BIP in Embedded Systems

TinyML: porting Machine Learning to MCU's

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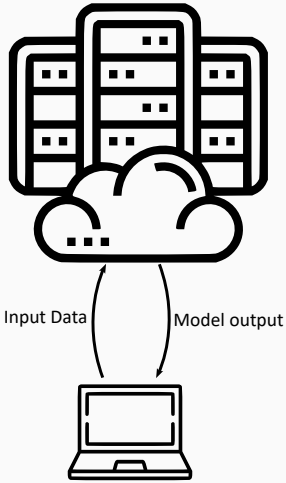
École d'ingénieurs de la HELHa

HELHa
Haute École Louvain en Hainaut

TinyML

Deployment of machine learning models on resource-constrained devices, such as microcontrollers and embedded systems.

Typical ML approach



- Model is trained and run in the cloud

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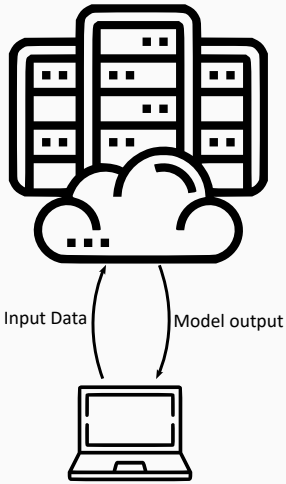

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- Input data and model outputs are in the wild

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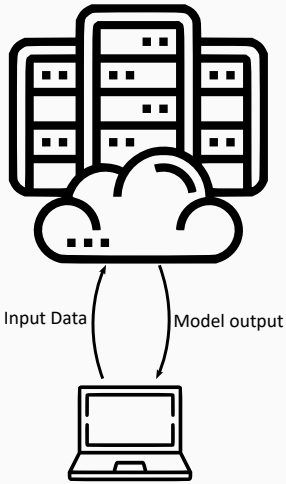

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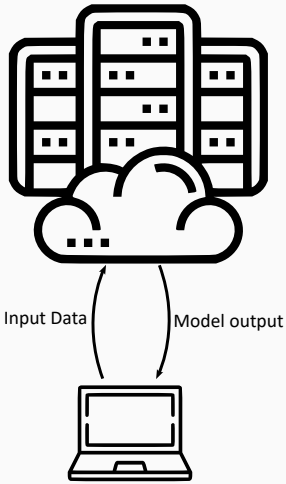
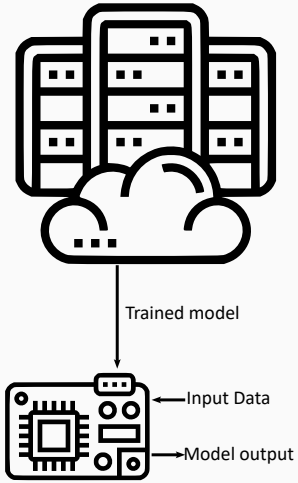


- Model is trained and run in the cloud
- Input data and model outputs are in the wild
- Requires heavy infrastructure
- **Latency!**

ML for embedded systems



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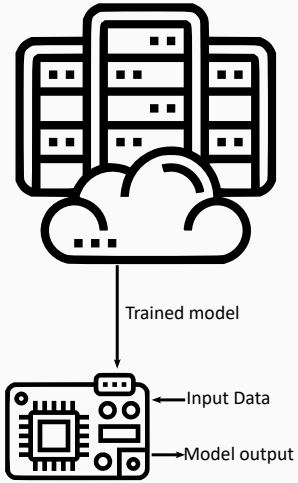
ML for embedded systems



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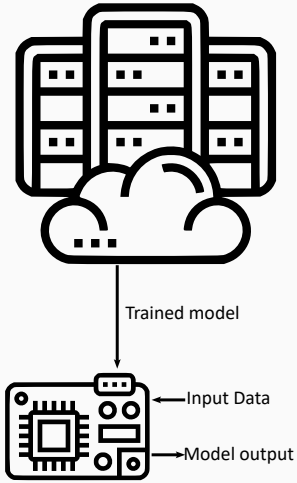
ML for embedded systems



- Model is created and trained on AI specific powerful hardware
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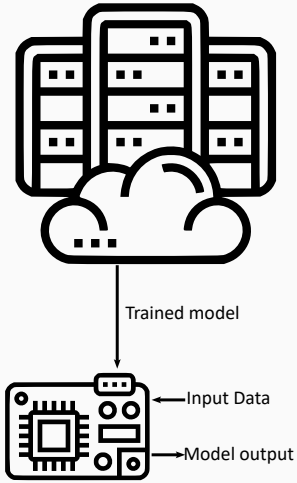
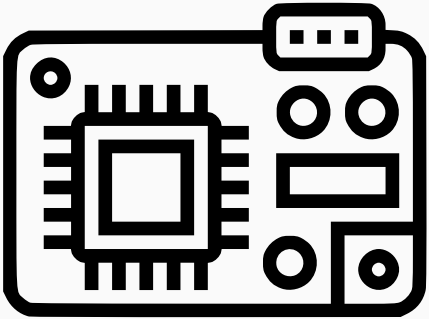
ML for embedded systems



- Model is created and trained on AI specific powerful hardware
- Input data and model outputs stay local
- Low power in use
- **Latency compatible with real-time constraints**

Challenges

- Limited work memory (RAM)
- Limited storage (Flash)



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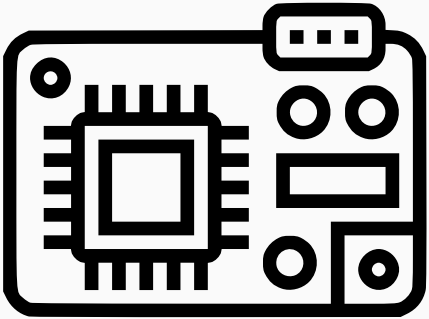

Challenges

- Limited work memory (RAM)
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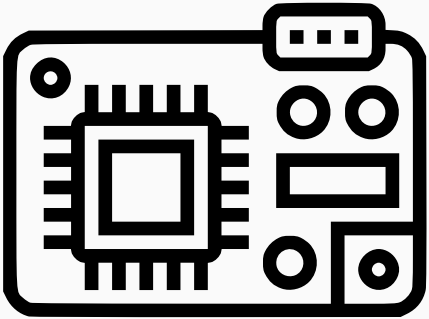
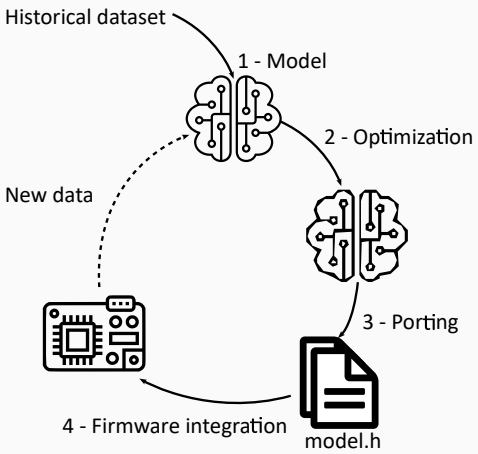
- Low power availability



Workflow



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   Important to keep the tinyml goal in mind!

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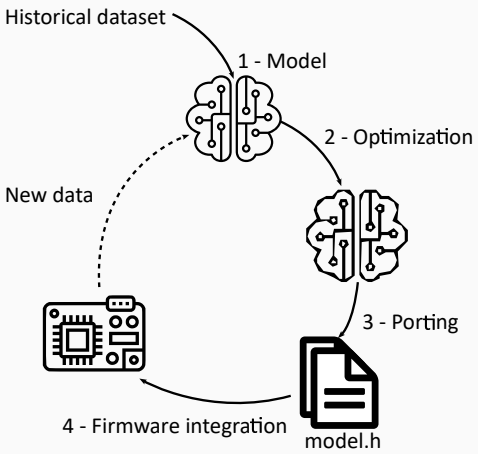

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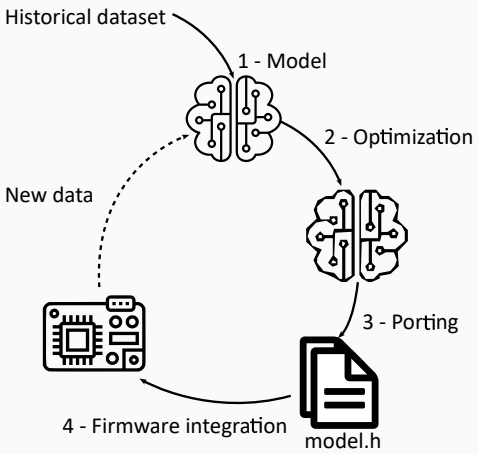

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   Output is C code + framework library

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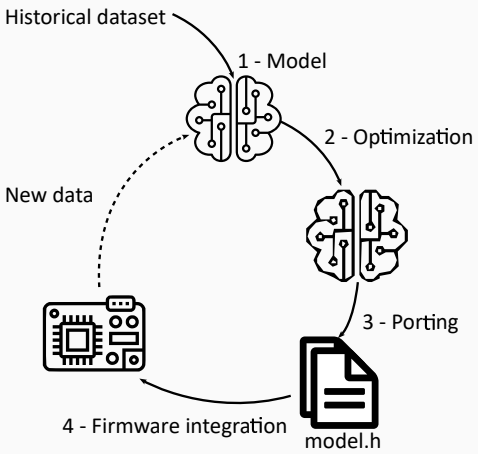

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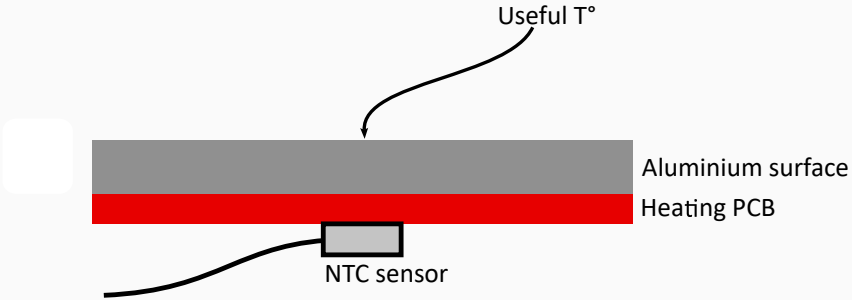
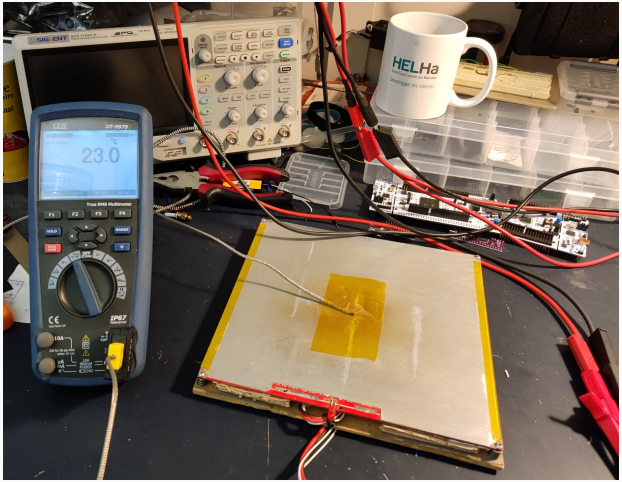
   Output is C code + framework library
4. **Integration into Firmware**

Demo - the problem



Demo - creating dataset



Demo - creating dataset

Temp [C]	NTC [V]
22.6	1.881
23.1	1.87
24.1	1.836
26.4	1.755
28.5	1.671
31	1.573
36.8	1.32
37.2	1.229
43.8	0.986
44.5	0.97
45.2	0.93
52.3	0.747
53.3	0.705
54.4	0.656
62.4	0.492

Demo - test circuit