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LAM CS 470

Monte Carlo Problems

Monte Carlo Method and Application:

Monte Carlo simulations are used to view any scenario as a system, one where you can model the probability of different outcomes in a computerized, mathematical way which allows people to account for risks and uncertainty in quantitative analysis and decision making. Since its introduction during World War II, Monte Carlo simulations have been being used to model several physical, as well as, conceptual systems. Monte Carlo simulations have found their way into being used in virtually every professional field ranging from business related areas like finance, project management, and marketing to more science-oriented careers like engineering, transportation and computer science.

One practical application on Monte Carlo simulations is to use it to model movements and changes in asset prices on a day-to-day basis. There are two key components to determine an asset's price movements: drift, which is a constant directional movement, and a random input which represents a market's volatility (the higher the volatility the riskier the investment). By analyzing historical price data, you can find the drift, standard deviation, variance and average price movement of an asset. After determining a periodic daily return and the drift, you have to obtain a random value by multiplying the standard deviation by the inverse of the cumulative standardized normal distribution when passed a randomly generated value (random value = standard deviation * NORMSINV(RAND())). With all these values found, you can then estimate the next day's price of an asset through the formula: today's price * e ^ (drift + random value).

By generating an arbitrary number of simulations, you can assess the probability that an asset's price will follow a given trajectory. This is an application of Monte Carlo simulation that would minimize the risk taking in stock choices (Kenton).

Another application, in the realm of transportation, is the age-old traveling salesman problem. Using Monte Carlo simulation to account for more realistic issues like rush hour traffic patterns or inclement weather patterns in certain areas along the salesman's route(s) might help determine whether or not a certain route is still optimal to take between Point A and Point B (Optimization).

Lastly, a third application could be selected from a wide array of tests done by NASA. Monte Carlo simulation allows for the identification of all possible outcomes of events, making it easier to assess the impacts of certain decisions under undefined initial conditions. By creating an extensive umbrella of "what-if" tests by treating every input variable as a probability distribution function you can avoid a lot of the risks of uncertainty. Being used for testing provides mission-critical software assurance for both current and future spacecraft and unmanned aerial vehicles. NASA relies on these simulation analyses to obtain a comprehensive and quantifiable view of not only what could happen, but the likelihood of its occurrence (Asbury).

Discussion Documentation:

Progress so far is steady working towards finding a Monte Carlo simulation to apply the parallelized algorithms to. As of now, we are thinking about just applying it to the Traveling Salesman problem but might try to simulate a second applicable problem. So far, we have two of the algorithms we are planning on using parallelized, as well as a direction to head in. We should be parallelizing a third algorithm before we start running simulations on the traveling salesman problem. The poster will include a brief introduction to the Monte Carlo Method including a description and brief history, it should include a similar description of the problems we are simulating (Traveling Salesman and maybe other(s)), and it will include the results of our tests and a synopsis of the findings. Currently there are no roadblocks and we should finish by the deadlines given to us.

GITHUB LINK:

https://github.com/CFHistory/cs470prngs/invitations

Works Cited

Monte Carlo Simulation

Will Kenton – https://www.incestopedia.com/terms/m/montecarlosimulation.asp

Optimization Of the Time-dependent Traveling Salesman Problem with Monte Carlo Methods

J Bentner-G Bauer-G Obermair-I Morgenstern-J Schneider –

https/://www.ncbi.nlm.nhi.gov/pubmed/115580476

Monte Carlo Simulation

Michael Asbury - https://www.nasa.gov/centers/ivv/jstar/monte_carlo.html