Introduction

Capstone Idea

Using contrastive learning on image data to detect pre-symptomatic viral maize diseases using maize leaf images. This involves subtle, early indicators (e.g., faint streaks or yellowing) not easily visible to the naked eye or classical CNNs.

Assignment Questions

1. **Describe the Observations**:

   In my capstone project, the observations are time-sequenced feature vectors extracted from the maize leaf images. These could be the contrastive learning embeddings, Image patch-level colour or texture descriptors, or CNN-extracted feature vectors that represent disease-relevant patterns.

2. **What type of HMM problem does this study primarily address?**
   Since this is an unsupervised learning HMM task, I do not know the hidden states in advance, so the HMM is used to learn hidden health states from patterns in observations and infer temporal transitions between stages of disease development. Thus, this aligns well with the **learning problem** in HMM theory.

3. **Training Algorithm:**
   The Baum-Welch algorithm iteratively estimates the optimal parameters (emission probabilities) to maximise the likelihood of the observation sequences.

   a. What values are known at the start?
   The observation sequences, the form of the emission distribution, and the number of hidden states are assumed.

   b. What values are unknown and need to be learned?
   The probabilities of starting in each hidden state, the Emission parameters and the actual hidden state sequence

4. **Which parameters are updated in each iteration of the training process?**
   Each iteration of the Baum-Welch algorithm updates:
   a. Initial probabilities based on how likely the sequence starts in each hidden state
   b. Transition Matrix between each pair of states across the observation sequence
   c. Emission probabilities