1 Supplementary Material

1.1 Class Hierarchy in Yago

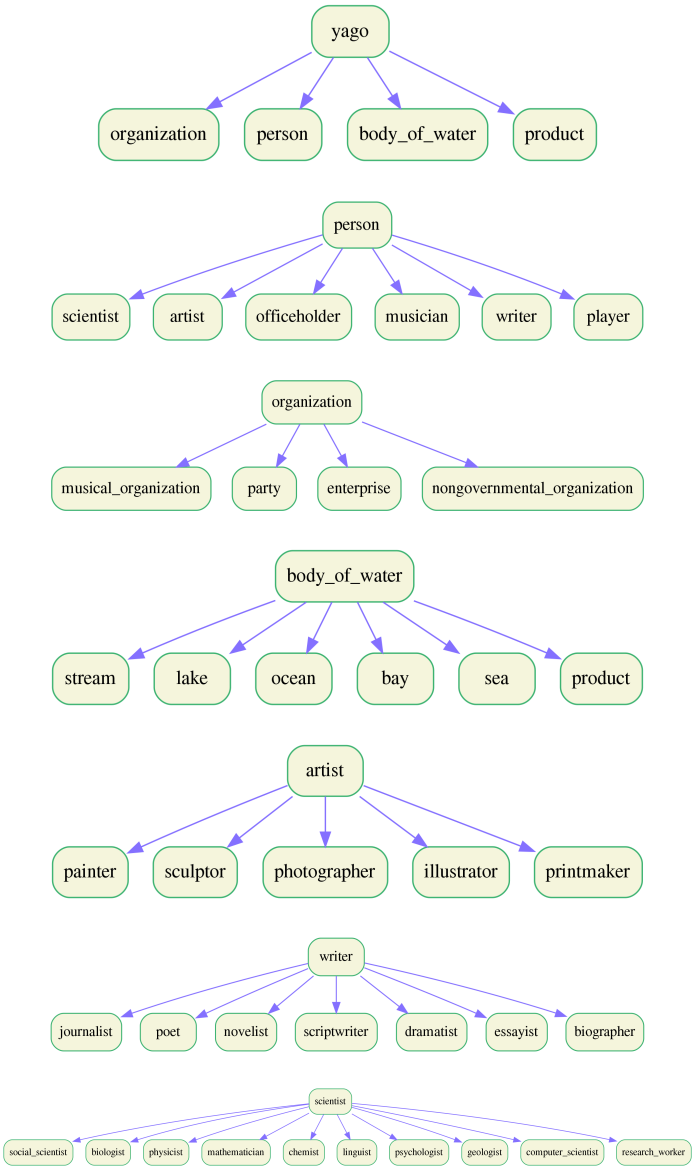

Fig. 1: Examples of Yago Class Hierarchy at Levels 1 to 3

1.2 Results of pre-trained embedding models

Table 1: Best performance of all models for Yago3-10 dataset

	MRR	Hits@1	Hits@3	Hits@10
ComplEx	.551	.476	.596	.682
TransE	.390	.273	.459	.612
RESCAL	.310	.223	.344	.479
ConvE	.506	.419	.557	.666
DistMult	.542	.456	.595	.696

1.3 SDType Precision-Recall curves

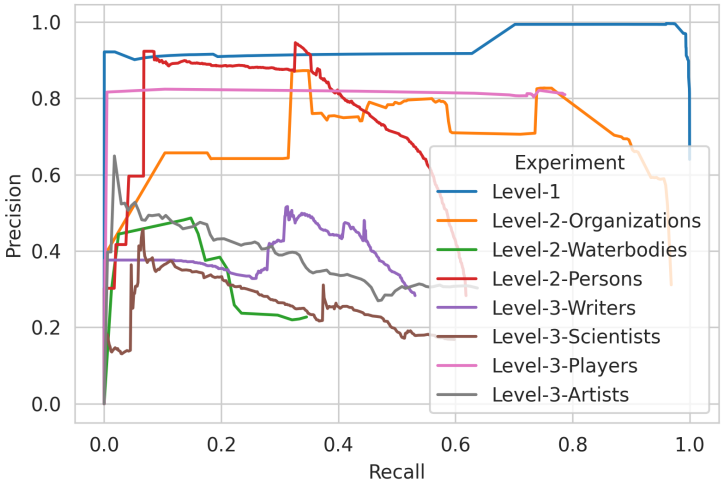

Fig. 2: Precision-Recall Curves for SDType on Yago.

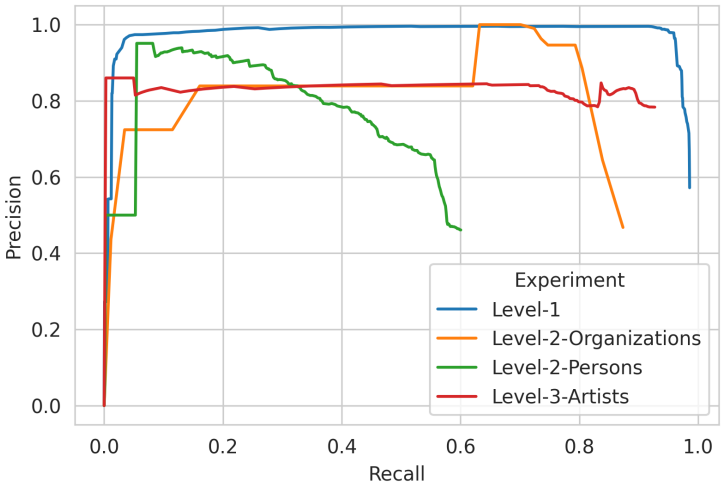

Fig. 3: Precision-Recall Curves for SDType on Freebase.

1.4 Full Experiment Results for Yago3-10 and FB15k-237

Table 2: Weighted F1 Measures for Yago in the Level-1 experiment.

Classifier Embedding	KNN	MLP	Random Forest
ComplEx	95.6	99.2	99.1
ConvE	72.7	99.4	99.1
DistMult	98.1	99.4	97.0
RDF2Vec	97.1	97.6	97.4
RESCAL	99.4	99.5	98.9
TransE	93.7	99.1	98.6

Table 3: Weighted F1 Measures for Yago in the Level-2-Organizations experiment.

Classifier Embedding	KNN	MLP	Random Forest
ComplEx	45.4	84.1	72.5
ConvE	23.8	82.5	74.4
DistMult	75.3	85.1	69.6
RDF2Vec	73.3	75.6	69.9
RESCAL	84.2	84.1	81.3
TransE	65.6	75.3	70.8

Table 4: Weighted F1 Measures for Yago in the Level-2-Waterbodies experiment.

Classifier Embedding	KNN	MLP	Random Forest
ComplEx	64.3	69.6	57.4
ConvE	37.2	59.7	54.2
DistMult	70.7	70.0	68.3
RDF2Vec	61.1	61.3	57.4
RESCAL	67.0	66.2	60.9
TransE	64.3	66.5	52.5

Table 5: Weighted F1 Measures for Yago in the Level-2-Persons experiment.

Classifier Embedding	KNN	MLP	Random Forest
ComplEx	54.3	67.2	62.0
ConvE	28.6	74.3	69.2
DistMult	72.3	75.8	54.3
RDF2Vec	69.2	70.6	70.6
RESCAL	77.1	73.2	76.0
TransE	70.6	67.6	63.1

Table 6: Weighted F1 Measures for Yago in the Level-3-Writers experiment.

Classifier Embedding	KNN	MLP	Random Forest
ComplEx	40.1	56.8	47.0
ConvE	34.3	60.5	43.0
DistMult	61.0	62.7	41.8
RDF2Vec	52.4	54.4	45.1
RESCAL	60.6	61.1	52.8
TransE	53.3	53.9	40.7

Table 7: Weighted F1 Measures for Yago in the Level-3-Scientists experiment.

Classifier Embedding	KNN	MLP	Random Forest
ComplEx	29.9	48.6	17.9
ConvE	9.5	54.0	16.1
DistMult	57.6	57.3	11.2
RDF2Vec	24.9	30.8	8.9
RESCAL	50.8	54.2	27.9
TransE	43.6	46.3	13.0

Table 8: Weighted F1 Measures for Yago in the Level-3-Players experiment.

Classifier Embedding	KNN	MLP	Random Forest
ComplEx	90.0	90.2	86.4
ConvE	84.4	90.7	87.4
DistMult	90.4	91.6	83.8
RDF2Vec	86.2	88.3	85.3
RESCAL	91.6	90.8	90.8
TransE	90.0	89.9	88.1

Table 9: Weighted F1 Measures for Yago in the Level-3-Artists experiment.

Classifier Embedding	KNN	MLP	Random Forest
ComplEx	18.3	43.7	36.5
ConvE	29.9	48.1	36.7
DistMult	44.6	52.1	35.5
RDF2Vec	43.0	48.4	41.0
RESCAL	53.6	49.7	39.8
TransE	36.4	46.6	32.9

Table 10: Weighted F1 Measures for Freebase in the Level-1 experiment.

Classifier Embedding	KNN	MLP	Random Forest
Complex	98.2	98.6	98.5
ConvE	98.8	98.7	98.7
DistMult	98.3	98.6	98.5
RDF2Vec	97.8	98.5	98.1
RESCAL	98.2	98.8	98.7
TransE	98.3	98.7	97.8

Table 11: Weighted F1 Measures for Freebase in the Level-2-Organizations experiment.

Classifier / Embedding	KNN	MLP	Random Forest
Complex	89.6	92.6	85.4
ConvE	87.4	93.2	91.4
DistMult	86.3	95.5	90.1
RDF2Vec	83.3	86.2	88.7
RESCAL	91.9	91.4	87.3
TransE	95.1	92.6	82.6

Table 12: Weighted F1 Measures for Freebase in the Level-2-Persons experiment.

Classifier / Embedding	KNN	MLP	Random Forest
Complex	78.1	80.3	76.4
ConvE	80.4	80.4	79.2
DistMult	77.6	79.9	78.2
RDF2Vec	74.1	73.8	72.5
RESCAL	78.8	79.6	75.7
TransE	79.2	79.1	73.0

Table 13: Weighted F1 Measures for Freebase in the Level-3-Artists experiment.

Classifier / Embedding	KNN	MLP	Random Forest
Complex	95.5	96.1	94.6
ConvE	95.7	96.2	94.2
DistMult	95.9	96.3	94.5
RDF2Vec	93.4	92.6	92.4
RESCAL	95.9	95.3	94.1
TransE	95.2	95.7	93.9

Table 14: Clustering results for Freebase in the Level-1 experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
ComplEx	0.768	0.773	0.743	0.167	0.184	-0.002	0.79	0.792	0.844	0.616	0.62	0.53
ConvE	0.738	0.746	0.645	0.169	0.188	-0.003	0.797	0.801	0.788	0.843	0.843	0.893
RDF2Vec	0.357	0.359	0.26	0.127	0.128	0.003	0.485	0.488	0.362	0.619	0.624	0.516
TransE	0.749	0.753	0.728	0.15	0.16	-0.024	0.742	0.743	0.768	0.594	0.599	0.504
RESCAL	0.711	0.718	0.602	0.155	0.164	0.005	0.72	0.728	0.611	0.654	0.661	0.702
DistMult	0.802	0.803	0.853	0.165	0.179	0.009	0.765	0.767	0.821	0.579	0.606	0.43

Table 15: Clustering Results for Freebase in the Level-2-Person experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
ComplEx	0.633	0.648	0.587	0.399	0.334	0.219	0.622	0.622	0.869	0.628	0.658	0.478
ConvE	0.601	0.543	0.644	0.223	0.419	0.414	0.71	0.526	0.619	0.669	0.569	0.541
RDF2Vec	0.48	0.378	0.327	0.483	0.364	0.11	0.479	0.387	0.311	0.486	0.418	0.413
TransE	0.633	0.514	0.587	0.301	0.327	0.314	0.689	0.444	0.686	0.664	0.425	0.53
RESCAL	0.702	0.683	0.703	0.394	0.4	0.301	0.627	0.535	0.681	0.558	0.569	0.551
DistMult	0.621	0.511	0.689	0.401	0.333	0.301	0.639	0.472	0.419	0.628	0.523	0.58

Table 16: Clustering Results for Freebase in the Level-2-Organization experiment

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
ComplEx	0.674	0.675	0.69	0.284	0.285	0.067	0.663	0.663	0.685	0.617	0.619	0.579
ConvE	0.685	0.685	0.655	0.26	0.263	0.031	0.685	0.685	0.655	0.673	0.673	0.646
RDF2Vec	0.41	0.412	0.367	0.234	0.238	0.022	0.397	0.4	0.372	0.503	0.503	0.495
TransE	0.71	0.71	0.74	0.243	0.243	0.039	0.721	0.722	0.763	0.693	0.693	0.661
RESCAL	0.697	0.697	0.715	0.218	0.218	0.02	0.665	0.666	0.682	0.672	0.673	0.641
DistMult	0.667	0.668	0.678	0.282	0.283	0.069	0.683	0.683	0.691	0.624	0.626	0.589

Table 17: Clustering results for Freebase in the Level-3-Artists experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
ComplEx	0.264	0.271	0.206	0.186	0.186	0.095	0.261	0.268	0.185	0.258	0.265	0.122
ConvE	0.292	0.301	0.218	0.191	0.191	0.084	0.279	0.287	0.197	0.216	0.22	0.075
RDF2Vec	0.197	0.201	0.218	0.127	0.128	-0.004	0.16	0.165	0.118	0.203	0.208	0.145
TransE	0.253	0.26	0.215	0.249	0.258	0.141	0.227	0.234	0.149	0.241	0.247	0.122
RESCAL	0.259	0.266	0.224	0.167	0.168	0.091	0.267	0.273	0.172	0.238	0.243	0.222
DistMult	0.282	0.29	0.189	0.165	0.165	0.015	0.32	0.329	0.221	0.248	0.255	0.124

Table 18: Clustering results for Yago in the Level-1 experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
Complex	0.281	0.297	0.156	0.103	0.111	0.063	0.438	0.460	0.269	0.467	0.497	0.518
ConvE	0.656	0.580	0.518	0.621	0.690	0.256	0.405	0.571	0.033	0.468	0.660	0.166
RDF2Vec	0.192	0.196	0.170	0.078	0.080	0.020	0.217	0.223	0.153	0.505	0.514	0.622
TransE	0.597	0.623	0.256	0.543	0.589	0.063	0.367	0.577	0.628	0.447	0.590	0.274
RESCAL	0.681	0.766	0.153	0.344	0.434	0.063	0.696	0.687	0.518	0.548	0.716	0.364
DistMult	0.421	0.432	0.366	0.111	0.123	0.081	0.473	0.485	0.379	0.261	0.261	0.143

Table 19: Clustering results for Yago in the Level-2-Waterbodies experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
Complex	0.173	0.174	0.148	0.208	0.214	0.046	0.219	0.220	0.171	0.194	0.194	0.139
ConvE	0.013	0.017	-0.007	0.076	0.087	0.001	0.025	0.028	-0.031	0.012	0.012	-0.018
RDF2Vec	0.041	0.041	0.034	0.237	0.259	0.018	0.067	0.068	0.022	0.018	0.018	-0.009
TransE	0.139	0.140	0.062	0.185	0.191	-0.046	0.177	0.178	0.103	0.218	0.219	0.117
RESCAL	0.198	0.199	0.135	0.207	0.222	-0.006	0.138	0.138	0.057	0.260	0.261	0.126
DistMult	0.319	0.320	0.278	0.188	0.192	-0.006	0.316	0.316	0.218	0.364	0.365	0.280

Table 20: Clustering results for Yago in the Level-2-Organization experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
Complex	0.475	0.475	0.400	0.264	0.282	0.026	0.423	0.426	0.354	0.201	0.234	0.083
ConvE	0.266	0.274	0.122	0.104	0.106	0.013	0.004	0.005	0.005	0.004	0.007	0.003
RDF2Vec	0.101	0.104	0.046	0.193	0.201	0.007	0.178	0.186	0.095	0.081	0.096	-0.023
TransE	0.506	0.507	0.300	0.176	0.180	-0.065	0.419	0.420	0.226	0.115	0.139	0.003
RESCAL	0.427	0.427	0.376	0.233	0.255	-0.046	0.439	0.439	0.385	0.448	0.452	0.265
DistMult	0.495	0.495	0.395	0.208	0.219	-0.053	0.454	0.454	0.345	0.050	0.071	0.011

Table 21: Clustering results for Yago in the Level-2-Persons experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
Complex	0.162	0.163	0.121	0.109	0.109	0.007	0.173	0.173	0.110	0.157	0.177	0.057
ConvE	0.000	0.001	0.000	0.033	0.042	-0.003	0.001	0.001	-0.001	0.001	0.001	-0.002
RDF2Vec	0.190	0.191	0.139	0.116	0.116	0.005	0.203	0.203	0.156	0.213	0.213	0.153
TransE	0.276	0.277	0.203	0.097	0.101	0.020	0.256	0.256	0.205	0.208	0.213	0.158
RESCAL	0.304	0.305	0.239	0.142	0.145	0.008	0.316	0.316	0.234	0.321	0.323	0.229
DistMult	0.140	0.140	0.070	0.133	0.135	0.004	0.251	0.251	0.192	0.045	0.057	0.002

Table 22: Clustering results for Yago in the Level-3-Scientists experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
Complex	0.111	0.111	0.058	0.108	0.122	-0.001	0.106	0.106	0.030	0.088	0.088	0.035
ConvE	0.093	0.094	0.069	0.022	0.052	0.002	0.011	0.013	0.003	0.013	0.016	0.001
RDF2Vec	0.067	0.068	0.028	0.132	0.136	-0.003	0.073	0.073	0.031	0.078	0.078	0.027
TransE	0.114	0.114	0.046	0.091	0.107	-0.005	0.104	0.104	0.033	0.107	0.107	0.026
RESCAL	0.165	0.165	0.090	0.171	0.174	0.002	0.126	0.127	0.064	0.165	0.165	0.051
DistMult	0.146	0.147	0.077	0.134	0.143	-0.001	0.144	0.144	0.055	0.155	0.155	0.052

Table 23: Clustering results for Yago in the Level-3-Artists experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
Complex	0.046	0.046	0.009	0.047	0.056	0.010	0.050	0.050	-0.022	0.039	0.040	-0.045
ConvE	0.021	0.024	-0.008	0.020	0.030	-0.005	0.027	0.033	0.011	0.027	0.031	0.009
RDF2Vec	0.061	0.062	0.044	0.129	0.132	-0.005	0.072	0.072	0.053	0.066	0.066	0.054
TransE	0.052	0.053	0.049	0.068	0.077	-0.013	0.071	0.071	0.097	0.044	0.044	0.001
RESCAL	0.087	0.088	0.068	0.144	0.144	0.037	0.077	0.077	0.074	0.099	0.099	0.066
DistMult	0.097	0.097	0.092	0.097	0.099	0.002	0.065	0.065	0.070	0.078	0.078	0.017

Table 24: Clustering results for Yago in the Level-3-Players experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
Complex	0.204	0.210	0.143	0.111	0.111	0.014	0.198	0.202	0.095	0.114	0.149	0.039
ConvE	0.160	0.163	0.123	0.037	0.045	0.001	0.002	0.003	0.005	0.002	0.004	0.002
RDF2Vec	0.115	0.115	0.070	0.091	0.092	0.022	0.132	0.132	0.072	0.175	0.179	0.079
TransE	0.217	0.223	0.138	0.092	0.092	0.004	0.198	0.203	0.107	0.205	0.216	0.058
RESCAL	0.161	0.167	0.110	0.128	0.140	0.007	0.147	0.152	0.070	0.330	0.341	0.127
DistMult	0.227	0.232	0.158	0.110	0.111	0.016	0.230	0.231	0.113	0.233	0.250	0.055

Table 25: Clustering results for Yago in the Level-3-Writers experiment.

	Kmeans			Optics			Agglomerative			Spectral		
Embedding	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI	V	NMI	ARI
Complex	0.080	0.081	0.068	0.070	0.074	-0.024	0.083	0.083	0.136	0.039	0.041	0.034
ConvE	0.003	0.003	-0.008	0.025	0.037	-0.007	0.003	0.003	-0.006	0.006	0.007	-0.009
RDF2Vec	0.119	0.120	0.126	0.121	0.121	0.005	0.114	0.115	0.130	0.120	0.120	0.231
TransE	0.144	0.145	0.138	0.061	0.075	0.007	0.143	0.143	0.186	0.137	0.137	0.138
RESCAL	0.172	0.174	0.101	0.129	0.130	-0.009	0.169	0.171	0.106	0.181	0.181	0.135
DistMult	0.165	0.167	0.127	0.118	0.118	-0.024	0.132	0.132	0.070	0.129	0.137	0.143