Development of a Numerical Comparative Analysis Tool:

A Quantitative Approach to Venn Diagrams

Defining the Problem

Comparative analysis often relies on qualitative assessments, such as those seen in Venn Diagrams, to understand similarities and differences between entities. However, there is a growing need for a more quantitative approach, especially in fields where numerical data is paramount (Verhoef & Casebeer, 1997). This paper proposes a new system that adapts the conceptual framework of Venn Diagrams to a quantitative context, allowing for a more precise and measurable comparison.

Solving the Problem

Traditional Venn Diagrams excel in illustrating qualitative overlaps and differences. My proposed system extends this concept by using numerical values to plot entities on a three-dimensional chart, where each axis represents a different quantitative trait or metric. This approach allows for a more nuanced and data-driven comparison (Lucidchart, n.d.).

Traditionally, identifying the volume of overlap of spherical entities on a three-dimensional level would require complex mathematical equations and a large amount of computational power (Weisstein, n.d.). My program counts and displays the exact number of overlapping pixels, making this arduous task very simple.

Methodology

Firstly, a selection of quantitative traits/metrics for the entities being compared must be identified. Data would then be collected based on the previously identified metrics and standardized to allow for consistent results. From there, using my Netlogo program, entities will be plotted in a three-dimensional space based on their values for the chosen traits, visually representing similarities and differences. These similarities and differences can then be examined by analyzing the overlapping entities and viewing the monitor displaying the number of overlapping pixels. This process will be akin to assessing the intersection area in a Venn Diagram but based on quantitative data.

Advantages

My method offers a more precise comparison based on measurable data. The user will be able to precisely assess the overlapping entities and find their exact areas of similarity and difference. Along with this advantage, the quantitative analysis method facilitates the analysis of entities in fields heavily reliant on numerical data. Quantitative research is fast, focused, and scientific (Williams, 2021).

Applications

This method's high versatility allows entities across various disciplines with different sets of quantitative traits to be compared easily. I believe the field of materials science could utilize this tool very effectively for a multitude of engineering applications. I can also see my project being useful in the field of finance for investment insights. However, I envision this to be most useful in the field of biology. Genetic, morphological, and behavioral traits of species can all be compared effectively with my program (UC San Diego, n.d.).

Progress

So far, I have been able to create a successful program using Netlogo 3D to analyze similarities and differences between the species I have tested. My NetLogo program currently supports up to 4 quantitative metrics, the three axes and the radius of the spherical entity used to represent these species. I compared a variety of animals using number of chromosomes, life span, size, and mass as metrics. I was able to observe the overlapping spheres to see where their similarities and differences lie along with exactly how many pixels were overlapping.

Expected Results

I envision this proposed numerical comparative analysis tool to bridge the gap between qualitative Venn Diagrams and the need for numerical precision in various scientific and business fields. I expect to continue advancements in this project by pursuing research to identify the optimal three-dimensional shape and the optimal metrics to be used to compare entities. Future enhancements could also include integrating statistical tools for more sophisticated data analysis.

References

Lucidchart. (n.d.). *What is a Venn Diagram*. Retrieved from Lucidchart: https://www.lucidchart.com/pages/tutorial/venn-diagram

UC San Diego. (n.d.). *What is Quantitative Biology (qBio)?* . Retrieved from Quantitative Biology UC San Diego: https://qbio.ucsd.edu

Verhoef, M. J., & Casebeer, A. L. (1997). Broadening horizons: Integrating quantitative and qualitative research . *The Canadian Journal of Infectious Diseases*, 65-66.

Weisstein, E. W. (n.d.). *Wolfram MathWorld*. Retrieved from Sphere-Sphere Intersection: https://mathworld.wolfram.com/Sphere-SphereIntersection.html

Williams, T. (2021, June 14). *Why Is Quantitative Research Important?* . Retrieved from Grand Canyon University: https://www.gcu.edu/blog/doctoral-journey/why-quantitative-research-important