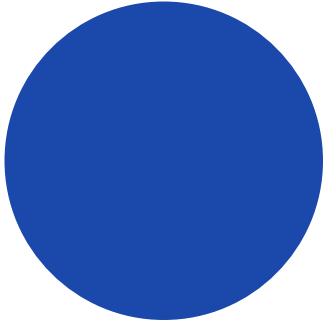
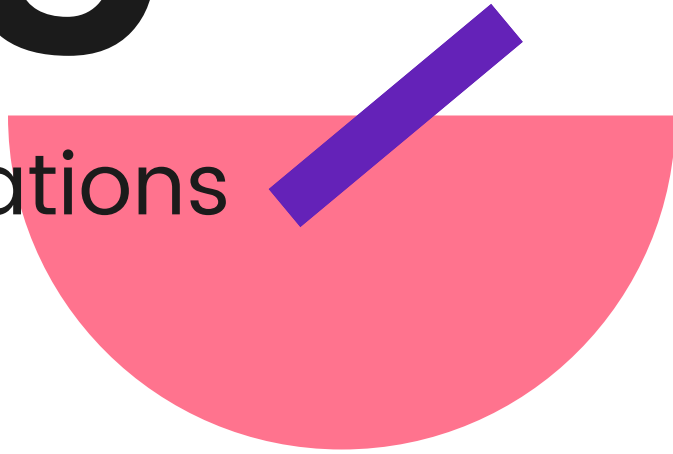
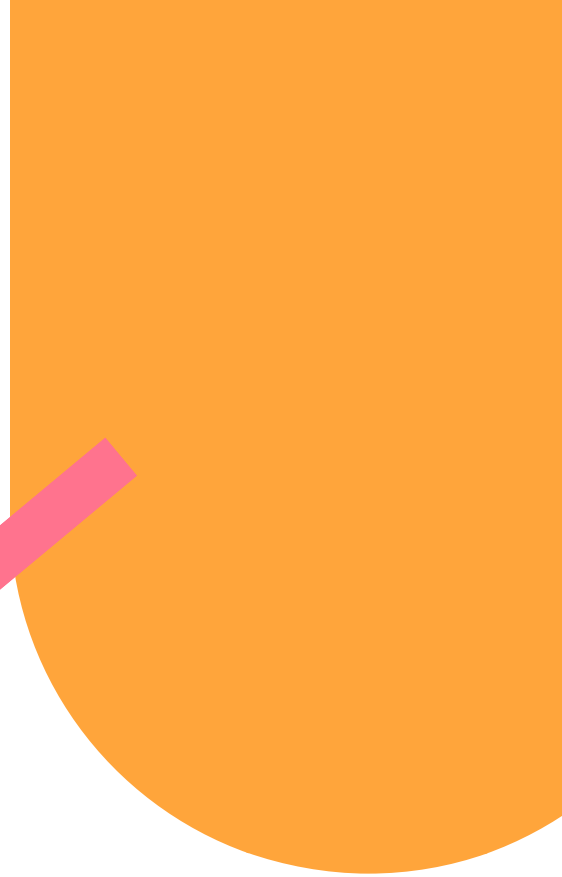




Intro to Embedded Machine Learning

Overview | Challenges | Applications





Overview





Machine Learning

Data + Labels

= > Rules

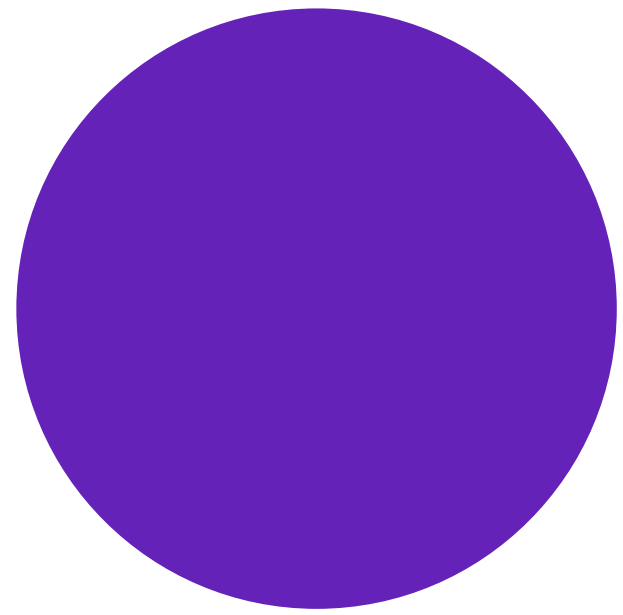


Made Possible

By ...

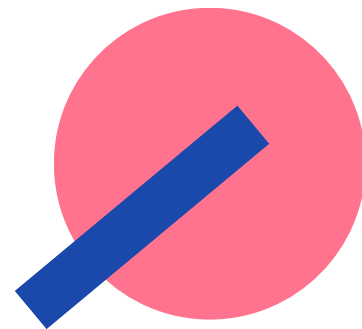
- massive amounts of data
- advances in compute
- cheap storage

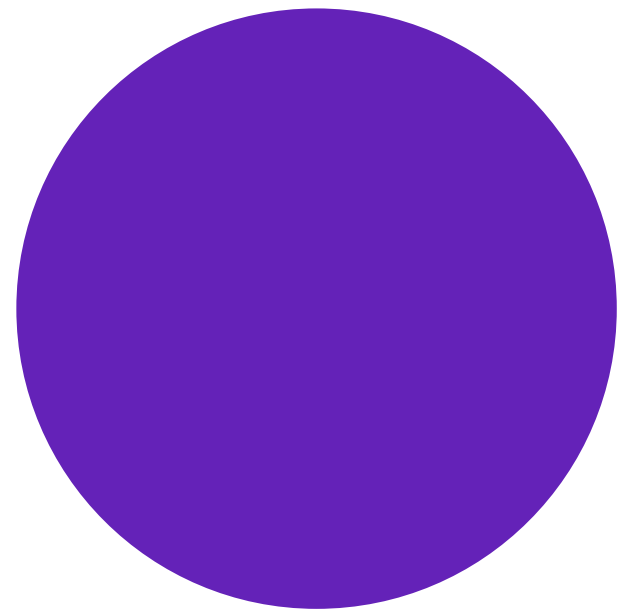




Training Phase

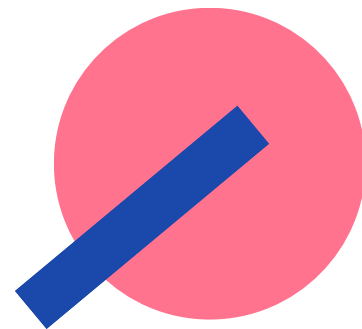
- Requires large compute
- Requires labeled data
- Model as outcome
- Model is a numerical tensor





Inference Phase

- Requires unlabeled data
- Matrix multiplication of data and model
- Output is a numerical variable

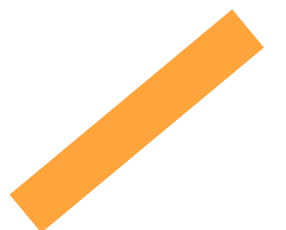


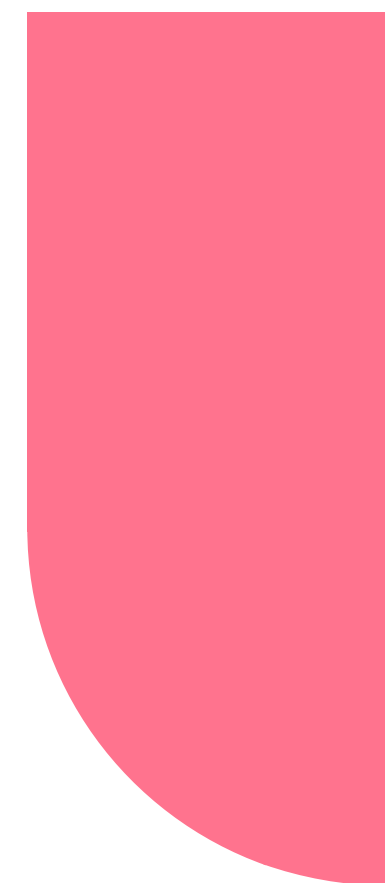
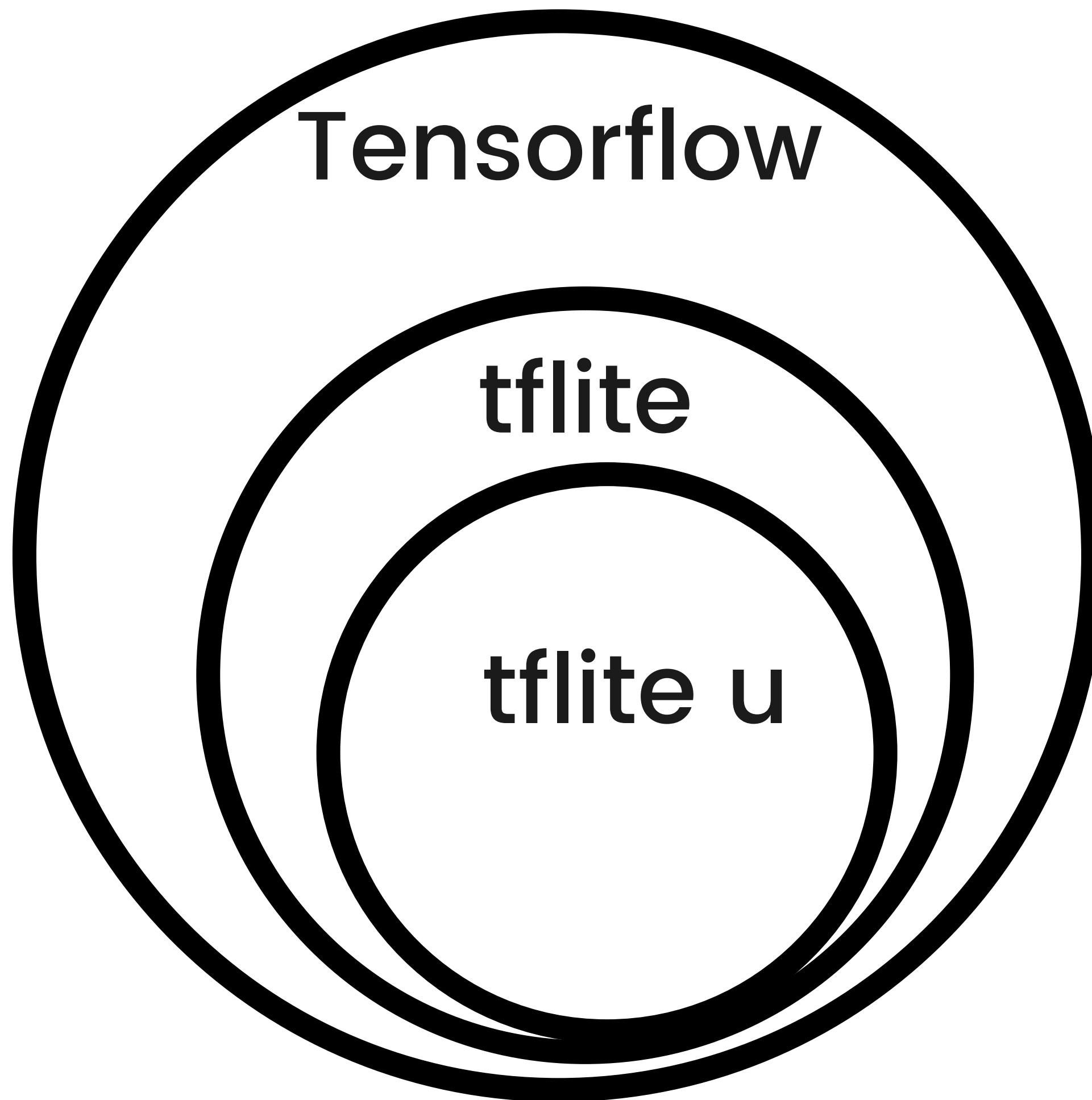
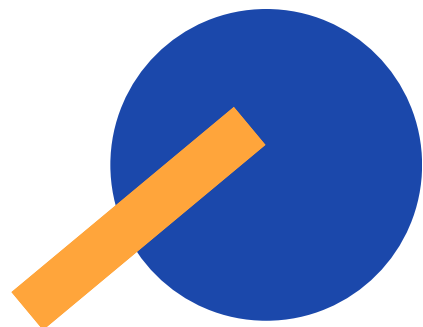


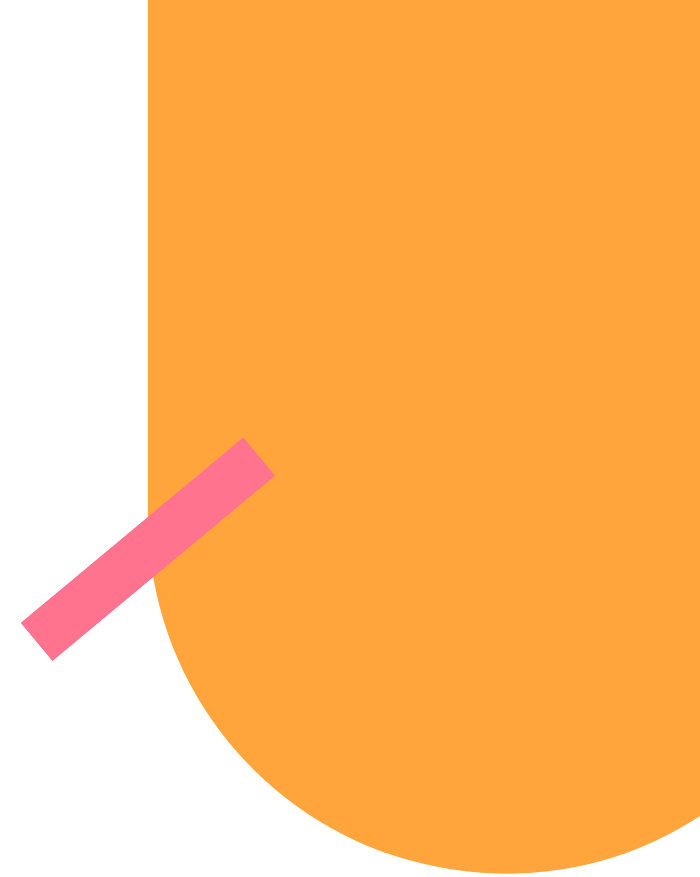
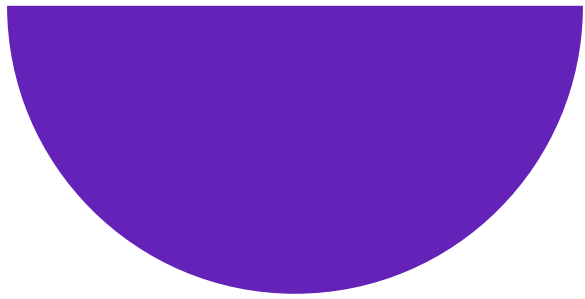
Arduino Portenta

Embedded Machine Learning

- Targeted at microcontrollers, etc.
- Strictly inference
- Normally offline
- Low power consumption
- Computational constraints

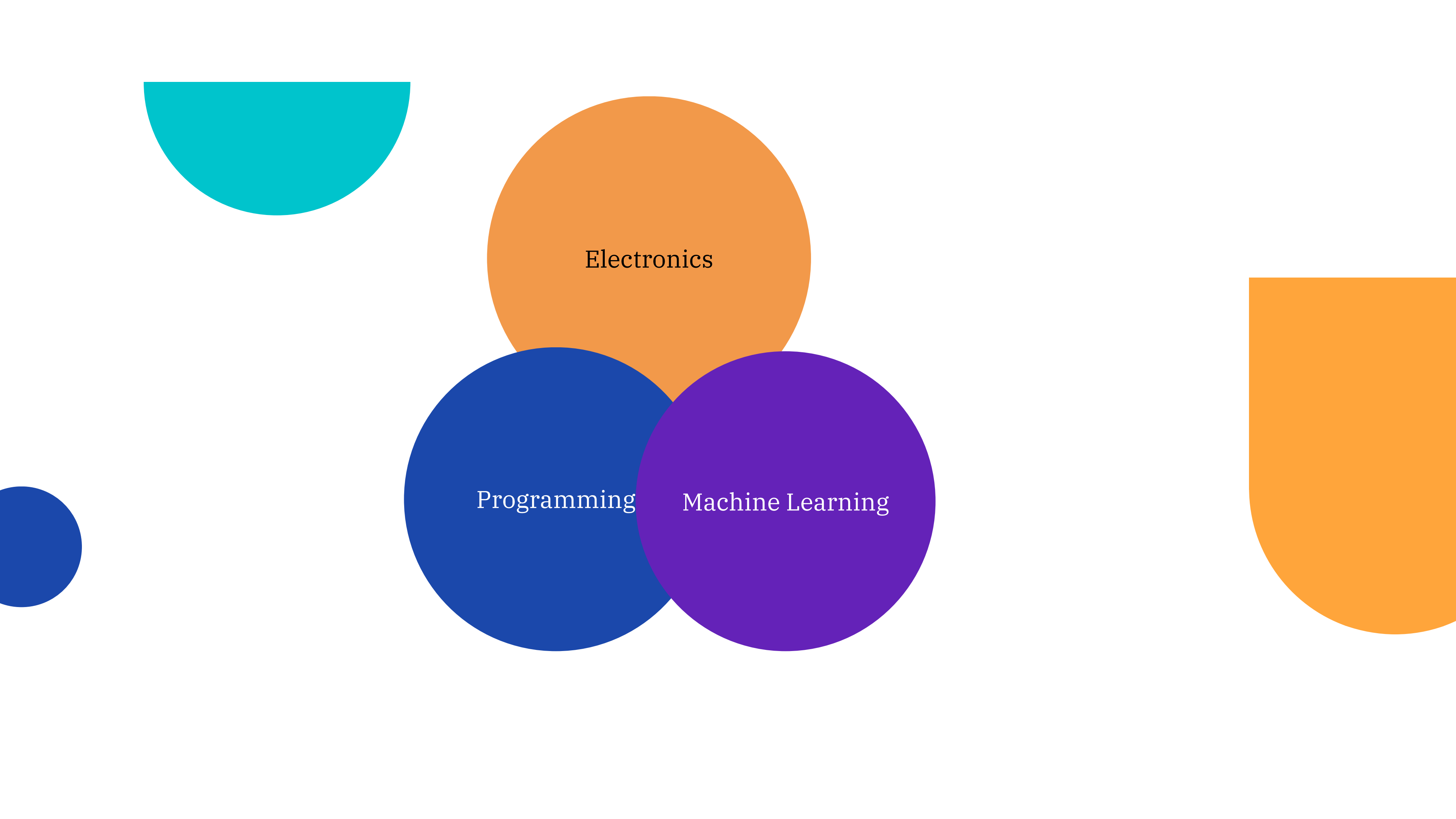






Challenges

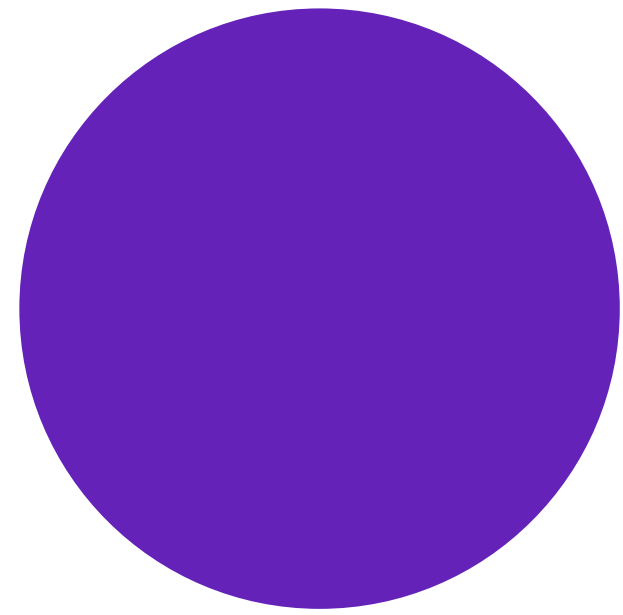




Electronics

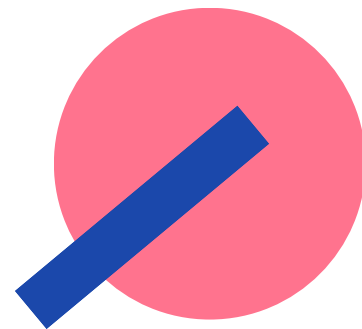
Programming

Machine Learning



ML Training

- Data Collection
- Data Annotation
- Model Selection
- Training
- Evaluation
- Conversion

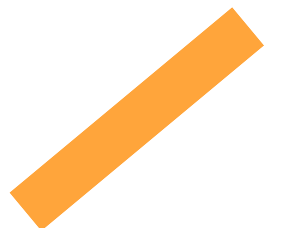


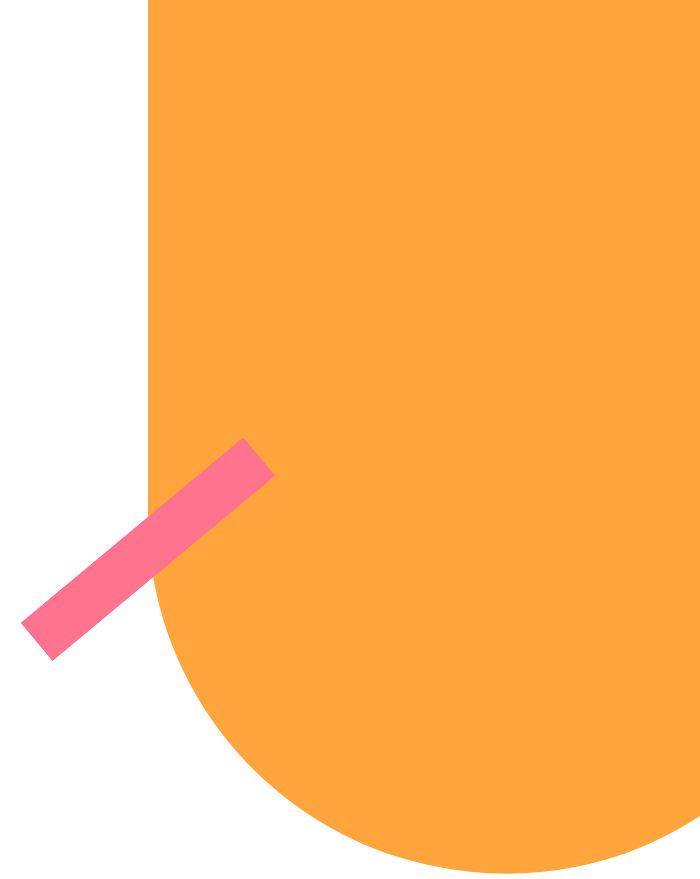
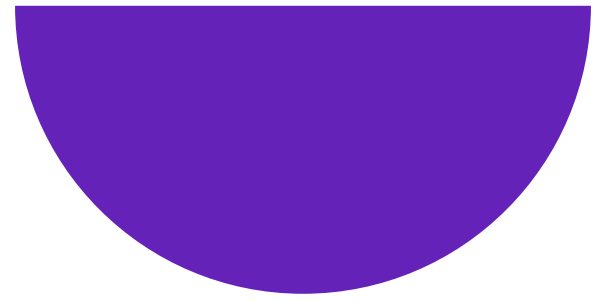


Arduino Portenta

Microcontrollers are Constrained

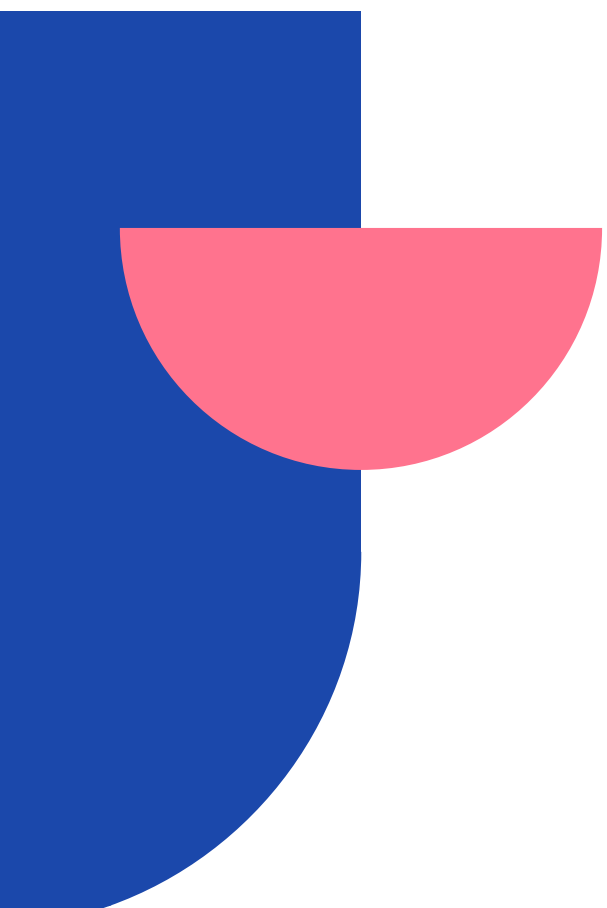
- Usually no OS
- Limited space for firmware
- Limited energy
- Models must be tiny
- Math operations mostly limited
- Not all mcu support TinyML
- Mostly offline





Applications





Smart Speakers

- Dedicated MCU listens for wakeword





Fall Detection

- Reading accelerometer and gyroscope data



Illegal Logging

- Dedicated MCU listens for chainsaw sounds



Poaching

- ElephantEdge Collar
- Using IMUs to determine the state of activity of animals
- Using microphones to determine trumpeting



Questions

Thank you for attending

