


**A NOVEL TEMPORAL
VISUALIZATION
FRAMEWORK FOR
RELATIONAL EVENT
REPRESENTATION**

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OUTLINE

- Temporal Logics
 - Visualization of events
 - Relations between events
 - Natural Language Processing
 - TimeML
- 

PURPOSE

This study focuses on the visualization of events from natural language texts.

Temporal logics are researched and extensions are suggested.

TimeML has been selected as a computable temporal logic.

Logic Levels:

Zero Order Logic

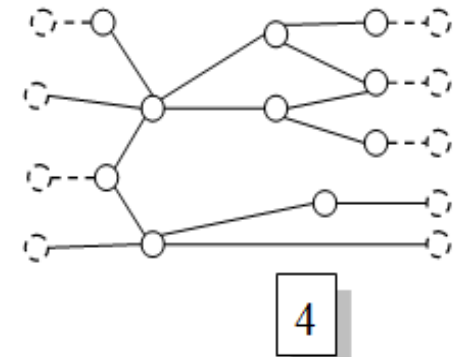
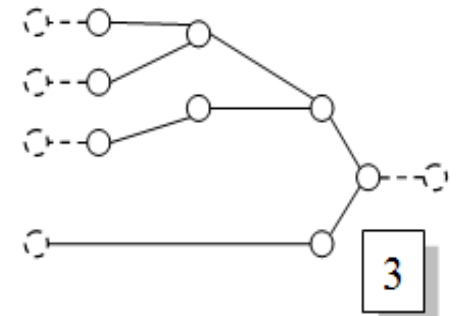
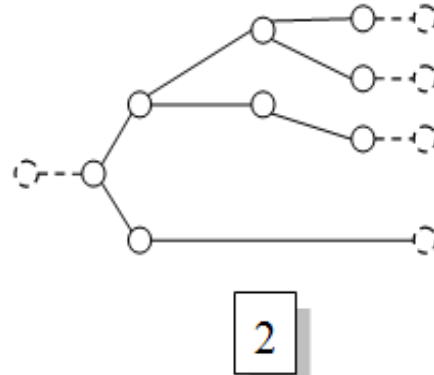
First Order Logic

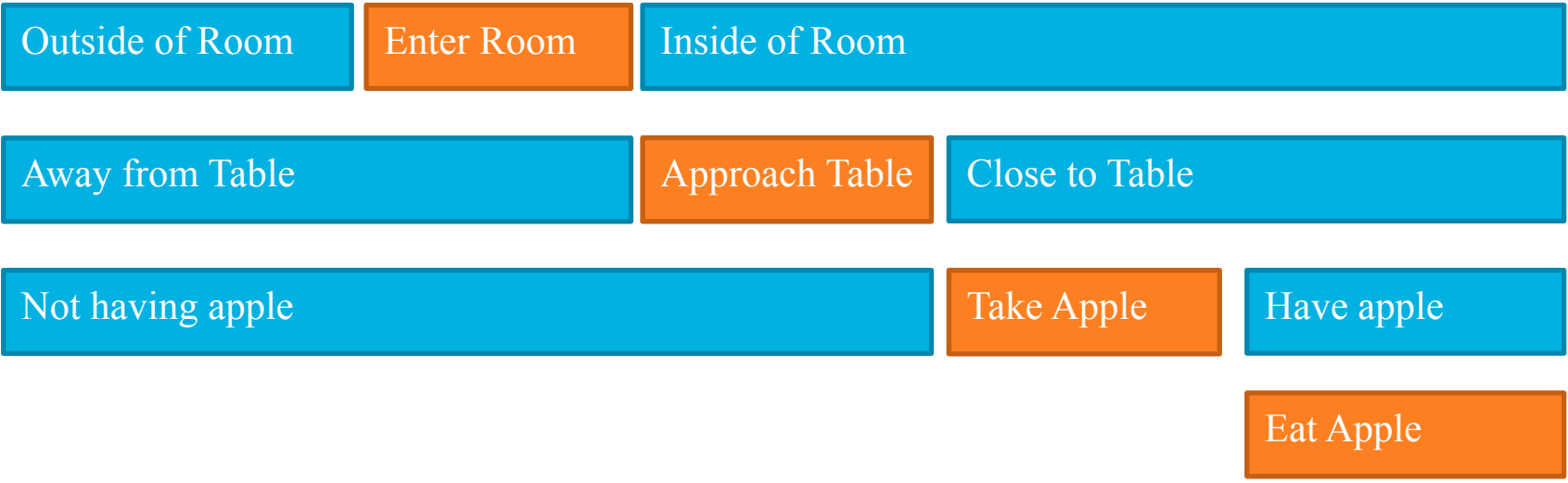
Second Order Logic



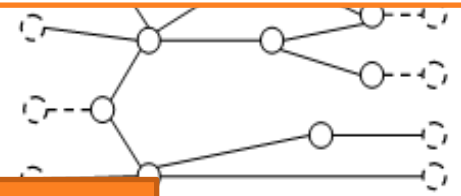
ALLEN'S TEMPORAL LOGIC (INTERVAL LOGIC)

- Linearity of timeline
- Sequence of events
- States depending on

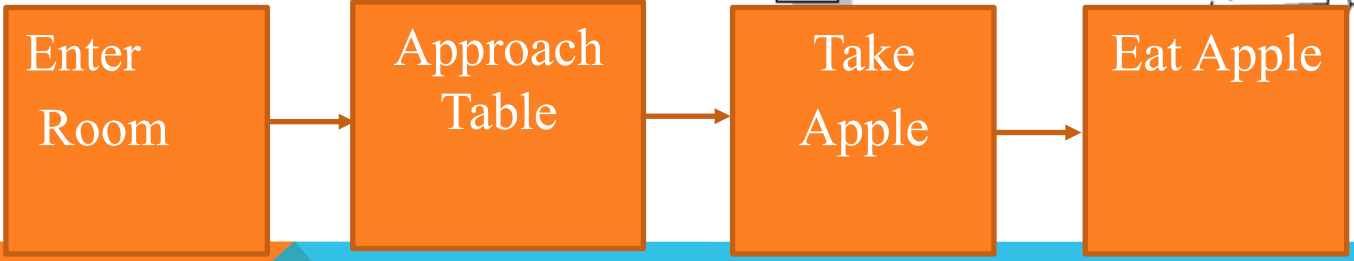




“John ate an apple at the table after he entered the room”



4



ALLEN'S INTERVAL LOGIC

- Before (x,y) or After (y,x)
- Overlaps (x,y) or Overlapped (y,x)
- Meets (x,y) or MetBy (y,x)
- Contains (x,y) or During (x,y)
- Starts (x,y) or StartedBy(y,x)
- Ends (x,y) or EndedBy (y,x)
- Equals (x,y)

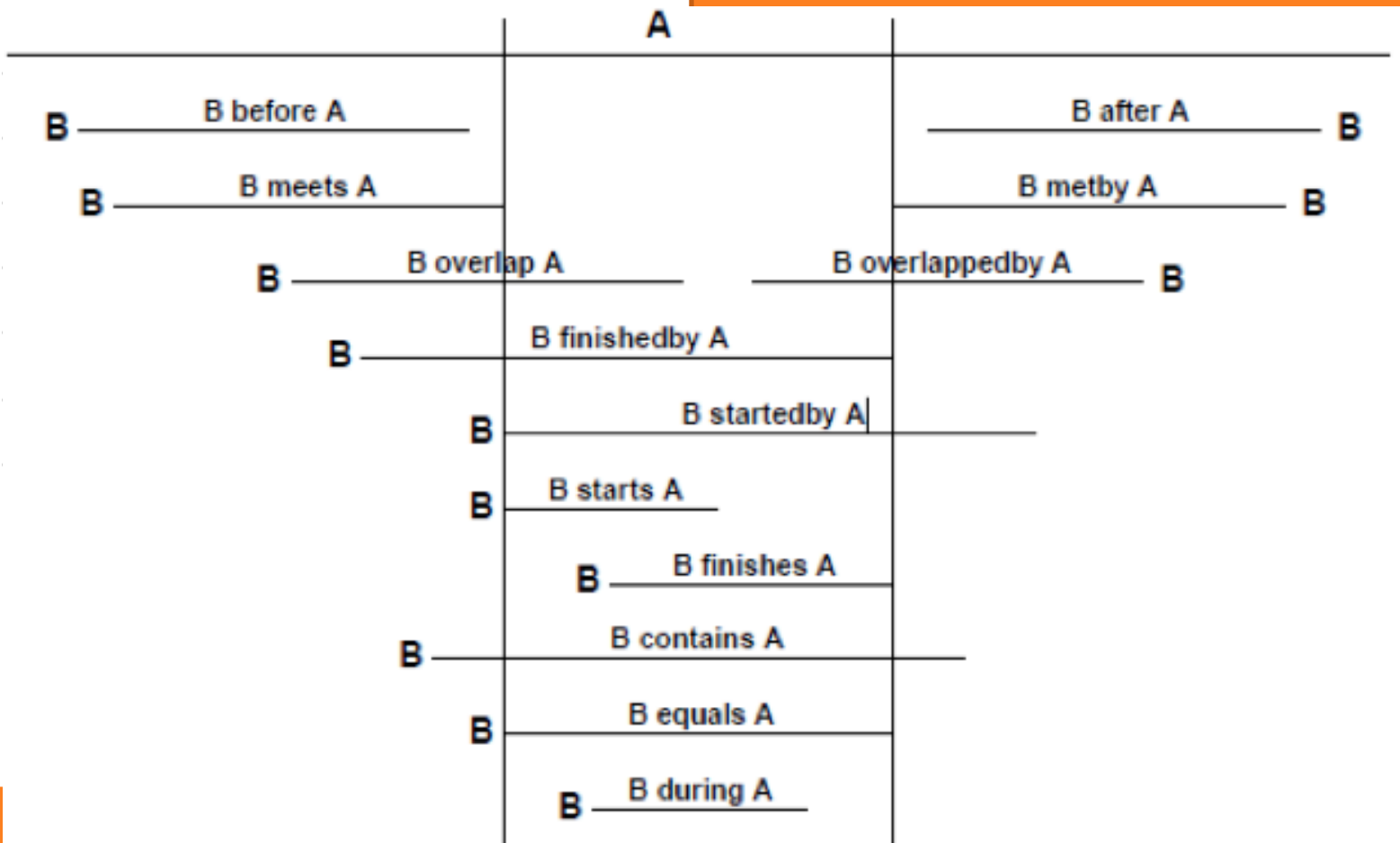
Entering room (ER) requires us to be outside of the room (OR); after entering the room, the state is inside the room (IR) and similarly, approaching the table (AT) changes the state of being away from the table (SAT) to the state of being close to the table (SCT). Taking the apple (TA) is a transformation of state from not having the apple (NHA) to having the apple (HA). All these states are pre-requirements in the case of eating the apple (EA).

$$\text{Meets(OR,ER)} \wedge \text{Meets(ER,IR)} \wedge \text{During(ER,SAT)} \wedge \text{During(AT,IR)} \wedge \text{Meets(SAT,AT)} \wedge \text{Meets(AT,SCT)} \wedge \text{During(AT,NHA)} \wedge \text{During(TA,IR)} \wedge \text{During(TA,SCT)} \wedge \text{Meets(NHA,TA)} \wedge \text{Meets(TA,HA)} \wedge \text{During(EA,HA)} \wedge \text{During(EA,CT)} \wedge \text{During(EA,IR)} \wedge \text{Meets(TA,EA)}$$

ALLEN'S INTERVAL LOGIC

Entering room (ER) requires us to be outside of the room (OR); after entering the room, the state is inside the room (IR) and similarly,

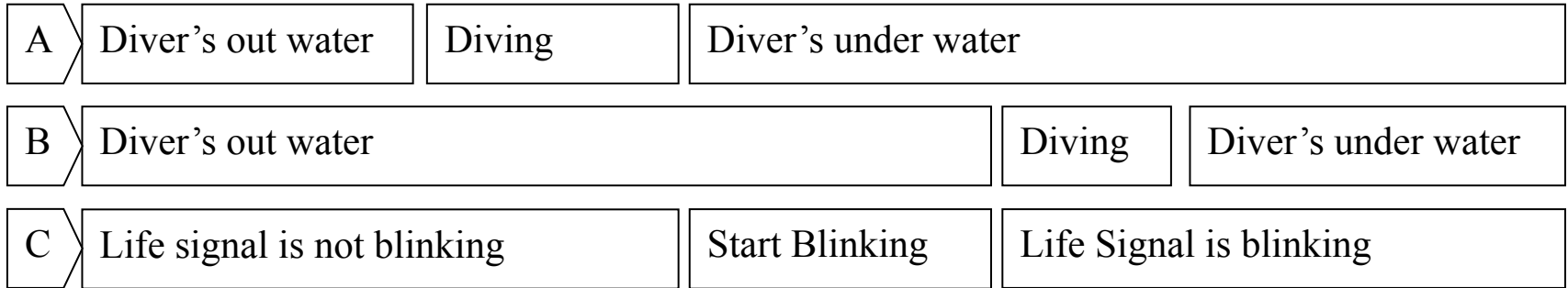
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apple



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AT) ^

RECURRING EVENTS

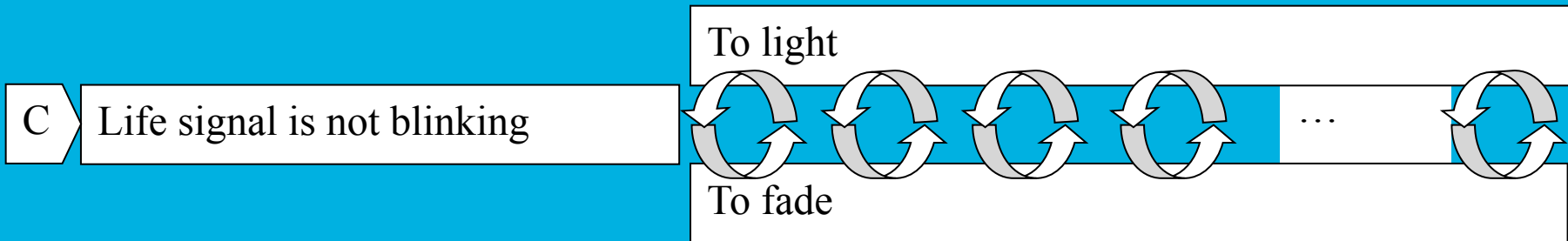
“The life signal on the safety buoy was blinking while the divers were under water.”



Blinking = To Light + To Fade

A Diver's out water Diving Diver's under water

B Diver's out of water Diving Diver's under water



C Life signal is not blinking Start Blinking Life Signal is blinking

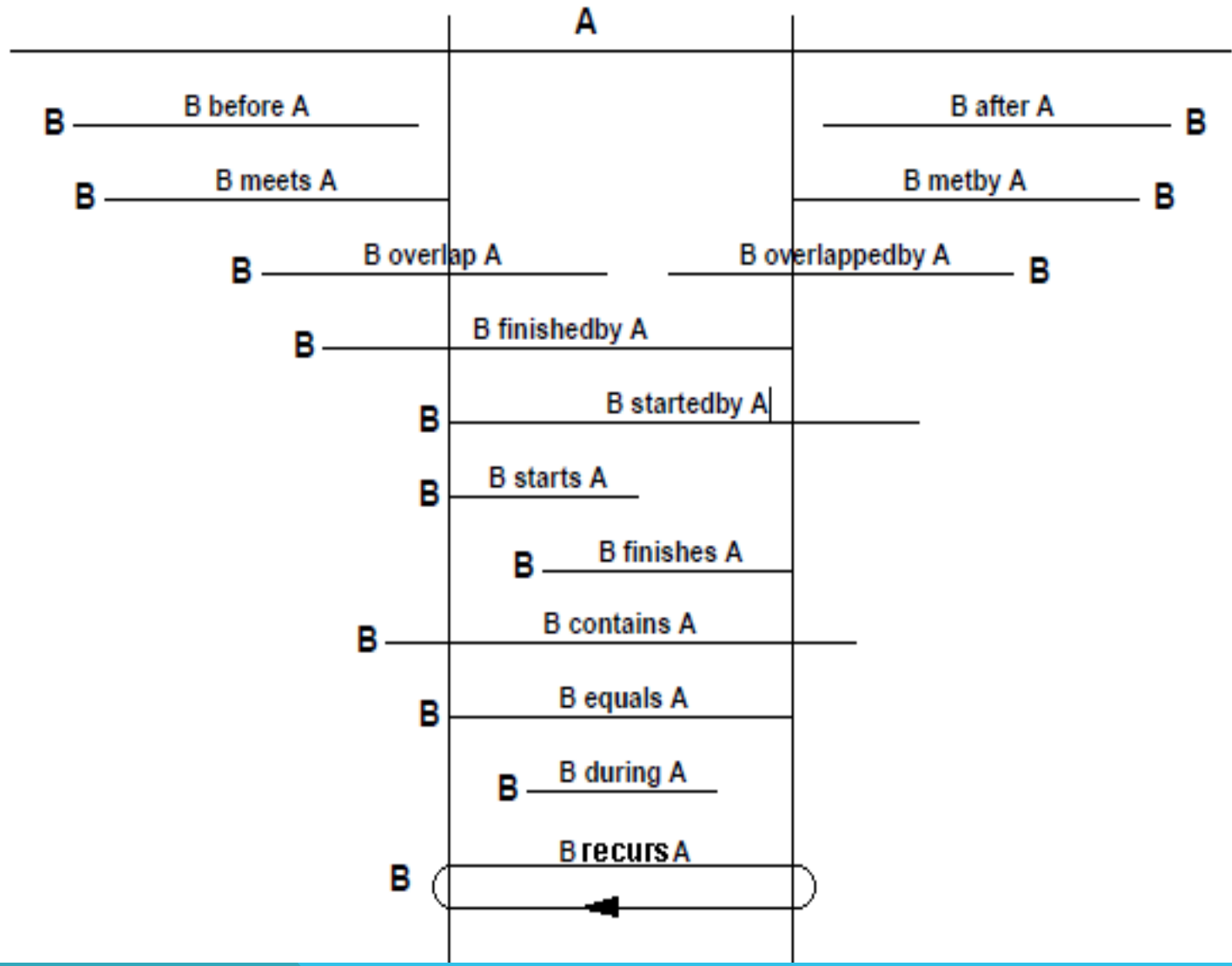
Blinking = To Light + To Fade

A Diver's out water Diving Diver's under water

B Diver's out water

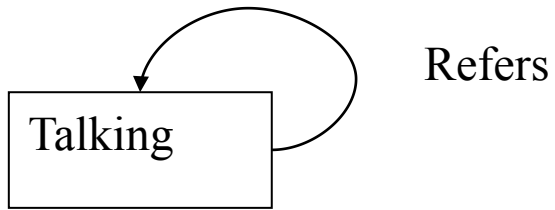
C Life span

C Life span



SELF REFERENCE

“My current talk is about temporal logic.”



NEVER OCCURRING EVENTS

- When do you play tennis?
- Never!"

"I never take notes when I attend classes."

During

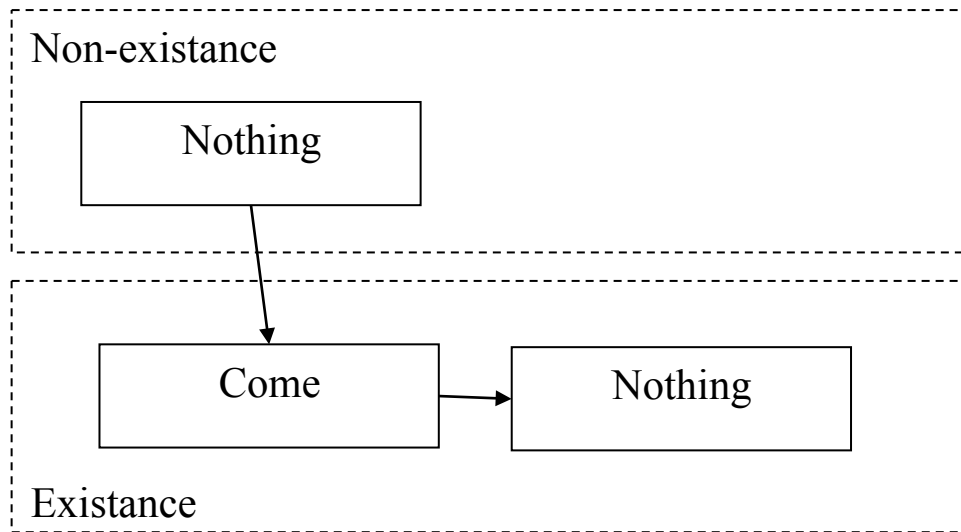
Attend Classes

Negative

Take Notes

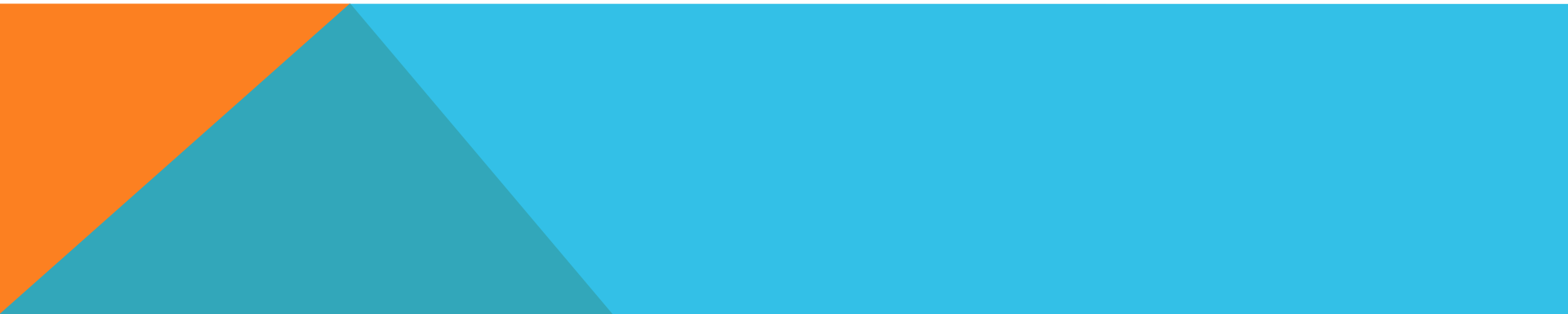
VISUALISATION OF NOTHING

“Nothing comes from nothing”, Parmenides



REICHENBACH TEMPORAL LOGIC

- 13 possible relation
- Logic mainlu focuses on natural language processing



REICHENBACH TEMPORAL LOGIC

- 13 poss
- Logic m

Permutation	Reichenbach Tense Name	English Tense	Sample
E<R<S	Anterior past	Past perfect	I had slept
E=R<S	Simple past	Simple past	I slept
R<E<S			
R<S=E	Posterior past		I would sleep
R<S<E			
E<S=R	Anterior present	Present perfect	I have slept
S=R=E	Simple present	Simple present	I sleep
S=R<E	Posterior present	Simple future	I will sleep
S<E<R			
S=E<R	Anterior future	Future perfect	I will have slept
E<S<R			
S<R=E	Simple future	Simple future	I will sleep
S<R<E	Posterior future		I shall be going to sleep

REICHENBACH TEMPORAL LOGIC

- 13 possible permutations
- Logic model

Permutation	Reichenbach Tense Name	English Tense	Sample
E<R<S	Anterior past	Past perfect	I had slept
E=R<S	Simple past	Simple past	I slept
R<E<S			
R<S=E	Posterior past		I would sleep
		Present perfect	I have slept
		Simple present	I sleep
		Simple future	I will sleep
S<E<R			
S=E<R	Anterior future	Future perfect	I will have slept
E<S<R			
S<R=E	Simple future	Simple future	I will sleep
S<R<E	Posterior future		I shall be going to sleep

In Turkish there are two types of past tenses. "Learnt" and "Story"



Relation	Sample	Translation to English	Relation	Sample	Translation to English
ST,E<R<S	Dün Geleceğim dedi	He said the has already come yesterday	LR,S=R=E	Geliyorum diyor	He is telling that he is coming
LR,E<R<S	Dün Geleceğim demişti	He had said the has already come yesterday	ST,S= R<E	Şimdiye dönecek	He will return now
ST,E=R<S	Geliyorum dedi	He said he is coming	LR,S= R<E	Şimdiye dönecek	He will return now
LR,E=R<S	Geliyorum demiş	He has said he is coming	ST,S<E<R	Geleceğim diyecek	He will say he will come
ST,R<E<S	Geleceğim dedi	He said he will come	LR,S<E<R	Geleceğim diyecek	He will say he will come
LR,R<E<S	Geleceğim demiş	He has said he will come	ST,S=E<R	Geleceğim diyor	He is saying he will come
ST,R<S=E	Geldim diyor	He is saying that he came	LR,S=E<R	Geleceğim diyor	He is saying he will come
LR,R<S=E	Geldim diyor		ST,E<S<R	Yarın geleceğini söyledi	He said, he will come tomorrow
ST,R<S<E	Geldim diyecek		LR,E<S<R	Yarın geleceğini söylemişti	He said, he will come tomorrow
LR,R<S<E	Geldim diyecek		ST,S<R=E	Geliyorum diyecek	He will say that he will come
ST,E<S=R	Şimdi döneceğini söyledi		LR,S<R=E	Geliyorum diyecek	He will say that he will come
LR,E<S=R	Şimdi döneceğini söylemişti		ST,S<R<E	Geldim diyecek	He will say that he has come
ST,S=R=E	Geliyorum diyor		LR,S<R<E	Gelmişim diyecek	He will say that he has been come

Sample

ad slept
lept

ould sleep

ave slept

leep
will sleep

will have slept

will sleep


will be going to sleep

—

VISUALIZATION TOOL HOLDING ALL THE EXTENSIONS

File Language Help

Palette



Query Panel

First box

Second box

Properties

Name

Id

X

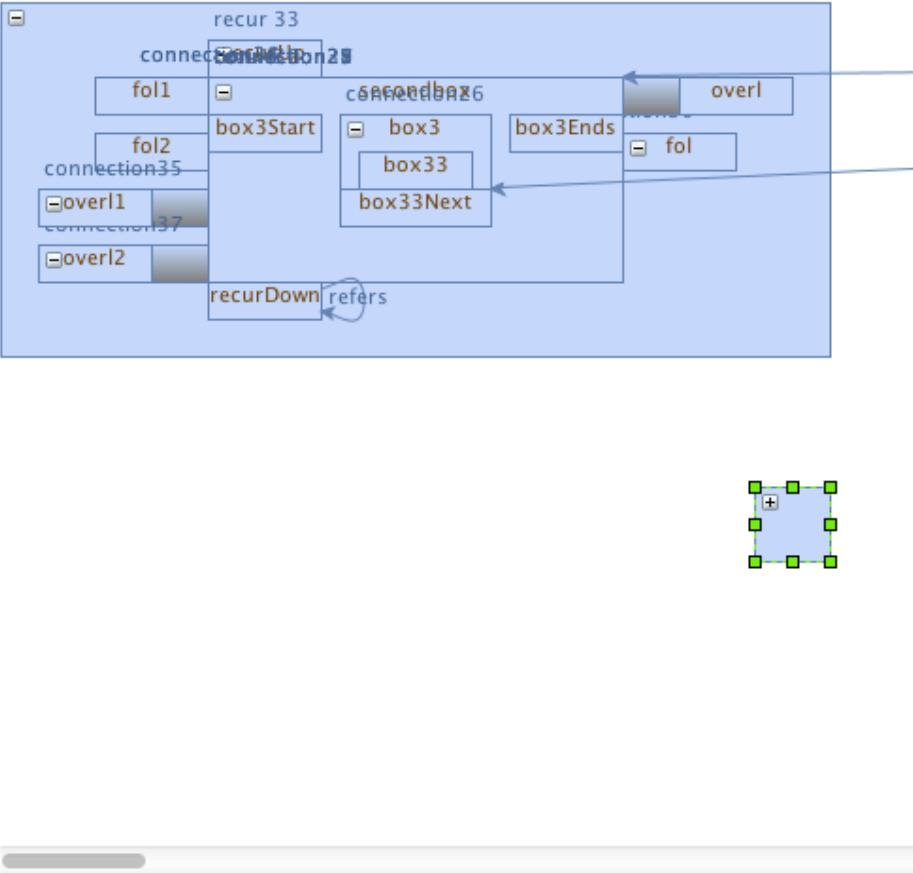
Width

Y

Height

Type

Create self reference



CONCLUSION

4 new visualization possibilities suggested

Increase on the visualization possibility of Events from 18% 100% for Turkish corpus.



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