

EMERGE: A Benchmark for Updating Knowledge Graphs with Emerging Textual Knowledge

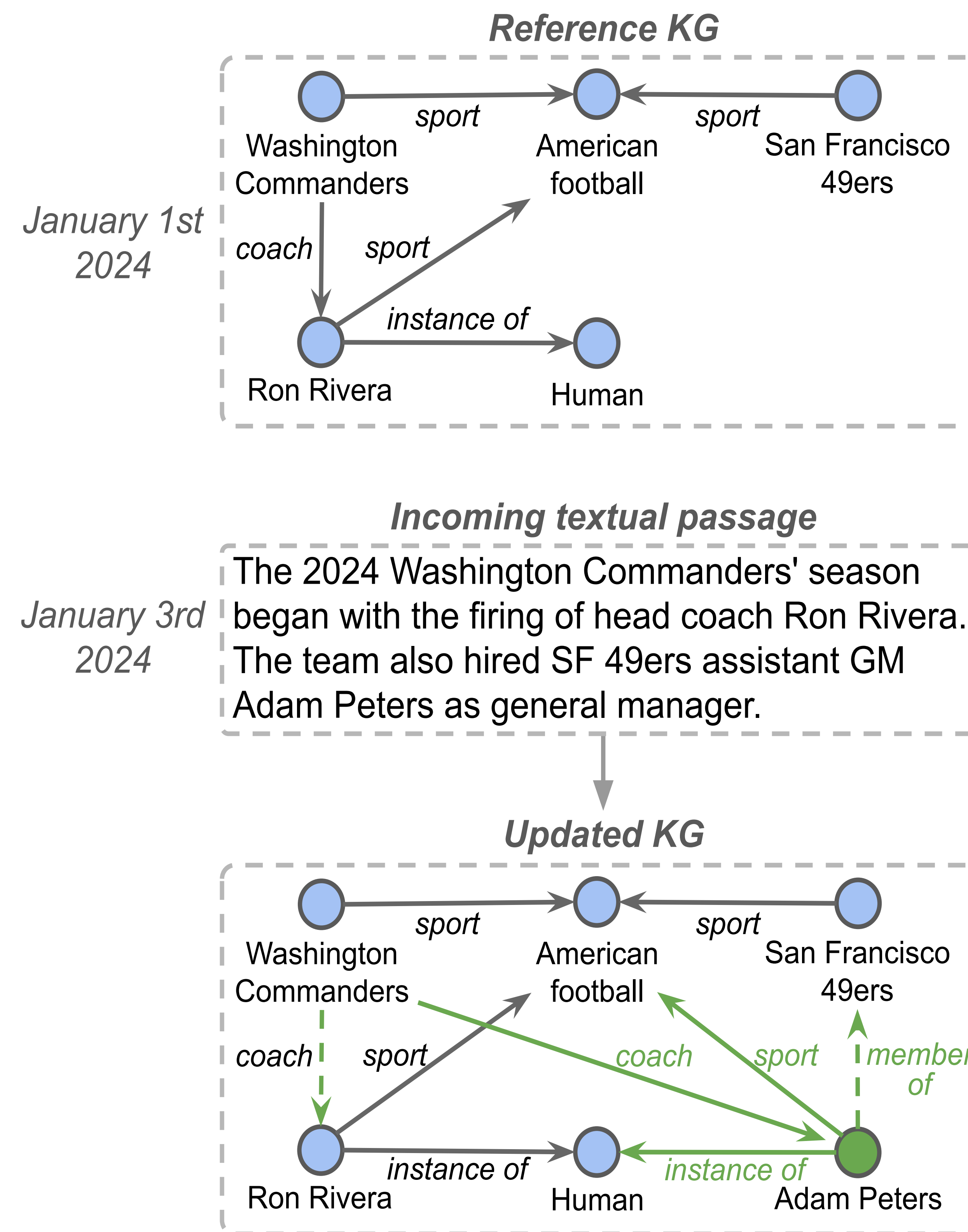
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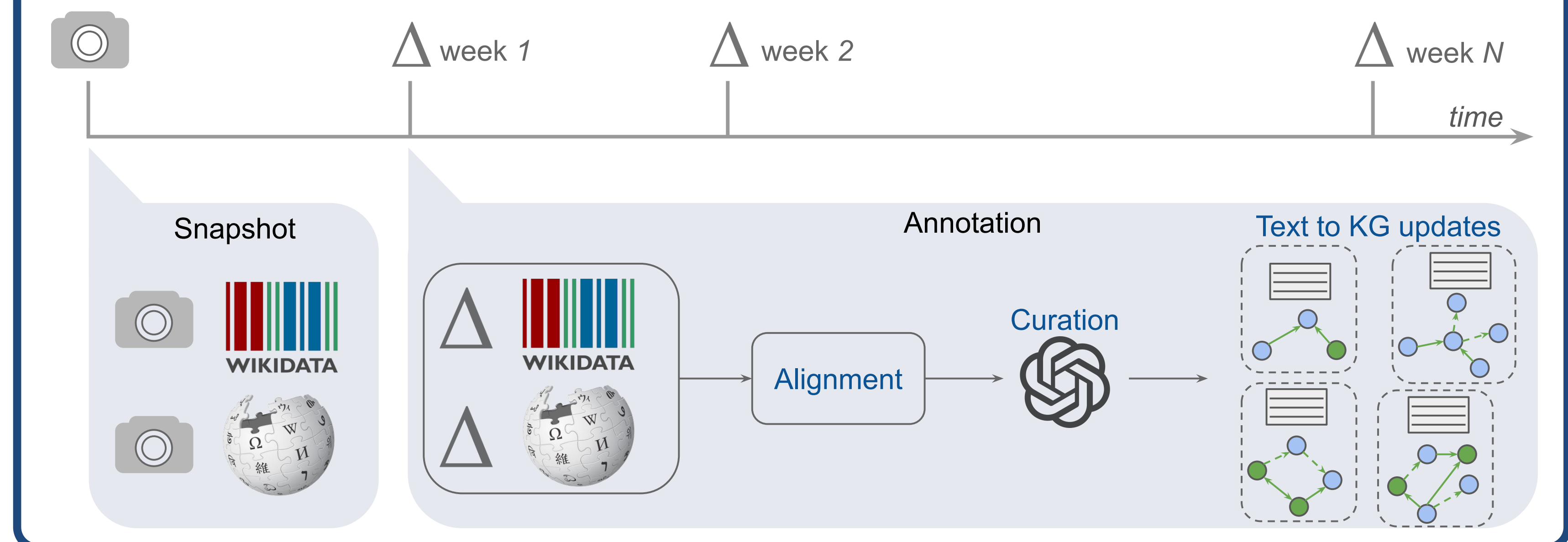
Summary

- **Motivation:** knowledge graph (KG) updating based on emerging knowledge in text.
- **EMERGE:** temporally evolving KG updating dataset:
 - 1.25M textual passages to KG updates.
 - 10 temporal snapshots of Wikidata.
 - Incremental weekly KG deltas aligned to emerging textual knowledge in Wikipedia.
 - Five types of **text-driven KG updating (TKGU) operations** based on emerging knowledge in text.
 - Lifelong publicly available framework to extend the dataset with emerging knowledge.
- We experiment with the **state-of-the-art** information extraction (IE) models:
 - Current IE models unable to detect deprecation of knowledge in KGs.
 - Low performance due to lack of access to KG schema.
 - Current IE models fail to integrate emerging entities into KGs.

Illustrative example



EMERGE creation pipeline



Text-driven KG updating (TKGU) operations

We define a KG *snapshot* at some point time t as a tuple $G_t = (V_t, R_t, T_t)$ where V_t is a set of entities, R_t is a set of relation types, and T_t is a set of *triples* of the form (s, p, o) where $s, o \in V_t$ are the subject and object, and $p \in R_t$ is the relation between them. Given a textual passage $d_{t'}$ created at some point in time $t' > t$, the task consists in generating a set of TKGU operations defined as follows:

Emerging triples (E-Triples). Addition of triples that are not present in the KG but involve entities that already exist in it; that is, $(s, p, o) \notin G_t$ and $s \in V_t \wedge o \in V_t$.

Emerging entities and triples (EE-Triples). Addition of triples that do not exist in the KG and involve a subject entity, object entity, or both that are also absent. That is, $(s, p, o) \notin G_t$ and $s \notin V_t \vee o \notin V_t$.

Emerging entities to KG triples (EE-KG-Triples). Addition of new triples in which exactly one of the subject or object entities is mentioned in a passage $d_{t'}$, while the other already exists in the KG and is not explicitly mentioned in the passage.

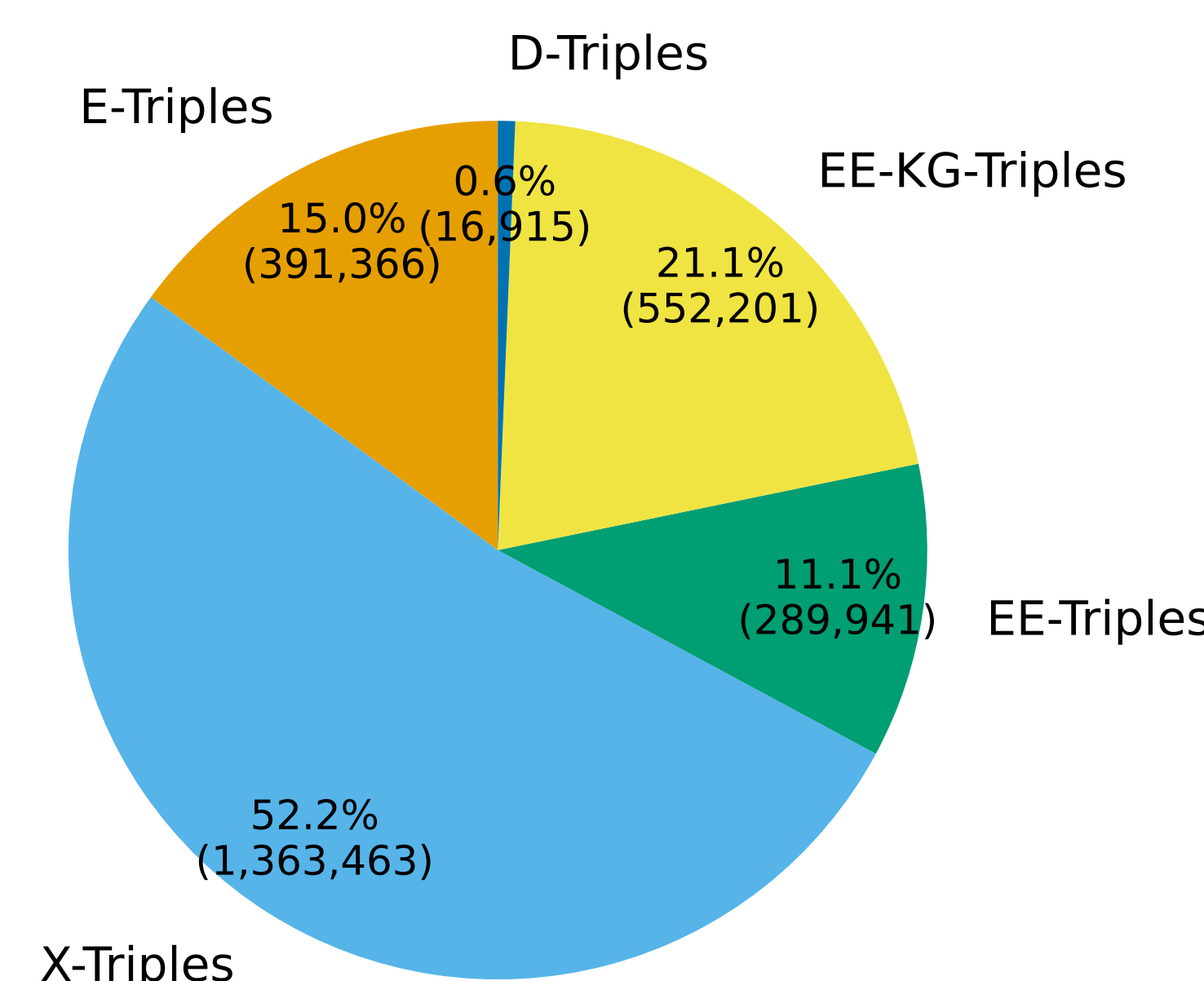
Deprecated triples (D-Triples). Deprecation of triples already existing in a KG based on emerging evidence in textual passage.

Existing triples (X-Triples). Detection of *already existing KG triples*.

Experimental results (completeness score)

TKGU Operations	Model	2019	2020	2021	2022	2023	2024	2025
X-Triples	ReLiK RE	22.4	23.1	20.3	22.1	20.6	18.1	19.3
	EDC+	10.3	8.2	9.3	10.5	11.5	8.8	11.4
E-Triples	ReLiK RE	18.6	19.0	17.1	14.1	14.3	13.2	14.4
	EDC+	20.6	23.5	19.4	22.0	21.1	20.5	22.9
EE-Triples	ReLiK RE	22.7	18.0	13.6	20.9	18.7	16.8	18.0
	EDC+	25.5	19.6	17.2	21.1	21.3	18.9	20.7
EE-KG-Triples	ReLiK RE	4.0	2.9	3.1	2.4	4.0	4.5	4.2
	EDC+	19.1	14.0	7.0	13.9	15.6	12.6	12.5
D-Triples	EDC+	0.0	20.8	8.6	18.8	19.2	11.8	19.5

TKGU operations distribution



EMERGE dataset statistics

Snapshot	Dataset statistics				KG statistics			
	Entities	Rel. Types	Triples	Passages	Entities	Rel. Types	Triples	
2019	36.61K	461	231.10K	41.70K	5.96M	5,646	25.73M	
2020	27.71K	466	255.00K	36.05K	6.14M	7,017	28.76M	
2021	36.49K	514	357.66K	45.98K	6.34M	8,216	30.84M	
2022	30.27K	520	239.73K	34.89K	6.54M	9,425	33.41M	
2023	24.31K	518	184.12K	29.89K	6.67M	10,599	34.99M	
2024.Q1	29.12K	535	256.18K	37.53K	6.80M	11,409	36.31M	
2024.Q2	24.55K	529	239.36K	32.77K	6.83M	11,692	36.58M	
2024.Q3	26.72K	538	287.98K	42.91K	6.86M	11,982	36.88M	
2024.Q4	29.95K	540	277.02K	36.91K	6.90M	12,137	37.22M	
2025.Q1	26.57K	539	284.34K	37.71K	6.93M	12,304	37.54M	