Project 6 – Numeric Computations with Taylor Polynomials

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This project consists of three parts. First, the construction of the Taylor expansion of a function with multiple variables. Second, using the Taylor expansion to calculate a numeric solution to a nonlinear differential equation. Finally, using a differential equation to model a problem in the context of a computer system.

**Responsibilities**

In the first part, two distinct differential equations were solved manually using Taylor’s method. The answers were numerically converted and represented in python code to create a visual representation. The second part involved solving another differential equation using the power series, to find the recurrence formula and consequently an approximate solution. This too was modeled in python. The final part involved finding a differential equation to measure performance for real-world situations.

**Specific problem solved**

*Part 1*

1. , ,
2. , ,

*Part 2*

**Mathematical Approach to Solving it**

A close-up of a piece of paper with writing on it

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A piece of paper with writing on it

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Diagram

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**Part 3**

The performance of a computer system is affected by multiple factors such as processor speed, memory, memory speed, storage size, size of data to process, type of computational tasks performed, and others. Thus based on this project and the ones before it, it is sensible to model these types of factors using differential equations. This is because differential equations relate derivatives or the rates of change of physical quantities, of which many correlate well with how computers performance metrics run. Thus, an example of a computer-based metric utilizing a differential model is throughput, the rate of production or rate at which something is processed. This a simple mathematical model for many things but represents how data is processed in a computerized system very well. This model can be simply y’ = m/t where m represents a material, in this case, data. While, t is time, thus we have material/data over time. This obviously may become more complex depending on the system, but this is an example of the concept with no changes or coefficients. Thus, by improving our imagined system, we can look at the model and see that to increase our production we can either decrease the amount of time between cycles or increase the amount of data being process in a given interval.

**Approach for Implementation**

Diagram

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**Screenshots Depicting key phases in Program Execution**

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References

*Differential Equations - Series Solutions*. (n.d.). Paul’s Online Notes. Retrieved November 30, 2021, from https://tutorial.math.lamar.edu/classes/de/seriessolutions.aspx

Faris, S. (2019, February 11). *How to Calculate Throughput Time*. Bizfluent. Retrieved November 30, 2021, from https://bizfluent.com/how-7550946-calculate-throughput-time.html