Rust + WebAssembly: 构筑大模型生态的基础设施

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分享事项

- Python + Docker 组合存在的问题
- Rust + WebAssembly组合的优势
- 实践项目分享

现状： Python + Docker 组合 – 1

- Python
  - 易：易学、易用
  - 大：社区活跃、生态繁荣、资源丰富
  - 广：适用于各种类型的AI任务，深入每一个环节
- Docker Container
  - 可移植性：利于分发
  - 隔离性：保证了安全性和稳定性
  - 可扩展性：资源利用率高

现状： Python + Docker 组合 – 2

- 痛点1：Python 在性能、并行性、内存管理等处于劣势

Table 1. Speedups from performance engineering a program that multiplies two 4096-by-4096 matrices. Each version represents a successive refinement of the original Python code. "Running time" is the running time of the version. "GFLOPS" is the billions of 64-bit floating-point operations per second that the version executes. "Absolute speedup" is time relative to Python, and "relative speedup," which we show with an additional digit of precision, is time relative to the preceding line. "Fraction of peak" is GFLOPS relative to the computer's peak 835 GFLOPS. See Methods for more details.

Version	Implementation	Running time (s)	GFLOPS	Absolute speedup	Relative speedup	Fraction of peak (%)
1	Python	25,552.48	0.005	1	–	0.00
2	Java	2,372.68	0.058	11	10.8	0.01
3	C	542.67	0.253	47	4.4	0.03
4	Parallel loops	69.80	1.969	366	7.8	0.24
5	Parallel divide and conquer	3.80	36.180	6,727	18.4	4.33
6	plus vectorization	1.10	124.914	23,224	3.5	14.96
7	plus AVX intrinsics	0.41	337.812	62,806	2.7	40.45

COMPUTER SCIENCE

There's plenty of room at the Top: What will drive computer performance after Moore's law?

Charles E. Leiserson, Neil C. Thompson*, Joel S. Emer, Bradley C. Kuszmaul, Butler W. Lampson, Daniel Sanchez, Tao B. Schardl

现状： Python + Docker 组合 – 3

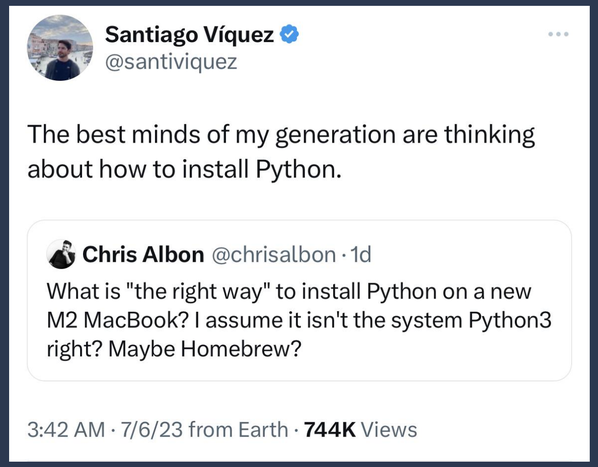
- 痛点2：Python + C/C++/Rust 混合编程维护成本高、移植能力差

```
466     py::class_<Graph>(m, "Graph")
467         .def(py::init<>(&Graph::create),
468              py::arg("name"))
469         .def_static("deserialize",
470                     &Graph::deserialize,
471                     py::arg("fname"),
472                     py::return_value_policy::move)
473         .def("get_name",
474              &Graph::get_name)
475         .def("create_op",
476              &helper::add_op,
477              py::arg("name"),
478              py::arg("kind"),
479              py::arg("attrs") = py::none(),
480              py::arg("input_ops") = py::none(),
481              py::arg("subgraph") = py::none(),
482              py::return_value_policy::reference_internal)
483         .def("create_const_op",
484              &helper::add_const_op,
485              py::return_value_policy::reference_internal)
486         .def("remove_op",
487              &Graph::remove_op,
488              py::arg("op"))
```

```
761     py::class_<Tensor, std::unique_ptr<Tensor, py::nodelete>>(m, "Tensor")
762         .def(py::init<>([](xir::Tensor* tensor) { return tensor; }))
763         .def_static("clone",
764                     py::overload_cast<const Tensor*>(&Tensor::clone))
765         .def_property("name",
766                       &Tensor::get_name,
767                       &Tensor::rename)
768         .def_property_readonly("ndim",
769                                &Tensor::get_dim_num)
770         .def_property_readonly("dims",
771                                &Tensor::get_shape)
772         .def_property_readonly(
773             "dtype",
774             [](const Tensor* tensor) {
775               return helper::to_lower(tensor->get_data_type().to_string());
776             })
777         .def_property_readonly("producer",
778                                py::overload_cast<>(&Tensor::get_producer),
779                                py::return_value_policy::reference_internal)
780         .def("get_element_num",
781              &Tensor::get_element_num)
782         .def("get_data_size",
783              &Tensor::get_data_size)
```

上述代码片段源自 https://github.com/Xilinx/Vitis-AI/blob/master/src/vai_runtime/xir/src/python/wrapper/wrapper.cpp

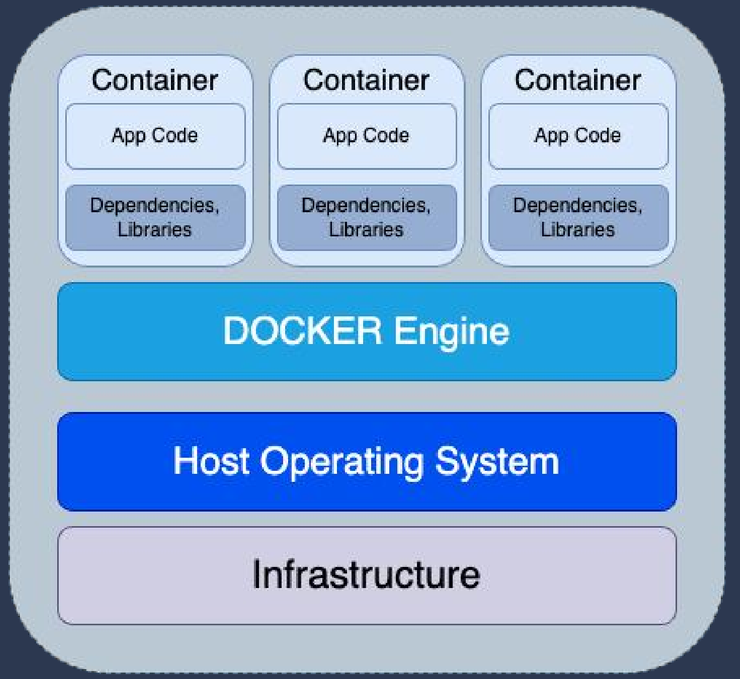
现状： Python + Docker 组合 – 4



LangChain图片引用自 https://deepwisdom.feishu.cn/docx/XDYbdhq7ro0KPexuXUkcB6mynmh#VygBdZS9poOgNfxKoFrcm6Bensh

现状： Python + Docker 组合 – 5

- 痛点3：Docker Container 的局限性
  - 冷启动性能：秒级
  - 磁盘空间：GiB级
  - 硬件加速器的支持：需要特定版本
  - 可移植性：依赖于CPU架构
  - 安全性：依赖于宿主OS的用户权限



部分文字引用自https://wasmedge.org/wasm_linux_container)

图片源自https://medium.com/@shivraj.jadhav82/webassembly-wasm-docker-vs-wasm-275e317324a1

AGI最佳：Rust + WebAssembly – 1

- Rust — AGI 时代的最佳选择
  - 性能与内存安全兼备
  - 无惧并发
  - 强大而富有表现力的类型系统
  - 现代化的包管理工具Cargo
  - 快速成长的生态系统：ndarray, llm, candle, burn, …

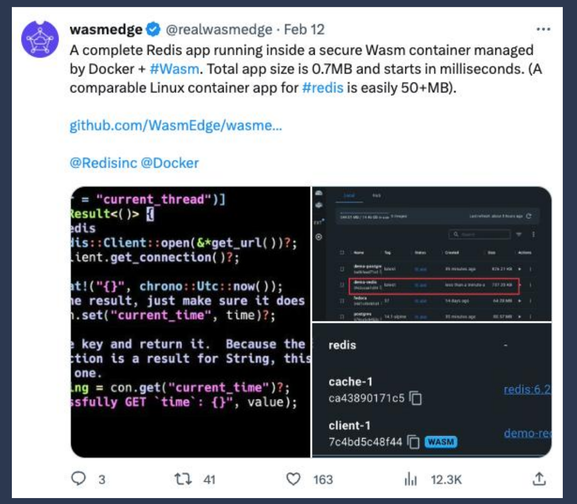
AGI最佳： Rust + WebAssembly – 2

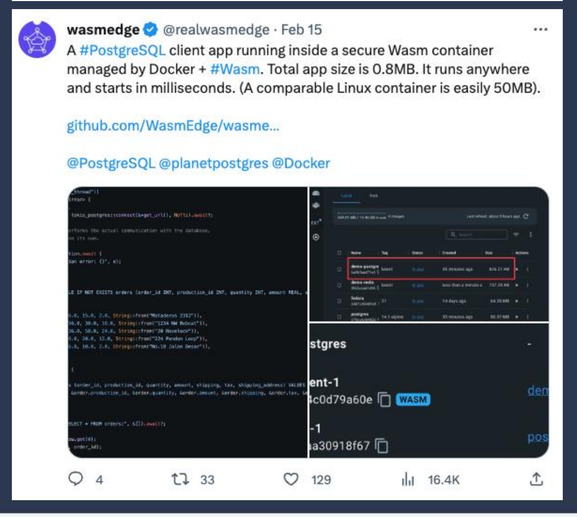
- WebAssembly — 更快、更轻、更安全

Aspect	Container	WASM
Size	10s or 1000 MBs	Few MBs
Performance	Far away from native	Native Speed
Startup Time	Seconds	Miliseconds
Runs in Web Browser	No	Yes
Cross Platform/Portability	Specific to System Architecture	High
System Interaction	Container contains OS and File System	Use WASI to access OS
Standards	OCI	W3C and OCI

WASM Vs Docker Performance Chart

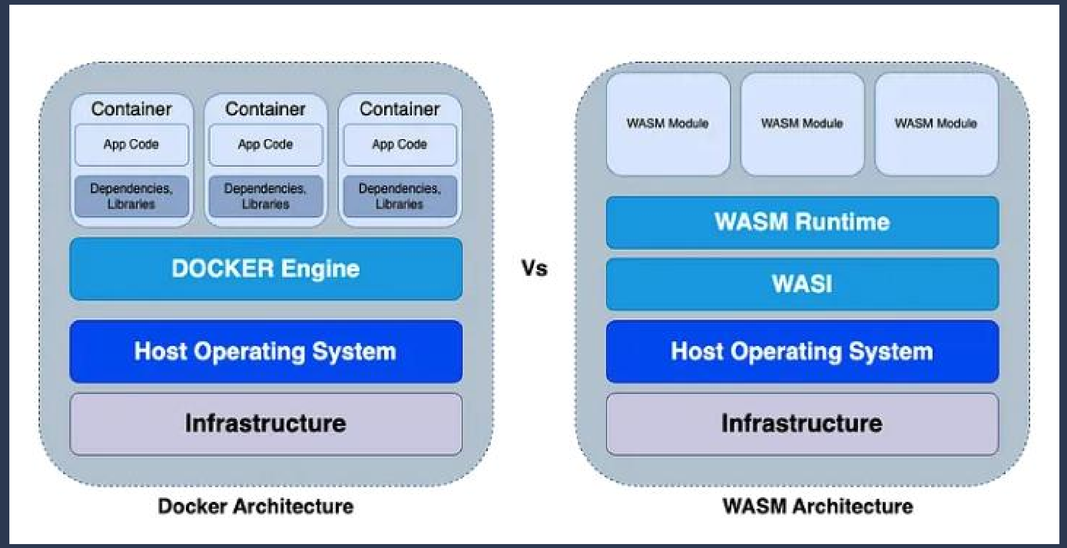
图片源自 https://medium.com/@shivraj.jadhav82/webassembly-wasm-docker-vs-wasm-275e317324a1





AGI最佳：Rust + WebAssembly – 3

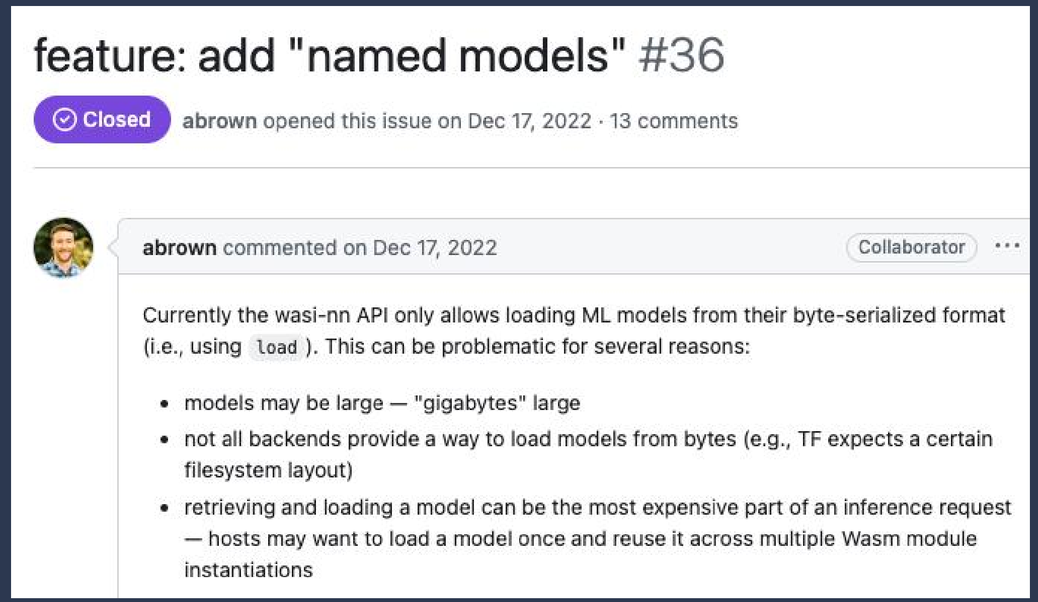
- WebAssembly — 更快、更轻、更安全
  - 沙盒机制提供了更安全的生产环境
    - 保护用户数据、系统资源
    - 字节码验证防止恶意代码
    - Wasm模块间相互隔离的执行环境



图片源自https://medium.com/@shivraj.jadhav82/webassembly-wasm-docker-vs-wasm-275e317324a1

AGI最佳：Rust + WebAssembly – 4

- WASI–NN 标准
  - 主流机器学习推理引擎
    - TensorFlow, PyTorch, OpenVINO, …
  - 针对大模型的功能扩展
    - Llama2.c, llama.cpp, …



feature: add "named models" #36

Closed **abrown** opened this issue on Dec 17, 2022 · 13 comments

abrown commented on Dec 17, 2022 Collaborator

Currently the wasi-nn API only allows loading ML models from their byte-serialized format (i.e., using `load`). This can be problematic for several reasons:

- models may be large — "gigabytes" large
- not all backends provide a way to load models from bytes (e.g., TF expects a certain filesystem layout)
- retrieving and loading a model can be the most expensive part of an inference request — hosts may want to load a model once and reuse it across multiple Wasm module instantiations

项目： 基于Rust + Wasm构建Agent – 1

- Agent 概念模型

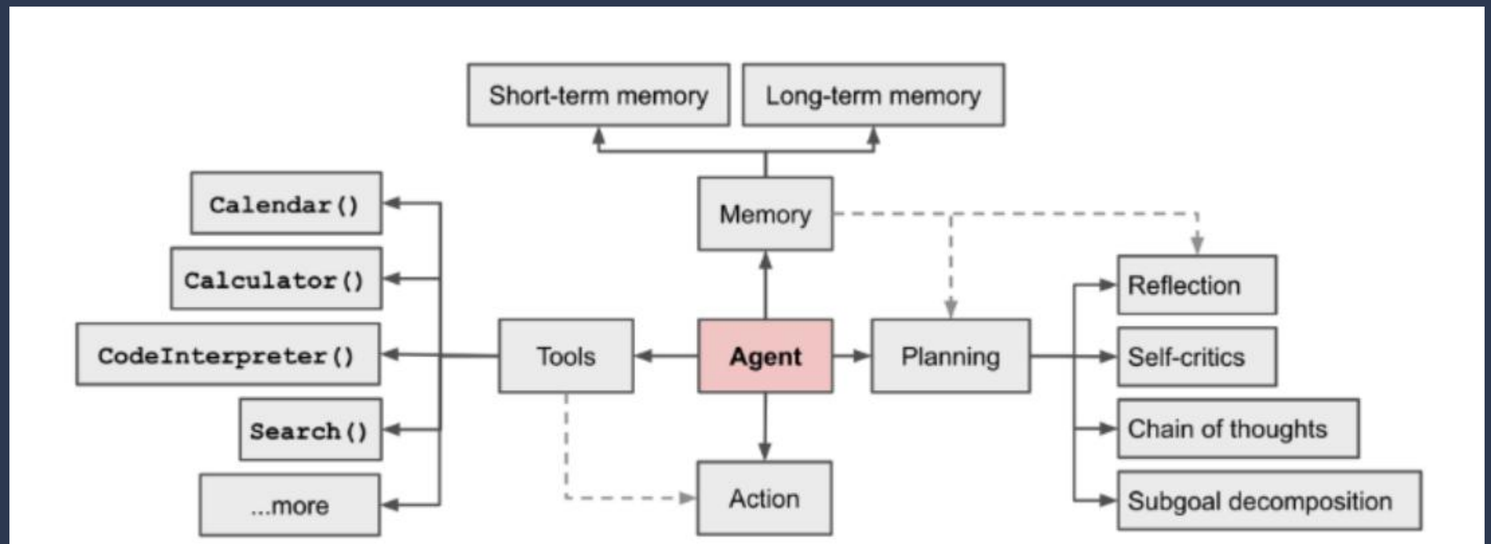
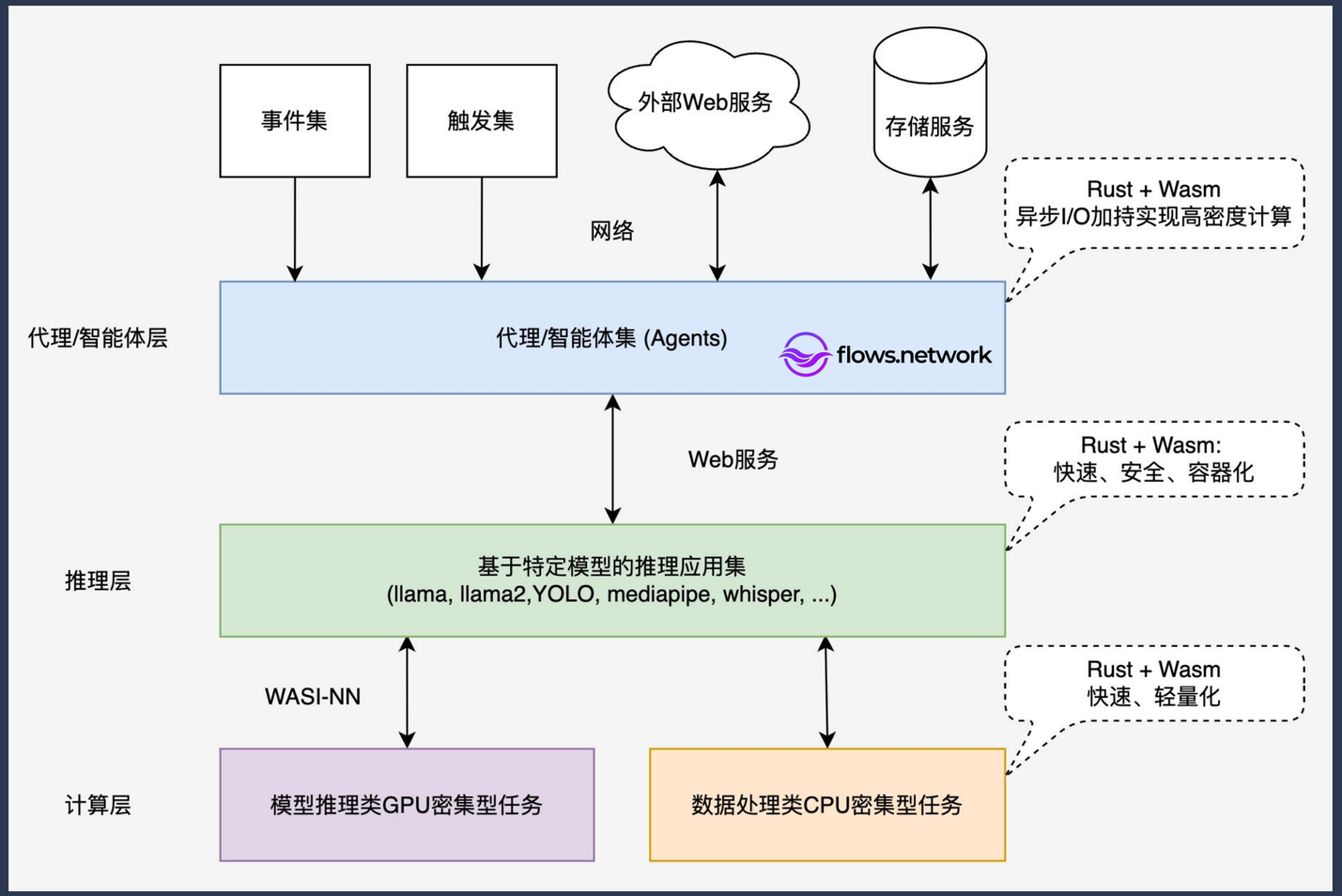


Fig. 1. Overview of a LLM-powered autonomous agent system.

项目：基于Rust + Wasm构建Agent – 2



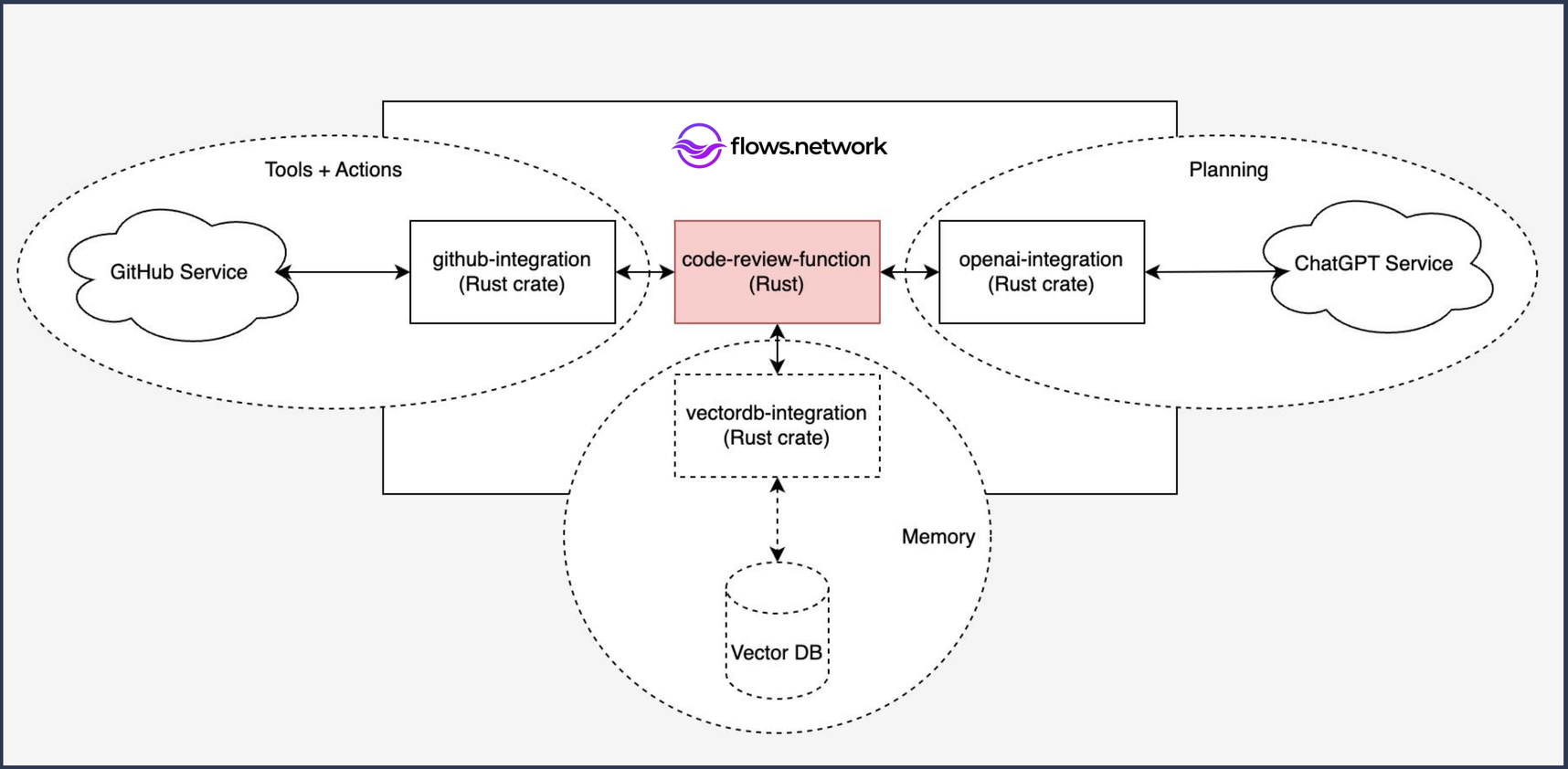
项目：基于Rust + Wasm构建Agent – 3

- Code Review Bot
  - 总结PR做了什么
  - 每一个commit做了哪些改动
  - 改动涉及的风险和潜在问题

《那些让 ChatGPT review 代码的程序员，后来都怎么样了？》

项目：基于Rust + Wasm构建Agent – 4

- Code Review Bot



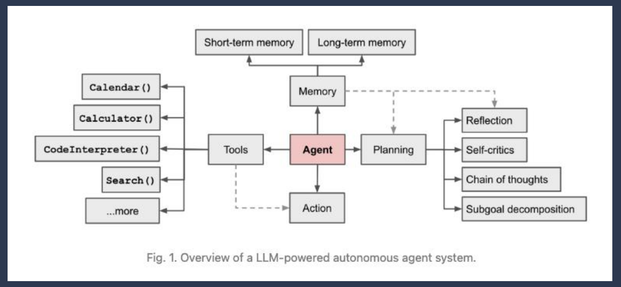
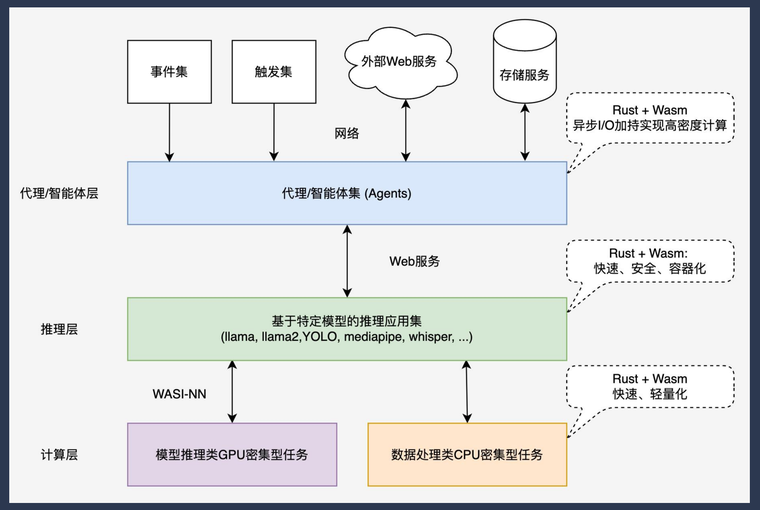
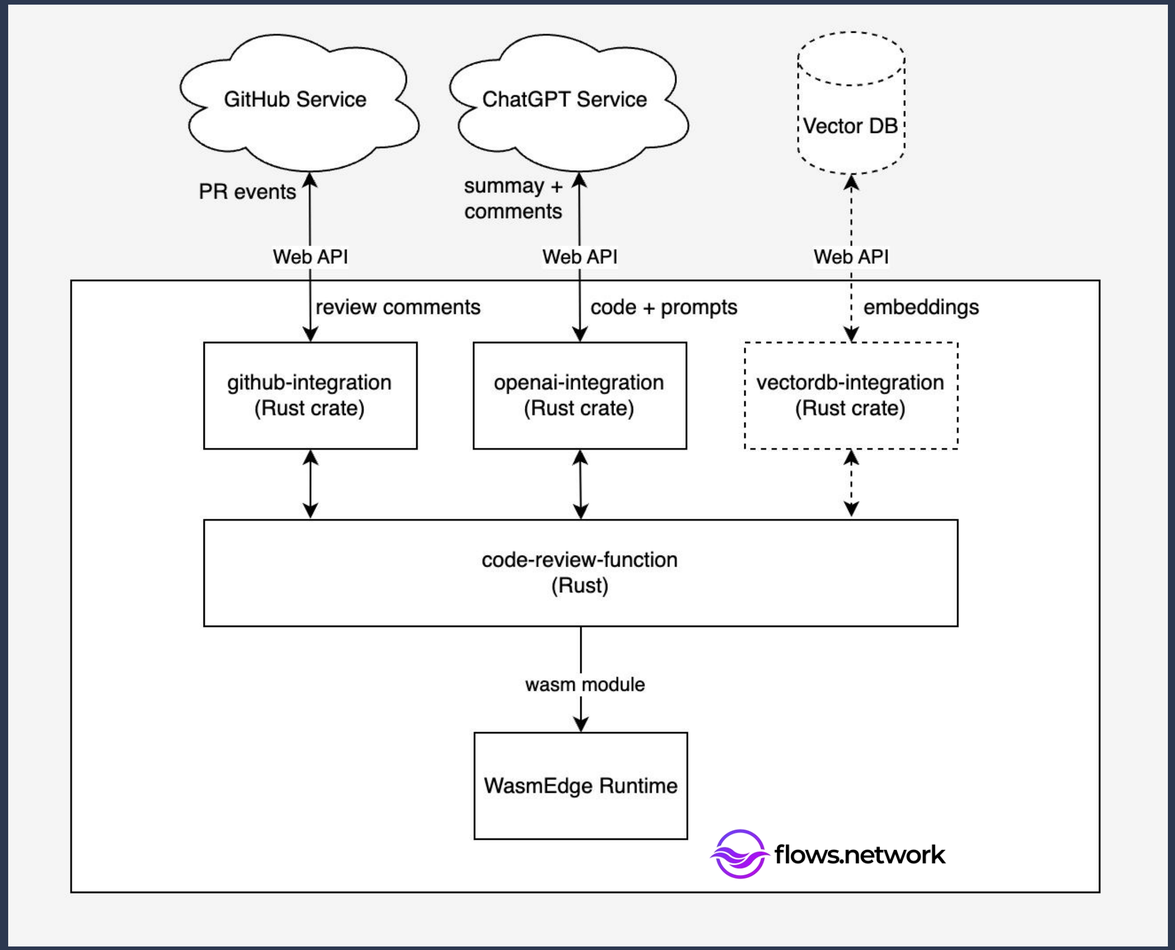


Fig. 1. Overview of a LLM-powered autonomous agent system.

项目：基于Rust + Wasm构建Agent – 5

- Code Review Bot





THANKS

软件正在重新定义世界

Software Is Redefining The World