

Islamic University of Technology (IUT)
Organization of Islamic Cooperation (OIC)
Department of Electrical and Electronic Engineering (EEE)

Course No.	Math 4522
Course Name	Numerical Methods Lab.
Experiment No.	05
Experiment Name	Introduction to Secant method

Objective

To get familiarized with the Secant method to find out the root of the nonlinear equation.

Theory

In the previous experiment, you were introduced to the “Open” method of finding the roots. Newton-Raphson is one of the most popular such approaches. The Secant method is quite similar to the Newton-Raphson method.

In Newton-Raphson, you have to find the derivative of a polynomial, which can be quite inconvenient and difficult for certain functions. There are numerical techniques to approximate the derivative. These techniques can be divided into three categories. Forward difference, Backward difference, and Central difference. These will be discussed in detail in later experiments. In secant method, backward finite difference method is used to approximate the derivative.

$$f'(x_i) = \frac{f(x_{i-1}) - f(x_i)}{x_{i-1} - x_i}$$

As you can see, you need two initial assumptions for secant method. Once you approximate the derivative using the assumptions, you can find the new value of x using the following equation –

$$x_{i+1} = x_i - \frac{f(x_i)(x_{i-1} - x_i)}{f(x_{i-1}) - f(x_i)}$$

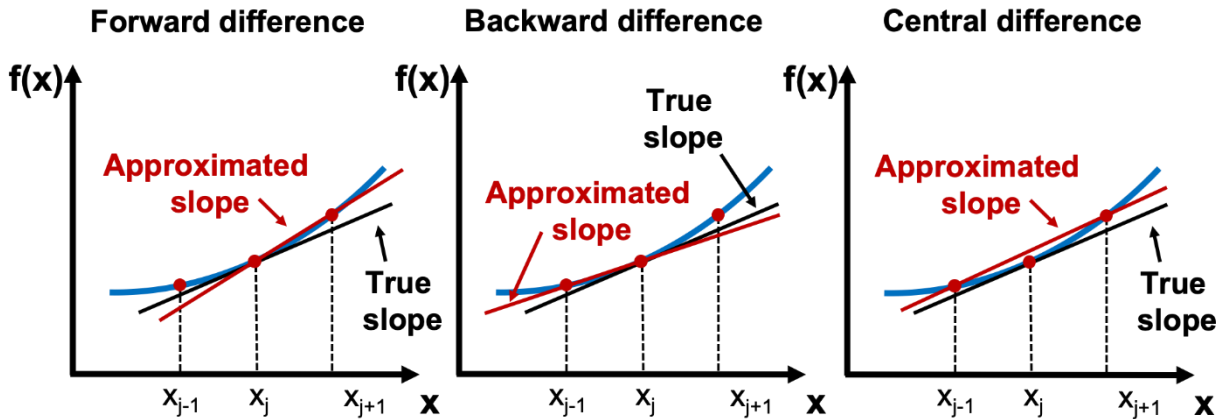


Figure 1: Different types of numerical techniques for approximating derivatives

Example:

Let's try to approximate the root for $f(x) = e^{-x} - x$.

Initial assumption: $x_{-1} = 0$ and $x_0 = 1$ – using these two values, approximate x_1

After 1st iteration: $x_1 = 0.61270$ and error = 8%. – using x_0 and x_1 , approximate x_2

After 2nd iteration: $x_2 = 0.56384$ and error = 0.58% – using x_1 and x_2 , approximate x_3

After 3rd iteration: $x_3 = 0.56717$ and error = 0.0048% – using x_2 and x_3 , approximate x_4

Continue this way until the tolerance limit is reached or the maximum number of iterations is reached.

Lab Task

Write a code to find the roots of the given equation $f(x) = e^{-x} - x$ using the Secant method.

Modified Secant Method

In the secant method, you need two initial assumptions to approximate the derivative. In the modified secant method, you modify the equations so that you need only one assumption to approximate the derivative.

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Assignment

1. Explain the difference between the secant method and the other techniques that you have learned so far for approximating the roots.
2. Write a code to find the roots of the given equation $f(x) = e^{-x} - x$ using Modified Secant method.
3. Determine the highest real root of $f(x) = 0.95x^3 - 5.9x^2 + 10.9x - 6$ using the secant method (use 2.5 and 3.5 as initial assumptions)

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