

Combining Graph Exploration and Fragmentation for ScalableRDF Query Processing

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1 Experimental queries

1.1 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 ?v3 ?v4 ?v8 WHERE
{
?v0 <http://schema.org/legalName> ?v1 .
?v0 <http://purl.org/goodrelations/offers> ?v2 .
?v2<http://schema.org/eligibleRegion> <http://db.uwaterloo.ca/~galuc/wsdbm/Country5> .
?v2 <http://purl.org/goodrelations/includes> ?v3 .
?v4 <http://schema.org/jobTitle> ?v5 .
?v4 <http://xmlns.com/foaf/homepage> ?v6 .
?v4 <http://db.uwaterloo.ca/~galuc/wsdbm/makesPurchase> ?v7 .
?v7 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseFor> ?v3 .
?v3 <http://purl.org/stuff/rev#hasReview> ?v8 .
?v8 <http://purl.org/stuff/rev#totalVotes> ?v9 .
}
```

C3.

```

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 WHERE
{
?v0 <http://xmlns.com/foaf/homepage> ?v1 .
?v0 <http://ogp.me/ns#title> ?v2 .
?v0 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?v3 .
?v0 <http://schema.org/caption> ?v4 .
?v0 <http://schema.org/description> ?v5 .
?v1 <http://schema.org/url> ?v6 .
?v1 <http://db.uwaterloo.ca/~galuc/wsdbm/hits> ?v7 .
?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/hasGenre>
    <http://db.uwaterloo.ca/~galuc/wsdbm/SubGenre55> .}

```

F3.

```

SELECT ?v0 ?v1 ?v2 ?v4 ?v5 ?v6 WHERE
{
?v0 <http://schema.org/contentRating> ?v1 .
?v0 <http://schema.org/contentSize> ?v2 .
?v0<http://db.uwaterloo.ca/~galuc/wsdbm/hasGenre>
    <http://db.uwaterloo.ca/~galuc/wsdbm/SubGenre42> .
?v4 <http://db.uwaterloo.ca/~galuc/wsdbm/makesPurchase> ?v5 .
?v5 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseDate> ?v6 .
?v5 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseFor> ?v0 .
}

```

F4.

```

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 .
}

```

F5.

```

SELECT ?v0 ?v1 ?v3 ?v4 ?v5 ?v6 WHERE
{
?v0 <http://purl.org/goodrelations/includes> ?v1 .
<http://db.uwaterloo.ca/~galuc/wsdbm/Retailer28001>
  <http://purl.org/goodrelations/offers> ?v0 .
?v0 <http://purl.org/goodrelations/price> ?v3 .
?v0 <http://purl.org/goodrelations/validThrough> ?v4 .
?v1 <http://ogp.me/ns#title> ?v5 .
?v1 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?v6 .
}

```

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 ?v1 WHERE
{

```

4 Authors Suppressed Due to Excessive Length

```
?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/likes> ?v1 .
?v0<http://db.uwaterloo.ca/~galuc/wsdbm/subscribes>
      <http://db.uwaterloo.ca/~galuc/wsdbm/Website50122> .
}
```

L4.

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

L5.

```
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 .
<http://db.uwaterloo.ca/~galuc/wsdbm/Retailer52462>
      <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 ?v1 ?v3 WHERE
{
?v0 <http://purl.org/dc/terms/Location> ?v1 .
?v0 <http://schema.org/nationality>
      <http://db.uwaterloo.ca/~galuc/wsdbm/Country14> .
?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/gender> ?v3 .
?v0 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
      <http://db.uwaterloo.ca/~galuc/wsdbm/Role2> .
}
```

S3.

```

SELECT ?v0 ?v2 ?v3 ?v4 WHERE
{
?v0 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
      <http://db.uwaterloo.ca/~galuc/wsdbm/ProductCategory14> .
?v0 <http://schema.org/caption> ?v2 .
?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/hasGenre> ?v3 .
?v0 <http://schema.org/publisher> ?v4 .
}

```

S4.

```

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> .
}

```

S5.

```

SELECT ?v0 ?v2 ?v3 WHERE
{
?v0 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
      <http://db.uwaterloo.ca/~galuc/wsdbm/ProductCategory7> .
?v0 <http://schema.org/description> ?v2 .
?v0 <http://schema.org/keywords> ?v3 .
?v0 <http://schema.org/language> <http://db.uwaterloo.ca/~galuc/wsdbm/Language0> .
}

```

S6.

```

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> .
}

```

S7.

```

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 .
}

```

1.2 LUBM queries

LB1.

```
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>.
}
```

LB2.

```
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#GraduateStudent>.
?y <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
    <http://swat.cse.lehigh.edu/onto/univ-bench.owl#University>.
?z <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
    <http://swat.cse.lehigh.edu/onto/univ-bench.owl#Department>.
?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#memberOf> ?z.
?z <http://swat.cse.lehigh.edu/onto/univ-bench.owl#subOrganizationOf> ?y.
?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#undergraduateDegreeFrom> ?y
}
```

LB3.

```
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/AssistantProfessor0>.
}
```

LB4.

```
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.
}
```

LB5.

```

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

```

LB6.

```

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

```

LB7.

```

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.
}

```

LB8.

```

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>.
}

```

LB9.

```

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>.
?y <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
      <http://swat.cse.lehigh.edu/onto/univ-bench.owl#FullProfessor>.
}

```

```
?z <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
    <http://swat.cse.lehigh.edu/onto/univ-bench.owl#Course>.
?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#advisor> ?y.
?x <http://swat.cse.lehigh.edu/onto/univ-bench.owl#takesCourse> ?z.
?y <http://swat.cse.lehigh.edu/onto/univ-bench.owl#teacherOf> ?z.
}
```

LB10.

```
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>.
}
```

LB11.

```
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>.
}
```

LB12.

```
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>.
}
```

LB13.

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

LB14.

```

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

```

1.3 DBLP queries

DBL1.

```

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 .
}

```

DBL2.

```

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> .
}

```

DBL3.

```

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

```

DBL4.

```

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 .
}

```

DBS1.

```

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 .
}

```

DBS2.

```

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 .
}

```

DBS3.

```

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 .
}

```

DBS4.

```

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

```

DBS5.

```

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 .
}

```

1.4 Grouping and Sorting queries

G1.

```

SELECT ?v6 COUNT(?v0) 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 .
}

```

GROUP BY ?v6;

G2.

```

SELECT ?v0 AVG(?v8) WHERE
{
?v0 <http://schema.org/legalName> ?v1 .
?v0 <http://purl.org/goodrelations/offers> ?v2 .
?v2 <http://schema.org/eligibleRegion> <http://db.uwaterloo.ca/~galuc/wsdbm/Country5> .
?v2 <http://purl.org/goodrelations/includes> ?v3 .
?v4 <http://schema.org/jobTitle> ?v5 .
?v4 <http://xmlns.com/foaf/homepage> ?v6 .
?v4 <http://db.uwaterloo.ca/~galuc/wsdbm/makesPurchase> ?v7 .
?v7 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseFor> ?v3 .
?v3 <http://purl.org/stuff/rev#hasReview> ?v8 .
?v8 <http://purl.org/stuff/rev#totalVotes> ?v9 .
}
GROUP BY ?v0

```

G3.

```

SELECT ?v3 COUNT(?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 .
}
GROUP BY ?v3

```

G4.

```

SELECT ?v6 COUNT(?v5) WHERE
{
?v0 <http://schema.org/contentRating> ?v1 .
?v0 <http://schema.org/contentSize> ?v2 .
?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/hasGenre>
    <http://db.uwaterloo.ca/~galuc/wsdbm/SubGenre42> .
?v4 <http://db.uwaterloo.ca/~galuc/wsdbm/makesPurchase> ?v5 .
?v5 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseDate> ?v6 .
?v5 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseFor> ?v0 .
}
GROUP BY ?v6

```

O1.

```

SELECT ?v0 ?v4 ?v6 ?v7 ?v3 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 .
}
```

```
ORDER BY ?v3
```

O2.

```
SELECT ?v0 ?v3 ?v4 ?v8 ?v9 WHERE
{
?v0 <http://schema.org/legalName> ?v1 .
?v0 <http://purl.org/goodrelations/offers> ?v2 .
?v2 <http://schema.org/eligibleRegion> <http://db.uwaterloo.ca/~galuc/wsdbm/Country5> .
?v2 <http://purl.org/goodrelations/includes> ?v3 .
?v4 <http://schema.org/jobTitle> ?v5 .
?v4 <http://xmlns.com/foaf/homepage> ?v6 .
?v4 <http://db.uwaterloo.ca/~galuc/wsdbm/makesPurchase> ?v7 .
?v7 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseFor> ?v3 .
?v3 <http://purl.org/stuff/rev#hasReview> ?v8 .
?v8 <http://purl.org/stuff/rev#totalVotes> ?v9 .
}
ORDER BY ?v8 ?v9
```

O3.

```
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 .
}
ORDER BY ?v6
```

O4.

```
SELECT ?v0 ?v1 ?v2 ?v4 ?v5 ?v6 WHERE
{
?v0 <http://schema.org/contentRating> ?v1 .
?v0 <http://schema.org/contentSize> ?v2 .
?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/hasGenre>
    <http://db.uwaterloo.ca/~galuc/wsdbm/SubGenre42> .
?v4 <http://db.uwaterloo.ca/~galuc/wsdbm/makesPurchase> ?v5 .
?v5 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseDate> ?v6 .
?v5 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseFor> ?v0 .
}
ORDER BY ?v6
```

1.5 Yago queries

Q1.

```

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 .
}

Q2.
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 .
}

Q3.
SELECT ?name1 ?name2 WHERE
{
  ?a1 <http://yago-knowledge.org/resource/hasPreferredName> ?name1 .
  ?a2 <http://yago-knowledge.org/resource/hasPreferredName> ?name2 .
  ?a1 <http://yago-knowledge.org/resource/actedIn> ?movie .
  ?a2 <http://yago-knowledge.org/resource/actedIn> ?movie .
}

Q4.
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 .
}

Q5.
SELECT ?c1 WHERE
{
  ?c1 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?c3 .
  ?c1 <http://www.w3.org/2000/01/rdf-schema#label> ?label .
  ?c1 <http://yago-knowledge.org/resource/hasInternalWikipediaLinkTo> ?c2 .
  ?c2 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?c4 .
  ?c2 <http://www.w3.org/2000/01/rdf-schema#label> ?label .
}

```

1.6 Wildcard queries

WC1.

```
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> .
FILTER(regex(str(?v4),"Website"))
}
```

WC2.

```
SELECT ?v0 ?v1 ?v2 ?v4 ?v5 ?v6 ?v7 WHERE
{
?v0 <http://xmlns.com/foaf/homepage> ?v1 .
?v0 <http://ogp.me/ns#title> ?v2 .
?v0 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?v3 .
?v0 <http://schema.org/caption> ?v4 .
?v0 <http://schema.org/description> ?v5 .
?v1 <http://schema.org/url> ?v6 .
?v1 <http://db.uwaterloo.ca/~galuc/wsdbm/hits> ?v7 .
?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/hasGenre>
    <http://db.uwaterloo.ca/~galuc/wsdbm/SubGenre55> .
FILTER(regex(str(?v6),"elementary"))
}
```

WC3.

```
SELECT ?v0 ?v1 ?v2 ?v4 ?v5 ?v6 WHERE
{
?v0 <http://schema.org/contentRating> ?v1 .
?v0 <http://schema.org/contentSize> ?v2 .
?v0 <http://db.uwaterloo.ca/~galuc/wsdbm/hasGenre>
    <http://db.uwaterloo.ca/~galuc/wsdbm/SubGenre42> .
?v4 <http://db.uwaterloo.ca/~galuc/wsdbm/makesPurchase> ?v5 .
?v5 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseDate> ?v6 .
?v5 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseFor> ?v0 .
FILTER(regex(str(?v6),"2012-04"))
}
```

WC4.

```

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 .
FILTER(regex(str(?v5),"Product21"))
}

```

WC5.

```

SELECT ?v0 ?v1 ?v3 ?v4 ?v5 ?v6 WHERE
{
?v0 <http://purl.org/goodrelations/includes> ?v1 .
<http://db.uwaterloo.ca/~galuc/wsdbm/Retailer28001>
  <http://purl.org/goodrelations/offers> ?v0 .
?v0 <http://purl.org/goodrelations/price> ?v3 .
?v0 <http://purl.org/goodrelations/validThrough> ?v4 .
?v1 <http://ogp.me/ns#title> ?v5 .
?v1 <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> ?v6 .
FILTER(regex(str(?v4),"2013"))
}

```

WC6.

```

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 .
FILTER(regex(str(?v2),"Product6"))
}

```

WC7.

```

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 .
FILTER(regex(str(?v1),"Country2"))
}

```

WC8.

```

SELECT ?v0 ?v2 WHERE
{
?v0 <http://ogp.me/ns#tag> <http://db.uwaterloo.ca/~galuc/wsdbm/Topic132> .
?v0 <http://schema.org/caption> ?v2 .
FILTER(regex(str(?v2),"Profiles"))
}

```

WC9.

```

SELECT ?v0 ?v1 ?v3 ?v4 ?v5 ?v6 ?v7 ?v8 ?v9 WHERE
{
?v0 <http://purl.org/goodrelations/includes> ?v1 .
<http://db.uwaterloo.ca/~galuc/wsdbm/Retailer52462>
  <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 .
FILTER(regex(str(?v6),"2013-10"))
}

```

WC10.

```

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> .
FILTER(regex(str(?v1),"User4"))
}

```

WC11.

```

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 .
FILTER(regex(str(?v0),"Product5"))
}

```

WC12.

```

SELECT ?v6 WHERE
{
?v0 <http://purl.org/goodrelations/includes> ?v1 .
?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 .
FILTER(regex(str(?v6),"2013-10"))
}

```

WC13.

```

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 .
FILTER(regex(str(?v8),"Language2"))
}

```

WC14.

```

SELECT ?v0 ?v3 ?v4 ?v8 WHERE
{
?v0 <http://schema.org/legalName> ?v1 .
?v0 <http://purl.org/goodrelations/offers> ?v2 .
?v2 <http://schema.org/eligibleRegion> <http://db.uwaterloo.ca/~galuc/wsdbm/Country5> .
?v2 <http://purl.org/goodrelations/includes> ?v3 .
?v4 <http://schema.org/jobTitle> ?v5 .
?v4 <http://xmlns.com/foaf/homepage> ?v6 .
?v4 <http://db.uwaterloo.ca/~galuc/wsdbm/makesPurchase> ?v7 .
?v7 <http://db.uwaterloo.ca/~galuc/wsdbm/purchaseFor> ?v3 .
?v3 <http://purl.org/stuff/rev#hasReview> ?v8 .
?v8 <http://purl.org/stuff/rev#totalVotes> ?v9 .
FILTER(regex(str(?v6),"Website60"))
}

```