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Bidirectional Machine Reading Comprehension for Aspect Sentiment Triplet Extraction

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Aspect sentiment triplet extraction task (ASTE) Review:

Aim to identify triplets from review sentences.

<aspect, opinion expression, sentiment>

Three challenges:

- How to adequately learn the association between aspect term extraction (ATE) and opinion term extraction (OTE) and make them mutually beneficial.
- How to flexibly and exactly detect the complicated relations between aspects and opinion expressions.
- How to properly introduce the detected relations into sentiment classification task.

Model

- > Transform ASTE task into a multi-turn machine reading comprehension (MTMRC) task.
- > Propose a bidirectional MRC (BMRC) framework.
- > Three types of queries:
 - Non-restrictive extraction query $Q^{\mathcal{N}} = \{q_i^{\mathcal{N}}\}_{i=1}^{|Q^{\mathcal{N}}|}$, Restrictive extraction query $Q^{\mathcal{R}} = \{q_i^{\mathcal{R}}\}_{i=1}^{|Q^{\mathcal{R}}|}$, Sentiment classification query $Q^{\mathcal{S}} = \{q_i^{\mathcal{S}}\}_{i=1}^{|Q^{\mathcal{S}}|}$
- > Encoding Layer: BERT
- Answer Prediction:
 - For extraction query:

$$p\left(y_i^{start}|x_i,q\right) = \operatorname{softmax}\left(\boldsymbol{h}_{|q|+2+i}W_s\right), \quad p\left(y_i^{end}|x_i,q\right) = \operatorname{softmax}\left(\boldsymbol{h}_{|q|+2+i}W_e\right)$$

For sentiment classification query:

$$p(y^{\mathcal{S}}|X,q) = \operatorname{softmax}(\boldsymbol{h}_1 W_c)$$

> Joint Learning: minimize the cross-entropy loss.

$$\mathcal{L}(\theta) = \mathcal{L}_{\mathcal{N}} + \mathcal{L}_{\mathcal{R}} + \mathcal{L}_{\mathcal{S}}$$

> Inference: fuse the answers to different queries and obtain triplets.

Input Review The *food* was *delicious*, but the *price* was indeed *expensive*. *A*→*O* Direction *O*→*A* Direction Non-restrictive $q_{A\to 0,1}^{\mathcal{N}}$: What aspects? $q_{0\rightarrow A,1}^{\mathcal{N}}$: What opinions? Extraction Answer: food, price Answer: delicious, expensive Query $q_{A\to 0,1}^{\mathcal{R}}$: What opinions given $q_{0\rightarrow A.1}^{\mathcal{R}}$: What aspects does the the aspect *food*? opinion delicious describe? Restrictive **Answer**: *delicious* Answer: food Extraction $q_{A\rightarrow 0.2}^{\mathcal{R}}$: What opinions given $q_{0\rightarrow A,2}^{\mathcal{R}}$: What aspects does the Query opinion expensive describe? the aspect *price*? Answer: price Answer: expensive q_1^S : What sentiment given the aspect *food* and the opinion *delicious*? Sentiment Answer: Positive Classification q_2^S : What sentiment given the aspect *price* and the opinion *expensive*? Query Answer: *Negative* **Output Triplets** {food, delicious, positive}, {price, expensive, negative}

The food was delicious, but the price was indeed expensive.

The result of aspect sentiment triplet extraction (ASTE):

{food, delicious, positive}

{price, expensive, negative}

Experiments

Experimental results (%). 'A-S', 'O', 'P' and 'T' denote aspect term and sentiment co-extraction, opinion term extraction, aspect-opinion pair extraction, and aspect sentiment triplet extraction.

Evaluation Models 14-Lap 14-Res 15-Res 16-Res TSF 63.15 78.22 50.00 40.40 76.60 84.72 47.76 44.18 67.65 78.07 49.22 40.97 71.18 81.09 52.35 46.76 Precision Li-unified-R+ 66.28 76.62 52.29 42.25 73.15 81.20 44.37 41.44 64.95 79.18 52.75 43.34 66.33 79.84 46.11 38.19																	
Evaluation	Models	14-Lap			14-Res			15-Res			16-Res						
Evaluation	Models	A-S	O	P	T	A-S	O	P	T	A-S	O	P	T	A-S	O	P	T
	TSF	63.15	78.22	50.00	40.40	76.60	84.72	47.76	44.18	67.65	78.07	49.22	40.97	71.18	81.09	52.35	46.76
Precision	RINANRTE+	41.20	78.20	34.40	23.10	48.97	81.06	42.32	31.07	46.20	77.40	37.10	29.40	49.40	75.00	35.70	27.10
	Li-unified-R+	66.28	76.62	52.29	42.25	73.15	81.20	44.37	41.44	64.95	79.18	52.75	43.34	66.33	79.84	46.11	38.19
	RACL+R	59.75	77.58	54.22	41.99	75.57	82.28	73.58	62.64	68.35	76.25	67.89	55.45	68.53	82.52	72.77	60.78
	Ours	72.73	84.67	74.11	65.12	77.74	87.22	76.91	71.32	72.41	82.99	71.59	63.71	73.69	85.31	76.08	67.74
	TSF	61.55	71.84	58.37	47.24	67.84	80.39	68.10	62.99	64.02	78.07	65.70	54.68	72.30	86.67	70.50	62.97
	RINANRTE+	33.20	62.70	26.20	17.60	47.36	72.05	51.08	37.63	37.40	57.00	33.90	26.90	36.70	42.40	27.00	20.50
Recall	Li-unified-R+	60.71	74.90	52.94	42.78	74.44	83.18	73.67	68.79	64.95	75.88	61.75	50.73	74.55	86.88	64.55	53.47
	RACL+R	68.90	81.22	66.94	51.84	82.23	90.49	67.87	57.77	70.72	83.96	63.74	52.53	78.52	91.40	71.83	60.00
	Ours	62.59	67.18	61.92	54.41	75.10	82.90	75.59	70.09	62.63	73.23	65.89	58.63	72.69	83.01	76.99	68.56
	TSF	62.34	74.84	53.85	43.50	71.95	82.45	56.10	51.89	65.79	78.02	56.23	46.79	71.73	83.73	60.04	53.62
F ₁ -score	RINANRTE+	36.70	69.60	29.70	20.00	48.15	76.29	46.29	34.03	41.30	65.70	35.40	28.00	42.10	54.10	30.70	23.30
	Li-unified-R+	63.38	75.70	52.56	42.47	73.79	82.13	55.34	51.68	64.95	77.44	56.85	46.69	70.20	83.16	53.75	44.51
	RACL+R	64.00	79.36	59.90	46.39	78.76	86.19	70.61	60.11	69.51	79.91	65.46	53.95	73.19	86.73	72.29	60.39
	Ours	67.27	74.90	67.45	59.27	76.39	84.99	76.23	70.69	67.16	77.79	68.60	61.05	73.18	84.13	76.52	68.13

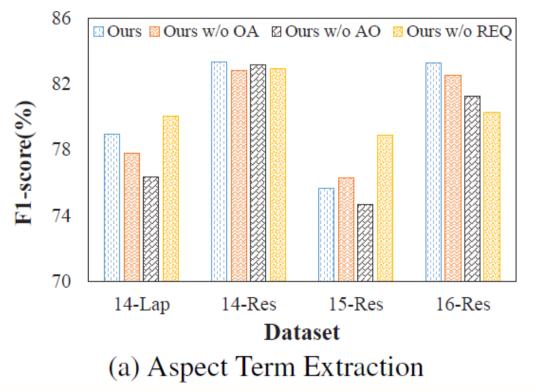
Ablation study on aspect sentiment triplet extraction (F1-score, %).

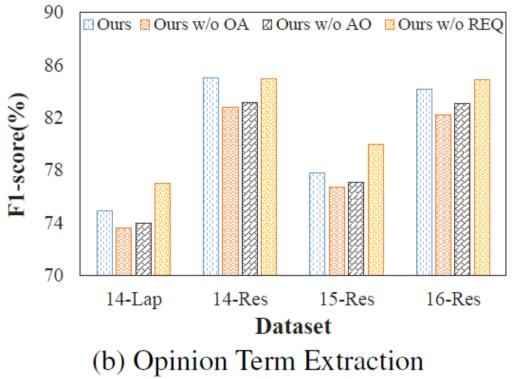
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Models	14-Lap	14-Res	15-Res	16-Res
TSF	43.50	51.89	46.79	53.62
Ours w/o BERT	48.15	63.32	53.77	63.16
Ours w/o REQ	51.40	57.20	47.79	61.03
Ours	59.27	70.69	61.05	68.13

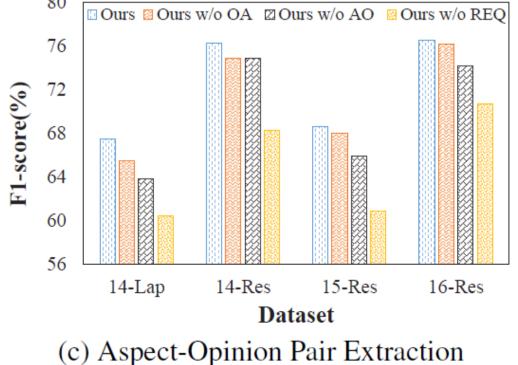
Ablation study on **sentiment classification** (F1-score, %).

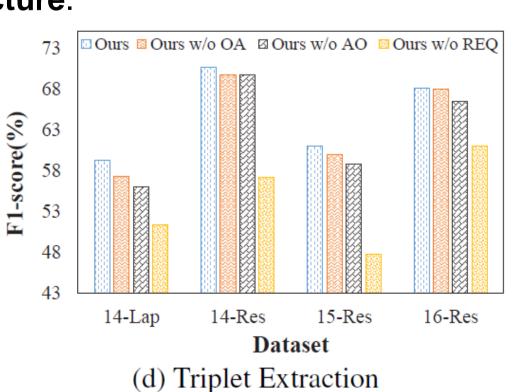
Datasets		A	A-S			
Datasets	Ours	Our w/o REQ	Ours	Ours w/o REQ		
14-Lap	78.94	80.06	67.27	61.61		
14-Res	83.31	82.73	76.39	66.26		
15-Res	75.67	79.00	67.16	56.82		
16-Res	83.28	80.60	73.18	68.82		

Ablation study on the restrictive extraction query and the bidirectional structure.









主办方: 中国中文信息学会青年工作委员会

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