BCMI-NLP Labeled-Alignment-Based Entailment System for NTCIR-10 RITE-2 Task

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Overview

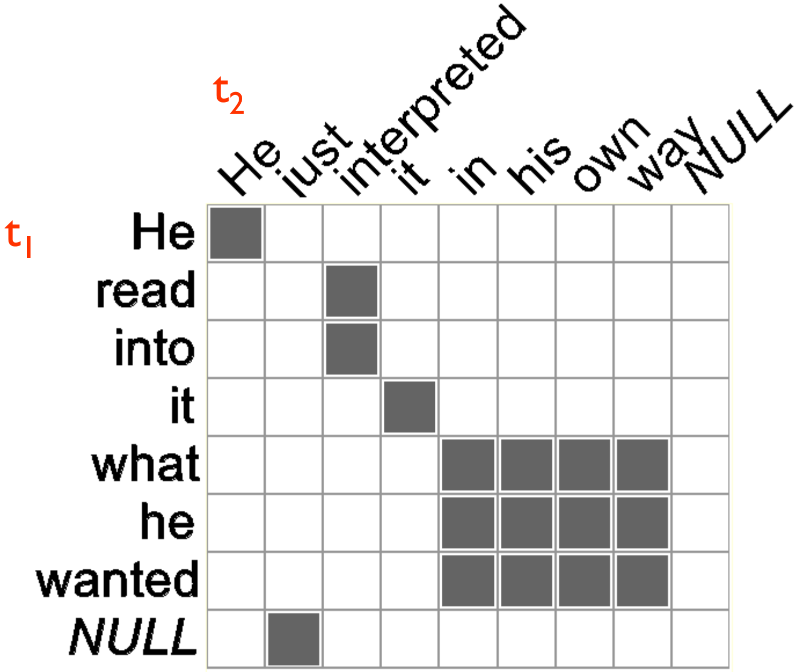
- Alignment-based RITE approach
- Labeled alignment scheme
- Labeled-alignment-based RITE approach
- Formal runs

Alignment-based RITE approach

- Intuition: sufficiently good alignment

  → close lexical and structural similarity

  → entailment relation

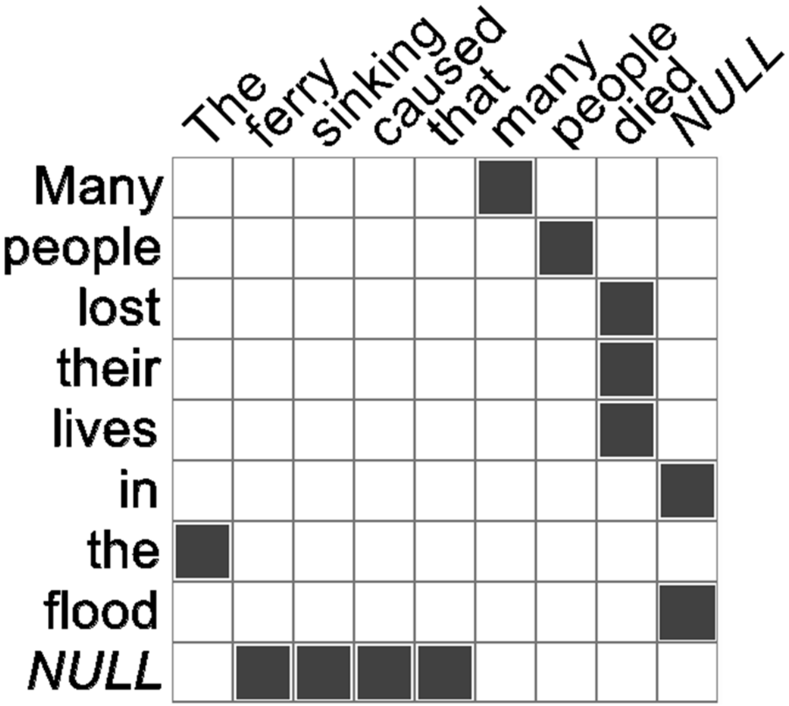


read into → interpreted
what he wanted → in his own way
NULL → just

Therefore, entailment

Alignment-based RITE approach

- Shortage:
  - originally developed for machine translation
  - not justify non-entailment pairs ☹



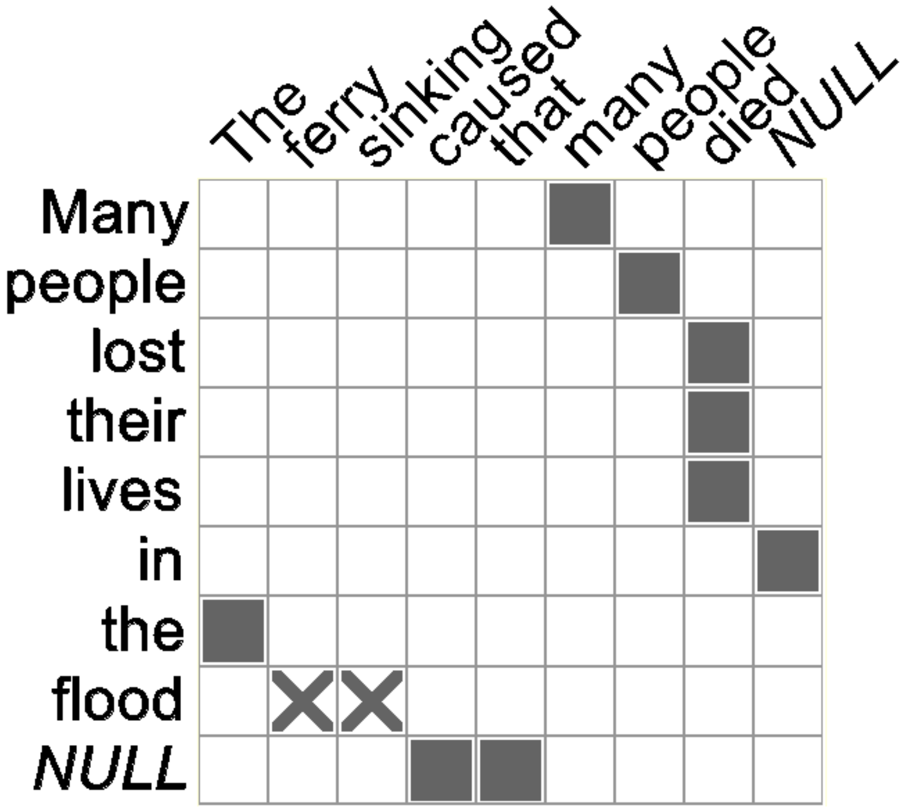
Critical non-aligned:
flood → NULL
NULL → ferry sinking

Non-critical non-aligned:
in → NULL
NULL → caused that

mixed, so hard to predict

Labeled alignment scheme

- Augment the normal alignment with negative links



Negative links:

flood ↛ ferry sinking

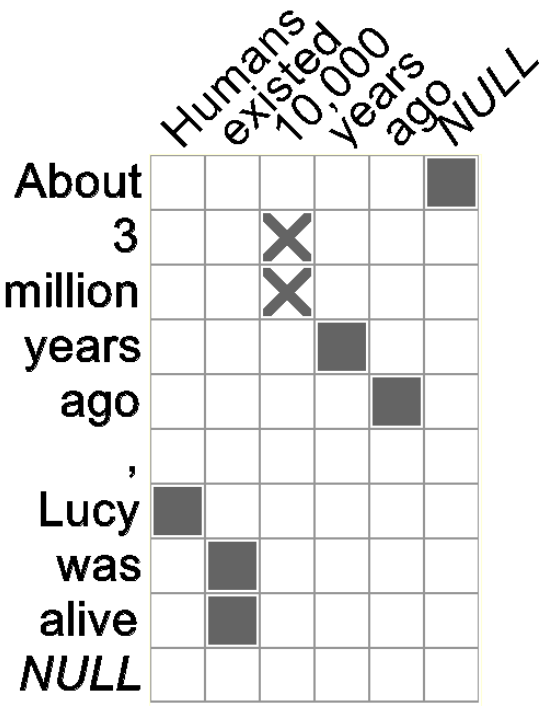
Therefore, non-entailment

Roadmap:

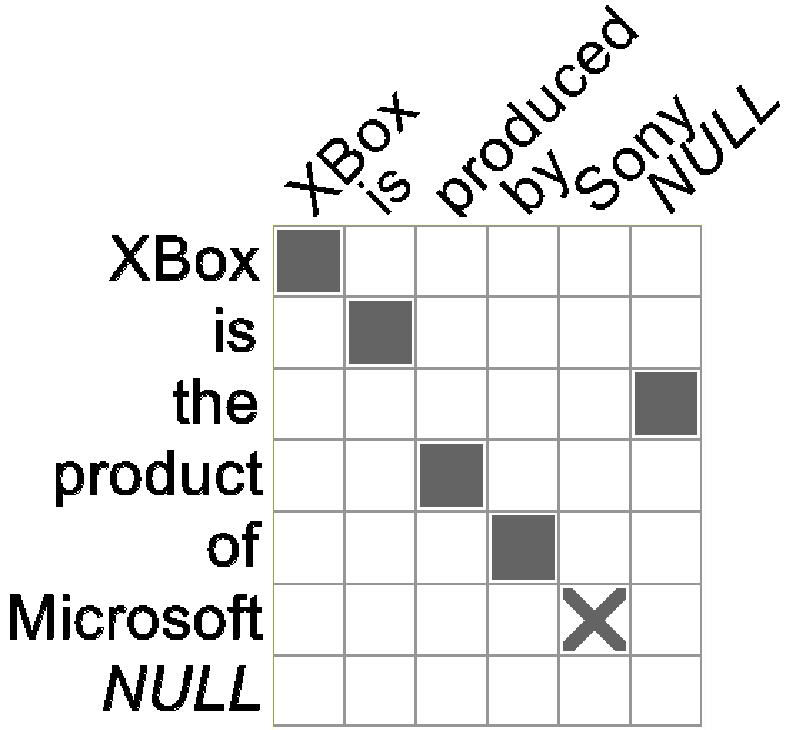
1) manually annotate
2) train an alignment model
3) train an RITE predict model

Labeled alignment scheme

- More examples



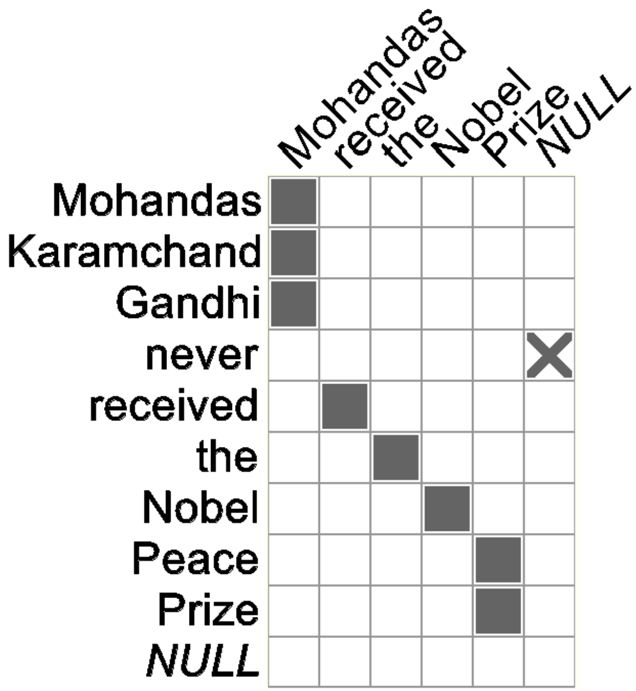
Mismatched numbers



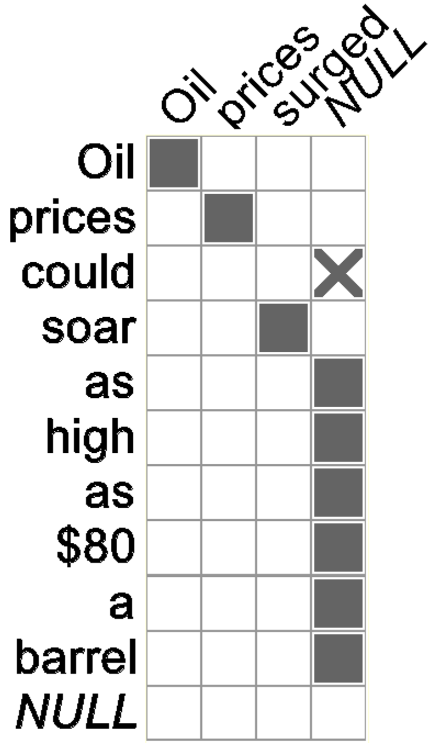
Different named entities

Labeled alignment scheme

- More examples

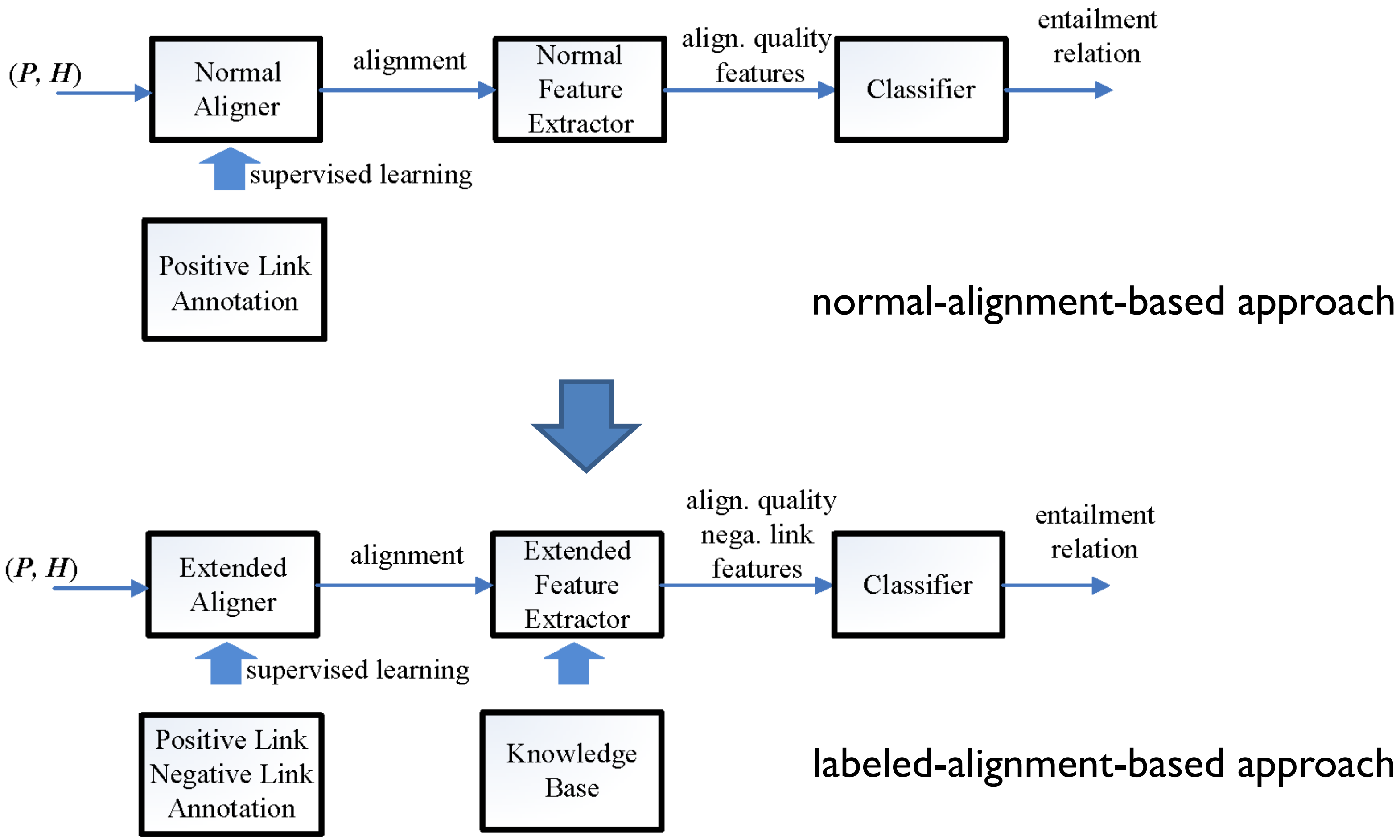


Negation



Non-happened event

Labeled-alignment-based RITE approach



Labeled-alignment-based RITE

Link Type Features

Whether e_1 and e_2 are in an antonym list
Whether e_1 and e_2 are in an synonym list
Whether e_1 and e_2 are unequal numbers
Whether e_1 and e_2 are different named entities
Relation of e_1 and e_2 in an ontology (hyponym, sibling, etc.)
Ontology-based similarities of e_1 and e_2
Count of common characters
Length of the common prefixes
Length of the common suffix
Tuple of the syntactic tags
Tuple of the ancestors in an ontology
Tuple of whether e_1 or e_2 is in a list of negative expressions
Tuple of whether e_1 or e_2 is the head of a noun phrase

Labeled-alignment-based RITE

- Classification component
  - Sample representation: single flat vector that combines the features extracted from all the links
  - Classifier: RBF-kerneled SVM (1-vs-rest for MC)
- Open question: why a cascaded system that

  - first classifies the link type

  - then classifies the RITE relation

  performs poorly ? (worse than baseline)

Labeled–alignment-based RITE

- Possible answer for the failure of a cascaded system : not robust enough under current (public) available resources

For example:

三峡旅游不再有淡旺季的问题

三峡旅游不再有枯水期的问题

- Hard to accurately decide whether two normal Chinese words are antonym or not with the knowledge base of CiLin and mini-Hownet.

Formal Run

- System Implement
  - automated supervised-learning aligner

    (N. chambers et al.,2007; B. MacCartny et al., 2008)

  - Manually annotate the training data set
    - alignment links
    - positive/negative labels

Formal Run -- aligner

Structured prediction
MIRA training process

Inputs

- training problems $\langle P_j, H_j \rangle, j = 1..n$
- corresponding gold-standard alignments E_j
- a number of learning epochs N (e.g. 50)
- a "burn-in" period $N_0 < N$ (e.g. 10)
- initial learning rate R_0 (e.g. 1) and multiplier r (e.g. 0.8)
- a vector of feature functions $\mathbf{\Phi}(E)$
- an alignment algorithm $\text{ALIGN}(P, H; \mathbf{w})$ which finds a good alignment for $\langle P, H \rangle$ using weight vector $\mathbf{w}$

Initialize

- Set $\mathbf{w} = 0$

Repeat for $i = 1$ to N

- Set $R_i = r \cdot R_{i-1}$, reducing the learning rate
- Randomly shuffle the training problems
- For $j = 1$ to n:
  - Set $\hat{E}_j = \text{ALIGN}(P_j, H_j; \mathbf{w})$
  - Set $\mathbf{w} = \mathbf{w} + R_i \cdot (\mathbf{\Phi}(E_j) - \mathbf{\Phi}(\hat{E}_j))$
- Set $\mathbf{w} = \mathbf{w} / \|\mathbf{w}\|_2$ (L2 normalization)
- Set $\mathbf{w}[i] = \mathbf{w}$, storing the weight vector for this epoch

Return an averaged weight vector:

- $\mathbf{w}_{avg} = 1/(N - N_0) \sum_{i=N_0+1}^{N} \mathbf{w}[i]$

Formal Run – aligner (decoding)

Inputs

- an alignment problem $\langle P, H \rangle$
- a number of iterations N (e.g. 100)
- initial temperature T_0 (e.g. 40) and multiplier r (e.g. 0.9)
- a bound on edit size max (e.g. 6)
- an alignment scoring function, $\textsc{score}(E)$

Initialize

- Let E be an "empty" alignment for $\langle P, H \rangle$ (containing only DEL and INS edits, no EQ or SUB edits)
- Set $\hat{E} = E$

Repeat for $i = 1$ to N

- Let $\{F_1, F_2, ...\}$ be the set of possible successors of E. To generate this set:
  - Consider every possible edit f up to size max
  - Let $C(E, f)$ be the set of edits in E which "conflict" with f (i.e., involve at least some of the same tokens as f)
  - Let $F = E \cup \{f\} \setminus C(E, f)$
- Let $s(F)$ be a map from successors of E to scores generated by $\textsc{score}$
- Set $p(F) = \exp s(F)$, and then normalize $p(F)$, transforming the score map to a probability distribution
- Set $T_i = r \cdot T_{i-1}$
- Set $p(F) = p(F)^{1/T_i}$, smoothing or sharpening $p(F)$
- Renormalize $p(F)$
- Choose a new value for E by sampling from $p(F)$
- If $\textsc{score}(E) > \textsc{score}(\hat{E})$, set $\hat{E} = E$

Return $\hat{E}$

Stimulated annealing algorithm

"Possible edit" means
"possible alignment link"

Generated from:

1) Each segmented word in t_1 → Each segmented word in t_2
2) Each syntactic node in t_1 → Each syntactic node in t_2
3) Each NE in t_1 → Each NE in t_2
4) Expression e_1 in t_1 → Expression e_2 in t_2 where,

(e_1, e_2) appears in a synonym list,
or a antonym list,
or in Cilin,
or in hownet,
or other resources

Formal Run

- System Implement
  - Segment: BaseSeg (Zhao and Kit, 2006)
  - Syntactic parser: Stanford factored parser
  - NER: BaseNER (zhao and Kit, 2008)
  - Chinese ontologies: Cilin (Mei et al.,1983; Luo, 2007), Hownet (Dong, 2003; Liu and Li, 2002; Liu and Singh, 2004)
  - Classifier: LibSVM (Lin, 2011)

Formal Run

Run	Method	Macro-F1 on BC	Macro-F1 on MC	Worse. Rank. on RITE4QA
Run01	Char-overlap	67.04	39.95	2.67*
Run02	Normal-align.	66.89	44.88	0.00*
Run03	Labeled-align.	73.84	56.82	8.00*

* not checked during formal run due to limit of time

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Thank you