Knowledge-oriented CNN for causal relation extraction

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Neural causal relation extraction

"Rising global temperatures create perfect conditions for tsunamis."

- Assume marked events e_1, e_2 in some sentence

- Binary classification of whether events are causally linked

- Neural architecture incorporating handcrafted knowledge
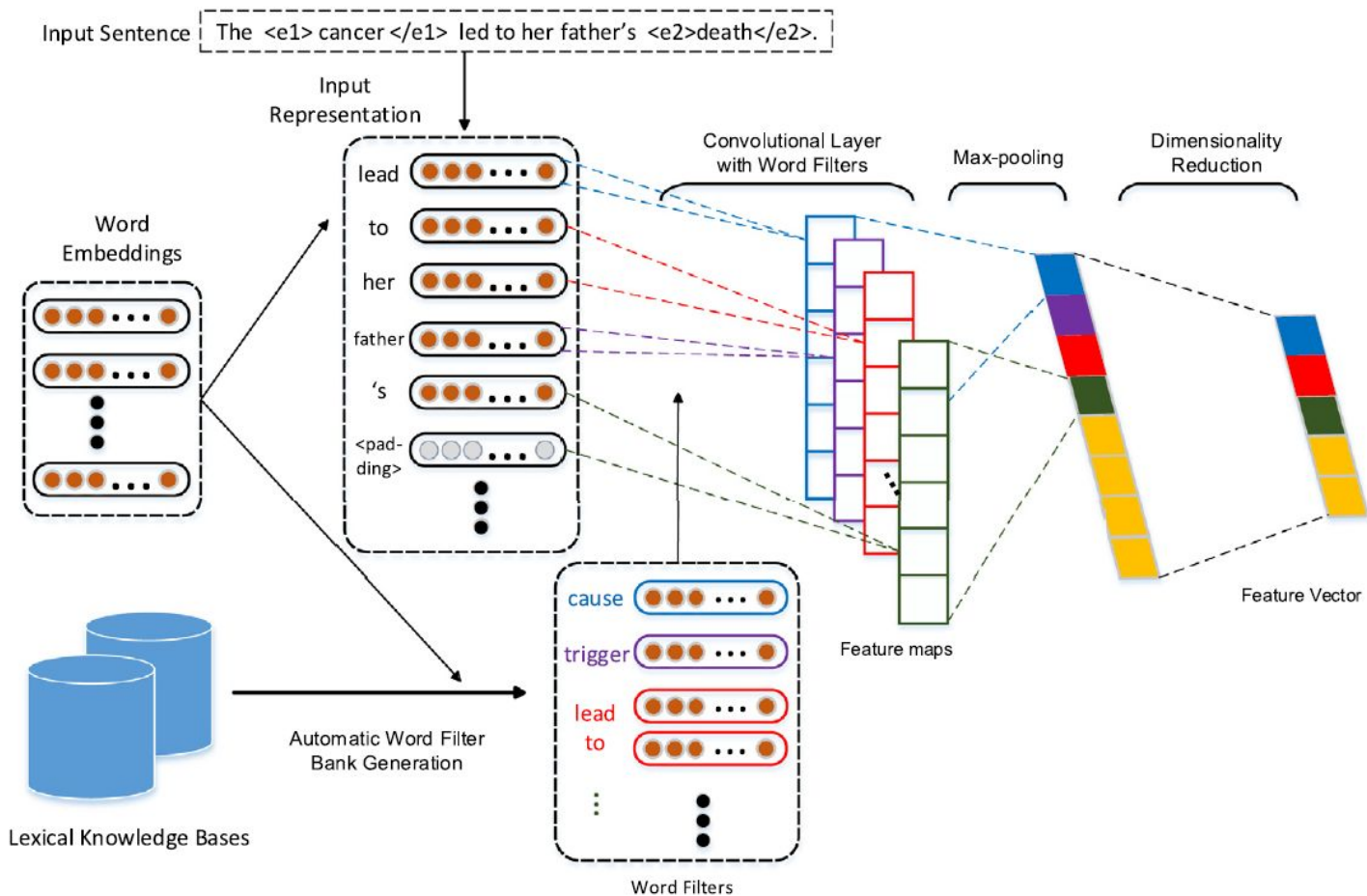
Idea: look for similarities with known causal indicators

"Rising global temperatures create perfect conditions for tsunamis."

- "Create" links the two events in a causal way

- We know about explicit linking words like "cause"

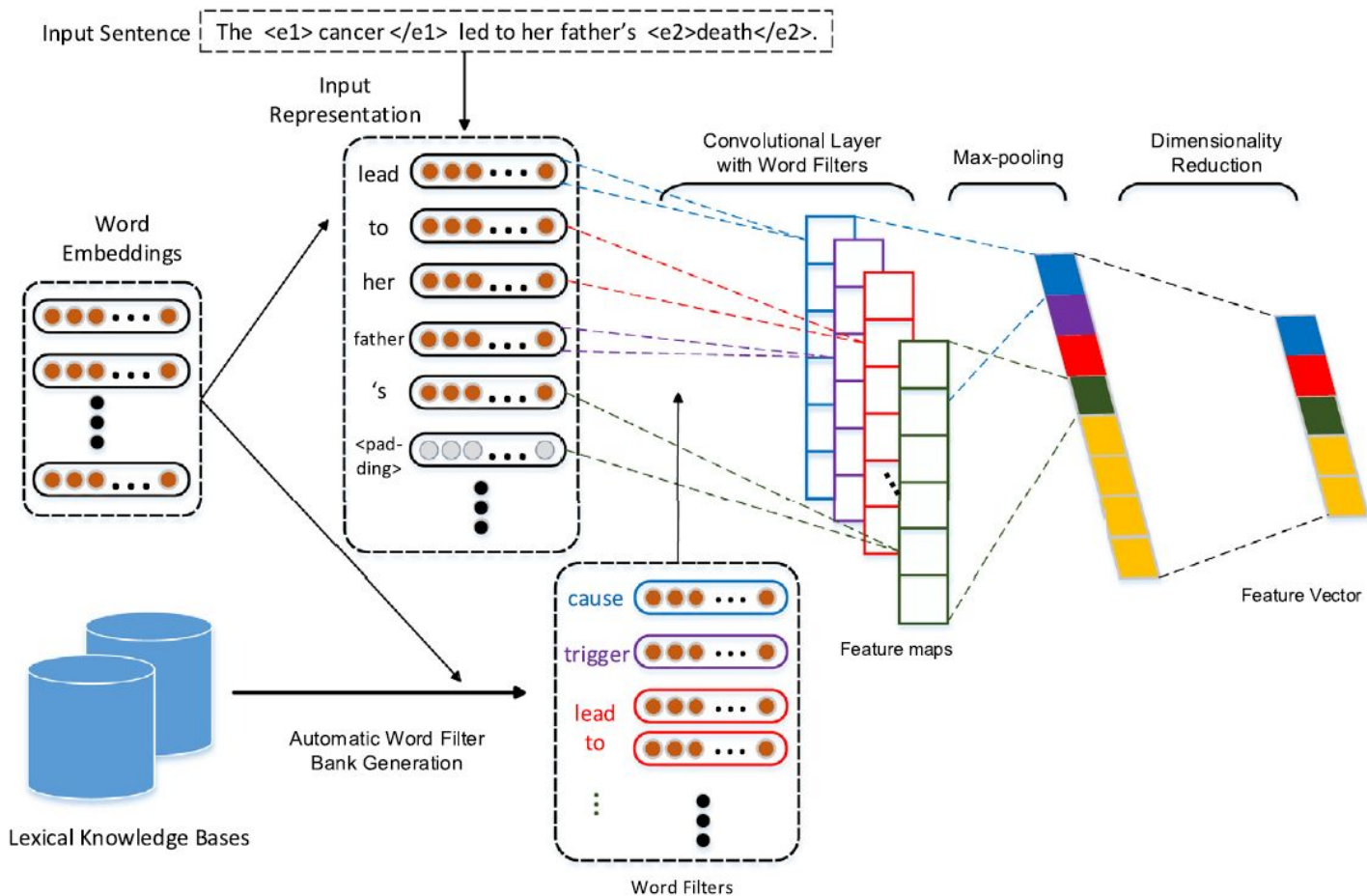- Can we leverage some similarity between "cause" and "create"?

Architecture

How to get known causal words?

1. 40 causal frames from FrameNet

    a. "Causation"

    b. "Reason"

    c. "Explaining_the_facts" ...

2. Get lexical units from these frames

3. Extract additional lexical units using WordNet synsets

4. K-means clustering of 800 lexical unit embeddings

Architecture

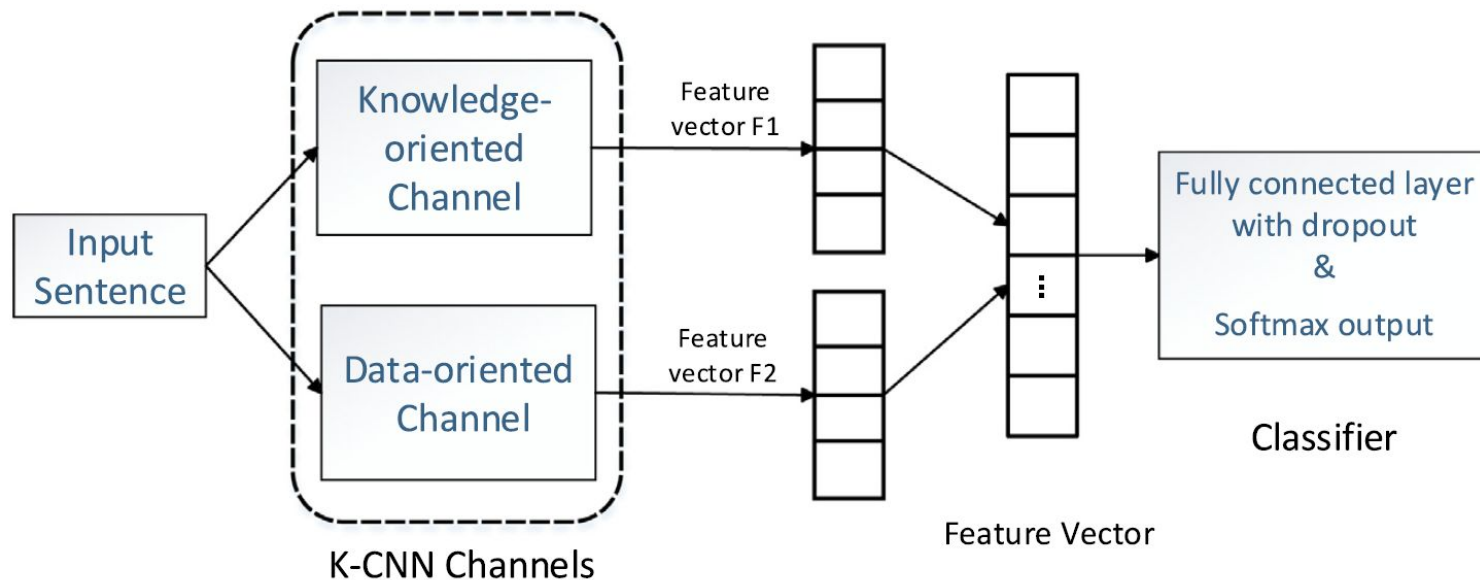# Full architecture with data-oriented channel

Fig. 1. Overall architecture of K-CNN.

Data-oriented channel

- Word embeddings of entire input sentence

- Wordnet top-level category of events

- Causal score based on FrameNet:

$$p(c \mid w_i) = \begin{cases} \|\text{sent}_{cf}\| / \|\text{sent}\| & \text{if } w_i \in \text{causal frames} \\ 0 & \text{if } w_i \notin \text{causal frames} \end{cases}$$

Proportion of the time the word is used in sentences that are examples of causal frames, out of 170,000 annotated frame example sentences

Experiments

- SemEval 2010 task 8:
  - restricted web, no named entities
  - 1,300 causal, 9000 not causal

- Causal-TB
  - News
  - 300 causal, 300 not causal

- Event Storyline
  - Calamity events
  - 110 causal, 220 not causal

Table 1

Macro-averaged precision (P), recall (R) and F1 scores of K-CNN without and with data-oriented channel. Scores are shown in percentage(%).

Datasets		K-CNN_K	K-CNN
SemEval	P	92.74	93.12
	R	85.56	90.73
	F1	88.85	**91.82**
Causal-TB	P	71.84	76.91
	R	70.24	75.85
	F1	70.92	**76.29**
Event-SL	P	77.38	82.07
	R	74.11	80.58
	F1	75.60	**81.25**

Impact of semantic features

Table 3

Macro-averaged precision (P), recall (R) and F1 scores of K-CNN without and with semantic features (SF). Scores are shown in percentage (%).

Datasets		K-CNN w/o SF	K-CNN with SF
SemEval	P	93.37	94.61
	R	91.40	90.87
	F1	92.34	**92.64**
Causal-TB	P	76.94	78.71
	R	75.70	77.26
	F1	76.21	**77.86**
Event-SL	P	82.78	84.57
	R	81.03	82.15
	F1	81.84	**83.31**