Event Extraction

Xiachong Feng

Outline

1. Basic Conception
2. Dataset
3. Metric
4. Paper Counts
5. Approach And Challenge
6. Major Team
7. Future Work

1.Basic Conception

Two models of events

- TimeML model
  - An event is a word that points to a node in a network of temporal relations.
  - Every event is annotated.
  - Time is an important information, used to index events.

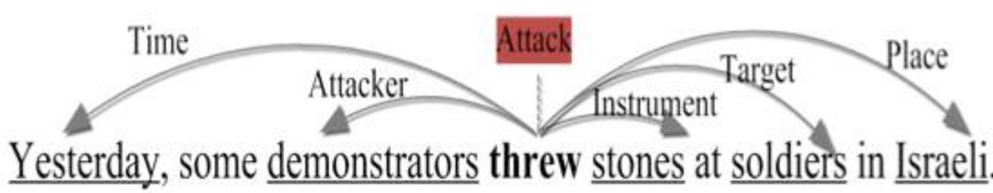
```
It's <EVENT class="OCCURRENCE">turning</EVENT>
out to be another <EVENT class="STATE">bad</EVENT>
financial week.
```

- ACE model
  - An event is a complex structure.
  - Only “interesting” events (events that fall into one of 34 predefined categories) are annotated.

From “The stages of event extraction”

Task Definition

- **Event Extraction(EE)** *ACE05 task definition*
  - Event is represented as a structure comprising an **event trigger and a set of arguments.**
- **Two core subtasks**
  - **Event Detection(ED):**
    - Identifying event triggers
    - Categorizing
  - **Argument Extraction(AE):**
    - Argument identification
    - Role classification



From "Automatically Labeled Data Generation for Large Scale Event Extraction" ACL17
"Exploiting Argument Information to Improve Event Detection via Supervised Attention Mechanisms" ACL17

Terminology

- **Event Trigger**
  - The main word that most clearly expresses the occurrence of an event (An ACE event trigger is typically a verb or a noun).
- **Event Attribute**
  - Type, Subtype, Modality（模态）, Polairty（倾向性）, Genericity（普遍性）, Tense（时态）, 8 types and 33 subtypes.(34 = 33 + None)

Justice	**Conflict**	**Business** :
Acquit	Attack	Declare-Bankruptcy
Appeal	Demonstrate	End-Org
Arrest-Jail	**Contact**	Merge-Org
Charge-Indict	Meet	Start-Org
Convict	Phone-Write	**Personnel** :
Execute	**Life** :	Elect
Extradite	Be-Born	End-Position
Fine	Die	Nominate
Pardon	Divorce	Start-Position
Release-Parole	Injure	**Transaction** :
Sentence	Marry	Transfer-Money
Sue	**Movement** :	Transfer-Ownership
Trial-Hearing	Transport	

Terminology

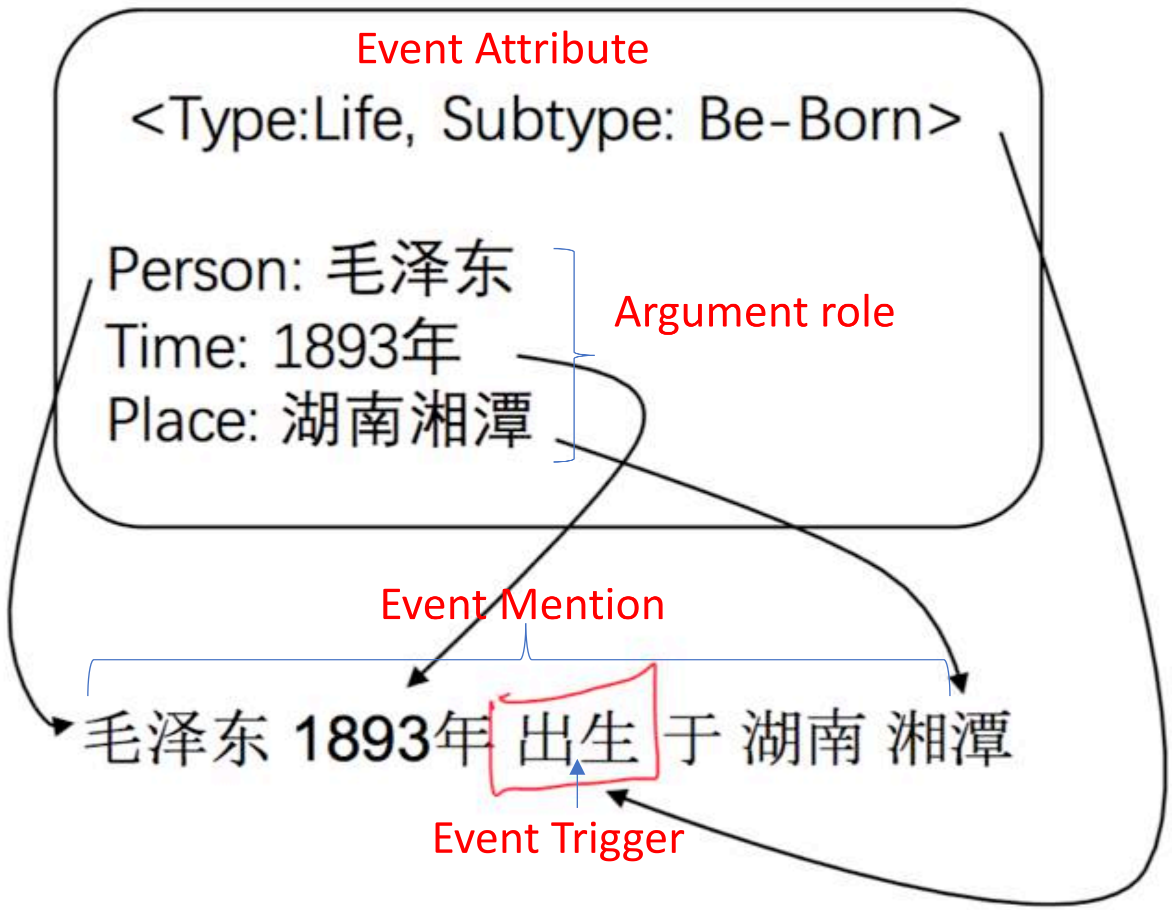
- **Argument Role**
  - The relationship between an argument to the event in which it participates.
  - All 35 argument roles:

Plaintiff	Person	Place	Beneficiary
Buyer	Seller	Price	Artifact
Origin	Destination	Giver	Recipient
Money	Org	Agent	Victim
Instrument	Entity	Target	Defendant
Adjudicator	Attacker	Prosecutor	Crime
Position	Sentence	Vehicle	time-after
time-before	time-at-end	time-starting	time-at-beginning
time-ending	time-holds	time-within	

- **Event Mention**
  - A **phrase** or **sentence** within which an event is described, including a trigger and arguments.

From "RESEARCH ON CHINESE EVENT EXTRACTION" Hongye Tan doctoral thesis

Example



From "REPRESENTATION LEARNING BASED INFORMATION EXTRACTION" Xiaocheng Feng doctoral thesis

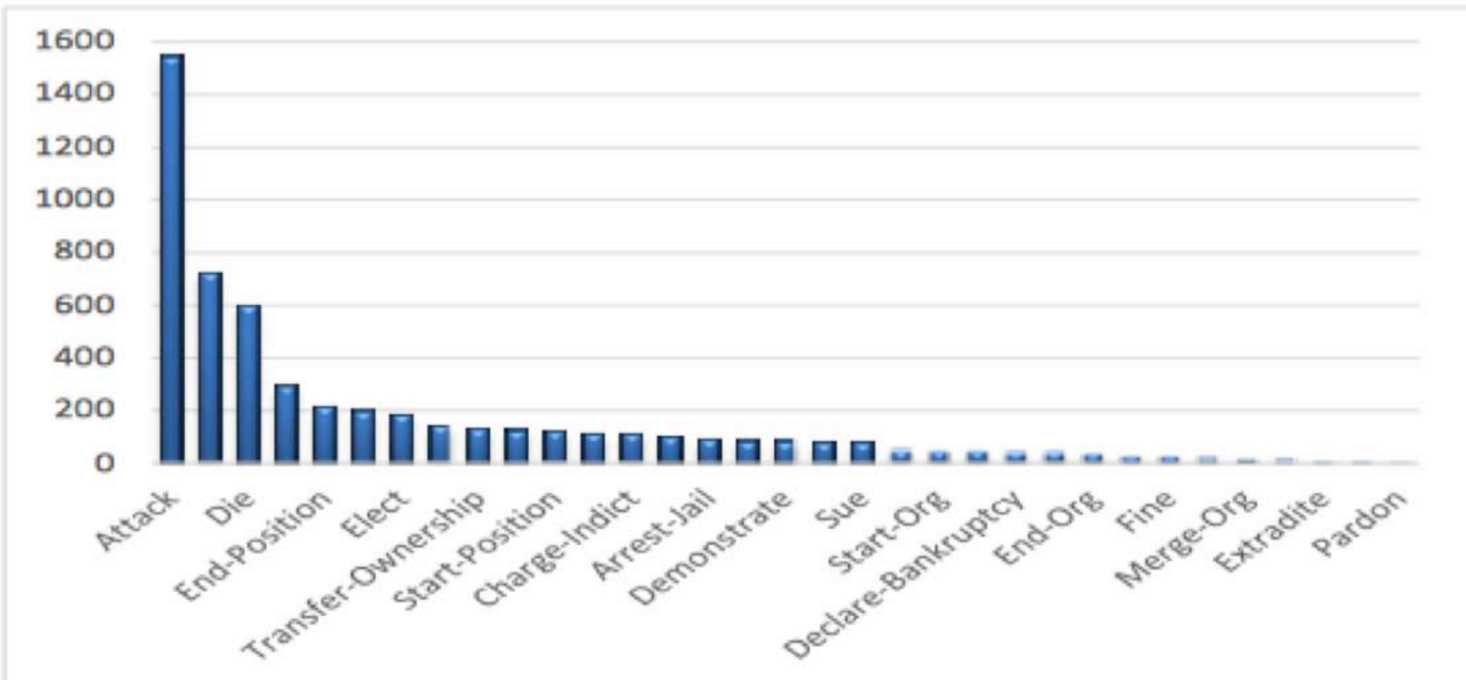
2.Dataset

ACE 2005

- Contains 599 documents, which include about 6,000 labeled events.
- Annotated with single-token event triggers
- 8 event types and 33 event subtypes that, along with the “non-event” class, constitutes a 34-class classification problem.

From “Event Nugget Detection with Forward-Backward Recurrent Neural Networks” ACL16

Dataset Drawback



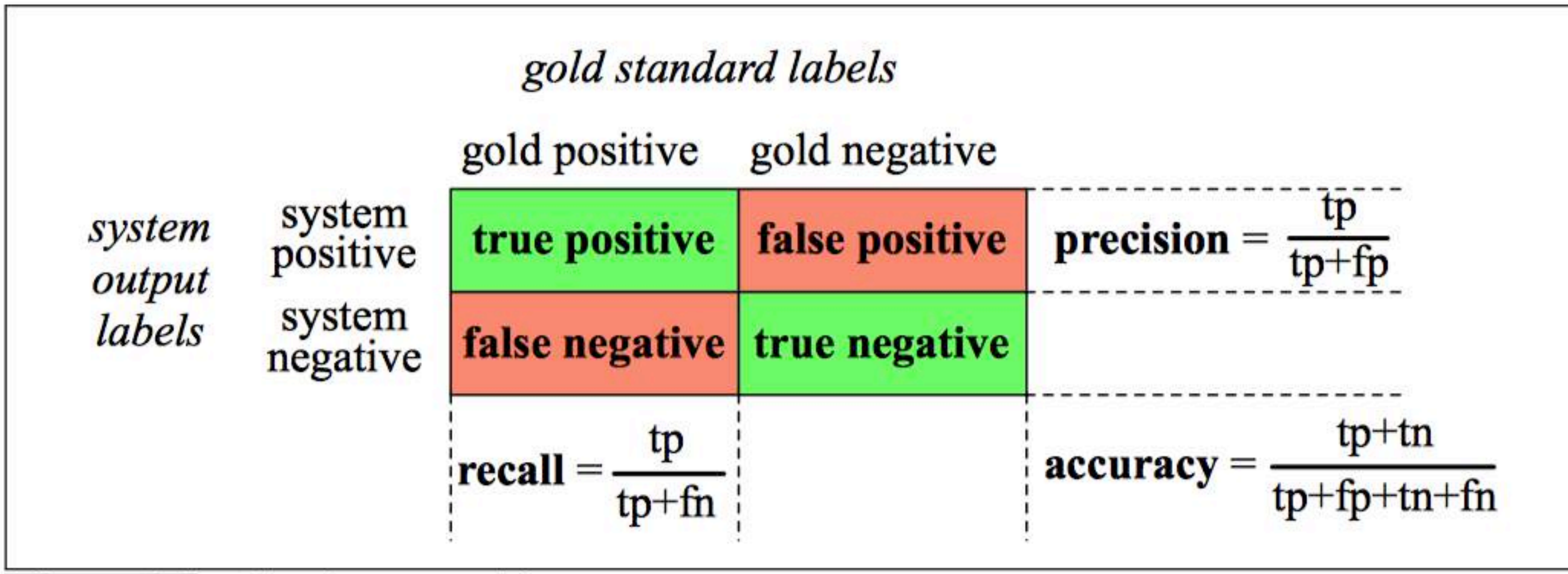
Statistics of ACE 2005 English Data

- Nearly 70% of event types in ACE 2005 have less than 100 labeled samples
- There are even 3 event types which have less than 10 labeled samples.

From "Event Detection via Gated Multilingual Attention Mechanism" AAAI18

3.Metric

Precision & Recall & F-score

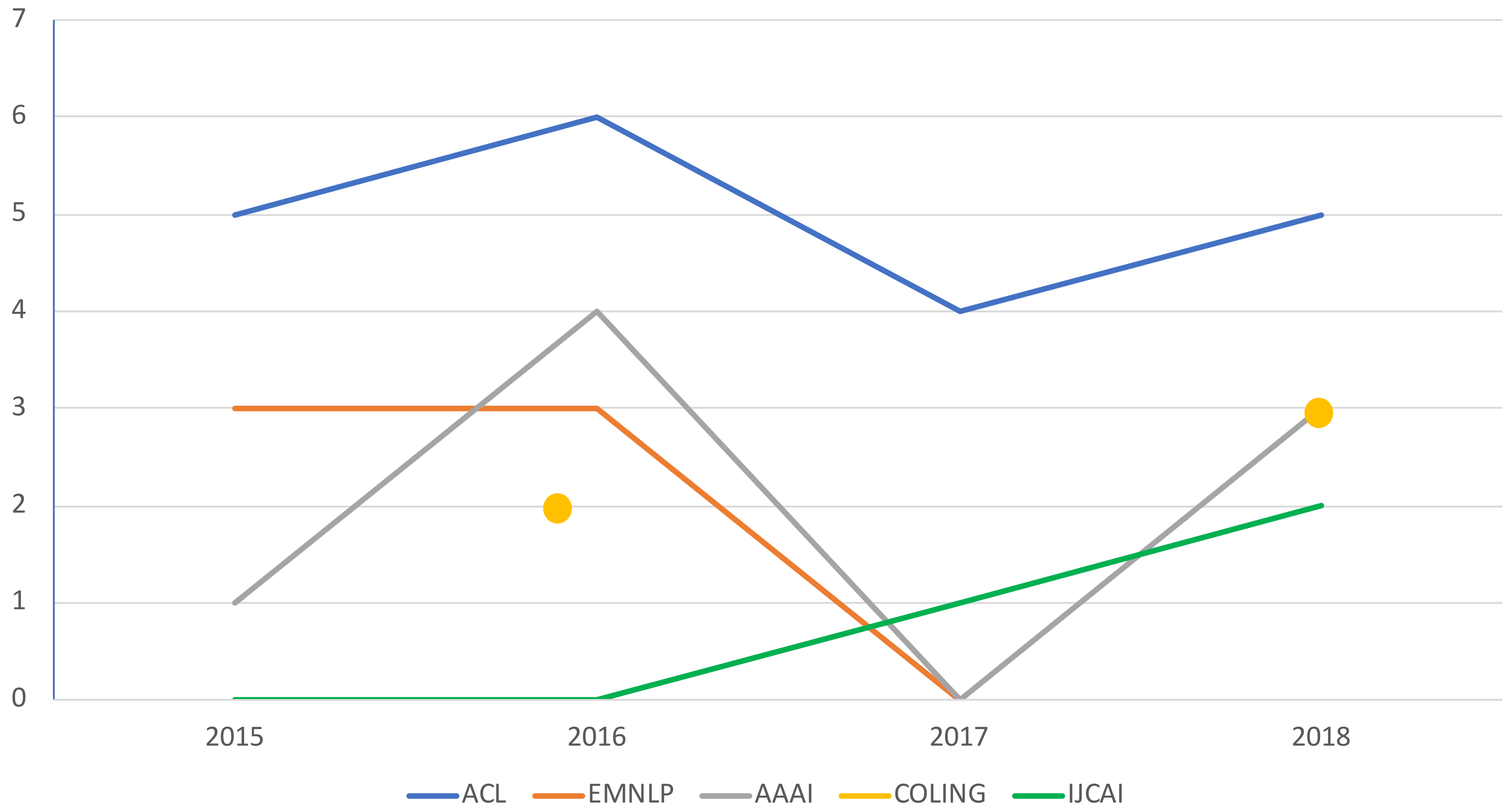


$$\textbf{Precision} = \frac{\text{true positives}}{\text{true positives} + \text{false positives}} \qquad \textbf{Recall} = \frac{\text{true positives}}{\text{true positives} + \text{false negatives}} \qquad F_1 = \frac{2PR}{P+R}$$

From "Speech And Language Processing" Draft 2018

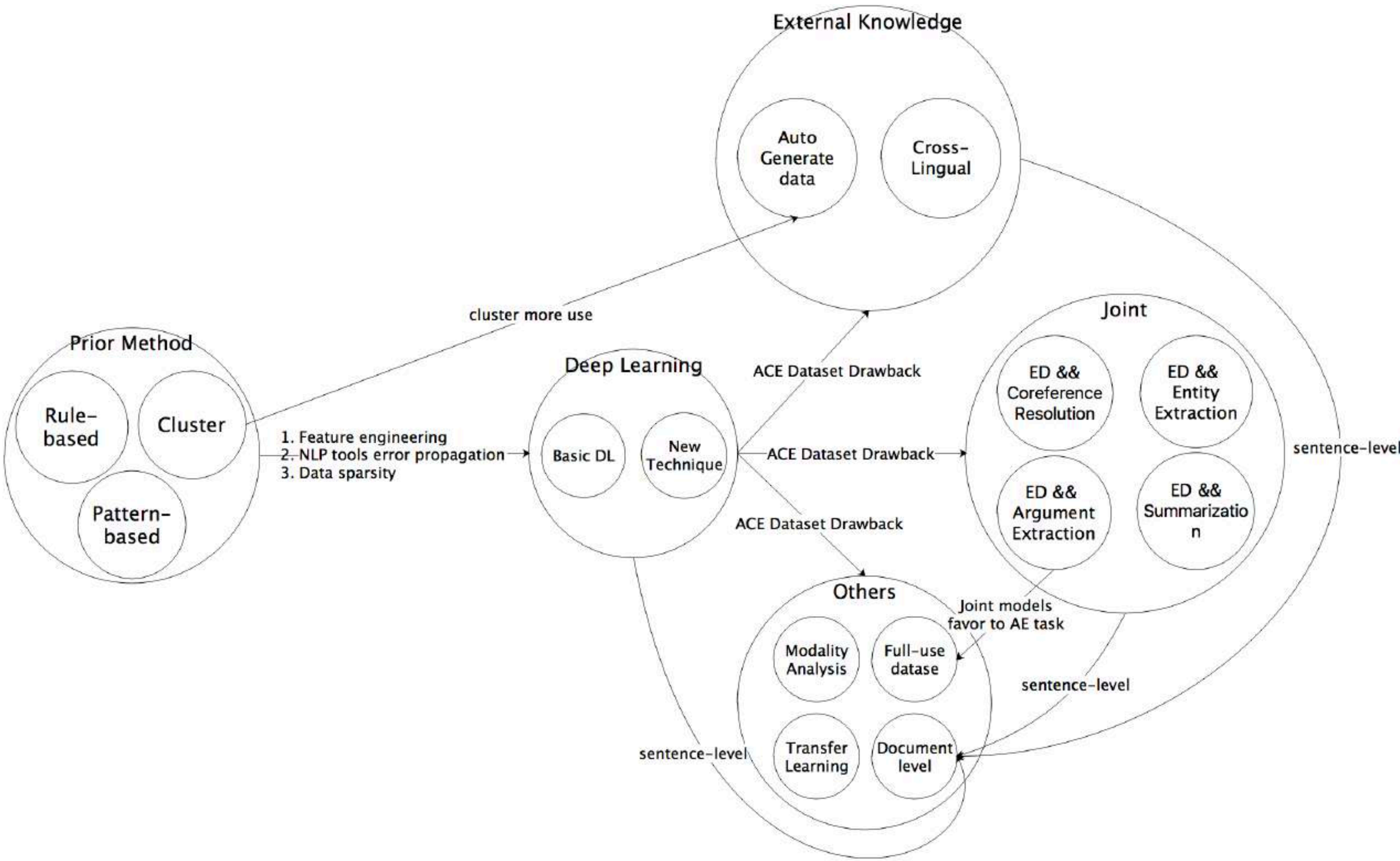
4.Paper Counts

ACL&EMNLP&AAAI&COLING&IJCAI



5.Approach And Challenge

Overview


External Knowledge
Auto Generate data
Cross-Lingual
cluster more use
Prior Method
Rule-based
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1. Feature engineering
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Joint models favor to AE task
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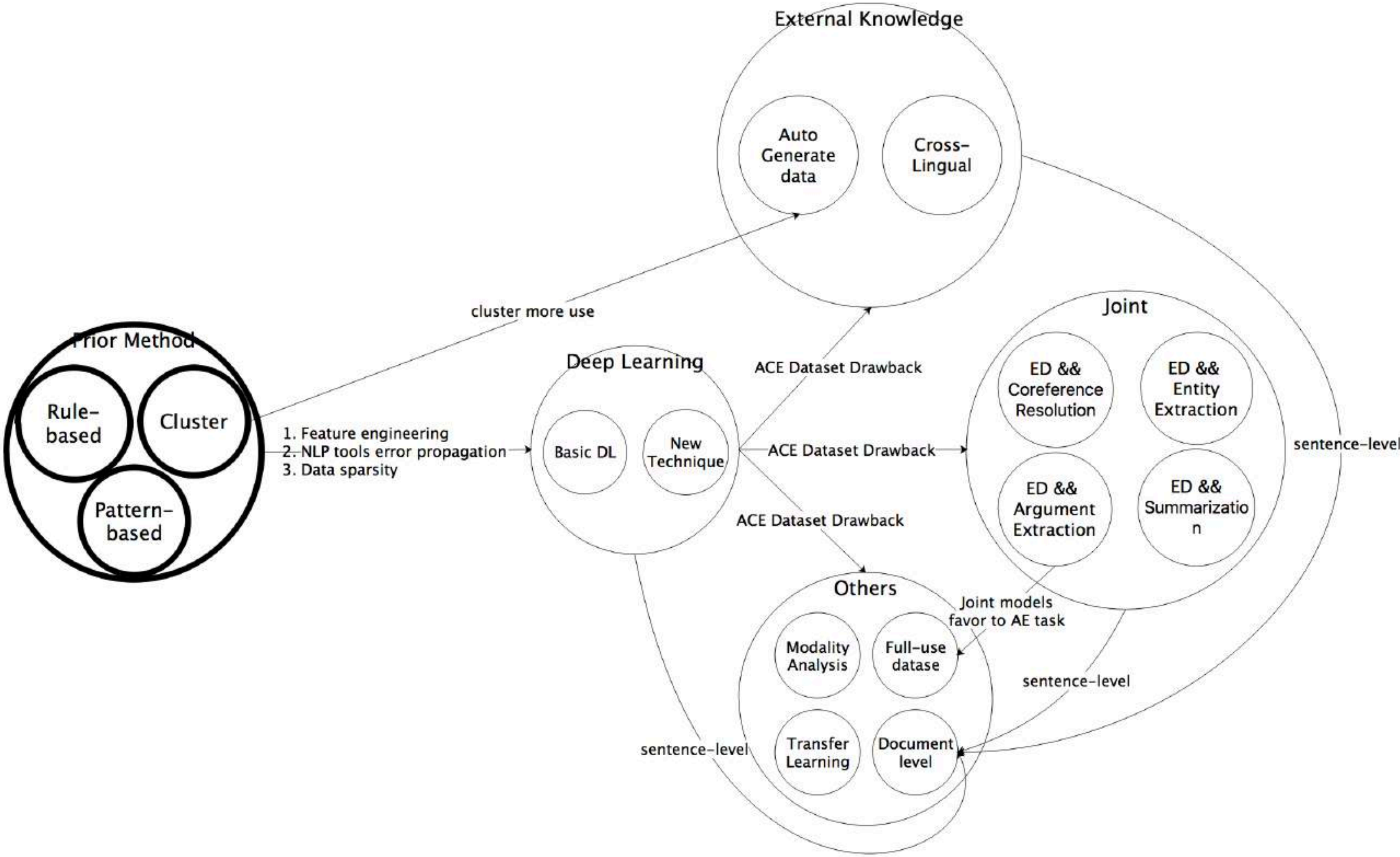
Prior Method



Rule-based & Pattern based

- **Advantage**
  - Rules are interpretable and suitable for rapid development and domain transfer
  - Humans and machines can contribute to the same model
- **Disadvantage**
  - Not a “standard way to express rules”
- **Example**

```
- name: Phosphorylation_1
  priority: 2
  label: [Phosphorylation, Event]
  pattern: |
    trigger = [lemma="phosphorylation"]
    theme:PhysicalEntity = prep_of
        (nn|conj|cc)*
    cause:PhysicalEntity? = prep_by
        (nn|conj|cc)*
```

From “A Domain-independent Rule-based Framework for Event Extraction” ACL15

Rule & Pattern based Papers

- A Domain-independent Rule-based Framework for Event Extraction **ACL15**
- RBPB: Regularization-Based Pattern Balancing Method for Event Extraction **ACL16**

Clustering

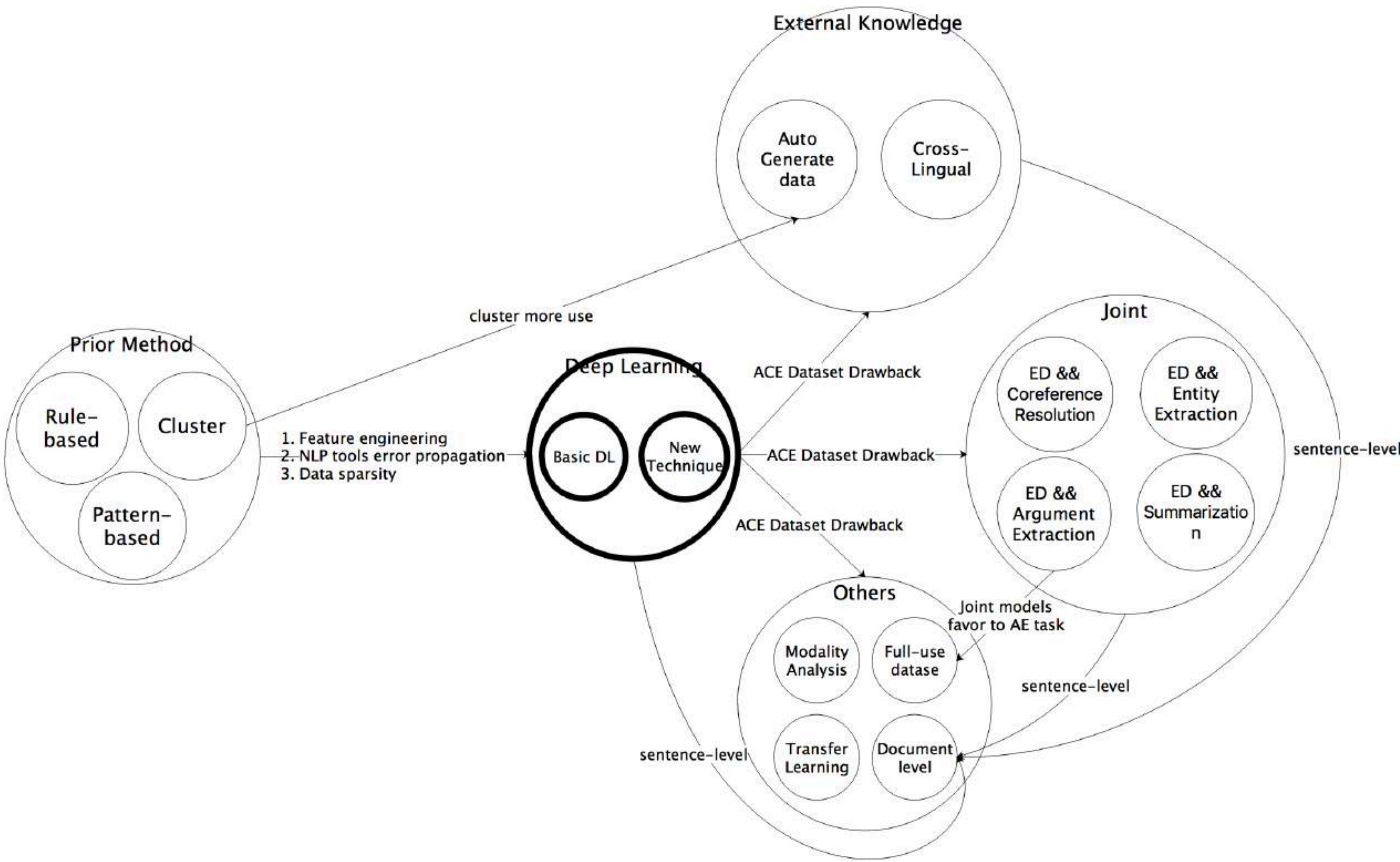
- **Open Domain: Twitter**
- **Challenge**
  - Noisy
  - Wide Variety
  - Redundancy
- **Method**
  - Latent Event & Category Model (LECM): automatically grouping events into categories organized by event types.
  - Each event category is assigned with an event type label without manual intervention.

From "An Unsupervised Framework of Exploring Events on Twitter: Filtering, Extraction and Categorization" AAAI15

Clustering Papers

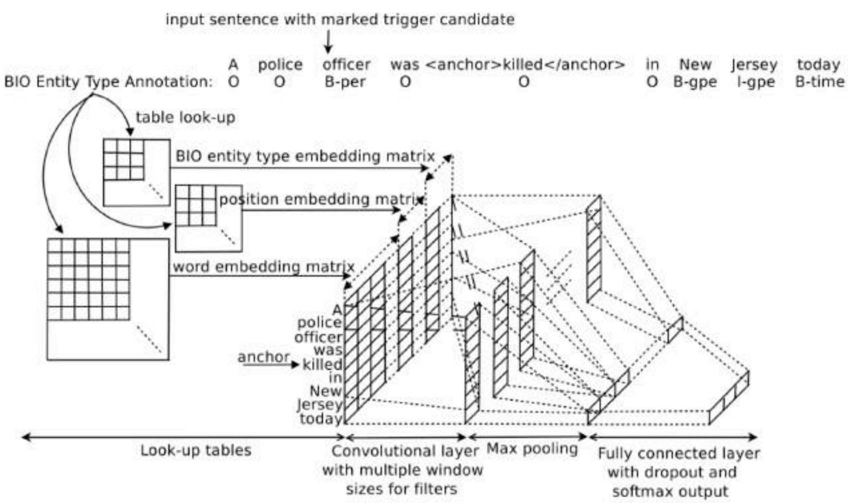
- An Unsupervised Framework of Exploring Events on Twitter: Filtering, Extraction and Categorization **AAAI15**
- Liberal Event Extraction and Event Schema Induction **ACL16**

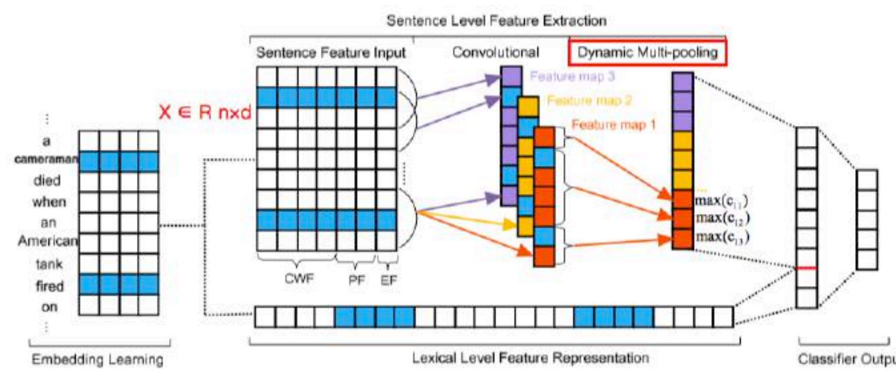
Deep Learning



Basic Deep Learning

- **Challenge**
  - Same event might appear in the form of various trigger expressions
  - An expression might represent different events in different contexts
- **CNN or LSTM(Multi-Class Classification Task)**

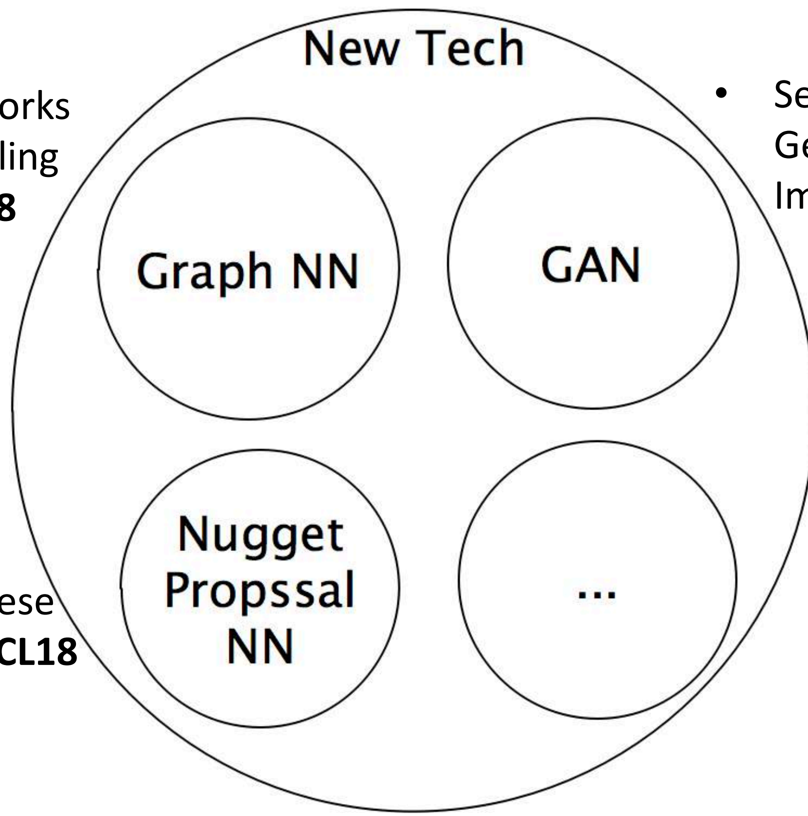




From "Event Detection and Domain Adaptation with Convolutional Neural Networks" ACL15
"Event Extraction via Dynamic Multi-Pooling Convolutional Neural Networks" ACL15

New Technique

- Graph Convolutional Networks with Argument-Aware Pooling for Event Detection **AAAI18**



- Self-regulation: Employing a Generative Adversarial Network to Improve Event Detection **ACL18**

- Nugget Proposal Networks for Chinese Event Detection **ACL18**

Deep Learning Papers

- **Basic DL**
  - Event Detection and Domain Adaptation with Convolutional Neural Networks **ACL15**
  - Event Extraction via Dynamic Multi-Pooling Convolutional Neural Networks **ACL15**
  - A Language-Independent Neural Network for Event Detection **ACL16**
  - Event Nugget Detection with Forward-Backward Recurrent Neural Networks **ACL16**
  - Modeling Skip-Grams for Event Detection with Convolutional Neural Networks **EMNLP16**
  - Bidirectional RNN for Medical Event Detection in Electronic Health Records **NAACL16**
- **New Technique**
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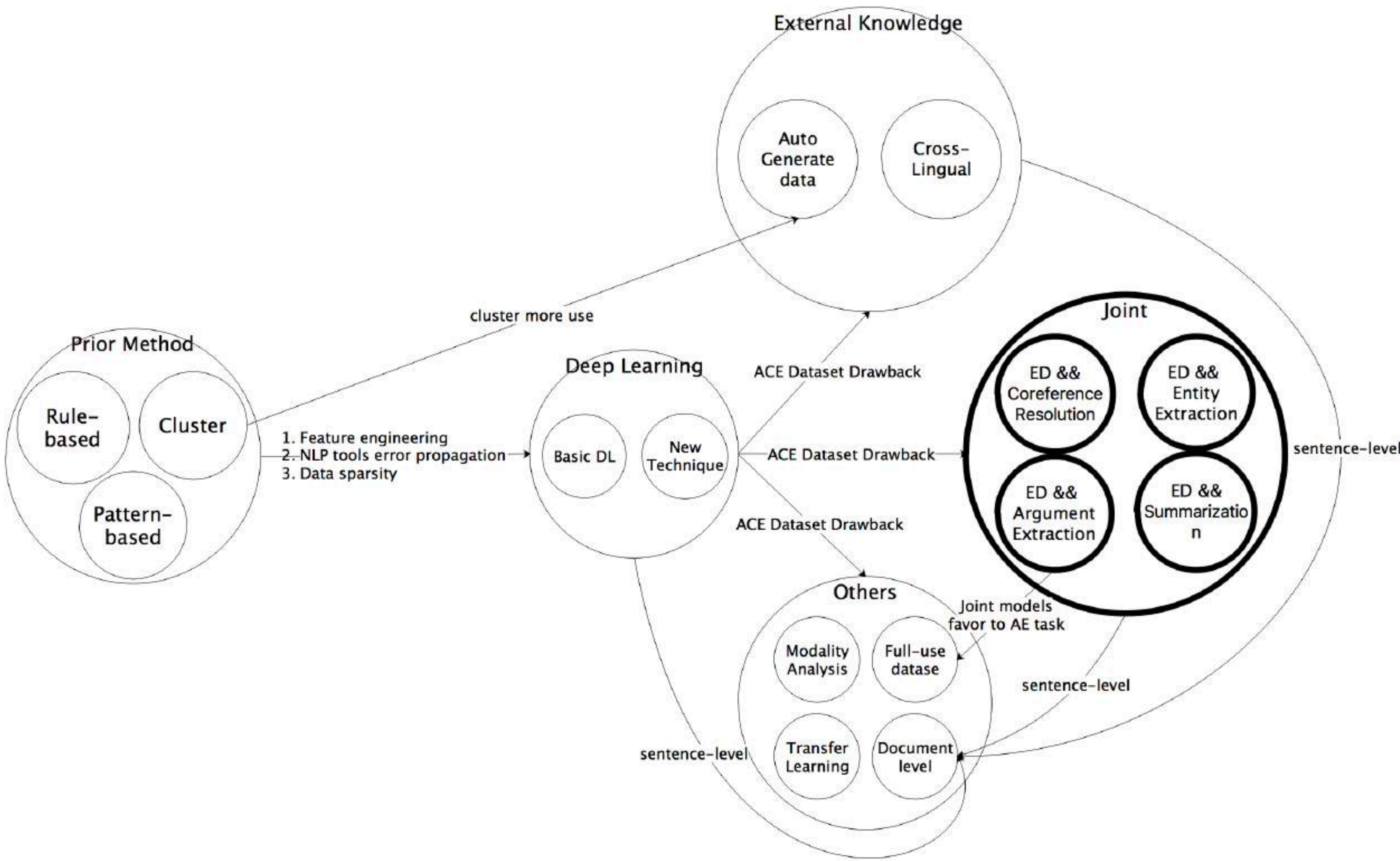
Joint Model



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Joint Model

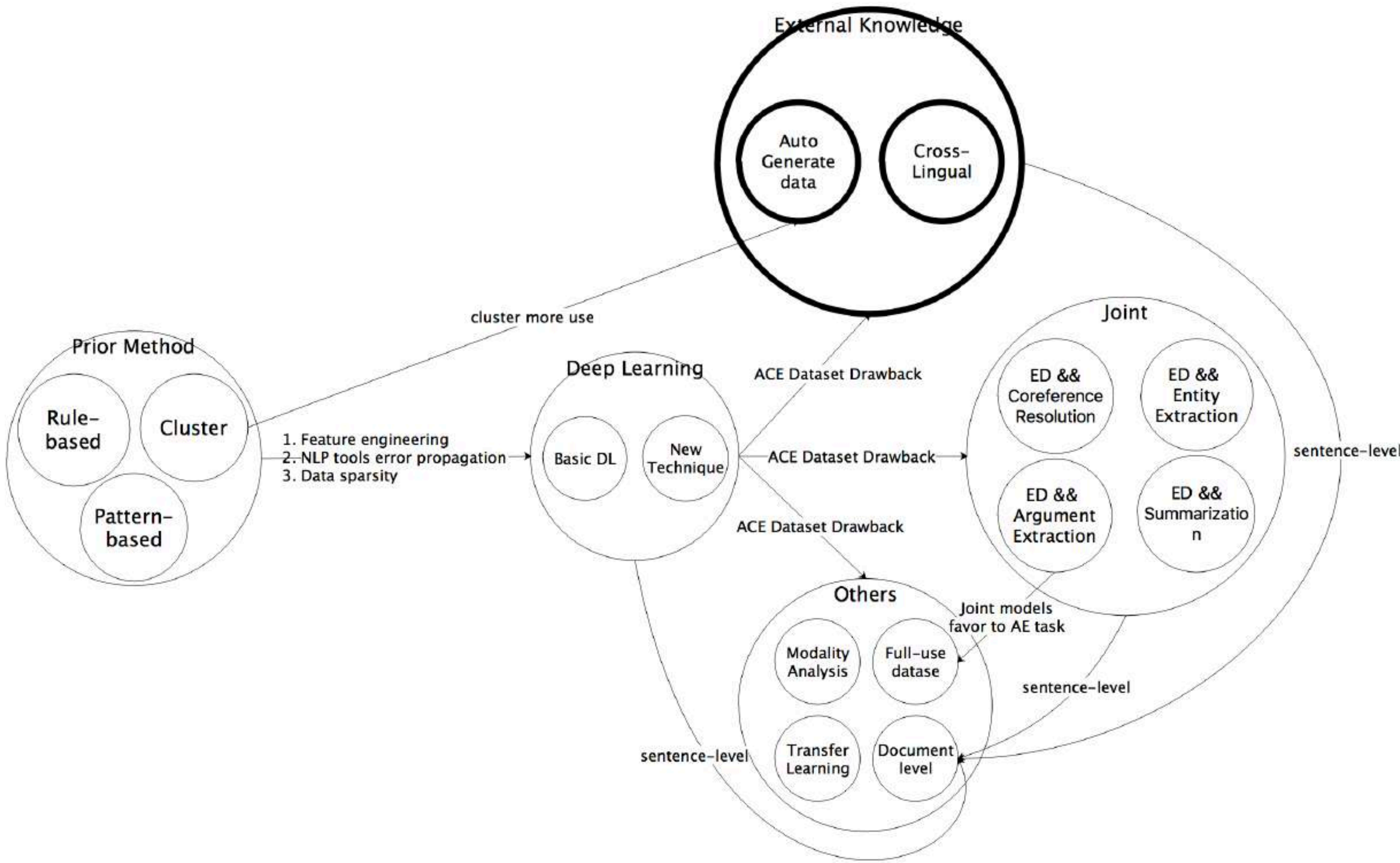
- **Two main approaches to EE**
  - **The joint approach** that predicts event triggers and arguments for sentences simultaneously as a structured prediction problem.
  - **The pipelined approach** that first performs trigger prediction and then identifies arguments in separate stages.
- **Joint framework**
  - Mitigating the error propagation problem of the pipelined approach.
  - Exploiting the inter-dependencies between event triggers and argument roles via discrete structures.

From "Joint Event Extraction via Recurrent Neural Networks" NAACL16

Joint Model Papers

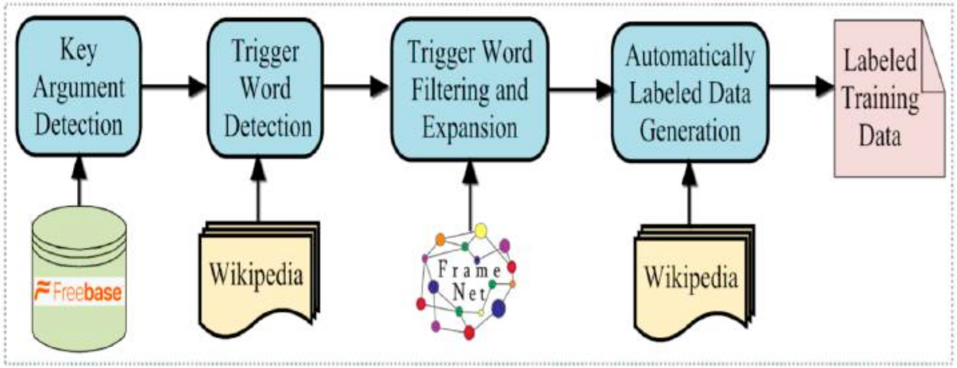
- Joint Event Trigger Identification and Event Coreference Resolution with Structured Perceptron **EMNLP15**
- Event Detection and Co-reference with Minimal Supervision **EMNLP16**
- Joint Extraction of Events and Entities within a Document Context **NAACL16**
- Joint Learning for Event Coreference Resolution **ACL17**
- A Neural Model for Joint Event Detection and Summarization **IJCAI17**

External Knowledge



Auto Generate Data

- **Challenge**
  - expensive to produce
  - in low coverage of event types
  - limited in size
- **Method**
  - World knowledge (Freebase)
  - Linguistic knowledge (FrameNet)
  - **Soft Distant Supervision (SDS)**



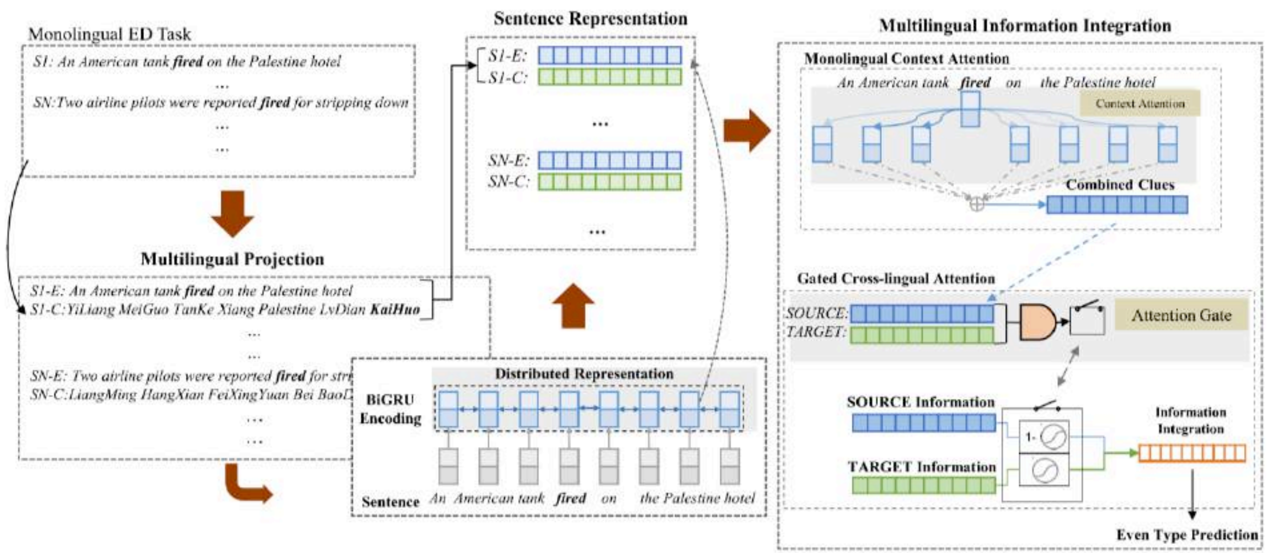
From "Automatically Labeled Data Generation for Large Scale Event Extraction" ACL17

Cross Lingual

- **Challenge**
  - Data scarcity
  - Monolingual ambiguity
- **Model**
  - Monolingual context attention
  - Gated cross-lingual attention

- Limited bilingual dictionaries
- Aligned multilingual word embeddings

From "Leveraging Multilingual Training for Limited Resource Event Extraction" COLING16

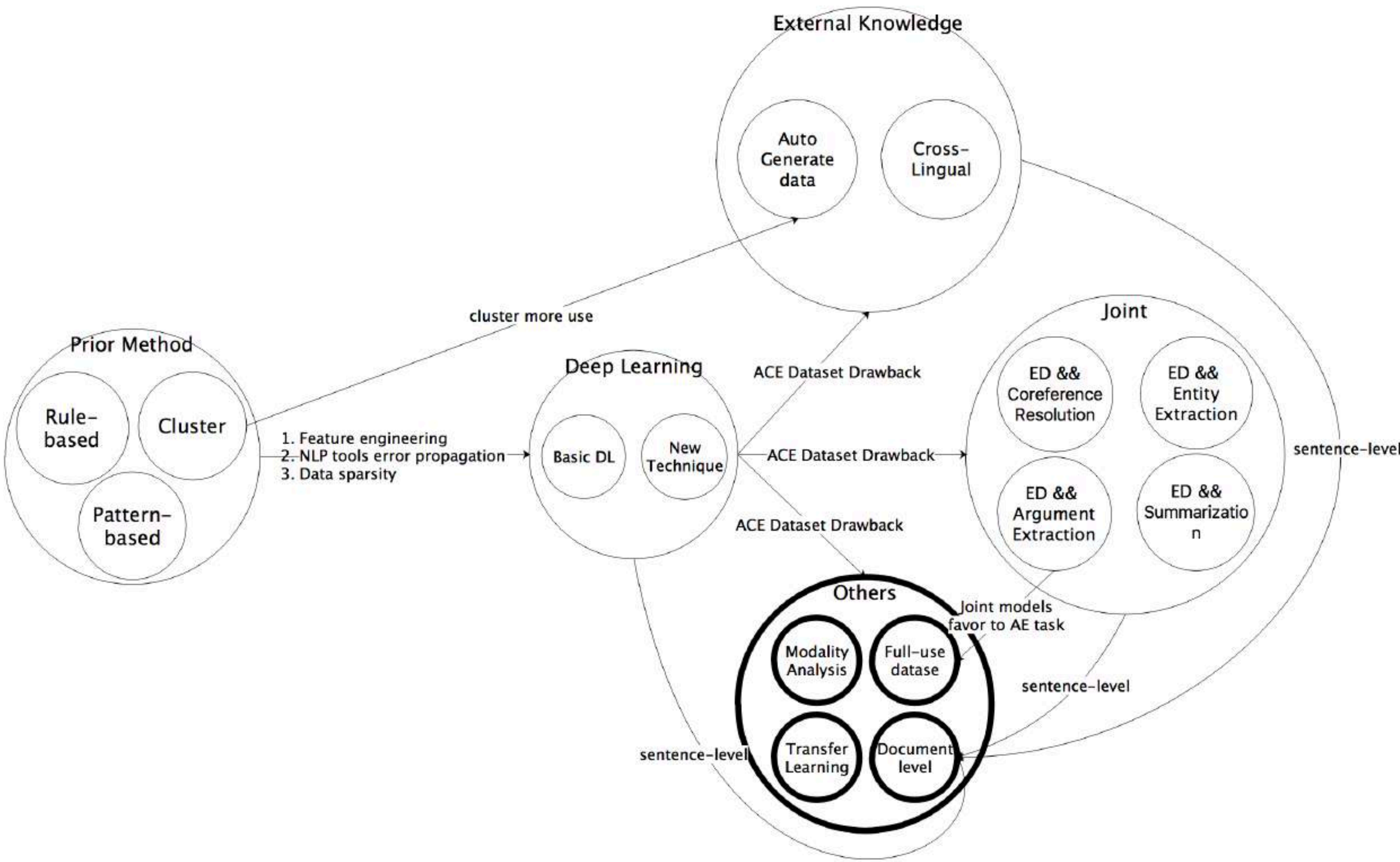


From "Event Detection via Gated Multilingual Attention Mechanism" AAAI18

External Knowledge Papers

- **Auto data generation**
  - Leveraging FrameNet to Improve Automatic Event Detection **ACL16**
  - Automatically Labeled Data Generation for Large Scale Event Extraction **ACL17**
  - Scale Up Event Extraction Learning via Automatic Training Data Generation **AAAI18**
  - Semi-Supervised Event Extraction with Paraphrase Clusters **NAACL18**
- **Cross-lingual**
  - Leveraging Multilingual Training for Limited Resource Event Extraction **COLING16**
  - Event Detection via Gated Multilingual Attention Mechanism **AAAI18**

Others



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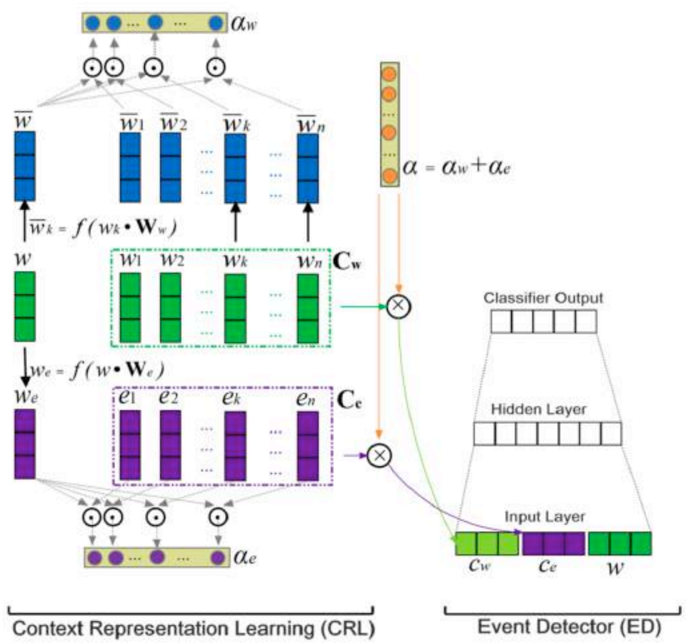
Full Use Dataset

- Joint Models favor to Argument Extraction Task
  - Training corpus contains much more annotated arguments than triggers (about 9800 arguments and 5300 triggers in ACE 2005 dataset) .
  - Pre-predicting potential triggers does not leverage any argument information.



From "Exploiting Argument Information to Improve Event Detection via Supervised Attention Mechanisms" ACL17

Document-Level

- **Challenge**
  - Lack of data
  - Document level data
- **Method**
  - Distant Supervision for generate data
  - Sequence tagging model for sentence-level events
  - Key-detection model and argument-filling strategy for document-level events

From "DCFEE: A Document-level Chinese Financial Event Extraction System based on Automatically Labeled Training Data" AAAI18

Other Papers

- Incremental Global Event Extraction **COLING16**
- Disease Event Detection based on Deep Modality Analysis **ACL15**
- Exploiting Argument Information to Improve Event Detection via Supervised Attention Mechanisms **ACL17**
- Zero-Shot Transfer Learning for Event Extraction **ACL18**
- DCFEE: A Document-level Chinese Financial Event Extraction System based on Automatically Labeled Training Data **ACL18**
- Document Embedding Enhanced Event Detection with Hierarchical and Supervised Attention **ACL18**

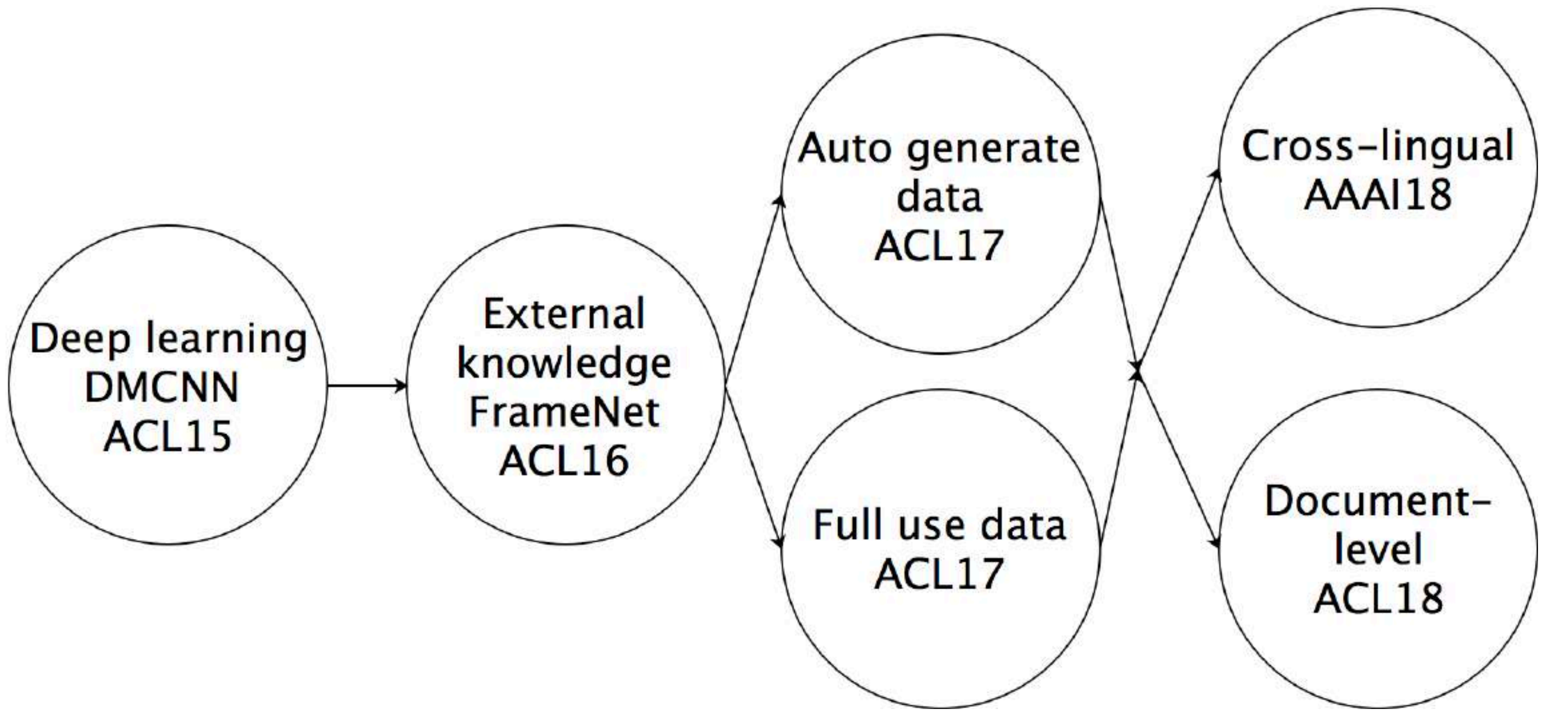
6.Major Team

Institute of Automation

- **Team**
  - National Laboratory of Pattern Recognition, Institute of Automation, Chinese Academy of Sciences, Beijing, China
- **People**
  - Jun Zhao, Kang Liu, Yubo Chen……
- **Papers**
  - Event Extraction via Dynamic Multi-Pooling Convolutional Neural Networks **ACL15**
  - Leveraging FrameNet to Improve Automatic Event Detection **ACL16**
  - A Probabilistic Soft Logic Based Approach to Exploiting Latent and Global Information in Event Classification **AAAI16**
  - Automatically Labeled Data Generation for Large Scale Event Extraction **ACL17**
  - Exploiting Argument Information to Improve Event Detection via Supervised Attention Mechanisms **ACL17**
  - Event Detection via Gated Multilingual Attention Mechanism **AAAI18**
  - DCFEE: A Document-level Chinese Financial Event Extraction System based on Automatically Labeled Training Data **ACL18**

Kang Liu Google scholar: https://scholar.google.com/citations?user=DtZCfl0AAAAJ&hl=zh-CN&oi=sra

Institute of Automation



15-18 Papers of Institute of Automation

7.Future Work

Future Work

- Based on ACE05, do some high-level tasks, like domain specific event graph.
- Do some document-level tasks.
- Combine event graph with inference.
- *To Be Finished.*

Thank You!