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GraalVM MySQL

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Running JavaScript Stored Programs Inside MySQL Server

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Program Agenda

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1. Stored Programs in MySQL
2. MySQL MLE: Multilingual Environment in MySQL
3. MySQL MLE: Demo
4. Future Work

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Stored Programs in MySQL

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- SQL/PSM
  - Procedural language defined in part 4 of SQL standard
- Stored Functions
  - Called from inside a statement like any built-in function
  - Returns a scalar value
- Stored Procedures
  - Invoked by a CALL statement
  - May return values in output parameters

```
SELECT f1(c1)
FROM t1
WHERE f2(c2) = 1;
```

```
CALL myproc('myparam');
```

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Why Stored Programs?

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- Performance
  - Reduced data volume to client (server-side filtering)
  - Fewer round-trips client/server
- Security
  - Control access to data
- Maintainability
  - Isolation of business rules
  - Easier to understand effects of schema changes

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Stored Programs – Limitations

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- Productivity
  - Unfamiliar programming language
  - Few available 3rd party libraries
  - Poor development tools
- Portability
  - Different language dialects
- Performance
  - Interpreted code

```
Create procedure p(x int, out err int, out nulls int)
begin
  declare count int default 0;
  set nulls = 0;
  begin
    declare c cursor for select name from t1;
    declare exit handler for not found close c;
    open c;
    loop
      begin
        declare n varchar(20);
        declare continue handler for sqlexception set err=1;
        fetch c into n;
        if isnull(n) then
          set nulls = nulls + 1;
        else
          set count = count + 1;
          update t2 set idx = count where name=n;
        end if;
        ...
```

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User-Defined Functions (UDF)

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- Compiled as library files
- Added and removed dynamically
- Written in C/C++
- Supports user-defined aggregate functions

```
CREATE FUNCTION udf_func
RETURNS INTEGER
SONAME mylib.so;
```

- NB! ***Programming errors in function may take down your server!***
  - Memory leaks
  - Segmentation faults

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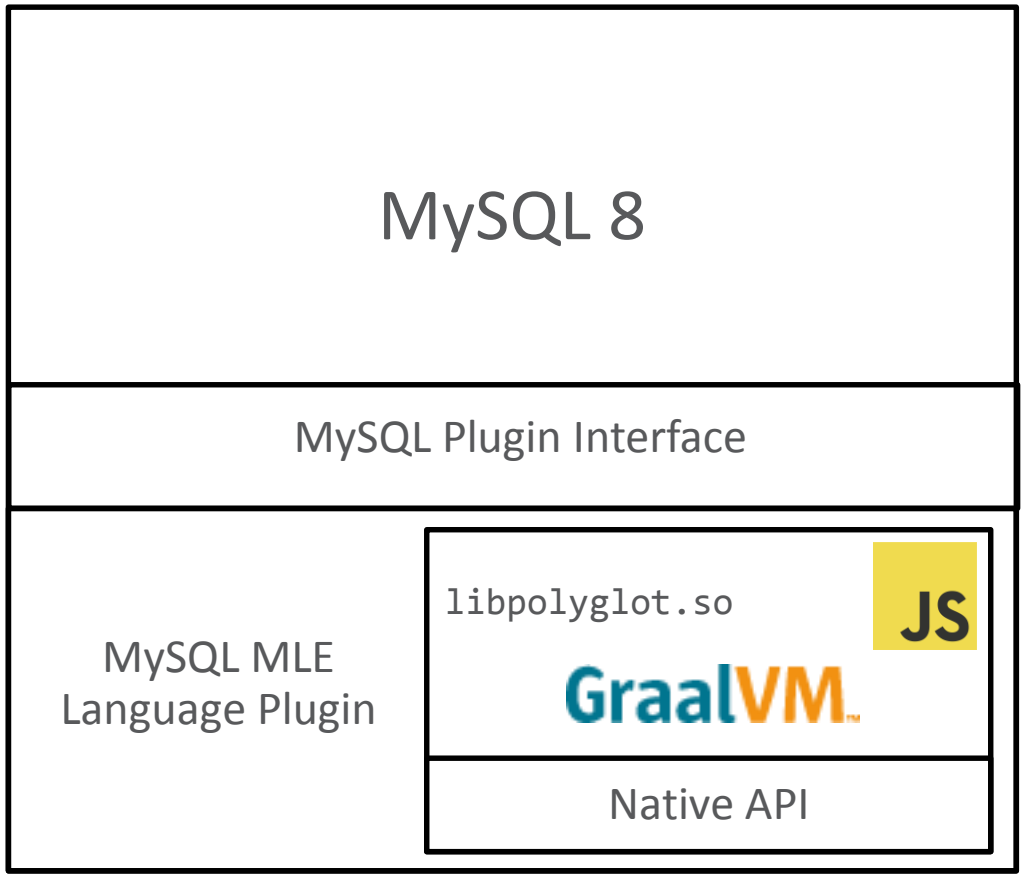
MySQL MLE: GraalVM in MySQL 8

- Developed as a language plugin
- Only JavaScript in the first release
- Functions and procedures defined in SQL



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GraalVM: Run Programs Faster Anywhere

GraalVM MySQL

More information at: http://www.graalvm.org/

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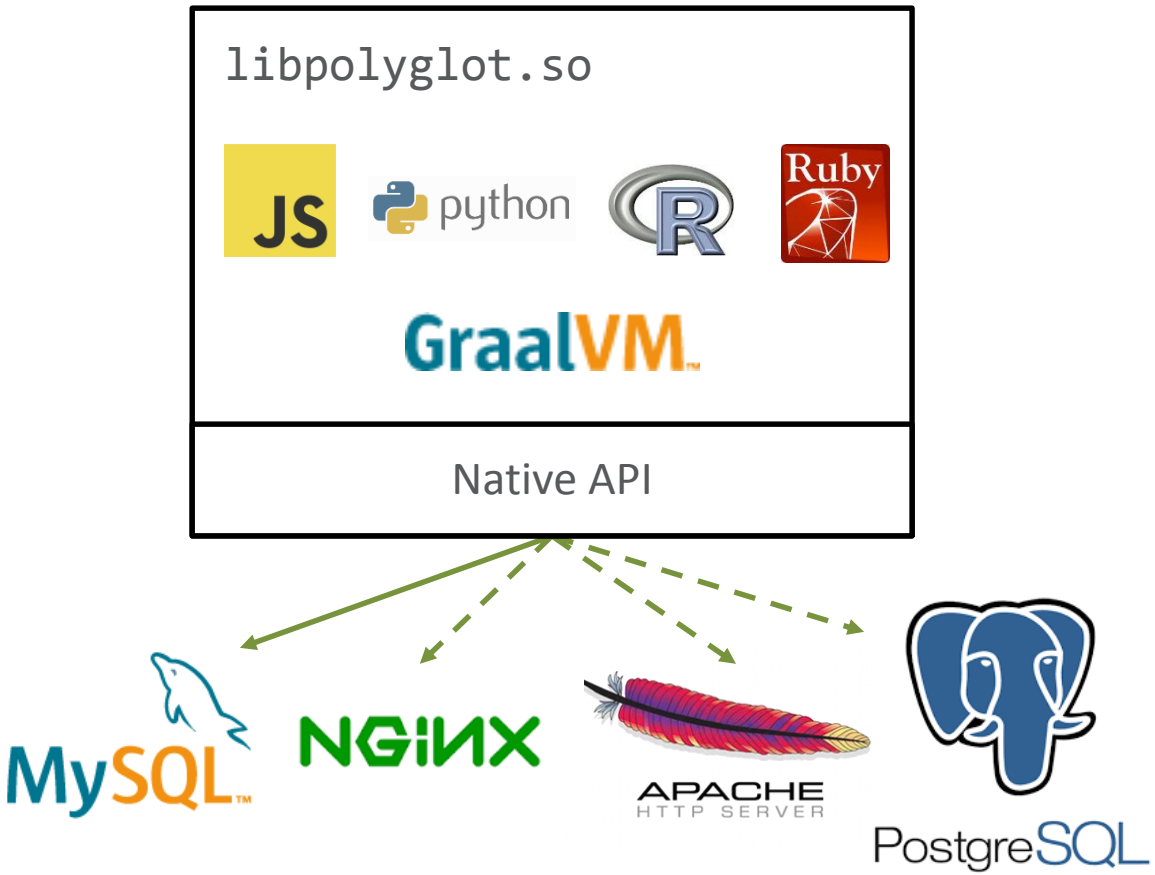
Embedding GraalVM: What Makes it Unique

- Quick Startup / low memory footprint
- Unified interface for all languages
- Debugging and profiling support
- High-performance implementation



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What's to come

- MySQL Labs Release!
- More Languages (Python)
- More MySQL data types
- Support for Windows
- Triggers and Events
- Support for Connectors (`mysql` and `mysql2`)

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Conclusions

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- Productivity:
  - Write stored programs in your preferred language
  - Leverage rich ecosystem of libraries / packages for each language
- Performance:
  - JIT compiled code
  - Application logic closer to your data

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Integrated Cloud

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GraalVM: Completeness and Performance

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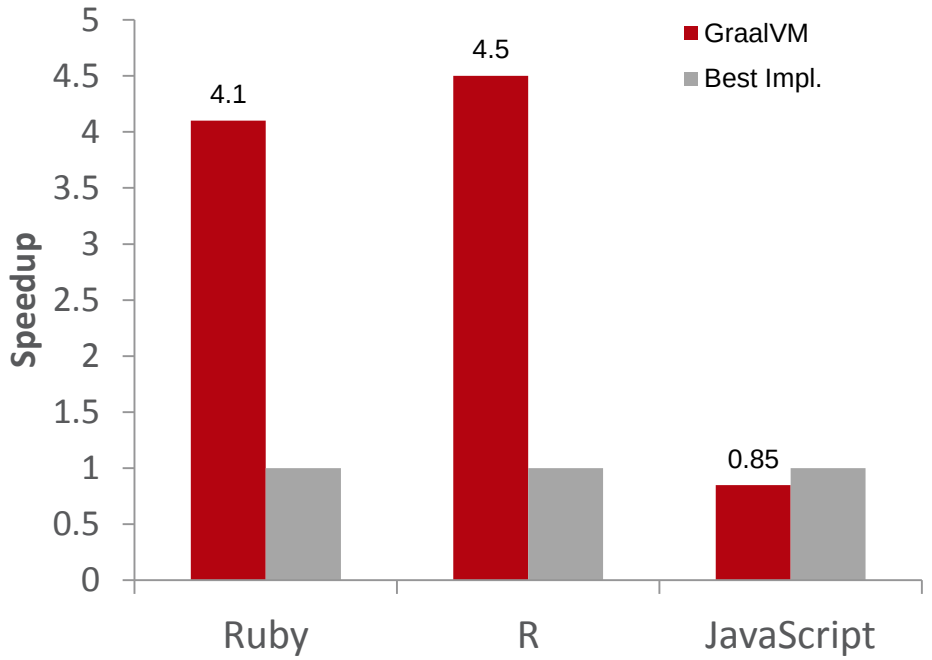
82.0% ECMA Script 2018

Node.js 8.9.3 LTS scores 81%

99.9% Ruby Language

Comparable to JRuby



Performance relative to: JRuby, GNU R, V8

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