



南京理工大学 文本挖掘实验室
Text Mining Lab, Nanjing University of Science & Technology

# 属性级情感分析研究新进展

南京理工大学 夏睿

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@第一届中国情感计算大会

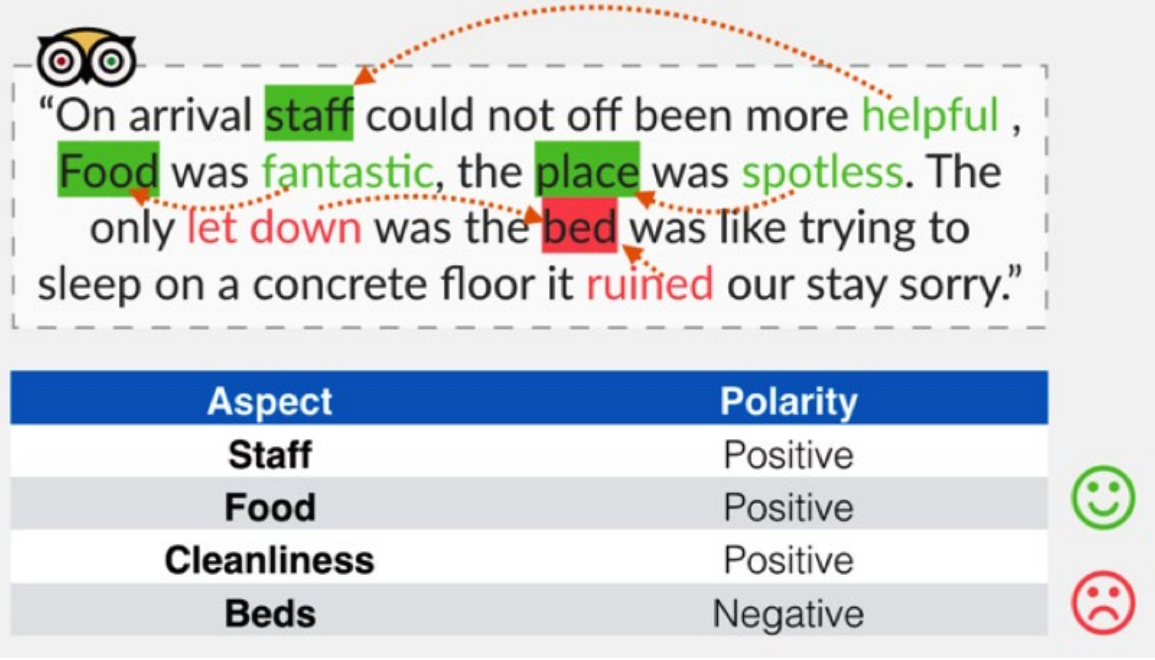
# 属性级情感分析

Web1.0时代
(门户网站)

Web2.0时代
(博客, 论坛)

新型社交网络
(微博, 微信,电子商务)

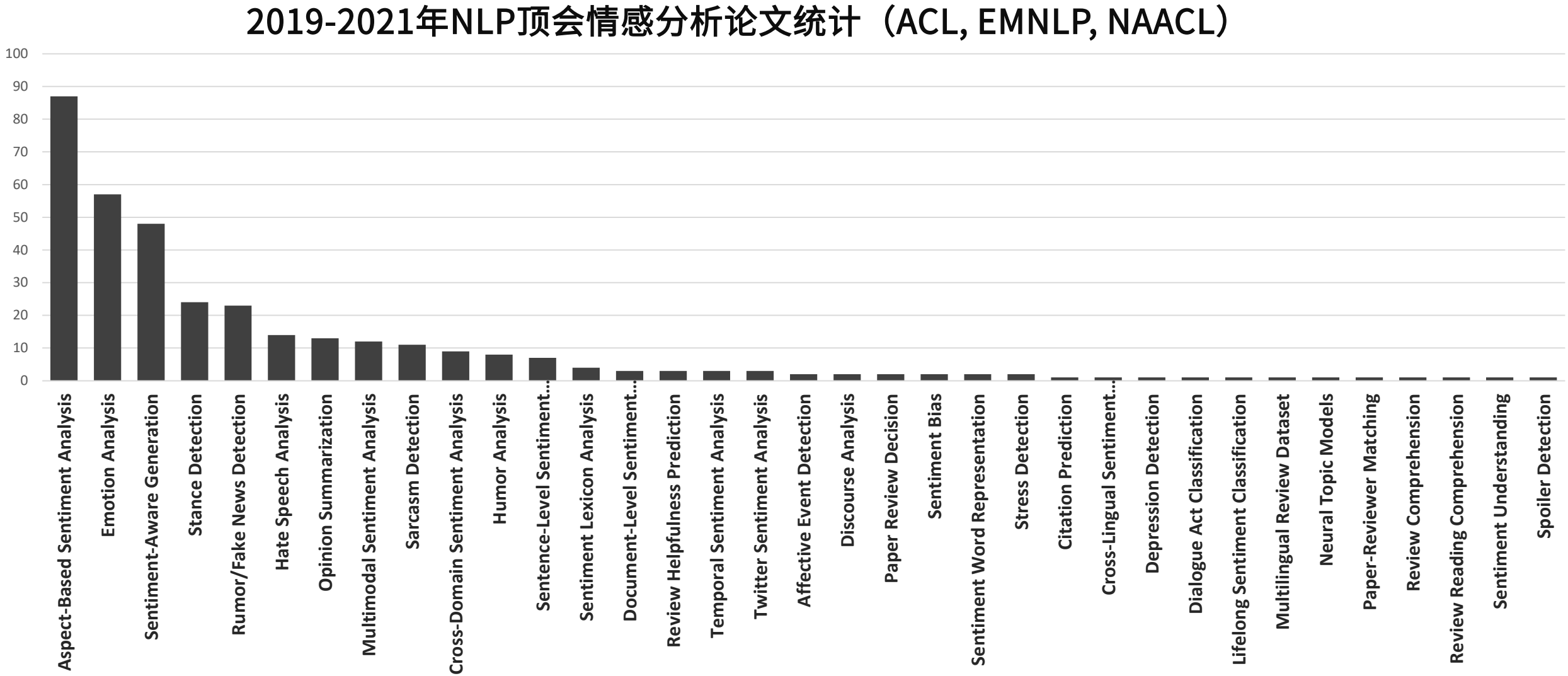
**海量主观评论文本**



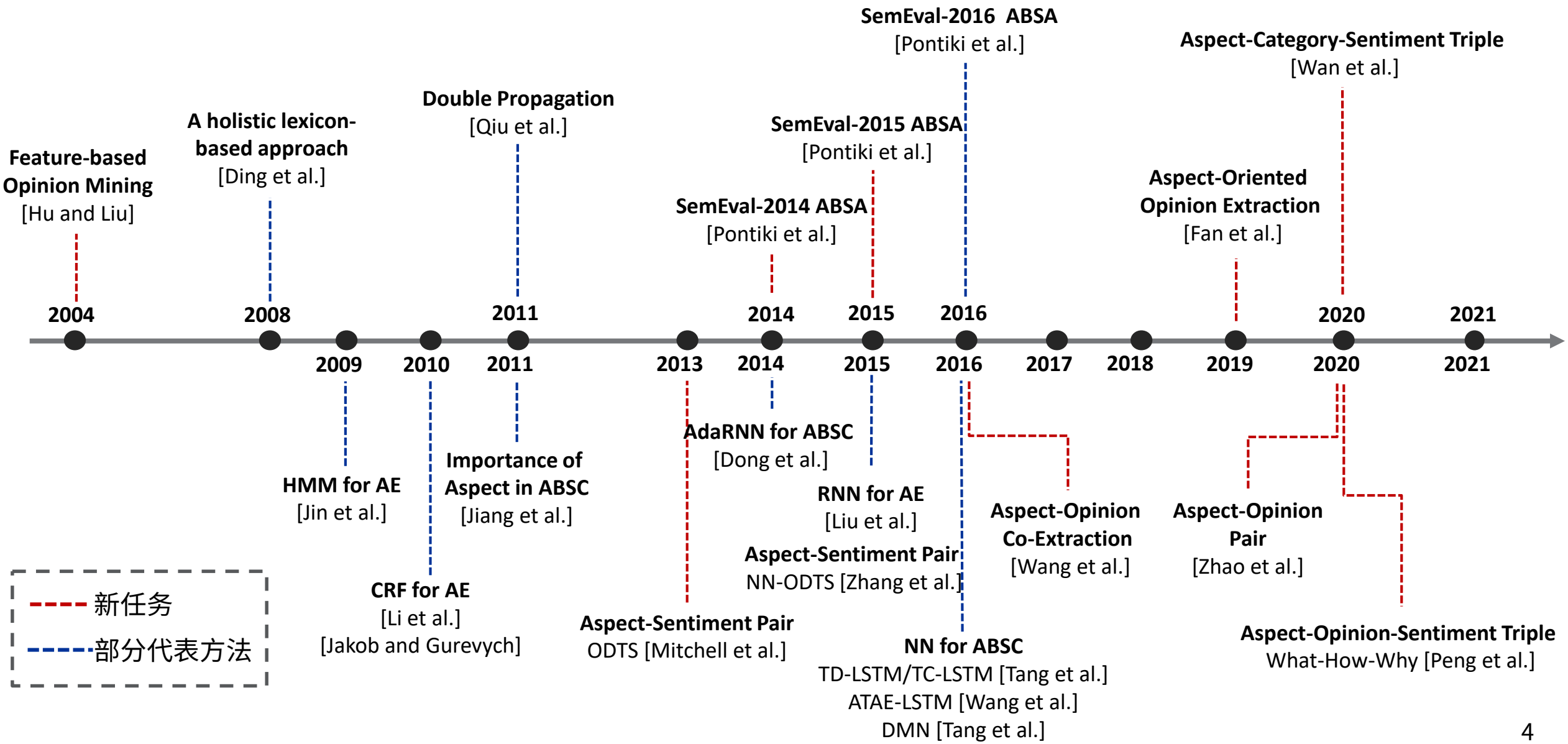


**属性级情感分析：从评论文本中挖掘评价对象并分析针对该评价对象的情感。**

# 文本情感计算领域当前最大热点



# 属性级情感分析研究17年



# 属性级情感分析发展回顾——基本任务

| | iPhone11很好看，速度很快，拍照也不错，就是信号有点弱。 |
|---|---|
| Aspect Extraction | **iPhone11**; **速度**; **拍照**; **信号** |
| Aspect-Oriented Sentiment Classification | **iPhone11**→正面; **速度**→正面; **拍照**→正面; **信号**→负面 |
| Aspect-Sentiment Pair Extraction | (**iPhone11**, 正面); (**速度**, 正面); (**拍照**, 正面); (**信号**, 负面) |

- [Hu and Liu, 2004]开创: feature-based opinion mining (基于特征的观点挖掘)
- 两步骤: Aspect Extraction (属性抽取); Aspect-Oriented Sentiment Classification (属性情感分类)
- [Liu, 2012]: 观点二元组$(g, s)$, 其中$g$表示target(对象), $s$表示sentiment(情感)。评价对象$g$包括评价的实体(entity)$e$ 及其属性(aspect)$a$ : $(g, s) = (e, a, s)$
- 为什么叫做属性级情感分析? → $(g, s) = (e, a, s) \cong (a, s)$
- 是否一定需要两步骤? → 一体化: Open domain targeted sentiment / Joint AE and ABSC / End-to-End ABSA = Aspect-Sentiment Pair Extraction (属性-情感二元组抽取)

# 属性级情感分析发展回顾——属性类别的引入

- [Liu, 2012]定义的aspect包含aspect expression和aspect category: $a = (at, ac)$

| | iPhone11很好看，速度很快，拍照也不错，就是信号有点弱。 |
|---|---|
| Aspect Expression | iPhone11; 速度; 拍照; 信号 |
| Aspect Category | {外观设计; 运行性能; 照相水平; 通信性能; 屏幕质量; 操作系统; 软件应用; …} |

- SemEval 2014/2015/2016: Laptop, Restaurant Benchmark Datasets，相应标注了aspect category
- Aspect Category相关任务的提出

| | iPhone11很好看，速度很快，拍照也不错，就是信号有点弱。 |
|---|---|
| Category Detection | 外观设计; 运行性能; 照相水平; 通信性能 |
| Category-Oriented Sentiment Classification | 外观设计→正面; 运行性能→正面; 照相水平→正面; 通信性能→负面 |
| Category-Sentiment Hierarchical Classification | (外观设计, 正面); (运行性能, 正面); (照相水平, 正面); (通信性能, 负面) |

# 属性级情感分析发展回顾——观点表述的引入

- Opinion Expression在Aspect Extraction的重要性

| | iPhone11很好看，速度很快，拍照也不错，就是信号有点弱。 |
|---|---|
| Opinion Expression | 很好看; 很快; 不错; 有点弱 |

- 陆续工作在SemEval数据基础上补充标注了Opinion Expression，通常为显式的形容词、副词等主观性的词或短语，也称为Opinion Term
- Opinion Expression相关的任务也相应提出

| | iPhone11很好看，速度很快，拍照也不错，就是信号有点弱。 |
|---|---|
| Aspect-Opinion Co-Extraction | iPhone11; 速度; 拍照; 信号; 很好看; 很快; 不错; 有点弱 |
| Aspect-Oriented Opinion Extraction | iPhone11→很好看; 速度→很快; 信号→有点弱 |
| Aspect-Opinion Pair Extraction | (iPhone11, 很好看); (速度, 很快); (信号, 有点弱) |

# 属性级情感分析发展回顾——三元组的提出

- Aspect-Category-Sentiment Triple Extraction

| | iPhone11很好看，速度很快，拍照也不错，就是信号有点弱。 |
|---|---|
| Aspect-Category-Sentiment Triple Extraction | (iPhone11, 外观设计,正面); (速度, 运行性能, 正面); (拍照, 照相水平, 正面); (信号, 通信性能, 负面) |

- Aspect-Opinion-Sentiment Triple Extraction

| | iPhone11很好看，速度很快，拍照也不错，就是信号有点弱。 |
|---|---|
| Aspect-Opinion-Sentiment Triple Extraction | (iPhone11, 很好看, 正面); (速度, 很快, 正面); (拍照, 不错, 正面); (信号, 有点弱, 负面) |

What, How, and Why? [Peng et al. 2020] → Aspect, Sentiment and Opinion

# 概念和术语的回溯

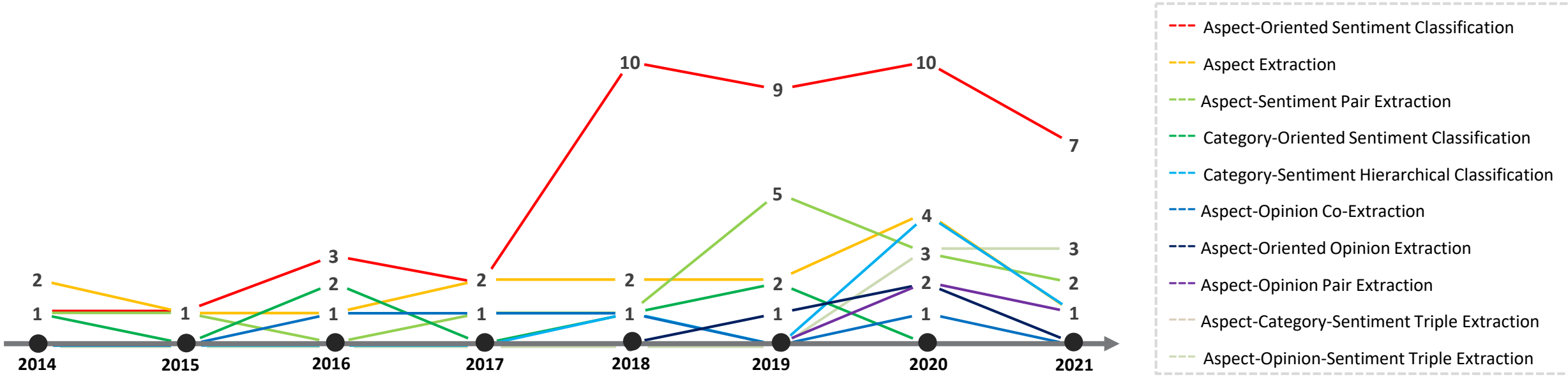
- Aspect Expression/Term (属性表述): 指示评价对象的实体及其属性，通常是评论文本中的名词或名词短语
- Aspect Category (属性类别): 属性在特定领域下的一组预定义的类别标签
- Opinion Expression/Term (观点表述): 针对属性的主观陈述，常被标注为一个主观性的词或短语
- Sentiment (情感): 针对属性的情感类别 (如正面、负面、中性), 也可以理解为Opinion Category

| 简称 | 名称 | iPhone11很好看，速度很快，拍照也不错，就是信号有点弱。 | 任务类型 |
|---|---|---|---|
| Aspect | Aspect Term | iPhone11; 速度; 拍照; 信号 | 抽取 |
| Category | Aspect Category | {外观设计; 运行性能; 照相水平; 通信性能; …} | 分类 |
| Opinion | Opinion Term | 很好看; 流畅; 不错 | 抽取 |
| Sentiment | Opinion Category | {正面, 负面, 中性} | 分类 |

# 属性级情感分析的10项子任务

| | iPhone11很好看，速度很快，拍照也不错，就是信号有点弱。 |
|---|---|
| Aspect Extraction | iPhone11; 速度; 拍照; 信号 |
| Aspect-Oriented Sentiment Classification | iPhone11→正面; 速度→正面; 拍照→正面; 信号→负面 |
| Aspect-Sentiment Pair Extraction | (iPhone11, 正面); (速度, 正面); (拍照, 正面); (信号, 负面) |
| Opinion Extraction | 很好看; 很快; 不错; 有点弱 |
| Aspect-Oriented Opinion Extraction | iPhone11→很好看; 速度→很快; 拍照→不错; 信号→有点弱 |
| Aspect-Opinion Pair Extraction | (iPhone11, 很好看); (速度, 很快); (拍照, 不错); (信号, 有点弱) |
| Category-Oriented Sentiment Classification | 外观设计→正面; 运行性能→正面; 照相水平→正面; 通信性能→负面 |
| Category-Sentiment Hierarchical Classification | (外观设计, 正面); (运行性能, 正面); (照相水平, 正面); (通信性能, 负面) |
| Aspect-Category-Sentiment Triple Extraction | (iPhone11, 外观设计, 很好看); (速度, 运行性能, 很快); (拍照, 照相水平, 不错); (信号, 通信性能, 有点弱) |
| Aspect-Opinion-Sentiment Triple Extraction | (iPhone11, 很好看, 正面); (速度, 很快, 正面); (拍照, 不错, 正面); (信号, 有点弱, 负面) |

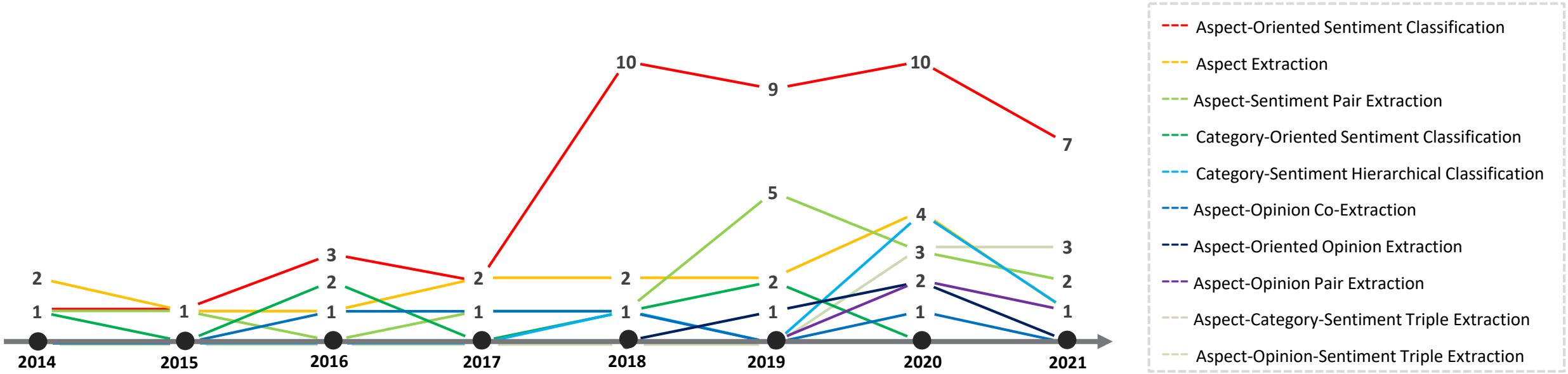
# 属性级情感分析研究现状分析




研究趋势

- **任务**（分类 → 抽取 → 抽取与分类复合）
- **要素**（单要素 → 要素耦合 → 二元组 → 三元组）
- **模型**（规则 → 传统机器学习 → 深度学习 → 预训练模型）

# 属性级情感分析研究现状分析




面临的挑战

一、属性级情感分析的**隐式属性和隐式观点**

二、属性级情感分析的**细粒度标注领域依赖**

三、**语言视觉融合的多模态**属性级情感分析

# 挑战一、属性级情感分析的隐式属性和隐式观点

| 显式/隐式类型 | 示例 |
| --- | --- |
| 显式属性 & 显式观点 | **Keyboard** is **comfortable** and **screen** is **sharp**. （键盘很舒服并且屏幕很清晰） |
| 隐式属性 & 显式观点 | **Nice**, I ordered this just for web browsing and personal use. （很好，我预定这个就是为了网页浏览和个人使用） |
| 显式属性 & 隐式观点 | I noticed the **battery** went to 67% for no reason. （我发现电量无缘无故变成了67%） |
| 隐式属性 & 隐式观点 | We waited for an hour to be seated. （我们等了一个小时入座。） |

**评论文本存在大量隐式的属性和观点!!!**

| | Restaurant | Laptop |
| --- | --- | --- |
| Explicit Aspect & Explicit Opinion | 63.34% | 56.06% |
| Implicit Aspect & Explicit Opinion | 19.47% | 17.54% |
| Explicit Aspect & Implicit Opinion | 12.38% | 27.55% |
| Implicit Aspect & Implicit Opinion | 14.83% | 8.24% |

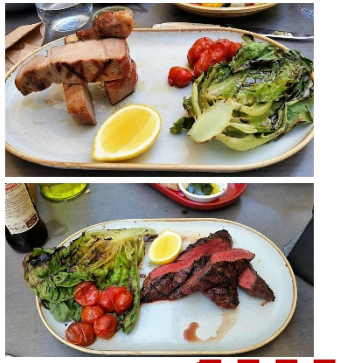
# 挑战二、属性级情感分析的细粒度标注领域依赖

训练数据

餐馆领域

情感分析器

预测数据



餐馆领域 80%


电子产品领域 40%

旅馆领域 60%

# 挑战三、语言视觉融合的多模态属性级情感分析

What a wonderful weather in Beijing!

The beach is so amazing!

直觉1: 图片包含的客观目标有助于更准确的识别评价实体 ⇒ **多模态属性抽取**

直觉2: 图片包含的情感语义有助于更准确的预测属性情感 ⇒ **多模态属性情感分类**

# 一、属性-类别-观点-情感 四元组抽取及隐式属性/观点建模


1. Hongjie Cai, Yaofeng Tu, Xiangsheng Zhou, Jianfei Yu, and Rui Xia*. Aspect-Category based Sentiment Analysis with Hierarchical Graph Convolutional Network. COLING, 2020.
2. Hongjie Cai, Rui Xia*, Jianfei Yu. Aspect-Category-Opinion-Sentiment Quadruple Extraction with Implicit Aspects and Opinions. ACL, 2021.

# 四元组抽取任务的提出

- Aspect Expression/Term (Aspect) → 名词性的文本片段，抽取任务，显式Aspect
- Aspect Category (Category) → 预定义的类别标签，分类任务，支持隐式Aspect
- Opinion Expression/Term (Opinion) → 主观性的文本片段，抽取任务，显式Opinion
- Opinion Category (Sentiment) → 预定义的情感类别，分类任务，支持隐式Opinion

Aspect-Category-Opinion-Sentiment (ACOS)
Quadruple Extraction
(属性-类别-观点-情感 四元组抽取)

(Aspect-Category)-(Opinion-Sentiment)

广义Aspect　　广义的Opinion

(广义的 属性-观点 二元组抽取)

**Review Sentence**

*Looks nice, and the surface is smooth, but certain apps take seconds to respond.*

Aspect-Category-Opinion-Sentiment
Quadruple Extraction

*surface*-Design-*smooth*-Positive
NULL-Design-*nice*-Positive
*apps*-Software-NULL-Negative

# 两个四元组数据集的标注

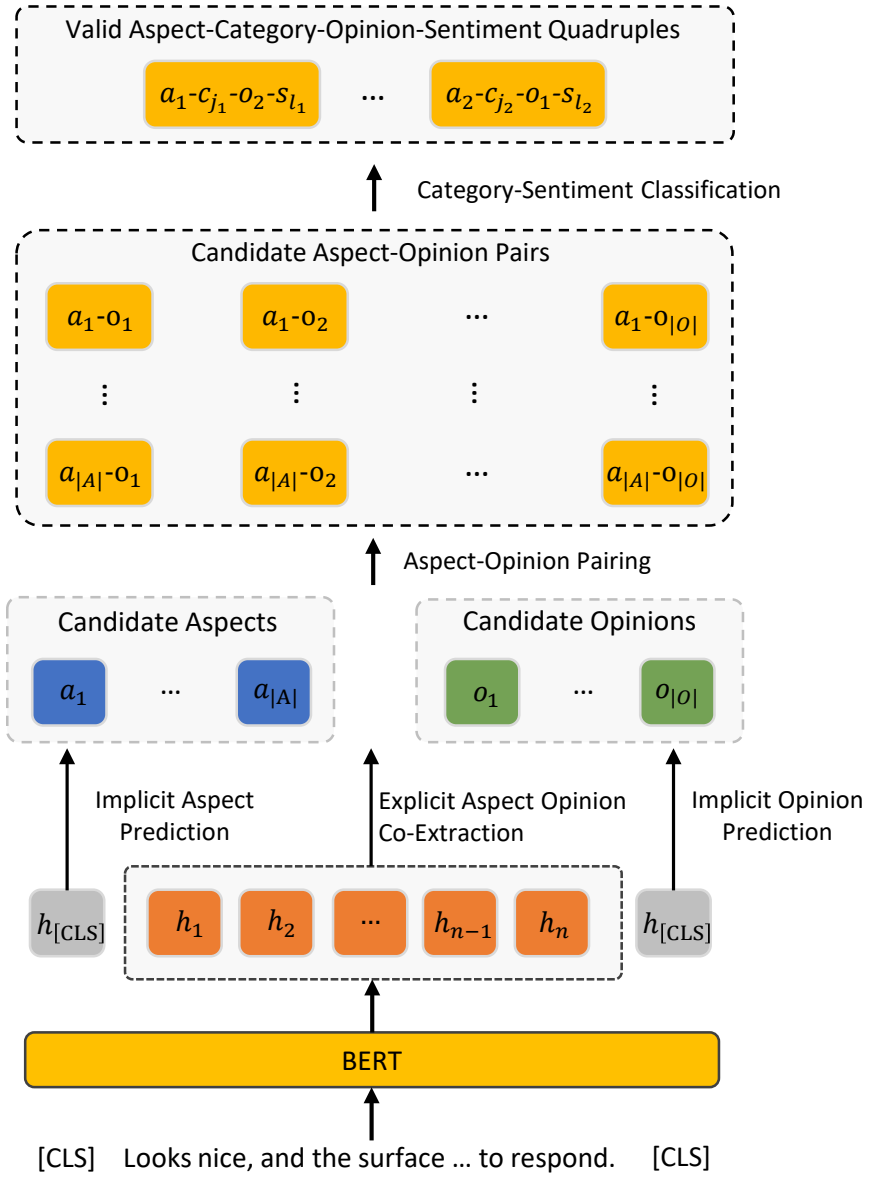
- **Restaurant-ACOS数据集**: SemEval Restaurant标注了Category，(Fan et al.,2019; Xu et al., 2020)标注了显式Opinion → 我们进一步整合四种要素，建立四元组，支持隐式Aspect和Opinion
- **Laptop-ACOS数据集**: SemEval Laptop规模较小、Aspect或Category信息缺失 → 我们爬取了2017-2018年Amazon平台7种品牌10种Laptop产品评论，采用SemEval Laptop一样的Category体系

| | Sentence | Aspect | Category | Opinion | Sentiment | AS Pair | AO Pair | AOS Triple | ACS Triple | ACOS Quadruple |
|---|---|---|---|---|---|---|---|---|---|---|
| Restaurant-2014 (Pontiki et al., 2014) | 3841 | 4827 | 4738 | - | 4534 | 4827 | - | - | - | - |
| Laptop-2014 (Pontiki et al., 2014) | 1910 | 3012 | - | - | 3012 | 3012 | - | - | - | - |
| Restaurant-2016 (Pontiki et al., 2016) | 2295 | 3122 | 3001 | - | 3122 | 3182 | - | - | 3364 | - |
| Laptop-2016 (Pontiki et al., 2016) | 2612 | - | 3705 | - | 3705 | - | - | - | - | - |
| Restaurant-2014-AO (Fan et al., 2019) | 2125 | 3503 | - | 3610 | - | - | 4092 | - | - | - |
| Restaurant-2016-AO (Fan et al., 2019) | 1407 | 1968 | - | 2146 | - | - | 2294 | - | - | - |
| Restaurant-2014-AOS (Xu et al., 2020) | 2068 | 3399 | - | 3443 | 3399 | 3399 | 3908 | 3908 | - | - |
| Restaurant-2016-AOS (Xu et al., 2020) | 1393 | 1946 | - | 2101 | 1946 | 1946 | 2247 | 2247 | - | - |
| Restaurant-ACOS (ours) | 2286 | 3110 | 2967 | 3335 | 3110 | 3155 | 3571 | 3575 | 3335 | 3658 |
| Laptop-ACOS (ours) | 4076 | 4958 | 4992 | 5378 | 4958 | 5035 | 5726 | 5731 | 5227 | 5758 |

**特点**：1. 规模大、标注全；2. 标注了隐式属性和隐式观点；3. 支持四元组抽取以及目前绝大部分ABSA任务

# 四种基线系统

- **Double-Propagation-ACOS**
  基于Double Propagation (Ding et al., 2011) 先抽取Aspect-Opinion-Sentiment三元组，再预测category
- **JET-ACOS**
  基于JET (Xu et al.,2020) 思路先抽取Aspect-Opinion-Sentiment三元组，再预测category
- **TAS-BERT-ACOS**
  基于TAS-BERT(Wan et al., 2020)思路先将Category-Sentiment作为BERT输入，在上层同步抽取Aspect和Opinion
- **Extract-Classify-ACOS**
  先进行Aspect-Opinion Co-Extraction，再进行Category-Sentiment分类



# 实例分析

| Aspect & Opinion Type | EA & EO | IA & EO | EA & IO | IA & IO |
|---|---|---|---|---|
| **Review Sentence** | *Keyboard is comfortable and screen is sharp.* | *Nice, I ordered this just for simple web browsing and personal use.* | *I noticed the battery went down to 67% for no reason.* | *We waited for an hour to be seated.* |
| AS Pair | *screen*-Pos ✓<br>*Keyboard*-Pos ✓ | N/A | ✗ | N/A |
| AO Pair | *screen*-*sharp* ✓<br>*Keyboard*-*comfortable* ✓ | N/A | N/A | N/A |
| ACS Triple | *screen*-Design&Feature-Pos ✓<br>*Keyboard*-Usability-Pos ✓ | ✗ | *battery*-Performance-Neg ✓ | ✗ |
| AOS Triple | *screen*-*sharp*-Pos ✓<br>*Keyboard*-*comfortable*-Pos ✓ | N/A | N/A | N/A |
| JET-ACOS | *screen*-Performance-*sharp*-Pos ✗<br>*Keyboard*-Usability-*comfortable*-Pos ✓ | N/A | N/A | N/A |
| TAS-BERT-ACOS | *screen*-Design&Feature-*sharp*-Pos ✓<br>*Keyboard*-Usability-*comfortable*-Pos ✓ | ✗ | *battery*-Performance-NULL-Neg ✓ | NULL-Service-NULL-Neg ✓ |
| Extract-Classify-ACOS | *screen*-Design&Feature-*sharp*-Pos ✓<br>*Keyboard*-Usability-*comfortable*-Pos ✓ | NULL-General-*Nice*-Pos ✓ | *battery*-Performance-NULL-Neg ✓ | NULL-Service-NULL-Neg ✓ |

# 二、跨领域属性级情感分析


1. Chengqong Gong, Jianfei Yu, and Rui Xia*. Unified Feature and Instance Based Domain Adaptation for End-to-End Aspect-Based Sentiment Analysis. EMNLP, 2020.
2. Jianfei Yu, Chenggong Gong, and Rui Xia*. Cross-Domain Review Generation for Aspect-Based Sentiment Analysis. ACL, Findings, 2021.

# 领域适应的两类方法

$$f_t^* = \arg\min_{f \in H} \int_{(w,y)} P_t(w,y) L(w,y;f)$$

$$= \arg\min_{f \in H} \int_{(w,y)} \frac{P_t(w,y)}{P_s(w,y)} P_s(w,y) L(w,y;f)$$

$$\approx \arg\min_{f \in H} \frac{1}{N_s} \sum_{i=1}^{N_s} \frac{P_t(w_i^s, y_i^s)}{P_s(w_i^s, y_i^s)} L(w_i^s, y_i^s; f)$$

$$= \arg\min_{f \in H} \sum_{i=1}^{N_s} \frac{P_t(y_i^s|w_i^s)}{P_s(y_i^s|w_i^s)} \frac{P_t(w_i^s)}{P_s(w_i^s)} L(w_i^s, y_i^s; f)$$

**Feature-based Adaptation**

**Instance-based Adaptation**

| Methods | Description | References [Jiang 2008; Pan 2010] |
|---|---|---|
| Feature-based Methods | Learn a new feature representation (or a new labeling function) for the target domain | [Daume III 2007; Blitzer 2007; Gao 2008; Pan 2009; Pan 2010; Ji 2011; Xia 2011; Samdani 2011; Glorot 2011; Duan 2012; Yu 2016; Yu 2017; Ding 2017] |
| Instance-based Methods | Learn the importance of labeled data in the source domain by instance weighting for domain adaptation | [Shimodaira 2000; Dudik 2005; Huang 2007; Sugiyama 2007; Bickel 2007; Tsuboi 2009; Kanamori 2009; Xia 2014; Wen 2015; Xia 2018] |

# 跨领域的特征表示学习

**Input:** labeled source data $\{(\mathbf{x}_t, y_t)_{t=1}^T\}$, unlabeled data from both domains $\{\mathbf{x}_j\}$

**Output:** predictor $f : X \to Y$

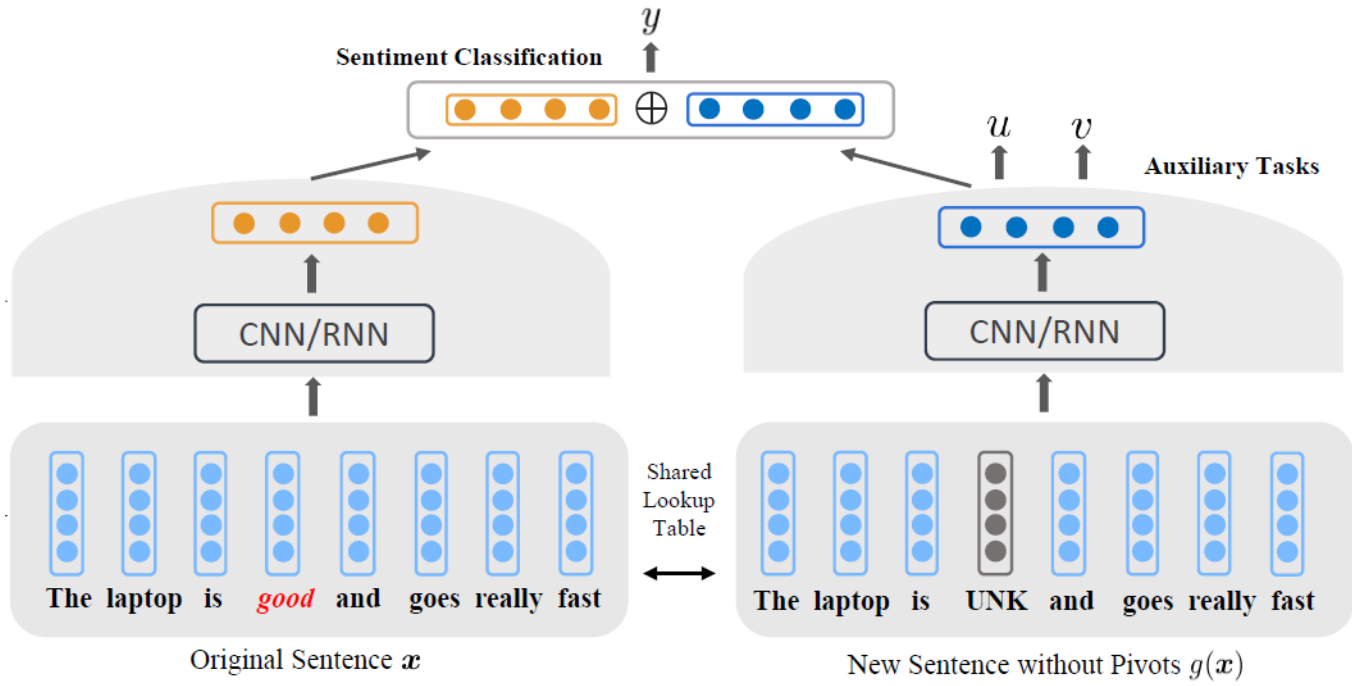
1. Choose $m$ pivot features. Create $m$ binary prediction problems, $p_\ell(\mathbf{x})$, $\ell = 1 \ldots m$
2. For $\ell = 1$ to $m$

$$\hat{\mathbf{w}}_\ell = \underset{\mathbf{w}}{\text{argmin}} \left( \sum_j L(\mathbf{w} \cdot \mathbf{x}_j, p_\ell(\mathbf{x}_j)) + \lambda ||\mathbf{w}||^2 \right)$$

end

3. $W = [\hat{\mathbf{w}}_1 | \ldots | \hat{\mathbf{w}}_m]$, $[U\ D\ V^T] = \text{SVD}(W)$, $\theta = U^T_{[1:h,:]}$
4. Return $f$, a predictor trained on $\left\{ \left( \begin{bmatrix} \mathbf{x}_t \\ \theta \mathbf{x}_i \end{bmatrix}, y_t \right)_{t=1}^T \right\}$

Structure Correspondence Learning [Blitzer, 2007]



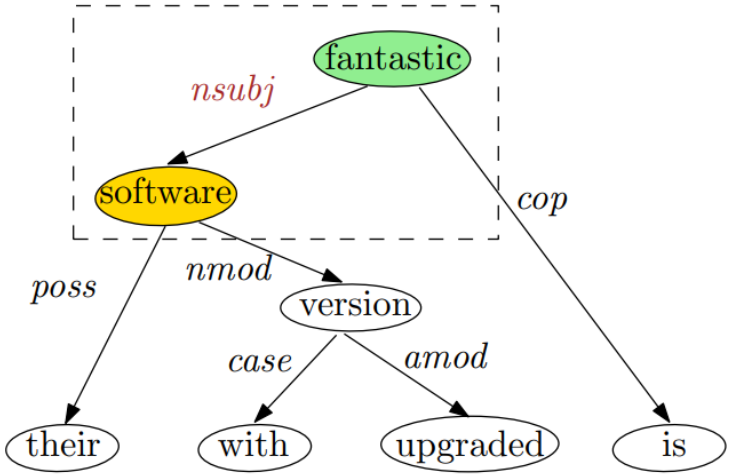

Auxiliary Tasks Learning [Yu et al., 2005]

核心：寻找和设计适合任务的领域**枢纽**，以自监督学习的方式学习领域通用的特征表示。

# 属性级情感分析中的枢纽特征

LAPTOP

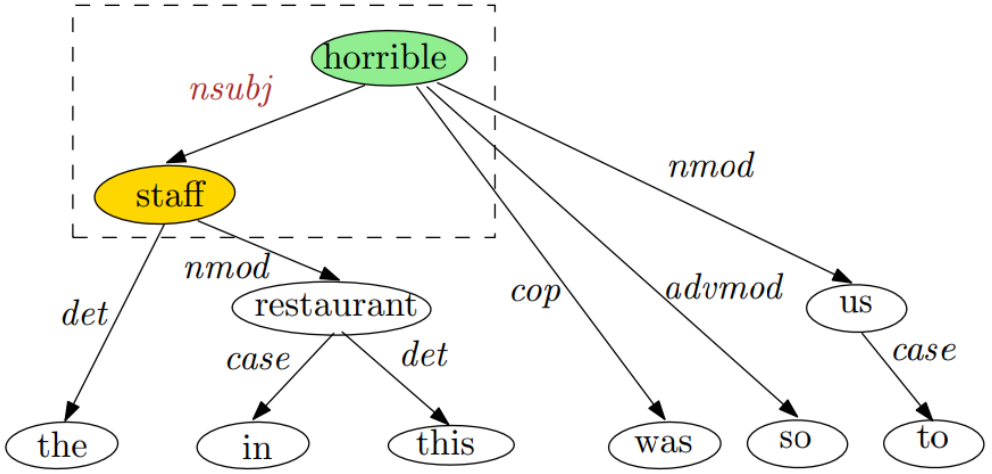
**Source Domain**




Their **software** with upgraded version is **fantastic**.

RESTAURANT

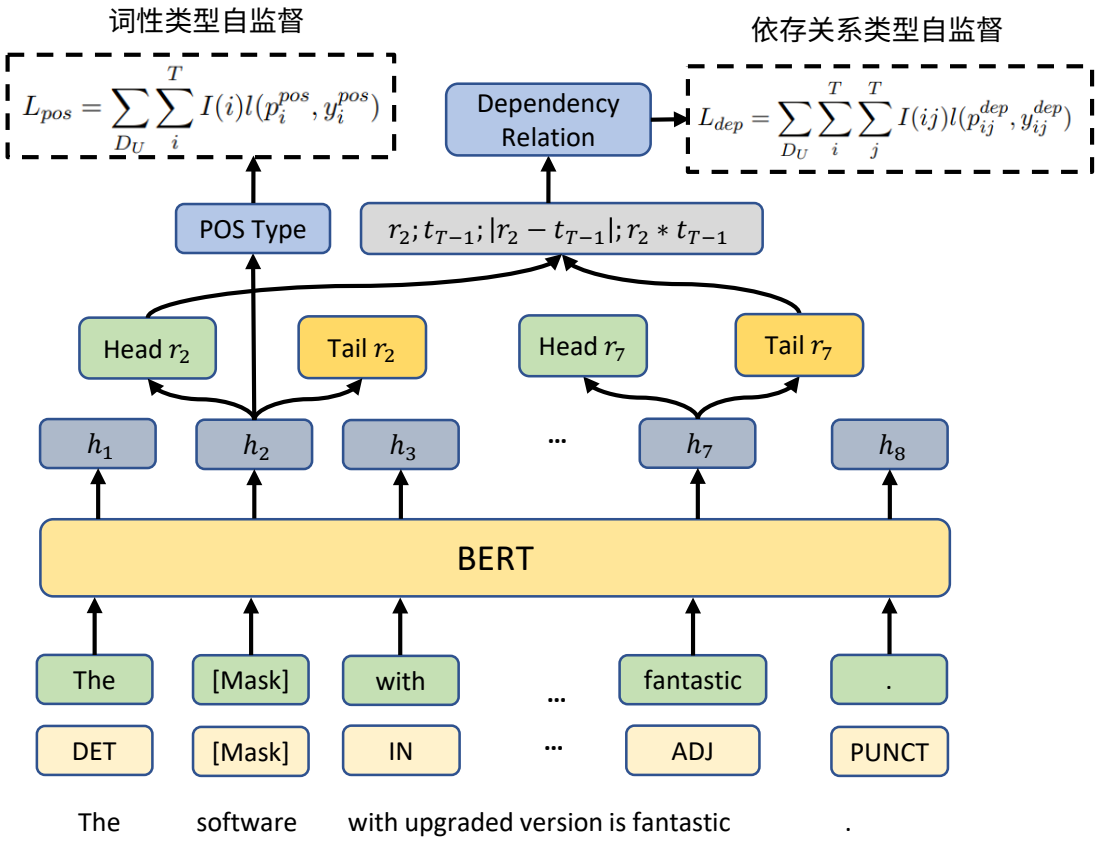
**Target Domain**



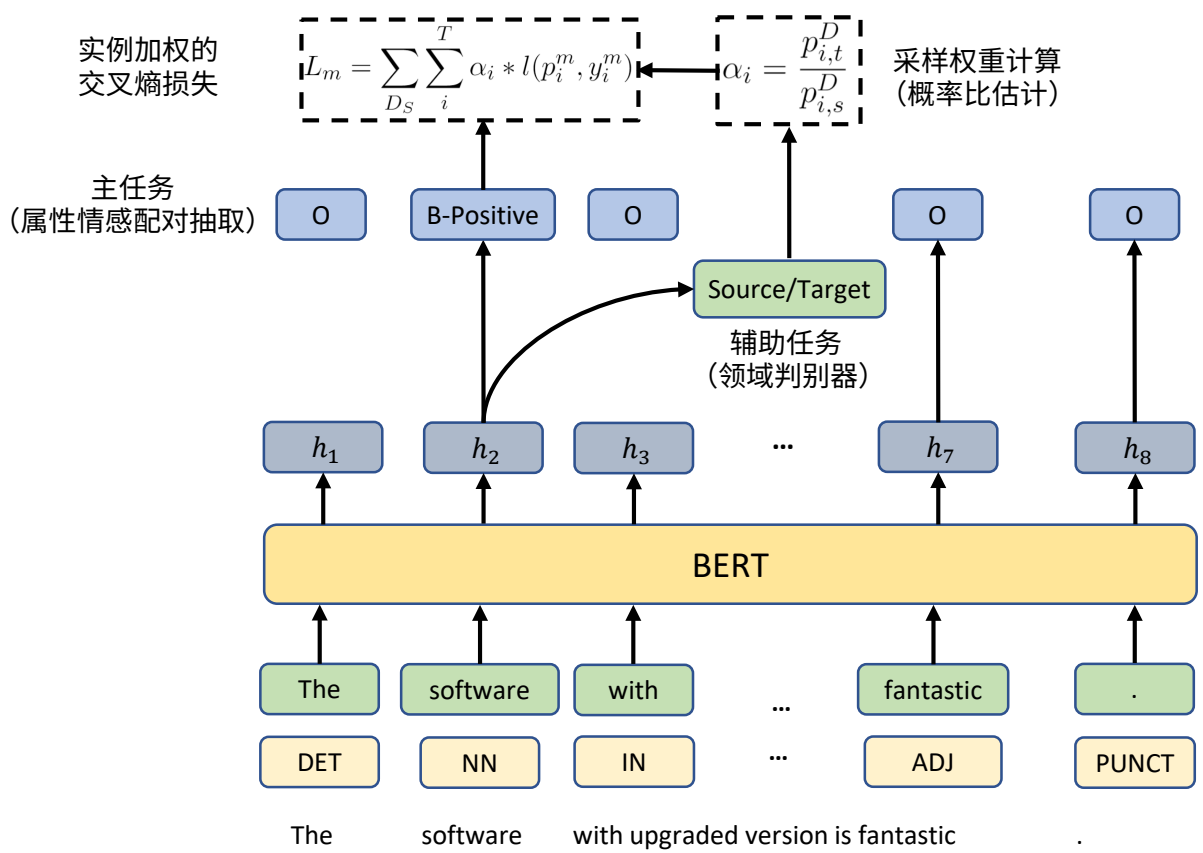

The **staff** in the restaurant was so **horrible** to us.

Pictures from: Wenya Wang, Sino Jialin Pan. Syntactically Meaningful and Transferable Recursive Neural Networks for Aspect and Opinion Extraction, Computational Linguistics, 2019.

# 基于特征和实例联合迁移的跨领域属性级情感分析




Step 1: 领域通用表示学习
（基于特征的领域适应）




Step 2: 领域适应权重采样
（基于实例的领域适应）

# 一种新的领域适应与迁移学习范式

$$f_t^* = \arg\min_{f \in H} \int_{(w,y)} P_t(w,y) L(w,y;f)$$

$$= \arg\min_{f \in H} \int_{(w,y)} \frac{P_t(w,y)}{P_s(w,y)} P_s(w,y) L(w,y;f)$$

$$\approx \arg\min_{f \in H} \frac{1}{N_s} \sum_{i=1}^{N_s} \frac{P_t(w_i^s, y_i^s)}{P_s(w_i^s, y_i^s)} L(w_i^s, y_i^s; f)$$

$$= \arg\min_{f \in H} \sum_{i=1}^{N_s} \frac{P_t(y_i^s|w_i^s)}{P_s(y_i^s|w_i^s)} \frac{P_t(w_i^s)}{P_s(w_i^s)} L(w_i^s, y_i^s; f)$$

基于目标领域标注样本生成的领域适应

**Feature-based Adaptation**

**Instance-based Adaptation**

LAPTOP **Source Domain**

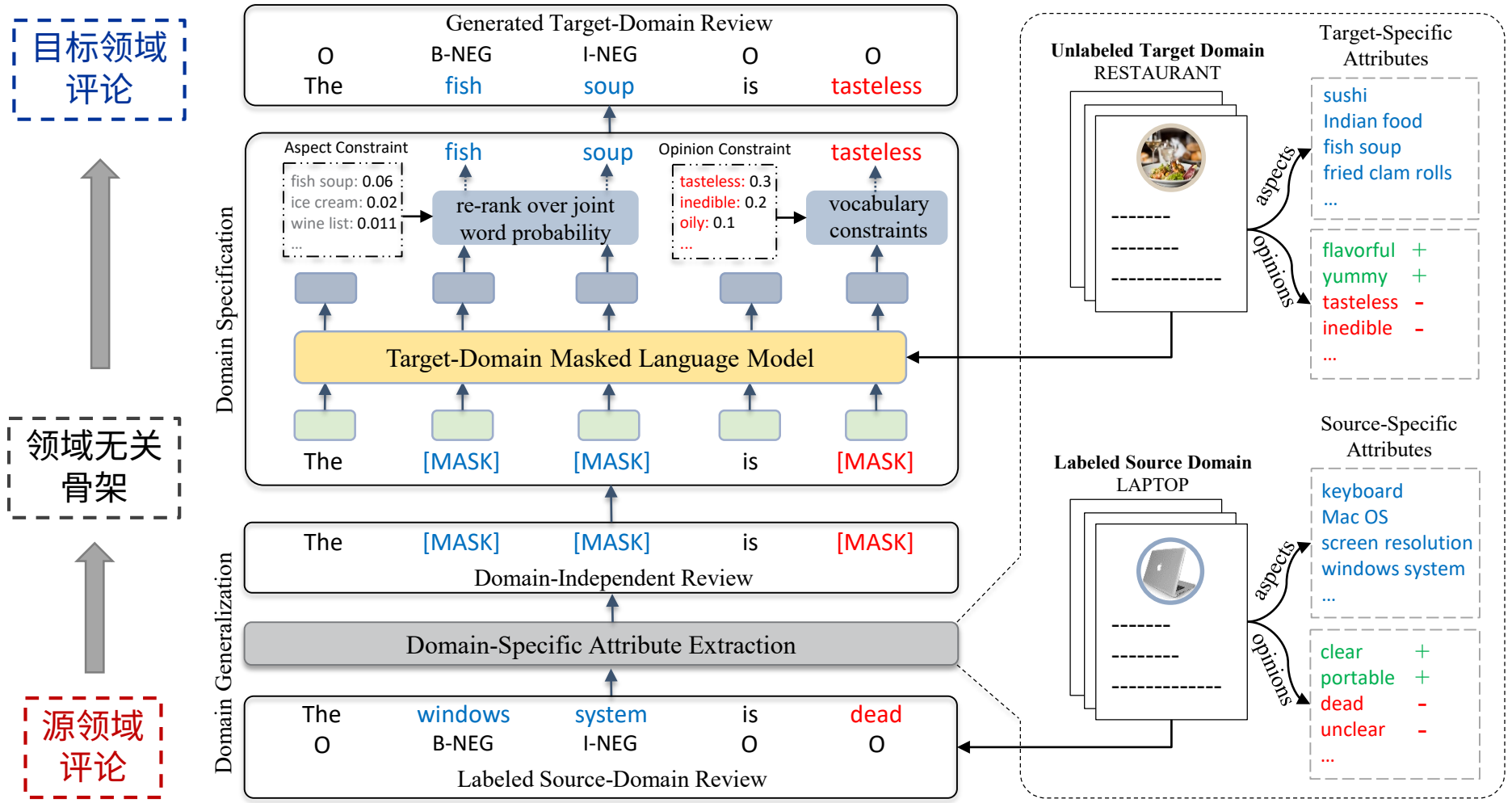
The [Macbook]$_{\text{Positive}}$ is lightweight , but the [battery]$_{\text{Negative}}$ never held a charge longer than 1 hour !

Cross-Domain Review Generation
with fine-grained annotation

RESTAURANT **Target Domain**

The [fish soup]$_{\text{Positive}}$ is delicious , but the [sushi]$_{\text{Negative}}$ never tastes as good as before !

# 基于属性/情感词迁移的目标领域标注样本生成



# 实例分析

| | | |
|---|---|---|
| Source Domain: Laptop→Target Domain: Restaurant | | |
| | 1. The [screen graphics]$_P$ and [clarity]$_P$, and [sharp ##ness]$_P$ are great. | 2. The [battery life]$_P$ is great. |
| $BERT_E$ | The [laptop,]$_P^✗$ and [sound]$_P^✗$, and [the ##s]$_P^✗$ are great. | The [touch screen]$_P^✗$ is great. |
| TD-MLM | The [food,]$_P^✗$ and [service]$_P^✗$, and [the prices]$_P^✗$ are great. | The [su here]$_P^✗$ is great. |
| TD-MLM-C | The [pizza ##s]$_P^✓$ and [atmosphere]$_P^✓$, and [service staff]$_P^✓$ are great. | The [su ##shi]$_P^✓$ is great. |
| Source Domain: Restaurant→ Target Domain: Laptop | | |
| | 3. The [food]$_P$ is [flavor ##ful], [pl ##ent ##iful] and reasonably priced. | 4. [Pizza]$_P$ is terrific, as is [homemade pasta]$_P$. |
| $BERT_E$ | The [food]$_P^✗$ is [flavor ##ful]$^✗$, [st ##ten ,]$^✗$ and reasonably priced. | [It]$_P^✗$ is terrific, as is [the price]$_P^✗$. |
| TD-MLM | The [keyboard]$_P^✓$ is [joy ##ful]$^✓$, [easy ##yl ,]$^✗$ and reasonably priced. | [It]$_P^✗$ is terrific, as is [the screen]$_P^✗$. |
| TD-MLM-C | The [keyboard]$_P^✓$ is [joy ##ful]$^✓$, [st ##yl ##ish]$^✓$ and reasonably priced. | [Speed]$_P^✓$ is terrific, as is [windows os]$_P^✓$. |

# 三、多模态属性级情感分析

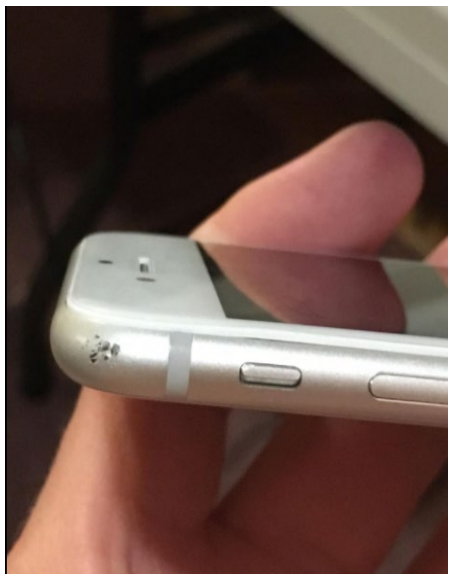

1. Jianfei Yu, Jing Jiang, Li Yang, and Rui Xia*. Improving Multimodal Named Entity Recognition via Entity Span Detection with Unified Multimodal Transformer. ACL 2020.
2. Jianfei Yu, Jing Jiang, and Rui Xia. Entity-Sensitive Attention and Fusion Network for Entity-Level Multimodal Sentiment Classification. IEEE/ACM TASLP, 2020.

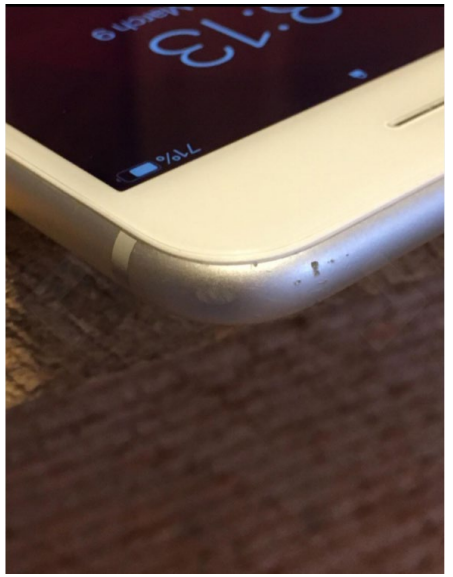
# 多模态属性级情感分析任务定义

#SamHunt Performs at Stagecoach #MusicFestival 2016

| Aspect (Entity) | Sentiment |
|---|---|
| SamHunt | Positive |
| Stagecoach | Neutral |

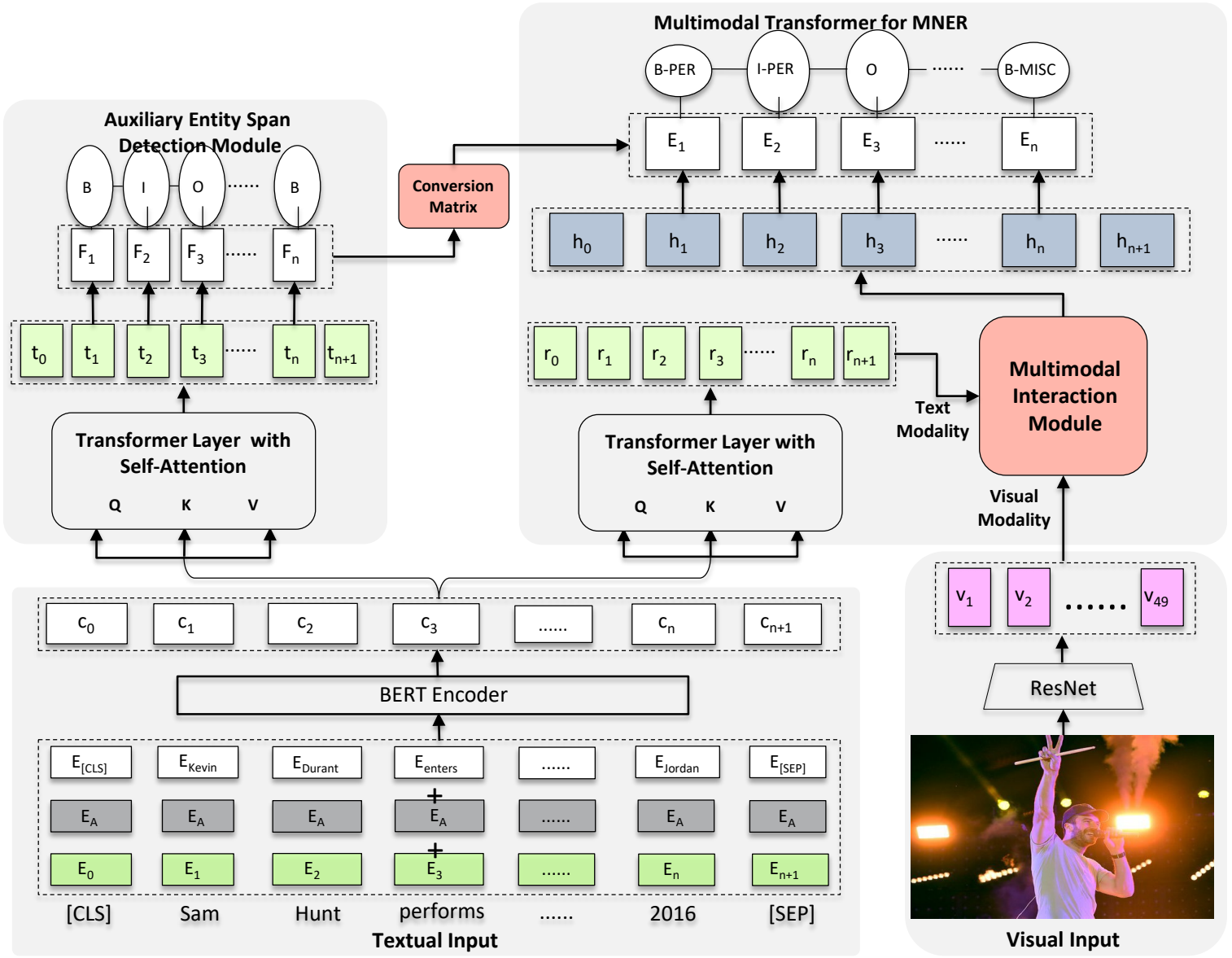
Not happy with this “renewed” iPhone 8 from AE Cells. According to Amazon, this should be like new. The battery health is at 80%. It is not worth the price.



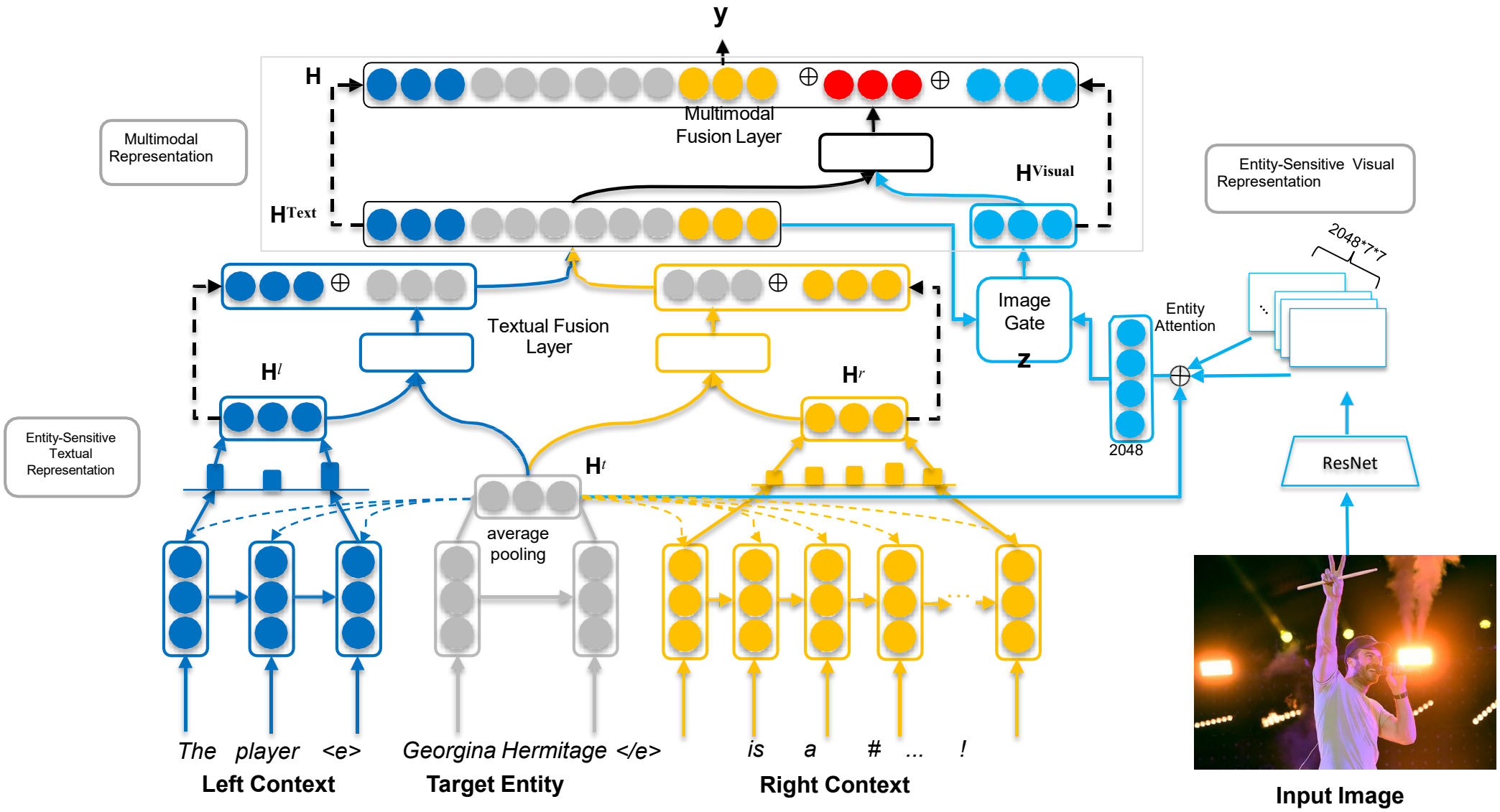


| Aspect (Category) | Sentiment (Rating) |
|---|---|
| Appearance | ★ |
| Battery | ★★★ |
| Price | ★★ |

# 多模态属性(实体)抽取

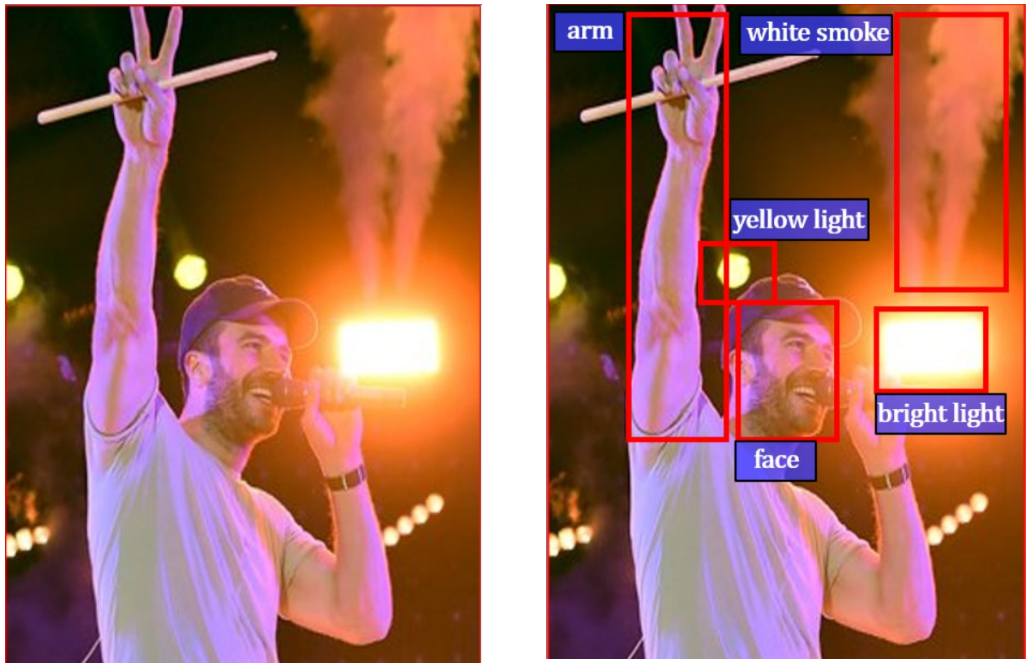

Multimodal Transformer for MNER
Auxiliary Entity Span Detection Module
B
I
O
B
Conversion Matrix
B-PER
I-PER
O
B-MISC
Transformer Layer with Self-Attention
Q K V
Transformer Layer with Self-Attention
Q K V
Text Modality
Multimodal Interaction Module
Visual Modality
BERT Encoder
[CLS] Sam Hunt performs 2016 [SEP]
Textual Input
ResNet
Visual Input

# 多模态属性级情感分类

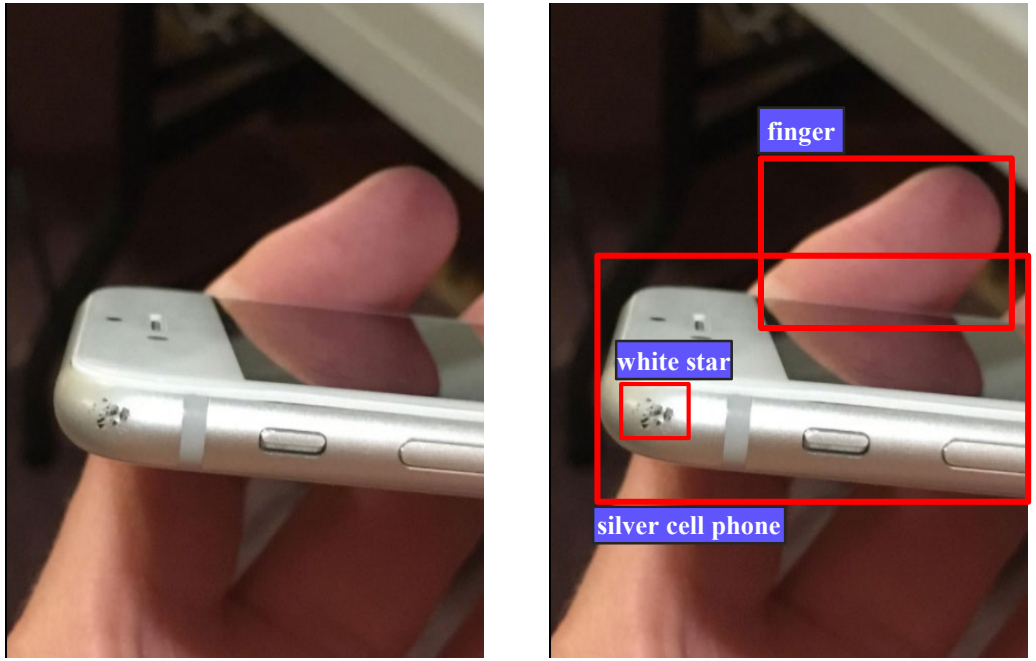

y
H
Multimodal Representation
Multimodal Fusion Layer
H^Text
H^Visual
Entity-Sensitive Visual Representation
2048*7*7
Image Gate
z
Entity Attention
2048
Textual Fusion Layer
H^l
H^r
H^t
Entity-Sensitive Textual Representation
ResNet
average pooling
The player <e>
Georgina Hermitage </e>
is a # ... !
Left Context
Target Entity
Right Context
Input Image

# 多模态属性级情感分析尚存在的问题

#Sam Hunt Performs at Stagecoach #MusicFestival 2016




The corner of this renewed IPhone 8 is heavily scratched. The screen is replaced with an aftermarket product. It is not worth the price to me.

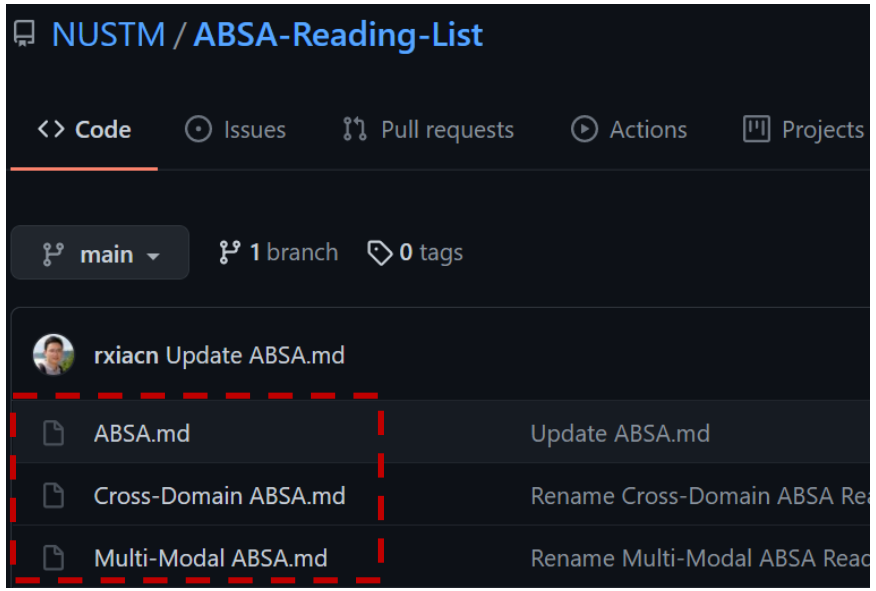



1. 如何有效地检测图片中的客观目标，并与文本中的评价实体对齐?
2. 如何准确地识别图片中包含的情感语义，特别是针对评价实体的情感?

# 总结

- **研究的趋势**
  - 任务（分类 -> 抽取 -> 抽取与分类复合）
  - 要素（单要素 -> 要素耦合 -> 二元组 -> 三元组 -> 四元组）
  - 模型（规则 -> 传统机器学习 -> 深度学习 -> 预训练模型）
- **存在的挑战**
  - 属性级情感分析的隐式属性和隐式观点
  - 属性级情感分析的细粒度标注领域依赖
  - 语言视觉融合的多模态属性级情感分析
- **三方面的工作**
  - 属性-类别-观点-情感 四元组抽取
  - 基于特征、实例的属性级情感分析; 目标领域细粒度标注评论生成
  - 多模态属性抽取、多模态属性情感分类

# 谢谢大家！请批评指正！




- 报告工作的代码和数据开源：https://github.com/NUSTM/
- ABSA阅读列表：https://github.com/NUSTM/ABSA-Reading-List/