Question Set 2

LPC, Dynamic Programming, Markov Model, Hidden Markov Model

1. Describe the principle of LPC analysis
   - Analysis window, principle of LPC, LPC parameters, estimation rate, optimization criterion.
   - Given a linear prediction order, what is the bit rate necessary to transmit speech signal sampled at 8kHz (using 8 bits per sample), before and after LPC coding? Explain your solution.

2. Principle of dynamic programming: goal (examples of applications), basic principle, typical equation.

3. *Deterministic* approach for speech recognition using dynamic programming
   - General principle
   - Reference sequences (templates)?
   - Comparison of the sequences?
   - Advantages and disadvantages, why is it deterministic?

4. Definition of first order discrete Markov model
   - Discuss an application example and underlying hypotheses
   - How many parameters are there if we have a K states fully connected Markov model?

5. In a discrete Markov model, how to calculate the probability to start from initial state q_i and end at final state q_f in N steps:
   - What are the two possible solutions?
   - For each of the solutions, give the recursion to be used?

6. In a state-of-the-art statistical speech recognition system, where do we use discrete Markov models and where do we use hidden Markov models?

7. Definition of a hidden Markov model:
   - Definition and differences with discrete Markov model?
   - Example of an application
   - How many parameters are there in a first order hidden Markov model with:
     - K states fully connected
     - Emitting a vector of *dimension d*
     - Each state is parameterized by a single Gaussian probability density function (with diagonal covariance matrix)