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Trenchless Technologies aware Edge Computing for Pipes Leakage Detection

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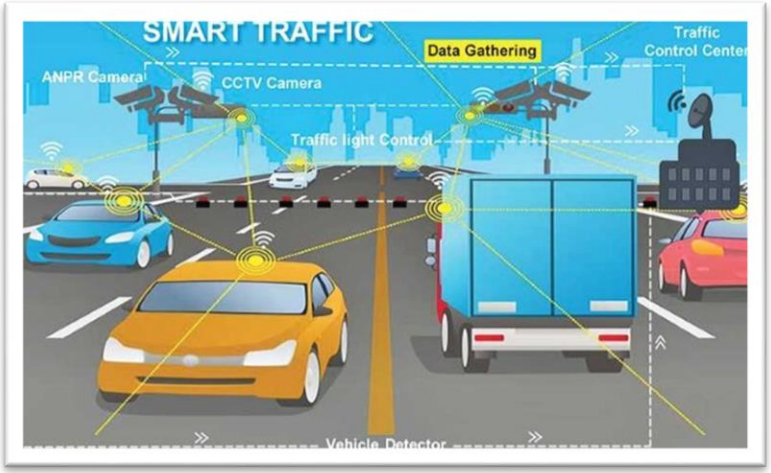
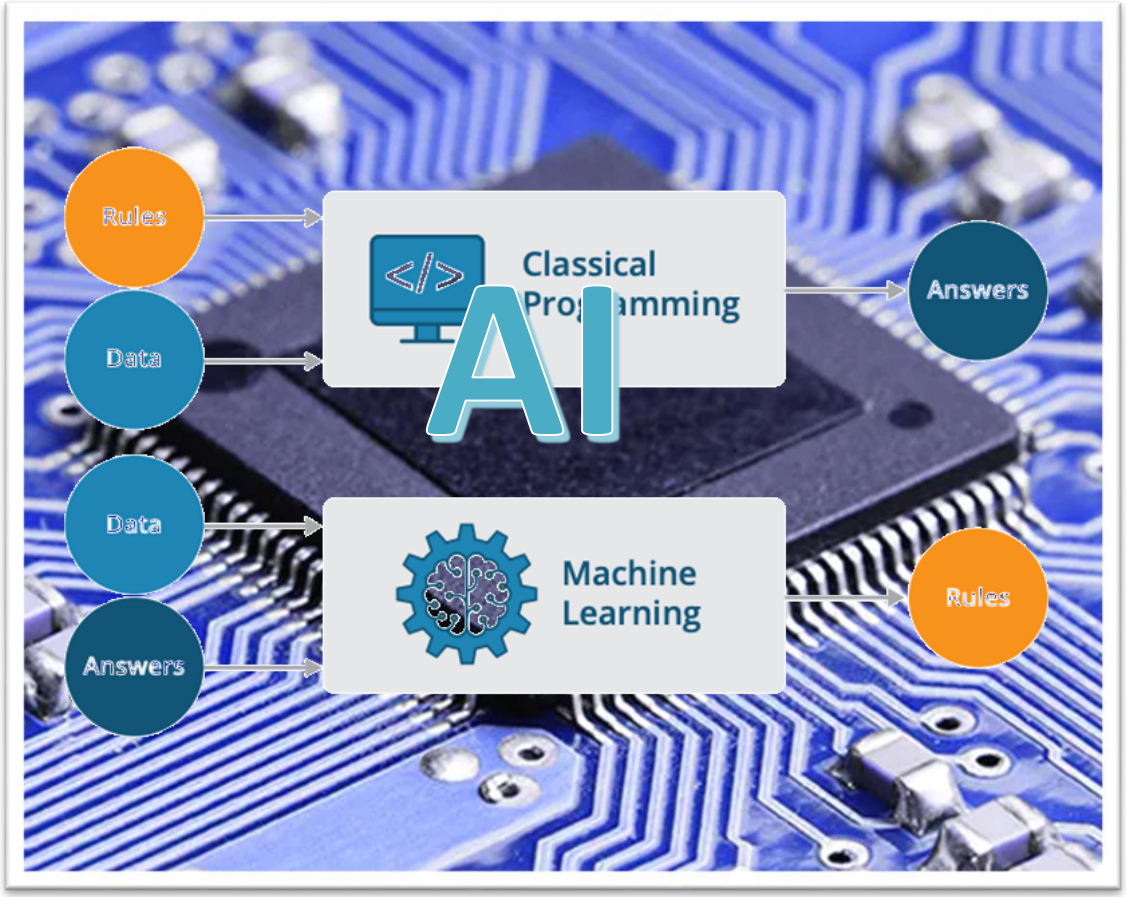
Summary

- Introduction
- Objectives
- Solution development
- Implementation results
- Conclusions

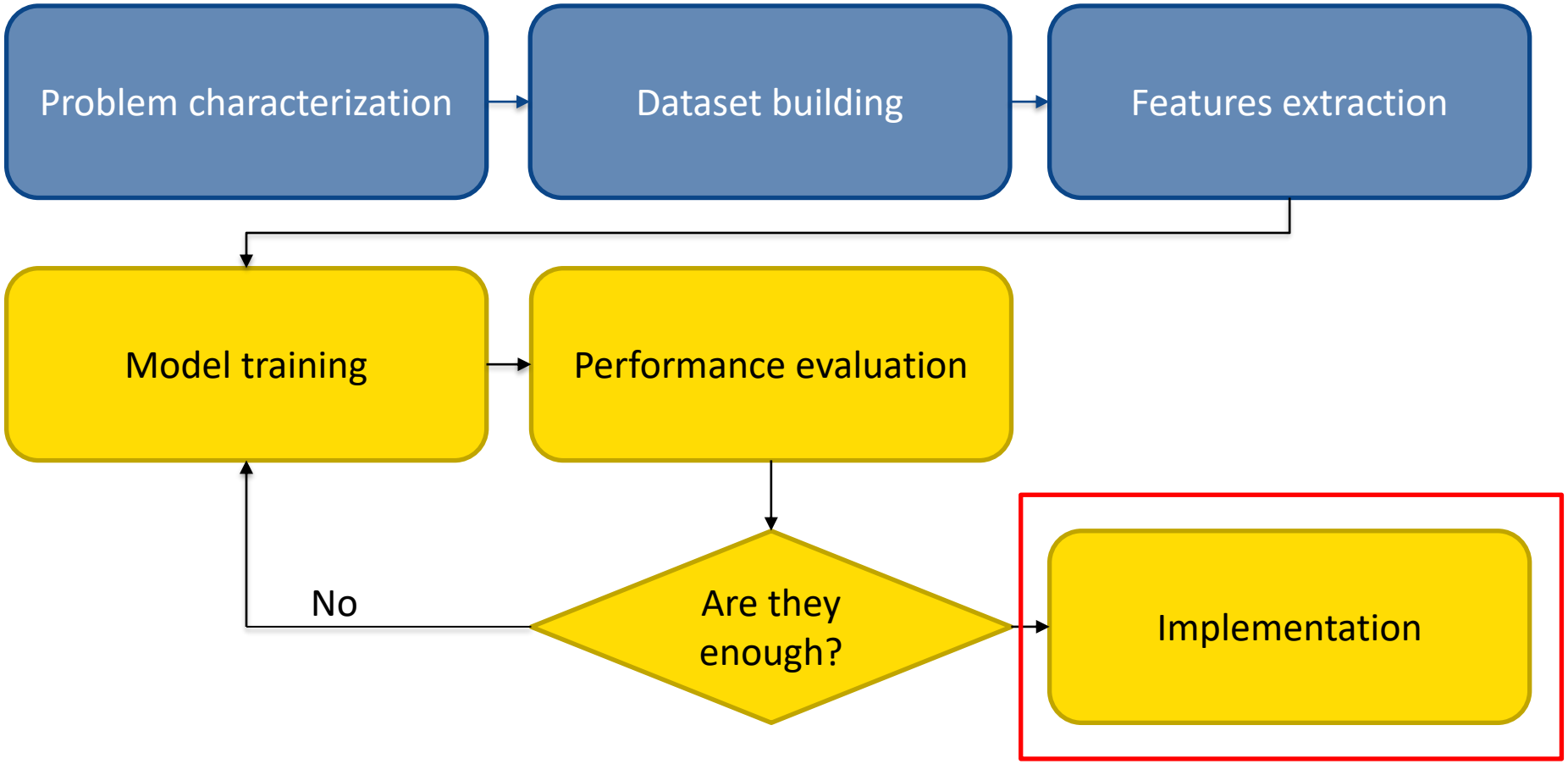
Edge Machine Learning



Machine Learning

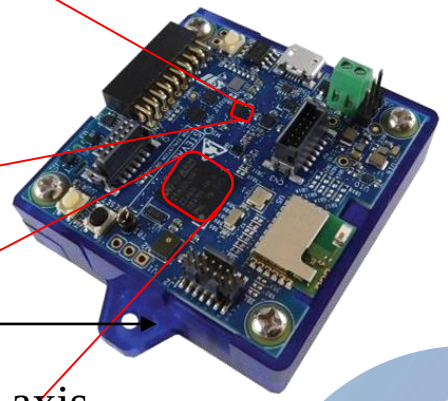


ML Development chain



Development choices

16bit integrated ADC
26ksps sampling frequency
3 axis



Up to 120 MHz clock frequency
640 kB RAM
2 MB Flash

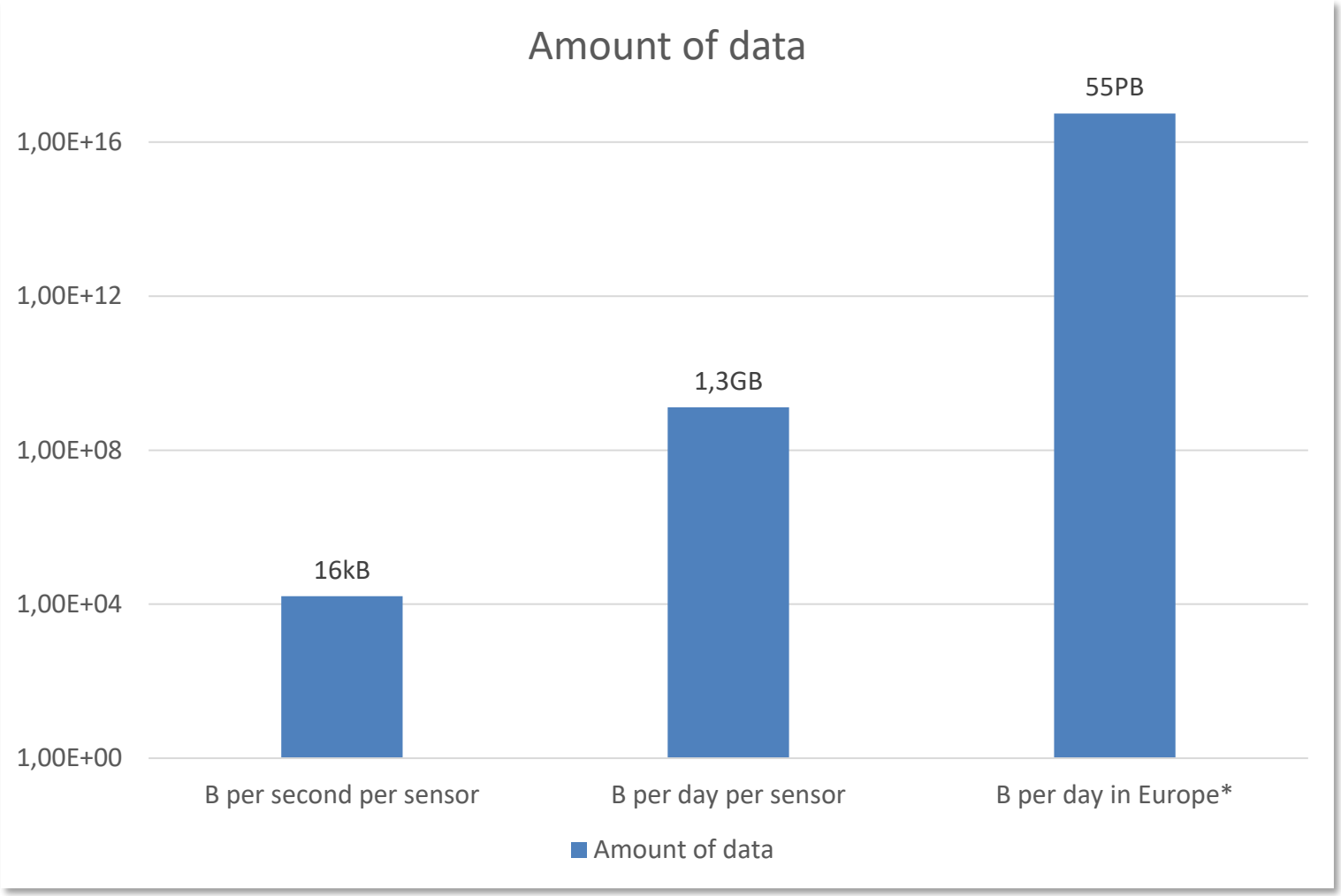
1 s = 26667 sample per axis

0,46 s = 12288 sample per axis = 73kB for all 3 axis

Feature extraction

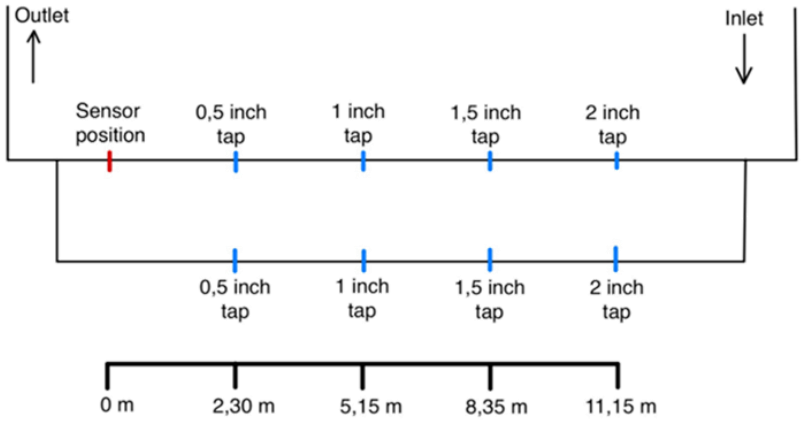
3000 training samples
600 test samples

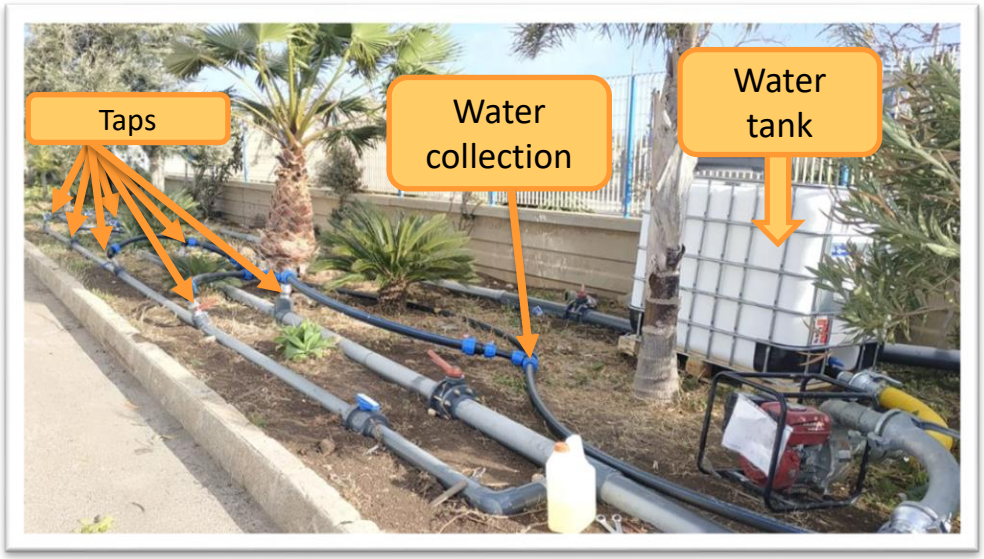
Scaling perspective

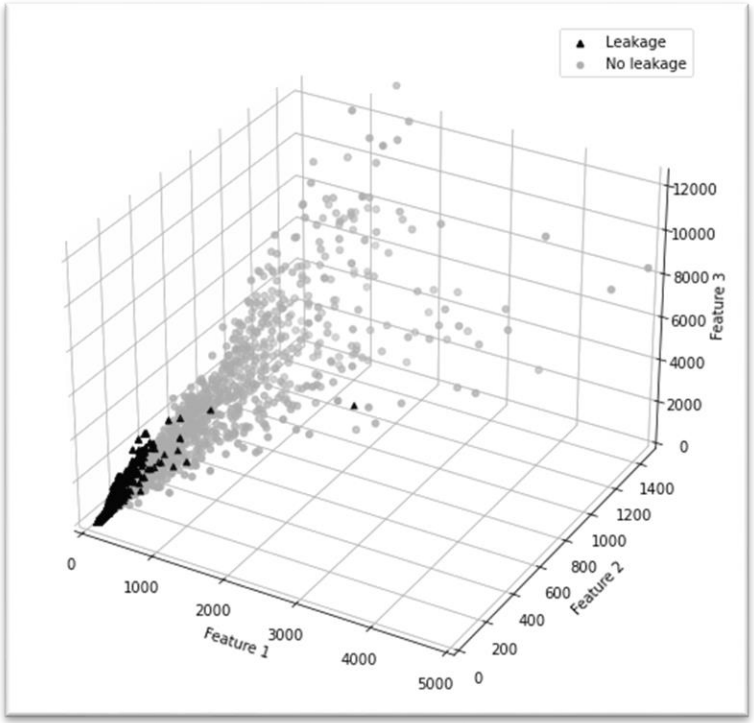


*Considering one sensor every 100m in the 4,3 billion km long european Water Distribution Network

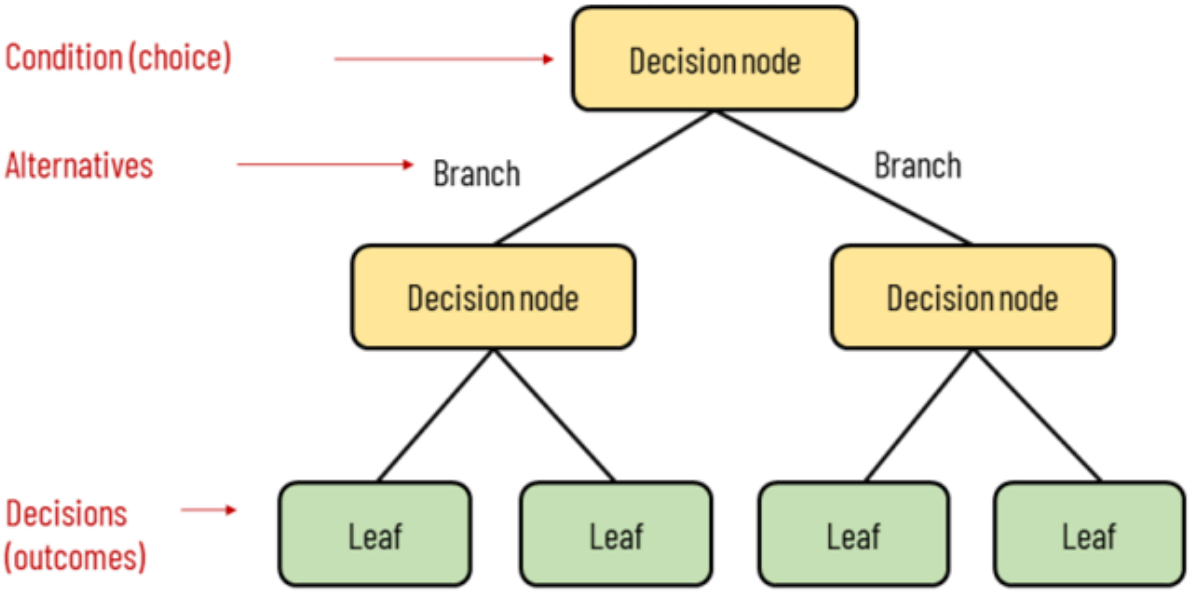
Training data





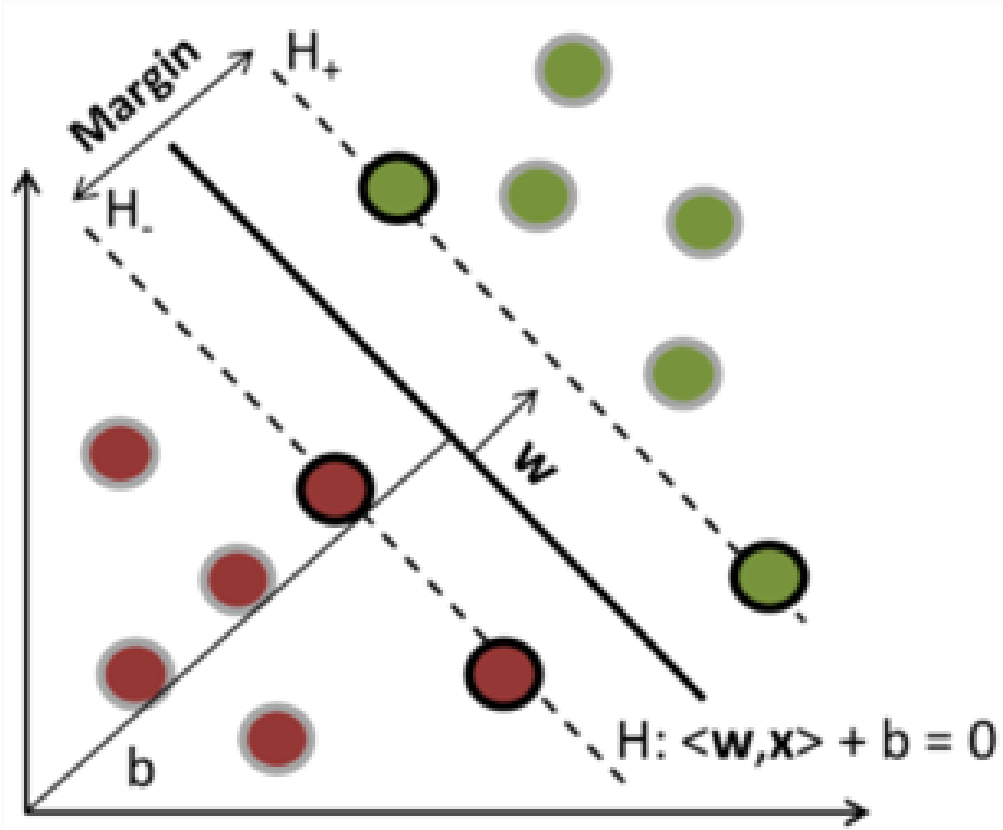


Decision trees



Trained model included 379 nodes and 190 leaves

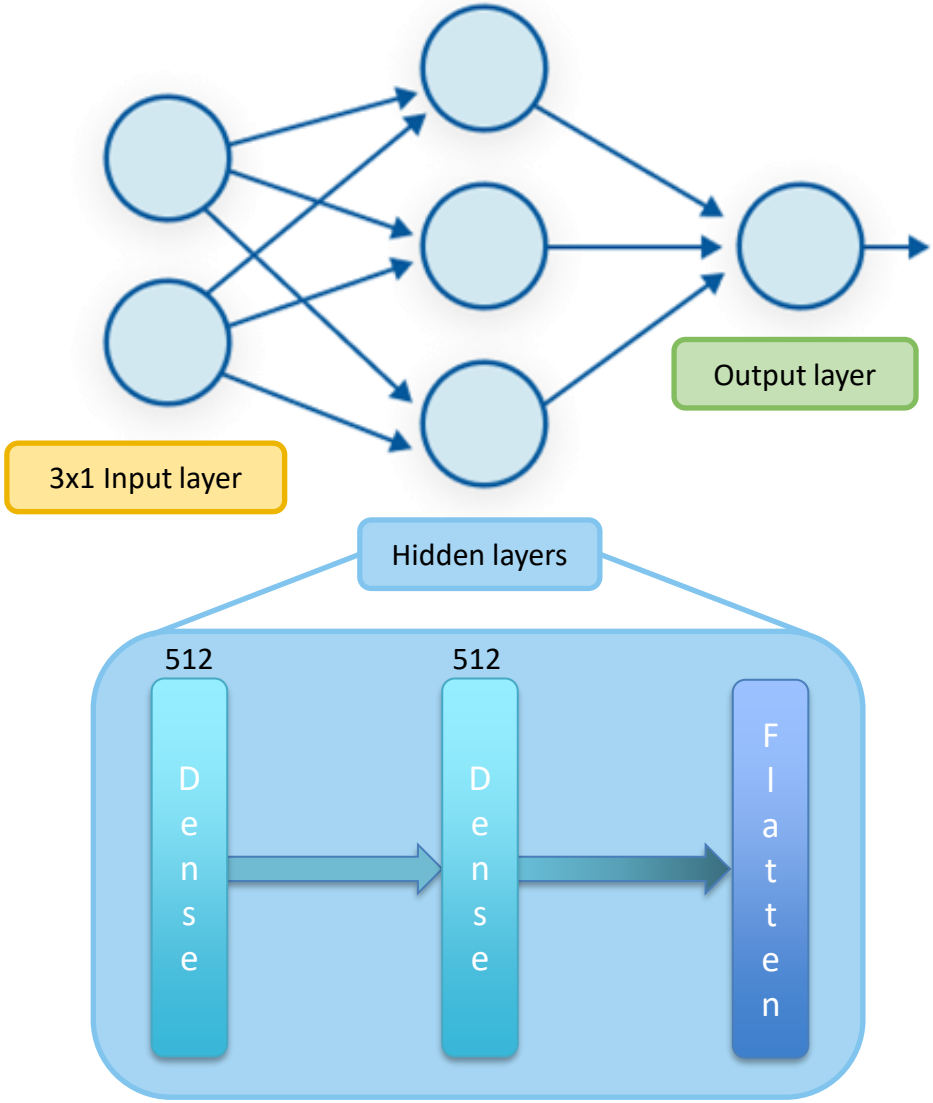
Support Vector Machines



Trained model considered 584 leak and 604 no leak samples

The hyperplane was calculated in 767 iterations

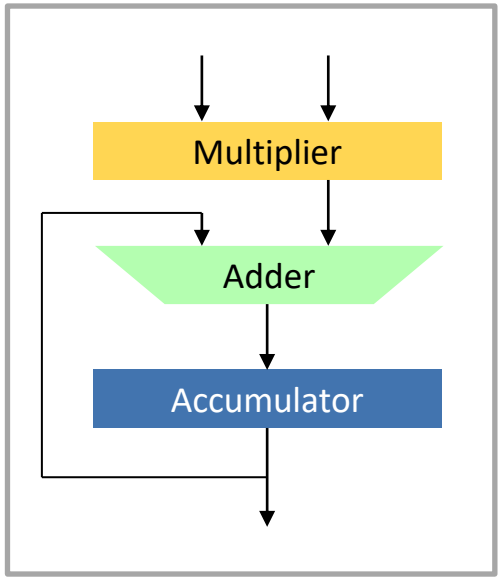
Multilayer Perceptron



Development tools

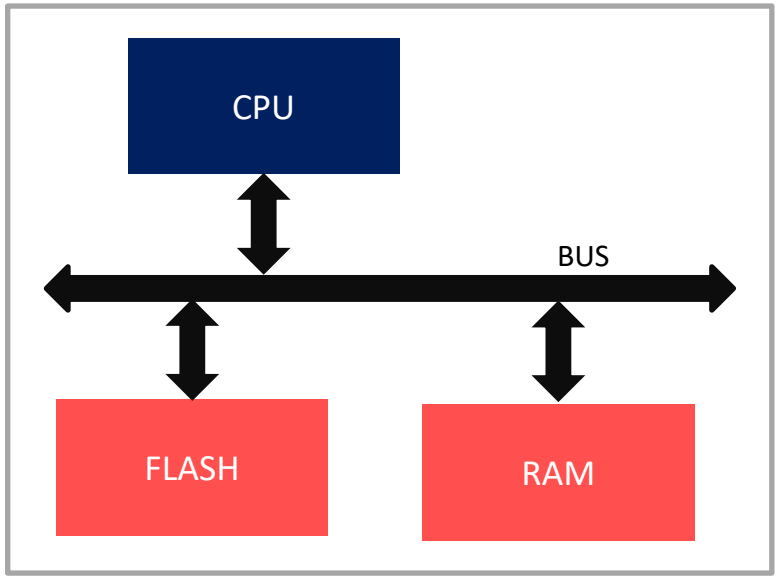
Performance criteria

Number of MACCs



MACC

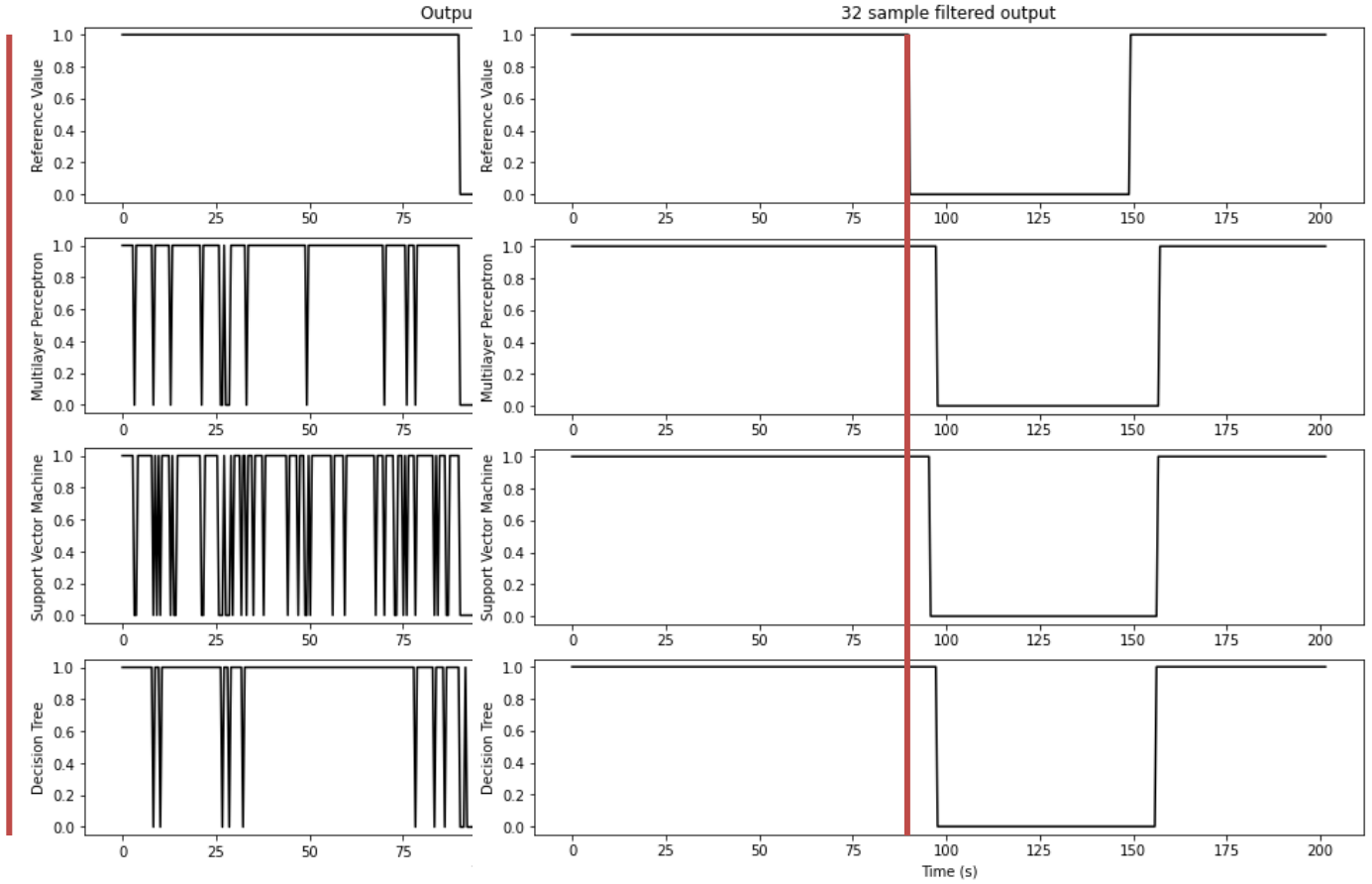
Memory occupancy



Implementation results

Model	Error on leaks	Error on no leaks	Number of MACCs	Ram (KB)	Flash Memory (KB)
MLP	12%	8%			
SVM	24.3%	5.3%			
DT	6%	8.3%			

Application on leakage vibration signals



Conclusions

- Selecting best suited ML models for embedded AI from the start of development is crucial for system performances
- Treating inference results with signal processing techniques can improve reliability of the embedded system

Thank you

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