

Events, Relationships, and Script Learning

Trigger Identification:

Bi-directional LSTM + CRF

- Concatenate character embeddings with pre-trained word embeddings to get vectors representing each word
- Run a bi-LSTM over the sequence of word vectors to obtain the two hidden states
- Use a CRF to find the sequence with the highest probability

Results	P	R	F1
JointEventEntity	61.4	71.0	65.9
Bi-LSTM + CRF	66.7	66.0	66.4

- Train SVMs to label triggers as belonging to one of 33 subtypes (e.g., attack, sentence, convict, etc.)
- However, with perfect trigger identification, F1 for trigger classification is 80.0.

Results	P	R	F1
JointEventEntity (reported)	75.1	63.3	68.7
JointEventEntity (reported)	61.5	71.2	66.0
SVM	81.6	54.5	65.3

Bottom line: Neither technique should be trusted to perform accurate trigger identification

Macro-Event Extraction

Document-level analysis – extract only the most important events in a text

The Shield Actor **Michael Jace** Found Guilty of Wife's Murder, Sentenced to 40 Years in Prison



ATTACK Macro-Event	
Perpetrator	Michael Jace
Victim - Dead	April Jace
Victim - Injured	None
Time	May 19, 2014
Location	Los Angeles

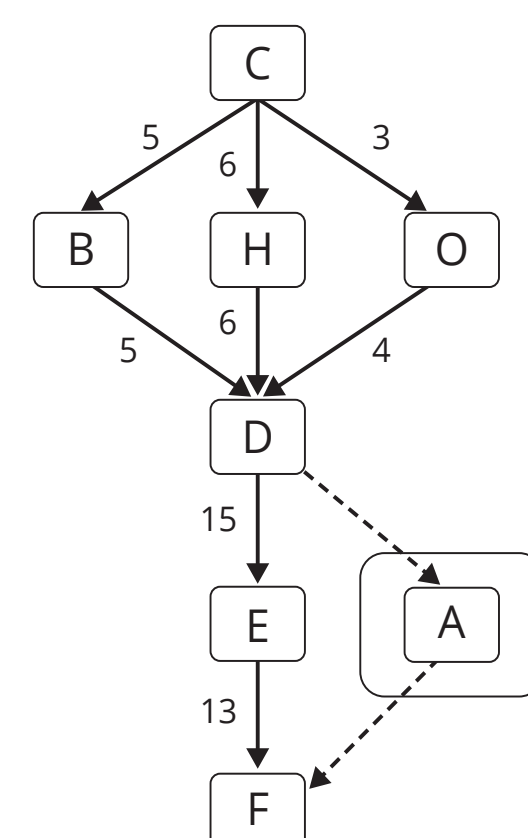
TRIAL Macro-Event	
Defendant	Michael Jace
Crime	Murder
Verdict	Guilty
Sentence	Prison
Time	Tuesday
Location	Los Angeles

ARREST Macro-Event	
Arrestee	Michael Jace
Time	2014
Location	Los Angeles

Developing two novel ML-based algorithms for solving this problem

- A structured prediction model based on Learning to Search
 - A deep neural network based on machine comprehension with no reliance on target domain training data
- Preliminary results on the attack and elections domains show significantly improved performance against baseline methods

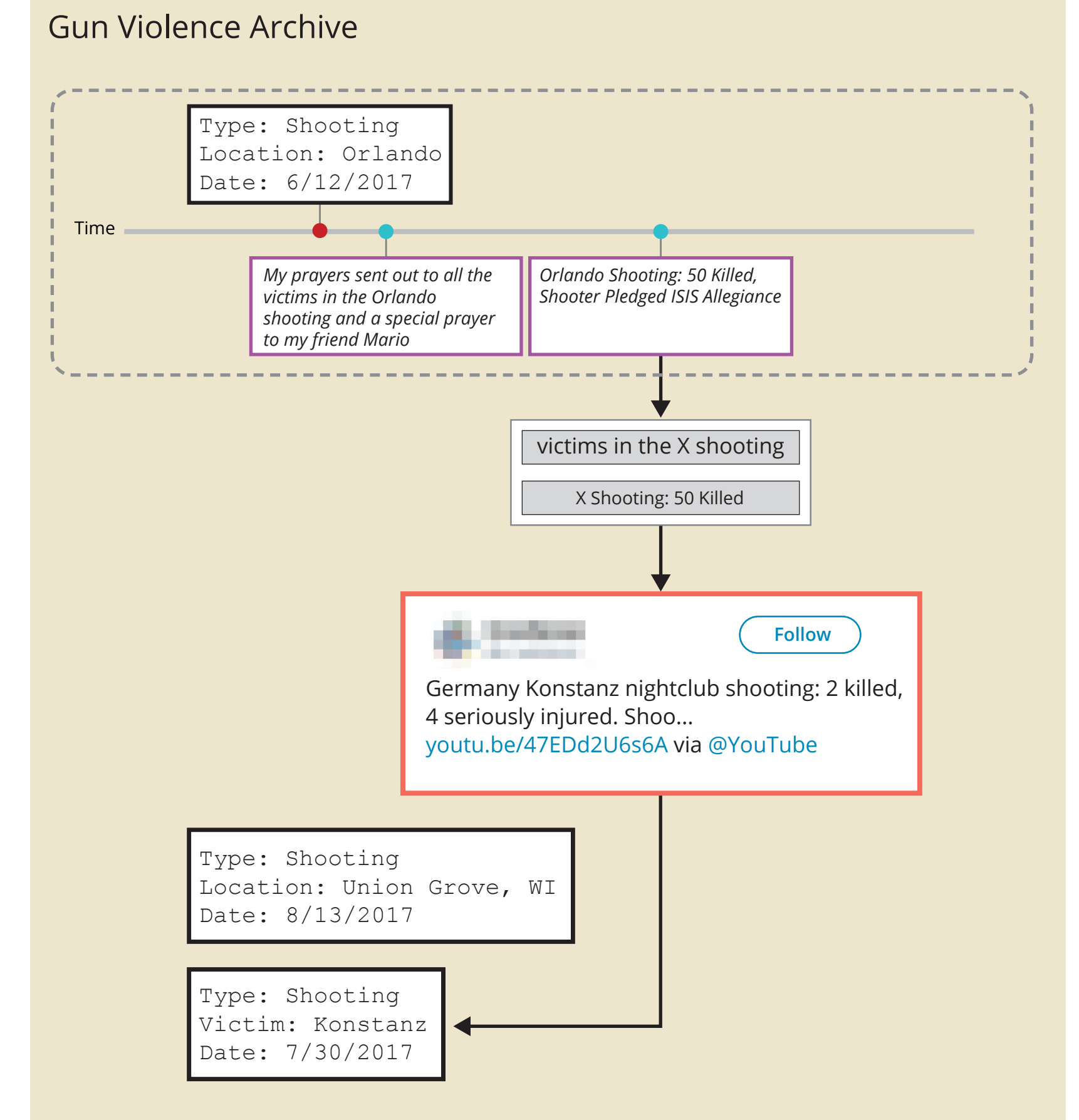
Currently gathering annotated data via Mechanical Turk



Extensions to FY16 Script Learning

- Better representation of the world
 - Finer-grain event representation (actor, location, etc.)
 - Probability distributions over the possible arguments
 - A refined similarity metric that can reflect the new representation
 - More robust script manipulation
 - Better script addition (avoiding adding rare instances, etc.)
 - Splitting / pruning existing scripts
- Use of macro-event knowledge for inferring constraints

Learning to Extract Events Minimal Supervision



Expectation Regularization

$$O(\theta) = \underbrace{\sum_i^N \log p_\theta(y_i|x_i)}_{\text{Log Likelihood}} - \underbrace{\lambda^U D(\tilde{p}||\hat{p}_\theta^{\text{unlabeled}})}_{\text{Label regularization}}$$

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