Summaries:

1. Gene finding and the Hidden Markov models
    a. In this paper, the Hidden Markov Model (HMM) and Viterbi Algorithm are used to identify regions of interest from nucleotide and amino acid sequences. Each segment in the sequence corresponds to a hidden state and the biological sequence is modeled as a sequence generated by a double stochastic process. A Markov chain then simulates the transition from a segment of one type to another when a hidden state changes to another. Once in each hidden state the sequence elements, nucleotides or amino acids are emitted to generate the corresponding segment.

       This is done by giving the model the initial probabilities p, transition matrix T, emission matrix E, an observable sequence s and the biological sequence.However, the p, T and E are frequently unknown, but we can estimate these values given an observable sequence s. In fact, we solve this by running the Viterbi algorithm iteratively on it. This gives us the maximum likelihood hidden sequence h* as well as estimates of p, T and E. HMMs can also be trained by supervised learning or unsupervised learning. In supervised learning, it uses a set of sequences for which the corresponding sequence is known and in unsupervised learning it uses approximately initial estimate of the initial p, E and T.

2. Hidden Markov Model for Stock Trading
    a. In this study, we use HMM for multiple independent variables: open, low, high and closing prices of the S&P500, select the best model and predict the S&P500 price. This predicted price was then compared to historical average return model (HAR) then the HMM and HAR are used to trade stock and confront the results. The models will be evaluated by 4 criteria: Akaike information criterion (AIC), Bayesian information criterion (BIC), Hannan-Quinn information criterion (HQC) and Bozdogan Consistent Akaike Information Criterion (CAIC) while the out-of-sample predicts will use out-of-sample R^2 and the cumulative squared predictive errors to compare the performances of HMM and HAR.

       They limited the number of states from 2-6 to keep it simple and feasible with cyclical economic stages. The Baum-Welch algorithm was used to maximize the log-likelihood of the model and the criterias calculatedwith their respective formulas. Using the S&P500 monthly data to train the HMM of ten year periods (Dec 1996-Nov 2006) and the 4 prices, to calibrate the HMM's parameters and calculate the

criteria. They used S&P500 monthly data over a ten year period (Dec 1996-Nov 2006) and the 4 prices to calibrate the HMM's parameters using the Baum-Welch Algorithm. The parameters were used to calculate the probability of the observations and finally to calculate the criterias with their respective formulas. This process is repeared 120 times for 120 blocks of data by moving the block of data upwards by a month each time and the AIC, BIC, HQC and CAIC were compared. They found that the 4-state HMM is the best model and used it to predict stock prices then compared it to historical average return method with data from Jan 1950- Nov 2016. They found that the HMM outperforms the historical average model in predicting stock returns and prices. Finally, when used in actual trading the HMM beats the HAR model in all cases as it captures very well the change of input data at a single point and also beats the Buy & Hold strategy, yielding higher returns.

3. **High Temperature and High Humidity Reduce the Transmission of COVID-19**
    a. This paper investigates the influence of air temperature and relative humidity on the transmission of COVID-19. They calculated the daily effective reproductive number R for 100 Chinese cities with more than 40 cases from January 21-23. THey used linear regression to observe the relationship between high temperature and transmission with the transmission of Covid-19. They found that high temperature and humidity significantly reduced the transmission of Covid-19, which was consistent with previous observations with influenza and SARS. They hope that the arrival of summer and rainy season in the northern hemisphere can reduce the transmission of Covid-19.