Applying Hidden Markov Models in a Heatwave Early Warning System for South Sudan

This project aims to develop a mobile-based AI system to predict extreme temperature events in South Sudan up to 10 days in advance. A Hidden Markov Model can be used to learn weather patterns and identify hidden climate states based on observed environmental data.

Observations

The HMM will use:

- Daily maximum temperature
- Humidity
- NDVI (vegetation stress)
- Solar radiation
- Soil moisture
    These are obtained from sources like NASA POWER and Google Earth Engine.

Type of HMM Problem

This is a learning problem, as the hidden weather states are not labelled and must be inferred from observed sequences.

Training Algorithm

We will use the Baum-Welch algorithm, which iteratively learns the best model parameters.

- Known values:

    - Observed data
    - Number of hidden states
    - HMM structure (Gaussian emissions)

- Unknown values:

    - Initial state probabilities
    - Transition probabilities
    - Emission parameters (means, variances)

Parameter Updates

The algorithm updates:

- Initial state probabilities
- State transition matrix
- Emission parameters per state (mean & variance)

This allows the model to learn the temporal pattern of heatwave events for early alerts.