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What is Elasticsearch? Why do we want it?

- Search and analytics engine built on Apache Lucene
  - Open-source
  - RESTful
  - Distributed

- Most popular search engine
  - Log analytics
  - Full-text search
What is Elasticsearch? Why do we want it?

- Accepts JSON documents using the API or ingestion tools such as Logstash.
- Automatically stores the original document
- Adds a searchable reference to the document in the cluster’s index.
- Permits you to search and retrieve the document using the Elasticsearch API
  - Can also use Kibana to visualize your data and build interactive dashboards.
What is Elasticsearch? Why do we want it?

- **High performance**
  - The distributed nature of Elasticsearch enables it to process large volumes of data in parallel, quickly finding the best matches for your queries.

- **Near real-time operations**
  - Elasticsearch operations such as reading or writing data usually take less than a second to complete. This lets you use Elasticsearch for near real-time use cases such as application monitoring and anomaly detection.
Differences between DB search and ES search

- **Main difference:** Allows for global blob (Code) and commit search
  - DB only allows project-level searches
- **Note:** Filtered search does not currently use Elasticsearch
Why isn’t it used on GitLab.com?

- Enabling it for all projects would result in a 66% storage increase
- Administration support is lacking
  - Work is ongoing: https://gitlab.com/groups/gitlab-org/-/epics/428
- No way to do zero-downtime deploys - requires a rails restart at a minimum (for now)
  - Problem is equivalent to DB migrations, but no good tooling around it
- Good news: an MVC is going live very soon as we’ve completed enough work (https://gitlab.com/groups/gitlab-org/-/epics/853) to allow us to enable it for a subset of groups/projects
Initial setup

- Installing Elasticsearch
  - Requirements available in our documentation

- Initial indexing of content
  - Done via rake tasks
    - Soon to be added to the admin console
  - `gitlab:elastic:index`
    - Runs all indexing operations in the foreground, except repo indexing
    - Suitable for all but extremely large instances, which must run each indexing operation separately in order to avoid overloading sidekiq

- Enabling indexing and search via Elasticsearch
Initial setup

Elasticsearch

Elasticsearch integration. Elasticsearch AWS IAM.

- Elasticsearch Indexing
- Use the new repository indexer (beta)
- Search with Elasticsearch enabled

URL

http://localhost:9200


Number of Elasticsearch shards

5

How many shards to split the Elasticsearch index over. Changes won’t take place until the index is recreated.

Number of Elasticsearch replicas

1

How many replicas each Elasticsearch shard has. Changes won’t take place until the index is recreated.
Initial setup

Elasticsearch indexing restrictions

- Limit namespaces and projects that can be indexed

Namespaces to index

- Jlevy
- Gitlab Org

Projects to index

- Gnuwget / elastic_test48
Schema and Analyzers

- All objects have the same document-type and live in the same index
  - Permits us to have parent-child relationships
  - We depend on these relationships for permission checks
  - Requires us to implement our own separate type checks
  - All types share all fields, which means we have lots of sparse fields
    - ES 6.0 has great storage improvements for sparse fields which means we don’t get a big storage penalty

- We should probably move to one index per type, but:
  - We lose the ability to filter by project attributes OR
  - We are forced to denormalize project data into every class type, ballooning storage usage
Schema and Analyzers

- Analyzers are where the search magic happens
  - Prepare the data for better searching
  - Each analyzer increases storage needs
  - They’re composed of tokenizers and filters

- For models by default we use the `standard tokenizer` with three filters
  - Standard: *doesn’t really do anything*
  - Lowercase: normalizes text to lowercase
  - My_stemmer: a custom stemmer filter that uses `light_english` stemmer

- Models also have a `my_ngram_analyzer` which creates 2- and 3-grams for Projects’ `name_with_namespace`
- Repositories and Commits have more interesting analyzers
- We do a lot of tokenizing with `asciifolding` and `lowercase` filters
- Code analyzer is special
  - `edgeNGram` filter that creates grams between 2 and 40 characters wide
  - Custom `code` filter with lots of regex patterns
    - Extracts digits, class names, terms inside quotes, separates terms on periods, and separates path terms
  - Custom `sha_analyzer` which tokenizes using ngrams between 5 and 40 characters
**Interaction with Rails models**

- We use a **customized** elasticsearch-rails gem to link up our models with ES
- **ApplicationSearch** module is the entry-point that defines callbacks and shared methods
  - Each class defines their own `*Search` module (for example, `ProjectsSearch`)
  - These classes define base elasticsearch query structure and special indexing concerns
- **ApplicationSearch** defines basic security concerns like filtering by projects the current user has access to
- **Elasticsearch::Git::Repository** defines Blob, WikiBlob, and Commit interactions
  - Need a separate module because repos are not in the database
  - We only index the default branch, otherwise costs would skyrocket
  - We have two indexers: a rails script (due to be removed!) and `gitlab-elasticsearch-indexer`
gitlab-elasticsearch-indexer

- Written in Go
- Replacement for bin/elastic_repo_indexer, slated for 12.1
- Greatly improved speed (3-10x!) and resource usage
  - Better memory handling, but still memory hungry
  - Much better I/O (our bottleneck when reading repository data) and encoding detection
  - Allows us to hide from the sidekiq OOM killer
- Used only for blobs (which includes wiki blobs) and commits
- Talks to Gitaly, gets a diff between last_commit as found in IndexStatus and the current SHA
  - Add new blobs, reindexes changed blobs, and deletes removed blobs to the ES index
  - Indexes commits as well!
    - Assumes that commits are only ever added (oops):
Interaction with Rails models

- **ApplicationSearch** defines callbacks for incremental indexing when models get updated
  - Insert, Update, and Destroy all trigger ES updates via **ElasticIndexerWorker**

- Repositories get updated via **GitPush** worker hooks
  - **ElasticCommitIndexerWorker** calls **Gitlab::Elastic::Indexer**
  - **Gitlab::Elastic::Indexer** decides whether to call rails script or **gitlab-elasticsearch-indexer**
    - Can trigger partial updates (FROM and TO SHAs)
  - The last commit that was indexed is kept in the DB in the **IndexStatus** model
How search works

- An Elasticsearch query is a JSON structure that can contain multiple filters
- We implement permissions as bool filters on the original Elasticsearch query
  - We can filter for projects a user has access
  - Filter for projects with features enabled (ex. public issue tracker)
- Highlighting is given to us by Elasticsearch
  - “Highlight” field in query with fields to highlight
  - Response contains a “highlight” element for each search hit with highlighted fragments
How search works

- We expose Elasticsearch’s `simple_query_string`
  - Allows users to use exclusion operators
  - Exact search matches
  - Complex, but powerful

- We also enhance it with our own `syntax search filters`
  - Defined using `Gitlab::Search::Query`
  - Relevant usages in `lib/gitlab/file_finder.rb` and `ee/lib/elasticsearch/git/repository.rb`
  - Allow users to filter by path, filename, or extension
Questions?

Check the Google Doc at
https://docs.google.com/document/d/1cwo5n3XYaTDAJ48sMZJ8bHQVJ0RD5dlsdf28L96OZQw/edit?pli=1#