Sprint 2 Presentation

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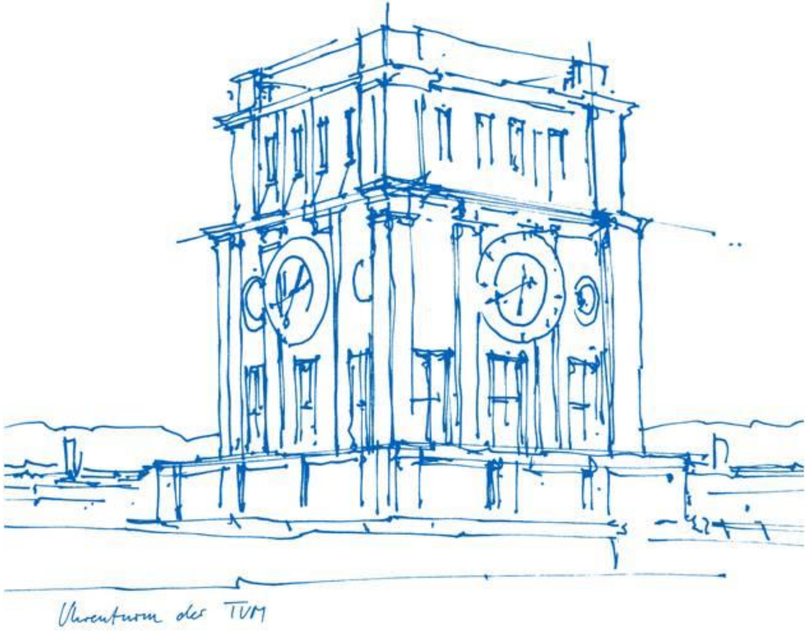
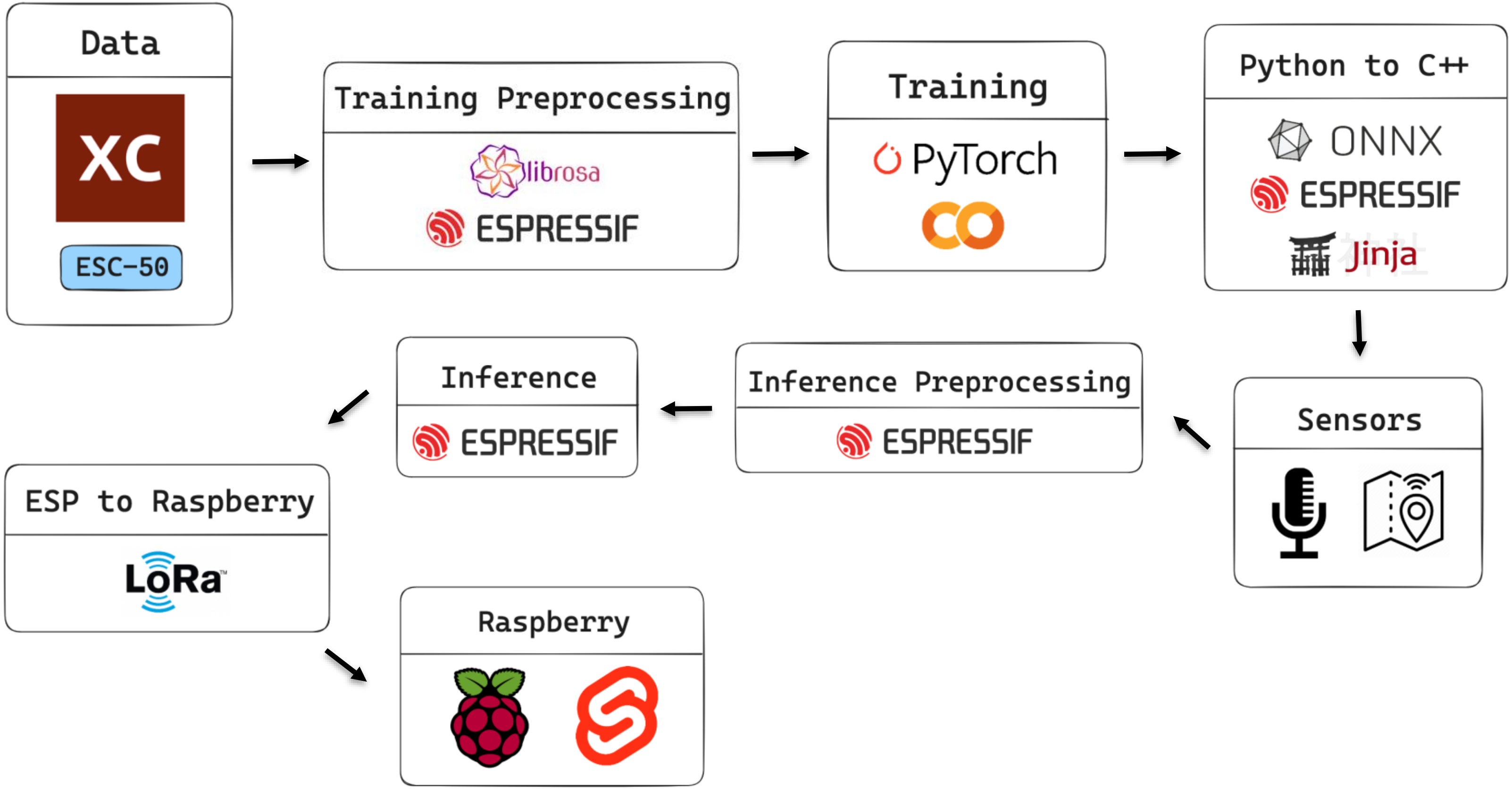
Edge Computing and the Internet of Things

Technische Universität München

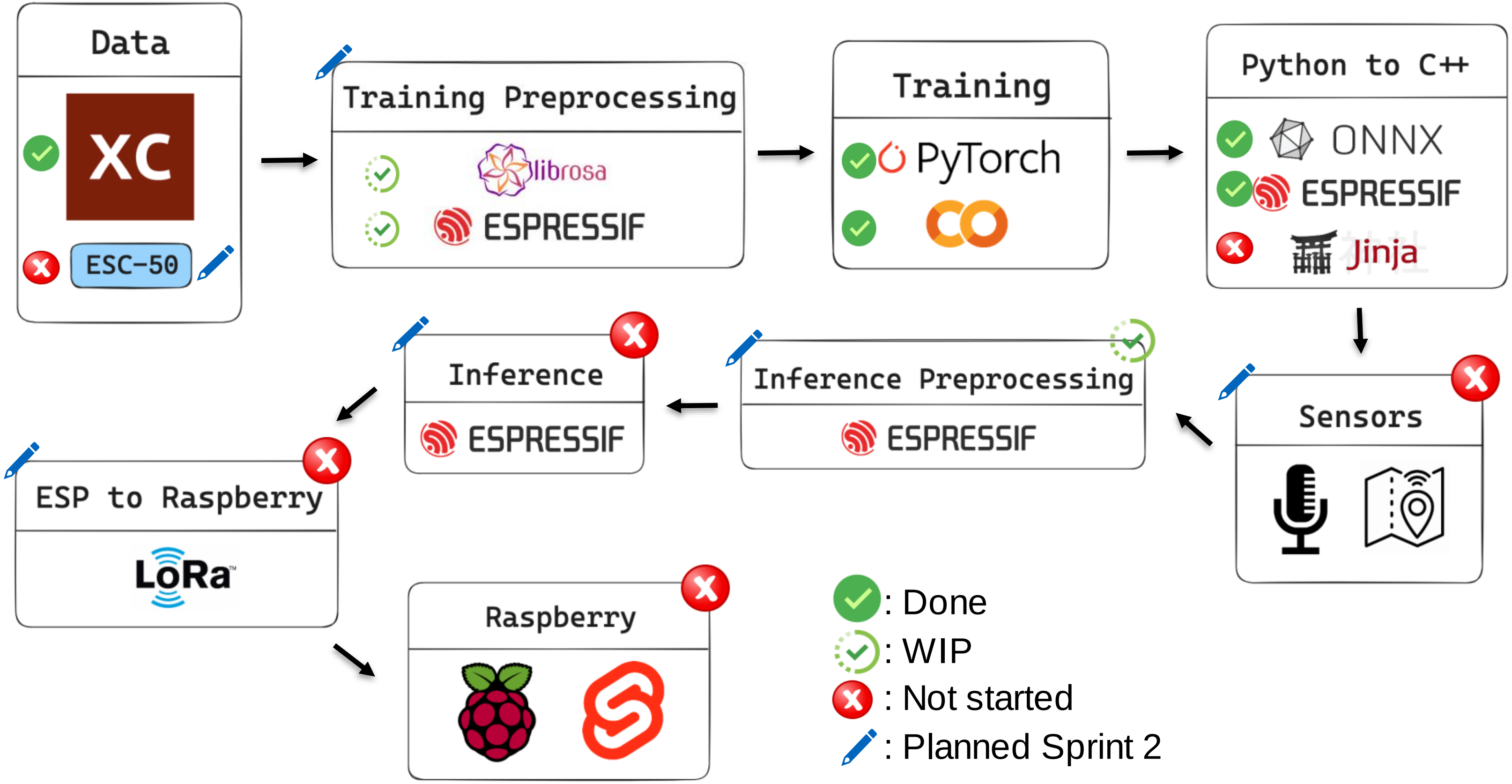
München, 08.12.2023



Functional Prototype Pipeline



Sprint 1



Data
- ✓ XC
- ✗ ESC-50 ✎

Training Preprocessing ✎
- ◌✓ librosa
- ◌✓ ESPRESSIF

Training
- ✓ PyTorch
- ✓ CO

Python to C++
- ✓ ONNX
- ✓ ESPRESSIF
- ✗ Jinja

Sensors ✎ ✗

Inference Preprocessing ✎ ◌✓
- ESPRESSIF

Inference ✎ ✗
- ESPRESSIF

ESP to Raspberry ✎ ✗
- LoRa

Raspberry ✗

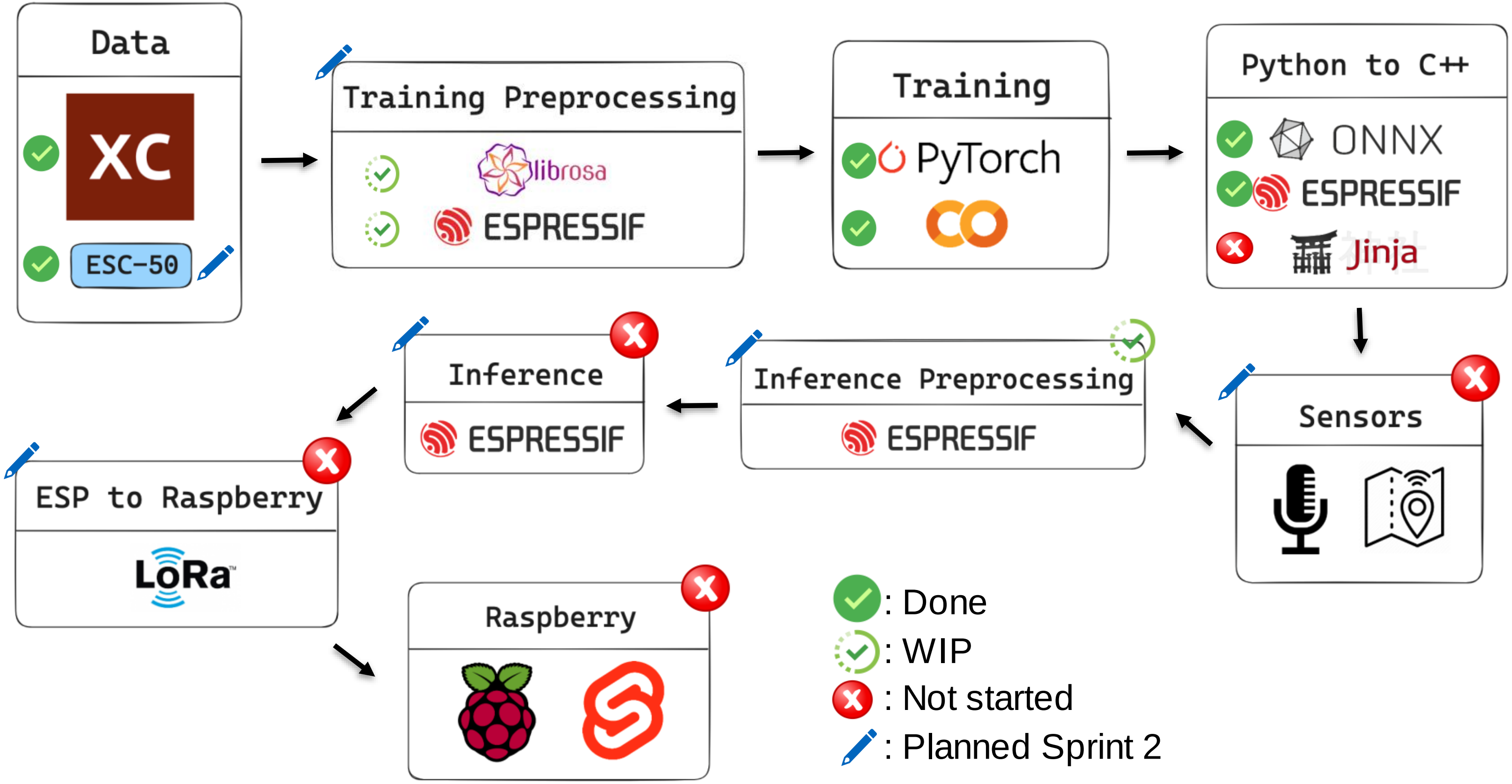
✓ : Done

◌✓ : WIP

✗ : Not started

✎ : Planned Sprint 2

Sprint 2: Integration of ESC50



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ESC-50

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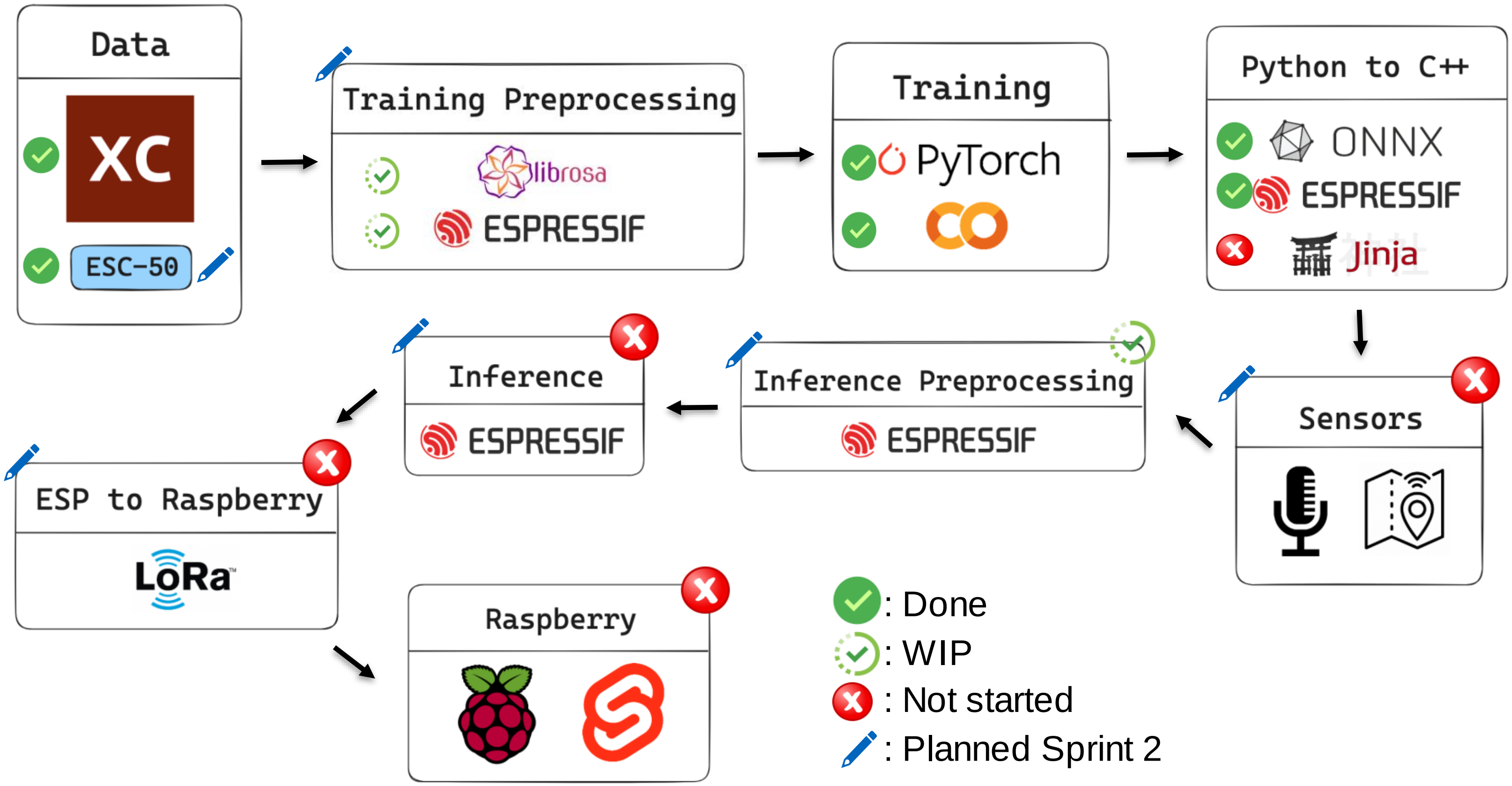
Sprint 2: Integration of ESC50

- Dataset for Environmental Sound Classification
- E.g., dog, insects, rain, thunderstorm, wind, siren, chainsaw

Sprint 2: Integration of ESC50



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Training

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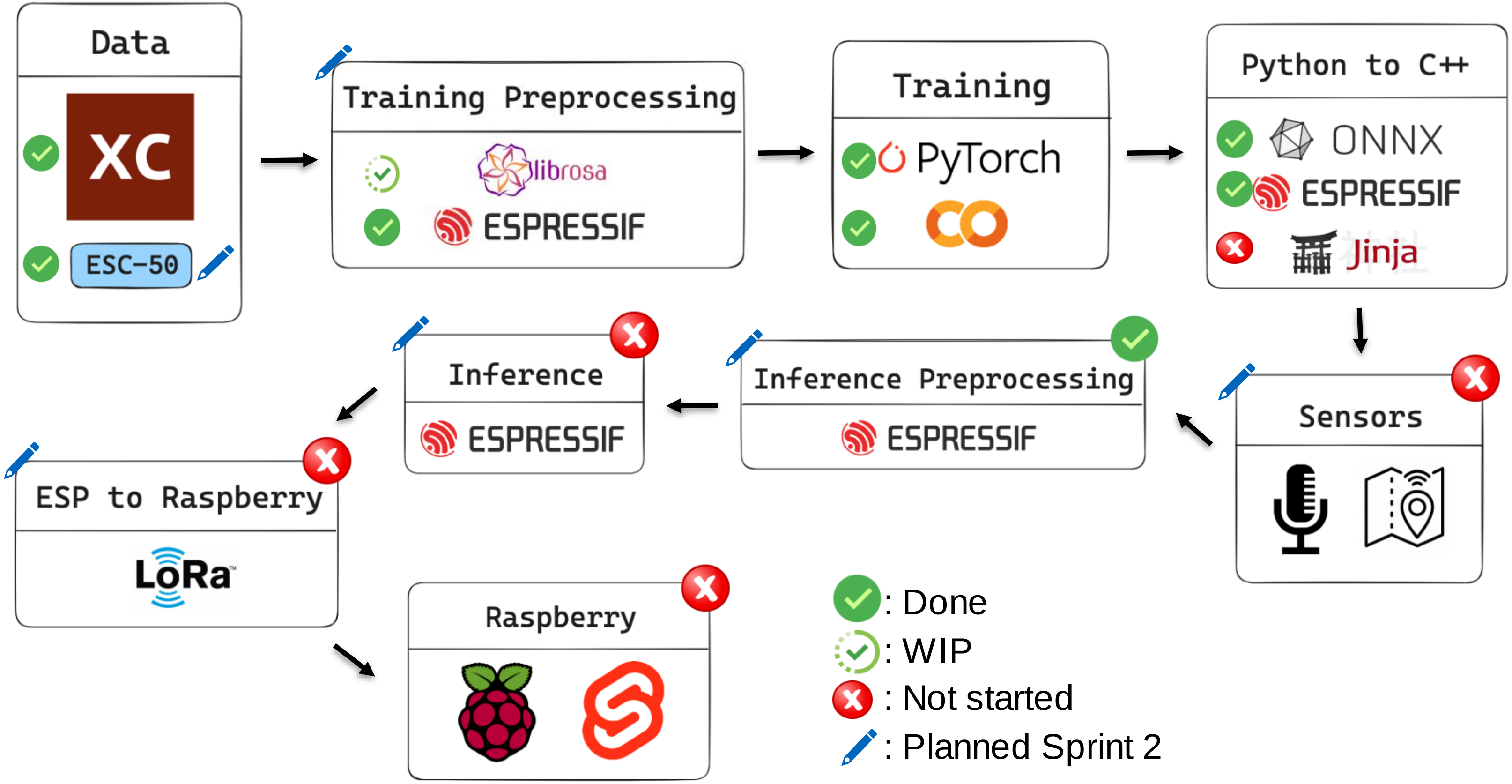
Sprint 2: Resolve MFCC discrepancies



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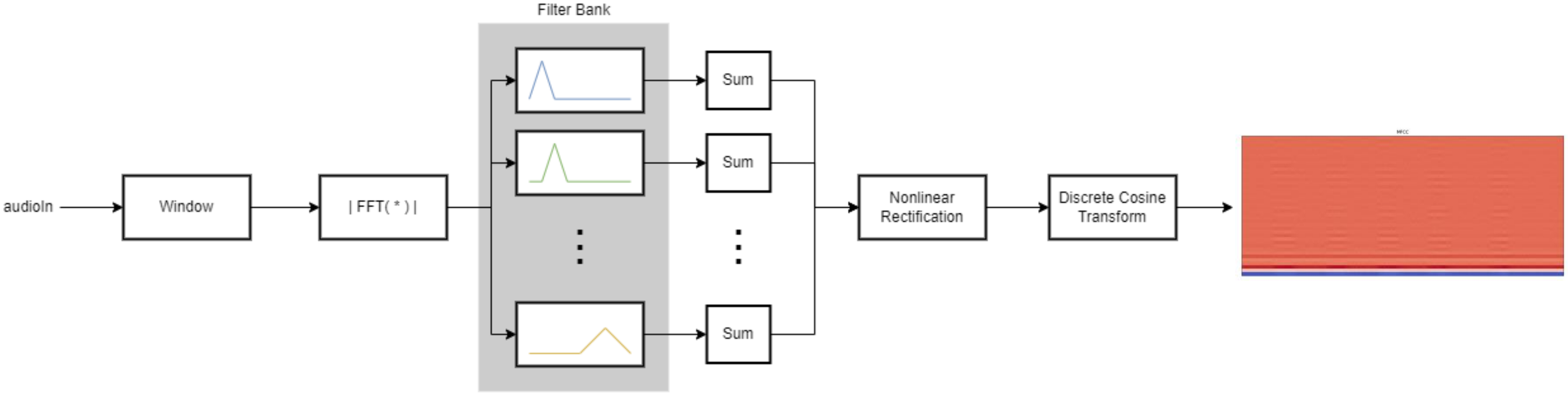
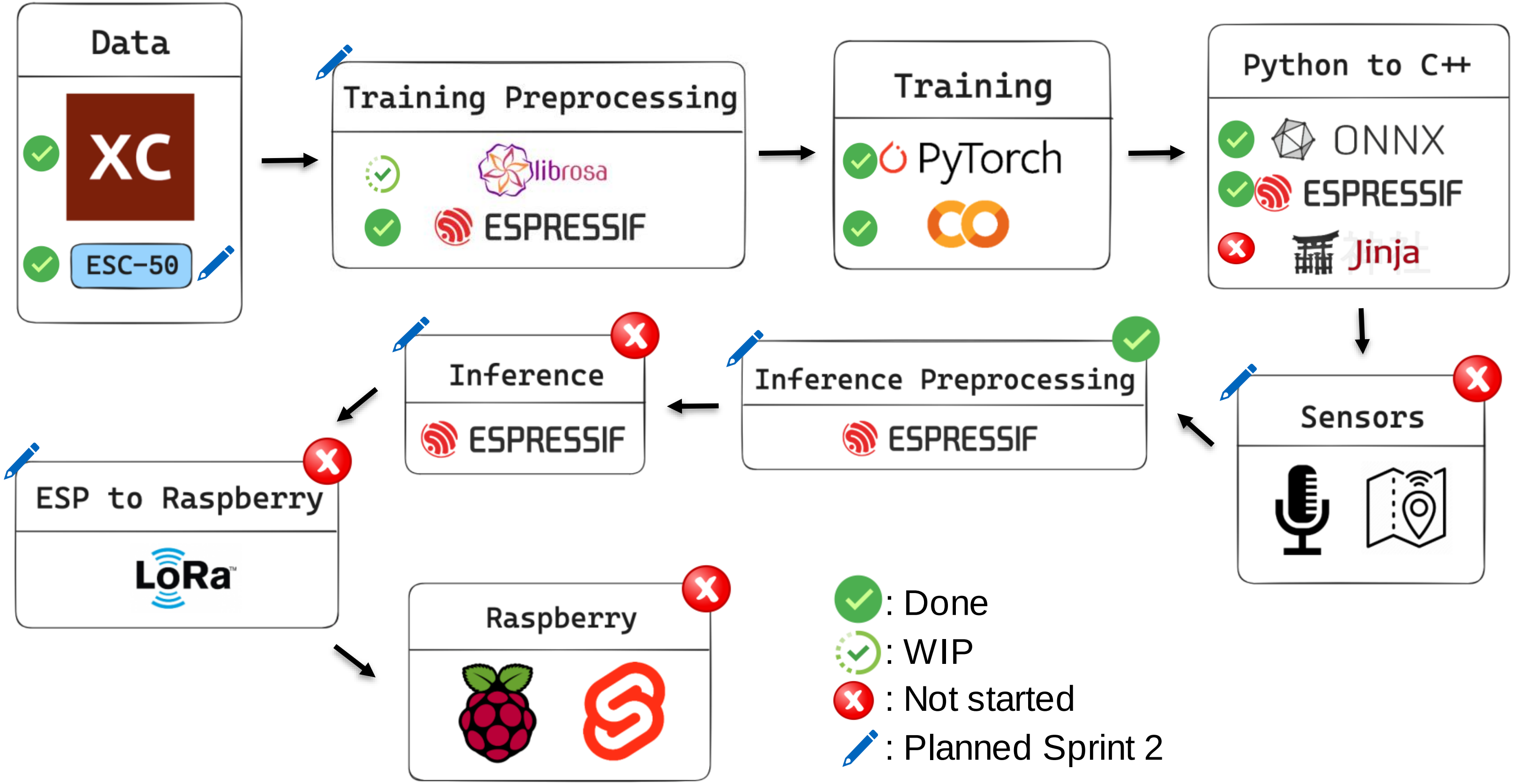
Sprint 2: Resolve MFCC discrepancies

- Custom ESP implementation using ESP-DSP functionality matches Librosa
- Additionally ported implementation to PC



[https://de.mathworks.com/help/audio/ref/mfcc.html]

Sprint 2: Resolve MFCC discrepancies



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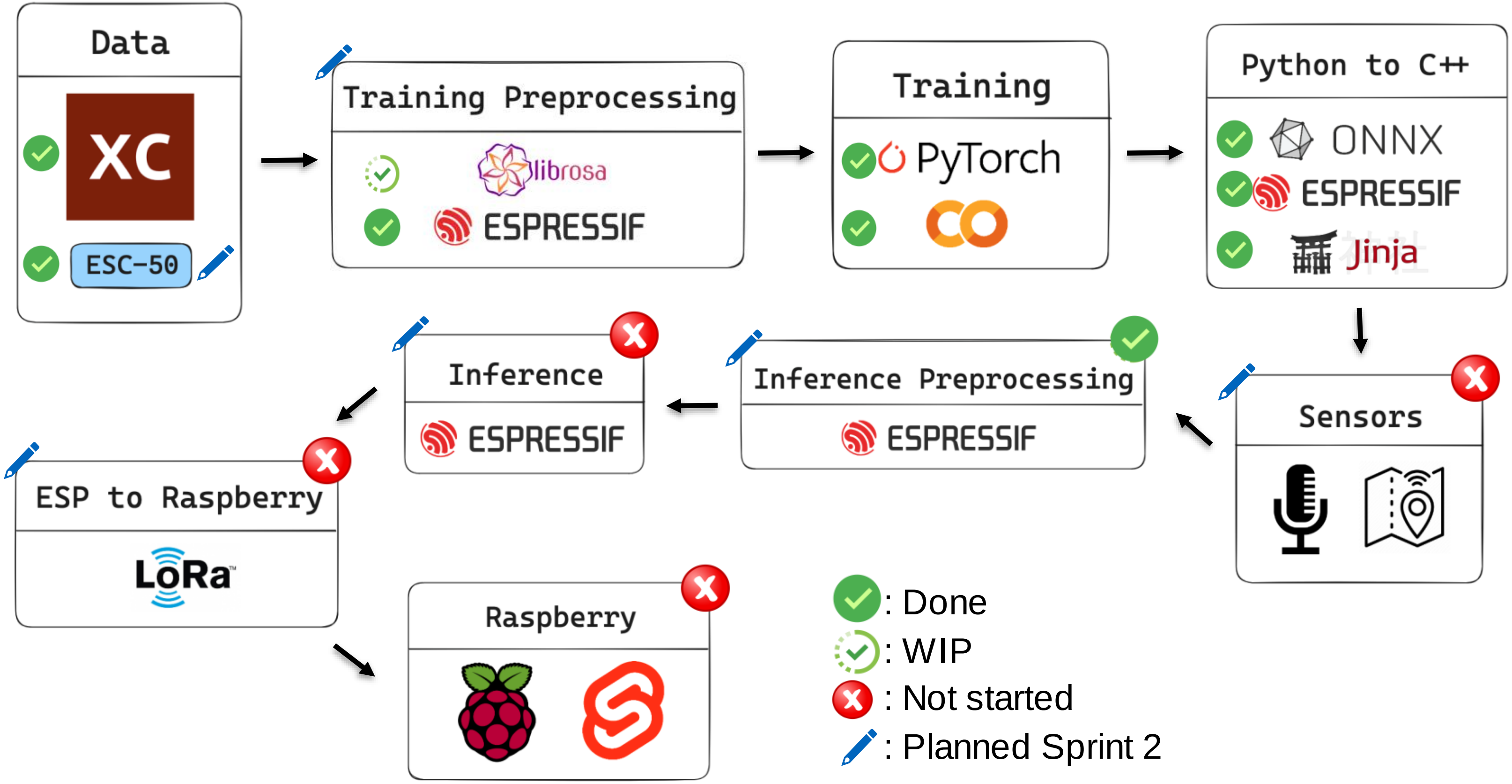
Sprint 2: PyTorch to C++ Template



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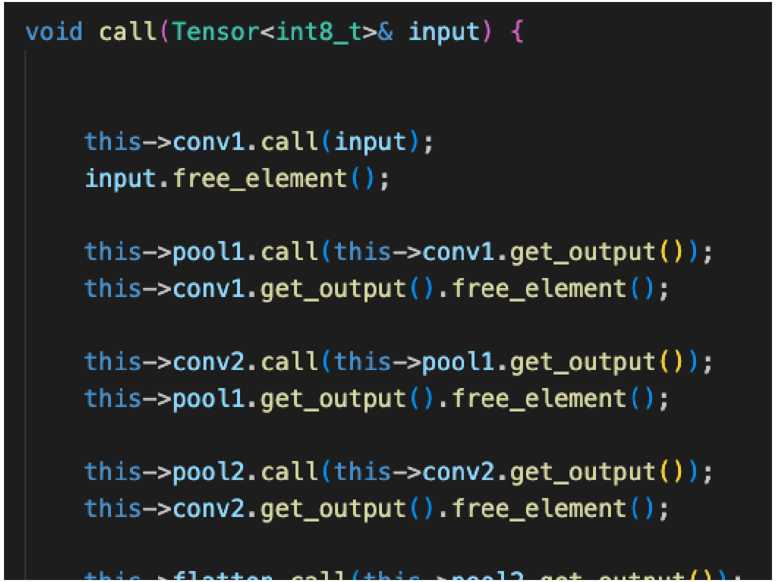
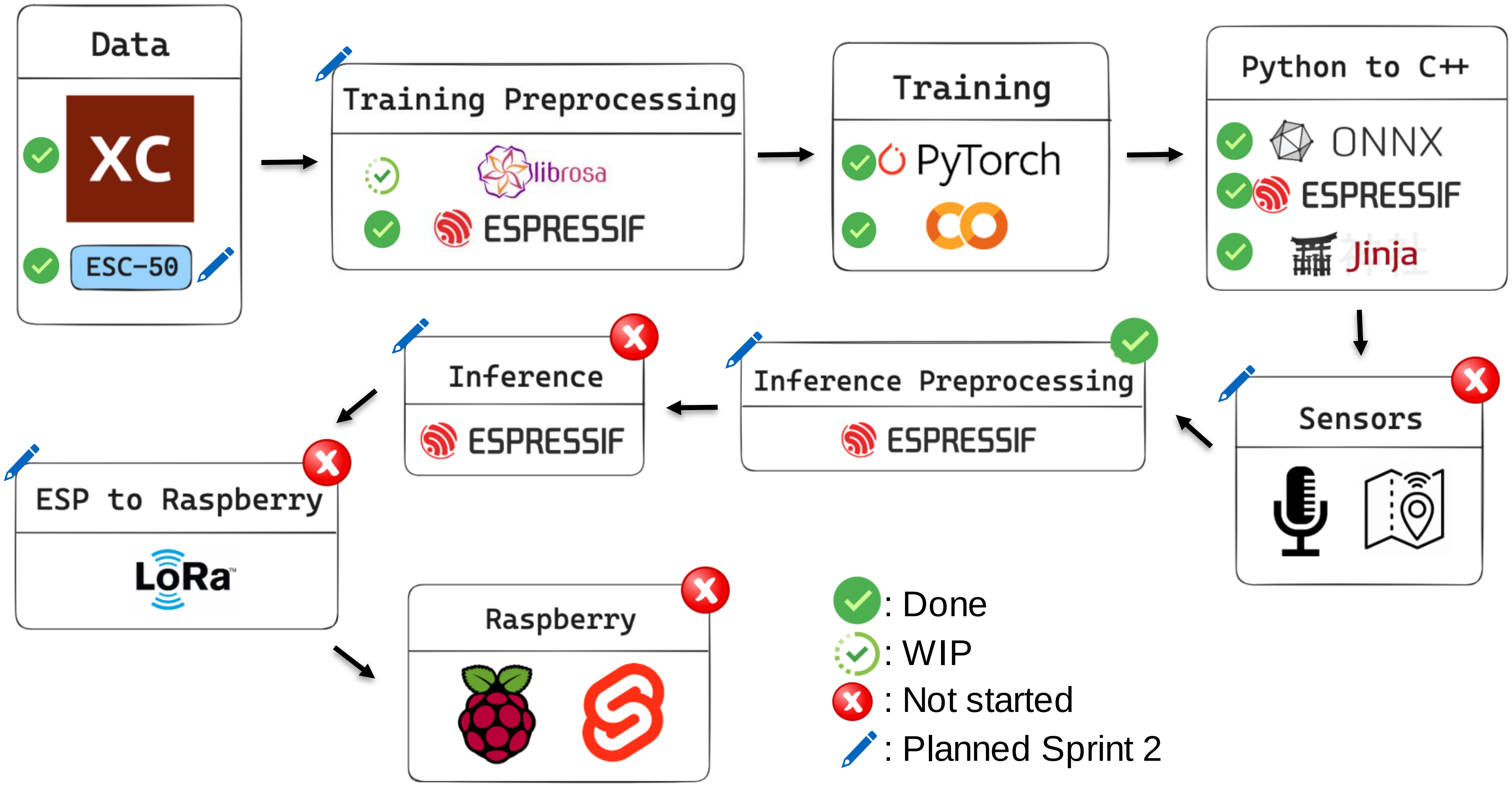
[Sprint 2] PyTorch to C++ Template

- ESP-DL Quantization generates weights but not model itself
- Jinja templates for automatic model.hpp generation



```
void call(Tensor<int8_t>& input) {


    this->conv1.call(input);
    input.free_element();

    this->pool1.call(this->conv1.get_output());
    this->conv1.get_output().free_element();

    this->conv2.call(this->pool1.get_output());
    this->pool1.get_output().free_element();

    this->pool2.call(this->conv2.get_output());
    this->conv2.get_output().free_element();

    this->flatten.call(this->pool2.get_output());
```

Sprint 2: PyTorch to C++ Template



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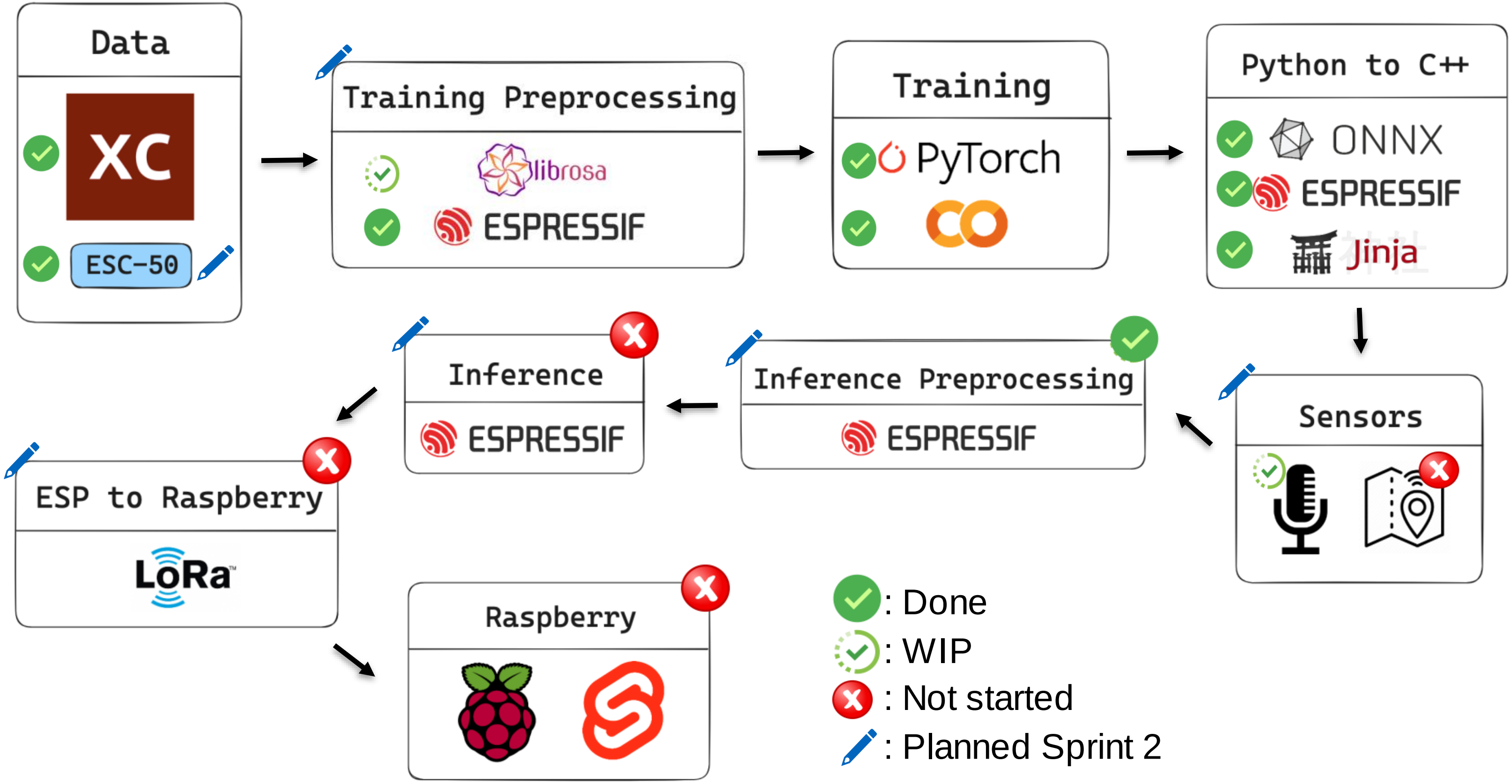
Sprint 2: Microphone



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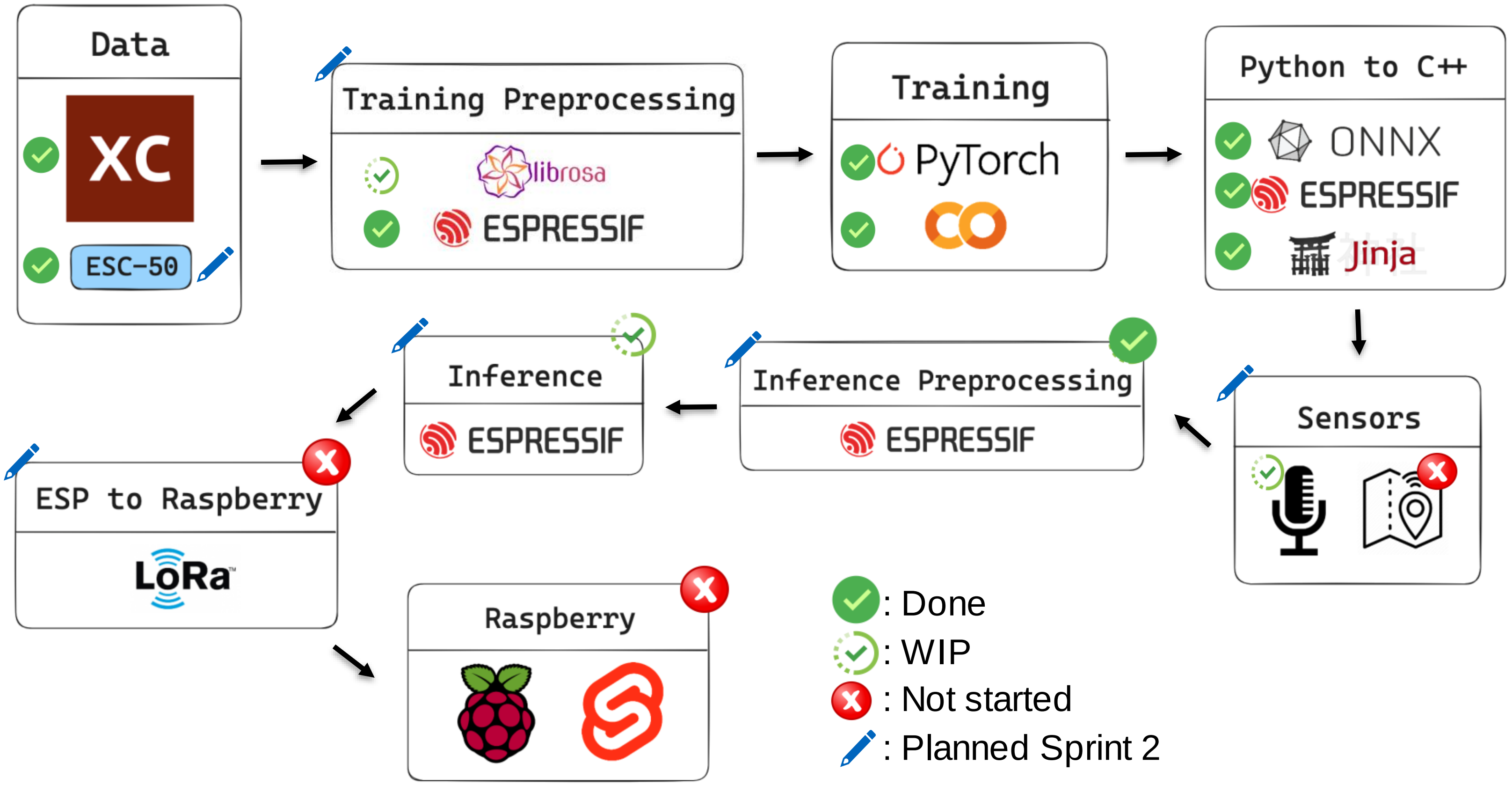
Sprint 2: Inference (Microphone – MFCC - DL)



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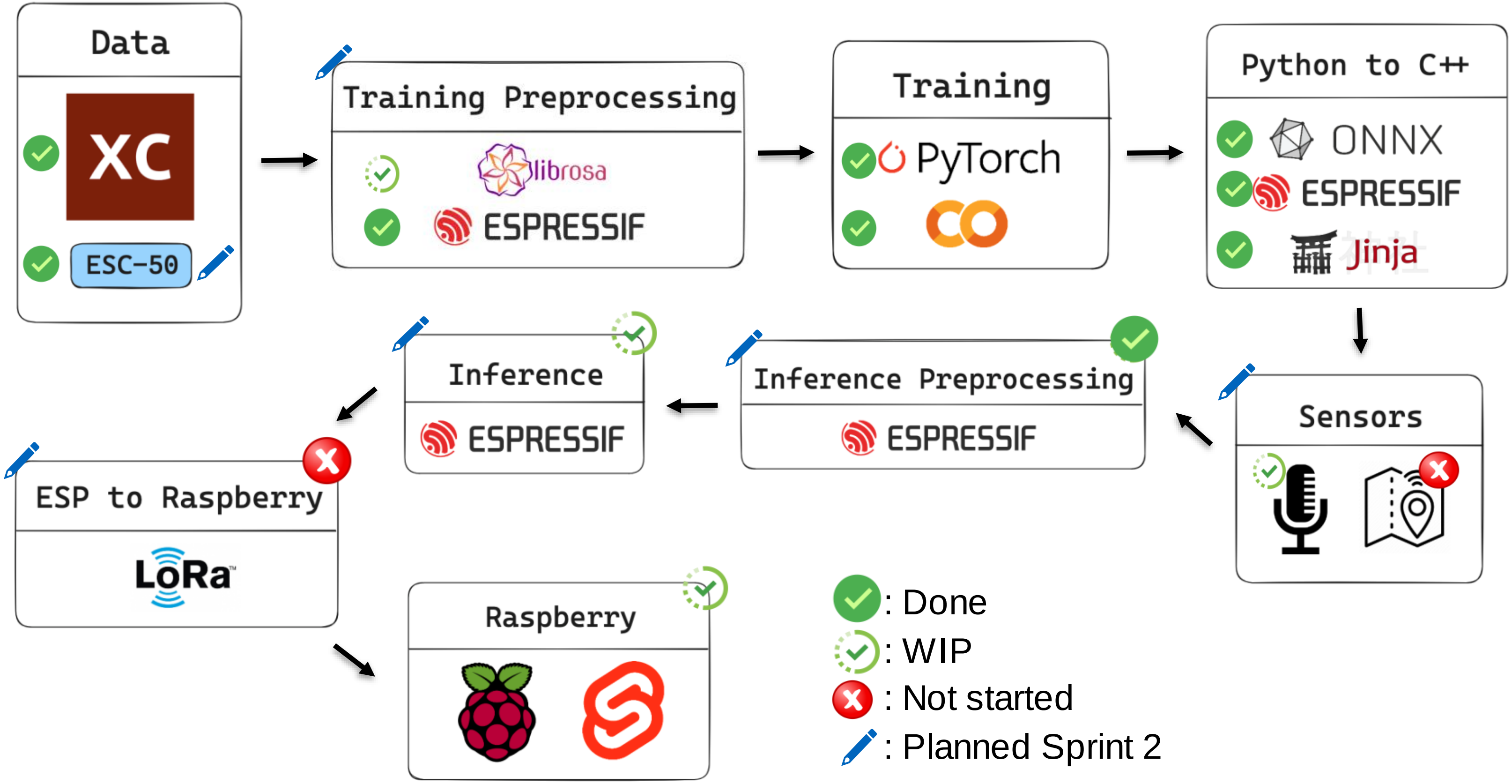
Sprint 2: Dashboard



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Sprint 2: Objectives

In general, assemble a **functional prototype**

- Integrate auxiliary data (e.g., ESC-50), resample (and split) audio files
- Build, train, and evaluate a first complete dataset
- Interconnect devices and enable sensor functionality
- Resolve MFCC discrepancies and execute the trained model on the ESP32
- (Optional) Start the development of a website/dashboard for visualization

Sprint 2: Objectives

In general, assemble a **functional prototype**

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- Build, train, and evaluate a first complete dataset
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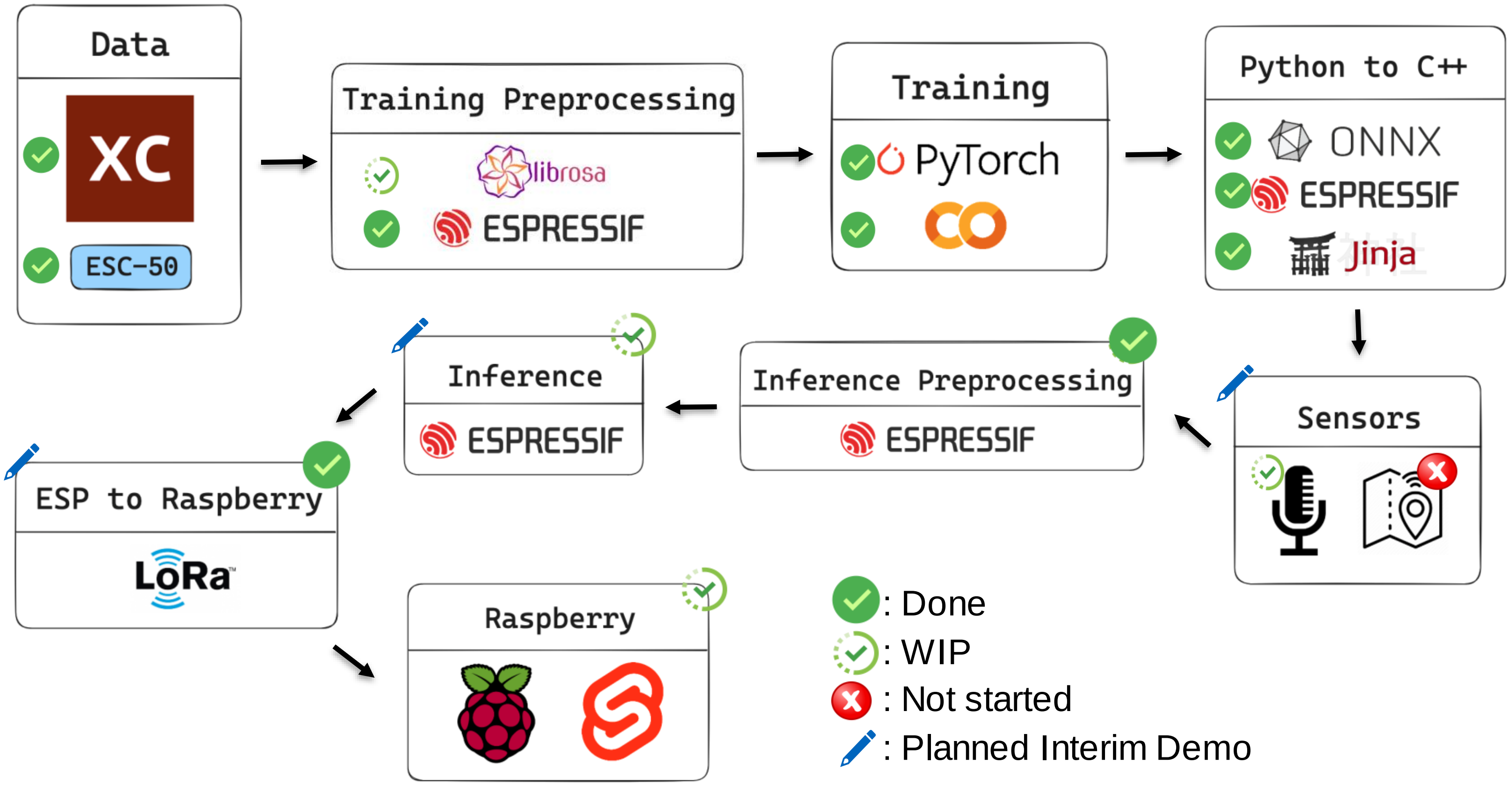
- Resolve MFCC discrepancies and execute the trained model on the ESP32
- (Optional) Start the development of a website/dashboard for visualization

Interim Demo: Objectives

In general, **run** a **functional prototype**

- **Execute the trained model on the ESP32**
- Interconnect devices (LoRa)
- (Optional) GPS
- (Optional) Improve website / visualization
- (Optional) Distinguish salient audio segments

Interim Demo: Objectives



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✎ : Planned Interim Demo