

Positive Triple



Negative Triple



Hardness



False Negative Triple

Negative Triples (h, r, t^-)

Hard Negative Sampling

False Negative Sampling

Entity Embedding Update

Aggregation

 e_h e_r e_t h r t e_{hr}

PLM

PLM

PLM

 t_1^- t_2^- t_3^- t_4^- t_5^-

PLM

 $e_{t_1}^-$ $e_{t_2}^-$ $e_{t_3}^-$ $e_{t_4}^-$ $e_{t_5}^-$ s_1^- s_2^-

PLM

 $e_{s_1}^-$ $e_{s_2}^-$

HaSa Loss Function