Hidden Markov Models -

a hidden markov model (HMM) models a sequence where the system has hidden states and observable outputs. the hidden state at time t depends only on the state at time t-1 (markov property).

an HMM is defined by three probability components:

- initial state distribution

$$\pi_i = P(s_1 = i)$$

- transition probabilities

$$A_{ij} = P(s_{t+1} = j \mid s_t = i)$$

- emission probabilities

~~$A_{ij} = P(s_{t+1} = j \mid s_t = i)$~~

$$B_j(o_t) = P(o_t \mid s_t = j)$$

the joint probability of a state sequence s and observation sequence O is:

$$P(O, s) = \pi_{s_1} B_{s_1}(O_1) \prod_{t=2}^{T} A_{s_{t-1} s_t} B_{s_t}(O_t)$$

the forward algorithm efficiently computes $P(O)$ by dynamic programming, while the viterbi algorithm finds the most likely hidden state sequence. HMM uses probability theory to model uncertainty and temporal structure in sequential data.