POLYGLOT DEVELOPMENT USING GRAALVM - MEMEGEN

KONSTANTIN LOMOTIN
BORIS SPASOJEVIĆ
**WHAT IS GRAALVM?**

**GraalVM** is a modified Java HotSpot VM which uses the Graal JIT compiler and supports the Truffle based interpreters.

It provides an environment for running code written in different languages within one application.

**Advantages:**
- Performance
- Polyglot
- Interoperability
- Embeddability
- Tooling (debuggers, profilers etc.)

**Supported Languages:**
- Java
- JavaScript (Node.js)
- Ruby
- Python (partially)
- R (partially)
Truffle is a framework for implementing languages as simple interpreters. Together with the **Graal compiler**, Truffle interpreters are automatically just-in-time compiled and programs running on top of them can reach performance of normal Java.

- Common AST structure enables interoperability. The framework executes AST nodes regardless of which language they come from.
Purpose: create a MemeGen web-application:

- Using frameworks and libraries
- Applying different mechanisms (databases, image processing)
- Using Node.js platform
WHAT IS MEMEGEN?

“Wow, so ruby

Much js”

“Very polyglot”

MemeGen

Wow, so ruby

Much js

Very polyglot
APPLICATION STRUCTURE

Implemented:
• Simple front-end interface
• Node.js server
• Image processing in Ruby
FRAMEWORKS AND LIBRARIES

Server:
- Express
- Multer
- Body-parser

Image processing script:
- Mini-Magick (uses C-extensions!)

Java database manager:
- Java SQL Connector
ACCESSING RUBY CODE FROM JAVASCRIPT

Ruby code implementing meme generation and export:

```ruby
def generateMeme(filename, top_caption, bot_caption)
end
```

`Truffle::Interop.export_method(:generateMeme)`

JavaScript code implementing the import of Ruby function:

```javascript
fs.readFile('process_image.rb', 'utf8', function(err, contents) {
  var rubyMemeGen = contents;
  Interop.eval("application/x-ruby", rubyMemeGen);
  makeMeme = Interop.import("generateMeme");
  console.log("Ruby code is loaded!");
});
```

Further this function is available by the name “makeMeme”
REVEALED ERRORS

1. Multithreaded behavior of the Ruby script caused **PolyglotIllegalStateException**.

- Node.js application is running in one thread
- The application invokes a function written in Ruby
- Ruby implicitly spawns a pool of threads
- Node.js is unable to manage this
- **Exception!**
REVEALED ERRORS

How it was fixed:

The work was proceeded with a new version of the GraalVM compiler with deactivated thread protection. It was substituted with the warning:
2. **CoercionError** while invoking the Ruby function from JavaScript passing the string parameter.

- Node.js script passes JS string in the imported Ruby function
- Ruby makes an attempt to call `.to_str()` method of the foreign object
- For some reasons, Ruby fails
- **Exception!**
REVEALED ERRORS

How it was fixed:

TruffleRuby team ensured that foreign objects which are foreign strings can be converted to Ruby strings.
FUTURE WORK

- Java database manager
- Front-end revision
WHAT WAS CONSIDERED

- GraalVM allows developers to run their applications written in Java, JavaScript, Ruby, Python and R languages on JVM.
- GraalVM performs highly effective optimization and provides good performance for also for interpreted languages.
- MemeGen web-application is aimed to create use-cases for this technology.
- During development some bugs and errors were revealed.
- The application will be developed further (Java database connectors will be introduced).