INTEGRATE A LARGE LANGUAGE MODEL WITH THE XEUS-CPP JUPYTER KERNEL

Google Summer of Code 2024 – Midterm Progress

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Princeton University

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24/07/2024

PROGRESS SO FAR

- Test coverage.
- Testing framework to test notebooks.
- Basic pipeline with OpenAI and Gemini.

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ABOUT XEUS

- Xeus is a framework meant to facilitate the implementation of kernels for Project Jupyter. It takes the burden of implementing the Jupyter Kernel protocol so developers can focus on implementing the interpreter part of the kernel.

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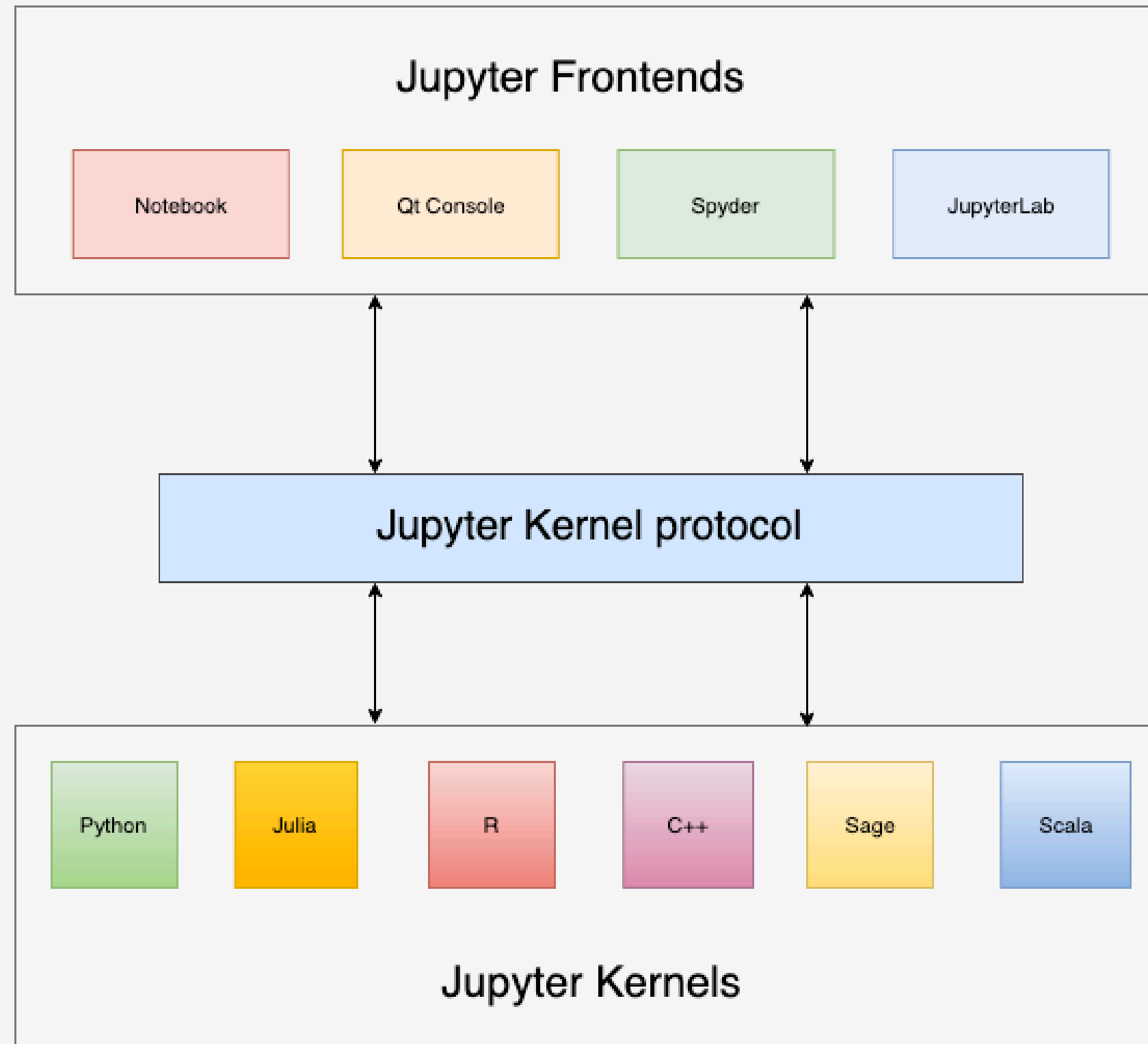
ABOUT XEUS

- **execute_request_impl** : This message type is used by frontends to ask the kernel to execute code on behalf of the user.
- **complete_request_impl** : This message type is used by frontends to complete the code present.
- **inspect_request_impl** : Code can be inspected to show useful information to the user.
- **is_complete_request_impl** : Called before code execution (terminal mode) in order to check if the code is complete and can be executed as it is.
- **kernel_info_request_impl** : Information request about the kernel: language name (for code highlighting), language version, terminal banner etc.
- **shutdown_request_impl** : Shutdown request from the client, this allows you to do some extra work before the kernel is shut down.

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TEST COVERAGE

- Understanding codebase.
- Updated tags definition in cmake.
- Explored xmagics.

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TESTING FRAMEWORK

- Papermill library to execute the notebook.
- Nbformat library to compare the notebooks.
- Debugging using tmate.
- Reruns causing an error.

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TESTING FRAMEWORK

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LLM IMPLEMENTATION

- OpenLLM research.
- Using cURL library in cpp.
- Saving API keys in text files.
- Customized JSON calls for each model.
- Error in windows and wasm builds.

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```
[1]: %%xassist gemini --save-key
```

API key saved for model gemini

```
[1]: %%xassist gemini
     write cpp20 code to get a square of a number
```

````cpp
#include <iostream>

int main() {
  int number;
  std::cout << "Enter a number: ";
  std::cin >> number;
  std::cout << "The square of " << number << " is " << number * number << std::endl;
  return 0;
}
````

Explanation:

1. **Include header:** `#include <iostream>` includes the input/output stream library for using `std::cin` and `std::cout`.
2. **Declare variable:** `int number;` declares an integer variable named `number` to store the input.
3. **Get input:**
   - `std::cout << "Enter a number: ";` prompts the user to enter a number.
   - `std::cin >> number;` reads the input number from the user and stores it in the `number` variable.
4. **Calculate and print square:**
   - `std::cout << "The square of " << number << " is " << number * number << std::endl;` does the following in one line:
     - Prints the string "The square of "
     - Prints the value of `number`
     - Prints the string " is "
     - Calculates the square by multiplying `number` by itself (`number * number`) and prints the result.
     - Prints a newline character (`std::endl`) to move the cursor to the next line.
5. **Return 0:** Indicates successful program execution.

This code is a concise way to calculate and print the square of a number in C++20. It directly calculates the square within the `std::cout` statement, making it shorter than the previous versions. However, it is less readable and might be less maintainable.

For larger projects, consider separating the calculation and output for better code clarity.

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WHAT'S LEFT?

- Debug WASM build.
- Add context to LLM calls.
- Give user more freedom on the model used.
- Support for open source models.
- Documentation.

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THANKS FOR LISTENING

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