

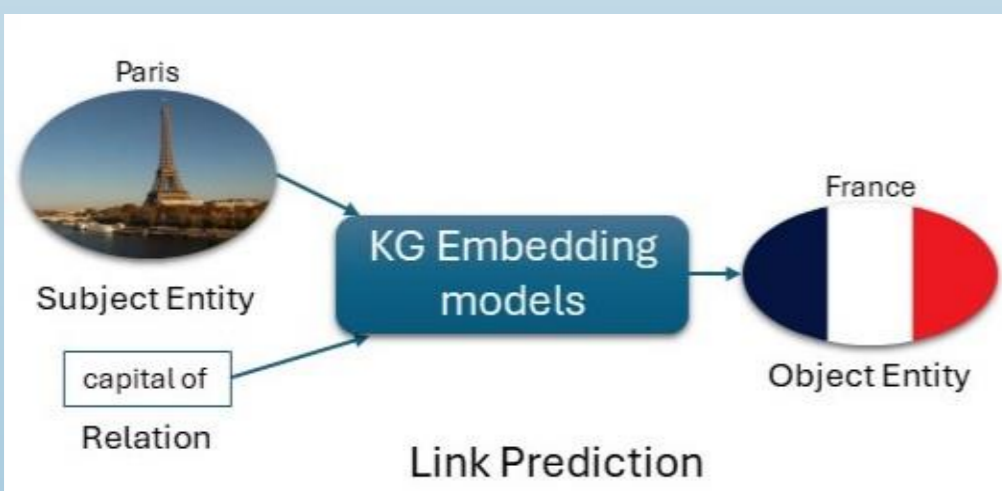
Evaluating KG Embeddings for Link Prediction:

A Study on the Influence of Relational Patterns and Cardinalities

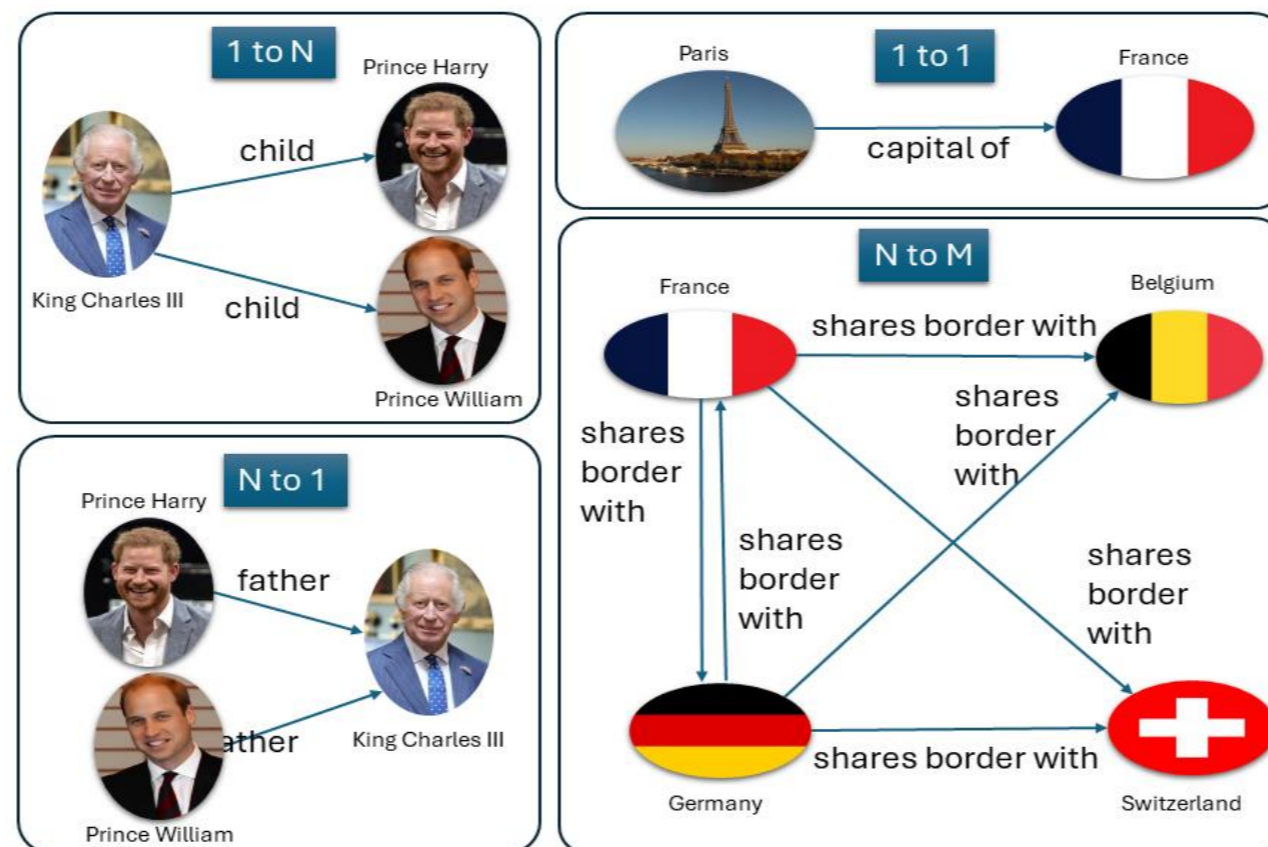
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Introduction:

- Knowledge Graphs (KGs) store data in graph structures.
- Inherent incompleteness is a major limitation.
- Link prediction methods using KG embeddings (KGE) help address this limitation.
- This study focuses on the influence of cardinalities and relational patterns, along with their distribution, on KGE models for link prediction performance.



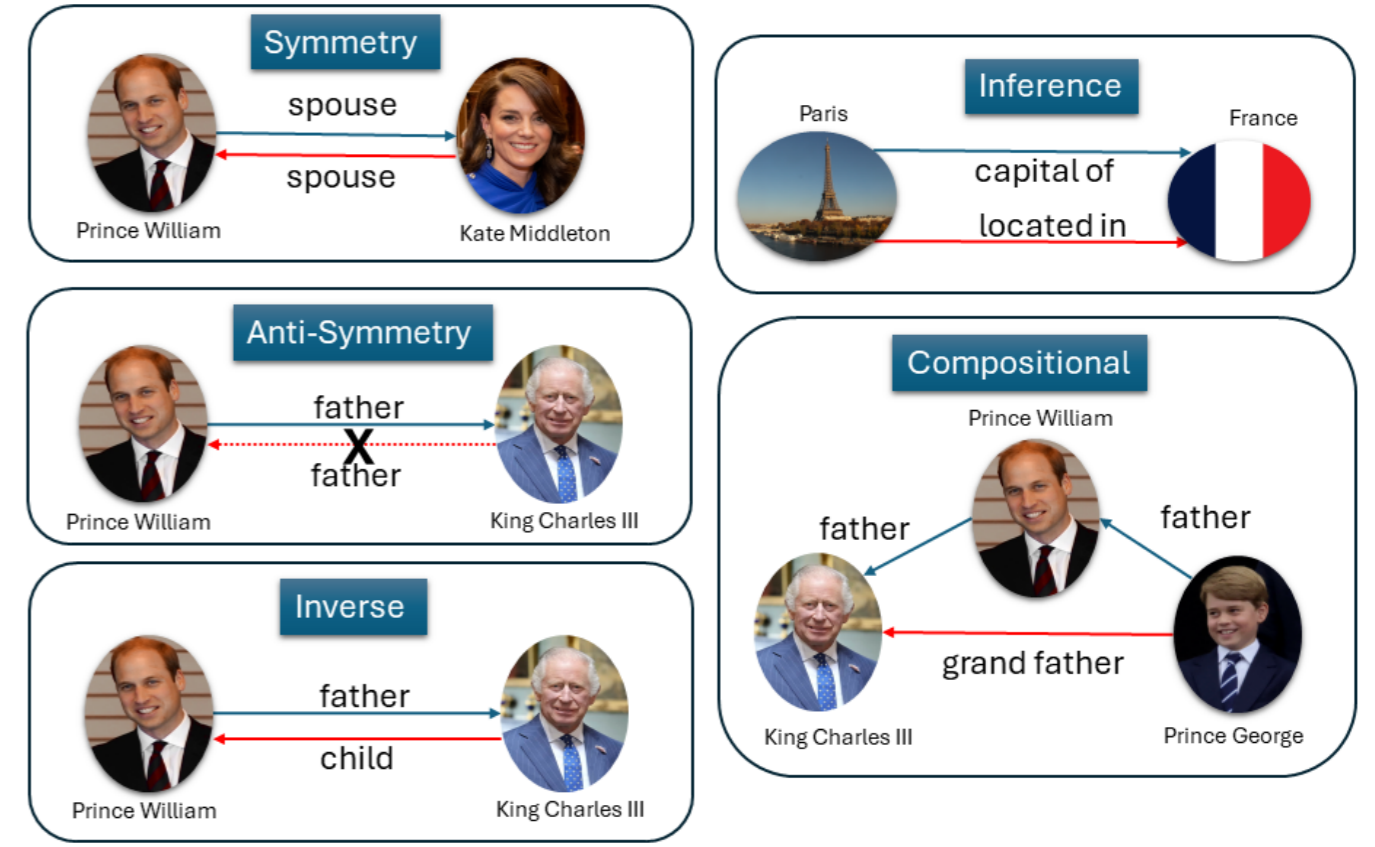
Cardinalities



KG Embedding Models

KGE Models	Scoring Function
TransE	$\ h + r - t\ _{1/2}$
Rescal	$h^T M_r t$
DistMult	$h^T \text{diag}(r) t$
Complex	$\text{Re}(\langle M_r, h, t \rangle)$
ConvE	$f(\text{vec}(f([h'; r'] * \omega))W)t$

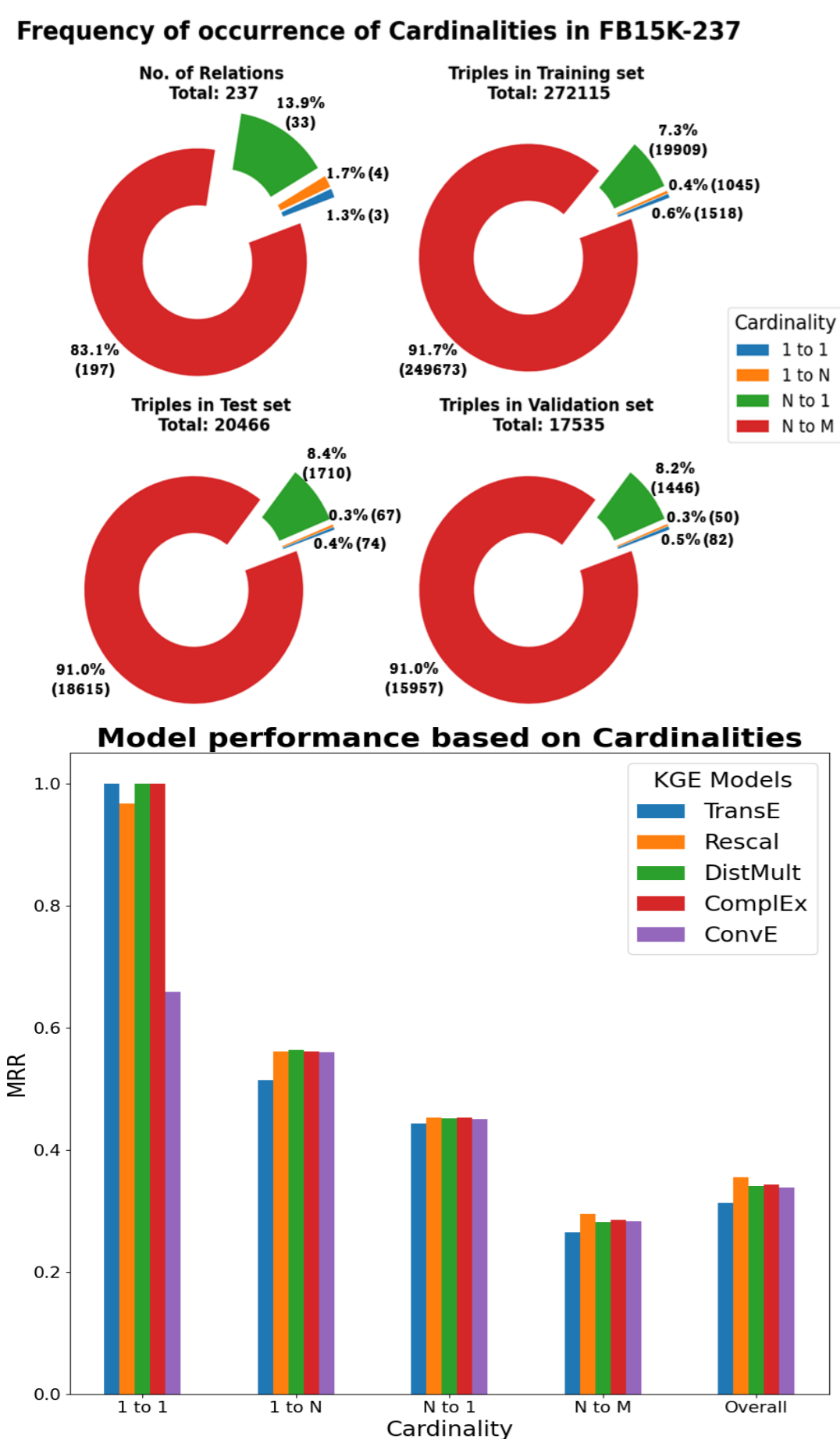
Relational Patterns



Datasets

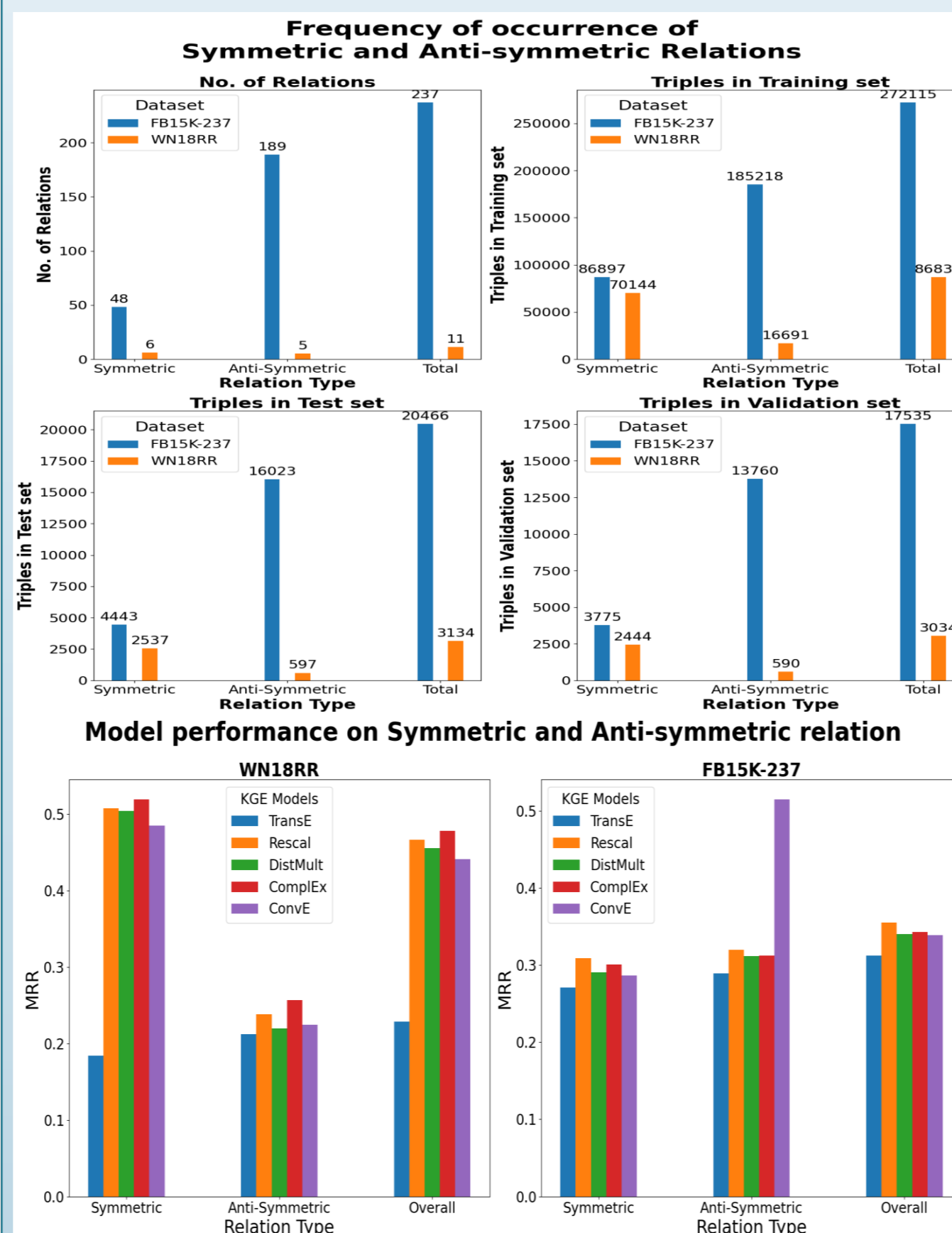
Dataset	WN18RR	FB15K-237
Triples	93003	310116
Relations	11	237
Entities	40943	14541
Train	272115	86835
Test	20466	3134
Valid	17535	3034

RQ1: Does the cardinality of relations affect link prediction?



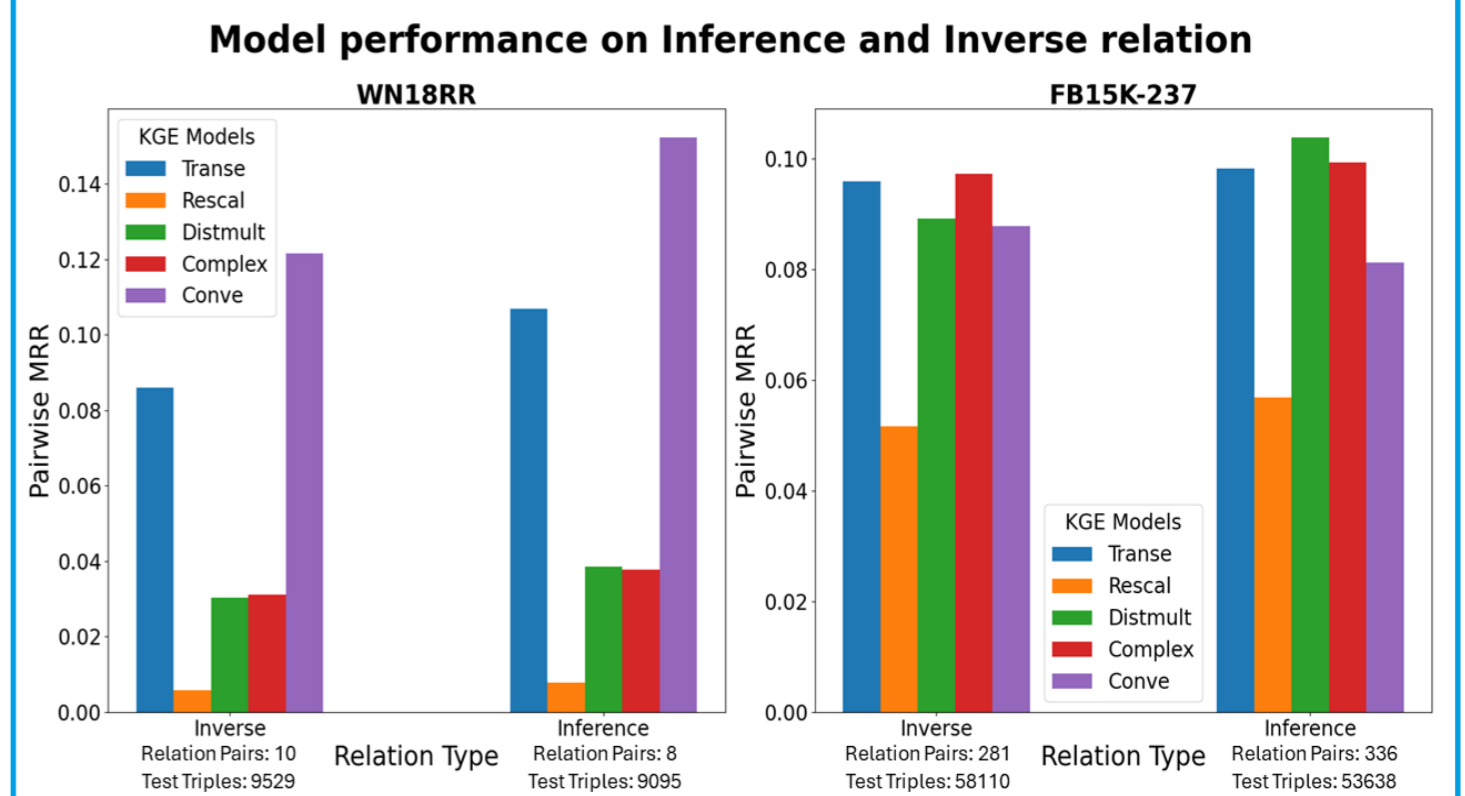
- Majority of relations in FB15K-237 are N-to-M.
- KGE models perform best for 1-to-1 relations and worst for N-to-M relations.
- TransE performs the worst for all cardinalities except 1-to-1.

RQ2: Do symmetric and anti-symmetric relations affect link prediction?



- FB15K-237 primarily consists of anti-symmetric relations (imbalance).
- ComplEx and ConvE perform the best for anti-symmetric relations in WN18RR and FB15K-237 respectively.
- TransE performs the worst on both datasets in understanding symmetry and anti-symmetry.

RQ3: Do inverse and inference relational patterns affect link prediction?



- Rescal fails to perform on inference and inverse relations for both datasets.
- Simple models like TransE can understand these relational patterns comparatively better.

Conclusion and Next Steps:

- Majority of relations in most KGs are N-to-M, however KGE models struggle to interpret N-to-M relations.
- Distribution of relational patterns plays a vital role in the KGE model performance.
- Simple models like TransE fail to understand complex relational patterns.
- Formulating a method to interpret KGE models based on relational patterns and cardinalities.
- Influence of completeness of relational patterns in the datasets on KGE models.