Homework 4

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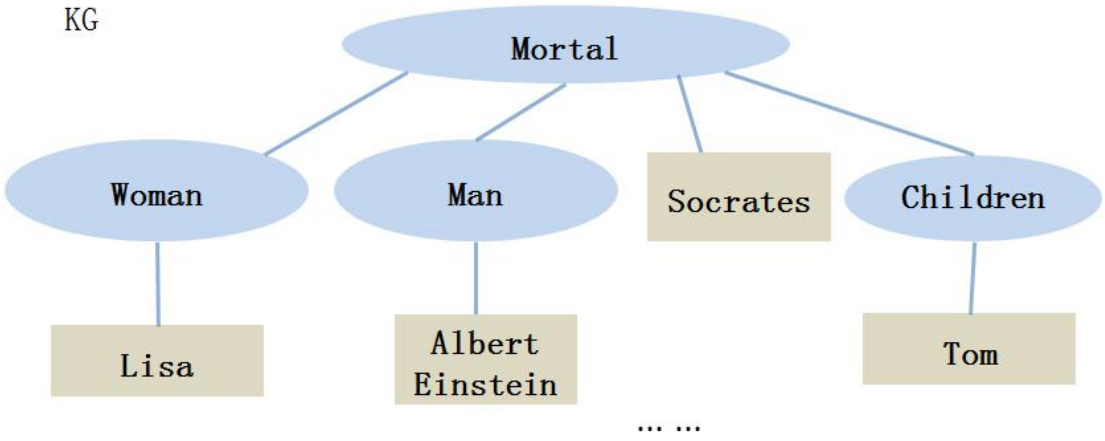
1) Given the following KG, please answer the question “Is Albert Einstein a mortal?” using query rewriting on the query *Mortal(Albert Einstein)* (this query is used for checking whether Albert Einstein is a mortal) .



Solution：

$$\text{Mortal}(x) \vee \text{Woman} \vee \text{Man}(x) \vee \text{Children}(x)$$

2) The following ontology is inconsistent. Please remove one axiom in it to make it consistent and provide a model of the new ontology.

Highvalue_Company $\sqsubseteq$ Solvent_Company

Solvent_Company $\sqsubseteq$ $\neg$ Bankrupt_Enterprise

Highvalue_Company(Lehman_Brothers_Holdings)

Bankrupt_Enterprise(Lehman_Brothers_Holdings)

Solution：

A. Remove ‘Bankrupt_Enterprise(Lehman_Brothers_Holdings)’;
   Model:
   Δ = {lbh}
   I_I(Lehman_Brothers_Holdings) = lbh,
   I_C(Highvalue_Company) = {lbh},
   I_C(Solvent_Company) = {lbh},
   I_C(Bankrupt_Enterprise) = {}

B. Remove ‘Solvent_Company $\sqsubseteq$ $\neg$ Bankrupt_Enterprise’;
   Model:
   Δ = {lbh}
   I_I(Lehman_Brothers_Holdings) = lbh,
   I_C(Highvalue_Company) = {lbh},
   I_C(Bankrupt_Enterprise) = {lbh},
   I_C(Solvent_Company) = {lbh}

C. Remove ‘Highvalue_Company(Lehman_Brothers_Holdings)’;
Model:

Δ = {lbh}
I_I(Lehman_Brothers_Holdings) = lbh,
I_C(Bankrupt_Enterprise) = {lbh},
I_C(Highvalue_Company) = {},
I_C(Solvent_Company) = {}

D. Remove ‘Highvalue_Company $\sqsubseteq$ Solvent_Company’;
Model:

Δ = {lbh}
I_I(Lehman_Brothers_Holdings) = lbh,
I_C(Bankrupt_Enterprise) = {lbh},
I_C(Highvalue_Company) = {lbh},
I_C(Solvent_Company) = {}

3) Why TransE cannot handle symmetric relation and one-to-many relation?

Solution：

① For an arbitrary triple <**h**, **r**, **t**>, the symmetric relation can be described as:

$$\begin{cases} \boldsymbol{h} + \boldsymbol{r} = \boldsymbol{t} \\ \boldsymbol{t} + \boldsymbol{r} = \boldsymbol{h} \end{cases}$$

So that, this will hold only if:

$$\begin{cases} \boldsymbol{r} = 0 \\ \boldsymbol{h} = \boldsymbol{t} \end{cases}$$

This is not a condition for any triple, so TransE cannot handle symmetric relation.

② For two arbitrary triples <**h**, **r**, $\mathbf{t_1}$> and <**h**, **r**, $\mathbf{t_2}$> with different vector $\mathbf{t_1}$ and $\mathbf{t_2}$, the one-to-many relation will be described as:

$$\mathbf{t_1} = \mathbf{h} + \mathbf{r} = \mathbf{t_2}$$

So that, this will hold only if:

$$\boldsymbol{t_1} = \boldsymbol{t_2}$$

This is contrary to the original conditions, so TransE cannot handle one-to-many relation.