Improving (Dis)agreement Detection with Inductive Social Relation Information From Comment-Reply Interactions

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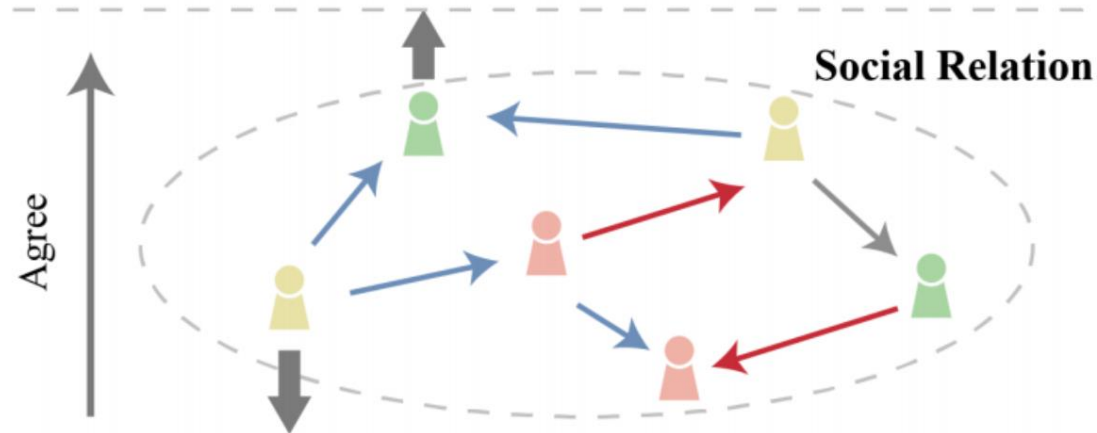Hangzhou, China
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code: https://github.com/LuoXiaoHeics/StanceRel.

Reported by Xiaoke Li

Figure 1: Examples for (dis)agreement detection in the DE-BAGREEMENT dataset.

Temporal (Dis)agreement Graph
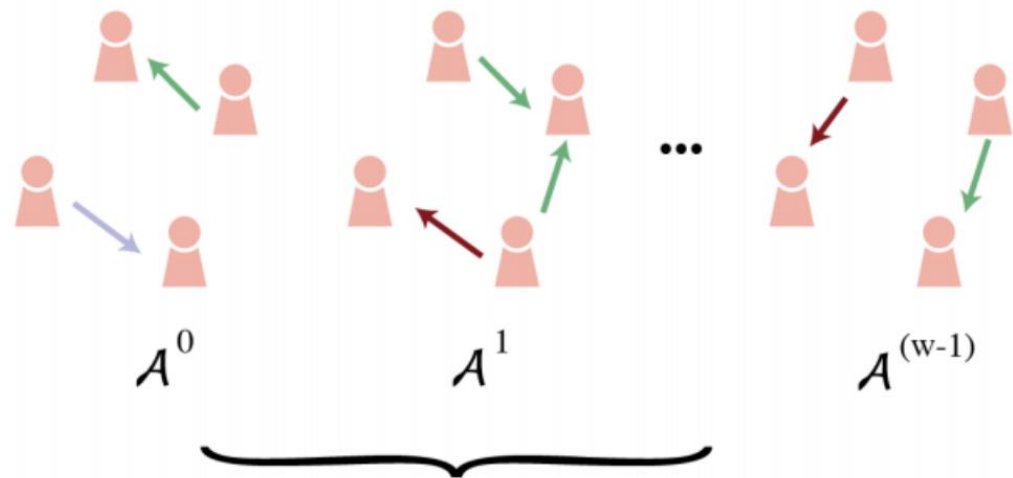
$$D = \{c_i, t_i, y_i, n_i^c, n_i^t\}_{i=1}^{N}$$

agree/disagree/neutral

$$a_{i,j}^k = +1/-1/0$$

$$\mathcal{A}^0 \qquad \mathcal{A}^1 \qquad \mathcal{A}^{(w-1)}$$

$$\mathcal{A}^* = \mathcal{A}^0 + \mathcal{A}^1 + ... + \mathcal{A}^{(w-1)}.$$

Inductive Social Graph
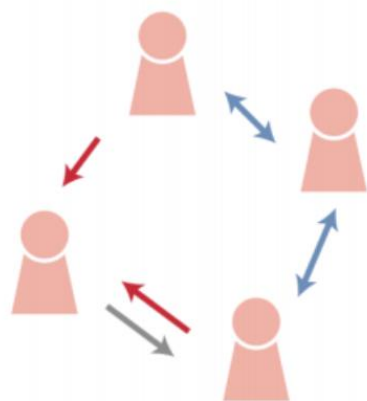
→ Agree
→ Disagree
→ Neutral
→ Supporter
→ Opponent
→ Acquaintance

$$r = \begin{cases} supporter & \text{if } a_{ij}^* > 0, \\ opponent & \text{if } a_{ij}^* < 0, \\ acquaintance & \text{if } a_{ij}^* = 0 \text{ and } a_{ij}^k \neq 0, \end{cases}$$

Figure 2: The illustration of the construction of the social relation graph using the temporal order information.

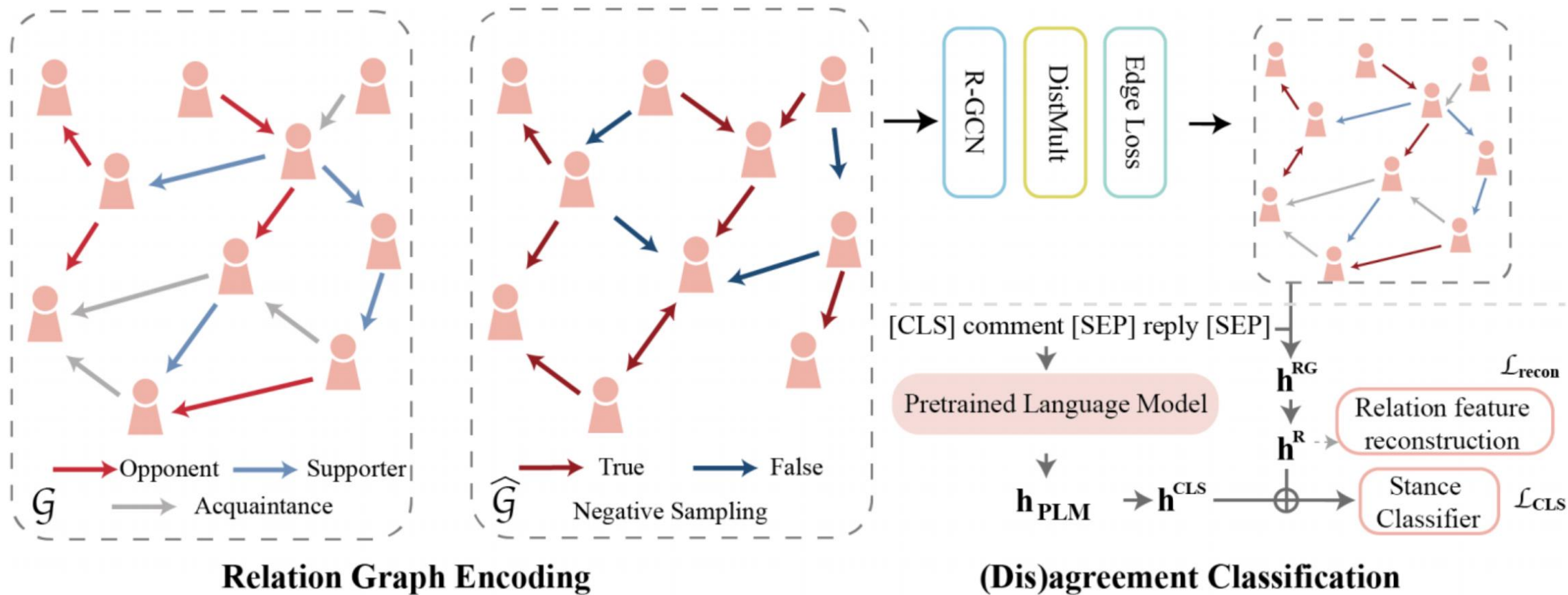Figure 3: Framework of our proposed model, which contains two components, (1) relation graph encoding, (2) (dis)agreement detection with social relation information.
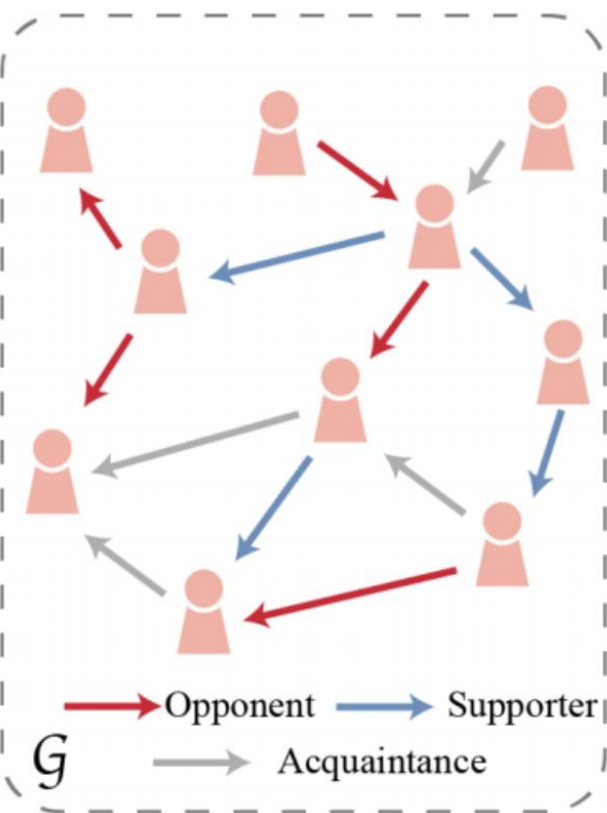
Relation Graph Encoding
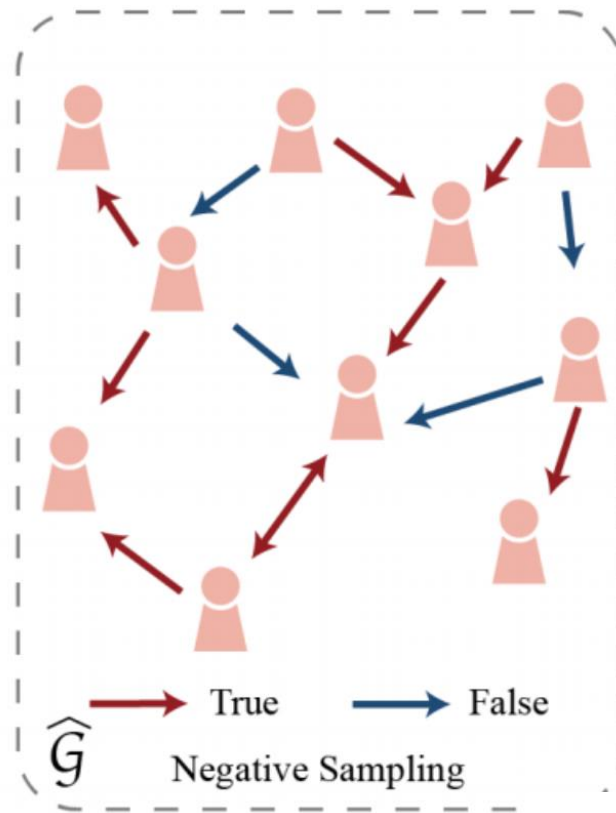
$$f(x_i, l) = \sigma(W_0^{(l)} x_i + \sum_{r \in \mathcal{R}} \sum_{j \in N_i^r} \frac{1}{n_{i,r}} W_r^{(l)} x_j),$$

$$\mathbf{h}_i = \mathbf{h}_i^{(2)} = f(\mathbf{h}_i^{(1)}, 2) \; ; \; \mathbf{h}_i^{(1)} = f(\mathbf{u}_i, 1), \qquad (1)$$

$$s(n_i, r, n_j) = \sigma(\mathbf{h}_{n_i}^T R_r \mathbf{h}_{n_j}), \qquad (2)$$

where σ is a logistic function; $\mathbf{h}_{n_i}, \mathbf{h}_{n_j} \in \mathbb{R}^n$ are the encoding feature vectors through the graph encoder for author n_i and n_j; every type of relation $r \in \mathcal{R}$ is associated with a diagonal matrix $R_r \in \mathbb{R}^{n \times n}$.

$$\mathcal{L}_{\mathcal{G}'} = -\frac{1}{2|\hat{\mathcal{E}}'|} \sum_{(n_i, r, n_j, y) \in \mathcal{U}} (y \log s(n_i, r, n_j)$$
$$+ (1 - y) \log(1 - s(n_i, r, n_j))). \qquad (3)$$

Relation Graph Encoding   **(Dis)agreement Classification**
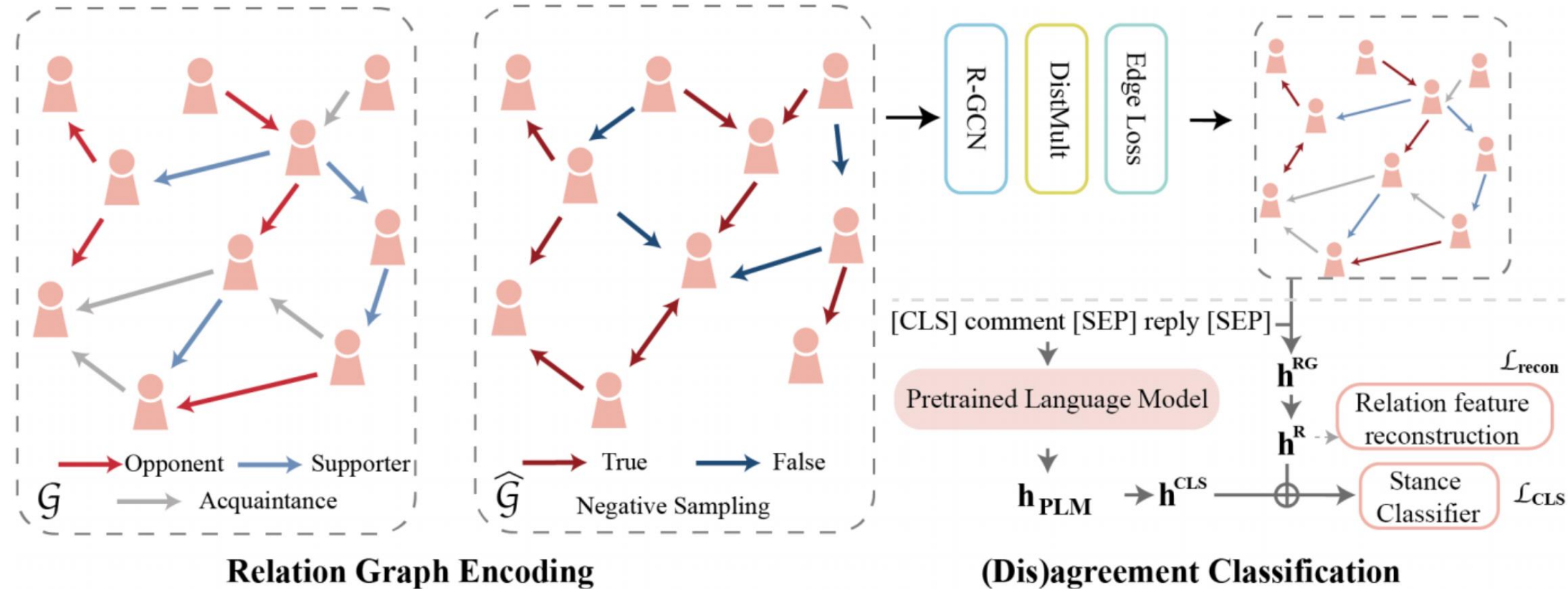
$$\mathbf{h}^{RG} = RGCN(\mathcal{G}_A). \quad (4) \qquad \mathbf{h}^R = W_R\,\mathbf{h}^{RG} + b_R \ (5) \qquad \mathbf{h}_{PLM} = PLM(x_i). \quad (6)$$

$$p = Softmax(W[\mathbf{h}^{CLS}, \mathbf{h}^R] + b), \ (7)$$

Relation Graph Encoding

(Dis)agreement Classification

$$\mathcal{L}_{train} = \mathcal{L}_{stance} + \mathcal{L}_{recon}. \qquad (8)$$

$$\mathcal{L}_{stance} = -\frac{1}{|N|} \sum_{(x_i, y_i)} y_i \log p(y_i), \qquad (9)$$

$$\mathcal{L}_{recon} = -E_{\mathbf{h}^{RG}} (||D_{recon}(\mathbf{h}^R) - \mathbf{h}^{RG}||_2^2). \qquad (10)$$
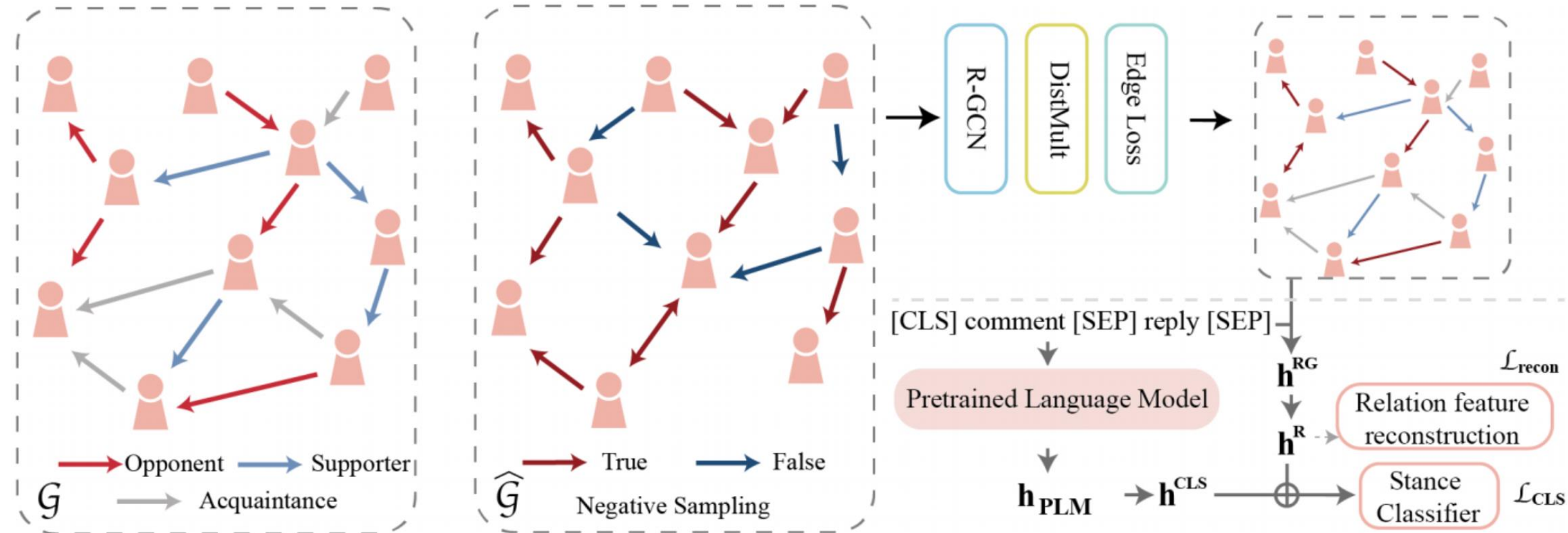
	r/Br	r/Cl	r/BLM	r/Re	r/De
#nodes	722	4,580	2,516	8,832	6,925
#edges	15,745	5,773	1,929	9,823	9,624
Agree	29%	32%	45%	34%	42%
Neutral	29%	28%	22%	25%	22%
Disagree	42%	40%	33%	41%	36%

Table 1: Statistics on DEBAGREEMENT. Br for the subreddit Brexit; Cl for the subreddit Climate; BLM for the subreddit BLM; Re for the subreddit Republican and De for the subreddit Democrats, henceforth.

	r/Br	r/Cl	r/BLM	r/Re	r/De	All
#Supporter	2,159	989	511	1,882	2,299	7,833
#Opponent	3,040	1,304	357	2,170	1,957	8,820
#Interaction	7,613	3,383	1,039	5,723	5,276	23,004
Degree	35.39	2.48	1.51	2.22	2.75	3.43
Betweenness	1.54	0.49	0.01	0.22	0.52	0.53

Table 2: Statistics metrics on the inductive social relation graph and the subgraph of each subreddit. Degree and betweenness are the averaged metrics on each subgraph, which indicate the graph centrality.

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Model	Agree			Disagree			Neutral			All	
	Prec	Rec	F1	Prec	Rec	F1	Prec	Rec	F1	Acc	M-F1
BiLSTM	47.29	47.85	47.56	47.86	61.96	54.00	44.44	25.87	32.70	47.11	44.75
BERT-sep	68.92	68.26	68.44	68.79	73.29	70.58	53.29	48.55	50.80	64.68	63.27
BERT-joint	67.88	67.78	66.30	68.84	74.80	70.36	54.44	48.12	50.28	65.50	63.59
RoBERTa-joint	**72.28**	69.18	70.56	74.11	69.80	71.89	51.31	58.67	54.57	66.78	65.67
Ours											
BiLSTM-rel	50.35	57.65	53.75	51.87	55.71	53.77	42.23	28.79	34.17	49.62	47.23
BERT-rel	70.15	70.60	70.35	73.62	71.19	72.34	52.52	54.68	53.51	66.82	65.40
RoBERTa-rel	70.97	**72.01**	**71.44**	**75.62**	**73.01**	**74.27**	**54.16**	**55.95**	**55.02**	**68.38**	**66.91**

Table 3: In-domain testing results. The models are trained on the five subreddits and tested on the corresponding test data. (Prec , Rec, F1, Acc and M-F1 for the metrics of precision, recall, micro-F1 score, accuracy and macro-F1 score, henceforth).

	r/Br	r/Cl	r/BLM	r/Re	r/De
BiLSTM	44.82	43.08	51.81	46.59	52.86
BERT-joint	64.10	64.90	66.90	66.10	67.20
BERT-sep	63.68	65.05	64.24	65.11	66.73
RoBERTa-joint	65.83	66.92	71.23	69.38	67.55
BiLSTM-rel	46.15	44.46	53.89	50.05	53.27
BERT-rel	65.99	66.99	70.17	67.77	67.04
RoBERTa-rel	**66.81**	**68.77**	**71.37**	**70.25**	**68.24**

Table 4: Accuracies of RoBERTa-rel on each subreddit.
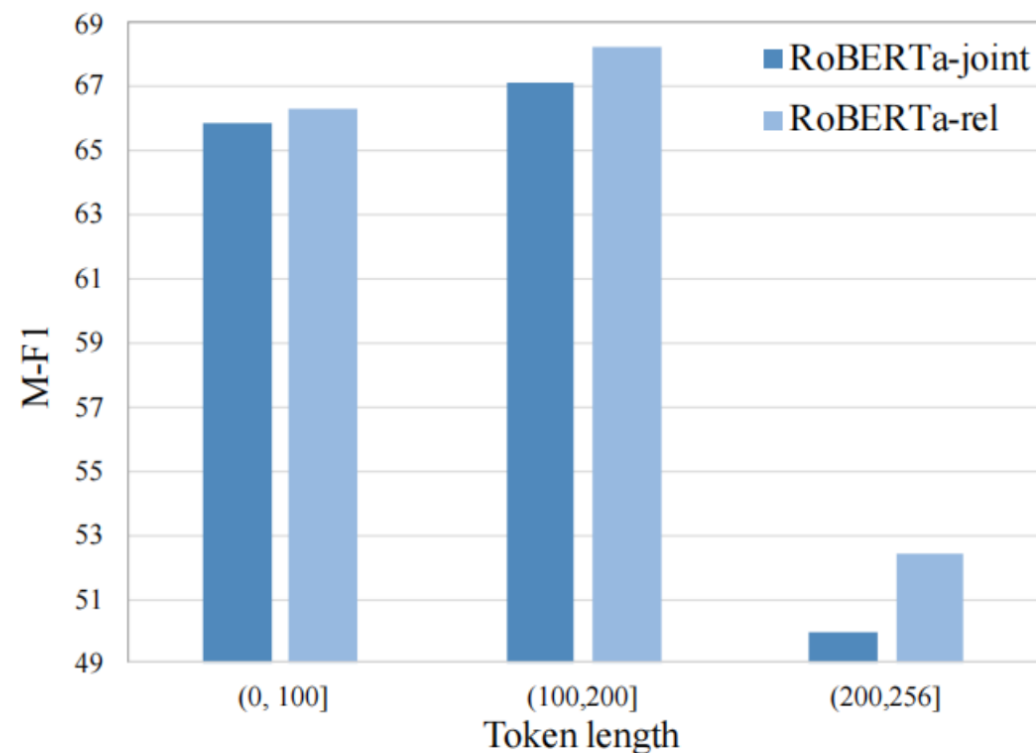
Figure 4: Results of RoBERTa-rel with respect to the different token lengths of the comment-reply pairs.

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Model	r/Br		r/Cl		r/BLM		r/Re		r/De		Average	
	Acc	M-F1	Acc	M-F1	Acc	M-F1	Acc	M-F1	Acc	M-F1	Acc	M-F1
BiLSTM	42.60	41.90	41.52	40.24	46.11	39.73	47.30	41.32	50.88	46.79	45.68	42.00
BERT-sep	61.84	61.73	63.82	63.11	65.80	62.86	64.23	61.51	65.91	63.52	64.32	62.71
BERT-joint	64.12	62.56	64.42	64.34	65.32	62.13	66.64	63.25	66.03	63.21	65.30	63.10
RoBERTa-joint	65.43	64.07	67.64	65.95	69.15	66.06	66.02	64.94	64.80	61.45	66.61	64.46
Ours												
BiLSTM-rel	44.32	43.19	42.33	43.14	46.33	41.05	49.32	44.13	50.78	48.14	46.62	43.93
BERT-rel	**66.49**	**65.13**	65.44	64.05	68.30	65.60	66.57	64.38	64.22	62.43	66.20	64.32
RoBERTa-rel	66.03	64.49	**68.29**	**66.83**	**69.17**	**66.49**	**70.23**	**67.88**	**67.96**	**66.88**	**68.34**	**66.51**

Table 5: Cross-domain testing results. The models are trained on the four subreddits and tested on the left subreddit.

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Figure 5: Ablation study on RoBERTa-rel, and differe methods of information fusing in the in-domain testing.
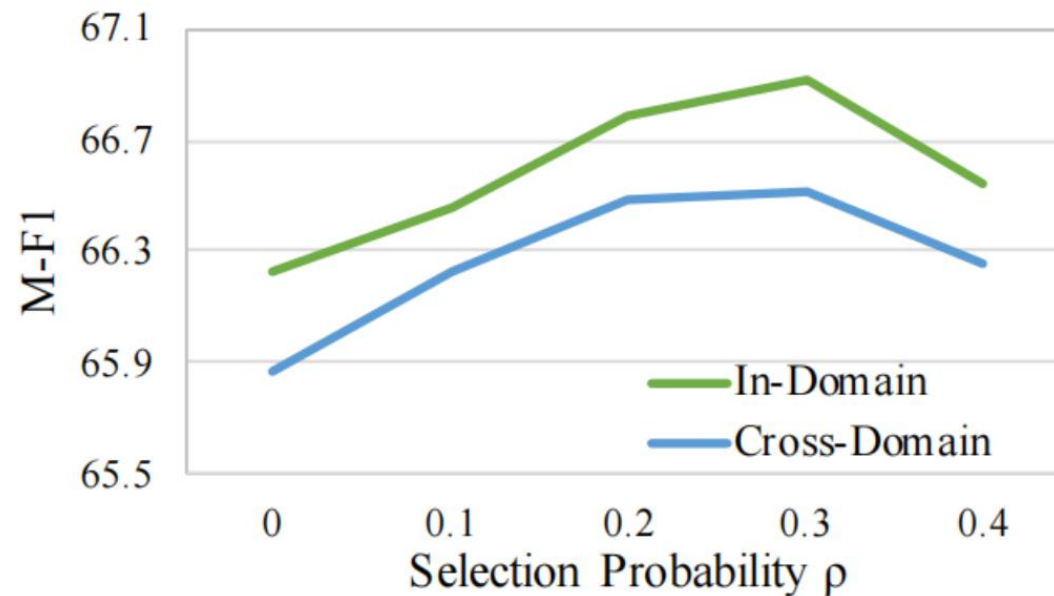

Figure 6: Results of RoBERTa-rel with respect to different rates of selected *interaction* edges in the training set. For the in-domain task, the model is trained in all subreddits and evaluated on the test data. For the cross-domain task, the metric is the averaged macro-F1 score of the five tasks in Section 4.4.

Comment	Reply	Soci Rel.	Label	Output
By that standard, every person on the internet is hundreds of times more guilty than rural villagers in Africa and India. Why don't you give up your technology?	That wasn't the point. I just read a news article telling people what they can do to stop climate change when he himself has multiple private jets. He can take first class on a normal plane but that would inconvenience him.	Supporter	Agree	Agree
Am I the only person who gets worried when they see a line of only other people! lol. jokes but... actually not joking. It scares me now.	I smile (awkwardly, I'm sure) at poc. I'll knock a person up if anyone were to harass someone who's just minding their own business.	Interaction	Disagree	Disagree

Table 6: Case Study. Soci Rel. is for social relations.

Thanks