

# Temporal Knowledge Acquisition and Modeling

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EKAU 2010 - Knowledge Engineering and Knowledge Management by the Masses

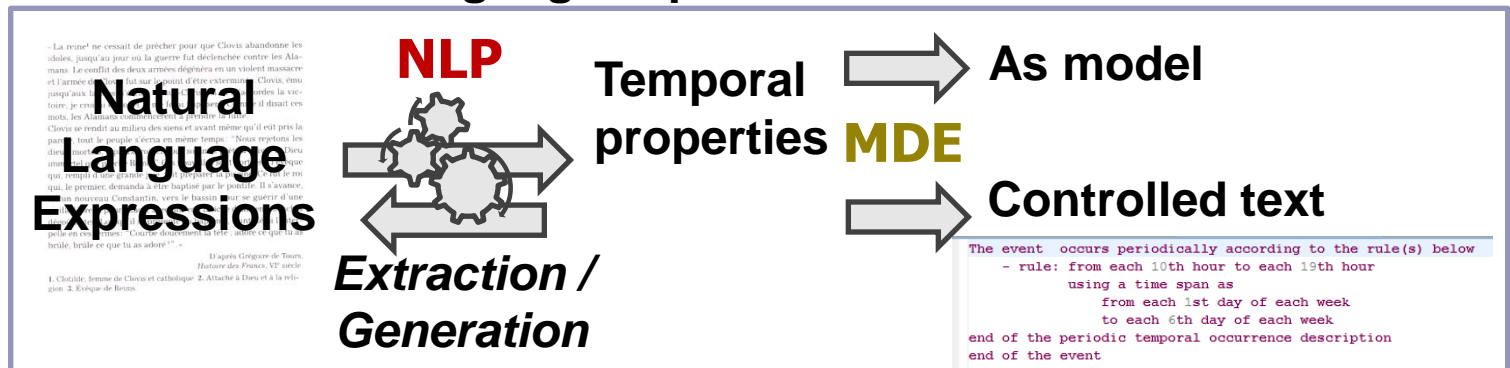
11th October-15th October 2010 - Lisbon, Portugal

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# Introduction

- **Context:** Leisure and cultural event programming (festival, theater, etc.) & opening dates and hours (restaurant, exhibition, museums)
- **Contrib:** Temporal Knowledge Acquisition and Modeling Chain
  - From natural language expressions to controlled text



- Facilitating the work of human operators for acquisition of temporal properties/knowledge about “Access Periods”
- **NLP & MDE techniques**
  - Natural Language Processing
  - Model Driven Engineering

# From Natural Language Expressions to Controlled text

## ● Natural language expressions

- (1) *The museum is open every day except Tuesday and the following French holidays: December 25, January 1, May 1, and August 15. Opening hours: Monday, Thursday, Saturday, Sunday: from 9 a.m. to 6 p.m. Wednesday, Friday: from 9 a.m. to 10 p.m.*
- (2) *Opening times: Monday to Friday: Lunch (12 noon to 2 p.m.) Dinner (6.30 p.m. to 11 p.m.). Saturday: Dinner (6.30 p.m. to 11 p.m.)*
- (3) *Opened every day from 10:00 to 18:00, except Tuesdays.*

## ● Controlled text (close to natural language)

- is constrained by a grammar
- can be interpreted by a machine

```
The event occurs periodically according to the rule(s) below
- rule: from each 12th hour
      to each 14th hour
using a time span as from each Monday
      to each Friday
- rule: from each 30th minute of each 18th hour
      to each 23th hour
using a time span as from each Monday
      to each Friday
end of the periodic temporal occurrence description
end of the event
```

```
The event occurs periodically according to the rule(s) below
- rule: from each 30th minute of each 18th hour
      to each 23th hour
using a time span as from each Saturday
      to each Saturday
end of the periodic temporal occurrence description
end of the event
```

# Temporal knowledge

- **Temporal knowledge is expressed as a set of intensional expression**
  - *Opening times: Monday to Friday: Lunch (12 noon to 2 p.m.) Dinner (6.30 p.m. to 11 p.m.). Saturday: Dinner (6.30 p.m. to 11 p.m.)*
- **Translation into extension for visualization/control tasks**
  - extension / concrete dates: closed on Sunday = closed Sunday 2010-09-19, closed Sunday 2010-09-26, closed Sunday 2010-10-03



# Detailed workflow

The screenshot displays the 'Access Period Annotator' software interface. On the left, a 'Text input frame' contains the text: 'Opening times: Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm. Saturday, from 6.30pm to 11pm.' Below this frame, the language is set to 'en', and there are 'show annotation' and 'validate' buttons. The 'Data Export' section includes an 'export format' dropdown set to 'owl', and date pickers for 'start date' and 'end date' both set to 'Sep 27 2010'. An 'export' button is located at the bottom of this section.

The right side of the interface shows a calendar view for the week of September 27, 2010, to October 3, 2010. The calendar grid shows opening times as green blocks labeled 'OPENED'. The blocks are present for Monday through Friday from 12 pm to 2 pm, and from 6 pm to 11 pm. Saturday has a block from 6 pm to 11 pm. The Sunday column (Oct 3) is highlighted in red, indicating no opening times. The time slots on the y-axis range from 10 am to 11 pm.

Time	Mon, Sep 27	Tue, Sep 28	Wed, Sep 29	Thu, Sep 30	Fri, Oct 1	Sat, Oct 2	Sun, Oct 3
10 am							
11 am							
noon	OPENED	OPENED	OPENED	OPENED	OPENED		
1 pm	OPENED	OPENED	OPENED	OPENED	OPENED		
2 pm							
3 pm							
4 pm							
5 pm							
6 pm	OPENED	OPENED	OPENED	OPENED	OPENED	OPENED	
7 pm	OPENED	OPENED	OPENED	OPENED	OPENED	OPENED	
8 pm							
9 pm							
10 pm							
11 pm							



# Detailed workflow

The screenshot shows the 'Access Period Annotator' interface. At the top, a text input frame contains the text: "Opening times: Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm. Saturday, from 6.30pm to 11pm." Below this, an 'Annotation Result' window displays the processed output. A large arrow points from the text input frame to the annotation result window, with the text "Automatic annotation (Unitex patterns) + post-treatment to lift ambiguities" written next to it. The annotation result window shows two entries, each starting with ">>>>>> ACCESS PERIOD <<<<<<<" followed by the original text and a structured list of fields: "OPENED:", "FROM:", "SPECIFICATION:", "TO:", "hour:", "minute:", and "second:". The first entry corresponds to the Monday-Friday period, and the second to the Saturday period. To the right of the annotation result window is a calendar grid for the week of September 28 to October 3, 2010. The grid shows time slots from 10 am to 11 pm. Green blocks labeled "OPENED" are present in the 12 pm to 2 pm slot for Monday-Friday and the 6 pm to 11 pm slot for Saturday. A red vertical bar is visible on the right side of the calendar grid, indicating a selected or highlighted period.

Access Period Annotator

Opening times: Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm. Saturday, from 6.30pm to 11pm.

**Text input frame**

Annotation Result

>>>>> ACCESS PERIOD <<<<<<<  
"Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm."  
OPENED:  
FROM:  
day\_of\_week:monday  
TO:  
day\_of\_week:friday  
SPECIFICATION:  
FROM:  
hour:12  
TO:  
hour:14  
SPECIFICATION:  
FROM:  
hour:18 minute:30  
TO:  
hour:23

>>>>> ACCESS PERIOD <<<<<<<  
"Saturday, from 6.30pm to 11pm."  
OPENED:  
day\_of\_week:saturday  
SPECIFICATION:  
FROM:  
hour:18 minute:30  
TO:  
hour:23

**Automatic annotation (Unitex patterns) + post-treatment to lift ambiguities**

**Annotations**

2010 Mon, Sep Tue, Sep 28 Wed, Sep Thu, Sep 30 Fri, Oct 1 Sat, Oct 2 Sun, Oct 3

10 am  
11 am  
noon  
1 pm  
2 pm  
3 pm  
5 pm  
6 pm  
7 pm  
9 pm  
10 pm  
11 pm

OPENED OPENED OPENED OPENED OPENED  
OPENED OPENED OPENED OPENED OPENED

# Detailed workflow

Access Period Annotator

Opening times: Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm. Saturday, from 6.30pm to 11pm.

### Text input frame

2010	Mon, Sep	Tue, Sep 28	Wed, Sep	Thu, Sep 30	Fri, Oct 1	Sat, Oct 2	Sun, Oct 3
10 am							
11 am							
noon	OPENED	OPENED	OPENED	OPENED	OPENED		
1 pm							
2 pm							
3 pm							
4 pm							
5 pm							
6 pm							
7 pm	OPENED	OPENED	OPENED	OPENED	OPENED	OPENED	
8 pm							
9 pm							
10 pm							
11 pm							

### Annotation Result

```
>>>>> ACCESS PERIOD <<<<<<
"Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm."
OPENED:
FROM:
day_of_week:monday
TO:
day_of_week:friday
SPECIFICATION:
FROM:
hour:12
TO:
hour:14
SPECIFICATION:
FROM:
hour:18 minute:30
TO:
hour:23

>>>>> ACCESS PERIOD <<<<<<
"Saturday, from 6.30pm to 11pm."
OPENED:
day_of_week:saturday
SPECIFICATION:
FROM:
hour:18 minute:30
TO:
hour:23
```

Annotations

### Serialization in XMI/XML

```
<?xml version="1.0" encoding="ASCII"?>
<xml:XML xmlns:xmi="2.0" xmlns:xmns="http://www.omg.org/XMI" xmns:accessperiod="http://accessperiod1.0">
  <accessperiod:AccessPeriod label="Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm."
    <base xmi:type="accessperiod:CalendarExpressionInterval">
      <start dayOfWeek="11">
        <end dayOfWeek="5"/>
      </start>
    </accessperiod:CalendarExpressionInterval>
    <start hour="12">
      <end hour="14">
    </start>
    </specification>
    </specification xmi:type="accessperiod:CalendarExpressionInterval">
      <start minute="30" hour="18">
        <end hour="23">
      </start>
    </specification>
  </accessperiod:AccessPeriod>
  <accessperiod:AccessPeriod label="Saturday, from 6.30pm to 11pm."
    <base xmi:type="accessperiod:CalendarExpression" dayOfWeek="6">
      <specification xmi:type="accessperiod:CalendarExpressionInterval">
        <start minute="30" hour="18">
          <end hour="23">
        </start>
      </specification>
    </accessperiod:AccessPeriod>
</xml:XML>
```

# Detailed workflow

The screenshot displays the 'Access Period Annotator' software interface. At the top, a calendar navigation bar shows the date '2010 Mon, Sep' and a grid of dates from 'Tue, Sep 28' to 'Sun, Oct 3'. The main area is a calendar grid with time slots from 10 am to 11 pm. Green 'OPENED' buttons are placed in the grid, indicating access periods. A red vertical bar is on the right side of the calendar.

**Text input frame**: A text box at the top left contains the text: "Opening times: Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm. Saturday, from 6.30pm to 11pm." An arrow points from this text to the calendar grid.

**Text / Calendar Synchronization**: A large arrow points from the text input frame to the calendar grid, indicating the synchronization process.

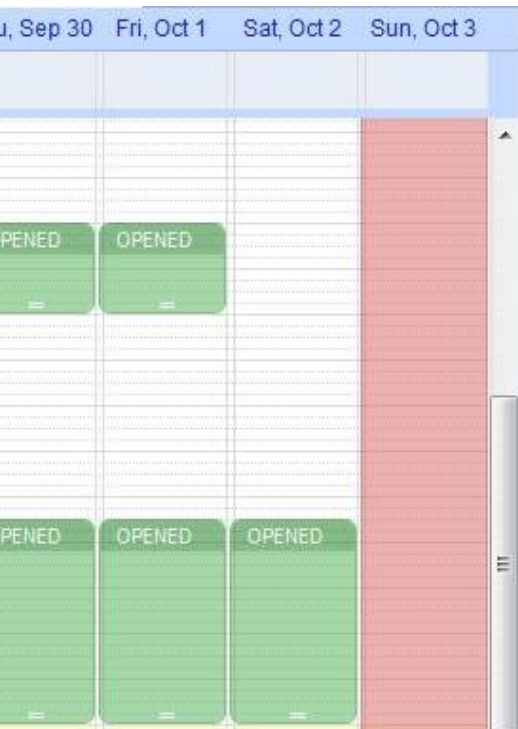
**Annotations**: A window titled 'Annotation Result' shows the following text:  
>>>>> ACCESS PERIOD <<<<<<  
"Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm."  
OPENED:  
FROM:  
day\_of\_week:monday  
TO:  
day\_of\_week:friday  
SPECIFICATION:  
FROM:  
hour:12  
TO:  
hour:14  
SPECIFICATION:  
FROM:  
hour:18 minute:30  
TO:  
hour:23  
  
>>>>> ACCESS PERIOD <<<<<<  
"Saturday, from 6.30pm to 11pm."  
OPENED:  
day\_of\_week:saturday  
SPECIFICATION:  
FROM:  
hour:18 minute:30  
TO:  
hour:23

**Serialization in XMI/XML**: A window titled 'xmi export' shows XML code for the annotations. An arrow points from the 'Annotations' window to this XML window.

**Calendar editing**: A 'Calendar Event Edition' dialog box is open, showing fields for 'Status' (radio buttons for 'Opened' and 'Closed'), 'Start Time' (12:00), 'End Time' (14:00), and 'All day' (checkbox). Buttons for 'save' and 'delete' are at the bottom. An arrow points from the calendar grid to this dialog box.



# Detailed workflow



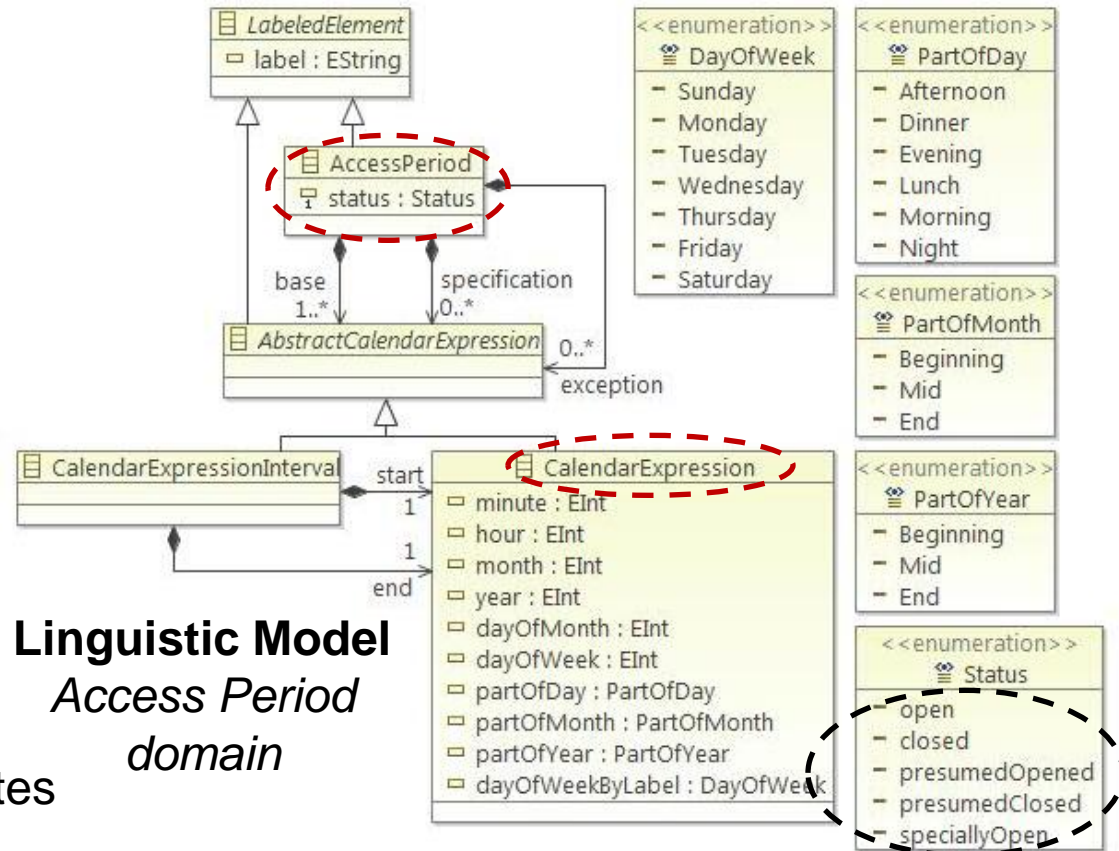
```

xmi export
<?xml version="1.0" encoding="ASCII"?>
<xml:XML xmlns:version="2.0" xmlns:xmi="http://www.omg.org/XMI" xmlns:accessperiod="http://accessperiod/1.0">
  <accessperiod:AccessPeriod label="Monday to Friday, from 12am to 2pm and from 6.30pm to 11pm.">
    <base xmi:type="accessperiod:CalendarExpressionInterval">
      <start dayOfWeek="1"/>
      <end dayOfWeek="5"/>
    </base>
    <specification xmi:type="accessperiod:CalendarExpressionInterval">
      <start hour="12"/>
      <end hour="14"/>
    </specification>
    <specification xmi:type="accessperiod:CalendarExpressionInterval">
      <start minute="30" hour="18"/>
      <end hour="23"/>
    </specification>
  </accessperiod:AccessPeriod>
  <accessperiod:AccessPeriod label="Saturday, from 6.30pm to 11pm.">
    <base xmi:type="accessperiod:CalendarExpression" dayOfWeek="6"/>
    <specification xmi:type="accessperiod:CalendarExpressionInterval">
      <start minute="30" hour="18"/>
      <end hour="23"/>
    </specification>
  </accessperiod:AccessPeriod>
</xml:XML>
  
```

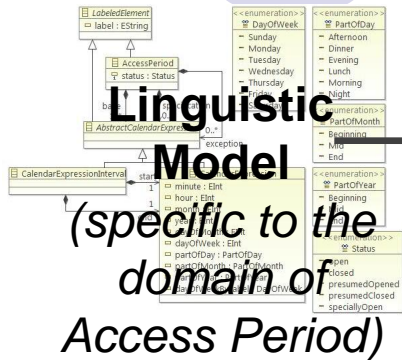
**Serialization in XMI/XML**

populates

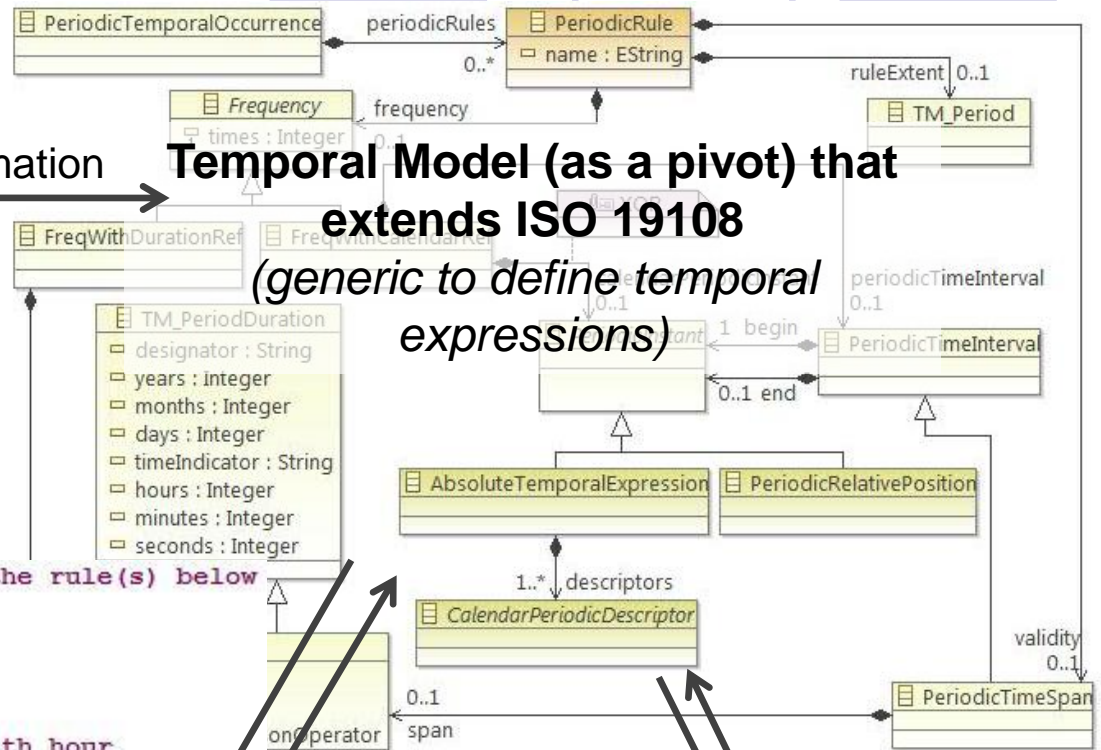
**Linguistic Model  
Access Period  
domain**



# Detailed workflow



model transformation



The event occurs periodically according to the rule(s) below

```

- rule: from each 12th hour
      to each 14th hour
using a time span as from each Monday
      to each Friday
- rule: from each 30th minute of each 18th hour
      to each 23th hour
using a time span as from each Monday
      to each Friday
end of the periodic temporal occurrence description
end of the event
    
```

The textual representation conforms to the grammar defined in Xtext

```

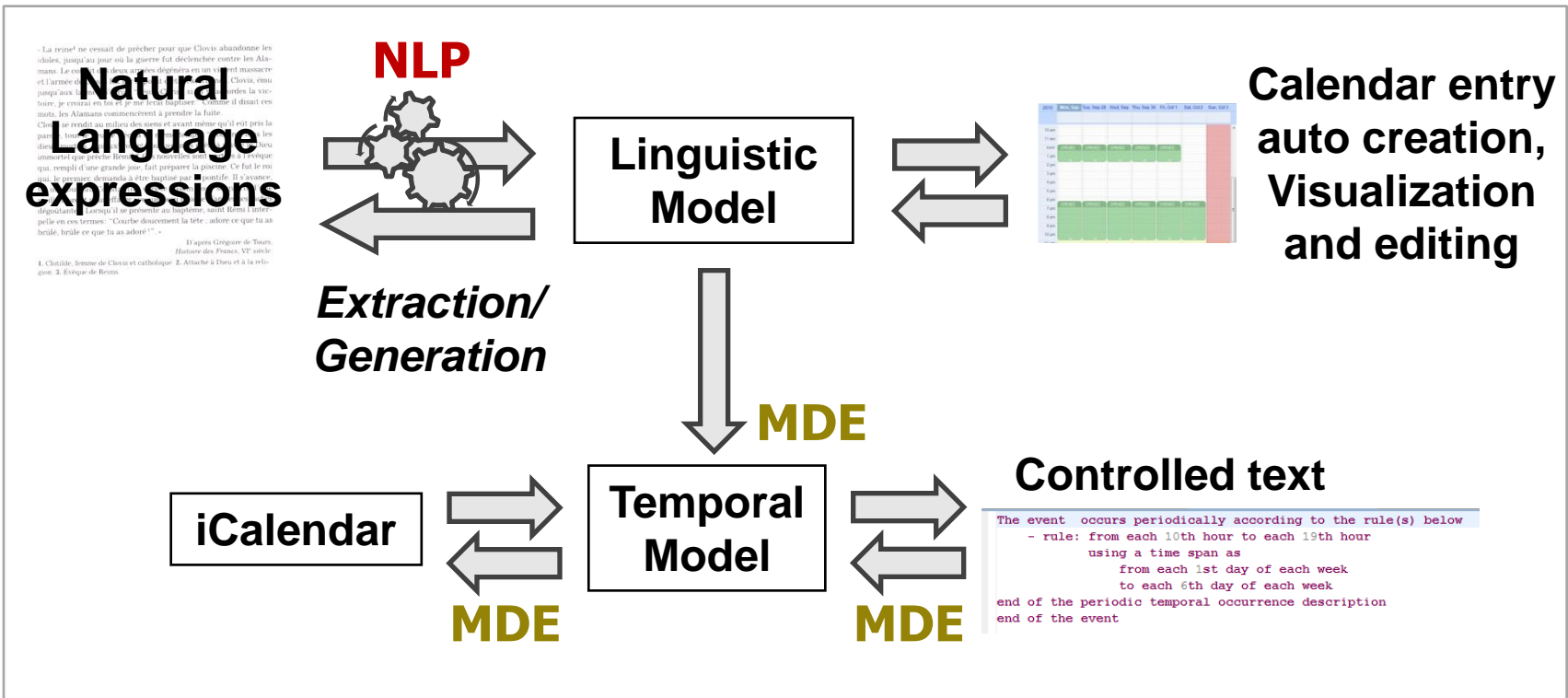
- rule: from each 30th minute of each 18th hour
      to each 23th hour
using a time span as from each Saturday
      to each Saturday
end of the periodic temporal occurrence description
end of the event
    
```

**iCalendar export**

*Temporal data in extension over a time span*

# Conclusions

- **Workflow synthesis**



- **Future work**

- Query engine (upon intensional expressions)