Temporal Knowledge Graph Reasoning via Multi-granularity Knowledge Refinement

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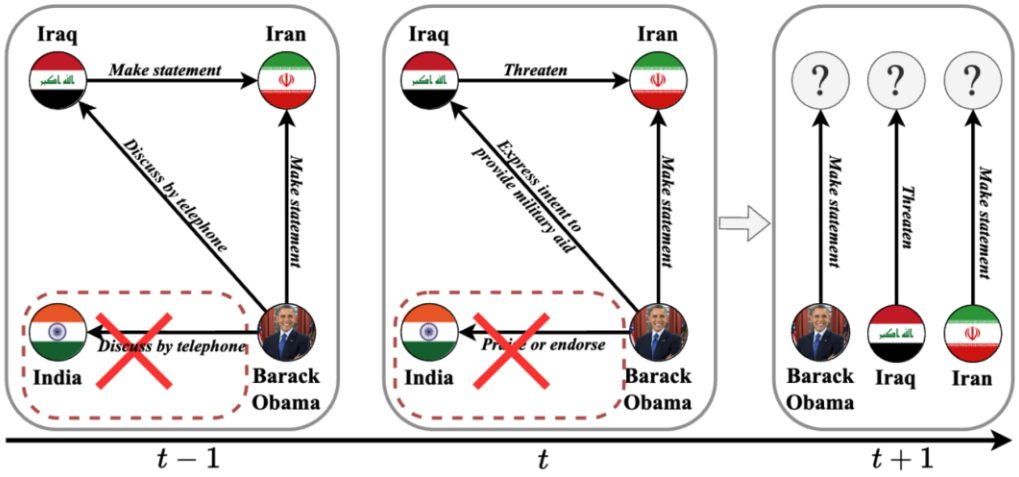
Problems & Ideas

- Problems of conventional TKG reasoning approaches:
  - Existing TKG reasoning methods typically aggregate all historical facts within a given time window indiscriminately.
  - This introduces outdated or irrelevant information, which hinders reasoning performance as TKGs grow in scale and complexity.
- Ideas: A Temporal Knowledge Graph reasoning model via Multi-granularity Knowledge Refinement (T-MKR) to selectively prune irrelevant edges and unnecessary nodes, effectively filtering out uninformative historical interactions.



An illustration of the irrelevant facts. The red boxes represent facts that are not relevant to the reasoning at timestamp t+1.

Main Contributions

- Contributions:
  - Addressed the challenge of irrelevant facts in TKG reasoning by introducing a multi-granularity knowledge refinement mechanism, consisting of node-granularity and edge-granularity refinement;
  - Proposed a subgraph gating integration and an alignment mechanism to enhance the connection between node-refined and edge-refined subgraphs via contrastive learning;
  - Validated the effectiveness of T-MKR on six commonly used datasets, demonstrating substantial improvements over state-of-the-art baselines.

Model	ICE14			ICE05-15			ICE18			GDELT			WIKI			YAGO		
	MRR	H@1	H@10	MRR	H@1	H@10	MRR	H@1	H@10	MRR	H@1	H@10	MRR	H@1	H@10	MRR	H@1	H@10
RE-NET‡	39.86	30.11	58.21	43.67	33.55	62.72	29.78	19.73	48.46	19.55	12.38	34.00	58.32	50.01	73.57	66.93	58.59	86.84
CyGNet‡	37.65	27.43	57.90	40.42	29.44	61.60	27.12	17.21	46.85	20.22	12.35	35.82	58.78	47.89	78.70	68.98	58.97	86.98
RE-GCN‡	42.00	31.63	61.65	48.03	37.33	68.51	32.62	22.39	52.68	19.69	12.46	33.81	78.53	74.50	84.70	82.30	78.83	88.58
TITer†	41.73	32.74	58.44	47.60	38.29	64.86	29.98	22.05	44.83	18.19	11.52	31.00	73.91	71.70	76.96	87.47	80.09	90.27
TiRGN‡	44.04	33.83	63.84	50.04	39.25	70.71	33.66	23.19	54.22	21.67	13.63	37.60	81.65	77.77	87.08	87.95	84.34	92.92
HGLS◇	47.00	35.06	**70.41**	46.21	35.32	67.12	29.32	19.21	49.83	19.04	11.79	33.23	82.04	78.07	-	87.48	83.17	-
DLGR◇	46.72	36.67	-	-	-	-	35.48	25.11	-	-	-	-	82.98	80.14	-	88.87	84.60	-
RPC◇	44.55	34.87	65.08	51.14	39.47	71.75	34.91	24.34	55.89	22.41	14.42	38.33	81.18	76.28	88.71	88.87	85.10	94.04
TempValid◇	45.78	35.50	65.06	50.31	39.46	70.55	33.50	23.91	52.33	21.88	14.37	37.00	83.19	74.67	**97.54**	79.72	74.64	85.73
CoH◇	43.94	33.07	64.90	49.71	38.01	71.25	32.98	21.83	54.92	-	-	-	-	-	-	-	-	-
CognTKE◇	46.06	36.49	64.49	53.13	42.62	72.70	35.24	**25.21**	54.71	-	-	-	83.21	80.01	87.34	-	-	-
T-MKR	**48.91**	**38.03**	69.32	**53.96**	**44.01**	**73.42**	**35.90**	25.14	**57.49**	**23.48**	**15.15**	**40.23**	**83.77**	**81.02**	89.79	**89.52**	**86.70**	**94.16**

The experimental results on six widely used TKG reasoning datasets demonstrate the effectiveness of T-MKR method.