ELASTIC Project
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Isolating high-performance ML workloads with WebAssembly

WebAssembly Components

Portable and sandboxed workloads with modular interfaces and lightweight isolation.

Confidential Virtual Machines (CVMs)

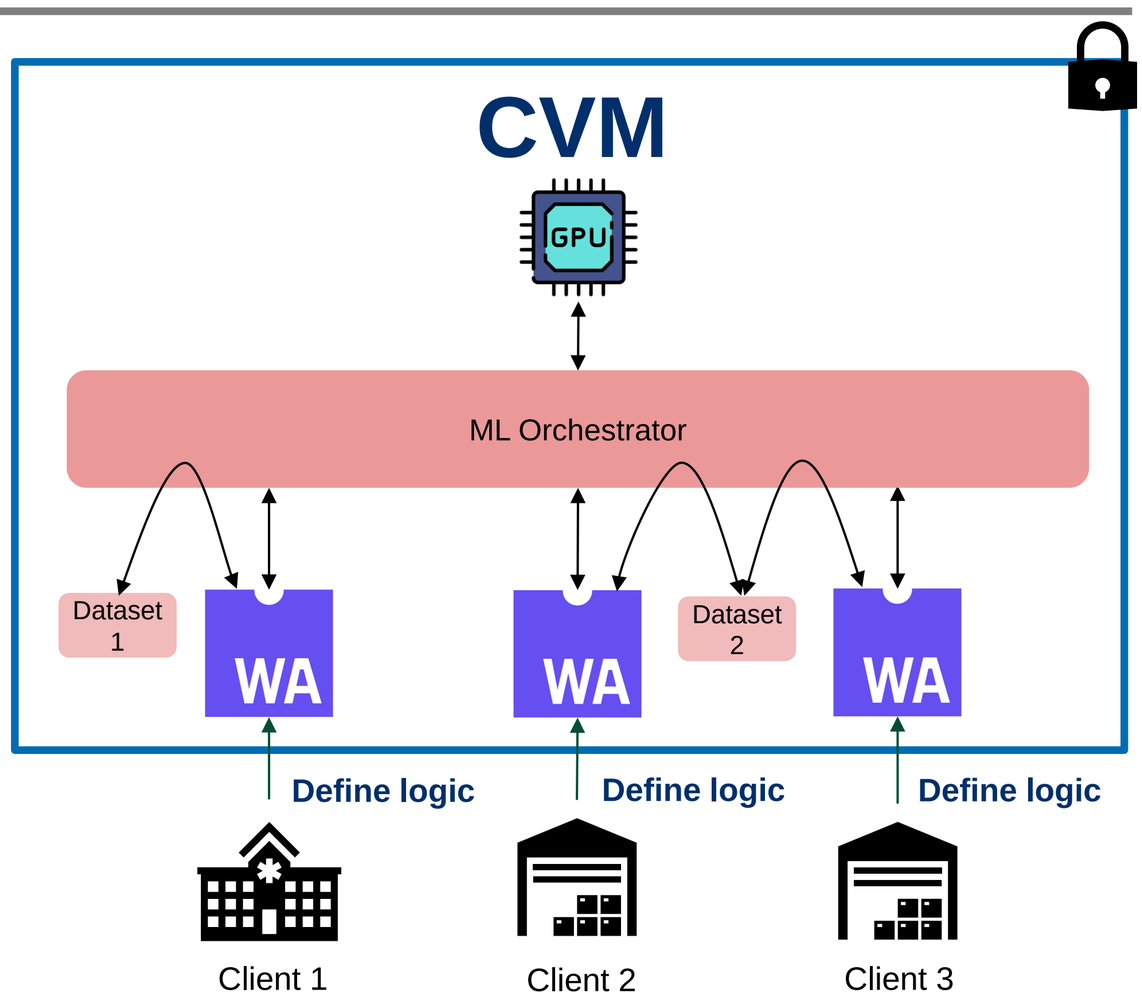
Trusted virtual machines with hardware-enforced memory isolation and remote attestation capabilities.

Motivations

- CVMs protect sensitive computations and data.
- Confidential GPU provide limited partitioning capabilities (e.g., NVIDIA H100 MIG supports up to 7 GPU instances).

Design Goals

- ❖ Low-cost isolation within CVMs.
- ❖ Workload flexibility through Wasm-managed logic.
- ❖ Compatibility with GPU accelerators.
- ❖ Remote attestation should also allow you to verify the results

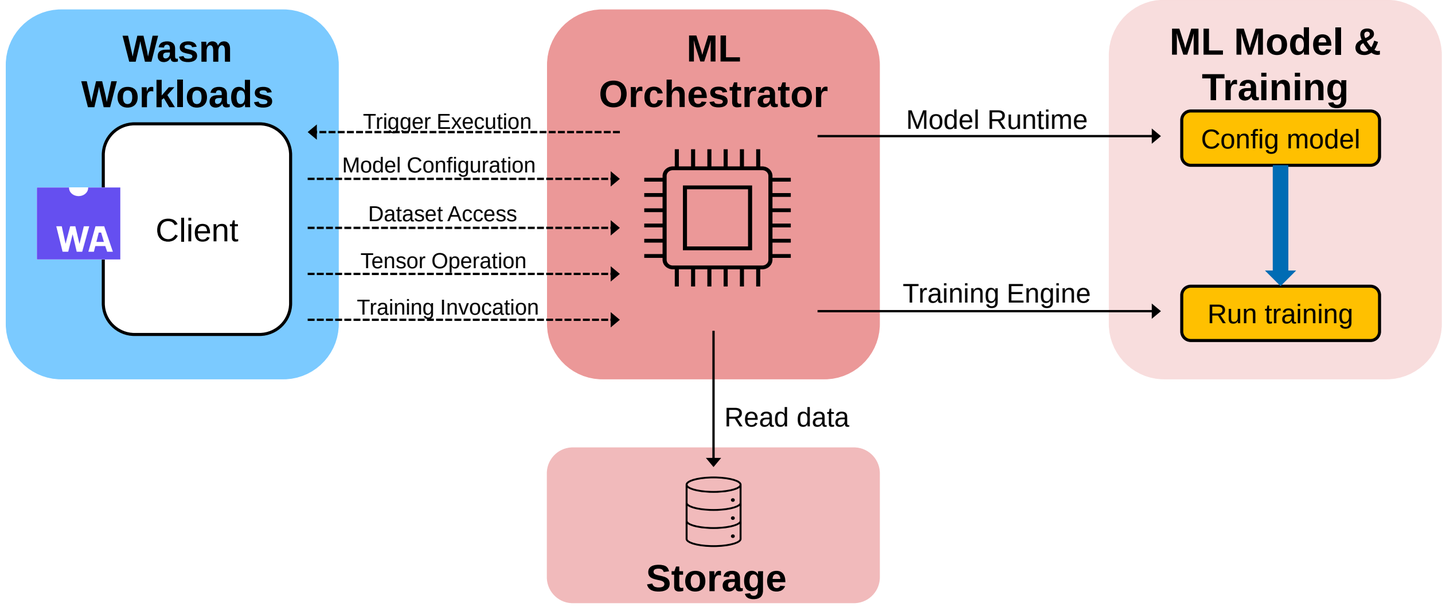


Implementation

- Design a generic WIT-based interface to orchestrate ML workflows across the Wasm boundary :
  - WIT types for models, tensors, and datasets
  - Resource handles to avoid copying data in and out of the sandbox
- Host implementation in Rust, using the `tch` Torch bindings for high-performance ML execution.

Performance

Data size	Type	Training	Pre-computation	Other	Total time
1GB	Native	86.70s ± 0.16s	2.58s ± 0.07s	1.05s ± 0.01s	90.33s ± 0.17s
	Wasm	87.35s ± 0.15s	3.33s ± 0.10s	1.10s ± 0.01s	91.78s ± 0.16s
	Overhead	**0.75% ± 0.26%**	**29.01% ± 1.09%**	**4.70% ± 1.02%**	**1.60% ± 0.26%**
3GB	Native	282.47s ± 0.46s	6.71s ± 0.05s	1.32s ± 0.02s	290.50s ± 0.44s
	Wasm	284.50s ± 0.46s	8.75s ± 0.08s	1.38s ± 0.01s	294.62s ± 0.45s
	Overhead	**0.71% ± 0.23%**	**30.32% ± 1.45%**	**4.55% ± 1.42%**	**1.42% ± 0.22%**



Future work

- Integrate CVM/TEE to enable attestation for verifiable ML.
- Implement different ML workloads (federated learning, generative AI, inference, etc.)

Aalto University

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