

# Extracting and interpreting temporal information from text



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## PROBLEM

Temporal aspects are important to **organise knowledge**. They allow people to filter information and infer temporal **flow of events**. This is particularly important in **clinical documents**, where patient's medical events are not often presented chronologically. The temporal extraction task is challenging because involves also the interpretation of temporal expressions.

## METHOD

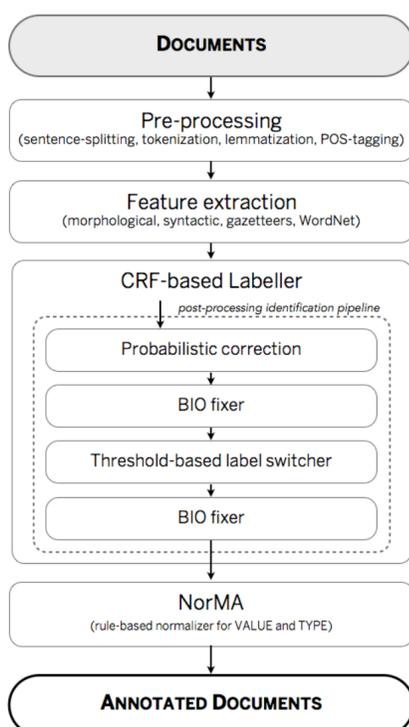
Documents are pre-processed using natural language processing tools and **93 features** are extracted according to different focuses: morphological, syntactic, gazetteer-based and WordNet-based.

Then temporal expressions are **identified** ...

She delivered a 3680 gram male infant on **10/12/2004 at 10:17 pm** with apgar scores of 9 and 9 at approximately **one** and **five minutes** respectively at **40.0 weeks** gestation via spontaneous vertex vaginal delivery. She was discharged **three days after in the morning**.

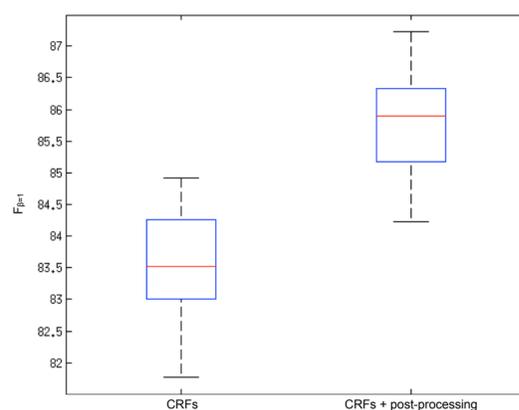
... and **normalised** according to ISO-TimeML format.

```
<TIMEX3 tid="t1" value="2004-10-12T22:17" type="TIME" />
<TIMEX3 tid="t2" value="PT1M" type="DURATION" mod="APPROX" />
<TIMEX3 tid="t3" value="PT5M" type="DURATION" mod="APPROX" />
<TIMEX3 tid="t4" value="P40W" type="DURATION" />
<TIMEX3 tid="t5" value="2004-10-15TMO" type="TIME" mod="START" />
```

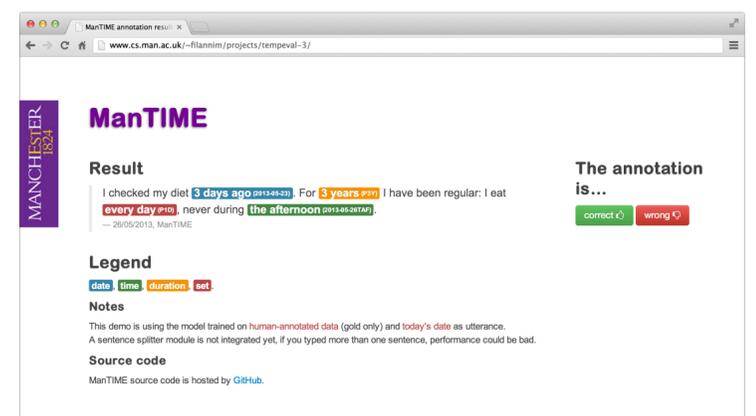


Candidate temporal expressions are identified by using **Conditional Random Fields**. The predictions are further improved with a **probabilistic post-processing pipeline** composed of 3 different statistical modules. The normalisation is carried out using **NorMA** [1], a state-of-the-art rule-based system.

The pipeline is called **ManTIME** [2] and it is the best performing machine-learning based system in the major temporal extraction challenge [3]. The pipeline is also available through web interface.



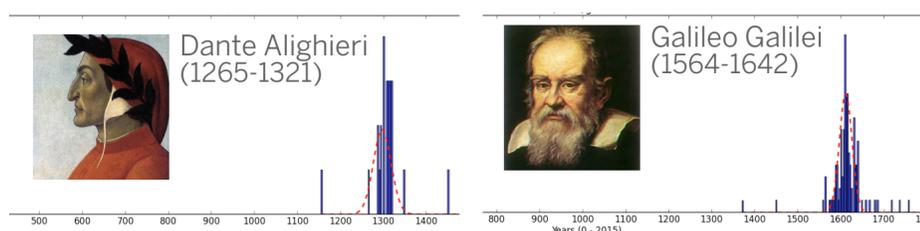
Evaluation of post-processing pipeline



Online DEMO

## TEMPORAL PLACEMENT & QA

Entities from **Wikipedia** can be located on the time line by analysing their description.

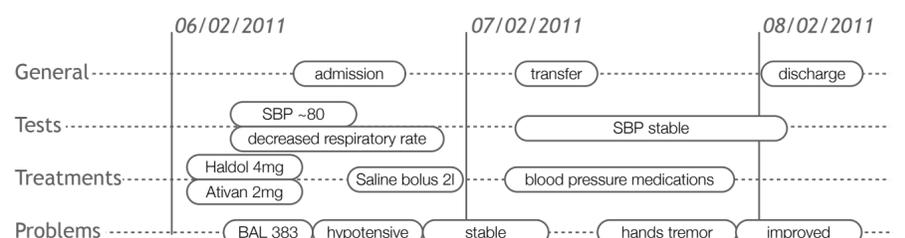


Moreover, **question answering** systems can provide temporally plausible answers.

- What **computer** did **Galileo Galilei** use for his calculations? ❌
- Did **Richard Feynman** use **computers**? ✅
- Where did **Dante Alighieri** meet **Galileo Galilei**? ❌

## CLINICAL TIME LINE EXTRACTION

**ADMISSION DATE:** 2011-02-06; **DISCHARGE DATE:** 2011-02-08; **HISTORY OF PRESENT ILLNESS:** Mr. Pohl is a 53 - year-old male with history of alcohol use and hypertension. Blood alcohol level was 383. Agitated in emergency room requiring 4 leather restraints, received 5 mg of Haldol, 2 mg of Ativan. He became hypotensive in the emergency room with a systolic blood pressure in the 80 's and had decreased respiratory rate. He received a normal saline bolus of 2 liters of good blood pressure response. The patient was then admitted to the medical Intensive Care Unit for observation and then transferred to our service on medicine when the blood pressures remained stable overnight...



[1] Filannino, M. Temporal expression normalisation in natural language texts. CoRR abs/1206.2010 (2012).

[2] Filannino, M., Brown, G., and Nenadic, G. ManTIME: Temporal expression identification and normalization in the Tempeval-3 challenge. Proceedings of SemEval 2013, ACL, pp. 53–57.

[3] UzZaman, N., Llorens, H., Derczynski, L., Allen, J., Verhagen, M., and Pustejovsky, J. Semeval-2013 task 1: Tempeval-3: Evaluating time expressions, events, and temporal relations. Proceedings of SemEval 2013, ACL, pp. 1–9.