Interaction Embeddings for Prediction and Explanation in Knowledge Graphs

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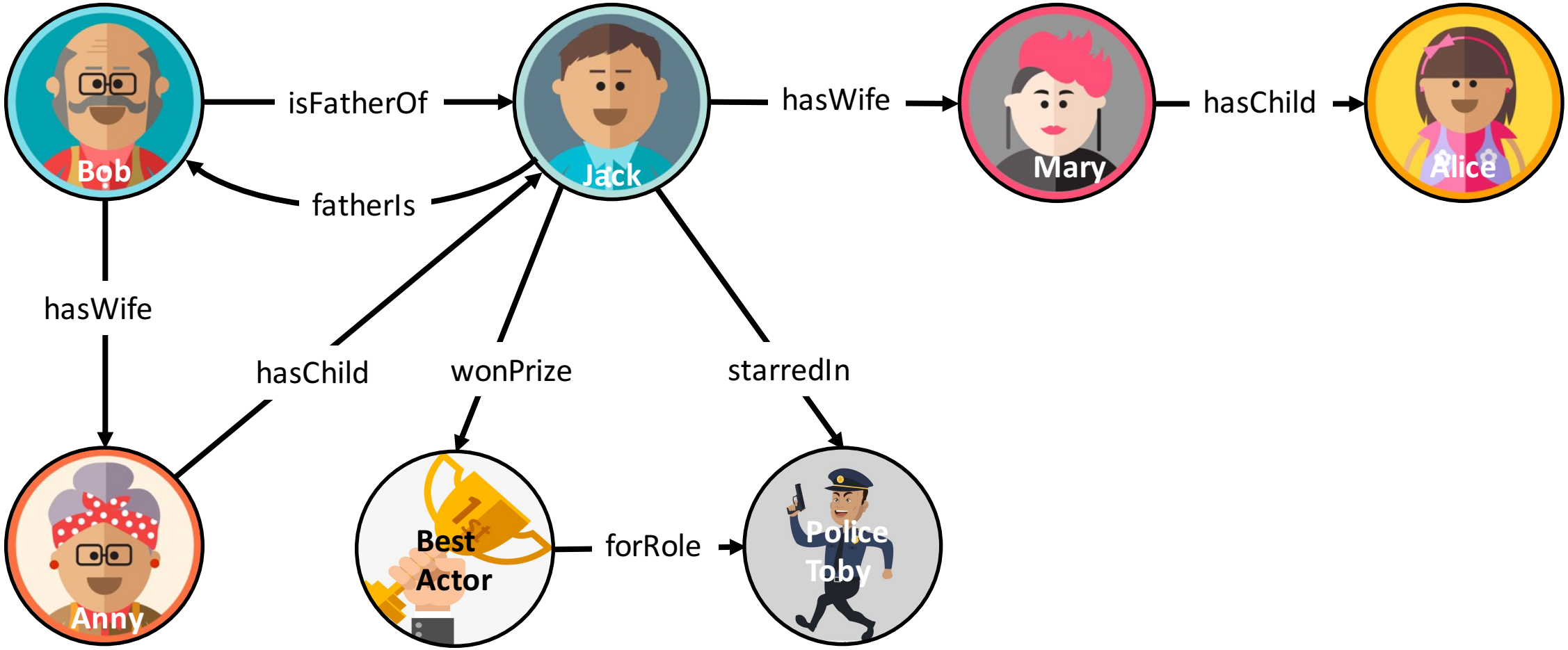
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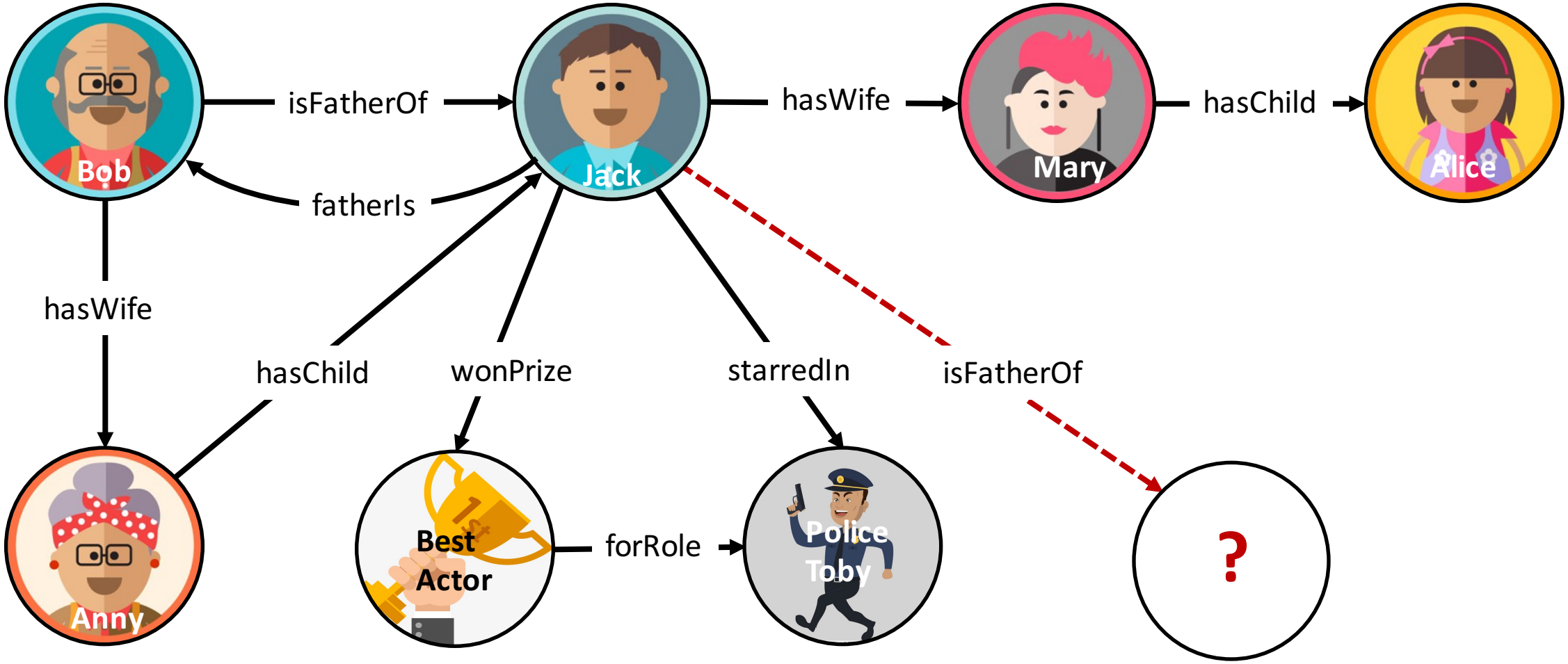
isFatherOf
Jack
hasWife
Mary
hasChild
Alice
fatherIs
hasWife
hasChild
wonPrize
starredIn
Anny
Best
Actor
forRole
Police
Toby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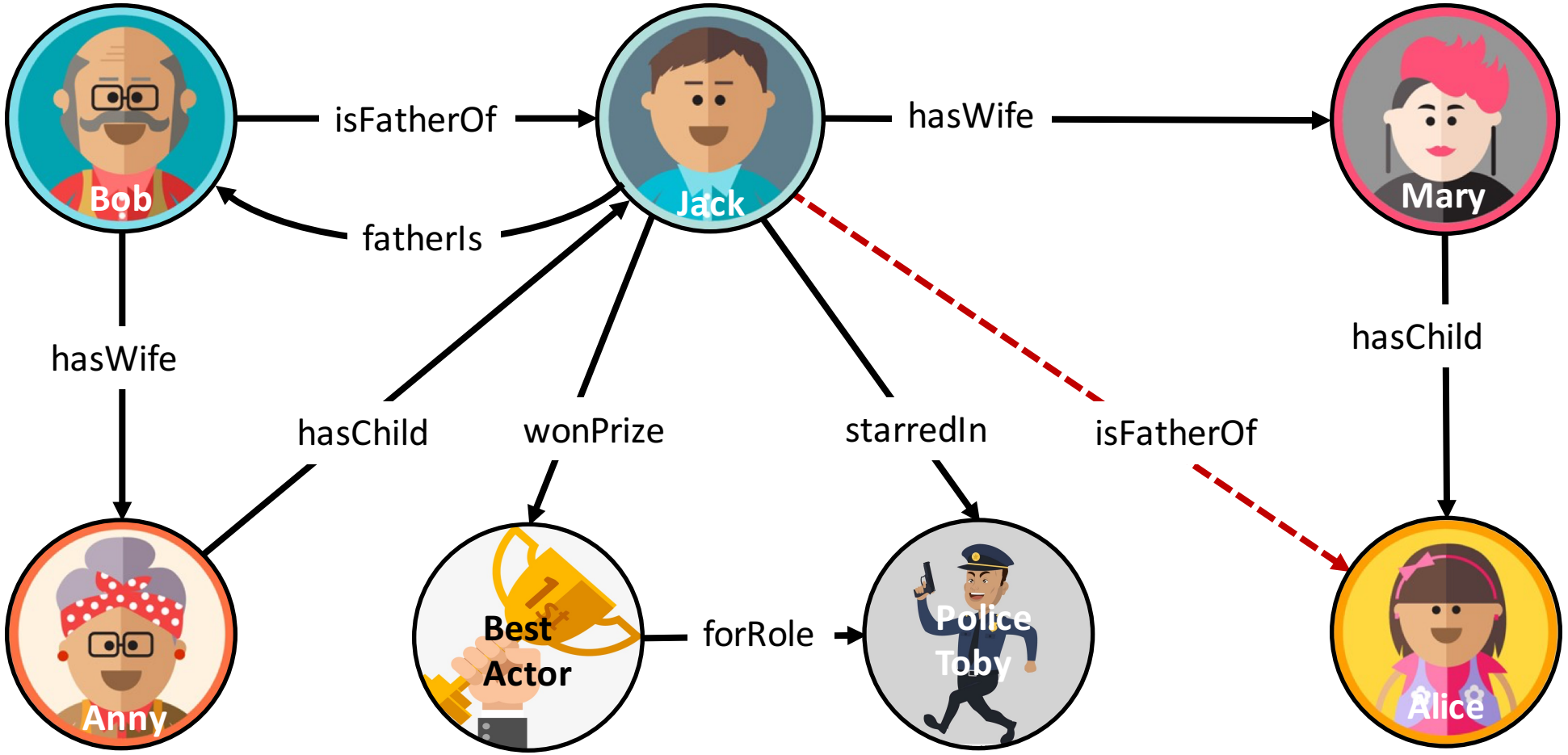
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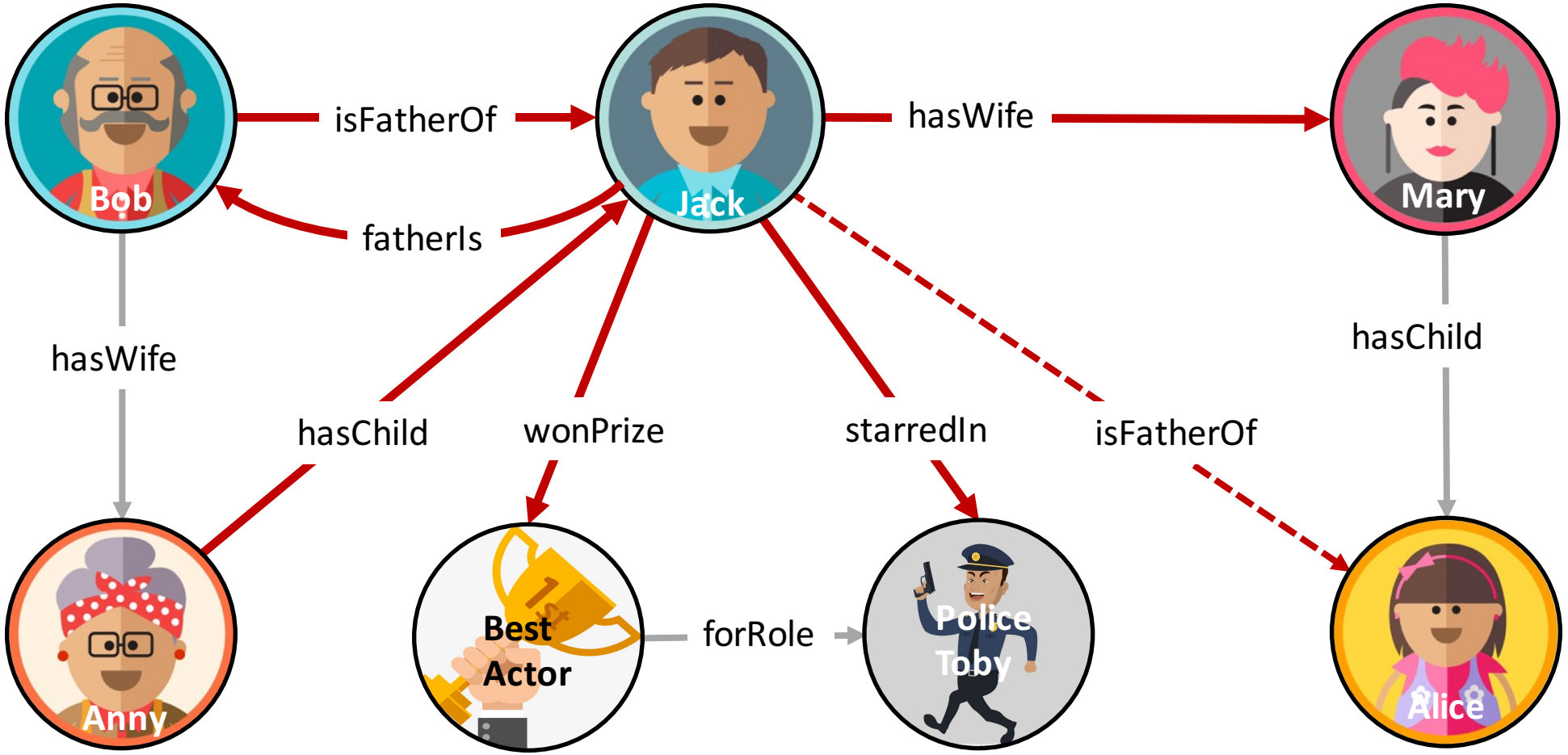
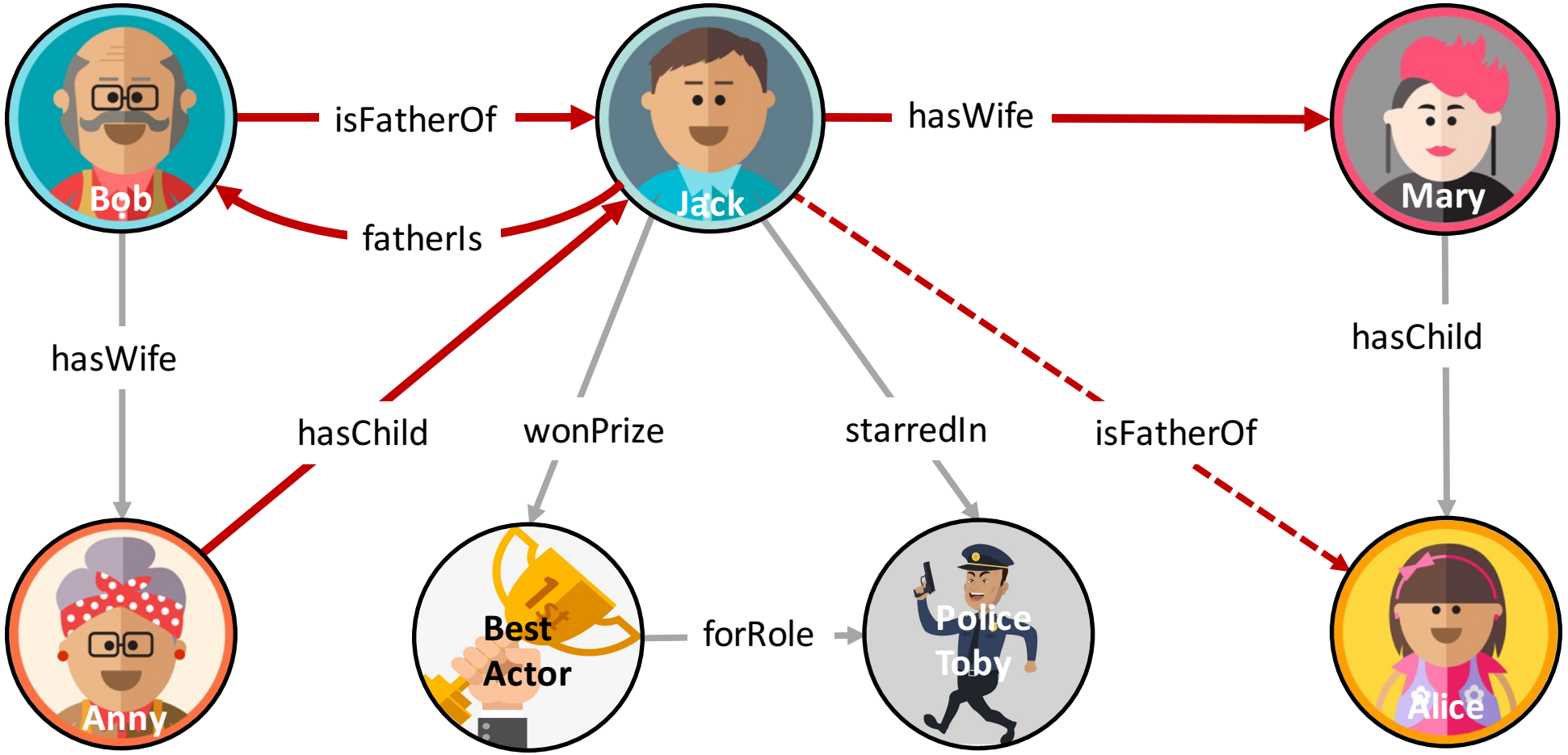


crossover interaction

(Jack, isFatherOf, ?)



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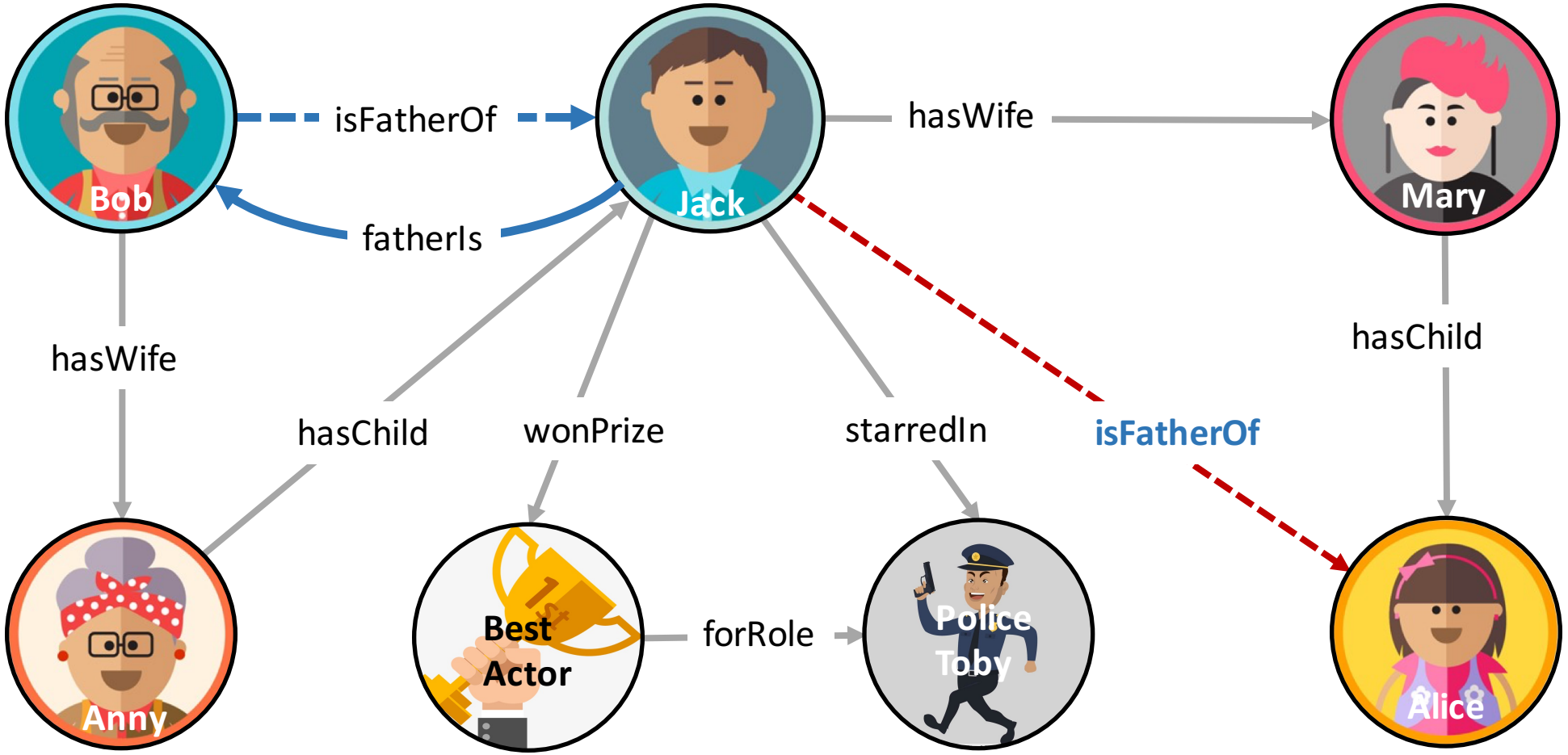

crossover interaction

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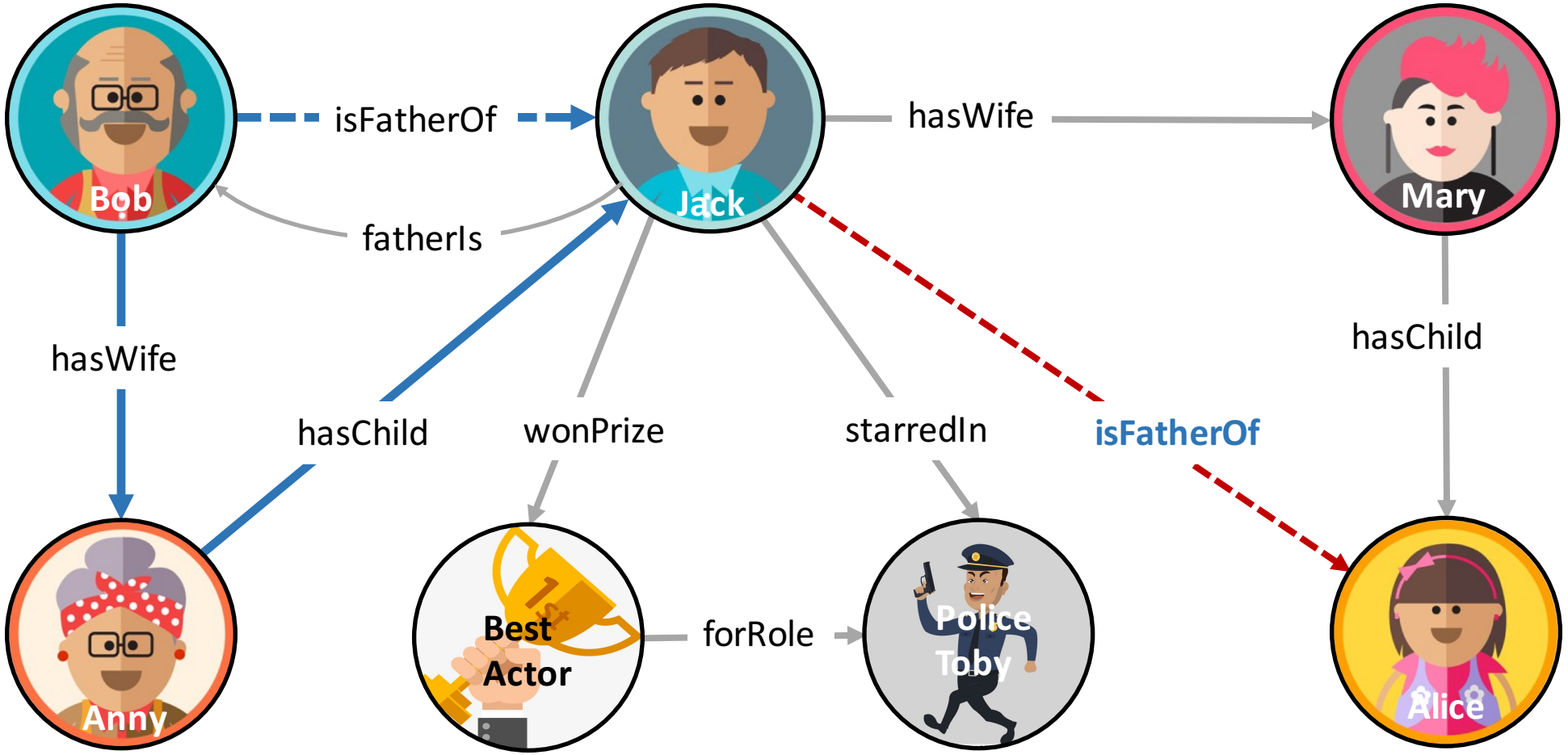

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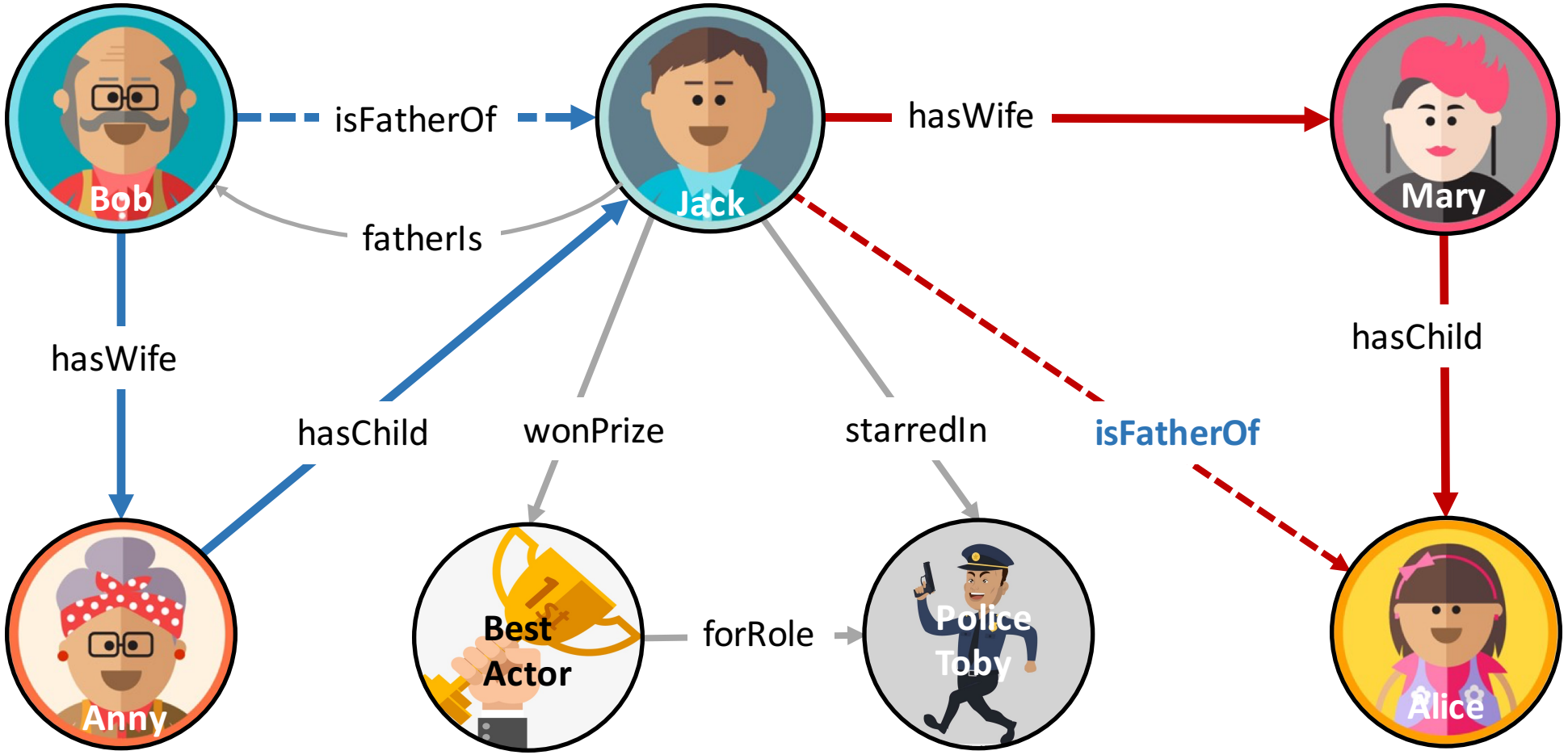

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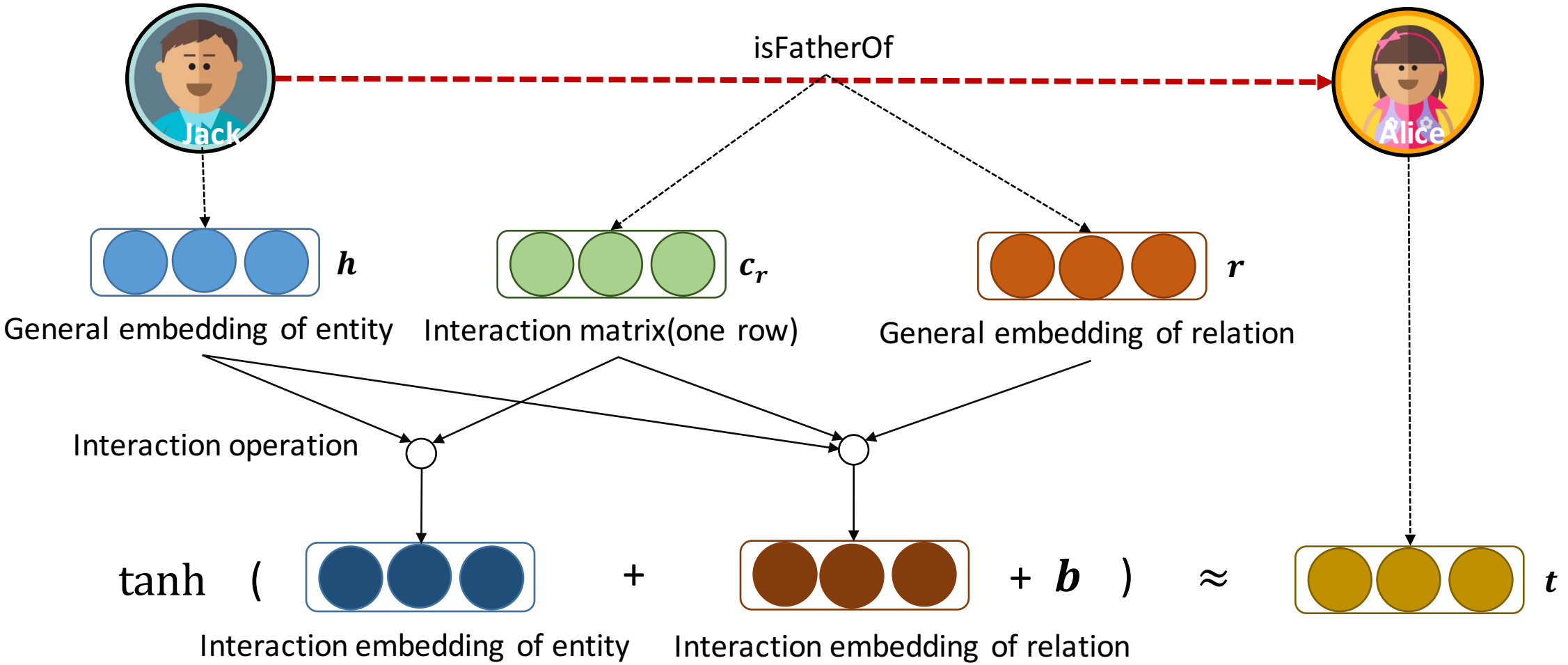

CrossE: Score function for triple (h, r, t):

$$f(h, r, t) = \sigma(\tanh(\boldsymbol{c}_r \circ \boldsymbol{h} + \boldsymbol{c}_r \circ \boldsymbol{h} \circ \boldsymbol{r} + \boldsymbol{b})\, \boldsymbol{t}^{\mathsf{T}})$$

What is a good embedding?

Link prediction results

Mean Rank

Hit@n

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Capability of generating explanations for prediction

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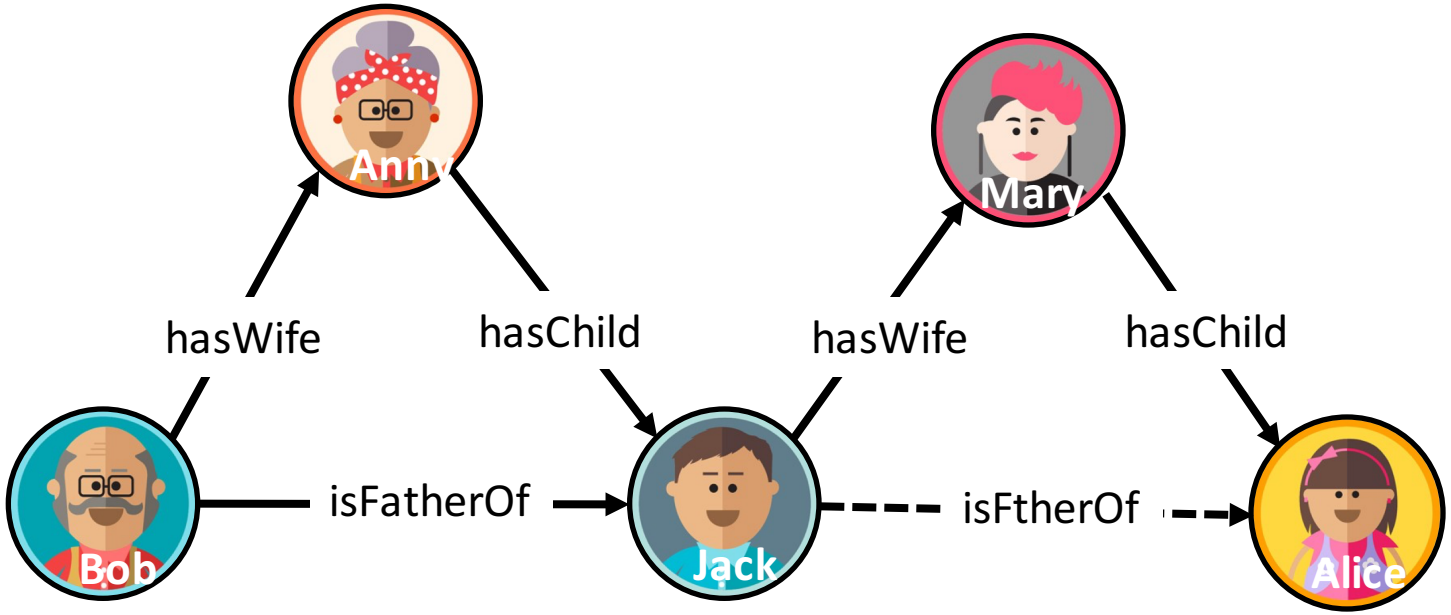
Generate explanation for prediction:
Step 1: search for similar relations of r.
Step 2: search for path between h and t.
Step 3: search for similar entities.
Step 4: search for similar structure as supports.

Recall

AvgSupport



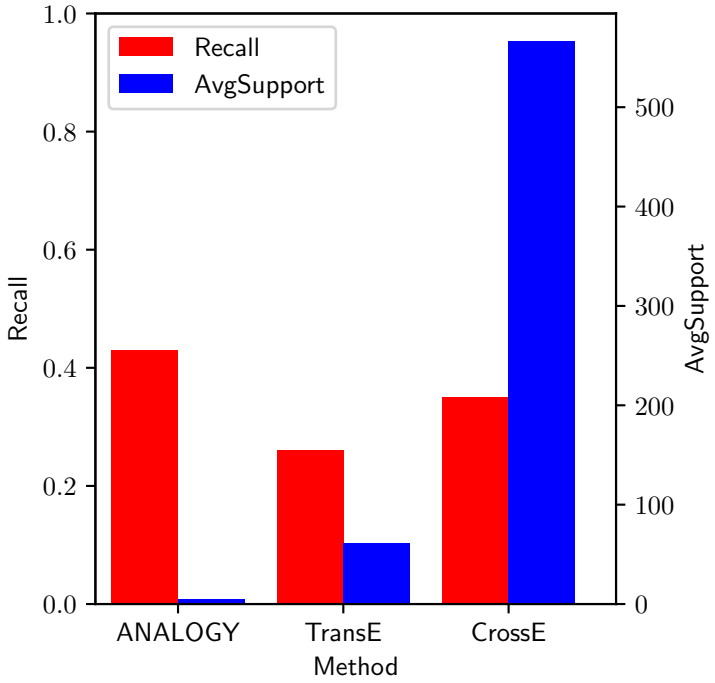
Similar structures

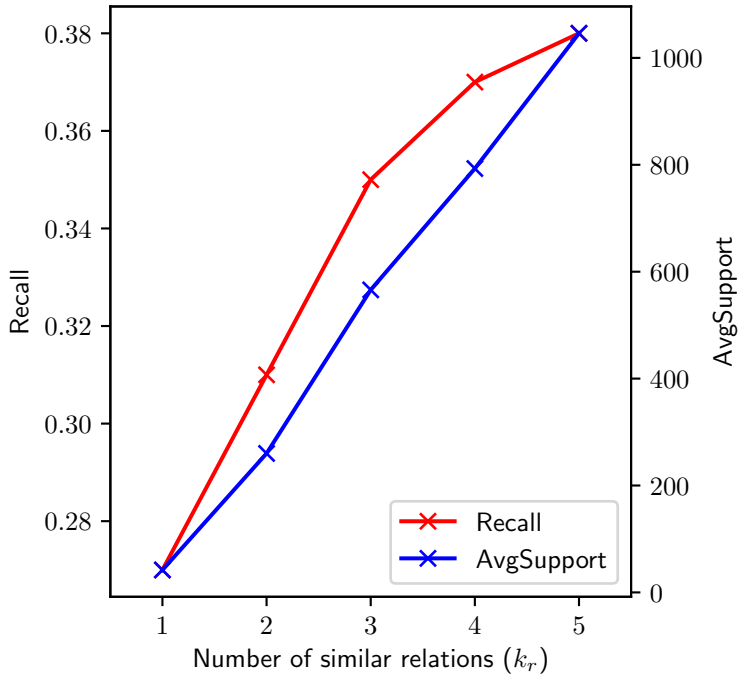
Link Prediction experiment

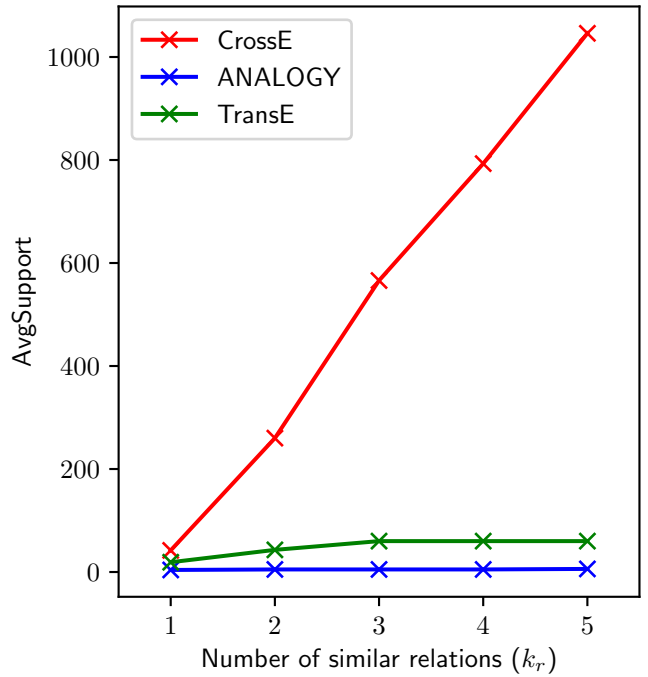
	WN18			FB15k		
	MRR	Hit@		MRR	Hit@	
	filter/raw	1	3	filter/raw	1	3
RESCAL[26]	89.0 / 60.3	84.2	90.4	35.4 /18.9	23.5	40.9
TransE[4]	45.5 / 33.5	8.9	82.3	38.0 / 22.1	23.1	47.2
DistMult[41]	82.2 / 53.2	72.8	91.4	65.4 / 24.2	54.6	73.3
HOlE[25]	93.8 / 61.6	93.0	**94.5**	52.4 / 23.2	40.2	61.3
ComplEx[35]	94.1 / 58.7	93.6	**94.5**	69.2 / 24.2	59.9	75.9
ANALOGY[20]	**94.2/65.7**	**93.9**	94.4	72.5 / 25.3	**64.6**	78.5
R-GCN [28]	81.9 / 56.1	69.7	92.9	69.6 / 26.2	60.1	76.0
CrossE	83.0 / 57.0	74.1	93.1	**72.8/26.7**	63.4	**80.2**†
CrossE$_S$	46.9 / 39.6	21.7	70.6	46.4 / 25.4	28.4	61.9

	FB15k-237				
	MRR (raw)	MRR (filter)	Hit@1 (filter)	Hit@3 (filter)	Hit@10 (filter)
DistMult[41]	-	25.0	-	-	40.8
Node+LinkFeat [34]	-	23.0	-	-	34.7
Neural LP[42]	-	24.0	-	-	36.2
R-GCN [28]	15.8	24.8	15.3	25.8	41.4
R-GCN+ [28]	15.6	24.9	15.1	26.4	41.7
ComplEx [35]	12.0	22.1	13.2	24.4	40.8
ANALOGY [20]	11.8	21.9	13.1	24.0	40.5
CrossE	**17.7**	**29.9**	**21.1**†	**33.1**†	**47.4**†
CrossE$_S$	6.40	11.0	6.7	11.7	19.8

Generating explanation experiment







Crossover interactions between entity and relation are common and should be considered by knowledge graph embedding methods.

Embeddings can be evaluated from multiple perspectives, not only link prediction performance but also the capability of **generating explanations** for prediction.

Thank you!