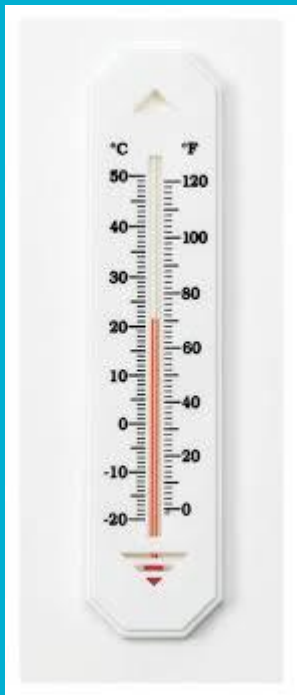


Temperature Forecasting with TinyML

Group Group: Allison Lampe, Sonia Aung, Claire Chiang,
Zourong Jiang

Problem



- Predict next hour temperature change from barometric, humidity, and current temperature
- 70%+ Accuracy
- 50 kB of RAM and 200 kB of flash
- Adaptable for multiple training features



Team

- Zourong Jiang - Data collection and model training
- Claire Chiang - Model refining
- Allison Lampe - Microcontroller configuration and data collection
- Sonia Aung - Testing
- Creating final deliverables - Everyone

Data Collection And Preprocessing

Collection

- Data source: Historic weather data from meteostat.com
- Time range: Jan 1, 2024 – Dec 1, 2024
- Raw features: Temperature (°C), Relative humidity (%), Air pressure (hPa)
- Removed missing values → clean time series of temperature

Goal

- Input different training figures
- Determine which features lead to optimal output
- Tradeoffs between higher data and higher memory usage

Data Collection And Preprocessing

Preprocessing

- Converted time series → supervised learning samples
- Final dataset size: 8,005 samples

- ```
time temp rhum pres
2024-01-01 00:00:00 8.0 49.0 1016.0
2024-01-01 01:00:00 7.8 49.0 1015.5
2024-01-01 02:00:00 6.7 55.0 1016.0
2024-01-01 03:00:00 5.0 62.0 1015.1
2024-01-01 04:00:00 5.0 60.0 1014.7
(8005, 24) (8005,)
```

# Data Training - Model Architecture - One Example

Neural Network Model Framework: TensorFlow/Keras

Input dimension: 24 (past 24 temperature readings)

Architecture (fully connected):

- Dense(32, ReLU)
- Dense(16, ReLU)
- Dense(1) - predicted temperature

Total parameters: 1,345(~5.25KB)

Small model size → suitable for deployment on Arduino Nano 33 BLE Sense

Model: "sequential"

| Layer (type)    | Output Shape | Param # |
|-----------------|--------------|---------|
| dense (Dense)   | (None, 32)   | 800     |
| dense_1 (Dense) | (None, 16)   | 528     |
| dense_2 (Dense) | (None, 1)    | 17      |

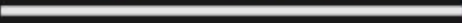

Total params: 1,345 (5.25 KB)  
Trainable params: 1,345 (5.25 KB)  
Non-trainable params: 0 (0.00 B)

# Data Training - Setup

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Split train dataset and test dataset: 80% - train, 20% - test (No Shuffling)

So far, 85% accuracy with past 24 hour temperature. Other metrics will be tested

```
995 - val_loss: 0.7922 - val_mae: 0.6311
 1/51  0s 15ms/step - loss: 0.3831 - mae: 0.50
51/51  0s 1ms/step - loss: 1.2754 - mae: 0.852
6
Test MAE (°C): 0.8525585532188416
```

