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LT14: I can find the Taylor series of a function.

1. Find the Taylor series expansion for the function $f(x) = \ln(1-x)$ by using the definition or by using a known Taylor series. Write at least 4 terms of the series.

Where do you expect this Taylor series to converge?

$$f(x) = \ln(1-x)$$

$$f(0) = 0$$

$$f'(x) = \frac{1}{1-x}$$

$$f'(0) = -1$$

$$f''(x) = -\frac{2}{1-x^2}$$

$$f''(0) = -2$$

$$f'''(x) = \frac{6}{1-x^3}$$

$$f'''(0) = 6$$

$$f^{(4)}(0) = -18$$

$$f^{(4)}(x) = -\frac{18}{x^4}$$

$$\begin{aligned} 1n & x^{-1-1} \\ \frac{1}{x} & -2x^{-2} \\ -2 & -2x^{-2-1} \\ \frac{-2}{x^2} & 6x^{-3} \\ \frac{6}{x^3} & -18x^{-3-1} \\ \frac{-18}{x^4} & \end{aligned}$$

$$\begin{array}{cccccc} \cancel{0} & 1 & -2 & 6 & -18 \\ \cancel{0!} & 1! & 2! & 3! & 4! \\ \cancel{0} & 1 & 2 & 6 & 24 \\ \cancel{0} & 1 & 2 & 6 & 24 \end{array}$$

$$f(x) = \ln(1-x) = 1(x-0) - \frac{2(x-0)^2}{2!} + \frac{6(x-0)^3}{3!} - \frac{18(x-0)^4}{4!} + \dots$$