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COG 356 - Markov Investigation

Abstract

In this document, I will present some information gathered from resources acquired online pertaining to Markov processes and their founder.

Markov chains are a stochastic process used to predict future states based on a given present state. They were first conceived of by a man named Andrei Markov around the year 1906, when Markov was 50 years old. Markov attended St. Petersburg Grammar School as a youth, where he excelled almost exclusively in mathematical subjects. He later taught calculus and probability in St. Petersburg as a professor. His invention of Markov chains were incredibly important to the development of probability theory and modeling, as they could be used to predict many real-world events. Before their discovery, it was thought that only independent probabilities could converge to real numbers, but Markov managed to prove that dependent probabilities could as well, as long as every possible state was reachable. Markov's brother, Vladimir, was on his way to eminence in the mathematical field as well, though he died tragically of tuberculosis at the age of 25.

Markov chains use a probability matrix to represent the chances of transitioning to a state, given a starting state. They have applications in modeling animal populations, musical compositions, certain games (gambling), speech recognition, market trends, and much more. The first application of a markov chain by Markov himself was an analysis of a Russian poem, using

occurrences of vowels and consonants to predict the following letters. Since Markov chains will always converge to real numbers if repeated long enough, this means that given a large enough sample size, a system with constant dependent states can be “encoded” into a state transition probability matrix. Such a matrix seems to be able to grasp some essence of the system that inspired it, to a degree which varies depending on the transience of its transition probabilities.

Markov models are helpful for modeling things that have discrete, constant, and stochastic state transition probabilities, but are not as good at modeling things which have unpredictable or independent transition probabilities, such as what a person eats for breakfast. A markov model has no room for external triggers, which makes it a poor choice for modeling things like the migration of birds. It is also memoryless, which can be a strength or a weakness, depending on whether you aren’t aware of past states, or past states are able to impact future transitions, respectively.

Sources

Markov Chains Clearly Explained! Part - 1

https://www.youtube.com/watch?v=i3AkTO9HLXo&ab_channel=NormalizedNerd

Markov Chain

https://en.wikipedia.org/wiki/Markov_chain

Andrey Markov

https://en.wikipedia.org/wiki/Andrey_Markov

Markov and the creation of markov chains

https://www.maths.usyd.edu.au/u/eseneta/senetamcfinal.pdf

Origins of markov chains

https://www.youtube.com/watch?v=Ws63I3F7Moc

An introduction to markov chains and their applications within finance

http://www.math.chalmers.se/Stat/Grundutb/CTH/mve220/1617/redingprojects16-17/IntroMarkovChainsandApplications.pdf

Markov Chain Examples and Use Cases - A Tutorial on Markov Chains

https://www.youtube.com/watch?v=4q3H_ZN01kk&ab_channel=FullstackAcademy