GP Assignment – Simple Markov Process Investigation

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Abstract: This assignment entails a search for knowledge about Markov processes, real world applications of Markov processes, and perspectives on the strengths and weaknesses of Markov models. It then calls for the expression of that knowledge in the form of a short essay.

Conception and Establishment of Markov Processes

Markov Processes were studied by Russian mathematician Andrey Markov in 1906 - 1907 when he published his first paper on the topic titled, *Extension of the Law of Large Numbers to Dependent Quantities*. Within this paper, Markov showed that under certain conditions the average outcomes of the Markov chain would converge to a fixed vector of values and proved that independence isn't necessary for the *weak law of large numbers* to hold. Andrey Markov applied mathematics to poetry when he found patterns of vowels and consonants in Pushkin's poem titled *Eugene Onegin*. On January 23rd, 1913, he released his findings to the Imperial Academy of Sciences in St. Petersburg. The technique Andrey Markov developed within these papers is now known as the **Markov Chain**.

Real World Applications of Markov Processes

In 1948, Claude Shannon publishes *A Mathematical Theory of Communication*, which lays the foundations of information theory. Within this paper, Shannon used Markov Chains to model the English language and produce English-like text. In 1957, Lejaren Hiller and Leonard Isaacson compose the *Illiac Suite*, which was made using the ILLIAC I computer. Within the composition, Markov Chains were used with manually specified transition probabilities. Other less specific

examples of modern-day applications of Markov Chains include *text prediction, text generation, traffic light times, salmon fishing, hospital admissions, weather prediction, Google PageRank, macroeconomics,* and many others.

Strengths and Weaknesses of Markov Processes as a Modeling Tool

The fact that Markov Chains are memoryless can be both a strength and a weakness. Only memoryless systems can be solved directly in terms of the global balance equations. However, the memoryless quality is also the Markov Chain's main weakness as the memoryless quality derives from the dependence on exponential distribution. In other words, relying on the idea that future behavior is independent of past behavior creates a globally accessible model, yet a model that is dependent on *all* inter-event times being exponentially distributed.

References

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