Servo & SQLGitHub

A JOURNEY OF TRANSFORMING FAILURES INTO A GOOD IDEA

Servo

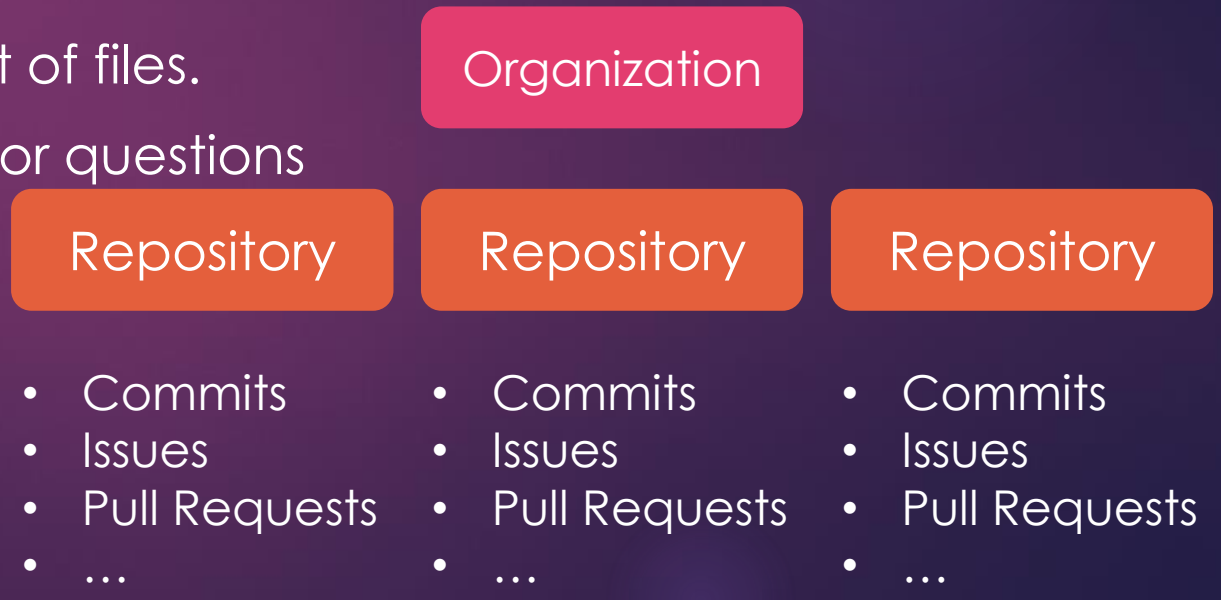
- A new browser engine written from scratch in Rust by Mozilla
- Original Project: Write an Android frontend for servo
- Issues, Issues and issues
  - Zero knowledge about mobile development and Rust
  - Incomplete, outdated documentation
  - Almost no support from Mozilla
  - Possible directions pitched by mentor all led to dead-end
- Tried approaching in various ways, but to no avail
- Made installation and packaging guide and reported issues

SQLGitHub – Motivation (I)

- **Who is stealing all my easy bugs/issues?**
- There are very limited tools for managing GitHub organizations
- Open-source organizations are usually understaffed
- The Servo project on GitHub for example,
  contains 129 repositories
  managed by practically **1 person**.

SQLGitHub – Background

- **Organization**: Organizations are shared accounts where businesses and open-source projects can collaborate across many projects at once.
- **Repository**: A repository contains all of the project files, and stores each file's revision history.
- **Commit**: An individual change to a set of files.
- **Issue**: Suggested improvements, tasks or questions
- **Pull Request**: Proposed change to a repository.



https://help.github.com/articles/github-glossary/

SQLGitHub – Motivation (II)

- Common questions/problems an organization admin include:
  - Obtain certain metrics of the organization in machine-friendly format for post-processing (eg. KPI report)
  - Get the current list of projects hosted on GitHub
  - List of the most popular repositories in the organization
  - Get the list of issues closed (resolved) for the past 7 days
  - What are the critical issues that are still left open?
  - Who are the top contributors of the past month?
  - … endless possible questions

Abstract

- SQLGitHub features a SQL-like syntax that allows you to: **Query information about an organization as a whole**.
- You may also think of it as a better, enhanced frontend layer built on top of GitHub's RESTful API

```
SQLGitHub> select updated_at, title from servo.issues.closed.3 order by updated_at desc
[u'updated_at', u'title']
[datetime.datetime(2017, 10, 15, 15, 25, 5), u'OSX Travis fix and Gecko update']
[datetime.datetime(2017, 10, 15, 12, 22, 12), u'Change AttrValue::Url to AttrValue::ResolvedUrl']
[datetime.datetime(2017, 10, 15, 12, 22, 11), u"Add a default 'unstable' feature to CEF"]
[datetime.datetime(2017, 10, 15, 12, 22, 9), u'Update stable Rust version to 1.20.0']
[datetime.datetime(2017, 10, 15, 11, 52, 13), u'Support Range<T>, RangeFrom<T>, RangeTo<T> and RangeFull']
[datetime.datetime(2017, 10, 15, 11, 19, 18), u'Update bindgen.']
[datetime.datetime(2017, 10, 15, 10, 57, 11), u'Upgrade to rustc 1.22.0-nightly (7778906be 2017-10-14)']
[datetime.datetime(2017, 10, 15, 9, 20, 51), u'style: Do not expose LocalMatchingContext.']
[datetime.datetime(2017, 10, 15, 8, 55, 24), u'Update domparsing spec links to not point at WHATWG']
[datetime.datetime(2017, 10, 14, 22, 15, 9), u'Introduce ClipChain']
[datetime.datetime(2017, 10, 14, 21, 34, 49), u'Update OSMesa.']
```

Introduction – Supported Schema

- **SELECT**
  select_expr [, select_expr ...]
  FROM {org_name | org_name.{repos | issues | pulls | commits}}
  [**WHERE** where_condition]
  [**GROUP BY** {col_name | expr}
  [ASC | DESC], ...]
  [**HAVING** where_condition]
  [**ORDER BY** {col_name | expr | position}
  [ASC | DESC], ...]
  [**LIMIT** row_count]

Introduction – Use Case (I)

- Get name and description from all the repos in apple.
  - select name, description from apple.repos

```
SQLGitHub> select name, description from apple.repos
[u'name', u'description']
[u'cups', u'Official CUPS Sources']
[u'swift-lldb', u'This is the version of LLDB that supports the Swift programming language & REPL.']
[u'swift', u'The Swift Programming Language']
[u'swift-llbuild', u'A low-level build system, used by Xcode 9 and the Swift Package Manager']
[u'swift-package-manager', u'The Package Manager for the Swift Programming Language']
[u'swift-llvm', None]
[u'swift-clang', None]
```

Introduction – Use Case (II)

- Get last-updated time and title of the issues closed in the past week (7 days) in servo listed in descending order of last-updated time.
  - select updated_at, title from servo.issues.closed.7 order by updated_at desc

```
SQLGitHub> select updated_at, title from servo.issues.closed.7 order by updated_at desc
[u'updated_at', u'title']
[datetime.datetime(2017, 10, 16, 17, 19, 58), u'Remove the use of unstable Rust features.']
[datetime.datetime(2017, 10, 16, 16, 21, 38), u'fix windows build issue #18055']
[datetime.datetime(2017, 10, 16, 16, 21, 36), u'Install/build on Windows 10 not working']
[datetime.datetime(2017, 10, 16, 15, 12, 56), u'Fix tests']
[datetime.datetime(2017, 10, 16, 14, 49, 43), u'Make every function unsafe for now']
[datetime.datetime(2017, 10, 16, 14, 44, 28), u'style: Remove the ElementExt trait.']
[datetime.datetime(2017, 10, 16, 14, 27, 14), u'Add cast function for transform2d/3d.']
[datetime.datetime(2017, 10, 16, 14, 5, 44), u'Release build fix']
[datetime.datetime(2017, 10, 16, 14, 4, 17), u'Add Rust API for startup, shutdown, and canPlayType']
[datetime.datetime(2017, 10, 16, 14, 1, 17), u'Run JetStream benchmark']
```

Introduction – Use Case (III)

- Get top 10 most-starred repositories in servo.
  - select concat(concat("(", stargazers_count, ") ", name), ": ", description) from servo.repos order by stargazers_count desc, name limit 10

```
SQLGitHub> select concat(concat("(", stargazers_count, ") ", name), ": ", description) from servo.repos order by
[u'concat(concat("(", stargazers_count, ") ", name), ": ", description)']
[u'(10246) servo: The Servo Browser Engine']
[u'(801) webrender: A GPU-based renderer for the web']
[u'(529) html5ever: High-performance browser-grade HTML5 parser']
[u'(267) rust-url: URL parser for Rust']
[u'(266) cocoa-rs: Cocoa/Objective-C bindings for the Rust programming language']
[u'(200) gaol: Cross-platform application sandboxing for Rust']
[u'(158) ipc-channel: A multiprocess drop-in replacement for Rust channels']
[u'(113) rust-cssparser: Rust implementation of CSS Syntax Level 3']
[u'(111) homu: A bot that integrates with GitHub and your favorite continuous integration service']
[u'(106) rust-mozjs: Rust bindings to SpiderMonkey']
-
Total rows: 10
Total execution time: 9.585s
```

Introduction – Use Case (IV)

- Get top 10 contributors in servo for the past month (30 days) based on number of commits.
  - select login, count(login) from servo.commits.30 group by login order by count(login) desc, login limit 10

```
SQLGitHub> select login, count(login) from servo.commits.30 group by login order by count(login) desc, login limit 10
[u'login', u'count(login)']
[u'bors-servo', 374]
[u'emilio', 131]
[u'nox', 123]
[u'glennw', 73]
[None, 68]
[u'SimonSapin', 61]
[u'philn', 33]
[u'cpearce', 31]
[u'jdm', 26]
[u'bholley', 24]
-
Total rows: 10
Total execution time: 186.437s
```

Introduction – Technology Stack

- **Python**
- **re** & **regex**, regular expression libraries
- **PyGithub** (patched), an unofficial client library for GitHub API
- prompt_toolkit, a library for building prompts
- pygments, a library for syntax highlighting

Introduction – (Simplified) Flow

Fetch data with required fields from GitHub API

Evaluate where conditions and filter fetched data

Evaluate group exprs and other "field" exprs

Generate table groups by values of group exprs

Evaluate having conditions and filter tables

Sort within and between tables

Evaluate select exprs

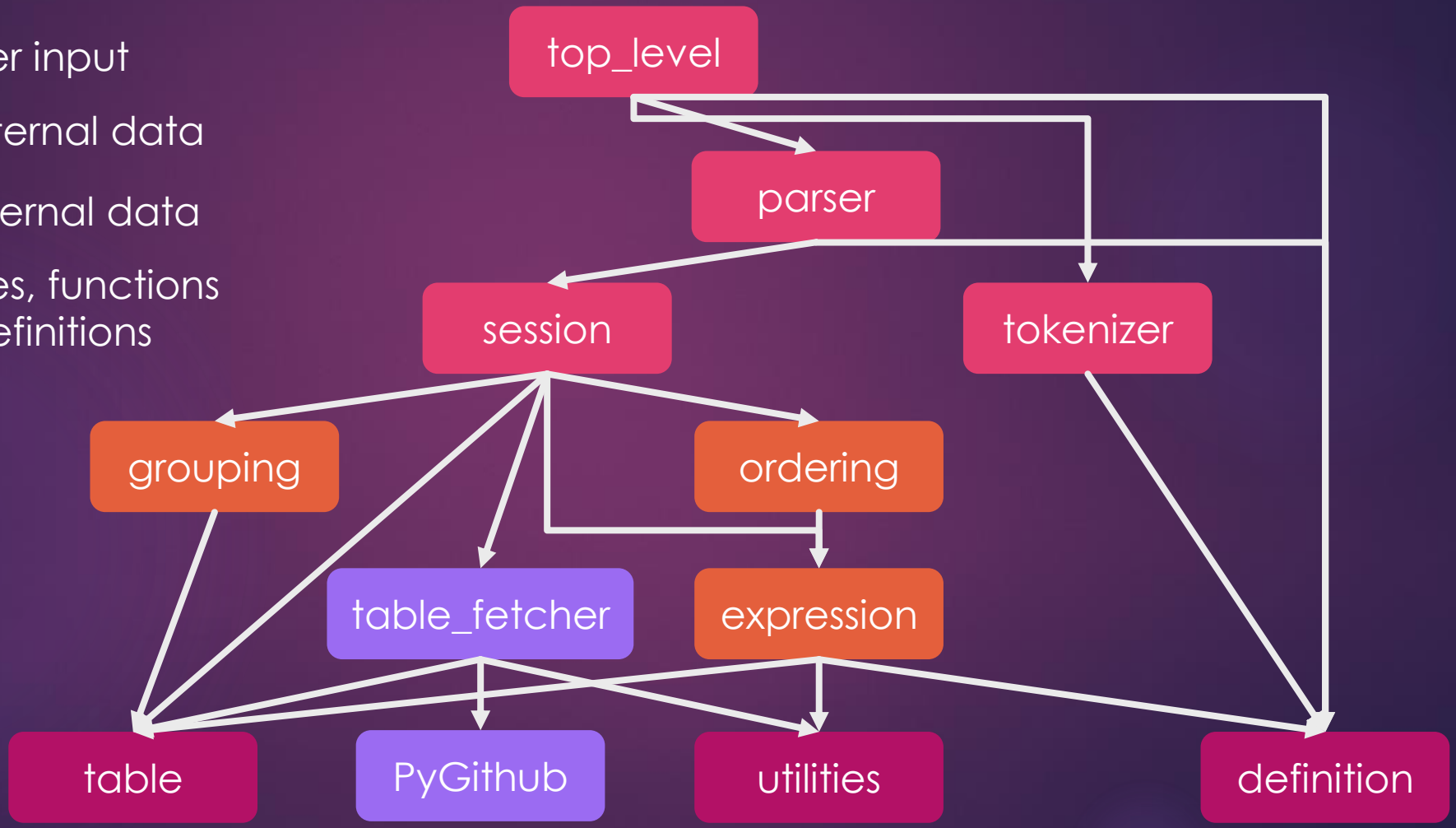
Introduction – Architecture

process user input

process external data

fetches external data

base classes, functions and SQL definitions



Introduction – Challenges (I)

- Algorithm of parsing is almost identical to that of expression evaluation → waste of time
- **Lazy Parsing**: Only parse **clauses** (eg. select, from, where) and **comma-separated fields**
- Comma-separated fields, strings and escape characters
  Evaluate this: `concat("[)\"Stars\"(: ", stargazers_count)`
- concat("[)\"Stars\"(: ", stargazers_count)
  concat("[)\"Stars\"(: ", stargazers_count)
- concat("[)\"Stars\"(: ", stargazers_count)

Introduction – Challenges (II)

- Extracting relevant fields from expressions to fetch
- select concat("[)\"-> avg(stargazers_count)\"(: ", stargazers_count - avg(stargazers_count), "] ", name) from apple.repos where description like "%library%" order by id
- Algorithm: for each expression,
  - Remove all literal strings. Use r"\"(?:[^\\\"]|\\.)*\"“ to match.
  - Find all possible tokens with r"([a-zA-Z_]+)(?:[^\(a-zA-Z_] | $)“.
  - For each token, check if it’s a predefined token (ie. part of SQL).

Introduction – Challenges (III)

- Expression Evaluation is really complicated
  - Regular (eg. `concat`, `floor`) and Aggregate functions (eg. `max`, `min`)
    - Have to evaluate an entire table at once
  - Nested functions (eg. `sum(avg(field_a) + avg(field_b))`)
    - Use **recursive regex patterns** to extract tokens – r"**\((?:(?>[^\(\)]+|(?R))*)\)**"
    - Assign special precedence and insert extra logic in place
  - Operator Precedence
- **Modified 2-stack evaluation approach** +
- **Finite State Machine + One-token Lookahead**

Introduction – Challenges (IV)

- Python's built-in sort is not customizable:
  sorted(*iterable, *, key=None, reverse=False*)
- order by requires sorting with multiple keys each with potentially different reverse:
  ```
  order by field_a desc, field_b asc, field_c, desc
  ```
- Wrote **custom sort** that integrates better with the workflow

Future Directions

- Improve SQL, MySQL compatibility
- Extend to end users not just organizations
- Migrate to the new GraphQL backend (GitHub API v4)
- Integrate SQLGitHub directly on the server end (better efficiency and perhaps better security!)

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