Event Summarization

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ACL Tutorials

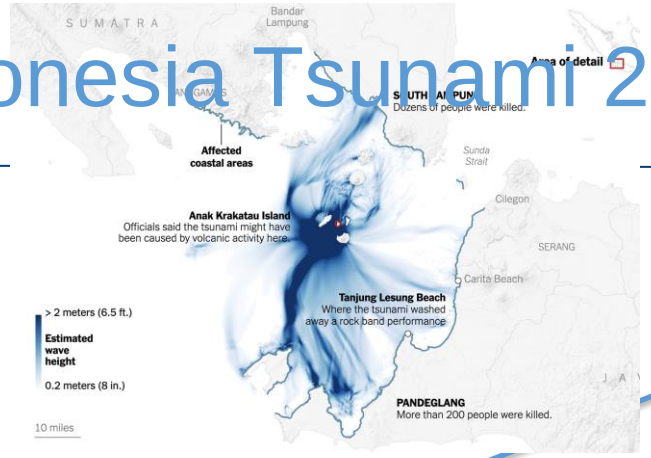
Event-Centric Natural Language Processing

A Different Kind of Event

- Large-scale events
  - Composed of many fine-grained events
  - Also called *complex events*

- Elections, disasters, disease outbreaks, economic impacts

Indonesia Tsunami 2018



FEATURE: Five years after tsunami, Indonesia better prepared for catastrophes

UN Photo/E. Schneider | Aerial view of the vast destruction of the Indonesian coast caused by the Indian Ocean tsunami in 2004.

What Might be Useful?

- Track an event
- Provide updates
- Timeline summarization
- Event summarization

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Tracking an Event in the News

- Did a new major event start?
- Do news articles continue to refer to the event?
- Has the event forked into two sub-events?
- Typically done at the article level using some form of clustering

Dataset - Miranda et al (2018)

Multilingual news stream clustering dataset

- English portion – 21k articles from 815 event topics
- Articles annotated with language, timestamp and event topic cluster
- Contains training set for tuning clustering parameters
- Training and test sets are temporally disjoint
- SOTA results reported for comparative evaluation

Statistic	Dataset Split	
	Training	Evaluation
# Articles	12, 233	8,726
# Tokens / Article	434 (± 364)	521 (± 495)
# Events	593	222
# Articles / Event	21 ± 32	39 ± 88
Earliest Article Date	Dec 18, 2013	Feb 2. 2014
Latest Article Date	Nov 2, 2014	Aug 25, 2015

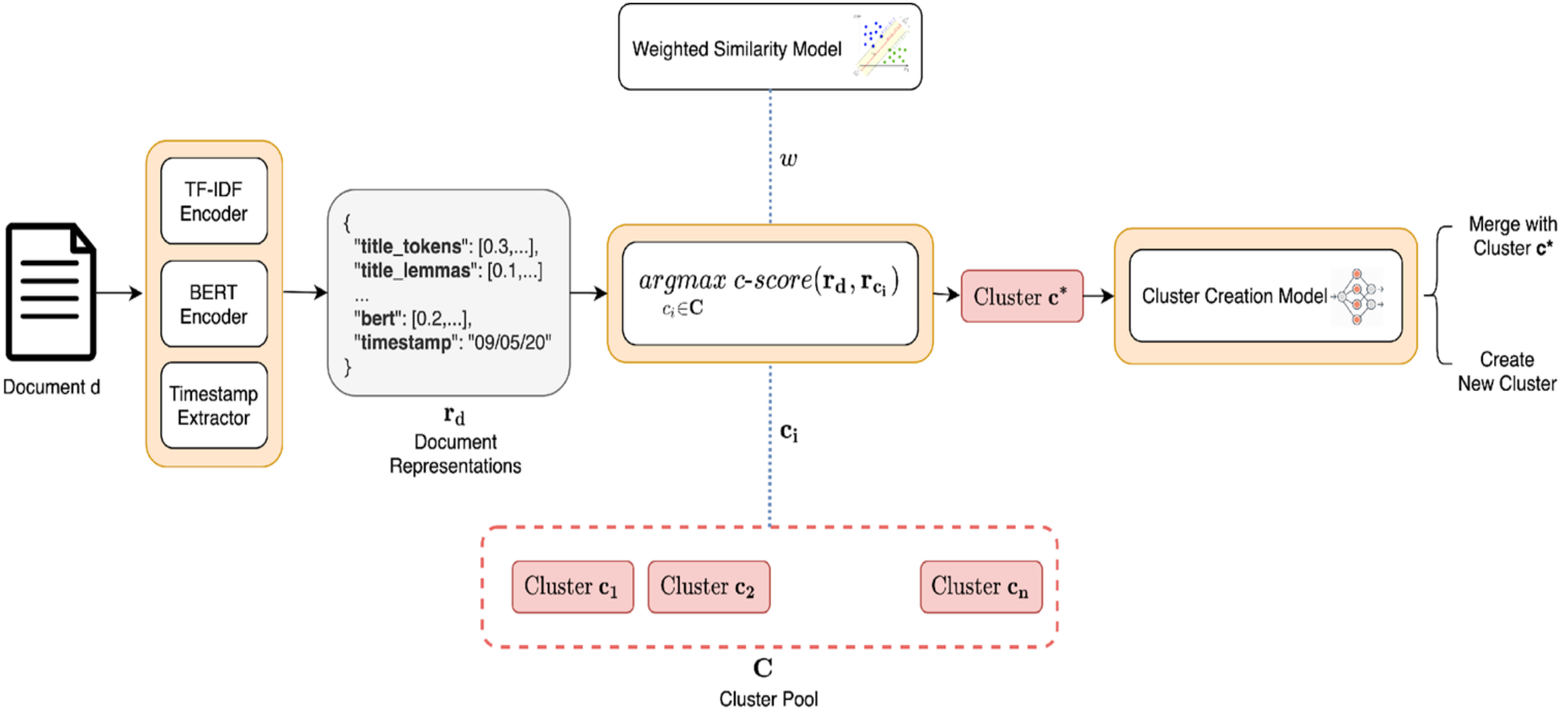
Approaches

- Batch-clustering
  - Document stream is batched temporally (with partial overlap between batches)
  - Each batch is clustered and clusters across batches are linked using similarity
  - TF-IDF representation of document text and Louvian algorithm for clustering
  - Laban and Hearst (2017), Staykovski et al (2019), Linger and Hajaiej (2020)
- Stream clustering
  - Online clustering paradigm where new documents are clustered incrementally
  - Robust to temporal density variations in document stream
  - Doesn’t require the tuning of the batch size and overlap hyperparameters
  - Miranda et al (2018), Saravanakumar et al (2021)

Document Representations

- Vectors represent title, body, title+body
- TF*IDF Term Frequency * Inverse Document Frequency (Miranda et al 2018, Staykovski et al 2019)
- Dense representations (Staykovski et al 2019)
  - Staykovski could not get improvement over TF*IDF alone
- TF*IDF plus fine-tuned dense representations (Saravanakumar et al 2021)
  - Entity aware, event aware
- Time
  - Document time-stamp, cluster time max, average, min

Model Architecture (Saravanakumar et al 2021)



Results (Saravanakumar et al 2021)

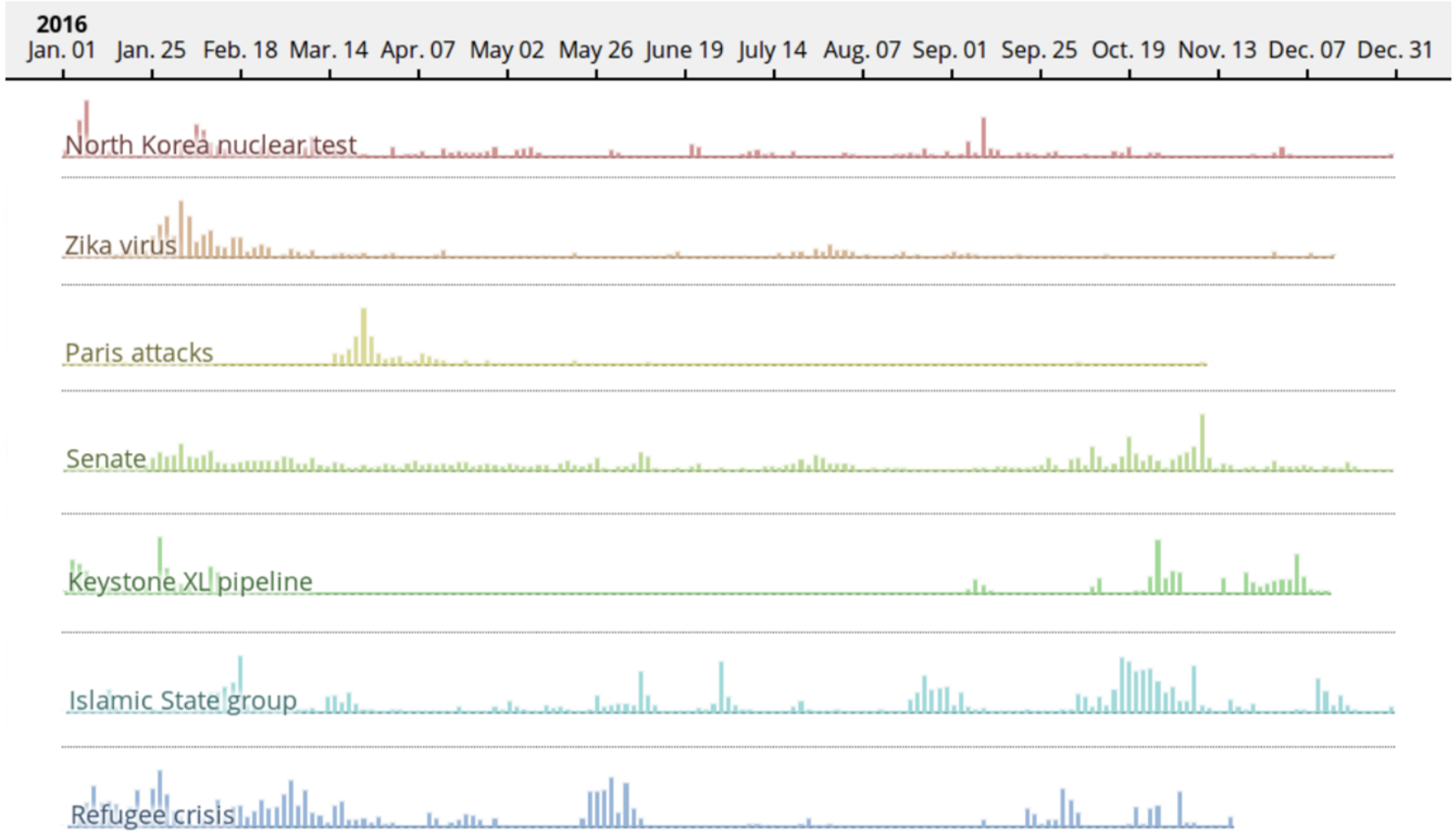
Model	Clusters Count (True Count - 222)	B-Cubed Metrics			
		Precision	Recall	F_1 Score	
Laban and Hearst (2017)	873	94.37	85.58	89.76	
Miranda et al. (2018)	326	94.27	90.25	92.36	
Staykovski et al. (2019)	484	95.16	93.66	94.41	
Linger and Hajaiej (2020)	298	94.19	93.55	93.86	
Ours - TF-IDF	530	93.50	80.23	86.36	
Ours - TF-IDF (out-of-order)	413	90.57	87.51	89.01	1
Ours - TF-IDF + Time	222	87.57	96.27	91.72	
Ours - E-S-BERT	452	79.76	60.77	68.98	
Ours - E-S-BERT + Time	471	92.70	74.69	82.73	2
Ours - TF-IDF + P-BERT + Time	196	83.12	**97.26**	89.63	
Ours - TF-IDF + C-BERT + Time	321	83.10	91.33	87.03	3
Ours - TF-IDF + S-BERT + Time	247	88.30	96.10	92.04	
Ours - TF-IDF + E-S-BERT	433	89.40	86.99	88.18	
Ours - TF-IDF + E-S-BERT (out-of-order)	384	91.15	88.60	89.86	4
Ours - TF-IDF + E-S-BERT + Time	276	**94.28**	95.25	**94.76**	

Table 1: Results of clustering performance for different document representation strategies as compared against contemporary models. P-BERT refers to pre-trained BERT; C-BERT refers to BERT fine-tuned on event classification S-BERT refers to BERT fine-tuned using triplet loss on event similarity; E-S-BERT refers to entity aware BERT fine-tuned on event similarity.

What Might be Useful?

- Track an event
  - Visualize
- Provide updates
- Timeline summarization
- Event summarization

Visualization (Laban & Hearst 2017)



- Using the batch clustering approach to tracking, stories across time are identified (TF*IDF representation)
- Noun phrase keywords selected from the cluster as labels

Detail View (Laban & Hearst 2017)

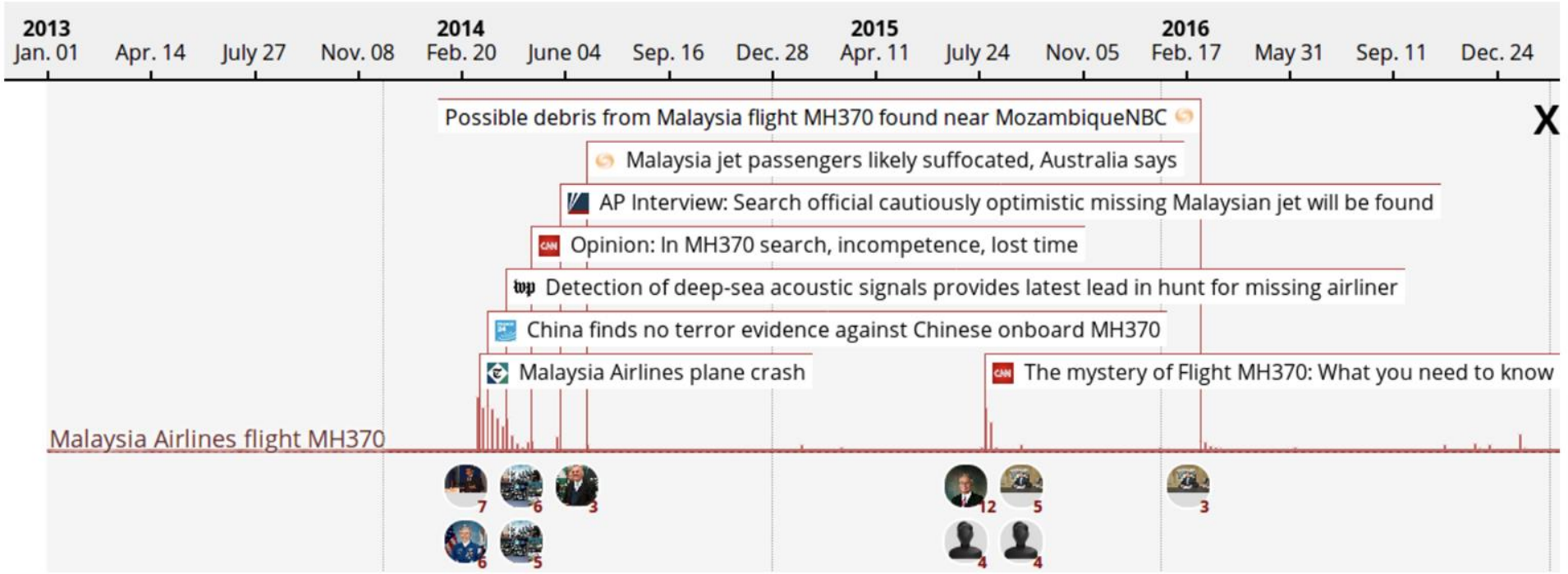


Figure 4: Timeline of the "Malaysia Airline flight MH370", it has large time gaps with no articles.

Headlines of articles at timepoints with a lot of information are selected to provide a detailed view

What Might be Useful?

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Update Summarization

Data from NIST: 2011 – 2013 Web Crawl, 11 categories

Data

- Trec Temporal Summarization Track
  - TREC KBA Stream Corpus
  - hourly web crawl
  - October 2011 - February 2013
  - 16.1TB!
- Training Data drawn from Wikipedia
- The update summarizer must decide when to give the update (and thus, how many articles to include in the summary)

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headlines: Rothko at the Modern ... city insists brown water safe to drink

The U.S. Pacific Tsunami Warning Center said there was a possibility of a local U.S. Pacific Tsunami Warning Center said there was a possibility of a local tsunami, within 100 or 200 miles of the epicenter, but they were not issuing an immediate warning for the broader region.

The magnitude-7.5 quake, about 20 miles deep, was centered off the town of Champerico.

People fled buildings in Guatemala City, in Mexico City and in the capital ofthe Mexican state of Chiapas, across the border from Guatemala.

Would you like to contribute to this story? Start a discussion.

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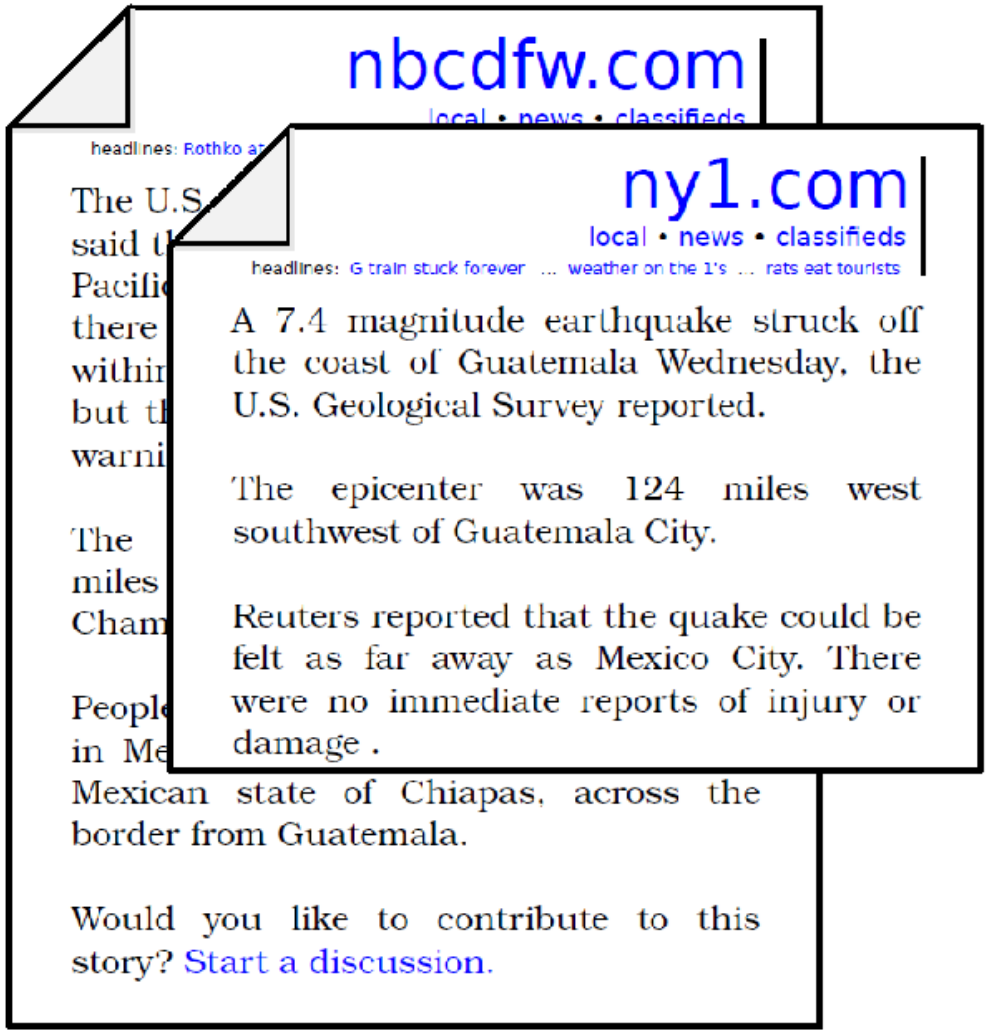
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headlines: G train stuck forever ... weather on the 1's ... rats eat tourists
A 7.4 magnitude earthquake struck off the coast of Guatemala Wednesday, the U.S. Geological Survey reported.
The epicenter was 124 miles west southwest of Guatemala City.
Reuters reported that the quake could be felt as far away as Mexico City. There were no immediate reports of injury or damage .

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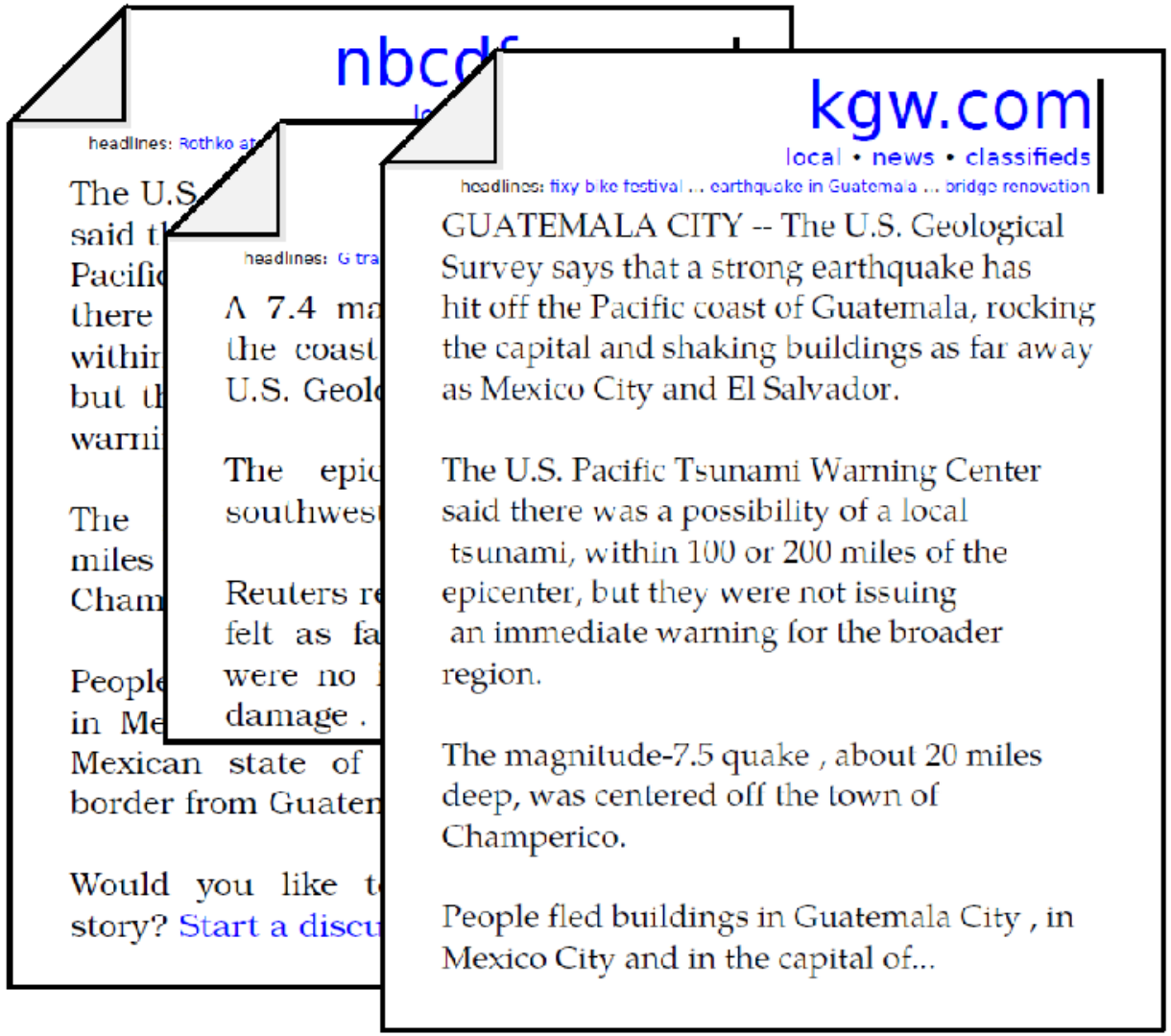
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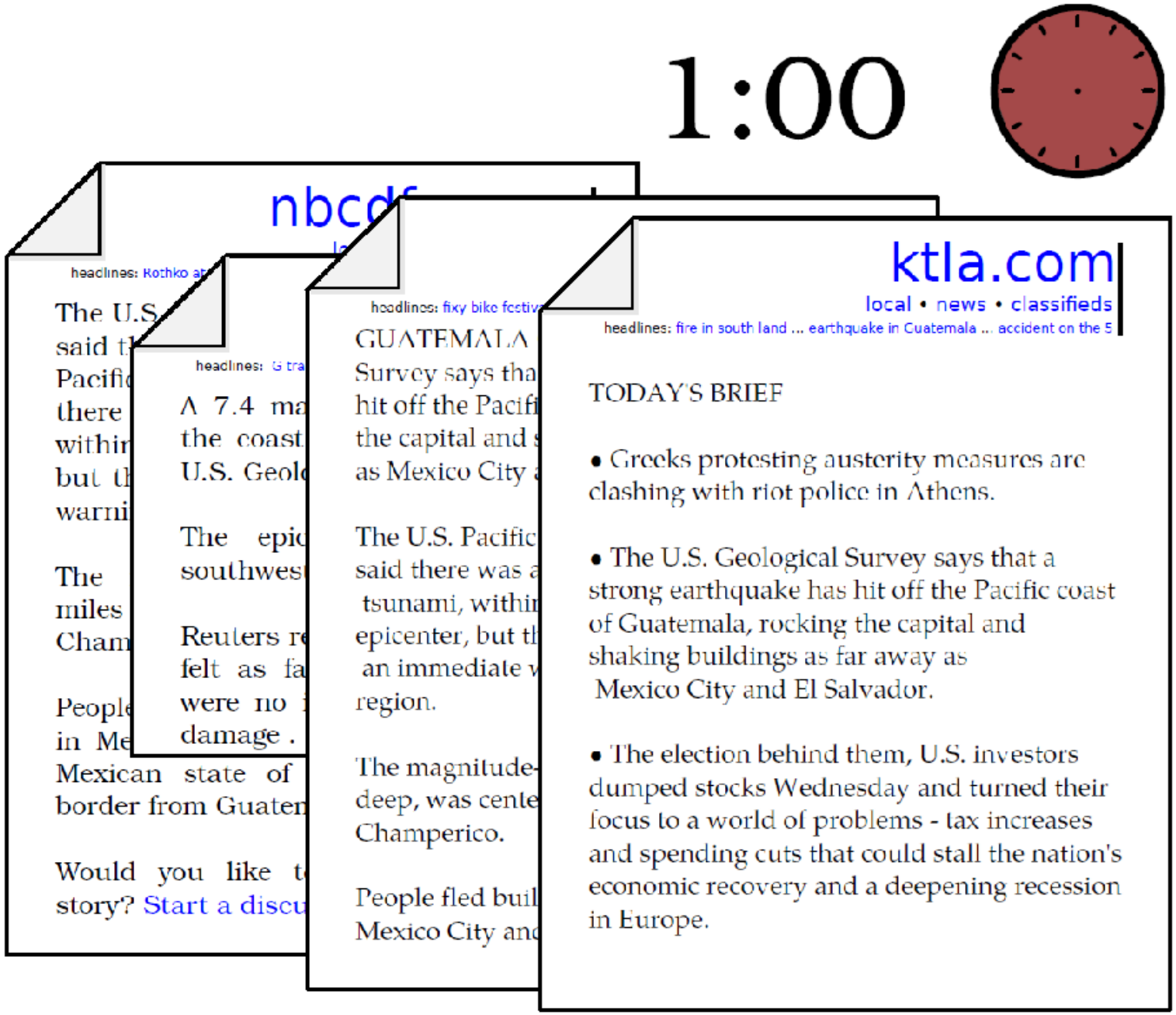
GUATEMALA CITY -- The U.S. Geological Survey says that a strong earthquake has hit off the Pacific coast of Guatemala, rocking the capital and shaking buildings as far away as Mexico City and El Salvador.
The U.S. Pacific Tsunami Warning Center said there was a possibility of a local tsunami, within 100 or 200 miles of the epicenter, but they were not issuing an immediate warning for the broader region.
The magnitude-7.5 quake , about 20 miles deep, was centered off the town of Champerico.
People fled buildings in Guatemala City , in Mexico City and in the capital of...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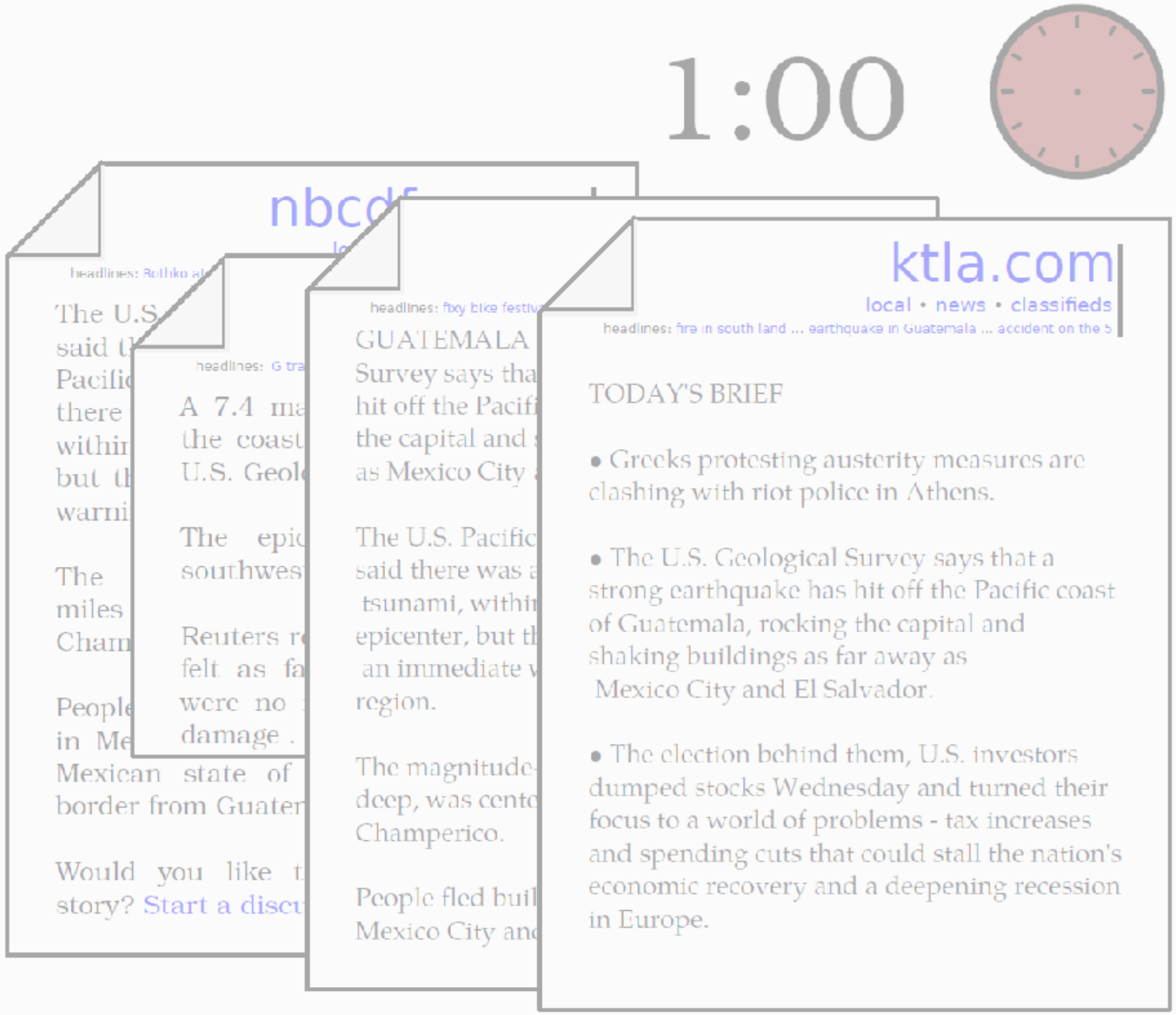
TODAY'S BRIEF
• Greeks protesting austerity measures are clashing with riot police in Athens.
• The U.S. Geological Survey says that a strong earthquake has hit off the Pacific coast of Guatemala, rocking the capital and shaking buildings as far away as Mexico City and El Salvador.
• The election behind them, U.S. investors dumped stocks Wednesday and turned their focus to a world of problems - tax increases and spending cuts that could stall the nation's economic recovery and a deepening recession in Europe.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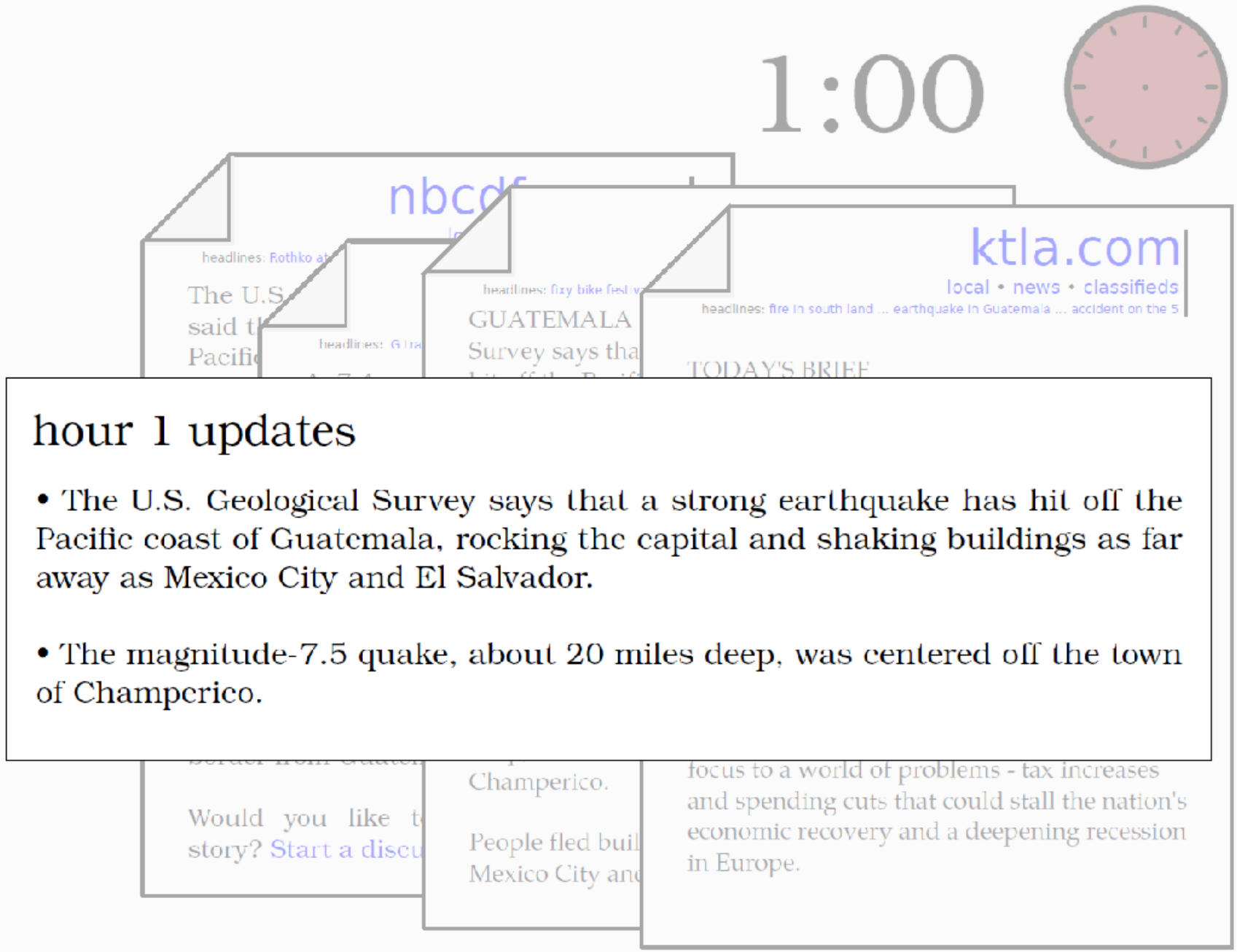


hour 1 updates

- The U.S. Geological Survey says that a strong earthquake has hit off the Pacific coast of Guatemala, rocking the capital and shaking buildings as far away as Mexico City and El Salvador.

- The magnitude-7.5 quake, about 20 miles deep, was centered off the town of Champerico.

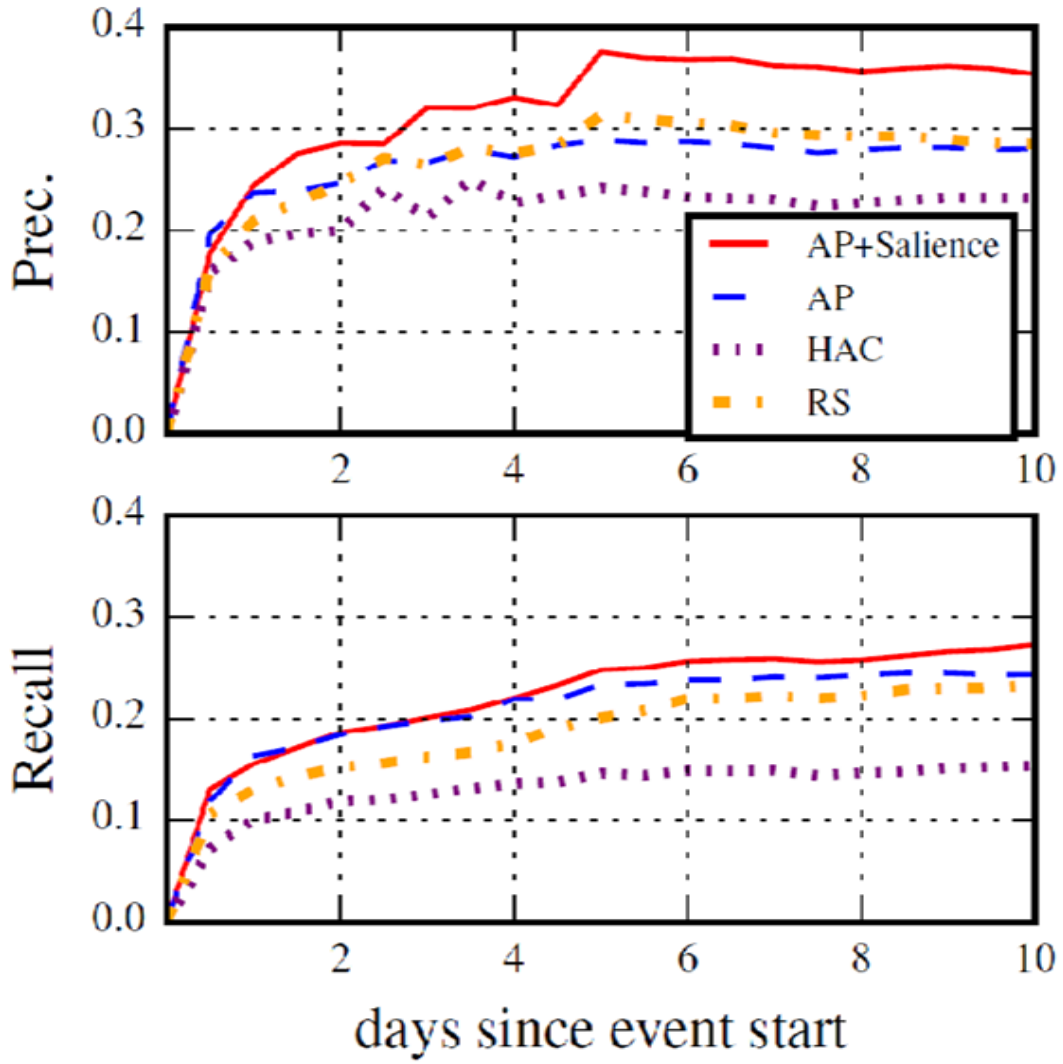
Temporal Summarization Approach

At time **t**:

- Predict salience for input sentences
  - A domain specific language model to score sentences by event typicality
  - Location to indicate current event
  - Semantics: event type synonyms, hyernyms, hyponyms
- Remove redundant sentences
- Cluster and select exemplar sentences incorporating salience prediction as a prior

Kedzie & al, Bloomberg Social Good Workshop, KDD 2014
Kedzie & al, ACL 2015

Salience Helps



- Salience predictions lead to high precision quickly
- Salience predictions allow us to more quickly recover more information

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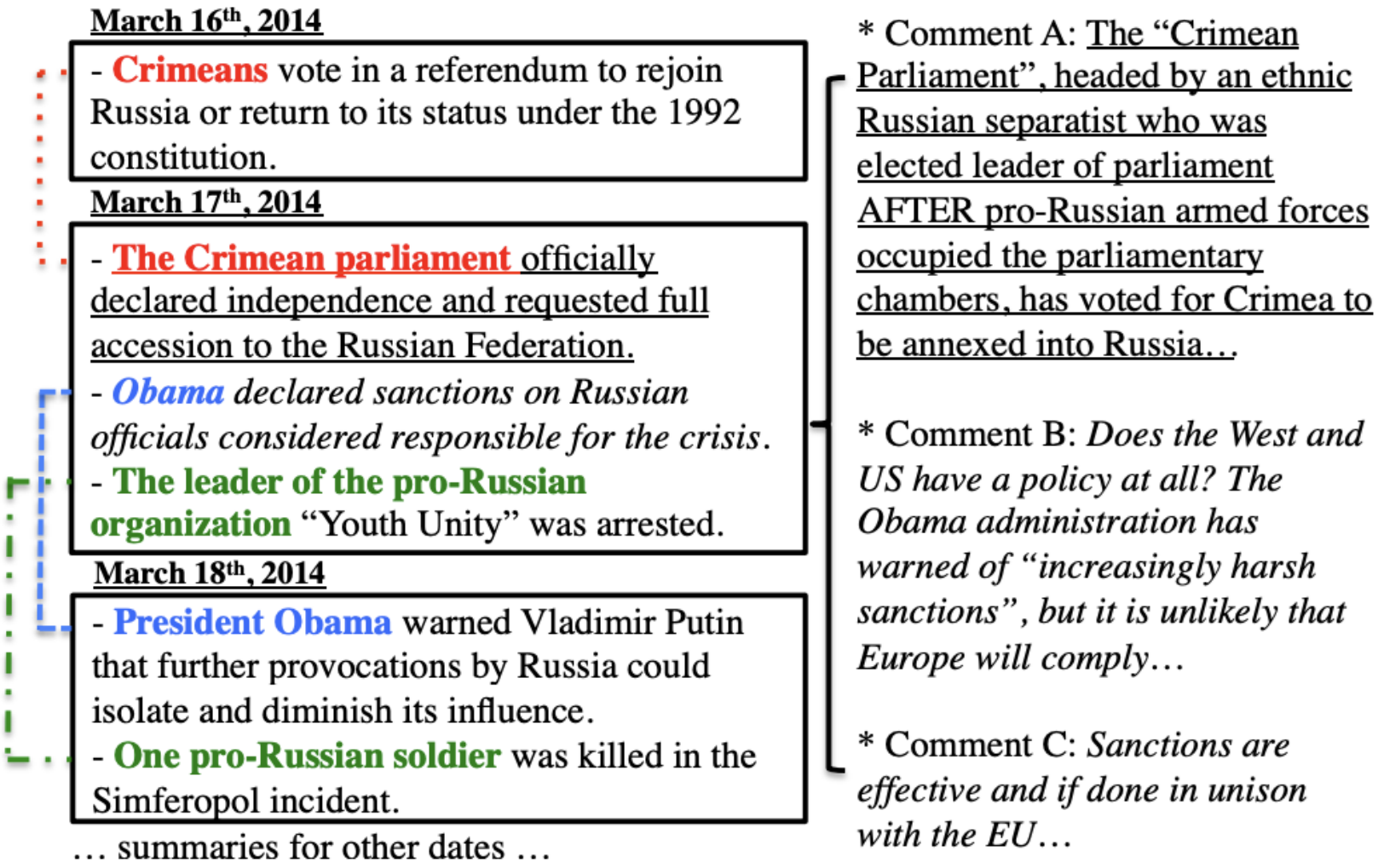
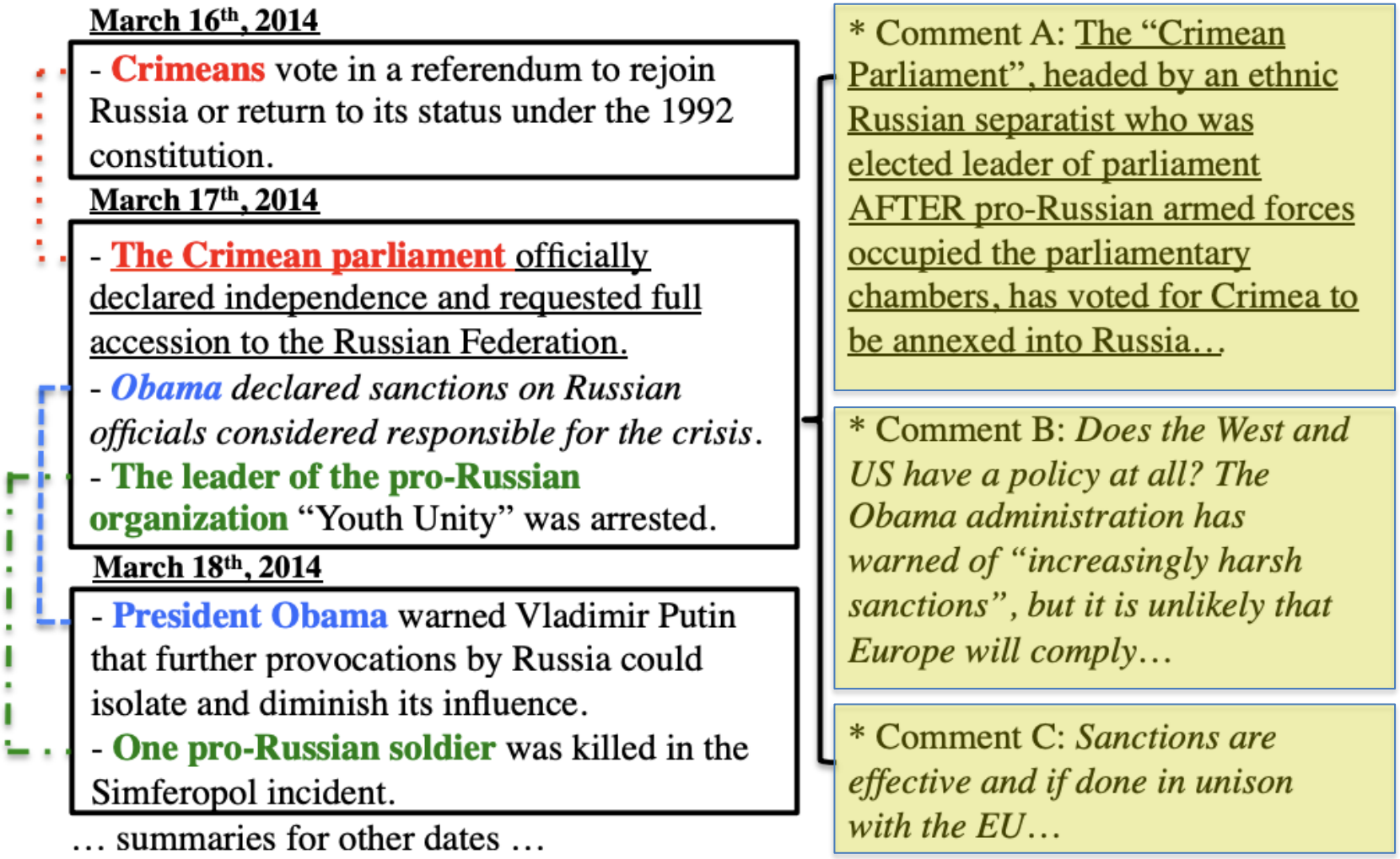
Event Timeline Summarization



Gold standard event timeline for the Ukraine Crisis (Wang et al 2015)

Event Timeline Summarization



Gold standard event timeline for the Ukraine Crisis (Wang et al 2015)

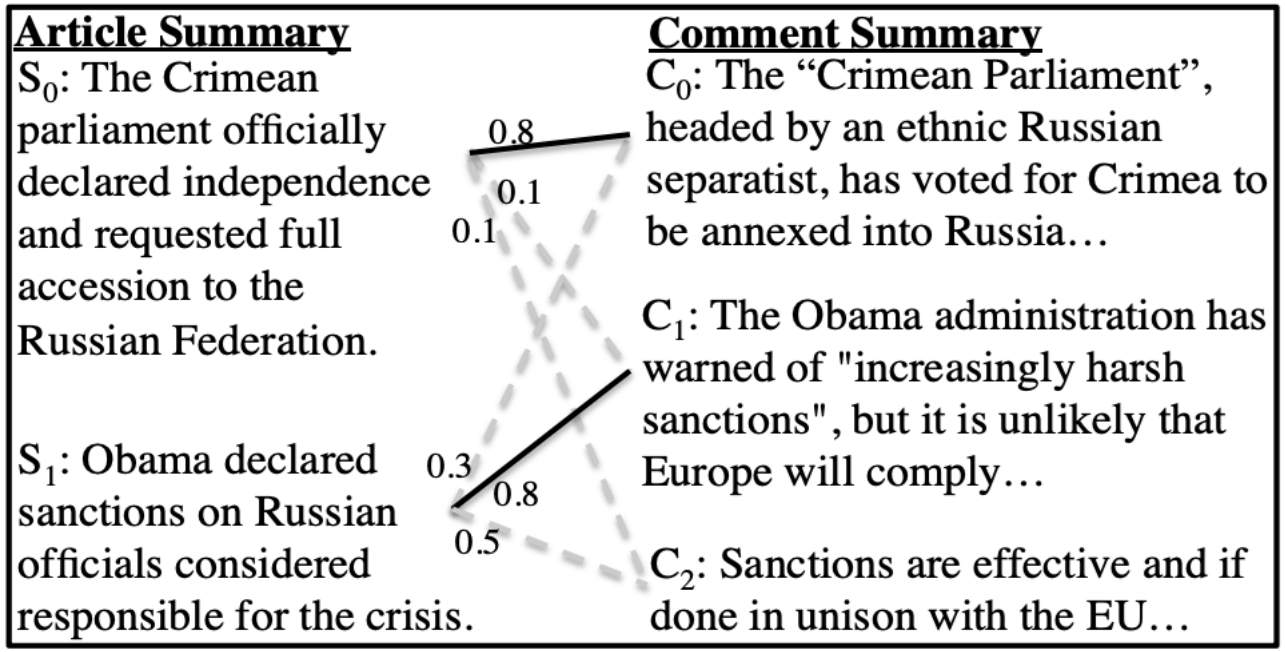
Data: collected by Wang et al

	Time span	# articles	# comments
MH370	03/08-6/30	955	406,646
Ukraine	03/08-6/30	3,779	646,961
Israel-Gaza	07/20-9/30	909	322,244
NSA	3/23-6/30	145	60,481

- Comments in addition to articles
- Summaries are for an article on the event on day x (i.e., not an update)

Approach

- Joint learning for sentence importance
  - Article summary
  - Comment summary
- Use of event threading to connect an article summary to previous events in the timeline
- Graph –based algorithm



(Wang et al 2015)

Human Evaluation

- How well could students answer questions about an event (with and without event threads)?

Answer Type	Avg ± STD	Rated 5 (%)	Rated 4 (%)
No Thread	2.58 ± 1.20	7%	23%
With Threads	3.29 ± 1.28	17%	26%

Table 6: Human evaluation on the informativeness of answers written after reading timelines *with threads* vs. with *no thread*. Answers written with access to threads are rated higher (3.29) than the ones with no thread (2.58).

(Wang et al 2015)

Other Approaches to Timeline Summarization

- Abstractive summarization using a memory based timeline summarization model (MTS) (Chen et al 2019)
  - Embeddings of time serves as *keys*
  - Event embeddings are indexed by time
  - RNN with attention over the memory

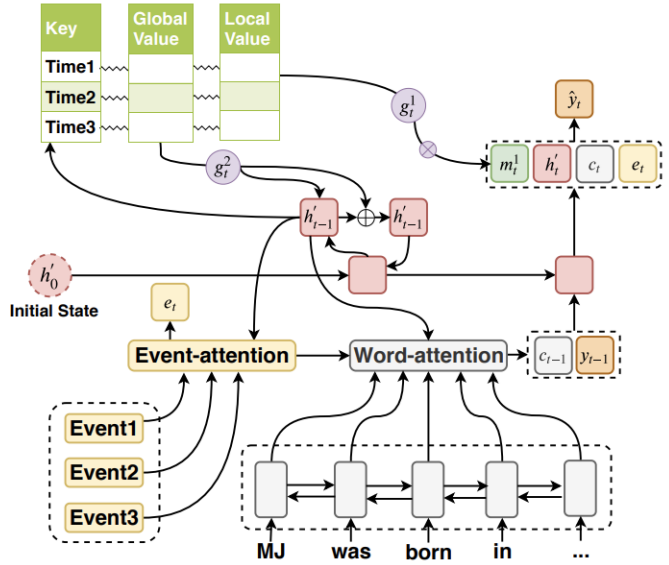


Figure 2: An overview of the summary generator.

(Chen et al 2019)

- Query focused event ranking timeline summarization (Nguyen et al 2014)

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Multi-Document Summarization

- A summary of a single event on a single day drawn from multiple documents
- Datasets:
  - Multi-News (Fabbri et al 2019)
    - 56,216 articles/summary pairs drawn from newser.com
    - Summaries professionally written
    - > 1500 news sites
  - WikiSum (Liu et al 2018)
    - Input: Wikipedia title (topic)
    - Articles: non-Wikipedia articles referenced from Wikipedia
    - Summary: Lead of the Wikipedia article

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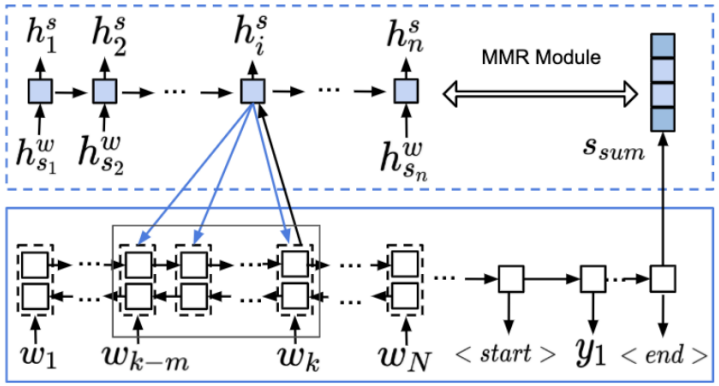
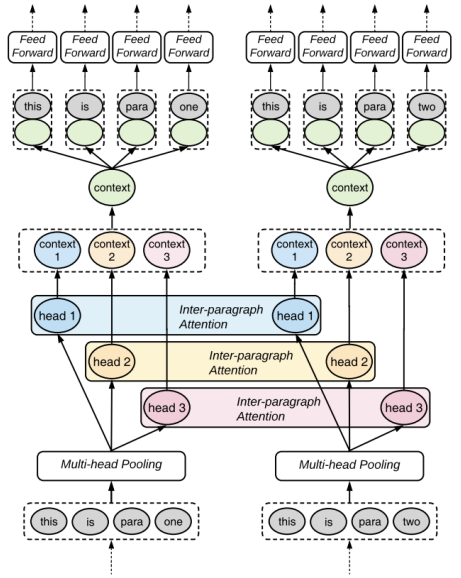
Multi-document Summarization Models

- Both hierarchical
- Architectures
  - Integrate Maximal Marginal Relevance and standard pointer-generator network to learn parameters for similarity and redundancy (Fabbri et al 2019
  - Extractive/abstractive models
    - Rank paragraphs in comparison to title using semantic similarity (Lui et al 2018)
    - Rank paragraphs in comparison to summary augmented with graph learning representing semantic similarity between paragraphs and discourse relations (Liu et al 2019)



Pointer-generator Network

Fabbri et al 2019



Liu et al 2019

What Have We Learned?

- Research on complex events focuses on many tasks

- An event can be represented by
  - A cluster of articles (tracking)
  - A single article (timeline summarization)
  - Multiple articles since last update (update summarization)
  - Multiple articles on one day (multidocument summarization)

- What about multiple large-scale events in one article? Is granularity at the right level?

- Could we use temporal relations between events?

- How can we use multiple media, multiple languages, different viewpoints

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Thank you