Event-Centric Natural Language Understanding

- Human Language is used to describe and reason about events.

- We use it to
  - Describe what happened
    - (and would could have happened, or may happen)
  - Reason about Who did what to whom, and why
  - Understand what led to what? What caused what?
  - We describe thoughts, hypotheses feelings, and plans that pertain to events
  - We summarize events and make predictions with respect to future events.

In the months leading up to the riot, Mr. Lee had helped organize a series of pro-Trump car caravans around the country, including one that temporarily blockaded a Biden campaign bus in Texas and another that briefly shut down a Hudson River bridge in the New York City suburbs. To help pay for dozens of caravans to meet at the Jan. 6 rally, he had teamed up with an online fund-raiser in Tampa, Fla., who secured money from small donors and claimed to pass out tens of thousands of dollars.

Rodgers finished 23-of-36 for 296 yards and two touchdowns. His numbers could've been even better had his receivers not dropped a couple of his passes. One dropped ball was a potential score to Allen Lazard. Despite the drop, Lazard made up for it by leading the Packers in receiving. With Davante Adams tied up with Jalen Ramsey, Lazard was able to snatch four balls for 96 yards and a touchdown. Adams still had a great game despite Ramsey's coverage, hauling in nine of his 10 targets for 66 yards and a touchdown. The score frustrated Ramsey because another defensive back was supposed to pick up Adams, who was in motion.
We describe events at different levels of abstractions

1. Napoleon Invades Russia
2. Damascus sends note to Ankara over Syrian plane.
3. Turkey Escalates Confrontation with Syria.

We reason about events in multiple granularities

What really happened?
- What sequence of events led to it?

What will happen?

With a range of goals in mind
Most of the work in NLP focuses on understanding “what the text says”
- We analyze “what’s written here” at the sentence level (mostly)
  - But more and more also at a document level
  - And even, rarely, at a multi-document level

But with the level of progress in “what the text says”
- We can now attend to “what is happening”
  - And ground it in the world
Understanding “What is Happening”

- Event-Centric Natural Language Understanding and Information Extraction
  - Brings some change in foci and priorities
  - It requires “local” text understanding
  - But necessitates integrating information from multiple documents (and modalities)
    - Information aggregation and consolidation
    - Understanding multiple types of events
    - Understanding relations between events
    - Understanding time and causality
    - Acquiring and using background and commonsense knowledge
    - The ability to generalize from specific, observed, processes
    - The ability to predict – implicit events and possible future events
    - Eventually, it will also require us to identify that there are multiple perspectives
    - ...

- And integrating all these into an understanding of “what is happening”
Compiling a History Book

- Ideally, at multiple levels of granularities
  - And accounting for multiple perspectives and interpretations

The history of Democracy

- One way to start is with the French revolution

Credit: The Flow of History, by Chris Butler

Some say that the Americans’ victory over the British has had a significant impact on the French revolution, and that the newly formed government in the United States became a model for the French reformers.
- Ideally, at multiple levels of granularities
  - And accounting for multiple perspectives and interpretations

The history of Democracy

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The history of Democracy

13. The Age of Revolutions

Credit: The Flow of History, by Chris Butler

The place of the French revolution in the bigger picture

This is one way to compile and represent a summary of events, done by processing large body of text
Ideally, at multiple levels of granularities
- And accounting for multiple perspectives and interpretations

Credit: The Flow of History, by Chris Butler

It is challenging to compile such an account given a lot of historical text, and even more so to build it from reported events, as we they occur.
This Tutorial
In Baghdad, a cameraman died when a combat tank fired on the Palestine Hotel.

The government of China has ruled Tibet since 1951 after dispatching troops to the Himalayan region in 1950.

Event Extraction

- Event Definition and Representation
- Event Extraction
  - From Supervised to zero-shot
  - Cross-media event extraction
- Hierarchies, event schemas
- Event-event Relations:
  - Coreference
  - Sub-events
  - Temporal Relations
Event extraction needs to be done across multiple sources and multiple modalities
Relations between Events

- Types of events
- Relations:
  - Coreference, Temporal, parent-child
- Incorporating knowledge constraints
  - Declarative, Statistical

On Tuesday, there was a typhoon-strength storm in Japan. One man got killed and thousands of people were left stranded. Police said an 81-year-old man died in central Toyama when the wind blew over a shed, trapping him underneath. Later this afternoon, with the agency warning of possible tornadoes, Japan Airlines canceled 230 domestic flights. There were 31,600 passengers.

In Los Angeles that lesson was brought home Friday when tons of earth cascaded down a hillside, ripping two houses from their foundations. No one was hurt, but firefighters ordered the evacuation of nearby homes and said they’ll monitor the shifting ground until March 23rd.

Police tried to eliminate the pro-independence army and restore order. At least 51 people were killed in clashes between police and citizens in the troubled region.
1. Event process completion

How to do this task?

2. Event intention prediction

What are they doing?

3. Event processes in downstream NLU tasks

Narrative development
Large-scale Events

- Complex Events that are composed of many fine-grained events
  - Elections, disasters, wars, disease outbreaks, economic impacts

- What might be useful?
  - Understanding the structure of a complex event
  - Track an event
  - Provide updates
  - Timeline summarization
  - Event summarization

Event Timeline summarization: Ukraine Crisis

Timely Updates

1:00

March 16th, 2014
- Crimeans vote in a referendum to rejoin Russia or return to its status under the 1992 constitution.

March 17th, 2014
- The Crimean parliament officially declared independence and requested full accession to the Russian Federation.
- Obama declared sanctions on Russian officials considered responsible for the crisis.
- The leader of the pro-Russian organization "Youth Unity" was arrested.

March 18th, 2014
- President Obama warned Vladimir Putin that further provocations by Russia could isolate and diminish its influence.
- One pro-Russian soldier was killed in the Simferopol incident.

... summaries for other dates ...
Background and Commonsense Knowledge

- Knowledge Resources that are important to facilitate reasoning about events.
- Commonsense: Event Relations
- Temporal Commonsense

**Typical Time**

[Elazar et al. ACL’19]

**Typical Temporal Relations**

[Ning et al. NAACL’18]

**Figure 1:** Our model’s predicted distributions about event duration and frequency. The model is able to distinguish fine-grained contexts and produce quality estimations.

[Zhou et al. ACL’20]

Bosselut et al. ACL’19
Tutorial Outline

- **Introduction** 20 min.
  - Dan Roth

- **Event-Centric Information Extraction** 40 min.
  - Heng Ji, Mingling Li

- **Event-Centric Information Extraction: Relations** 30 min.
  - Qiang Ning

- **Break** 30 min.

- **Event-Centric Prediction: Processes** 35 min.
  - Muhao Chen

- **Event-Centric Knowledge Acquisition: Commonsense** 35 min.
  - Hongming Zhang

- **Event Summarization** 30 min.
  - Kathleen McKeown

- **Conclusion and Future Work** 20 min.
  - Heng Ji, Dan Roth
The End