Video Timeline Modeling For News Story Understanding

Meng Liu, Mingda Zhang, Jialu Liu, Hanjun Dai

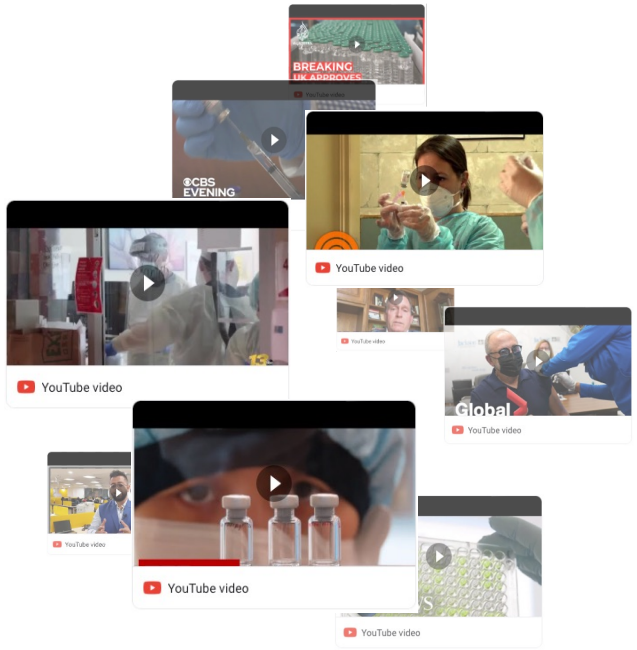
Ming-Hsuan Yang, Shuiwang Ji, Zheyun Feng, Boqing Gong

TEXAS A&M UNIVERSITY
Engineering

NeurIPS 2023 Track on Datasets and Benchmarks

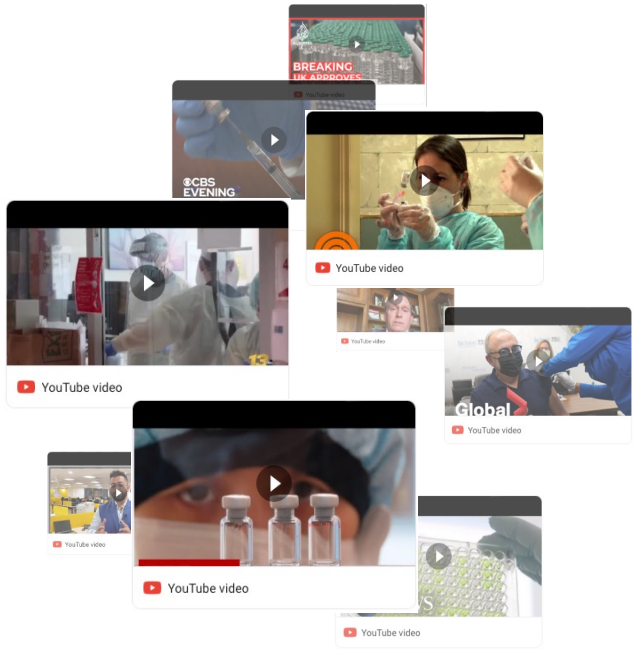
The News Video Boom

- The news video universe is expanding



The News Video Boom

- The news video universe is expanding



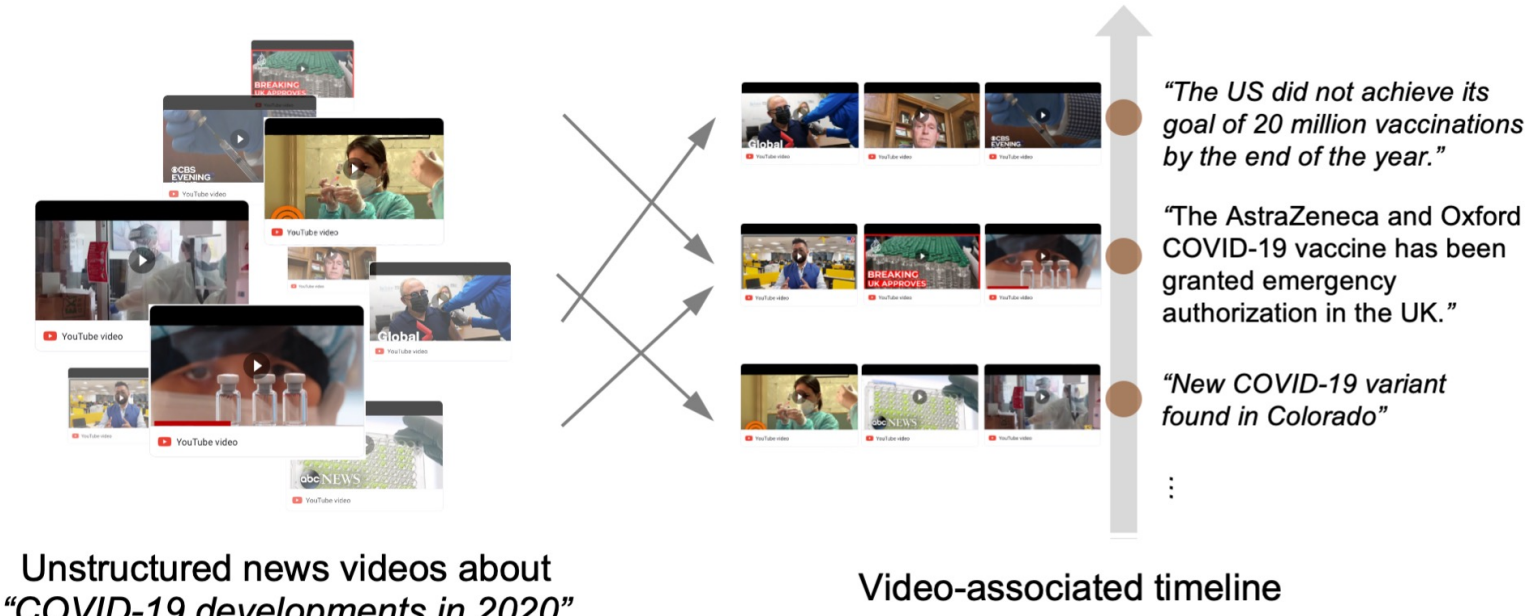
- How to organize such unstructured videos for better story understanding?

Contributions

- Formulate the video timeline modeling problem
- Present a realistic benchmark dataset: YouTube-News-Timeline
- Formalize quantitative metrics
- Propose several exploratory deep learning methods

Video Timeline Modeling

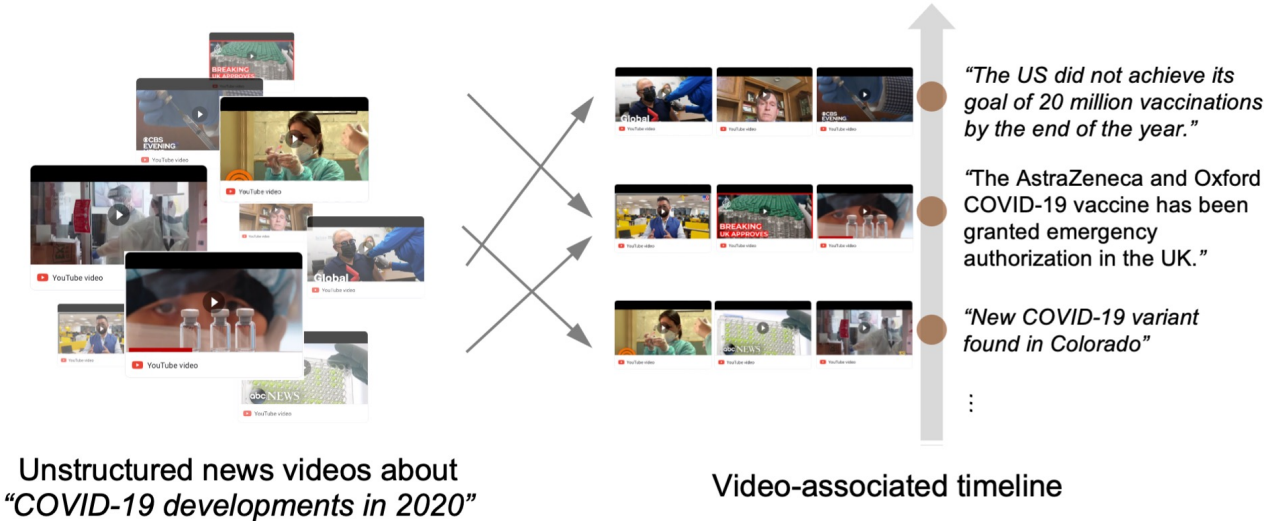
- A set of videos belonging to a specific news topic --> a number of ordered nodes to form a timeline, where each node corresponds to a set of videos selected from the input video set



- Arrange a collection of unstructured news videos into a evolutionary timeline story

Dataset Challenges

- News stories are complicated
- Lack a golden timeline for a news topic
- Impossible to assign an overwhelming number of videos to nodes with human service

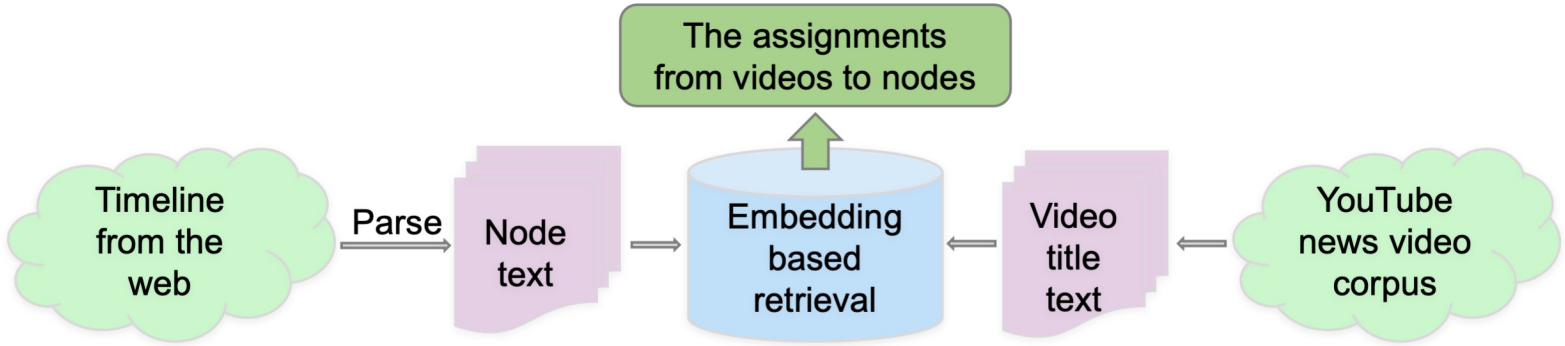


Unstructured news videos about *"COVID-19 developments in 2020"*

Video-associated timeline

The YouTube-News-Timeline Dataset

- Data collection pipeline
  - NewsEmbed [1]

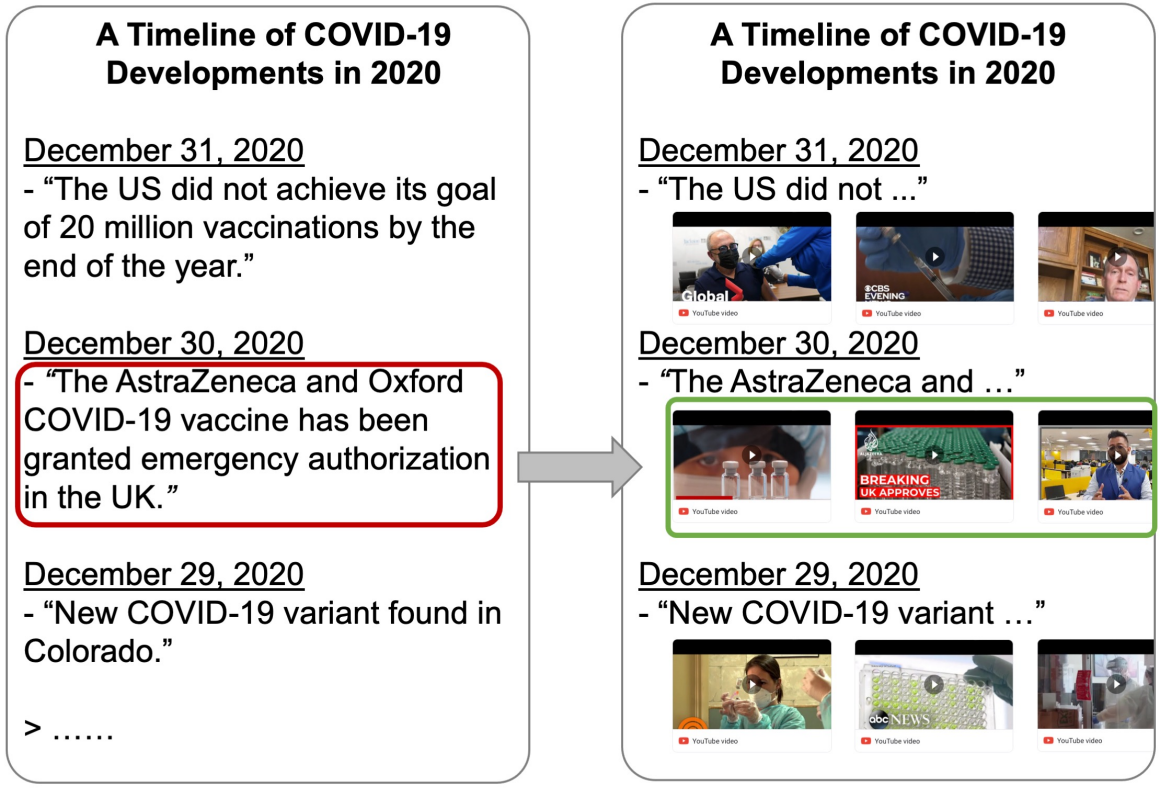


- Sanity assurance
  - Prioritize high precision in the retrieval
  - Reduce ambiguity between consecutive events

[1] Jialu Liu, Tianqi Liu, and Cong Yu. "NewsEmbed: Modeling news through pre-trained document representations." KDD, 2021.

The YouTube-News-Timeline Dataset

- Data example

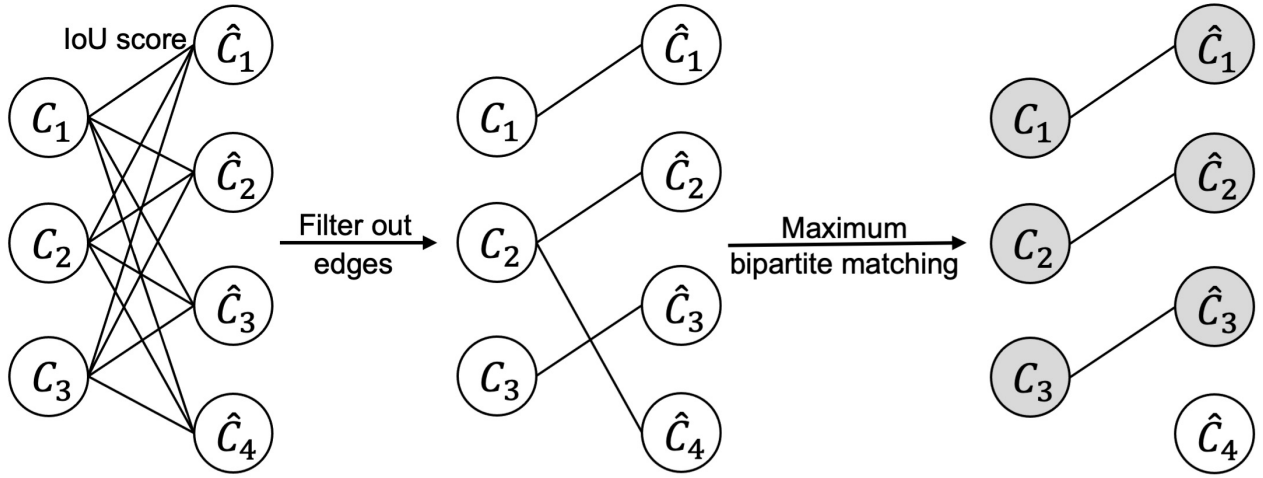


(a) A crawled timeline *(b) The labeled timeline*

- More than 12k timelines and 300k videos

Evaluation Protocol

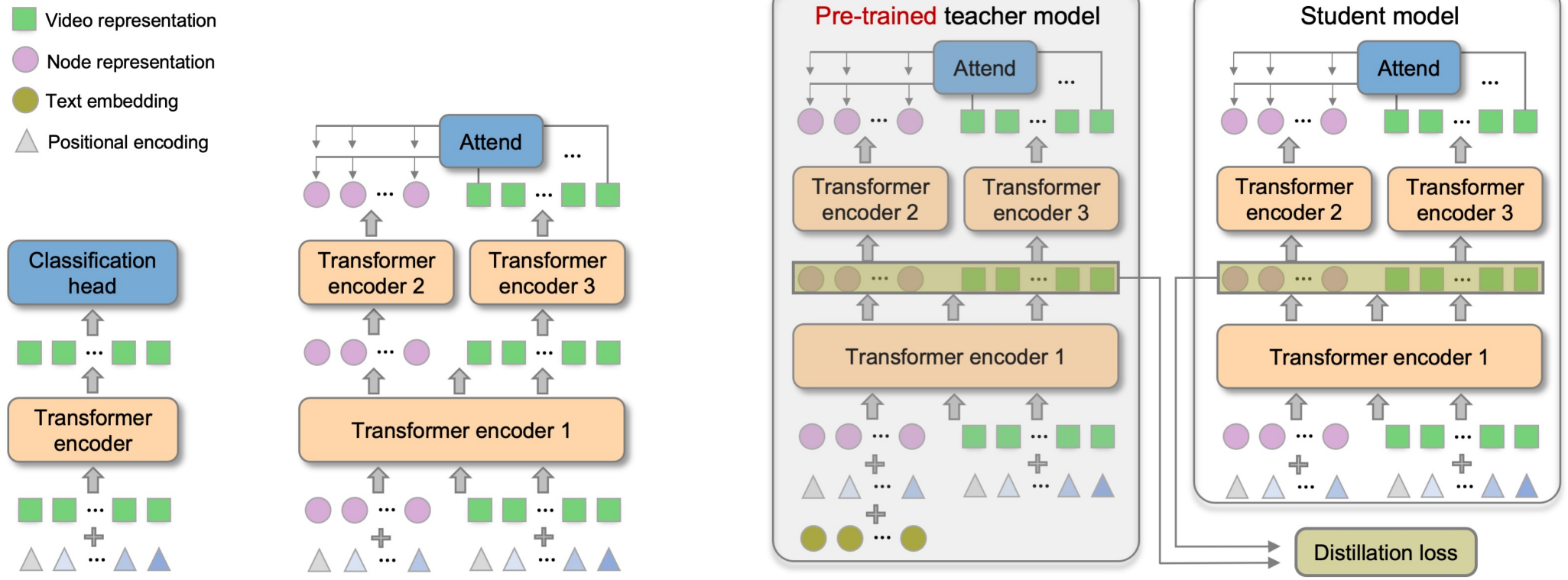
- What aspects should we measure?
  - If the events are correctly identified?
  - If the video ordering is correct to represent the story evolution?



- Node-level precision and recall
- Node-level Hamming distance
- Node-level Euclidean distance
- Video pairwise agreement accuracy

Methods for the Problem

- V-Transformer, Tri-Transformer, w/ cross-modal distillation

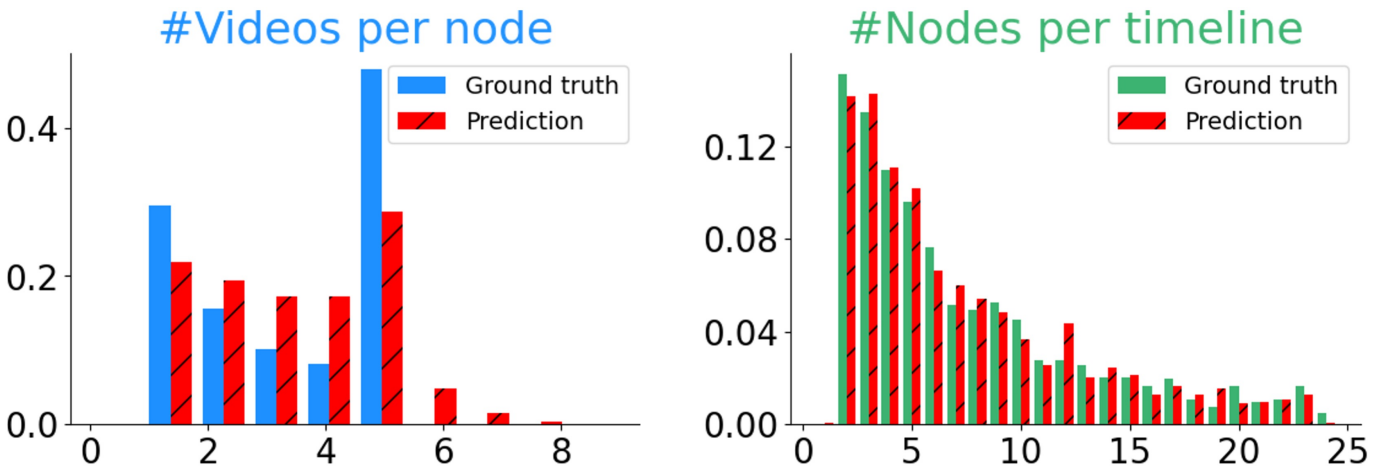


(a) V-Transformer *(b) Tri-Transformer* *(c) Tri-Transformer + cross-modal distillation*

Experiments

- Performance of the proposed models
  - Reference optimum: the test performance of the teacher model with text information

Method	Precision/Recall↑		Hamming distance↓		Euclidean distance↓		Agreement accuracy↑	
	Macro	*Micro*	*Macro*	*Micro*	*Macro*	*Micro*	*Macro*	*Micro*
V-Transformer	68.8%/68.9%	64.4%/63.0%	0.477	0.519	0.765	0.916	84.2%	93.8%
Tri-Transformer	71.4%/**71.2%**	66.6%/65.6%	0.453	0.490	0.716	0.837	**85.4%**	94.3%
Tri-Transformer + cross-modal distillation	**72.5%**/71.1%	**68.4%**/**65.9%**	**0.436**	**0.470**	**0.684**	**0.804**	85.2%	**94.5%**
A reference optimum	79.8%/78.3%	75.0%/72.9%	0.308	0.362	0.380	0.473	88.8%	95.5%

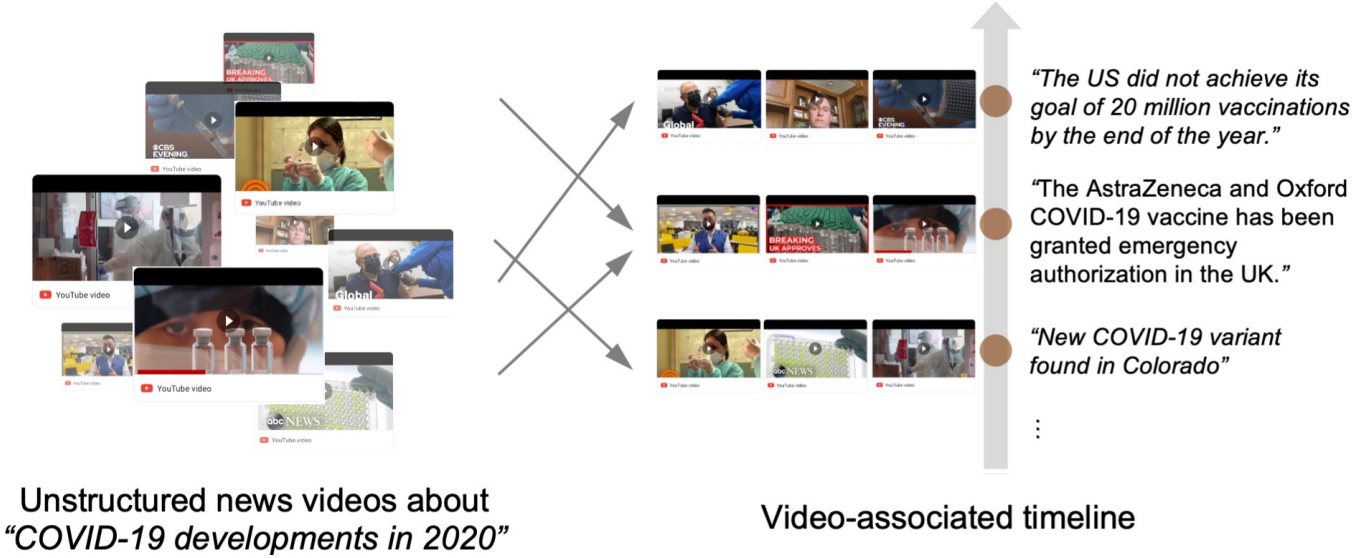


Experiments

- Example of predicted timeline

#ground truth nodes = 8, #predicted nodes = 8, #videos = 29
node-level precision/recall = 100.0%/100.0%, video-level Hamming distance = 0.103, video-level Euclidean distance = 0.103, video pairwise agreement accuracy = 96.6%

Node ID	Ground truth videos (titles)	Predicted videos (titles)
1	tT_AWx7dgjg ("China Rocket Launches, Spacewalk Next") YJrnfvQZNYo ("China Launches Its Third Manned Space Mission")	tT_AWx7dgjg ("China Rocket Launches, Spacewalk Next") YJrnfvQZNYo ("China Launches Its Third Manned Space Mission")
2	UIcL9aXpOYE ("LIFT OFF: China launches space module rocket Tiangong 1") 8zK8jHpLV9c ("China launches first module for space station") 2CU0RKMW2n8 ("China launches first stage of space station plan")	UIcL9aXpOYE ("LIFT OFF: China launches space module rocket Tiangong 1") 8zK8jHpLV9c ("China launches first module for space station")
3	MAx8UrCm5Cg ("SPACE MISSION: China's Shenzhou-8 carries out first docking") Tj1zGxShID4 ("Success as China passes its first space docking test")	2CU0RKMW2n8 ("China launches first stage of space station plan") MAx8UrCm5Cg ("SPACE MISSION: China's Shenzhou-8 carries out first docking") Tj1zGxShID4 ("Success as China passes its first space docking test")
4	3A6pvG676aM ("China Lands Spacecraft on Moon") l-XYRQWGEZM ("China's Chang'e3 unmanned spacecraft lands on the moon") BxdBFCwqlGw ("State TV in China broadcasts Moon landing") oEHniKlucL0 ("China lands rover on the moon") PGrf1_ipjH0 ("Chinese lunar rover lands on moon")	3A6pvG676aM ("China Lands Spacecraft on Moon") l-XYRQWGEZM ("China's Chang'e3 unmanned spacecraft lands on the moon") BxdBFCwqlGw ("State TV in China broadcasts Moon landing") oEHniKlucL0 ("China lands rover on the moon") PGrf1_ipjH0 ("Chinese lunar rover lands on moon")
5	RodztOlgZW0 ("China launches Tiangong-2 space lab") euBlfv9S-ZE ("China successfully launches 2nd space laboratory Tiangong-2") goRzJM4PIEI ("China successfully launches Tiangong-2 space lab") Dw9RHNVmswE ("The launch of Tiangong-2 space lab") 1stYgsnT9Zs ("Cina, lanciato in orbita il laboratorio spaziale Tiangong-2")	RodztOlgZW0 ("China launches Tiangong-2 space lab") euBlfv9S-ZE ("China successfully launches 2nd space laboratory Tiangong-2") goRzJM4PIEI ("China successfully launches Tiangong-2 space lab") Dw9RHNVmswE ("The launch of Tiangong-2 space lab") 1stYgsnT9Zs ("Cina, lanciato in orbita il laboratorio spaziale Tiangong-2")
6	kQrLjgvIXEc ("Chinese probe Chang'e 4 lands on far side of moon") A2AXeRN-7Uk ("China's Chang'e-4 lands on moon's far side") WpzJblVRdO4 ("China lands Chang'e-4 space probe on the far side of the moon") apVqFquXYIg ("Chang'e-4 Probe Takes Panoramic Photos on Moon's Far Side") iEThGnpwAxU ("Chang'e-4 Probe Takes First Photo of Moon's Far Side")	kQrLjgvIXEc ("Chinese probe Chang'e 4 lands on far side of moon") A2AXeRN-7Uk ("China's Chang'e-4 lands on moon's far side") WpzJblVRdO4 ("China lands Chang'e-4 space probe on the far side of the moon") apVqFquXYIg ("Chang'e-4 Probe Takes Panoramic Photos on Moon's Far Side") iEThGnpwAxU ("Chang'e-4 Probe Takes First Photo of Moon's Far Side")
7	J7M-nEJnr4k ("China puts final satellite for Beidou into orbit") JCa9UPHMaWE ("China launches 100% domestically produced final satellite to complete Beidou system")	J7M-nEJnr4k ("China puts final satellite for Beidou into orbit") JCa9UPHMaWE ("China launches 100% domestically produced final satellite to complete Beidou system") WSkCBaN_CLM ("China launches unmanned probe in first independent Mars mission") fwuWTd0NScc ("China launches its first unmanned mission to Mars")
8	WSkCBaN_CLM ("China launches unmanned probe in first independent Mars mission") fwuWTd0NScc ("China launches its first unmanned mission to Mars") sCiwZTnxBvo ("Tianwen 1: China launches first independent mission to Mars") UqzBbubHtvc ("Beijing launches unmanned interplanetary mission to Mars") 0OCPNfGrrcQ ("China launches unnamed Mars probe")	sCiwZTnxBvo ("Tianwen 1: China launches first independent mission to Mars") UqzBbubHtvc ("Beijing launches unmanned interplanetary mission to Mars") 0OCPNfGrrcQ ("China launches unnamed Mars probe")



Unstructured news videos about
"COVID-19 developments in 2020"

Video-associated timeline

Thank You!

@mengliu_1998