GoFast: Graph-based Optimization For Efficient and Scalable Query Evaluation

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1   Experimental queries

Watdiv queries

C1.

```
SELECT ?v0 ?v4 ?v6 ?v7 WHERE
{
    ?v0 <http://schema.org/caption> ?v1 .
    ?v0 <http://schema.org/text> ?v2 .
    ?v0 <http://schema.org/contentRating> ?v3 .
    ?v0 <http://purl.org/stuff/rev#hasReview> ?v4 .
    ?v4 <http://purl.org/stuff/rev#title> ?v5 .
    ?v4 <http://purl.org/stuff/rev#reviewer> ?v6 .
    ?v7 <http://schema.org/actor> ?v6 .
    ?v7 <http://schema.org/language> ?v8 .
}
```

C2.

```
SELECT ?v0 WHERE
{
    ?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/likes> ?v1 .
    ?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/friendOf> ?v2 .
    ?v0 <http://purl.org/dc/terms/Location> ?v3 .
    ?v0 <http://xmlns.com/foaf/age> ?v4 .
    ?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/gender> ?v5 .
    ?v0 <http://xmlns.com/foaf/givenName> ?v6 .
}
```

F1.

```
SELECT ?v0 ?v2 ?v3 ?v4 ?v5 WHERE
{
    ?v0 <http://ogp.me/ns#tag> <http://db.uwaterloo.ca/~galuc/wsdbm/Topic172> .
    ?v0 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?v2 .
    ?v3 <http://schema.org/trailer> ?v4 .
    ?v3 <http://schema.org/keywords> ?v5 .
    ?v3 <http://db.uwaterloo.ca/~galuc/wsdbm/hasGenre> ?v0 .
    ?v3 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://db.uwaterloo.ca/~galuc/wsdbm/ProductCategory2> .
}
```

F2.

```
SELECT ?v0 ?v1 ?v2 ?v4 ?v5 ?v6 ?v7 ?v8 WHERE
{
    ?v0 <http://xmlns.com/foaf/homepage> ?v1 .
    ?v2 <http://purl.org/goodrelations/includes> ?v0 .
    ?v0 <http://ogp.me/ns#tag> <http://db.uwaterloo.ca/~galuc/wsdbm/Topic71> .
    ?v0 <http://schema.org/description> ?v4 .
    ?v0 <http://schema.org/contentSize> ?v8 .
    ?v1 <http://schema.org/url> ?v5 .
    ?v1 <http://db.uwaterloo.ca/~galuc/wsdbm/hits> ?v6 .
    ?v1 <http://schema.org/language> <http://db.uwaterloo.ca/~galuc/wsdbm/Language0> .
    ?v7 <http://db.uwaterloo.ca/~galuc/wsdbm/likes> ?v0 .
}
```

L1.

```
SELECT ?v0 ?v2 ?v3 WHERE
{
    ?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/subscribes> <http://db.uwaterloo.ca/~galuc/wsdbm/Website18627> .
    ?v2 <http://schema.org/caption> ?v3 .
    ?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/likes> ?v2 .
}
```

L2.

```
SELECT ?v1 ?v2 WHERE
{
    <http://db.uwaterloo.ca/~galuc/wsdbm/City107> <http://www.geonames.org/ontology#parentCountry> ?v1 .
    ?v2 <http://db.uwaterloo.ca/~galuc/wsdbm/likes> <http://db.uwaterloo.ca/~galuc/wsdbm/Product0> .
    ?v2 <http://schema.org/nationality> ?v1 .
}
```

L3.

```
SELECT ?v0 ?v2 WHERE
{
    ?v0 <http://ogp.me/ns#tag> <http://db.uwaterloo.ca/~galuc/wsdbm/Topic132> .
    ?v0 <http://schema.org/caption> ?v2 .
}
```

L4.

```
SELECT ?v0 ?v1 ?v3 WHERE
{
    ?v0 <http://schema.org/jobTitle> ?v1 .
    <http://db.uwaterloo.ca/~galuc/wsdbm/City24> <http://www.geonames.org/ontology#parentCountry> ?v3 .
    ?v0 <http://schema.org/nationality> ?v3 .
}
```

S1.

```
SELECT ?v0 ?v1 ?v3 ?v4 ?v5 ?v6 ?v7 ?v8 ?v9 WHERE
{
    ?v0 <http://purl.org/goodrelations/includes> ?v1 .
    ?V2 <http://purl.org/goodrelations/offers> ?v0 .
    ?v0 <http://purl.org/goodrelations/price> ?v3 .
    ?v0 <http://purl.org/goodrelations/serialNumber> ?v4 .
    ?v0 <http://purl.org/goodrelations/validFrom> ?v5 .
    ?v0 <http://purl.org/goodrelations/validThrough> ?v6 .
    ?v0 <http://schema.org/eligibleQuantity> ?v7 .
    ?v0 <http://schema.org/eligibleRegion> ?v8 .
    ?v0 <http://schema.org/priceValidUntil> ?v9 .
}
```

S2.

```
SELECT ?v0 ?v2 ?v3 WHERE
{
    ?v0 <http://xmlns.com/foaf/age> <http://db.uwaterloo.ca/~galuc/wsdbm/AgeGroup1> .
    ?v0 <http://xmlns.com/foaf/familyName> ?v2 .
    ?v3 <http://purl.org/ontology/mo/artist> ?v0 .
    ?v0 <http://schema.org/nationality> <http://db.uwaterloo.ca/~galuc/wsdbm/Country1> .
}
```

S3.

```
SELECT ?v0 ?v1 ?v2 WHERE
{
    ?v0 <http://purl.org/ontology/mo/conductor> ?v1 .
    ?v0 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?v2 .
    ?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/hasGenre> <http://db.uwaterloo.ca/~galuc/wsdbm/SubGenre83> .
}
```

S4.

```
SELECT ?v0 ?v1 ?v2 WHERE
{
    ?v0 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?v1 .
    ?v0 <http://schema.org/text> ?v2 .
    <http://db.uwaterloo.ca/~galuc/wsdbm/User145869> <http://db.uwaterloo.ca/~galuc/wsdbm/likes> ?v0 .
}
```

LUBM queries

1.

```
SELECT ?x WHERE
{
    ?x <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#GraduateStudent> .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#takesCourse> <http://www.Department0.University0.edu/GraduateCourse0> .
}
```

2.

```
SELECT ?x WHERE
{
    ?x <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#Publication> .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#publicationAuthor> <http://www.Department0.University0.edu/AssistantProfes
}
```

3.

```
SELECT ?x ?y1 ?y3 WHERE
{
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#worksFor> <http://www.Department0.University0.edu> .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#name> ?y1 .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#emailAddress> ?y2 .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#telephone> ?y3 .
}
```

4.

```
SELECT ?x WHERE
{
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#memberOf> <http://www.Department0.University0.edu> .
}
```

5.

```
SELECT ?x ?y WHERE
{
    ?x <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#UndergraduateStudent> .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#takesCourse> ?y .
    ?y <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#Course> .
    <http://www.Department0.University0.edu/AssociateProfessor0> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#teacherOf> ?y .
}
```

6.

```
SELECT ?x ?y WHERE
{
    ?x <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#UndergraduateStudent> .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#memberOf> ?y .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#emailAddress> ?z .
    ?y <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#Department> .
    ?y <http://swat.cse.lehigh.edu/onto/univ-bench.owl#subOrganizationOf> <http://www.University0.edu> .
}
```

7.

```
SELECT ?x WHERE
{
    ?x <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#GraduateStudent> .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#takesCourse> <http://www.Department0.University0.edu/GraduateCourse0> .
}
```

8.

```
SELECT ?x ?y WHERE
{
    ?x <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#ResearchGroup> .
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#subOrganizationOf> ?y .
    ?y <http://swat.cse.lehigh.edu/onto/univ-bench.owl#subOrganizationOf> <http://www.University0.edu> .
}
```

9.

```
SELECT ?x ?y WHERE
{
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#headOf> ?y .
    ?y <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://swat.cse.lehigh.edu/onto/univ-bench.owl#Department> .
    ?y <http://swat.cse.lehigh.edu/onto/univ-bench.owl#subOrganizationOf> <http://www.University0.edu> .
}
```

10.

```
SELECT ?x WHERE
{
    ?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#undergraduateDegreeFrom> <http://www.University0.edu> .
}
```

Yago queries

1.

```
SELECT ?GivenName ?FamilyName WHERE
{
    ?p <http://yago-knowledge.org/resource/hasGivenName> ?GivenName .
    ?p <http://yago-knowledge.org/resource/hasFamilyName> ?FamilyName .
    ?p <http://yago-knowledge.org/resource/wasBornIn> ?city .
    ?p <http://yago-knowledge.org/resource/hasAcademicAdvisor> ?a .
    ?a <http://yago-knowledge.org/resource/wasBornIn> ?city .
}
```

2.

```
SELECT ?GivenName ?FamilyName WHERE
{
    ?p <http://yago-knowledge.org/resource/hasGivenName> ?GivenName .
    ?p <http://yago-knowledge.org/resource/hasFamilyName> ?FamilyName .
    ?p <http://yago-knowledge.org/resource/wasBornIn> ?city .
    ?p <http://yago-knowledge.org/resource/hasAcademicAdvisor> ?a .
    ?a <http://yago-knowledge.org/resource/wasBornIn> ?city .
    ?p <http://yago-knowledge.org/resource/isMarriedTo> ?p2 .
    ?p2 <http://yago-knowledge.org/resource/wasBornIn> ?city .
}
```

3.

```
SELECT ?name1 ?movie WHERE
{
    ?a1 <http://yago-knowledge.org/resource/hasPreferredName> ?name1 .
    ?a1 <http://yago-knowledge.org/resource/actedIn> ?movie .
}
```

4.

```
SELECT ?name1 ?name2 WHERE
{
    ?p1 <http://yago-knowledge.org/resource/hasPreferredName> ?name1 .
    ?p2 <http://yago-knowledge.org/resource/hasPreferredName> ?name2 .
    ?p1 <http://yago-knowledge.org/resource/isMarriedTo> ?p2 .
    ?p1 <http://yago-knowledge.org/resource/wasBornIn> ?city .
    ?p2 <http://yago-knowledge.org/resource/wasBornIn> ?city .
}
```

5.

```
SELECT ?p WHERE {
    ?p <http://yago-knowledge.org/resource/hasGivenName> ?gn.
    ?p <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?h.
    ?p <http://yago-knowledge.org/resource/wasBornIn> ?city.
    ?city <http://yago-knowledge.org/resource/isLocatedIn> ?i.
    ?p <http://yago-knowledge.org/resource/livesIn> ?a.
    ?a <http://yago-knowledge.org/resource/wasBornIn> ?city2.
    ?city2 <http://yago-knowledge.org/resource/isLocatedIn> ?j.
}
```

6.

```
SELECT ?GivenName ?FamilyName ?city WHERE
{
    ?p <http://yago-knowledge.org/resource/hasGivenName> ?GivenName .
    ?p <http://yago-knowledge.org/resource/hasFamilyName> ?FamilyName .
    ?p <http://yago-knowledge.org/resource/wasBornIn> ?city .
    ?p <http://yago-knowledge.org/resource/hasAcademicAdvisor> ?a .
    ?a <http://yago-knowledge.org/resource/wasBornIn> <http://yago-knowledge.org/resource/Baltimore> .
}
```

7.

```
SELECT ?GivenName ?FamilyName WHERE
{
    ?p <http://yago-knowledge.org/resource/hasGivenName> ?GivenName .
    ?p <http://yago-knowledge.org/resource/hasFamilyName> ?FamilyName .
    ?p <http://yago-knowledge.org/resource/wasBornIn> ?city .
    ?p <http://yago-knowledge.org/resource/hasAcademicAdvisor> ?a .
    ?a <http://yago-knowledge.org/resource/wasBornIn> ?city .
    ?p <http://yago-knowledge.org/resource/isMarriedTo> ?p2 .
    ?p2 <http://yago-knowledge.org/resource/wasBornIn> ?city .
}
```

8.

```
SELECT ?name1 ?name2 WHERE
{
    ?p1 <http://yago-knowledge.org/resource/hasPreferredName> ?name1 .
    ?p2 <http://yago-knowledge.org/resource/hasPreferredName> ?name2 .
    ?p1 <http://yago-knowledge.org/resource/isMarriedTo> ?p2 .
    ?p1 <http://yago-knowledge.org/resource/wasBornIn> ?city .
    ?p2 <http://yago-knowledge.org/resource/wasBornIn> <http://yago-knowledge.org/resource/Baltimore> .
}
```

DBLP queries

1.

```
SELECT ?v0 ?v1 ?v2 WHERE
{
    ?v0 <http://purl.org/dc/elements/1.1/title> ?v1 .
    ?v0 <http://www.w3.org/2002/07/owl#sameAs> ?v3 .
    ?v0 <http://purl.org/dc/terms/bibliographicCitation> ?v2 .
}
```

2.

```
SELECT ?v0 ?v1 ?v2 ?v3 WHERE
{
    ?v0 <http://purl.org/dc/elements/1.1/creator> ?v1 .
    ?v0 <http://xmlns.com/foaf/0.1/maker> ?v2 .
    ?v0 <http://xmlns.com/foaf/0.1/homepage> ?v3 .
}
```

3.

```
SELECT ?v0 ?v1 WHERE
{
    ?v0 <http://purl.org/dc/terms/tableOfContent> ?v1 .
    ?v0 <http://purl.org/dc/terms/bibliographicCitation> <http://dblp.uni-trier.de/rec/bibtex/series/cogtech/Helbig2006> .
}
```

4.

```
SELECT ?v0 ?v1 ?v2 ?v3 WHERE
{
    ?v0 <http://swrc.ontoware.org/ontology#month> ?v1 .
    ?v0 <http://purl.org/dc/elements/1.1/subject> ?v2 .
    ?v0 <http://swrc.ontoware.org/ontology#isbn> ?v3 .
}
```

5.

```
SELECT ?v0 ?v1 WHERE
{
    ?v0 <http://www.w3.org/2000/01/rdf-schema#seeAlso> <http://dblp.l3s.de/d2r/resource/publications/books/ph/Shasha92> .
    ?v0 <http://purl.org/dc/terms/tableOfContent> ?v1 .
}
```

6.

```
SELECT ?v0 ?v1 ?v2 ?v5 WHERE
{
    ?v0 <http://purl.org/dc/elements/1.1/creator> ?v1 .
    ?v0 <http://xmlns.com/foaf/0.1/maker> ?v2 .
    ?v0 <http://swrc.ontoware.org/ontology#journal> ?v3 .
    ?v0 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?v4 .
    ?v0 <http://www.w3.org/2000/01/rdf-schema#label> ?v5 .
}
```

7.

```
SELECT ?v0 ?v4 ?v6 WHERE
{
    ?v0 <http://purl.org/dc/terms/tableOfContent> ?v1 .
    ?v0 <http://swrc.ontoware.org/ontology#editor> <http://dblp.l3s.de/d2r/resource/authors/Rodney_W._Topor> .
    ?v0 <http://swrc.ontoware.org/ontology#number> ?v3 .
    ?v0 <http://www.w3.org/2000/01/rdf-schema#label> ?v4 .
    ?v0 <http://purl.org/dc/terms/issued> ?v5 .
    ?v0 <http://purl.org/dc/terms/bibliographicCitation> ?v6 .
}
```

8.

```
SELECT ?v0 ?v3 ?v1 WHERE
{
    ?v0 <http://www.w3.org/2000/01/rdf-schema#seeAlso> ?v1 .
    ?v3 <http://xmlns.com/foaf/0.1/homepage> ?v1 .
}
```