Root Approximation Methods using Geogebra

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Abstract

Finding the roots of a function f(x) is straightforward in certain cases, such as polynomials of degree 0 to 4 or a few specific variations. However, for most functions, solving f(x) = 0 exactly is not feasible. In such scenarios, root approximation techniques become the most effective and practical approach to finding solutions.

The four primary root approximation techniques are **Bisection**, **Regula-Falsi**, **Secant**, and **Newton's Method**. These iterative methods provide increasingly accurate approximations to the roots with each new iteration. We can conclude this computationally. Visualizing these methods graphically allows users to gain a clearer understanding of why and how the methods work. The approximations converge to the roots with orders of convergence 1, 1, the golden ratio (phi), and 2, respectively. The order of convergence of a method is said to be p if every subsequent error of iteration e_{n+1}=k*e_{n}^p, where e_{n}=|approximation of root in the nth iteration - actual root|. Although these orders (p) can be mathematically derived, a visual representation offers a more intuitive grasp of their workings.

This project utilizes Geogebra to create an interactive visualization of these techniques, enabling users to explore, observe, and better understand the principles behind the 4 root approximation methods.

Keywords: Roots of a function f(x), Bisection method, Regula-Falsi method, Secant method, and Newton's Method, Geogebra.