Home Work (4) - Numerical Analysis

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1 Home Work

- Perform numerical differentiation using finite differences (front, back, and middle) on the following function:

$$f(x) = \frac{x^3 - 1}{x + 1}$$

Find $f'(x)$ using the least mean squares method on the dots $x = \{0, 1, 2, 3, 4, 5, 6\}$

- Perform numerical differentiation using the following method:

$$f'(x) = \frac{-f(x + 2h) + 8f(x + h) - 8f(x - h) + f(x - 2h)}{12h}$$

on the following function:

$$f(x) = \frac{e^x}{x}$$

for the dots $x = \{-4, -3, -2, -1, 0, 1, 2, 3, 4\}$ and find the approximation error in each one of this dots.

- For points $(0, 0), (1, 0.5), (2, 2)$ and $(3, 1.5)$, find the interpolating cubic spline $S(x)$, which satisfying $S'(0) = 0.2$ $S'(0) = 0.2$ and $S'(3) = -1$.

- Perform numerical integration of the following function using the Trapezoid Rule and $\Delta x = 0.1$:

$$\int_1^2 (ln(x^2)x + x^2)dx$$

- Perform numerical integration of the following function using the Simpson's Rule and $\Delta x = 0.05, 0.1, 0.2$:

$$\int_1^5 (\frac{x}{1 + x})dx$$

What you can see in the results for each Δx?