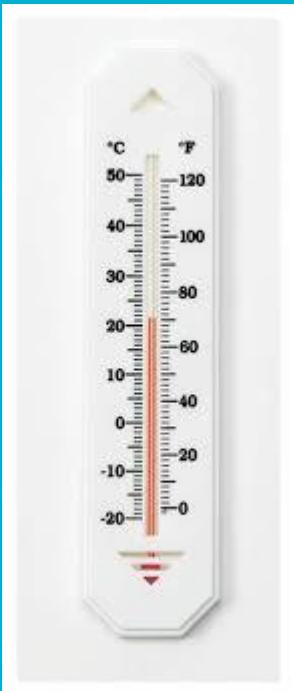


Temperature Forecasting with TinyML

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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)

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)

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

Data Training - Setup

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 ←
```