Question 3.

Problem 1: Given the observation sequence O = O1 , O2 , …, OT and a model λ = (A, B, π), how do we efficiently compute P(O|λ), the probability of the observation sequence given the model?

**The meaning of the above problem regarding the detection of anomalous patterns in stream data received from a continuously operating system can be conceptualized by the following:**

Suppose we are monitoring a supervisory control system that outputs a continual stream of data. Given a subset of this stream of data, and using machine learning techniques, we may produce a model λ = (A, B, π). That is, we may produce a model that, hopefully with some accuracy, is able to predict future observations or unearth the probability of seeing a sequence of observations.

Now, given the model we have created, suppose a set of data is produced by the supervisory control system that we are monitoring. We might conceptualize this new set as a sequence of observations O = O1 , O2 , …, OT. What we would like to know is, given the model that we produced based on the subset of stream data from the SCS, what is the probability of seeing this new set of observations? Is it anomalous? Is it "normal-ish?". Our challenge is to efficiently compute the probability of seeing this sequence of observations, given the model we have produced, so that we can make decisions about whether a cyber intrusion is occurring, or not, and if it is, how best to proceed.