Part C

For this part of the assignment, I have chosen to graph the function of

6. 𝑦 = 𝑥 / ln 𝑥 for 𝑥 ∈ [−1, 2]

This is the knowledge for what I have acquired during my calculus lesson. A white paper with mathematical equations

Description automatically generated

The solution I utilised to compute the function clearly shows that the presence of a vertical asymptote. After calculating the derivative of the function, it was found that the resulting critical points lie beyond the given range. Thus, across the given interval, the function does not exhibit any major change in its slope that would necessitate the identification of critical points.

Nevertheless, calculus methods can be somewhat laborious when it comes to manually calculating and drawing a graph.

Therefore, this is an interesting modern approach acquired from my studies in Introduction to Scientific Computing under the guidance of Dr. Goh.

Code:

A screen shot of a computer program

Description automatically generated

While working on this code, I have acquired new knowledge in the field of SymPy. According to SymPy documentation, SymPy can simplify expressions, compute derivatives, integrals, and limits, solve equations, work with matrices, and much, much more, and do it all symbolically. The utilisation of SymPy, a symbolic mathematics library in Python, was crucial for precisely portraying and evaluating the function. Using SymPy's symbolic computation capabilities, I was able to determine the critical points of the function by derivative. This process gave a set of points where the derivative is equal to zero. Subsequently, these critical points were computed using numerical methods and visually portrayed on the graph.

A computer screen shot of a program code

Description automatically generated

Logarithmic functions are undefined for non-positive values, including zero. The choice to start the x-axis region from 0.01 instead of -1 was taken in order to tackle the inherent difficulties linked to the logarithmic aspect of the function. To eliminate mathematical inconsistencies and errors associated with logarithmic computation near zero, I chose to start the x-axis range with a tiny positive value, specifically 0.01. This modification ensured that the logarithmic component inside the function remained well-defined across the required range, enabling precise numerical calculations and a seamless graphical display of the function. After that, the codes will mark the position of the critical points.

A computer screen shot of a program

Description automatically generated

The codes above shows that how I visualize the graph and identify interesting features such as undefined region, vertical asymptotes and critical point. As previously mentioned, a region will remain undefined since logarithmic functions are not defined within the range of x=-1.

At last, a graph is portrayed, and the value of critical points were shown.

A graph of a function

Description automatically generated

The graph demonstrated that this function is undefined for x<0 and the critical point is out of the range of x=[-1,2]

Reference:

Introduction - SymPy 1.12 Documentation.

https://docs.sympy.org/latest/tutorials/intro-tutorial/intro.html.