

CSIT 5930 Search Engines and Applications

Fall 2021 Homework 2 Report

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C) Query Result

"embedding":

document_id: 95
similarity: 0.4820251213721229
document_vector_norm: 61.40281956231339
unique_word_number: 42
top5_word_weight: {'entiti': 33.55698831542607, 'repres': 3.796271422928588, 'aspect': 4.080064388929179, 'singl': 4.018663844265036, 'fgs2ee': 19.207252689972385}

document_id: 277
similarity: 0.3582389148652805
document_vector_norm: 41.31000335801765
unique_word_number: 37
top5_word_weight: {'set': 4.788345958714484, 'deep': 3.8487388428227236, 'contextu': 11.96674950261295, 'e': 5.252692842972551, 'simpler': 12.037327688530072}

document_id: 213
similarity: 0.3490256403079279
document_vector_norm: 50.880562572999686
unique_word_number: 51
top5_word_weight: {'convers': 12.532084770852283, 'contain': 3.9031866268451, 'mani': 2.8893808273200694, 'type': 3.6967357493776736, 'pr': 25.810879034958578}

document_id: 202
similarity: 0.324401756864846
document_vector_norm: 72.99023738504802
unique_word_number: 60
top5_word_weight: {'goal': 4.796271422928588, 'knowledg': 5.751411780845986, 'graph': 6.160128777858358, 'kge': 9.603626344986193, 'conv': 28.810879034958578}

document_id: 294
similarity: 0.3166646502029884
document_vector_norm: 74.77361690518207
unique_word_number: 45
top5_word_weight: {'knowledg': 2.875705890422993, 'graph': 3.080064388929179, 'kg': 56.149310754120286, 'learn': 2.8079080002996553, 'compress': 20.388814268785765}

The first document top5 keyword about corresponding postings lists is as follows, where for stem word “entit” document 8 contains it and in the position 62 of document 8. Because it is so big, so I will put it in the appendix, and only display one of them:

```
document_id: 95
similarity: 0.4820251213721229
document_vector_norm: 61.40281956231339
unique_word_number: 42
top5_word_weight: {'entiti': 33.55698831542607, 'repres': 3.796271422928588, 'aspect': 4.080064388929179, 'singl': 4.018633844265036, 'fgs2ee': 19.207252689972385}
entiti: {8: [62], 20: [9], 23: [66, 74, 86, 138], 44: [7, 87, 107], 63: [28], 84: [89], 85: [15], 90: [12, 27, 43, 50, 62, 79, 97], 94: [9], 95: [0, 8, 22, 26, 39, 41, 70, 102, 118, 129], 98: [105], 101: [146], 113: [47], 115: [18], 126: [82], 131: [9], 133: [22, 29, 35, 84, 114, 120], 146: [4, 20, 118], 147: [73, 83], 148: [77], 153: [4], 155: [1], 169: [2, 9, 38, 55, 89, 95], 179: [20], 186: [9, 21, 44, 55, 67, 78], 190: [0, 7], 191: [0, 9, 13, 48, 58, 63, 134], 194: [11, 83, 182], 202: [18, 177], 207: [5, 64, 194], 215: [12], 226: [69], 263: [15, 44], 274: [2, 31, 45, 52, 115, 121], 288: [36], 294: [11, 67], 304: [133], 311: [1, 162], 318: [30, 141, 155, 164], 325: [22], 333: [193], 347: [60, 75, 94, 143], 349: [8, 1], 364: [236], 374: [139], 375: [7], 383: [1], 398: [5, 54, 71, 92, 100], 451: [100, 123], 461: [4, 23, 36], 508: [108], 534: [100], 543: [8, 49, 86], 547: [59, 68, 80], 549: [22], 551: [53, 85], 556: [15, 29, 37, 56, 96, 106, 128, 136], 562: [3, 10, 39, 52, 71, 97, 107, 137], 578: [14, 22, 46, 61, 77, 81, 90], 580: [28], 585: [78], 592: [46], 603: [1, 21, 29, 37, 109], 611: [10, 21, 35, 56, 73, 92, 103, 123], 618: [72, 81], 621: [72, 90, 143], 634: [5], 640: [1, 80, 93, 109, 120], 641: [92, 95, 103], 643: [11, 89], 664: [99], 687: [10, 28, 89, 131, 162], 688: [43], 714: [135], 761: [29], 768: [12, 1]}
repres: {20: [16], 29: [50], 54: [13], 59: [65], 77: [155], 82: [55], 95: [3], 138: [127], 164: [12], 194: [63, 80], 202: [12], 205: [41], 211: [57], 213: [54], 215: [20], 220: [147], 224: [95], 252: [86], 263: [17], 266: [86], 294: [65], 355: [106], 358: [73], 382: [42], 393: [121], 404: [52], 452: [53, 91], 456: [130], 462: [6], 470: [24], 473: [27], 495: [10, 4], 497: [16], 507: [96], 510: [99], 512: [62], 514: [56], 521: [16, 60, 71], 522: [117], 536: [12], 538: [101], 568: [65], 569: [23], 587: [92], 601: [70], 606: [129], 608: [9], 612: [62], 659: [39], 673: [40], 690: [15, 118], 700: [129], 717: [43], 720: [163], 732: [15], 752: [22]}
aspect: {7: [11, 24], 25: [60], 39: [61], 57: [36], 61: [115], 80: [177], 88: [79], 95: [5], 97: [22, 99], 104: [21], 136: [33], 143: [86], 149: [6, 47], 175: [19, 75], 195: [80], 208: [109, 125], 244: [201], 246: [30], 248: [0, 6, 52, 55, 95], 135], 255: [92], 257: [50], 300: [7, 18, 20, 68, 71, 84, 87, 106], 310: [2, 22], 317: [54], 319: [0, 10, 17], 334: [59], 413: [36], 470: [20], 482: [8], 505: [111], 550: [11], 591: [137], 594: [22, 99, 111], 640: [16, 46, 56], 643: [54], 664: [110], 684: [0, 17, 26, 65], 704: [22], 715: [35], 716: [8, 84], 717: [93], 728: [27], 739: [1, 13, 17, 50, 62, 69, 81, 92, 127, 151, 159], 754: [0, 13, 29, 45, 76, 85, 134], 760: [90], 762: [0, 14, 20, 46, 51, 95]}
singl: {9: [48], 22: [105], 27: [12], 29: [100, 125, 130], 61: [49], 95: [11], 100: [74], 146: [52], 157: [76], 170: [63], 183: [109], 184: [21, 62, 66], 196: [62], 213: [100], 222: [99], 262: [95], 281: [15], 312: [143, 172], 316: [112], 345: [28, 47], 366: [63], 390: [27, 89], 401: [129], 416: [96], 444: [96], 486: [49], 494: [9], 519: [68], 541: [141], 584: [37, 47], 587: [23], 600: [37, 41], 607: [61], 608: [87], 612: [67], 633: [10], 634: [123, 173], 648: [16], 650: [47, 163], 669: [99], 676: [149], 678: [76], 683: [11], 716: [42], 717: [46, 59], 722: [183, 189], 725: [19], 754: [48]}
fgs2ee: {95: [62, 83]}
```

language model

```
document_id: 349
similarity: 0.19612002895805933
document_vector_norm: 42.5887289290885
unique_word_number: 55
top5_word_weight: {'languag': 9.519987327696157, 'pretrain': 4.318224126123944, 'ubiquit': 6.796271422928588, 'natur': 4.160128777858358, 'crawl': 12.563396500197658}
```

```
document_id: 394
similarity: 0.18553895022622924
document_vector_norm: 37.57034165218137
unique_word_number: 56
top5_word_weight: {'languag': 8.329988911734137, 'multilingu': 13.423029984123676, 'neural': 1.6320827910354199, 'machin': 2.7209832956243507, 'interlingua': 9.603626344986193}
```

```
document_id: 654
similarity: 0.1655873409808997
document_vector_norm: 43.728610126026325
unique_word_number: 41
top5_word_weight: {'languag': 8.329988911734137, 'present': 4.5996911936181775, 'method': 2.7400133364529795, 'combin': 7.0323270074717055, 'commun': 18.236928902510954}
```

```
document_id: 473
```

similarity: 0.16025334997240523
document_vector_norm: 43.692004711304065
unique_word_number: 49
top5_word_weight: {'languag': 9.519987327696157, 'technolog': 11.8063732536902, 'contribut': 4.9031866268451, 'promot': 6.796271422928588, '7000': 9.603626344986193}

document_id: 411
similarity: 0.15261037513941306
document_vector_norm: 34.852664624418125
unique_word_number: 41
top5_word_weight: {'languag': 7.139990495772118, 'train': 4.383326819149983, 'multilingu': 4.4743433280412255, 'machin': 2.7209832956243507, 'mt': 12.037327688530072}

state of the art

document_id: 262
similarity: 0.12856840120221483
document_vector_norm: 33.90418454789961
unique_word_number: 36
top5_word_weight: {'state': 2.9797683578740073, 'art': 3.1847981791258757, 'advanc': 4.355698831542607, 'pre': 6.067541473310488, 'classif': 13.272896504495774}

document_id: 290
similarity: 0.1259927882712182
document_vector_norm: 42.383576808584216
unique_word_number: 45
top5_word_weight: {'state': 5.959536715748015, 'art': 1.5923990895629379, 'recent': 2.34623850229354, 'propos': 2.5763775224599392, 'dialogu': 23.58720601808818}

document_id: 329
similarity: 0.11614787536688266
document_vector_norm: 37.5298023112283
unique_word_number: 46
top5_word_weight: {'state': 2.9797683578740073, 'art': 3.1847981791258757, 'new': 5.751377453408921, 'larg': 2.2907433897018366, 'nli': 13.592542845857176}

document_id: 432
similarity: 0.11364277812116204
document_vector_norm: 84.07092823153519
unique_word_number: 59
top5_word_weight: {'state': 11.91907343149603, 'recent': 2.34623850229354, 'work': 1.8689167247603538, 'dialogu': 15.724804012058787, 'dst': 50.971887750691806}

document_id: 750

similarity: 0.11263014348647667
document_vector_norm: 58.052933252877395
unique_word_number: 68
top5_word_weight: {'state': 4.469652536811011, 'art': 4.777197268688814, 'transfer': 3.6728890074233056, 'learn': 2.8079080002996553, 'aggress': 16.03732768853007}

Natural Language Processing

document_id: 349
similarity: 0.22074908840054522
document_vector_norm: 42.5887289290885
unique_word_number: 54
top5_word_weight: {'natur': 4.160128777858358, 'languag': 9.519987327696157, 'process': 2.603626344986192, 'pretrain': 4.318224126123944, 'crawl': 12.563396500197658}

document_id: 481
similarity: 0.20417351082513727
document_vector_norm: 27.7406941729261
unique_word_number: 32
top5_word_weight: {'natur': 6.240193166787538, 'languag': 3.569995247886059, 'paper': 1.2682359902922669, 'trace': 7.603626344986192, 'bind': 9.603626344986193}

document_id: 490
similarity: 0.172185749151089
document_vector_norm: 23.685014222810334
unique_word_number: 21
top5_word_weight: {'languag': 2.379996831924039, 'process': 2.603626344986192, 'given': 3.127892914019794, 'complex': 3.6967357493776736, 'possibl': 8.563396500197658}

document_id: 679
similarity: 0.1720082383451278
document_vector_norm: 65.85632149372202
unique_word_number: 52
top5_word_weight: {'natur': 12.480386333575076, 'languag': 7.139990495772118, 'studi': 2.394172979357242, 'semant': 7.879039264458827, 'feedback': 29.126793000395317}

document_id: 760
similarity: 0.16556814780499457
document_vector_norm: 45.11373732479097
unique_word_number: 54
top5_word_weight: {'natur': 4.160128777858358, 'languag': 3.569995247886059, 'process': 5.207252689972384, 'nlp': 12.257870135512642, 'person': 11.032327007471705}

d) Other Data Structure

abstracts_list

This is the list of all the papers abstracts after tokenize, for instance, the first document (is the first element of the list as well) will display in this way:

```
['this', 'paper', 'focuses', 'on', 'generating', 'multi', 'hop', 'reasoning', 'questions', 'from', 'the', 'raw', 'text', 'in', 'a', 'low', 'resource', 'circumstance', 'such', 'questions', 'have', 'to', 'be', 'syntactically', 'valid', 'and', 'need', 'to', 'logically', 'correlate', 'with', 'the', 'answers', 'by', 'deducing', 'over', 'multiple', 'relations', 'on', 'several', 'sentences', 'in', 'the', 'text', 'specifically', 'we', 'first', 'build', 'a', 'multi', 'hop', 'generation', 'model', 'and', 'guide', 'it', 'to', 'satisfy', 'the', 'logical', 'rationality', 'by', 'the', 'reasoning', 'chain', 'extracted', 'from', 'a', 'given', 'text', 'since', 'the', 'labeled', 'data', 'is', 'limited', 'and', 'insufficient', 'for', 'training', 'we', 'propose', 'to', 'learn', 'the', 'model', 'with', 'the', 'help', 'of', 'a', 'large', 'scale', 'of', 'unlabeled', 'data', 'that', 'is', 'much', 'easier', 'to', 'obtain', 'such', 'data', 'contains', 'rich', 'expressive', 'forms', 'of', 'the', 'questions', 'with', 'structural', 'patterns', 'on', 'syntax', 'and', 'semantics', 'these', 'patterns', 'can', 'be', 'estimated', 'by', 'the', 'neural', 'hidden', 'semi', 'markov', 'model', 'using', 'latent', 'variables', 'with', 'latent', 'patterns', 'as', 'a', 'prior', 'we', 'can', 'regularize', 'the', 'generation', 'model', 'and', 'produce', 'the', 'optimal', 'results', 'experimental', 'results', 'on', 'the', 'hotpotqa', 'data', 'set', 'demonstrate', 'the', 'effectiveness', 'of', 'our', 'model', 'moreover', 'we', 'apply', 'the', 'generated', 'results', 'to', 'the', 'task', 'of', 'machine', 'reading', 'comprehension', 'and', 'achieve', 'significant', 'performance', 'improvements']
```

This data structure will help me deal with phase, for example, if I have a "English Teacher" phase query, I need to find the whole word which is contained by the abstracts. I can just compare word by word to judge.

query_weight

This is the query weight to help me calculate weight for convenience, which is a ordered dictionary. For example, if my query is 'a tree of "language model" apple tree', it will be transfer in this form as follows:

```
OrderedDict([('tree', 2), ('appl', 1), ('language model', 1)])
```

When I calculate numerator of cosine similarity, I need to multiply document weight by query weight element by element, it really helps to record the weight.

unique_word

This is a **dictionary(dict())** in one document, form like {'english': 2, 'graph': 1}, which record the occur times of one word, if one number of one word is 1, means that it is unique, and will be marked as unique.

e) Design Proposal

If there is no updating, in order to accelerate the computing speed, I will record a few information about these papers.

1. Record all weights of all documents in advance.
2. Record all idf of all stem in advance
3. Record all tf of all stem in every document

So, the only I need to do is to process the phase query, and other words' idf and tf have already been computed.

4. In the meanwhile, because it is static, so I can cache the idf and tf of previous phase query to accelerate query efficiency.

Tricks to Improve

1. I make a lot of Pruning to accelerate it. Such as:
 - a) When I calculate document weight, if one document doesn't have any word or phase of the query, I will skip it.
 - b) When I calculate numerator of cosine similarity, if it only calculates word or phase in the query, because others will be 0, skip a lot of multiply.
2. I use the ordered dictionary to record word weight and phase weight, and then merge them into query weight, and calculate numerator of cosine similarity.

Appendix:

"embedding":

document_id: 95

similarity: 0.4820251213721229

document_vector_norm: 61.40281956231339

unique_word_number: 42

top5_word_weight: {'entiti': 33.55698831542607, 'repres': 3.796271422928588, 'aspect': 4.080064388929179, 'singl': 4.018663844265036, 'fgs2ee': 19.207252689972385}

entiti: {8: [62], 20: [9], 23: [66, 74, 86, 138], 44: [7, 87, 107], 63: [28], 84: [89], 85: [15], 90: [12, 27, 43, 50, 62, 79, 97], 94: [9], 95: [0, 8, 22, 26, 39, 41, 70, 102, 118, 129], 98: [105], 101: [146], 113: [47], 115: [18], 126: [82], 131: [9], 133: [22, 29, 35, 84, 114, 120], 146: [4, 20, 118], 147: [73, 83], 148: [77], 153: [4], 155: [1], 169: [2, 9, 38, 55, 89, 95], 179: [20], 186: [9, 21, 44, 55, 67, 78], 190: [0, 7], 191: [0, 9, 13, 48, 58, 63, 134], 194: [11, 83, 162], 202: [18, 177], 207: [5, 64, 194], 215: [12], 226: [69], 263: [15, 44], 274: [2, 31, 45, 52, 115, 121], 288: [36], 294: [11, 67], 304: [133], 311: [1, 162], 318: [30, 141, 155, 164], 325: [22], 333: [193], 347: [60, 75, 94, 143], 349: [81], 364: [236], 374: [139], 375: [7], 383: [1], 398: [5, 54, 71, 92, 100], 451: [100, 123], 461: [4, 23, 36], 508: [108], 534: [100], 543: [8, 49, 86], 547: [59, 68, 80], 549: [22], 551: [53, 85], 556: [15, 29, 37, 56, 96, 106, 128, 136], 562: [3, 10, 39, 52, 71, 97, 107, 137], 578: [14, 22, 46, 61, 77, 81, 90], 580: [28], 585: [78], 592: [46], 603: [1, 21, 29, 37, 109], 611: [10, 21, 35, 56, 73, 92, 103, 123], 618: [72, 81], 621: [72, 90, 143], 634: [5], 640: [1, 80, 93, 109, 120], 641: [92, 95, 103], 643: [11, 89], 664: [99], 687: [10, 28, 89, 131, 162], 688: [43], 714: [135], 761: [29], 768: [12]}

repres: {20: [16], 29: [50], 54: [13], 59: [65], 77: [155], 82: [55], 95: [3], 138: [127], 164: [12], 194: [63, 80], 202: [12], 205: [41], 211: [57], 213: [54], 215: [20], 220: [147], 224: [95], 252: [86], 263: [17], 266: [86], 294: [65], 355: [106], 358: [73], 382: [42], 393: [121], 404: [52], 452: [53, 91], 456: [130], 462: [6], 470: [24], 473: [27], 495: [104], 497: [16], 507: [96], 510: [99], 512: [62], 514: [56], 521: [16, 60, 71], 522: [117], 536: [12], 538: [101], 568: [65], 569: [23], 587: [92], 601: [70], 606: [129], 608: [9], 612: [62], 659: [39], 673: [40], 690: [15, 118], 700: [129], 717: [43], 720: [163], 732: [15], 752: [22]}

aspect: {7: [11, 24], 25: [60], 39: [61], 57: [36], 61: [115], 80: [177], 88: [79], 95: [5], 97: [22, 99], 104: [21], 136: [33], 143: [86], 149: [6, 47], 175: [19, 75], 195: [80], 208: [109, 125], 244: [201], 246: [30], 248: [0, 6, 52, 55, 95, 135], 255: [92], 257: [50], 300: [7, 18, 20, 68, 71, 84, 87, 106], 310: [2, 22], 317: [54], 319: [0, 10, 17], 334: [59], 413: [36], 470: [20], 482: [8], 505: [111], 550: [11], 591: [137], 594: [22, 99, 111], 640: [16, 46, 56], 643: [54], 664: [110], 684: [0, 17, 26, 65], 704: [22], 715: [35], 716: [8, 84], 717: [93], 728: [27], 739: [1, 13, 17, 50, 62, 69, 81, 92, 127, 151, 159], 754: [0, 13, 29, 45, 76, 85, 134], 760: [90], 762: [0, 14, 20, 46, 51, 95]}

singl: {9: [48], 22: [105], 27: [12], 29: [100, 125, 130], 61: [49], 95: [11], 100: [74], 146: [52], 157: [76], 170: [63], 183: [109], 184: [21, 62, 66], 196: [62], 213: [100], 222: [99], 262: [95], 281: [15], 312: [143, 172], 316: [112], 345: [28, 47], 366: [63], 390: [27, 89], 401: [129], 416: [96], 444: [96], 486: [49], 494: [9], 519: [68], 541: [141], 584: [37, 47], 587: [23], 600: [37, 41], 607: [61], 608: [87], 612: [67], 633: [10], 634: [123, 173], 648: [16], 650: [47, 163], 669: [99], 676: [149], 678: [76], 683: [11], 716: [42], 717: [46, 59], 722: [183, 189], 725: [19], 754: [48]}

fgs2ee: {95: [62, 83]}

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unique_word_number: 37

top5_word_weight: {'set': 4.788345958714484, 'deep': 3.8487388428227236, 'contextu': 11.96674950261295, 'e': 5.252692842972551, 'simpler': 12.037327688530072}

set: {0: [156], 11: [46], 16: [45], 20: [46], 21: [14, 19, 37, 54, 77, 135], 25: [103], 28: [31], 29: [58], 30: [134], 41: [11], 50: [51], 51: [168], 72: [2, 56], 76: [6, 13, 93, 129], 78: [130], 82: [87, 94], 84: [80], 86: [35, 81, 131], 89: [111], 114: [52], 126: [118], 128: [123], 129: [89], 132: [29], 145: [66, 189], 153: [8, 15, 61], 154: [103], 159: [8, 189], 165: [92], 168: [22], 170: [4, 48, 78, 133], 176: [76], 190: [54], 191: [1, 10, 42, 49, 64, 95], 196: [84], 200: [154], 201: [142], 207: [47, 58, 149], 212: [12], 216: [62, 111], 220: [64, 94, 172], 222: [67], 237: [24], 244: [127, 135], 250: [102], 251: [18, 92], 260: [108], 270: [107], 277: [3, 40], 284: [22], 285: [87], 291: [61], 294: [52], 297: [226], 299: [85], 303: [205], 308: [88], 314: [14, 21], 322: [78, 118], 324: [90], 327: [7], 329: [54], 331: [14], 332: [26, 231], 333: [86, 118, 128], 334: [114, 132, 144, 171], 336: [63, 69], 348: [127], 355: [99, 134], 358: [85], 359: [136], 363: [121], 365: [132], 370: [71], 379: [131], 380: [14], 389: [73], 396: [60], 403: [39], 411: [20, 89, 102], 416: [98], 417: [154], 422: [58], 426: [133], 427: [49], 432: [13, 175], 440: [61], 447: [81], 448: [42, 54, 90], 449: [85, 90, 102], 450: [67], 454: [77], 459: [113], 472: [89], 482: [50], 483: [32, 89, 123, 230], 487: [16, 38, 76, 142], 490: [30, 55], 494: [35], 507: [43], 514: [55, 65, 74, 106, 124], 515: [18], 527: [64], 531: [184], 532: [174], 534: [64], 545: [145], 550: [30, 109], 558: [141], 566: [86], 569: [29], 574: [62], 578: [21], 585: [57], 586: [82], 587: [106], 592: [18, 135, 147], 598: [61], 602: [155], 607: [105], 614: [61, 67, 108], 618: [48], 621: [37, 83], 637: [137], 638: [68], 645: [86], 651: [49], 654: [136], 656: [4], 672: [76, 79], 678: [47], 680: [116], 689: [45, 94, 186], 694: [63], 699: [92], 700: [55, 58], 704: [95], 708: [68], 709: [104], 722: [187], 724: [124, 154], 727: [119], 728: [56], 763: [12], 764: [125, 150], 765: [200], 770: [32, 141], 777: [58, 68, 91]}

deep: {6: [20], 8: [0], 9: [2], 24: [103], 43: [61], 52: [99], 56: [35], 64: [12, 36], 90: [101], 107: [60], 115: [24, 125], 119: [0, 143], 152: [130], 168: [46, 166], 172: [111], 178: [56], 199: [79], 228: [0, 30], 233: [78], 239: [22], 270: [26], 277: [6], 279: [6, 94, 129], 299: [4], 307: [34, 88, 139, 166, 177], 309: [10], 323: [67, 139, 158, 180], 342: [24], 357: [10, 28], 388: [20], 442: [75], 447: [121], 481: [74], 495: [55], 526: [4], 539: [6], 542: [3, 144], 544: [1, 83, 106], 546: [9], 549: [122], 564: [1, 33], 566: [0], 586: [84], 595: [116], 598: [25], 600: [6, 70, 114], 605: [38, 65], 614: [11], 667: [1], 668: [1], 680: [5], 688: [69], 720: [1], 772: [82]}

contextu: {19: [66], 74: [102], 95: [53, 81], 98: [100], 103: [3, 26], 163: [16], 164: [14], 178: [3], 189: [53], 194: [145], 224: [94], 226: [18], 231: [64], 233: [79], 238: [43], 240: [57, 66, 88, 91, 114, 130, 148], 247: [30], 251: [0, 62, 75], 265: [0, 18], 269: [49], 276: [3, 56, 77, 92], 277: [7, 60, 86], 281: [126], 300: [60, 75], 303: [167], 315: [16], 318: [127], 330: [16], 336: [112], 370: [6, 32, 97], 381: [62], 386: [84], 438: [19, 107], 461: [51, 100, 134], 472: [52], 497: [88, 108], 499: [77], 578: [70], 599: [63, 85], 605: [27, 54], 623: [10], 632: [19, 69, 96], 670: [55], 676: [104, 127], 697: [86], 722: [30], 739: [115], 760: [99], 767: [152]}

e: {6: [133, 192], 13: [103], 16: [75], 19: [39, 84], 25: [22], 30: [58], 35: [96, 101], 59: [57], 60: [6], 61: [134, 155], 63: [23, 70], 72: [132], 75: [109], 79: [23], 84: [107], 87: [10], 98: [20], 107: [13], 108: [115], 114: [16], 119: [99], 122: [136], 127: [89], 144: [79], 147: [43, 56], 157: [67], 160: [60], 165: [12], 166: [11, 17], 168: [7], 174: [88], 179: [89], 183: [9], 189: [18, 44], 196: [22], 199: [49, 60, 117], 200: [127], 201: [112], 208: [67, 136], 209: [39], 213: [7], 217: [22], 223: [111], 240: [30], 244: [141, 149, 158], 245: [179], 250: [35], 251: [2, 27], 252: [48], 262: [34], 263: [12, 28], 269: [83], 272: [38, 48], 277: [9, 22], 281: [10], 285: [30], 300: [59], 302: [17], 312: [167], 319: [9], 324: [36, 47], 332: [34], 339: [32], 344: [55], 370: [9], 373: [59], 379: [68], 380: [13], 384: [101], 387: [133], 390: [12, 39], 392: [102], 398: [17], 404: [137], 429: [15], 437: [30, 58], 447: [116], 451: [43], 457: [129], 459: [143, 181], 462: [49], 467: [37], 483: [34], 486: [42], 498: [107], 503: [73, 112], 510: [24], 512: [34], 519: [21, 54], 528: [15], 529: [41], 534: [86], 538: [170], 546: [44], 558: [99], 563: [2, 25], 573: [12, 54], 583: [122], 587: [123],

591: [105], 593: [102], 598: [68], 609: [3], 615: [13, 87], 619: [157], 625: [19, 119], 632: [15], 637: [31], 664: [12], 668: [26], 670: [68], 672: [49], 674: [115], 682: [19], 696: [33], 706: [42], 709: [4], 710: [92], 714: [120], 720: [20], 724: [77], 739: [117], 745: [7], 747: [128], 756: [26], 759: [30, 122]}

simpler: {72: [112], 128: [29], 159: [85, 95], 196: [29], 209: [110], 277: [28, 56], 291: [96], 445: [24], 588: [14], 643: [40], 669: [138], 765: [186]}

document_id: 213

similarity: 0.3490256403079279

document_vector_norm: 50.880562572999686

unique_word_number: 51

top5_word_weight: {'convers': 12.532084770852283, 'contain': 3.9031866268451, 'mani': 2.8893808273200694, 'type': 3.6967357493776736, 'pr': 25.810879034958578}

convers: {6: [34], 10: [70], 15: [64], 39: [32, 39, 69, 110, 162], 46: [2, 80], 52: [13, 27, 86], 60: [14, 26, 51, 84, 101, 107, 124, 160, 204, 215], 69: [33, 41], 89: [31, 37, 119], 113: [13], 121: [5], 136: [121], 145: [14, 98], 149: [10, 18, 51, 145], 170: [12, 36, 71], 204: [53], 213: [1, 21, 31], 218: [6], 226: [13], 239: [16, 52], 246: [55], 275: [5, 22, 41, 51, 60, 80, 134], 355: [98, 132], 371: [3, 71], 374: [6, 86, 94], 397: [3], 401: [8, 72, 139], 423: [16], 428: [7, 109], 441: [19], 478: [180], 496: [1, 23, 28, 62], 504: [11, 44], 521: [12, 48], 535: [67, 90, 109, 116], 555: [2, 39, 89, 152, 172, 196], 650: [12, 53, 66, 126, 155], 659: [1, 17, 29, 33, 42, 85, 94, 112], 693: [3, 51, 147], 707: [4, 18, 30, 54, 100], 732: [5], 751: [67], 759: [6, 24]}

contain: {0: [104], 29: [33], 92: [148], 93: [60], 102: [42], 119: [76, 117], 135: [30], 136: [40], 138: [78], 139: [58], 148: [67], 153: [17], 156: [67], 167: [151], 213: [2], 218: [42], 227: [34, 48], 232: [52], 234: [37], 242: [65], 274: [86], 275: [57, 81], 277: [93], 324: [117, 178], 331: [109], 345: [12, 57], 390: [44], 410: [85], 416: [60], 446: [17], 451: [183], 455: [102], 458: [9], 475: [65], 523: [86], 535: [112], 538: [64], 556: [19], 560: [94], 589: [19], 598: [10, 145], 599: [75], 634: [72], 637: [26], 660: [22], 668: [41], 676: [10, 26, 47], 681: [3], 684: [21], 690: [82], 700: [74], 750: [109, 187]}

mani: {2: [0], 16: [80], 20: [24], 28: [13], 69: [79], 72: [1], 91: [6, 13, 25], 92: [71], 94: [60], 105: [43], 117: [14, 73, 91], 128: [49], 141: [97], 161: [1], 170: [142], 182: [93], 191: [26], 199: [46], 205: [28], 213: [3], 214: [0], 215: [1, 47], 242: [140], 244: [12], 245: [1], 251: [108], 256: [12], 265: [26], 269: [65], 274: [8], 278: [23], 280: [1], 285: [13], 289: [19], 294: [21, 49], 320: [196], 324: [0, 28], 332: [25], 338: [145, 153], 339: [3], 351: [18], 352: [80], 357: [117], 358: [29], 359: [4], 364: [0], 376: [16], 378: [14], 379: [126, 128, 130], 381: [9], 383: [8], 405: [8], 406: [21], 411: [96, 98], 428: [4], 447: [38], 456: [29], 465: [127], 474: [122], 478: [0], 482: [146], 489: [11, 68], 494: [5], 500: [9], 508: [95], 511: [0], 535: [14, 36, 113], 537: [15], 549: [27], 550: [10], 551: [10], 553: [10, 62], 554: [9], 558: [128], 559: [82], 566: [11], 573: [9], 580: [26], 589: [0, 126], 595: [18], 600: [13], 610: [43], 631: [12], 657: [21], 661: [76], 663: [43], 673: [80], 682: [11], 684: [27], 694: [10], 699: [5], 704: [19, 36], 705: [156], 709: [11, 32], 717: [99], 718: [70], 724: [39], 748: [4], 750: [12], 753: [1], 764: [35], 766: [19], 768: [0], 771: [19], 777: [18]}

type: {2: [13], 18: [84], 23: [82], 29: [88], 37: [21], 88: [70], 94: [17], 95: [90], 130: [129], 131: [134], 139: [65], 186: [22, 45, 56, 68, 79], 192: [9], 213: [4], 217: [14, 30, 46, 58, 81, 94, 99], 218: [58], 274: [122], 276: [87, 138], 292: [53], 295: [58], 314: [72], 318: [165], 332: [196], 338: [66], 347: [95], 358: [129], 367: [100, 109], 375: [31, 38, 64], 383: [25, 155], 384: [93, 96], 416: [117], 446: [33], 447: [109], 448: [58], 454: [71], 468: [86], 473: [46], 508: [32, 147], 517: [41], 523: [57, 93], 538: [94], 543: [53, 87], 562: [4, 11, 40, 48, 53, 72, 98, 108, 138], 578: [91], 580: [4], 583: [84], 597: [70], 618: [82], 626: [31], 654: [91, 127], 665: [55], 682: [41], 703: [35], 705: [135], 712: [13, 32], 717: [18], 719: [18, 50, 71, 83], 742: [93], 759: [13, 94], 773: [47]}

pr: {107: [143], 213: [26, 43, 118]}

document_id: 202
similarity: 0.324401756864846
document_vector_norm: 72.99023738504802
unique_word_number: 60
top5_word_weight: {'goal': 4.796271422928588, 'knowledg': 5.751411780845986, 'graph': 6.160128777858358, 'kge': 9.603626344986193, 'conv': 28.810879034958578}
goal: {3: [60], 60: [1], 82: [76], 90: [17], 94: [19], 145: [5, 62], 177: [13], 202: [1], 255: [37], 290: [109], 385: [76], 397: [160], 401: [1], 425: [2], 432: [153], 441: [1, 27, 105], 463: [83], 491: [24], 506: [17], 533: [5], 565: [34], 633: [62], 647: [16], 654: [21], 678: [18], 693: [1], 747: [30], 772: [28]}
knowledg: {3: [4, 9], 8: [39, 54], 27: [83, 127], 29: [120], 36: [82], 37: [116], 46: [0, 18, 43, 52, 57, 62, 71, 74, 85, 88, 133], 59: [12, 43, 61, 78], 63: [48, 58, 107, 157], 69: [37], 80: [112, 187], 81: [46, 77], 89: [32, 51], 94: [0], 99: [0], 113: [25, 28, 41, 63, 80, 99, 112, 126, 143], 119: [37, 101], 120: [34, 134, 232], 127: [75], 130: [163], 131: [0], 133: [14], 136: [9], 143: [15, 105], 159: [73], 161: [87], 169: [81], 170: [27], 171: [47, 57], 183: [11], 184: [90], 186: [60], 190: [13, 40], 202: [3, 129], 205: [94, 132], 207: [51], 213: [9], 235: [70], 269: [79, 141, 159], 275: [3, 28, 39, 53, 119, 129], 288: [11], 294: [0], 296: [47, 120], 306: [23], 318: [53], 320: [2, 11, 57, 129], 333: [25], 335: [33], 342: [52, 82], 351: [43, 99, 158], 353: [61], 358: [0, 3, 18, 39, 66, 103, 133], 372: [32], 377: [120], 390: [2, 20, 56], 395: [120], 416: [108], 449: [29, 55], 451: [139], 454: [33, 61], 461: [42], 465: [3, 34], 472: [45, 63, 82], 478: [144], 485: [92], 511: [9, 144, 152], 513: [93, 105], 516: [104], 520: [70], 531: [164], 534: [13], 543: [18], 545: [104], 551: [110], 558: [48], 560: [82], 562: [0, 26, 49, 58, 66, 112], 565: [10], 594: [16, 52, 76, 85], 611: [3], 619: [67, 140], 626: [28], 634: [22], 642: [103], 645: [26, 35, 55], 650: [2], 655: [4, 57], 657: [138, 147, 154], 659: [24, 92], 660: [34, 53], 686: [99, 104], 693: [13], 702: [0, 13], 706: [5], 712: [7], 723: [62, 75, 85, 135, 162], 724: [96], 733: [47, 58], 738: [126], 743: [14, 89], 744: [130], 745: [13], 756: [79], 767: [49, 146], 768: [44], 772: [3, 86]}
graph: {9: [32], 26: [61], 37: [7, 14, 23, 63, 104, 120, 168], 42: [27], 45: [72, 96], 48: [97], 53: [20, 55, 77], 63: [49, 108, 158], 68: [94], 88: [3, 17, 41, 86, 107], 90: [102, 112, 117, 136], 94: [1, 6], 98: [80, 132], 99: [1], 113: [29], 123: [94], 131: [1], 133: [1, 19, 62], 138: [103, 120, 137], 147: [61], 150: [26], 161: [102], 167: [113, 124], 183: [6, 12, 24, 47, 59, 91], 198: [82, 113], 202: [4, 130], 207: [52], 233: [26, 65, 119], 247: [10, 23, 65], 271: [3], 275: [54], 279: [52, 62, 78], 288: [12], 294: [1], 300: [97, 112], 303: [77, 116, 143, 160, 165, 217], 313: [1, 9, 25, 56, 71], 320: [3, 12, 58, 105, 115, 130], 324: [151], 325: [43, 95], 328: [15, 68], 336: [9, 22, 37, 41], 337: [59, 68], 350: [23, 28, 46], 358: [4, 19], 366: [40, 84, 90], 382: [104, 128, 132, 145, 169], 385: [67], 396: [72, 83], 407: [97, 109], 416: [29, 51, 87, 121], 427: [29, 58, 83, 85, 141], 431: [0, 40, 47, 50, 65, 90], 442: [77, 95], 449: [62], 451: [69, 88, 140], 465: [4, 35], 472: [69], 495: [64, 83, 88, 92], 499: [57], 521: [24, 28, 49, 103], 526: [41], 530: [10, 26], 536: [69], 537: [4, 16, 28, 43, 49, 66, 93, 106, 121, 156], 556: [9, 32, 46, 107, 114, 121], 562: [1, 27], 601: [59, 81, 100], 603: [58], 611: [4, 63, 79], 615: [5, 10, 21, 35, 42, 93], 630: [88], 633: [129], 642: [54], 645: [64, 72, 83], 649: [100], 657: [148], 659: [25, 58, 63], 663: [82, 107], 684: [53, 92, 109, 117, 142, 153], 702: [1, 14], 710: [133], 712: [50, 64, 74], 721: [80, 85, 113], 723: [95, 110, 129], 733: [59, 84], 745: [14], 754: [100, 150], 758: [46], 761: [92], 764: [5, 23, 100, 113], 767: [60]}
kge: {202: [6]}
conv: {202: [35, 73, 111]}

document_id: 294
similarity: 0.3166646502029884
document_vector_norm: 74.77361690518207
unique_word_number: 45

top5_word_weight: {'knowledg': 2.875705890422993, 'graph': 3.080064388929179, 'kg': 56.149310754120286, 'learn': 2.8079080002996553, 'compress': 20.388814268785765}

knowledg: {3: [4, 9], 8: [39, 54], 27: [83, 127], 29: [120], 36: [82], 37: [116], 46: [0, 18, 43, 52, 57, 62, 71, 74, 85, 88, 133], 59: [12, 43, 61, 78], 63: [48, 58, 107, 157], 69: [37], 80: [112, 187], 81: [46, 77], 89: [32, 51], 94: [0], 99: [0], 113: [25, 28, 41, 63, 80, 99, 112, 126, 143], 119: [37, 101], 120: [34, 134, 232], 127: [75], 130: [163], 131: [0], 133: [14], 136: [9], 143: [15, 105], 159: [73], 161: [87], 169: [81], 170: [27], 171: [47, 57], 183: [11], 184: [90], 186: [60], 190: [13, 40], 202: [3, 129], 205: [94, 132], 207: [51], 213: [9], 235: [70], 269: [79, 141, 159], 275: [3, 28, 39, 53, 119, 129], 288: [11], 294: [0], 296: [47, 120], 306: [23], 318: [53], 320: [2, 11, 57, 129], 333: [25], 335: [33], 342: [52, 82], 351: [43, 99, 158], 353: [61], 358: [0, 3, 18, 39, 66, 103, 133], 372: [32], 377: [120], 390: [2, 20, 56], 395: [120], 416: [108], 449: [29, 55], 451: [139], 454: [33, 61], 461: [42], 465: [3, 34], 472: [45, 63, 82], 478: [144], 485: [92], 511: [9, 144, 152], 513: [93, 105], 516: [104], 520: [70], 531: [164], 534: [13], 543: [18], 545: [104], 551: [110], 558: [48], 560: [82], 562: [0, 26, 49, 58, 66, 112], 565: [10], 594: [16, 52, 76, 85], 611: [3], 619: [67, 140], 626: [28], 634: [22], 642: [103], 645: [26, 35, 55], 650: [2], 655: [4, 57], 657: [138, 147, 154], 659: [24, 92], 660: [34, 53], 686: [99, 104], 693: [13], 702: [0, 13], 706: [5], 712: [7], 723: [62, 75, 85, 135, 162], 724: [96], 733: [47, 58], 738: [126], 743: [14, 89], 744: [130], 745: [13], 756: [79], 767: [49, 146], 768: [44], 772: [3, 86]}

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state of the art

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document_id: 750

similarity: 0.11263014348647667

document_vector_norm: 58.052933252877395

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aggress: {339: [40], 737: [18], 750: [52, 141]}

Natural Language Processing

similarity: 0.22074908840054522

document_vector_norm: 42.5887289290885

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Result of “knowledge graph”

"knowledge graph"

search

Orthogonal Relation Transforms with Graph Context Modeling for Knowledge Graph Embedding Yun Tang,Jing

Huang,Guangtao Wang,Xiaodong He,Bowen Zhou 2020

Distance-based knowledge graph embeddings have shown substantial improvement on the knowledge graph link prediction task, from TransE to the latest state-of-the-art RotatE. However, complex relations such as N-to-1, 1-to-N and N-to-N still remain challenging to predict. In this work, we propose a novel distance-based approach for knowledge graph link prediction. First, we extend the RotatE from 2D complex domain to high dimensional space with orthogonal transforms to model relations. The orthogonal transform embedding for relations keeps the capability for modeling symmetric/anti-symmetric, inverse and compositional relations while achieves better modeling capacity. Second, the graph context is integrated into distance scoring functions directly. Specifically, graph context is explicitly modeled via two directed context representations. Each node embedding in knowledge graph is augmented with two context representations, which are computed from the neighboring outgoing and incoming nodes/edges respectively. The proposed approach improves prediction accuracy on the difficult N-to-1, 1-to-N and N-to-N cases. Our experimental results show that it achieves state-of-the-art results on two common benchmarks FB15k-237 and WNRR-18, especially on FB15k-237 which has many high in-degree nodes.

Can We Predict New Facts with Open Knowledge Graph Embeddings? A Benchmark for Open Link Prediction Samuel

Broscheit,Kiril Gashteovski,Yanjie Wang,Rainer Gemulla 2020

Open Information Extraction systems extract (“subject text”, “relation text”, “object text”) triples from raw text. Some triples are textual versions of facts, i.e., non-canonicalized mentions of entities and relations. In this paper, we investigate whether it is possible to infer new facts directly from the open knowledge graph without any canonicalization or any supervision from curated knowledge. For this purpose, we propose the open link prediction task, i.e., predicting test facts by completing (“subject text”, “relation text”, ?) questions. An evaluation in such a setup raises the question if a correct prediction is actually a new fact that was induced by reasoning over the open knowledge graph or if it can be trivially explained. For example, facts can appear in different paraphrased textual variants, which can lead to test leakage. To this end, we propose an evaluation protocol and a methodology for creating the open link prediction benchmark OlpBench. We performed experiments with a prototypical knowledge graph embedding model for openlink prediction. While the task is very challenging, our results suggests that it is possible to predict genuinely new facts, which can not be trivially explained.

A Re-evaluation of Knowledge Graph Completion Methods Zhiqing Sun,Shikhar Vashishth,Soumya Sanyal,Partha Talukdar,Yiming

Yang 2020

Knowledge Graph Completion (KGC) aims at automatically predicting missing links for large-scale knowledge graphs. A vast number of state-of-the-art KGC techniques have got published at top conferences in several research fields, including data mining, machine learning, and natural language processing. However, we notice that several recent papers report very high performance, which largely outperforms previous state-of-the-art methods. In this paper, we find that this can be attributed to the inappropriate evaluation protocol used by them and propose a simple evaluation protocol to address this problem. The proposed protocol is robust to handle bias in the model, which can substantially affect the final results. We conduct extensive experiments and report performance of several existing methods using our protocol. The reproducible code has been made publicly available.

SEEK: Segmented Embedding of Knowledge Graphs Wentao Xu,Shun Zheng,Liang He,Bin Shao,Jian Yin,Tie-Yan Liu 2020

In recent years, knowledge graph embedding becomes a pretty hot research topic of artificial intelligence and plays increasingly vital roles in various downstream applications, such as recommendation and question answering. However, existing methods for knowledge graph embedding can not make a proper trade-off between the model complexity and the model expressiveness, which makes them still far from satisfactory. To mitigate this problem, we propose a lightweight modeling framework that can achieve highly competitive relational expressiveness without increasing the model