

2. Knowledge Graph Embedding

- a. If we have a knowledge graph with friendship and enemy relationship, which model(s) of the TransE, DistMult, and RotatE can we use? Please explain your reason based on the score function of each model. (Hint: Friendship and enemy are symmetric relationships.)

Answer: DistMult and RotatE are both suitable for handling symmetric relationships. The score function for the former does not impose directionality due to having a simple bilinear form, and the latter's score function is designed to capture rotational symmetries.

- b. If we have a knowledge graph with father, grandfather, mother, and grandmother relationship, which model(s) can we use? Please explain your reason based on the score function. (Hint: The father of father is grandfather. The mother of mother is grandmother. Which model(s) can model composition relationship? How?)

Answer: The RotatE model would be best suited for handling composition relationships like fathers, grandfathers, mothers, and grandmothers. The rotational nature of how relations are modeled allows for easier composition of relations via rotational operations in the embedding space.

- c. For each of TransE, DistMult, RotatE, provide an example (different from part (a) and (b)) for a scenario where it cannot model the particular relationship.

Answer: TransE would not be able to capture a symmetric relationship, such as "Country A is an ally of Country B". DistMult would not be able to capture a transitive relationship, such as "Event A precedes Event B"; adding that "Event B precedes Event C" would not necessarily mean DistMult can model "Event A precedes Event C" due to its bilinear score function. RotatE would not be able to capture a non-commutative relationship such as "Object A is a type of Object B".