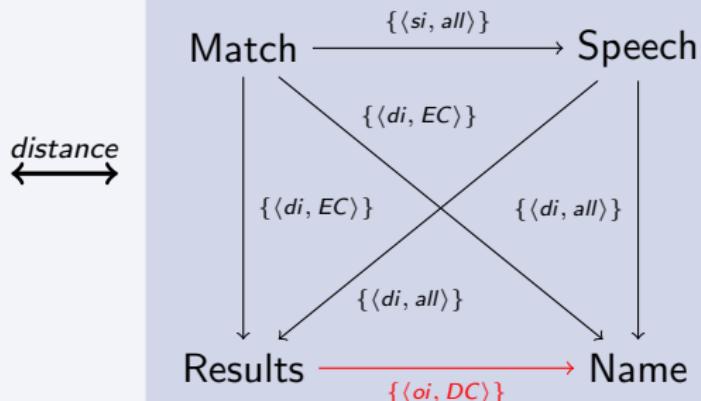
Example

- Compute adapted solutions close to the initial document.
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Initial relation graph



Consistent possible relation graph



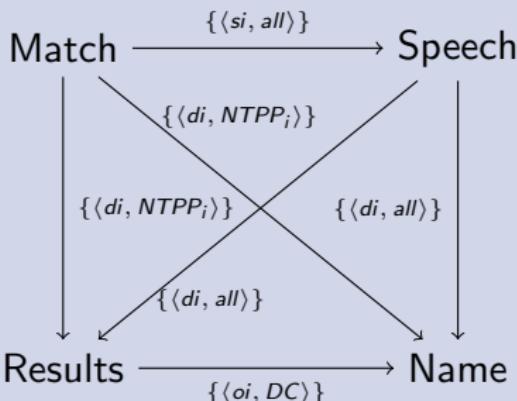
$distance$

$$distance = 0 + 3 + 3 + 0 + 0 + 0$$

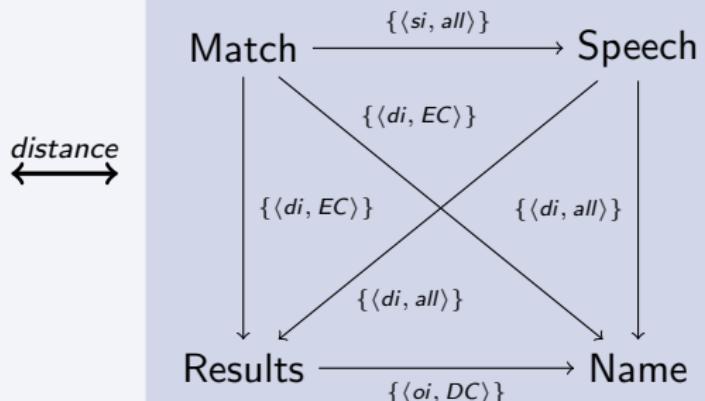
Example

- Compute adapted solutions close to the initial document.
 - Generate consistent possible relation graphs.
 - $distance = \sum_{i=1}^n \delta(r_i, p_i)$.

Initial relation graph



Consistent possible relation graph



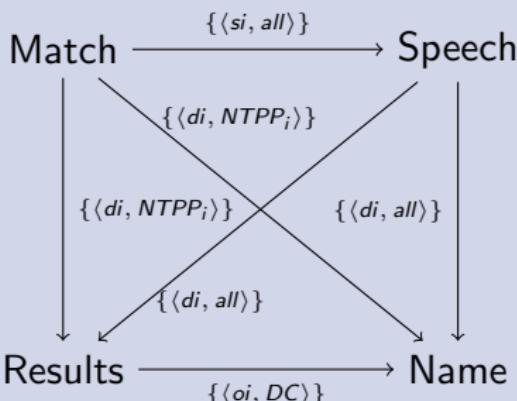
$distance$

$$distance = 0 + 3 + 3 + 0 + 0 + 0 = 6$$

Example

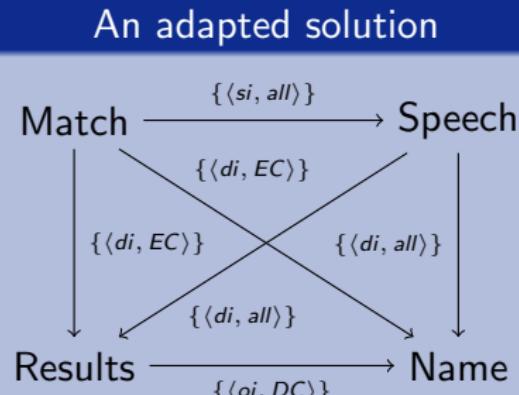
- Compute adapted solutions close to the initial document.
 - Generate consistent possible relation graphs.
 - $distance = \sum_{i=1}^n \delta(r_i, p_i)$.

Initial relation graph



$↔$
distance

Consistent possible relation graph



$$distance = 0 + 3 + 3 + 0 + 0 + 0 = 6 \text{ (minimal)}$$

A possible adapted execution

Spatio-temporal dimension

Temporal dimension

Name

Results

Speech



Spatial dimension



Jake La Motta

Wins: 83
Loses: 19
Draws: 4
KOs: 30

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1 Spatio-temporal proximities

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- Define spatio-temporal proximities

2 The case of animated documents

3 Refining the spatio-temporal proximities

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Multimedia objects move

Spatio-temporal dimension

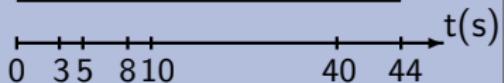
Temporal dimension

Name

Results

Speech

Match

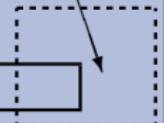


Spatial dimension

Results

Match

Name



$$\text{Name } \langle r_T, r_S^1 \rightarrow \dots \rightarrow r_S^n \rangle \text{ Results}$$

Multimedia objects move

Spatio-temporal dimension

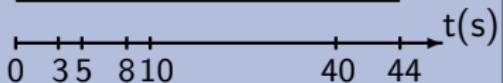
Temporal dimension

Name

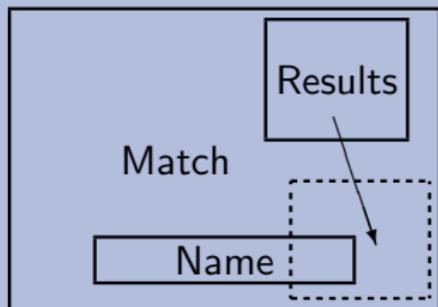
Results

Speech

Match



Spatial dimension



Name \langle overlaps, disconnected \rightarrow externally connected \rightarrow overlaps \rangle Results

Multimedia objects move

Spatio-temporal dimension

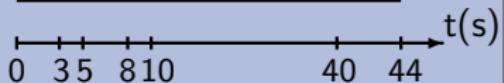
Temporal dimension

Name

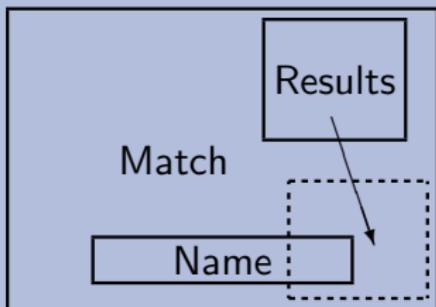
Results

Speech

Match



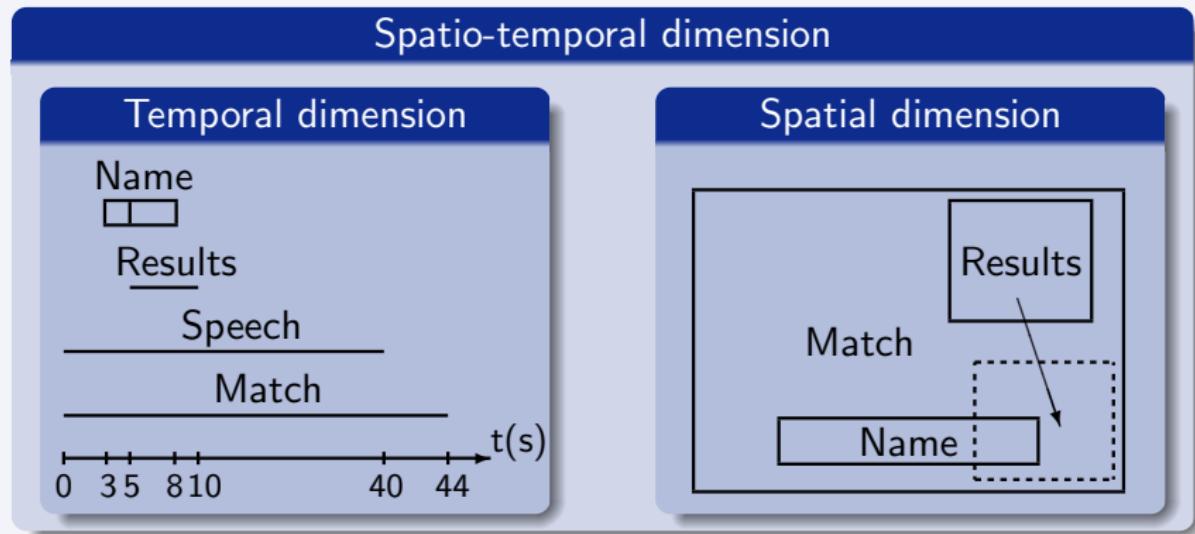
Spatial dimension



Name *(overlaps, disconnected → externally connected → overlaps)* Results

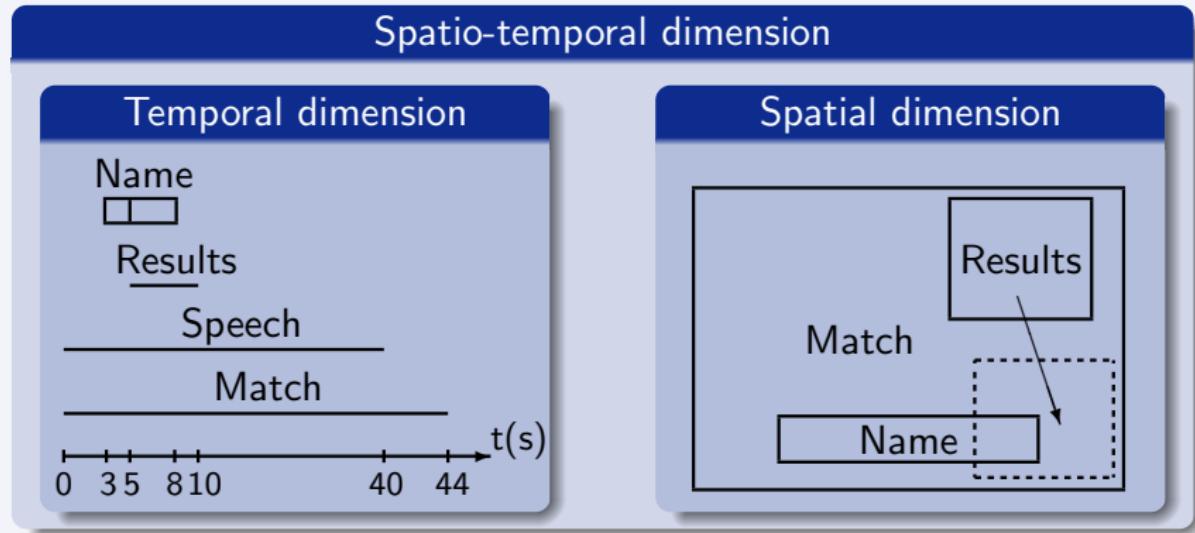
Problem: Does Name occult Results between $t(5)$ and $t(8)$?

Spatio-temporal partition of the animation



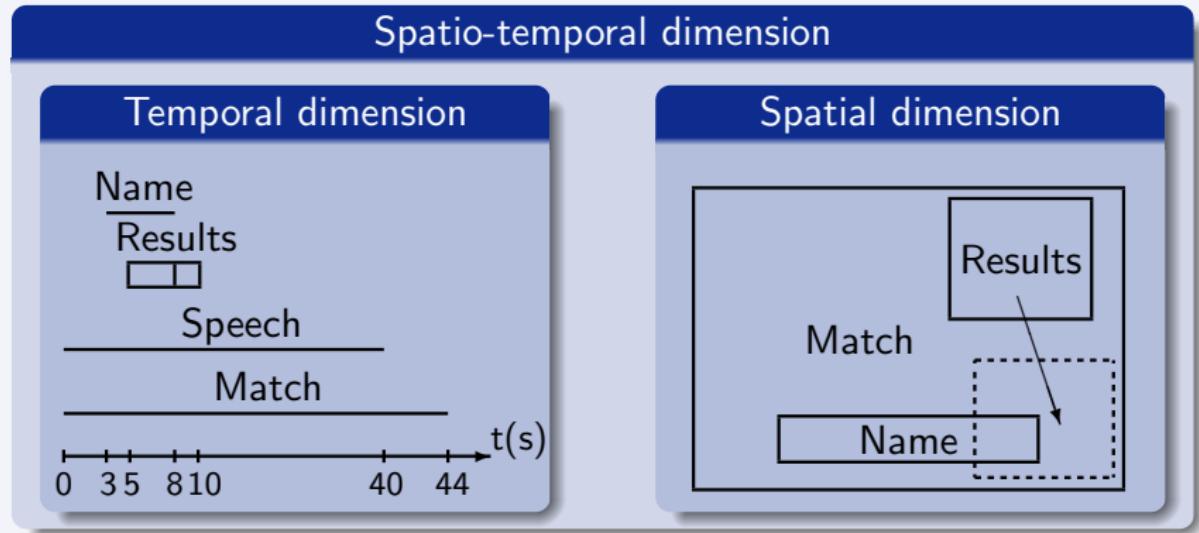
Name $r_1 \rightarrow \dots \rightarrow r_n$ Results

Spatio-temporal partition of the animation



Name $\langle \text{meets}, \text{disconnected} \rangle \rightarrow \langle \text{starts}, \text{externally connected} \rangle$ Results

Spatio-temporal partition of the animation



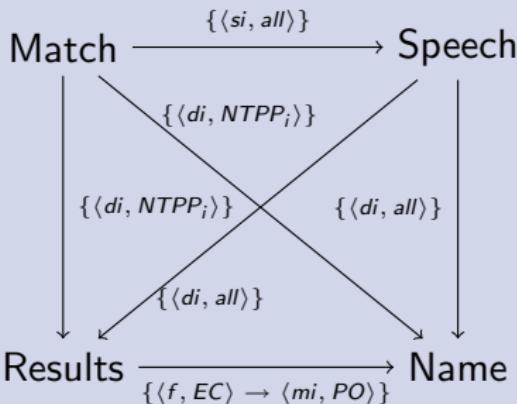
Name $\langle \text{meets}, \text{disconnected} \rangle \rightarrow \langle \text{starts}, \text{externally connected} \rangle$ Results

Results $\langle \text{finishes}, \text{externally connected} \rangle \rightarrow \langle \text{met - by}, \text{overlaps} \rangle$ Name

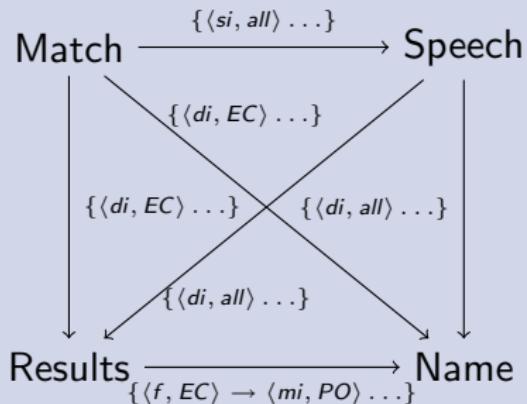
Example

- Compute adapted solutions close to the initial document.

Initial relation graph



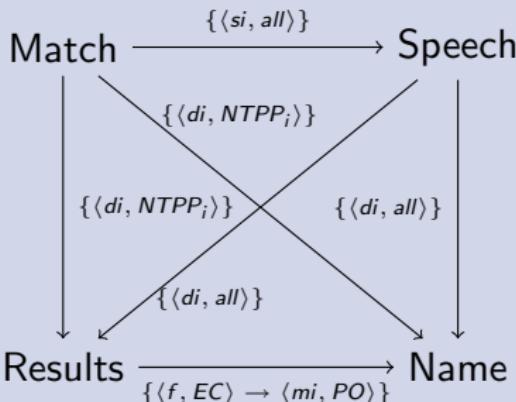
Possible relation graph



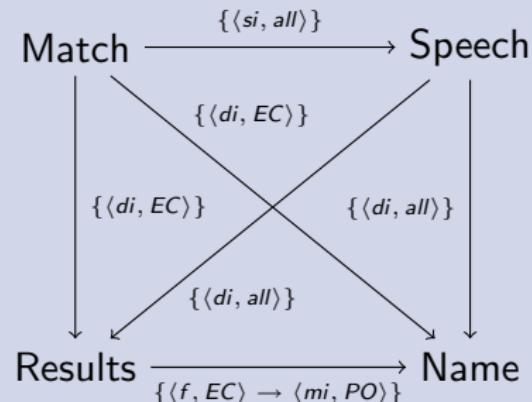
Example

- Compute adapted solutions close to the initial document.
 - Generate consistent possible relation graphs.

Initial relation graph

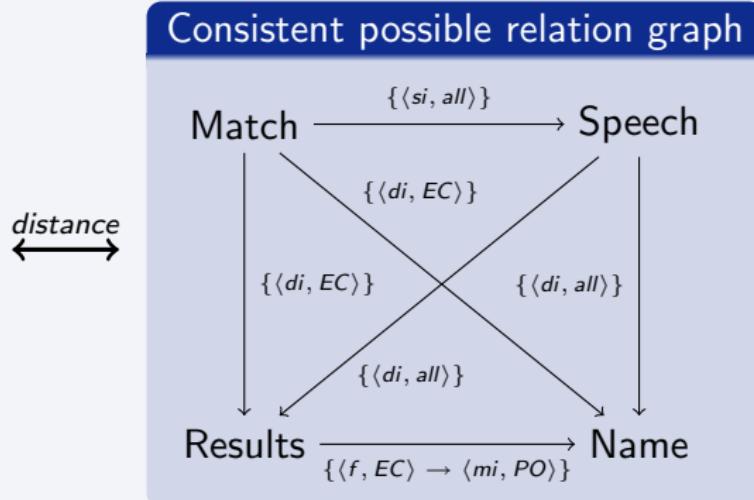
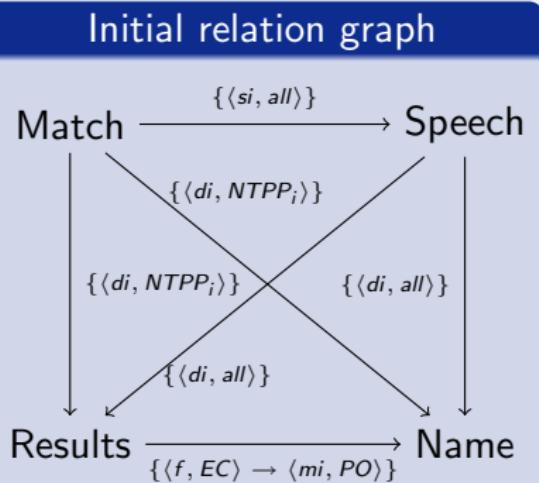


Consistent possible relation graph



Example

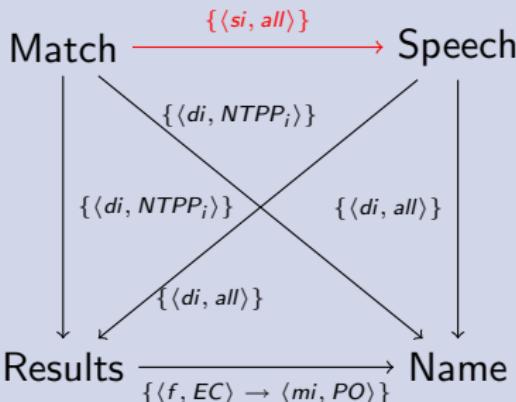
- Compute adapted solutions close to the initial document.
 - Generate consistent possible relation graphs.
 - $distance = \sum_{i=1}^n \sum_{j=1}^m \delta(r_i^j, p_j^i)$.



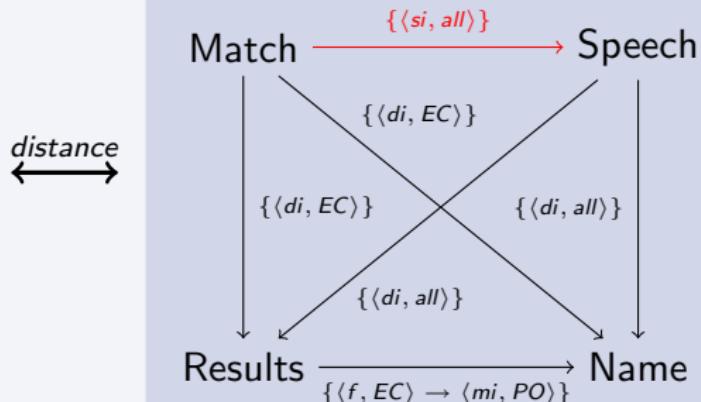
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Consistent possible relation graph

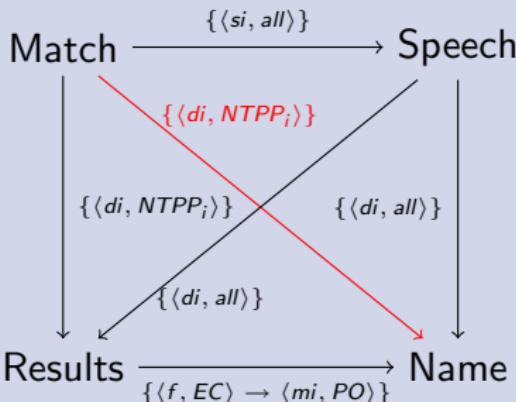


$$distance = 0$$

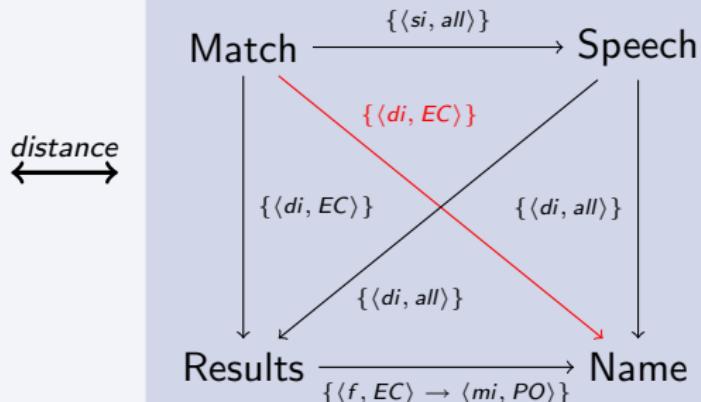
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Initial relation graph



Consistent possible relation graph

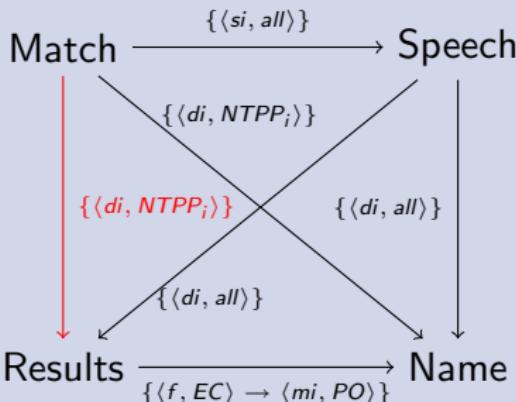


$$distance = 0 + 3$$

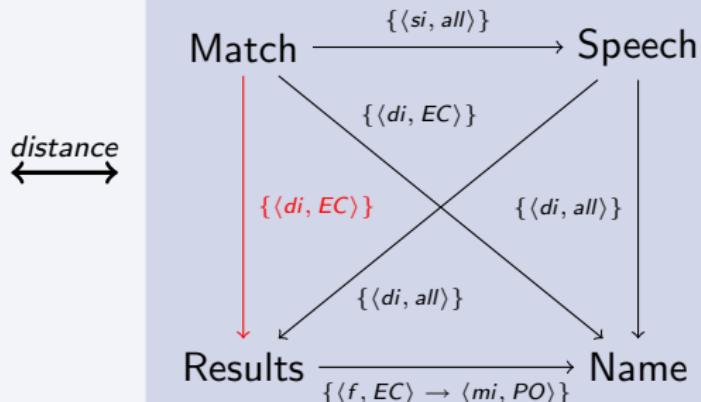
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- Compute adapted solutions close to the initial document.
 - Generate consistent possible relation graphs.
 - $distance = \sum_{i=1}^n \sum_{j=1}^m \delta(r_i^j, p_i^j)$.

Initial relation graph



Consistent possible relation graph



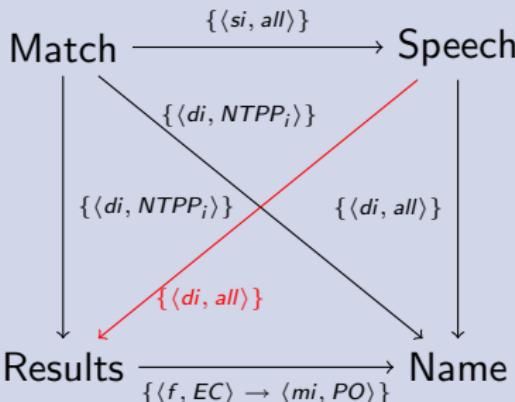
$distance$

$$distance = 0 + 3 + 3$$

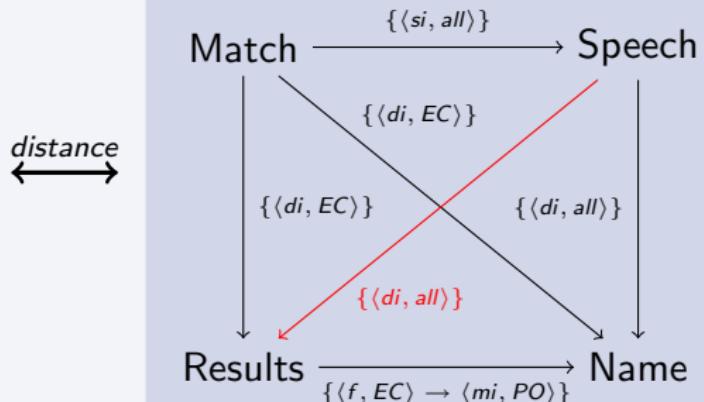
Example

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Initial relation graph



Consistent possible relation graph

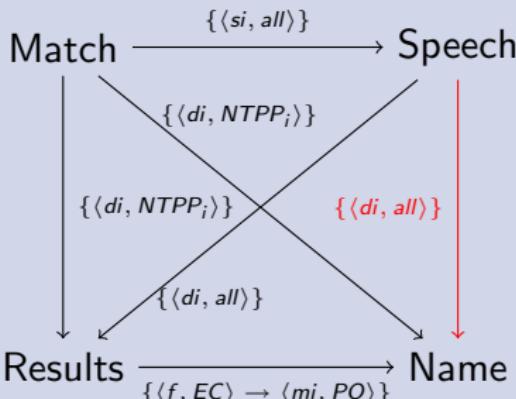


$$distance = 0 + 3 + 3 + 0$$

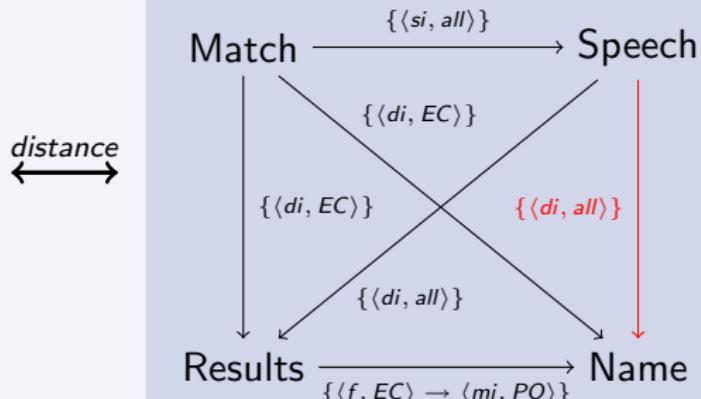
Example

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Initial relation graph



Consistent possible relation graph



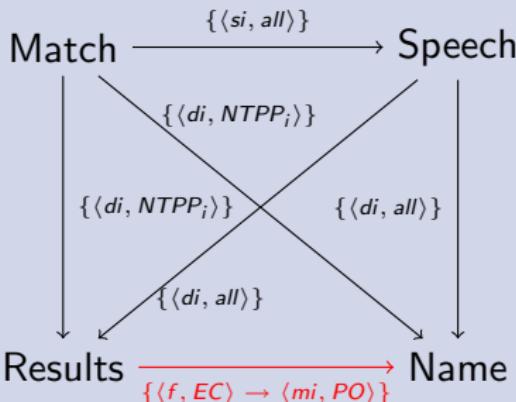
$distance \leftrightarrow$

$$distance = 0 + 3 + 3 + 0 + 0$$

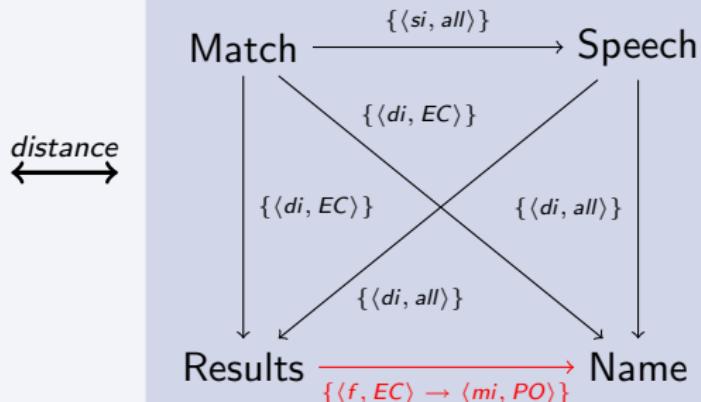
Example

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Initial relation graph



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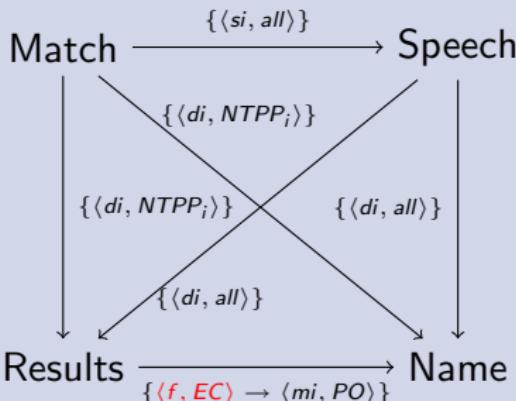
$distance$

$$distance = 0 + 3 + 3 + 0 + 0 + ()$$

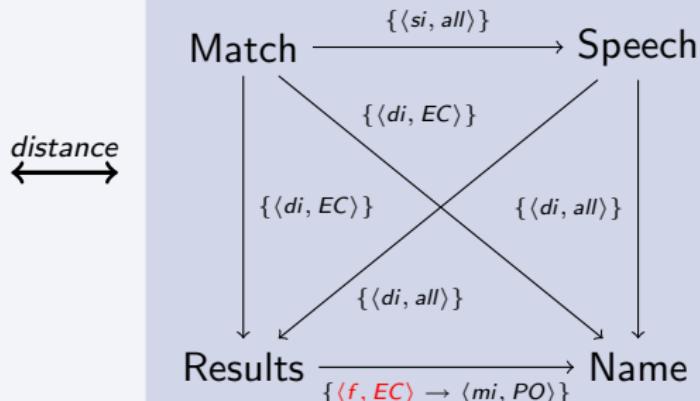
Example

- Compute adapted solutions close to the initial document.
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 - $distance = \sum_{i=1}^n \sum_{j=1}^m \delta(r_i^j, p_i^j)$.

Initial relation graph



Consistent possible relation graph

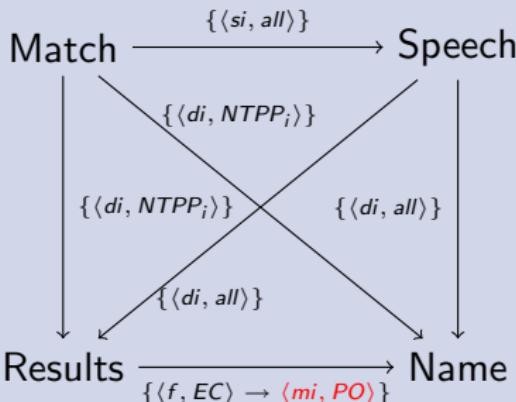


$$distance = 0 + 3 + 3 + 0 + 0 + (0)$$

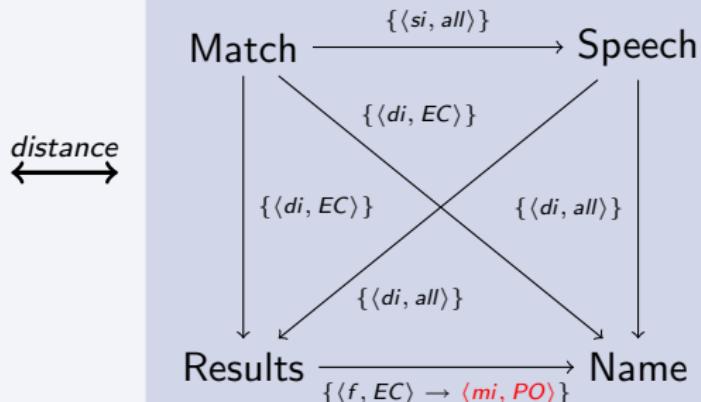
Example

- Compute adapted solutions close to the initial document.
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 - $distance = \sum_{i=1}^n \sum_{j=1}^m \delta(r_i^j, p_i^j)$.

Initial relation graph



Consistent possible relation graph

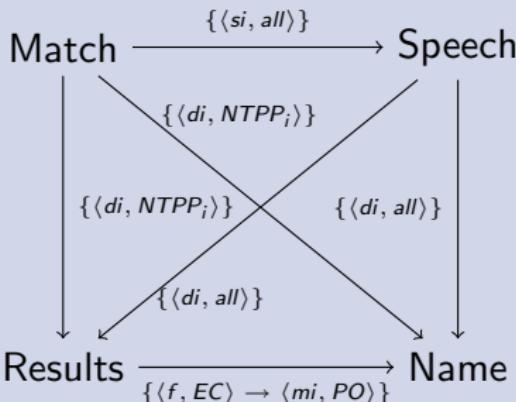


$$distance = 0 + 3 + 3 + 0 + 0 + (0 + 0)$$

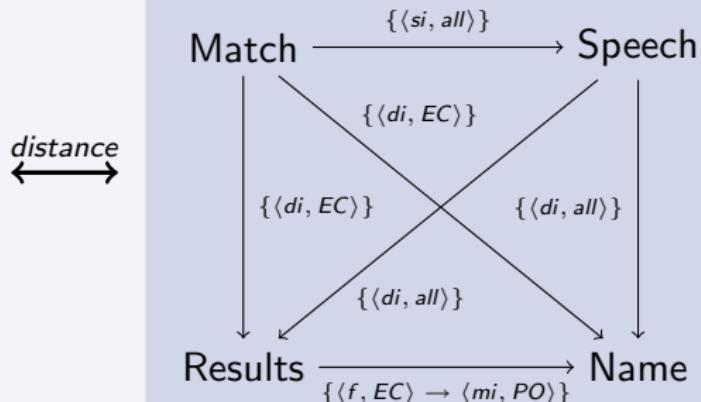
Example

- Compute adapted solutions close to the initial document.
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 - $distance = \sum_{i=1}^n \sum_{j=1}^m \delta(r_i^j, p_i^j)$.

Initial relation graph



Consistent possible relation graph



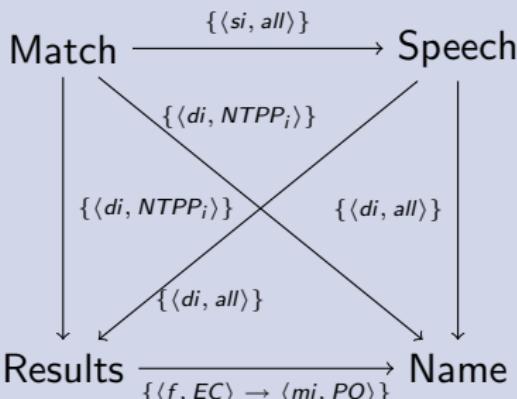
$distance$

$$distance = 0 + 3 + 3 + 0 + 0 + (0 + 0) = 6$$

Example

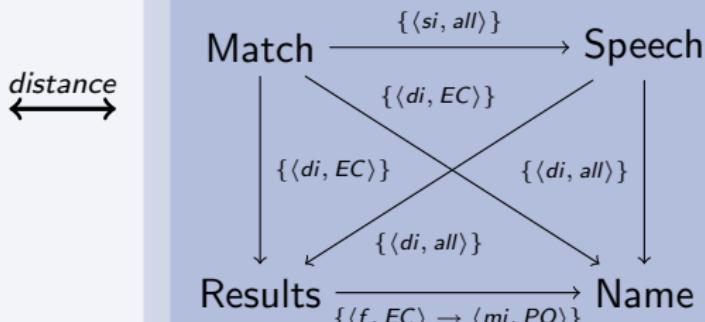
- Compute adapted solutions close to the initial document.
 - Generate consistent possible relation graphs.
 - $distance = \sum_{i=1}^n \sum_{j=1}^m \delta(r_i^j, p_i^j)$.

Initial relation graph



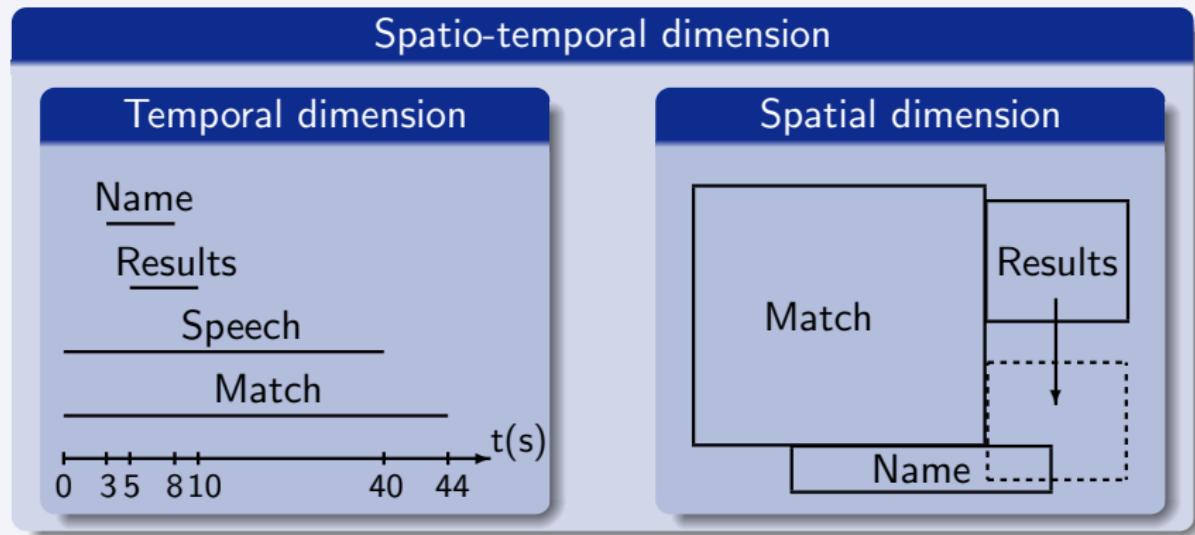
Consistent possible relation graph

An adapted solution



$$distance = 0 + 3 + 3 + 0 + 0 + (0 + 0) = 6 \text{ (minimal)}$$

A possible adapted execution



Outline

1 Spatio-temporal proximities

- Specify a qualitative spatio-temporal representation
- Define spatio-temporal proximities

2 The case of animated documents

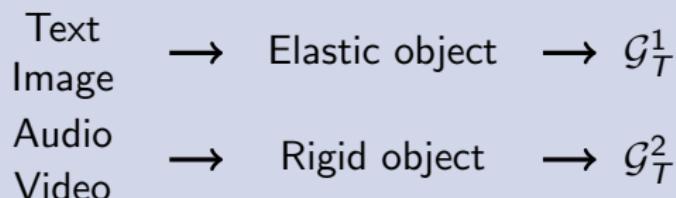
3 Refining the spatio-temporal proximities

4 Conclusion

Multimedia object properties

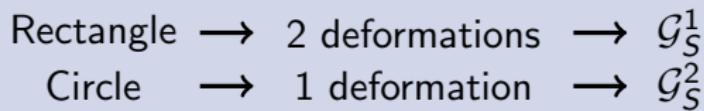
Temporal properties

Media Type :

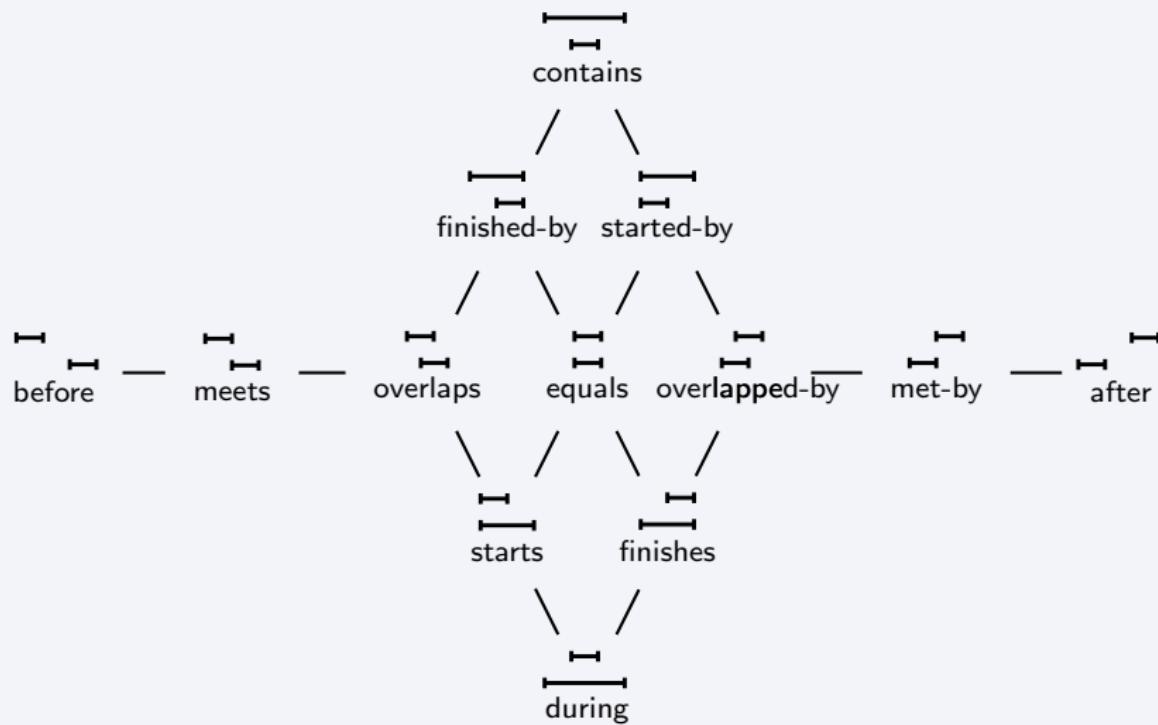


Spatial properties

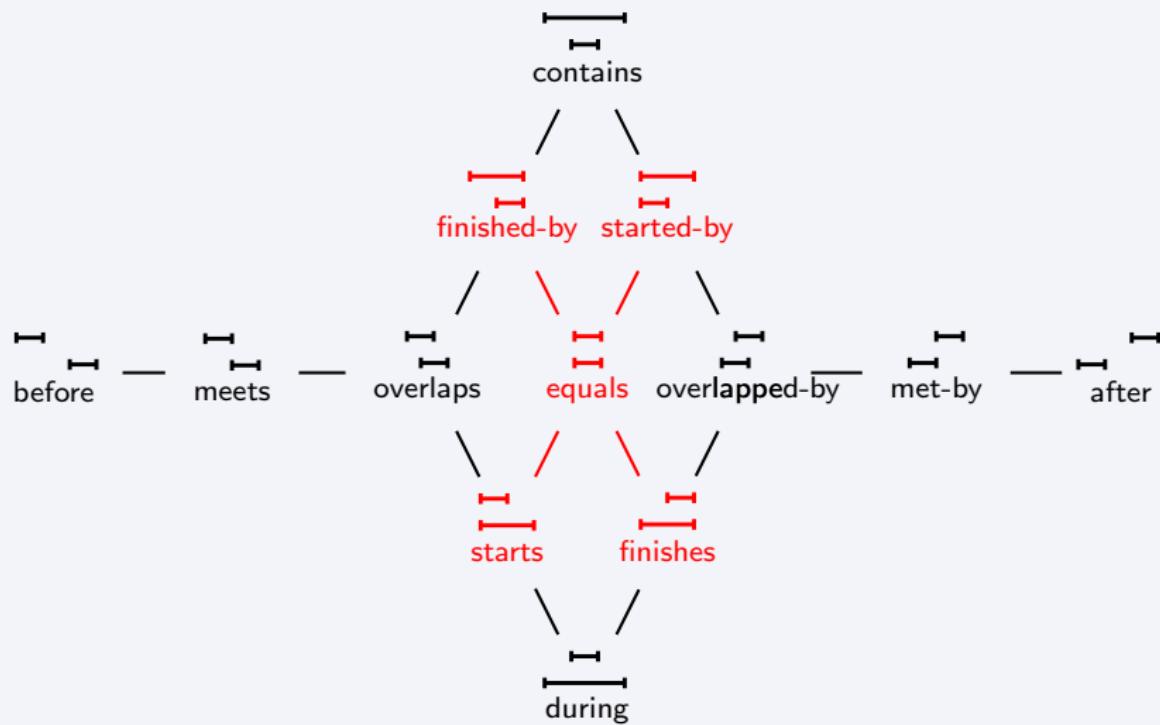
Shape :



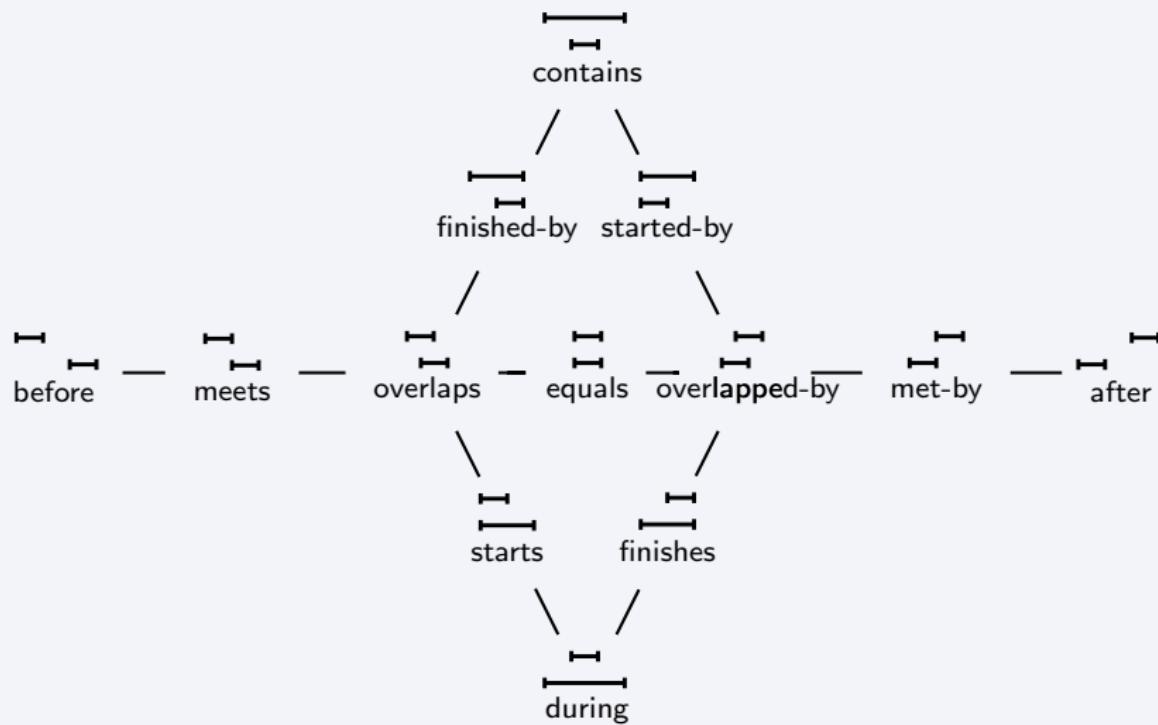
Temporal proximities for elastic objects



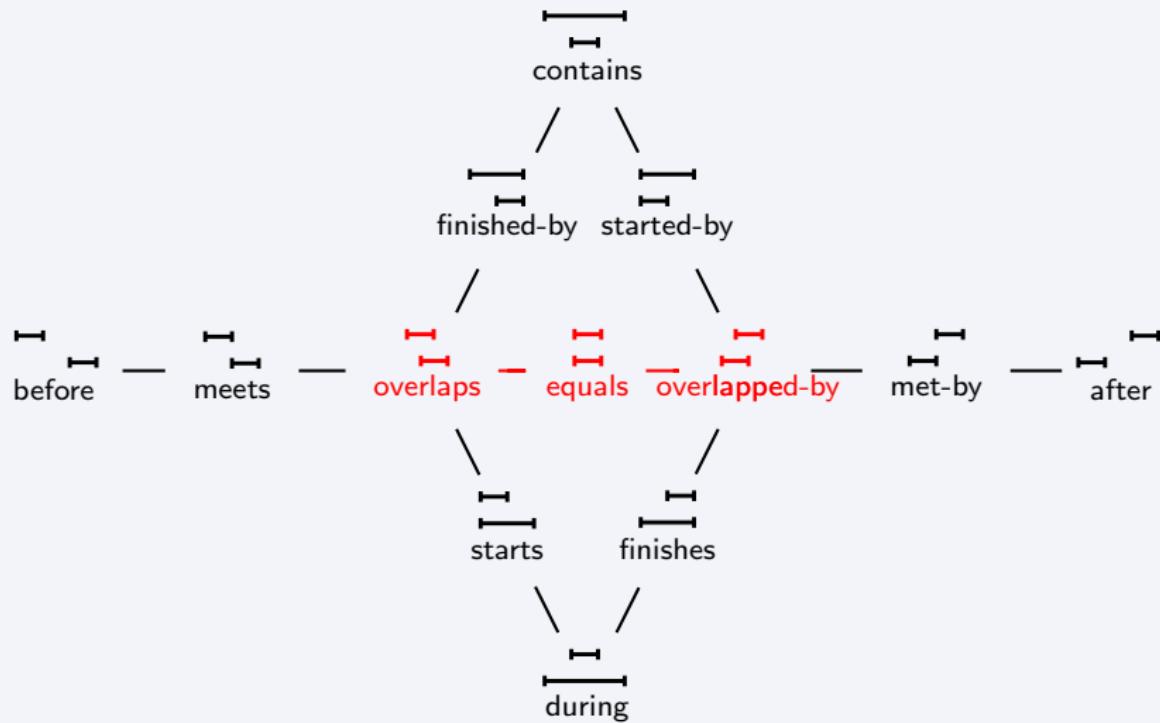
Temporal proximities for elastic objects



Temporal proximities for rigid objects



Temporal proximities for rigid objects

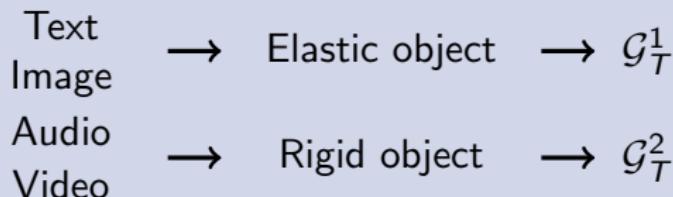


Multimedia object properties

The adaptation is refined by selecting appropriate proximities.

Temporal properties

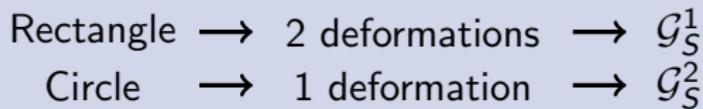
Media Type :



$$\mathcal{G}_T^i \times \mathcal{G}_S^j$$

Spatial properties

Shape :



Outline

1 Spatio-temporal proximities

- Specify a qualitative spatio-temporal representation
- Define spatio-temporal proximities

2 The case of animated documents

3 Refining the spatio-temporal proximities

4 Conclusion

Conclusion and future works

Conclusion :

- Spatio-temporal proximities.
- Spatio-temporal adaptation (static and animated documents).
- Refining the spatio-temporal proximities.

Future Works :

- Adapt other multimedia dimensions (e.g., interactive dimension).
- Adapt standard multimedia description languages (e.g., SMIL).

Questions ?

Thank you for your attention !

sebastien.laborie@inrialpes.fr