



max planck institut
informatik

Temponym Tagging: Temporal Scopes for Textual Phrases

Erdal Kuzey, Jannik Strötgen, Vinay Setty, Gerhard Weikum

jannik.stroetgen@mpi-inf.mpg.de

TempWeb – Montréal, April 12, 2016

Why temporal information extraction?



Why temporal information extraction?

temporal information is frequent

Greece Makes 'Good Progress' in Payment Talks

By Marc Perrakis and Nikolas

Sep 20, 2011 10:39 PM GMT+0200 [also in Greek](#)

Greek Finance Minister Evangelos Venizelos made "good progress" in a second round of talks with the European Union and International Monetary Fund aimed at staving off default, the EU said.

The telephone talks, which followed a similar session on Monday, were intended to damp concerns that Greece might default on its debt.

The EU statement said a "full mission" will return to Athens next week for discussions in coming days at the IMF's annual meeting in Washington.

Staying in the euro area is an "irreversible and fundamental national choice," Venizelos said in a statement. "We will continue to work to bring the euro area back to a state of sustainable growth and economic recovery," he said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

The EU said it will continue to provide financial assistance to Greece. The next payment for Greece is on track to be made next month, the EU said.

1979 Soviet invasion

October 31, 1979 marks the Afghan Armed Forces premier Brezhnev, relayed information for them to undergo maintenance cycles for their tanks and other crucial equipment.

Meanwhile, telecommunications links to areas outside of Kabul were severed, isolating the capital. With a deteriorating security situation, large numbers of Soviet airborne troops and began to land in Kabul.

Amir moved the offices of the president to the Tajbeg Palace, believing this location to be more secure from possible threats.

According to Colonel General Yuliyevich and Mervinsky, Amir was fully informed of the military movements, having requested Soviet military assistance to northern Afghanistan.

December 17, 1979, the General Dmitry Chugayev, to work out initial routes and locations for Soviet troops.

December 27, 1979, used in Afghan uniforms, including KGB and GRU special forces units to train the Afghan army at Zhetysay, occupied major governmental, military and media buildings in Kabul, including their primary target - the Tajbeg Presidential Palace.

That operation was planned by the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.

December 28, 1979, the KGB-led Soviet Zenth Group destroyed military command and control centers in Kabul.



The Soviet invasion



December 28, 1979



A portrait of Friedrich Georg Wilhelm von Bessel, 1806

Travels and work in Europe

In 1794 he was appointed to the position of professor of astronomy and mathematics at the University of Göttingen.

June 7, 1795 he was appointed to the position of professor of astronomy and mathematics at the University of Göttingen.

the summer of 1795 he was appointed to the position of professor of astronomy and mathematics at the University of Göttingen.

1790 he said a short visit to Göttingen in 1795 he was appointed to the position of professor of astronomy and mathematics at the University of Göttingen.

February 29, 1792, to the state was required to join as any an apprentice to the service of science, he fulfilled his duties with such conspicuous ability that not only did he rise rapidly to the highest post in his department, but he was also entrusted with several important diplomatic missions.

the death of his mother, November 19, 1796, he was appointed to the position of professor of astronomy and mathematics at the University of Göttingen.

The best of his talents, was serving in official connections, he waited for an opportunity to fulfil his long-cherished dream of travel.

News articles.

Narrative documents.

Biographies.

Why temporal information extraction?

temporal information is frequent

Greece Makes 'Good Progress' in Payment Talks

By Marc Perrakis and Nikolas

Sep 20, 2011 10:39 PM GMT+0200 [Add to Outlook](#)

Greek Finance Minister Evangelos Venizelos made "good progress" in a second round of talks with the European Union and International Monetary Fund aimed at staving off default, the EU said.

The telephone talks, which took place on Tuesday, were intended to damp concerns that Greece might not meet its reduction targets and to clear the way for a sixth instalment of €10 billion in EU funds. The EU statement said a "full mission" will return to Athens next week for discussions in coming days at the IMF's annual meeting in Washington.

Staying in the euro area is an "irreversible and fundamental national choice," Venizelos said in a statement. "We are determined to tackle once and for all" the eurozone debt and economic crisis, he said.

The EU said Greece is on track to meet its next payment for Greece is on track to be released next month, after George Papandreou fights

Sept. 20, 2011

1979 Soviet invasion

October 31, 1979 marks the Afghan Armed Forces premier Brezhnev, relayed information for them to undergo maintenance cycles for their tanks and other crucial equipment. Meanwhile, telecommunications links to areas outside of Kabul were severed, isolating the capital. With a deteriorating security situation, large numbers of Soviet airborne troops and began to land in Kabul.

December 25, 1979, the Soviet Union moved the offices of the president to the Tajikistan, believing this location to be more secure from possible threats. According to Colonel General Yakubov and Mervinsky, Amin was fully informed of the military movements, having requested Soviet military assistance to northern Afghanistan. The Soviet Union met with the commander of the 40th Army and the location for Soviet troops.

December 27, 1979, the Soviet Union used in Afghan uniforms, including KGB and GRU special forces units to seize the Tajikistan, occupied major governmental, military and media buildings in Kabul, including their primary target - the Tajik Presidential Palace.

December 28, 1979, the KGB-led Soviet Zentri Group destroyed a military command post in the city of Herat. The operation was planned, president Hafizullah Amin was killed. Six Soviet objectives were destroyed.



The Soviet invasion



A portrait of Friedrich Georg Wilhelm von Bessel, 1806

Travels and work in Europe
 In 1794 he was appointed to the Prussian Academy of Sciences and contributed to the new periodical, Die Horen, a philosophical society created by Leibniz, under the name of the summer of 1790 he said a short visit to the summer of 1792 and 1797 as in Vienna, in 1795 made a general business tour through Switzerland and Italy. He had obtained in the meantime official appointment he undertook an extensive series of trips at Berlin. February 29, 1792, to the state was required to join as an apprentice to the service of science, he fulfilled his duties with such conspicuous ability that not only did he rise rapidly to the highest post in his department, but he was also entrusted with several important diplomatic missions. The death of his mother, November 19, 1796, the best of his genius, was serving in official connections, he waited for an opportunity to fulfil his long-cherished dream of travel.

News articles.

Narrative documents.

Biographies.

temporal information can be normalized
 same semantics → same value

■ "today", "April 12, 2016" → 2016-04-12



Why temporal information extraction?

temporal information is frequent

Greece Makes 'Good Progress' in Payment Talks

By Marc Perrakis and Nikolas

Sep 20, 2011 10:39 PM GMT+0200 [Add to Outlook](#)

Greek Finance Minister Evangelos Venizelos made 'good progress' in a second round of talks with the European Union and International Monetary Fund aimed at staving off default, the EU said.

The telephone talks, which took place on Monday, were intended to damp concerns that Greece might miss its reduction targets and to clear the way for a sixth instalment of emergency funds. The EU statement said a 'full mission' will return to Athens next week for discussions in coming days at the IMF's annual meeting in Washington.

Staying in the euro area is an "irreversible and fundamental national choice," Venizelos said in a statement. "We are determined to tackle once and for all" the euro zone's debt and economic crisis.

The EU said Greece's next payment for Greece is on track to be released next month after George Papandreou fights

1979 Soviet invasion

October 31, 1979 marks the Afghan Armed Forces premier Brezhnev, relayed information for them to undergo maintenance cycles for their tanks and other crucial equipment.

Meanwhile, telecommunications links to areas outside of Kabul were severed, isolating the capital. With a deteriorating security situation, large numbers of Soviet airborne troops and began to land in Kabul.

Amn moved the offices of the president to the Tajbeg Palace, believing this location to be more secure from possible threats. According to Colonel General Yakubov and Murovsky, Amn was fully informed of the military movements, having requested Soviet military assistance to northern

December 27, 1979, used in Afghan uniforms, including KGB and GUR special force units to occupy major government, military and media buildings in Kabul, including their primary target - the Tajbeg Presidential Palace.



That operation was planned, president Hafizullah Amin was killed. Six objectives were destroyed or damaged. The KGB-led Soviet Zenth Group destroyed the Tajbeg Presidential Palace on December 28, 1979.



Travels and work in Europe

In 1794 he was appointed to the position of professor of mathematics and contributed to the work of the Berlin Academy. He was a member of the Prussian Academy of Sciences. In 1795 he made a short visit to the summer of 1790. He had obtained in the meantime official appointment as assistant of physics at Berlin. He fulfilled his duties with such conspicuous ability that not only did he rise rapidly to the highest post in his department, but he was also entrusted with several important diplomatic missions. The death of his mother, November 19, 1796, was a severe blow to him. He was determined to fulfill his long-cherished dream of travel.

News articles.

Narrative documents.

Biographies.

temporal information can be **normalized**
same semantics → same value

- "heute", "aujourd'hui", "today", "April 12, 2016" → 2016-04-12

goal of this work

temporal enrichment of documents



So far addressed: temporal tagging



So far addressed: temporal tagging

two tasks of a temporal tagger

1. extraction of temporal expressions

Greece Makes 'Good Progress' in Payment Talks

By Maria Petrakis and Natalie **Sep 20, 2011 10:39 PM GMT+0200** [ADD TO QUEUE](#)

[Recommend](#) 10

[Tweet](#) 33

[Share](#) 4

[+1](#) 2

[Enlarge image](#)



Evangelos Venizelos, Greece's finance minister, listens to an aide during a

Sep. 20, 2011
Taronis/Bloomberg

Greek Finance Minister Evangelos Venizelos made "good progress" in a second round of talks with the European Union and [International Monetary Fund](#) aimed at staving off default, the EU said.

The telephone meeting **tonight**, which followed **yesterday**, were intended to damp concerns that Greece would miss **reduction targets** and to clear the way for a sixth installment of **IMF** funds. The EU statement said a "full mission" will return to Athens **next week** for discussions in coming days at the IMF's annual meeting in Washington.

Staying in the euro area is an "irreversible and fundamental national choice," Venizelos said in a statement. He **earlier today** warned that the fiscal "data and economic situation are serious" and the euro zone is "determined to tackle once and for all."

The **EL** **next month** payment for Greece is on track to be released, **minister George Papandreou** lights

So far addressed: temporal tagging

two tasks of a temporal tagger

1. **extraction** of temporal expressions
2. **normalization** of temporal expressions

Greece Makes 'Good Progress' in Payment Talks

By Maria Petrakis and Natalie Sep 20, 2011 10:39 PM GMT+0200 [ADD TO QUEUE](#)

[Recommend](#) 10

[Tweet](#) 33

[Share](#) 4

[+1](#) 2

[Enlarge image](#)



Evangelos Venizelos, Greece's finance minister, listens to an aide during a

Taronis/Bloomberg

Greek Finance Minister Evangelos Venizelos made "good progress" in a second round of talks with the European Union and International Monetary Fund aimed at staving off default, the EU said.

The telephone meeting **tonight**, which followed **yesterday**, were intended to damp concerns that Greece would miss **next week** reduction targets and to clear the way for a sixth installment of rescue funds. The EU statement said a "full mission" will return to Athens for **next week** discussions in coming days at the IMF's annual meeting in Washington.

Staying in the euro area is an "irreversible and fundamental national choice," Venizelos said in a statement. "We will continue to work with the euro area to ensure that the fiscal, labor and economic reforms are implemented. The euro area is determined to tackle once and for all."

The European Commission's **next month** payment for Greece is on track to be released **next month**, Finance Minister **George Papandreu** lights

tonight → **2011-09-20TNI**

yesterday → **2011-09-19**

next week → **2011-W39**

Sept. 20, 2011 → **2011-09-20**

next month → **2011-10**

So far addressed: temporal tagging

Addressed types of temporal expressions

TimeML standard:

[Pustejovsky et al. '10]

- **dates** (“May 1, 2015”, “today”)
- **times** (“9 pm”, “last night”)
- **durations** (“three years”)
- **set expressions** (“twice a day”)

So far addressed: temporal tagging

Addressed types of temporal expressions

TimeML standard:

[Pustejovsky et al. '10]

- **dates** (“May 1, 2015”, “today”)
- **times** (“9 pm”, “last night”)
- **durations** (“three years”)
- **set expressions** (“twice a day”)

dates and times may be:

- **explicit** (“May 1, 2015”)
- **implicit** (“Christmas 2012”)
- **relative** (“last night”)
- **underspecified** (“Monday”)

So far addressed: temporal tagging

Addressed types of temporal expressions

TimeML standard:

[Pustejovsky et al. '10]

- **dates** (“May 1, 2015”, “today”)
 - **times** (“9 pm”, “last night”)
 - **durations** (“three years”)
 - **set expressions** (“twice a day”)
- dates and times may be:
 - **explicit** (“May 1, 2015”)
 - **implicit** (“Christmas 2012”)
 - **relative** (“last night”)
 - **underspecified** (“Monday”)

normalization difficultly varies between types, but:
all are obvious temporal expressions

So far ignored: free-text temporal expressions

Idea

standard text phrases may be associated with temporal scopes

Outline

- Temponyms
- WWW'16 Approach
- The Temporal Tagger HeidelTime
- Temponym Tagging with HeidelTime

So far ignored: free-text temporal expressions

Idea

standard text phrases may be associated with temporal scopes

- **temponyms**

refer to arbitrary kinds of **named events or facts**

So far ignored: free-text temporal expressions

Idea

standard text phrases may be associated with temporal scopes

■ temponyms

refer to arbitrary kinds of **named events or facts with temporal scopes**

So far ignored: free-text temporal expressions

Idea

standard text phrases may be associated with temporal scopes

■ temponyms

refer to arbitrary kinds of **named events or facts with temporal scopes** that are merely given by a text phrase but have unique interpretations **given the context and background knowledge**.

So far ignored: free-text temporal expressions

Idea

standard text phrases may be associated with temporal scopes

- **temponyms**

refer to arbitrary kinds of **named events or facts with temporal scopes** that are merely given by a text phrase but have unique interpretations **given the context and background knowledge**.

- **temponym tagging**

is the **detection** and **normalization** of temponyms.

Examples of temponyms

John F. Kennedy's death marked a watershed in the memories of almost every American.

President Obama awarded the nation's highest military honor to a Union soldier who was killed more than 150 years ago during the Battle of Gettysburg.

Examples of temponyms

John F. Kennedy's death marked a watershed in the memories of almost every American.

publication date: 2014-11-06

President Obama awarded the nation's highest military honor to a Union soldier who was killed **more than 150 years ago** during the Battle of Gettysburg.

normalized temporal information
(temporal tagging)

1864

Examples of temponyms

John F. Kennedy's death marked a watershed in the memories of almost every American.

publication date: 2014-11-06

President Obama awarded the nation's highest military honor to a Union soldier who was killed **more than 150 years ago** during **the Battle of Gettysburg**.

normalized temporal information
(temporal tagging, temponym tagging)

1963-11-22

1864
[1863-07-01, 1863-07-03]

Examples of temponyms

phrases with temponyms

The Cuban Revolutionary War

The second inauguration of Bill Clinton

2008 Mexico City plane crash

2016 WWW Conference

Examples of temponyms

temporal tagging

The Cuban Revolutionary War

The second inauguration of Bill Clinton

2008

2008 Mexico City plane crash

2016

2016 WWW Conference

Examples of temponyms

temporal tagging vs. temponym tagging

– vs.

[1953-07-26,1959-01-01]

The Cuban Revolutionary War

– vs.

1997-01-20

**The second inauguration of
Bill Clinton**

2008 vs.

2008-11-04

2008 Mexico City plane crash

2016 vs.

[2016-04-11,2016-04-15]

2016 WWW Conference

Examples of temponyms

temporal tagging vs. temponym tagging

– vs.

[1953-07-26,1959-01-01]

The Cuban Revolutionary War

– vs.

1997-01-20

**The second inauguration of
Bill Clinton**

2008 vs.

2008-11-04

2008 Mexico City plane crash

2016 vs.

[2016-04-11,2016-04-15]

2016 WWW Conference

temponyms add new or more precise temporal information

Our WWW'16 paper

- all temponyms, not only explicit ones, e.g., “during **his presidency**”
- often year-level temporal scopes



Our WWW'16 paper

- all temponyms, not only explicit ones, e.g., “during **his presidency**”
- often year-level temporal scopes
- approach with ILP for joint inference
- approach requires deep analysis → not very scalable



Our WWW'16 paper

- all temponyms, not only explicit ones, e.g., “during **his presidency**”
- often year-level temporal scopes
- approach with ILP for joint inference
- approach requires deep analysis → not very scalable

Friday, April 15, 2016

As Time Goes By: Comprehensive Tagging
of Textual Phrases with Temporal Scopes

Our WWW'16 paper

- all temponyms, not only explicit ones, e.g., “during **his presidency**”
- often year-level temporal scopes
- approach with ILP for joint inference
- approach requires deep analysis → not very scalable

Friday, April 15, 2016

As Time Goes By: Comprehensive Tagging
of Textual Phrases with Temporal Scopes

Today

- explicit temponyms, day-level temporal scopes
- completely other approach than WWW'16 approach:
temponym tagging with HeidelTime



The temporal tagger HeidelTime

HeidelTime's characteristics

rule-based, multilingual, domain-sensitive



The temporal tagger HeidelTime

HeidelTime's characteristics

rule-based, multilingual, domain-sensitive

Four domains [LRE'13]

- news, narrative, colloquial, autonomic

The temporal tagger HeidelTime

HeidelTime's characteristics

rule-based, multilingual, domain-sensitive

Four domains [LRE'13]

- news, narrative, colloquial, autonomic

13 languages [TALIP'14, EACL'14, EVALITA'14, Camp & Christiansen '12, Moriceau & Tannier '14, Skukan et al. '14]

- English, Spanish, French, Italian, Portuguese, German, Dutch,
- Arabic, Russian, Croatian, Chinese, Vietnamese, Estonian

The temporal tagger HeidelTime

HeidelTime's characteristics

rule-based, multilingual, domain-sensitive

Four domains [LRE'13]

- news, narrative, colloquial, autonomic

13 languages [TALIP'14, EACL'14, EVALITA'14, Camp & Christiansen '12, Moriceau & Tannier '14, Skukan et al. '14]

- English, Spanish, French, Italian, Portuguese, German, Dutch,
- Arabic, Russian, Croatian, Chinese, Vietnamese, Estonian

200+ languages [EMNLP'15]

- with automatically developed resources



Domain-sensitivity is crucial

normalization of relative and underspecified expressions



Domain-sensitivity is crucial

normalization of relative and underspecified expressions

News 1998-04-18

... for the United States, he said

today

... However, cited by police

in December for driving under
the influence of alcohol ...

Domain-sensitivity is crucial

normalization of relative and underspecified expressions

News 1998-04-18

... for the United States, he said
today ...
 ... However, **cited** by police
 in **December** for driving under
 the influence of alcohol ...

Narrative 2009-12-19

1979 Soviet invasion
 .. land in Kabul on
December 25 ...
 Afghanistan from the north on
December 27. In **the morning**

Domain-sensitivity is crucial

normalization of relative and underspecified expressions

News 1998-04-18

... for the United States, he said
today ...
 ... However, **cited** by police
 in **December** for driving under
 the influence of alcohol ...

The diagram shows a box containing the date '1998-04-18'. Two arrows originate from this box: one points to the word 'today' in the text, and the other points to the word 'December' in the text. This illustrates how relative and underspecified temporal expressions are normalized to a specific date.

Narrative 2009-12-19

1979 Soviet invasion
 .. land in Kabul on
December 25 ...
 Afghanistan from the north on
December 27. In **the morning**

The diagram shows a box containing the date '2009-12-19'. Three arrows originate from this box: one points to the year '1979', another points to 'December 25', and a third points to 'December 27'. This illustrates how relative and underspecified temporal expressions are normalized to a specific date.

cross-domain evaluation

corpus	temporal tagger	extraction	extr. & normalization
news (TempEval3)	HeidelTime-news SUTime [#]		
Wikipedia (WikiWars)	HeidelTime-narratives SUTime [#]		
	[#] [Chang & Manning '12]	*official TempEval-3 results	

Domain-sensitivity is crucial

normalization of relative and underspecified expressions

News 1998-04-18

... for the United States, he said
today ...
 ... However, **cited** by police
 in **December** for driving under
 the influence of alcohol ...

Narrative 2009-12-19

1979 Soviet invasion
 .. land in Kabul on
December 25 ...
 Afghanistan from the north on
December 27. In **the morning**

cross-domain evaluation

corpus	temporal tagger	extraction	extr. & normalization
news	HeidelTime-news	90.3*	77.6*
(TempEval3)	SUTime[#]	90.3*	67.4*
Wikipedia	HeidelTime-narratives		
(WikiWars)	SUTime [#]		

[#][Chang & Manning '12]

*official TempEval-3 results



Domain-sensitivity is crucial

normalization of relative and underspecified expressions

News 1998-04-18

... for the United States, he said
today ...
 ... However, **cited** by police
 in **December** for driving under
 the influence of alcohol ...

The diagram shows a box labeled 'News' with the date '1998-04-18'. Below it is a text snippet. The word 'today' is highlighted in a blue box, and 'December' is also highlighted in a blue box. A blue arrow points from 'today' to the date box, and another blue arrow points from 'December' to the date box. The word 'cited' is circled in blue.

Narrative 2009-12-19

1979 Soviet invasion
 .. land in Kabul on
December 25 ...
 Afghanistan from the north on
December 27. In **the morning**

The diagram shows a box labeled 'Narrative' with the date '2009-12-19'. Below it is a text snippet. The words '1979', 'December 25', and 'December 27' are highlighted in blue boxes. Blue arrows point from each of these boxes to the date box '2009-12-19'. The phrase 'the morning' is also highlighted in a blue box.

cross-domain evaluation

corpus	temporal tagger	extraction	extr. & normalization
news	HeidelTime-news	90.3*	77.6*
(TempEval3)	SUTime[#]	90.3*	67.4*
Wikipedia	HeidelTime-narratives	87.9	78.7
(WikiWars)	SUTime [#]	88.2	48.1

[#][Chang & Manning '12]

*official TempEval-3 results

Temponym tagging with HeidelTime

Temponym creation process

- YAGO 2/3 [Hoffart et al. '13, Mahdisoltani et al. '15]
 - temporal predicates
holdsPosition, isMarriedTo, diedOn
startedOnDate, endedOnDate, happenedOnDate
e.g., John F. Kennedy – diedOn – 1963-11-22

Temponym tagging with HeidelTime

Temponym creation process

- YAGO 2/3 [Hoffart et al. '13, Mahdisoltani et al. '15]
 - temporal predicates
holdsPosition, isMarriedTo, diedOn
startedOnDate, endedOnDate, happenedOnDate
e.g., John F. Kennedy – diedOn – 1963-11-22
- AIDA [Hoffart et al. '11]
 - alias names for entities
e.g., “John F. Kennedy” – “John Fitzgerald Kennedy”

Temponym tagging with HeidelTime

Temponym creation process

- YAGO 2/3 [Hoffart et al. '13, Mahdisoltani et al. '15]
 - temporal predicates
holdsPosition, isMarriedTo, diedOn
startedOnDate, endedOnDate, happenedOnDate
e.g., John F. Kennedy – diedOn – 1963-11-22
- AIDA [Hoffart et al. '11]
 - alias names for entities
e.g., “John F. Kennedy” – “John Fitzgerald Kennedy”
- temponym pattern dictionary
 - (noun / verb) phrases mapped to Yago's predicates
e.g., diedOn – <X>'s death – <X> was killed – <X> died

Temponym tagging with HeidelTime

Fact and event-style temponyms

- with time points or intervals
- due to imprecise intervals in YAGO:
re-extraction of temporal scopes from Wikipedia info boxes



Temponym tagging with HeidelTime

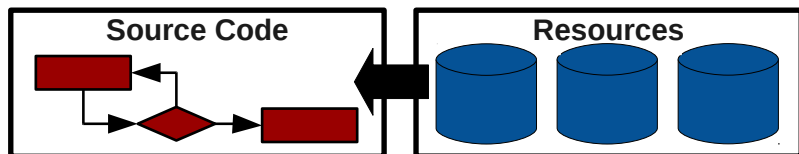
Fact and event-style temponyms

- with time points or intervals
- due to imprecise intervals in YAGO:
re-extraction of temporal scopes from Wikipedia info boxes

how are temponyms handled in HeidelTime?

Temponym tagging with HeidelTime

HeidelTime's simplified architecture



In the source code:

- domain-dependent normalization strategies
 - resource interpreter
- **language-independent**

In the resources:

- pattern files
 - normalization files
 - rule files
- **language-dependent**

Temponym tagging with HeidelTime

HeidelTime's temporal tagging resources – examples



Temponym tagging with HeidelTime

HeidelTime's temporal tagging resources – examples

reMonth

April
May
...

normMonth

"April", "04"
"May", "05"
...

Temponym tagging with HeidelTime

HeidelTime's temporal tagging resources – examples

reMonth

April
May
...

normMonth

"April", "04"
"May", "05"
...

rule1, ("April 2016" → "2016-04")

```
extract="%reMonthg1 %reYear4Dg2"  
norm="g2-%normMonth(g1)"
```


Temponym tagging with HeidelTime

HeidelTime's temponym tagging resources – examples

Starting point:

- YAGO 2/3 output
- AIDA synonyms
- temporal pattern dictionary



Temponym tagging with HeidelTime

HeidelTime's temponym tagging resources – examples

YAGO 2/3 output

normDeath

"Che Guevara", "1967-10-09"

"John F. Kennedy", "1963-11-22"

...

Temponym tagging with HeidelTime

HeidelTime's temponym tagging resources – examples

YAGO 2/3 output + AIDA synonyms

normDeath

"Che Guevara", "1967-10-09"

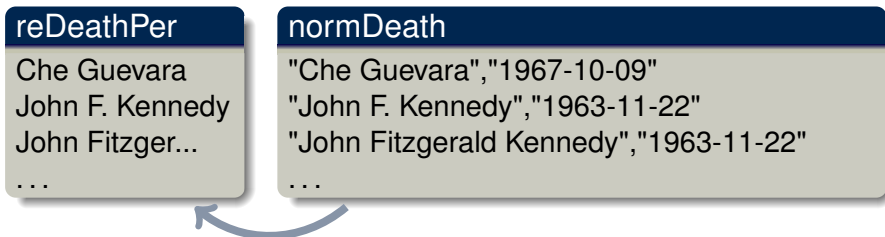
"John F. Kennedy", "1963-11-22"

"John Fitzgerald Kennedy", "1963-11-22"

...

Temponym tagging with HeidelTime

HeidelTime's temponym tagging resources – examples



Temponym tagging with HeidelTime

HeidelTime's temponym tagging resources – examples

reDeathPer

Che Guevara
John F. Kennedy
John Fitzger...
...

normDeath

"Che Guevara","1967-10-09"
"John F. Kennedy","1963-11-22"
"John Fitzgerald Kennedy","1963-11-22"
...

**temporal
pattern
dictionary**



reDeathN

death
suicide
...

Temponym tagging with HeidelTime

HeidelTime's temponym tagging resources – examples

reDeathN

death
suicide
...

reDeathPer

Che Guevara
John F. Kennedy
...

normDeath

"Che Guevara", "1967-10-09"
"John F. Kennedy", "1963-11-22"
...

Temponym tagging with HeidelTime

HeidelTime's temponym tagging resources – examples

reDeathN

death
suicide
...

reDeathPer

Che Guevara
John F. Kennedy
...

normDeath

"Che Guevara", "1967-10-09"
"John F. Kennedy", "1963-11-22"
...

rule2a, e.g., "John F. Kennedy's death" → "1963-11-22"

extract="%"reDeathPer_{g1}'s %reDeathN_{g2}"

norm="%"normDeath(g1)"

Temponym tagging with HeidelTime

HeidelTime's temponym tagging resources – examples

reDeathN

death
suicide
...

reDeathPer

Che Guevara
John F. Kennedy
...

normDeath

"Che Guevara", "1967-10-09"
"John F. Kennedy", "1963-11-22"
...

rule2a, e.g., "John F. Kennedy's death" → "1963-11-22"

extract="reDeathPer_{g1}'s reDeathN_{g2}"
norm="normDeath(g1)"

rule2b, e.g., "death of John F. Kennedy" → "1963-11-22"

extract="reDeathN_{g1} of reDeathPer_{g2}"
norm="normDeath(g2)"

Temponym tagging with HeidelTime

HeidelTime's temponym tagging resources – examples

reDeathN

death
suicide
...

reDeathPer

Che Guevara
John F. Kennedy
...

normDeath

"Che Guevara", "1967-10-09"
"John F. Kennedy", "1963-11-22"
...

rule2a, e.g., "John F. Kennedy's death" → "1963-11-22"

extract="reDeathPer_{g1}'s reDeathN_{g2}", **fast="reDeathN"**
norm="normDeath(g1)"

rule2b, e.g., "death of John F. Kennedy" → "1963-11-22"

extract="reDeathN_{g1} of reDeathPer_{g2}", **fast="reDeathN"**
norm="normDeath(g2)"

Temponym tagging with HeidelTime

Postprocessing

- all temponyms converted into 4-tuple intervals [Berberich et al. '10] to address uncertainty of temporal expressions

Temponym tagging with HeidelTime

Postprocessing

- all temponyms converted into 4-tuple intervals [Berberich et al. '10] to address uncertainty of temporal expressions
- [earliest begin, latest begin, earliest end, latest end]



Temponym tagging with HeidelTime

Postprocessing

- all temponyms converted into 4-tuple intervals [Berberich et al. '10] to address uncertainty of temporal expressions
- [earliest begin, latest begin, earliest end, latest end]
e.g., April 2016 to May 2016
[2016-04-01, 2016-05-31]



Temponym tagging with HeidelTime

Postprocessing

- all temponyms converted into 4-tuple intervals [Berberich et al. '10] to address uncertainty of temporal expressions
- [earliest begin, latest begin, earliest end, latest end]
e.g., April 2016 to May 2016
[2016-04-01, 2016-04-30, 2016-05-01, 2016-05-31]

Temponym tagging with HeidelTime

Postprocessing

- all temponyms converted into 4-tuple intervals [Berberich et al. '10] to address uncertainty of temporal expressions
- [earliest begin, latest begin, earliest end, latest end]
e.g., April 2016 to May 2016
[2016-04-01, 2016-04-30, 2016-05-01, 2016-05-31]

Temponyms in HeidelTime

- 496k birth temponyms
- 161k death temponyms
- 26k event temponyms (battles, wars, awards, ...)
- with a variety of formulations for many temponyms



Temponym tagging with HeidelTime

temporal enrichment analysis

- WikiWars corpus [Mazur & Dale '10]
 - Wikipedia articles about famous wars in history
 - with manually annotated temporal expressions
 - 2,681 temporal expressions



Temponym tagging with HeidelTime

temporal enrichment analysis

- WikiWars corpus [Mazur & Dale '10]
 - Wikipedia articles about famous wars in history
 - with manually annotated temporal expressions
 - 2,681 temporal expressions
- temponym tagging of WikiWars
 - 212 extracted temponyms
 - many provide additional / more precise temporal information
 - all addressed temponyms are explicit,
 - correct normalization is very likely



Temponym tagging with HeidelTime

temporal enrichment analysis

how much time is in here?

After Benito Juárez's death in 1872, Porfirio Díaz wanted to take over as Mexico's leader. As allies, the two men had fought against the French in the Battle of Puebla, but once Juárez rose to power, Díaz tried to unseat him.

[WikiWars, Mexican Revolution]

Temponym tagging with HeidelTime

temporal enrichment analysis

1872

After Benito Juárez's death in **1872**, Porfirio Díaz wanted to take over as Mexico's leader. As allies, the two men had fought against the French in the Battle of Puebla, but once Juárez rose to power, Díaz tried to unseat him.

[WikiWars, Mexican Revolution]

Temponym tagging with HeidelTime

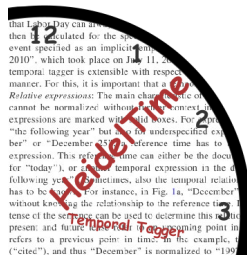
temporal enrichment analysis

1872, 1872-07-18, 1862-05-05

After **Benito Juárez's death** in **1872**, Porfirio Díaz wanted to take over as Mexico's leader. As allies, the two men had fought against the French in the **Battle of Puebla**, but once Juárez rose to power, Díaz tried to unseat him.

[WikiWars, Mexican Revolution]

HeidelTime as temporal and temponym tagger



Publicly available:

- UIMA version
- JAVA standalone version (API)
- online demo
- soon: within GATE [LREC'16]

**Feedback is appreciated,
thank you for your attention!**

References I



[Pustejovsky et al. '10] Pustejovsky, Lee, Bunt, Romary, "ISO-TimeML: An International Standard for Semantic Annotation," *LREC*, 2010.



[WWW'16] Kuzey, Setty, Strötgen, Weikum, "As Time Goes By: Comprehensive Tagging of Textual Phrases with Temporal Scopes," *WWW*, 2016.



[TALIP'14] Strötgen, Armiti, Canh, Zell, Gertz, "Time for More Languages: Temporal Tagging of Arabic, Italian, Spanish, and Vietnamese," *TALIP*, 2014.



[EACL'14] Li, Strötgen, Zell, Gertz, "Chinese Temporal Tagging with HeidelTime," *EACL*, 2014.



[EVALITA'14] Manfredi, Strötgen, Zell, Gertz, "HeidelTime at EVENTI: Tuning Italian Resources and Addressing TimeML's Empty Tags," *EVALITA*, 2014.



[Camp & Christiansen '12] van de Camp, Christiansen, "Resolving Relative Time Expressions in Dutch Text with Constraint Handling Rules," *CSLP*, 2012.



[Moriceau & Tannier '14] Moriceau, Tannier, "French Resources for Extraction and Normalization of Temporal Expressions with HeidelTime," *LREC*, 2014.



[Skukan et al. '14] Skukan, Glavaš, Šnajder, "HeidelTime.Hr: Extracting and Normalizing Temporal Expressions in Croatian," *LTC*, 2014.



[EMNLP'15] Strötgen, Gertz, "A Baseline Temporal Tagger for All Languages," *EMNLP*, 2015.

References II



[LRE'13] Strötgen, Gertz, "Multilingual and Cross-domain Temporal Tagging," *Language Resources and Evaluation*, 2013.



[Chang & Manning '12] Chang, Manning, "SUTime: A Library for Recognizing and Normalizing Time Expressions," *LREC*, 2012.



[Hoffart et al. '13] Hoffart, Suchanek, Berberich, Weikum, "YAGO2: A Spatially and Temporally Enhanced Knowledge Base from Wikipedia," *IJCAI*, 2013.



[Mahdisoltani et al. '15] Mahdisoltani, Biega, Suchanek, "YAGO3: A Knowledge Base from Multilingual Wikipedias," *CIDR*, 2015.



[Hoffart et al. '11] Hoffart, Yosef, Bordino, Fürstenau, Pinkal, Spaniol, Taneva, Thater, Weikum, "Robust Disambiguation of Named Entities in Text," *EMNLP*, 2011.



[Berberich et al. '10] Berberich, Bedathur, Alonso, Weikum, "A Language Modeling Approach for Temporal Information Needs," *ECIR*, 2010.



[Mazur & Dale '10] Mazur, Dale, "WikiWars: A New Corpus for Research on Temporal Expressions," *EMNLP*, 2010.



[LREC'16] Derczynski, Strötgen, Maynard, Greenwood, Jung, "GATE-Time: Extraction of Temporal Expressions and Events," *LREC*, 2016.