Pairwise Tagging Framework for End-to-end Emotion-cause Pair Extraction

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Problems & Ideas

- Problems of existing works:
  - Pipelined methods: easily suffer from error propagation.
  - Multi-task learning methods: cannot optimize all subtasks of ECPE globally and may lead to suboptimal extraction results.

- Ideas: A novel Pairwise Tagging Framework (PTF) that tackles the complete emotion-cause pair extraction in one unified tagging task.
  - PTF innovatively transforms all subtasks of ECPE, i.e., emotions extraction, causes extraction, and causal relations detection between emotions and causes, into one unified clause-pair tagging task.

Tags	Meanings
E	the clause-pair (c_i, c_i) expresses emotion, i.e., c_i is an emotion clause.
C	the clause-pair (c_j, c_j) expresses cause, i.e., c_j is a cause clause.
P	the clause-pair (c_i, c_j) contains a casual relation.
O	no above three relations for clause-pair (c_i, c_j).

The meanings of PTF tags for the ECPE task.

	c_1	c_2	c_3	$\mathbf{c}_4$	$\mathbf{c}_5$	c_6	
	O	O	O	O	O	O	c_1
		C	O	P	O	O	c_2
			C	P	O	O	c_3
				E	O	O	$\mathbf{c}_4$
					E	P	$\mathbf{c}_5$
						C	c_6

PTF tagging example. There are three emotion-cause pairs (c_4, c_2), (c_4, c_3) and (c_5, c_6) in the document $(c_1, \cdots, c_6)$

Main Contributions

- Contributions:
  - A novel tagging framework PTF that is the first work to solve all subtasks of ECPE with a global and unified clause-pair tagging task, instead of multi-task learning;
  - A PTF-based end-to-end neural network PTN that avoids error propagation and improves the performance of ECPE significantly;
  - PTN introduces three helpful mechanisms and achieves state-of-the-art performance on the ECPE benchmark dataset.

Models	Emotion Extraction			Cause Extraction			Emotion-Cause Pair Extraction		
	P	R	F1	P	R	F1	P	R	F1
Indep	83.75	80.71	82.10	69.02	56.73	62.05	68.32	50.82	58.18
Inter-CE	84.94	81.22	83.00	68.09	56.34	61.51	69.02	51.35	59.01
Inter-EC	83.64	81.07	82.30	70.41	60.83	65.07	67.21	57.05	61.28
E2EECPE	85.95	79.15	82.38	70.62	60.30	65.03	64.78	61.05	62.80
ECPE-2D(base)	85.37	81.97	83.54	71.51	62.74	66.76	71.73	57.54	63.66
ECPE-2D	85.12	82.20	83.58	72.72	62.98	67.38	69.60	61.18	64.96
TransECPE	80.80	84.39	82.56	67.42	65.34	66.36	65.15	63.54	64.34
RankCP(top-1)	87.35	81.46	84.28	71.30	64.68	67.90	69.10	62.54	65.62
RankCP	87.03	84.06	85.48	69.27	67.43	68.24	66.98	65.46	66.10
PTN(base)	84.12	81.61	82.82	72.02	63.66	67.50	71.38	59.48	64.80
PTN	84.47	82.78	83.60	71.75	64.70	67.99	76.00	59.18	66.50

Best and second-best results are respectively in bold and underline. With the help of novel unified tagging framework PTF, the proposed end2end model PTN outperforms the pipelined methods such as Inter-CE, Inter-EC, and multi-task methods such as E2EECPE, ECPE-2D, and RankCP.