Classification of Fever Patterns using Deep Learning

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Problem Statement and Objectives

- Problem Statement
  - Use deep learning algorithms on temperature data of patients to classify diseases like TB, dengue, etc.
- Objectives
  - Classify diseases faster and with higher accuracy.
  - Find patterns in temperature data characteristic of various disease.

Data

- Dataset consists of temperature data for every minute a day (1440 data points) for 185 patients.
- We consider only 4 classes - Dengue, Non-Infectious Diseases, Non-tubercular Bacterial Infection, Tuberculosis.
- Total 144 records have been chosen.
- Train - test split of 80% - 20%
- Training records: 115
- Testing records: 29

Data

Disease	Counts
Dengue	47
Leptospirosis	15
Malaria	16
Malignancy	7
Non-Infectious Diseases	28
Non-Tubercular Bacterial Infection	37
Pyogenic Sepsis	2
Thyroiditis	1
Tuberculosis	32

Table 1: Dataset Description

Data

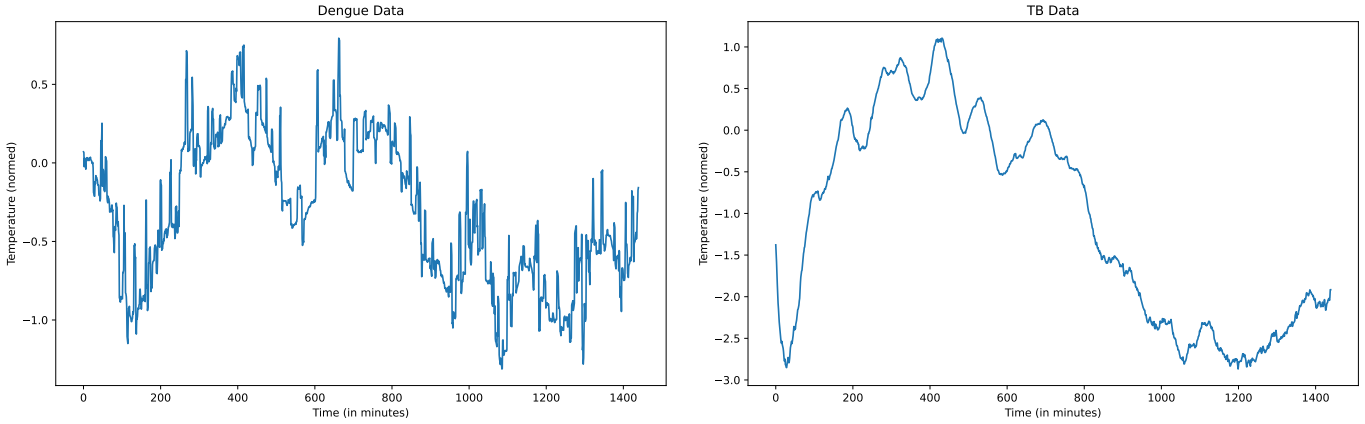

Figure 1: Temperature visualization for Dengue and Tuberculosis

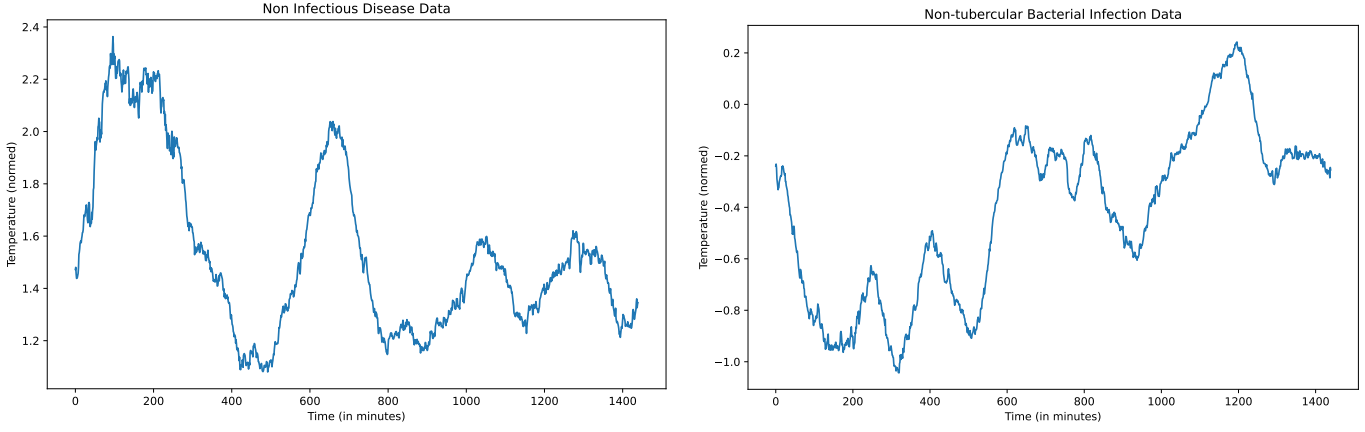

Figure 2: Temperature visualization for Non-Infectious Diseases and Non-Tubercular Bacterial Infection

Models

Model Name	# of params	Model Size (MB)
Multi Layer Perceptron	5,764	0.07
Three Layer NN (with/without dropout)	2,033,476	8.28
1D CNN	123,012	8.39
1D Two Block CNN	53,572	10.72
1D Three Block CNN	63,428	14.22
1 Layer RNN	4,548	5.96
2 Layer RNN	12,868	6.00
3 Layer RNN	21,188	6.03
LSTM	83,972	6.28

Table 2: Model Details

Training Results

Model Name	Optimizer	Loss	Accuracy	Precision	Recall	F1 Score
Multi Layer Perceptron	SGD	1.072	0.662	0.691	0.662	0.657
	Adam	1.019	0.701	0.721	0.701	0.702
Three Layer NN without Dropout	SGD	**0.847**	0.718	0.744	0.718	0.685
	Adam	1.443	0.330	0.365	0.330	0.256
Three Layer NN with Dropout	SGD	0.910	0.587	0.505	0.587	0.500
	Adam	1.423	0.361	0.269	0.361	0.243
1D CNN	SGD	1.033	0.679	0.697	0.679	0.683
	Adam	1.108	0.585	0.582	0.585	0.575
1D Two Block CNN	SGD	0.909	0.780	0.784	0.780	0.780
	Adam	0.863	0.799	0.806	0.799	0.800
1D Three Block CNN	SGD	0.873	**0.812**	**0.814**	**0.812**	**0.811**
	Adam	1.001	0.746	0.755	0.746	0.747
1 Layer RNN	SGD	1.378	0.284	0.145	0.284	0.164
	Adam	1.355	0.306	0.220	0.306	0.231
2 Layer RNN	SGD	1.366	0.311	0.137	0.311	0.166
	Adam	1.331	0.342	0.284	0.34	0.292
3 Layer RNN	SGD	1.370	0.325	0.149	0.325	0.166
	Adam	1.347	0.356	0.305	0.356	0.279
LSTM	SGD	1.368	0.321	0.103	0.321	0.15
	Adam	1.382	0.350	0.216	0.350	0.242

Table 3: Model Training Metrics

Testing Results

Model Name	Optimizer	Loss	Accuracy	Precision	Recall	F1 Score
Multi Layer Perceptron	SGD	1.411	0.344	0.363	0.344	0.337
	Adam	1.401	0.310	0.324	0.310	0.311
Three Layer NN without Dropout	SGD	1.363	0.379	0.445	0.379	0.324
	Adam	1.398	0.344	0.748	0.344	0.409
Three Layer NN with Dropout	SGD	**1.288**	0.413	0.551	0.413	0.459
	Adam	1.329	0.413	**1.000**	0.413	0.585
1D CNN	SGD	1.369	0.344	0.340	0.344	0.337
	Adam	1.369	0.379	0.393	0.379	0.369
1D Two Block CNN	SGD	1.453	0.241	0.476	0.241	0.260
	Adam	1.426	0.275	0.384	0.275	0.286
1D Three Block CNN	SGD	1.457	0.275	0.521	0.275	0.342
	Adam	1.416	0.310	0.439	0.310	0.360
1 Layer RNN	SGD	1.338	**0.448**	0.635	**0.448**	**0.524**
	Adam	1.373	0.310	0.366	0.310	0.334
2 Layer RNN	SGD	1.352	0.413	0.770	0.413	0.534
	Adam	1.372	0.275	0.351	0.275	0.306
3 Layer RNN	SGD	1.356	0.344	0.896	0.344	0.498
	Adam	1.413	0.344	0.896	0.344	0.498
LSTM	SGD	1.367	0.344	**1.000**	0.344	0.512
	Adam	1.460	0.206	0.455	0.206	0.283

Table 4: Model Testing Metrics

Future Steps

- Run GradCAM and other explainable AI tools.
- Run models on other available open-source temperature datasets to check performance on OOD data.
- Optimize model to work with less data point, rather than entire 1440 data points.

References

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