Scaling Wikidata Query Service

Unlimited access to all the world's knowledge for everyone is hard

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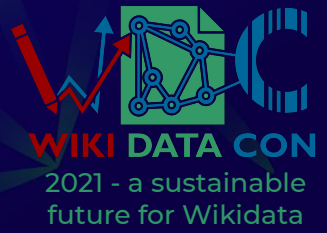


An introduction to:
WIkidata Query Service (WDQS)

The Wikidata Query Service

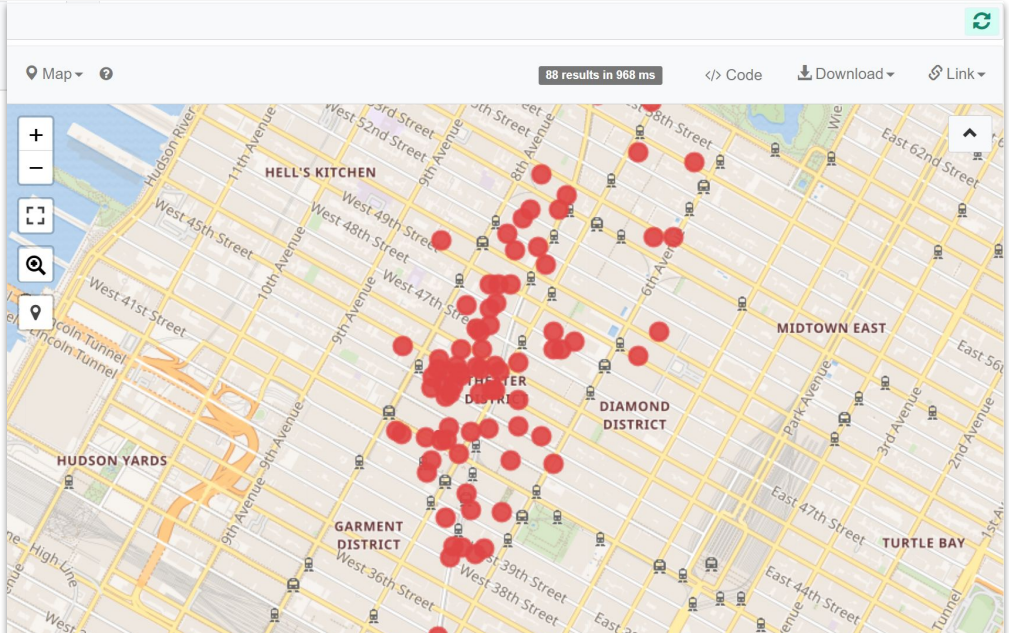
- Wikimedia SPARQL server deployed in 2015 (6 years)
- Enables users and scripts to access Wikidata data, and query entity graph connections, via a SPARQL API and User Interface

Wikidata Query Service | Examples | Query Builder

```
#Map of Broadway venues
#defaultView:Map
# Venues in Broadway
SELECT DISTINCT ?venue ?venueLabel ?coords {
    ?venue wdt:P1217 ?IDBDB .
    wd:Q235065 wdt:P625 ?broadWayLoc .

    SERVICE wikibase:around {
      ?venue wdt:P625 ?coords .
      bd:serviceParam wikibase:center ?broadWayLoc .
      bd:serviceParam wikibase:radius "1.5" .
    }

  SERVICE wikibase:label {
    bd:serviceParam wikibase:language "en" .
  }
```

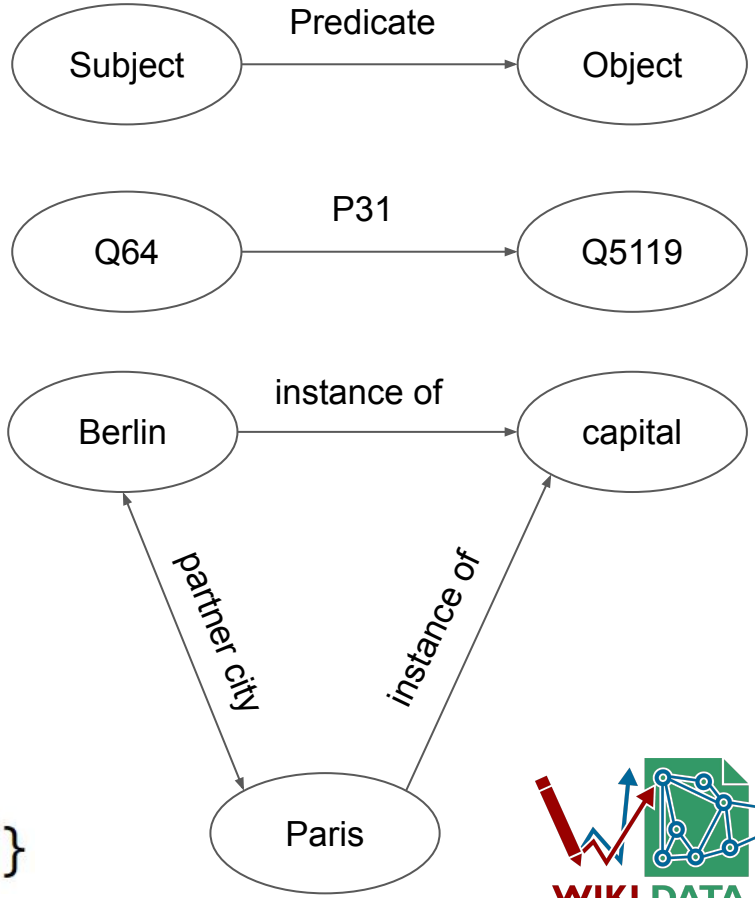


SPARQL, Graphs & Triples

SPARQL: A query language for graph content

Graph: Set of objects in which some object pairs are related

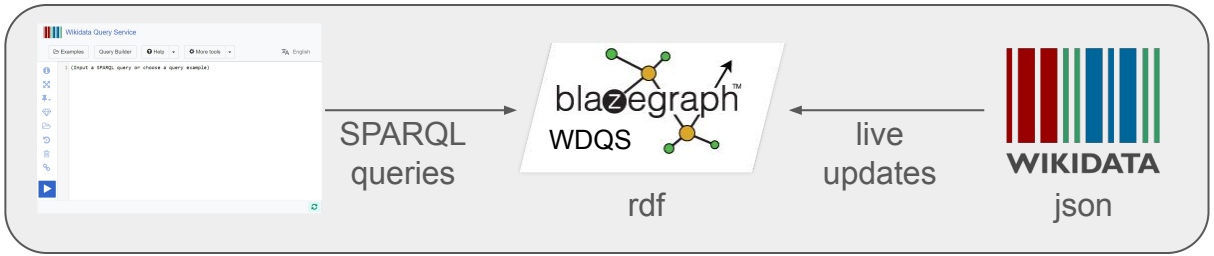
Triple: Set of 3 objects that codified a statement about semantic data




```
SELECT ?item
WHERE { ?item wdt:P31 wd:Q5119 }
```

Technology

- One of the largest public SPARQL endpoint on the internet
- Based on the Blazegraph engine



- 11 public servers (across 2 data centres), 6 internal servers [1]
- Specs similar to Dual Intel(R) Xeon(R) CPU E5-2620 v3, 1600GB raw raided space SSD, 128GB RAM

1 https://wikitech.wikimedia.org/wiki/Wikidata_Query_Service#Hardware

Scale

- 13.2 billion triples [1] from 95 million Wikidata entities [2]
  - (Averages 139 triples per entity, Large entities can have 10s of thousands of triples)
- Regular peaks of 700 Wikidata edits per minute
  - 700 per minute (12 per second) ≅ 20k triple updates per minute (330 per second) [1]
- 25.14 million peak requests per day (290 per second) [3]
  - 10-20% of these generally hit a cache

- So in a single second each backend server would generally peak handling ~58 SPARQL queries , ~12 Wikidata edits which makes up ~330 triple updates

1 https://grafana.wikimedia.org/d/000000489/wikidata-query-service
2 https://grafana.wikimedia.org/d/000000167/wikidata-datamodel
3 https://discovery.wmflabs.org/wdqs/#wdqs_usage

Scaling challenges

Current challenges of WDQS

- Keeping up with write load
  - WDQS lagging behind Wikidata
- Keeping up with data size
  - No sharding support => larger disks and memory size required over time
  - Internal Blazegraph limitations (see T213210)
- All those challenges are linked
- Keeping up with query load
  - System overloaded, leading to high response times and timeouts
- Keeping stable and secured
  - Servers crashing leading to limited capacity and overload
  - Blazegraph no longer actively developed / maintained

Short term: Disaster mitigations

Catastrophic failure scenarios

Two major modes of catastrophic failure:

- Maxing out on data size
  - Not able to ingest any new data
  - Only historical data stays available
  - Breaks most editing workflows

- Query load vs. update lag
  - Can’t keep up updates under load
  - To a point where we never catch up

Disaster mitigation goals

1. Prevent total collapse of WDQS
2. Preserve minimum level of functionality

Disaster mitigation != long term goals

- Disaster mitigation is not the same as ideal end state
- Playbook for how to keep WDQS alive in the event of an emergency
- Some of these actions may be applicable to long term scaling

Planning for catastrophic failure

Steps we identified:

1. Transparency with community about current state of WDQS
2. Blazegraph size: prioritize data to (temporarily) delete from Blazegraph
3. Determine acceptable compromise between query loads and update lag

Blazegraph size: Data prioritization

We may need to temporarily delete/split data from Blazegraph

- Data will still exist in Wikidata and dumps

Currently investigating shape of the Wikidata graph and queries:

- Remove descriptions/labels/etc (vertical slicing)
- Delete subgraphs (horizontal slicing)
  - E.g. ~50% of Wikidata triples (40% of entities) are scholarly articles; ~2% of queries[1]
  - Astronomical objects; Lexemes also appear to be distinct subgraphs
  - May lead to medium-long term graph splitting

1 https://wikitech.wikimedia.org/w/index.php?title=User:AKhatun/Wikidata_Scholarly_Articles_Subgraph_Analysis

Query Load vs. Update lag

In production:

- New Streaming Updater: ~10 edits/sec → ~88 edits/sec

Options:

- Determine compromise for WDQS lag vs. updates, max lag threshold, max rate limit tolerance
- More aggressively rate limit bots
  - we already do to some extent

Disaster Mitigation summary

Emergency playbook for catastrophic failure scenarios

We are working on:

- Prioritizing graph data deletion/splitting
- Balance query load and update lag

We look forward to hearing more from the community as more information about our options becomes clear

User survey:
Towards a long-term strategy

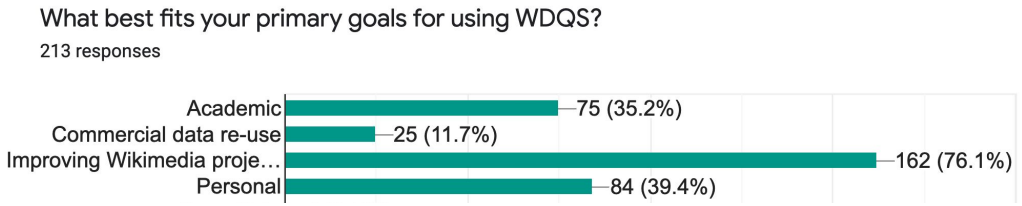
WDQS User Survey

- **Goal**: Learn more about WDQS user priorities, so we can optimize our scaling strategy with user needs in mind

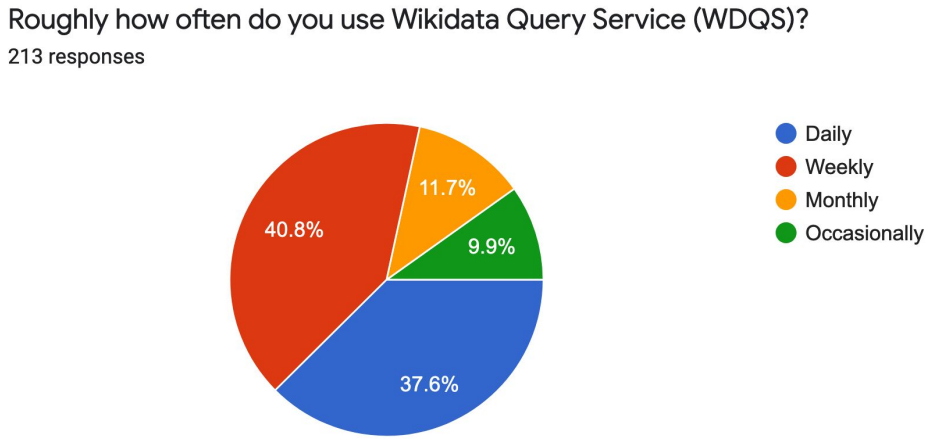
- Currently have 213 responses (12 Aug - 16 Sept)

WDQS User demographic

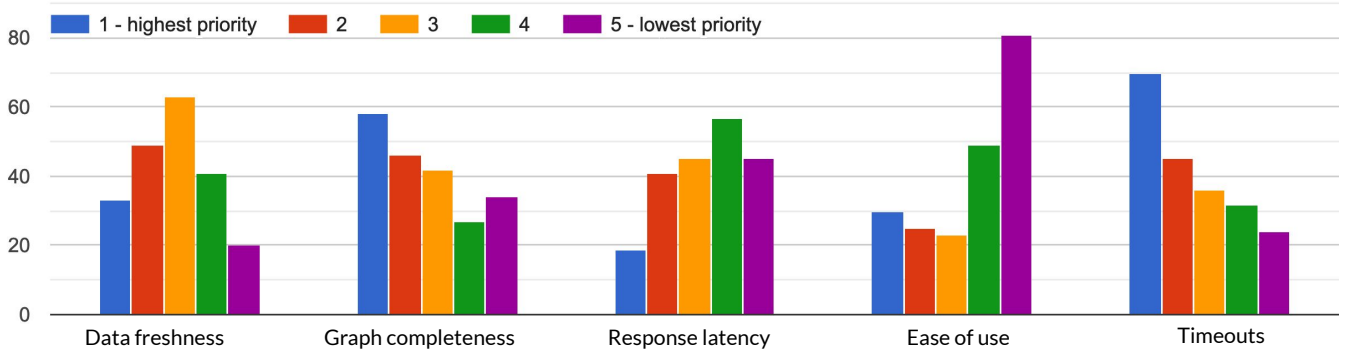
- Most users are interested in improving Wiki projects
  - Relatively low commercial use



- Most users use WDQS weekly or daily
  - Roughly equal number of weekly and daily users



WDQS User priorities



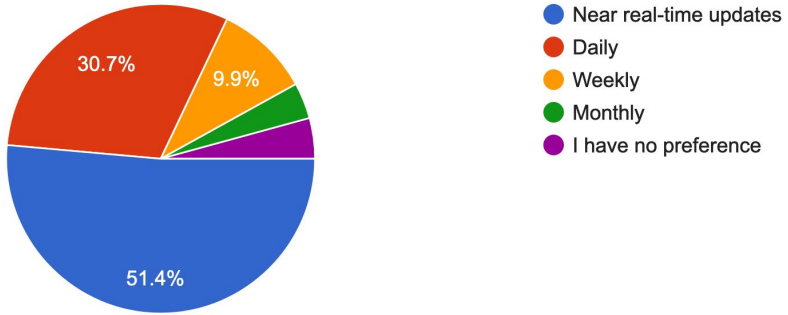
Eyeballing:

- Timeouts are top priority
- Graph completeness & data freshness next priorities
- Response latency relatively low priority
- Ease of use is lowest priority

WDQS User survey: data freshness

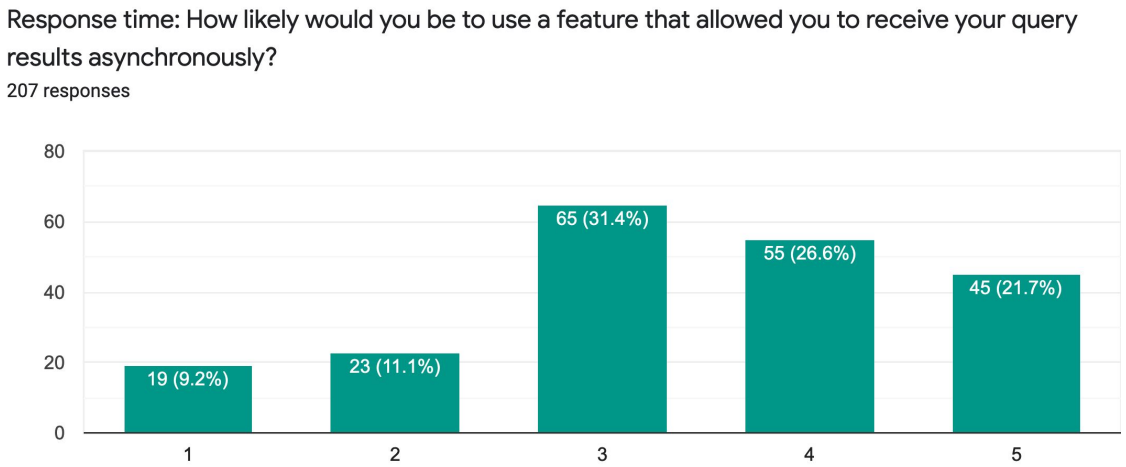
Data freshness: Generally speaking, how quickly do you need Wikidata edits be reflected in WDQS results?

212 responses



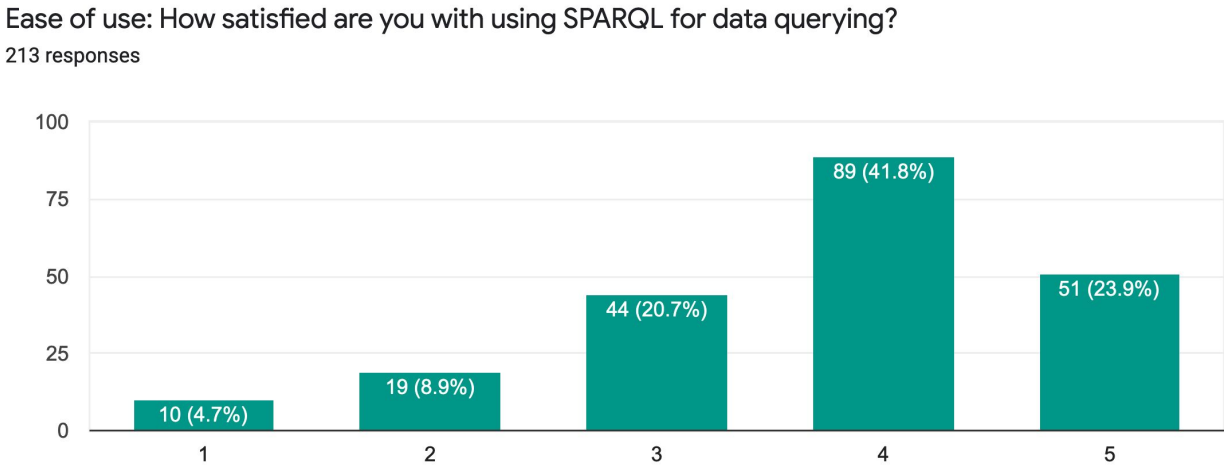
- ~50% want real-time data freshness
- May be skewed when considered independently
  - Who doesn't want freshest data all things being equal?

WDQS User survey: async results



- Most people would use a service with async results
- ...presumably that allowed for lenient timeout restrictions

WDQS User survey: SPARQL ease of use



- Most people are satisfied with using SPARQL
  - Caveat: most daily/weekly users are likely comfortable with SPARQL

WDQS survey summary

- Most users use WDQS at least once a week, and are interested in improving Wiki projects
- Timeouts are the biggest priority
- Half+ users want near real time data freshness
- Most would use an async querying service

Takeaway:

- Users are likely to use async results if they can fully run longer queries
- Optimizing for timeouts may require sacrificing data freshness and/or graph completeness

Long term: Where we go from here

Steps we are taking

- Identify and evaluate possible new backends
- Take pressure off the system
  - Create additional alternative services (e.g. REST API, search, ...)
  - Make it easier to run your own instance
  - Make Wikibase installation and maintenance easier so some content can find a better home

We need your help

How you can help

- Provide feedback on the plans we presented (-> unconference session, Wikidata:Query Service scaling update Aug 2021)
- Fill out our survey about your current use of WDQS (tinyurl.com/WDQSsurvey)
- Give input on selection criteria for new backend (-> T291207)
- Research and trial new backends (-> T206560)
- Contribute ideas for specialized additional services (-> T291340)

WIKI DATA CON
2021 - a sustainable future for Wikidata

Thanks for your attention!

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