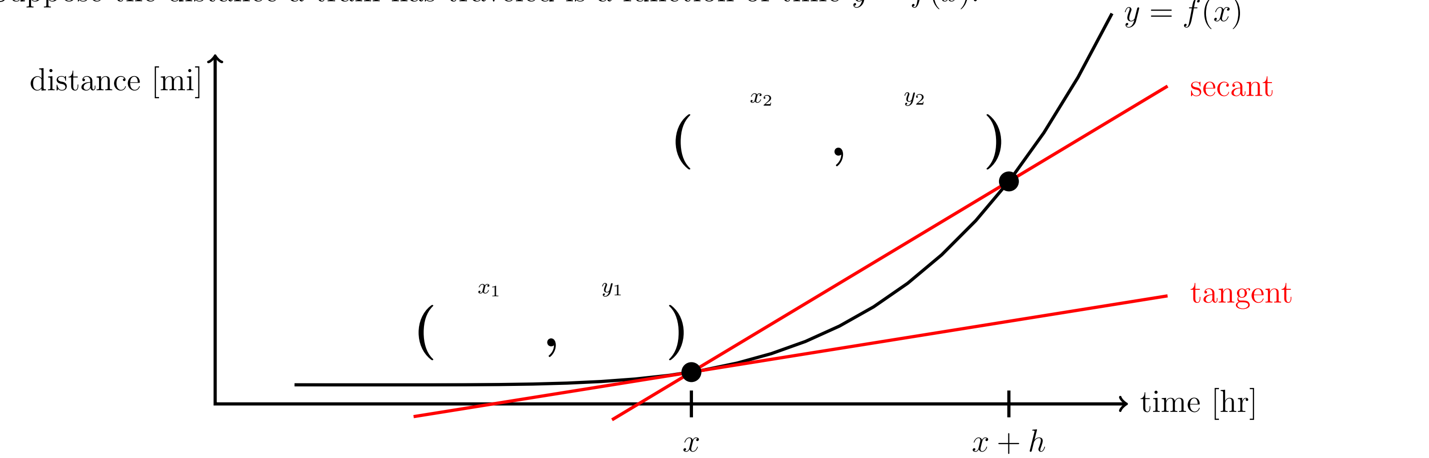
N1. **Definition.** The Limit Definition of Derivative

Suppose the distance a train has traveled is a function of time $y = f(x)$.

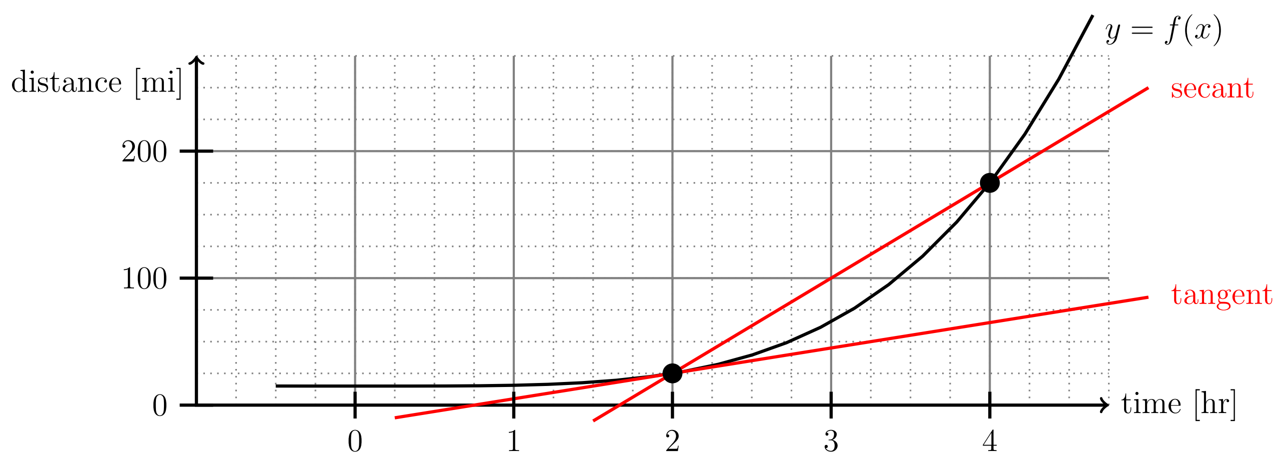


average velocity over $[x, x{+}h]$ = average rate of change over $[x, x{+}h]$ = slope of secant between $x, x{+}h$ $= \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \boxed{}$ = definition of difference quotient

("instantaneous") velocity at x = rate of change at x = slope of tangent at x $= \boxed{\lim_{h \to} }$ = definition of derivative written y' or $\frac{dy}{dx}$ or $f'(x)$ or $\frac{d}{dx}f(x)$

N2. **Exercise.** Estimate from the diagram: the slope of the **secant** through 2 and 4.

N3. **Exercise.** Estimate from the diagram: the slope of the **tangent** at 2.



N4. Example. Suppose $f(x) = 15 + \frac{5}{8}x^4$. Compute the slope of the **secant** through x and $x + h$.

$f(x+h) \quad = 15 + \frac{5}{8}(x+h)^4 \quad = 15 + \frac{5}{8}x^4 + \frac{20}{8}x^3h + \frac{30}{8}x^2h^2 + \frac{20}{8}xh^3 + \frac{5}{8}h^4$

$\frac{f(x+h) - f(x)}{h} =$

N5. **Exercise.** Suppose $f(x) = 15 + \frac{5}{8}x^4$. Compute the slope of the **tangent** line at x.

N6. **Exercise.** Use your answer to N5 to compute $f'(2)$.

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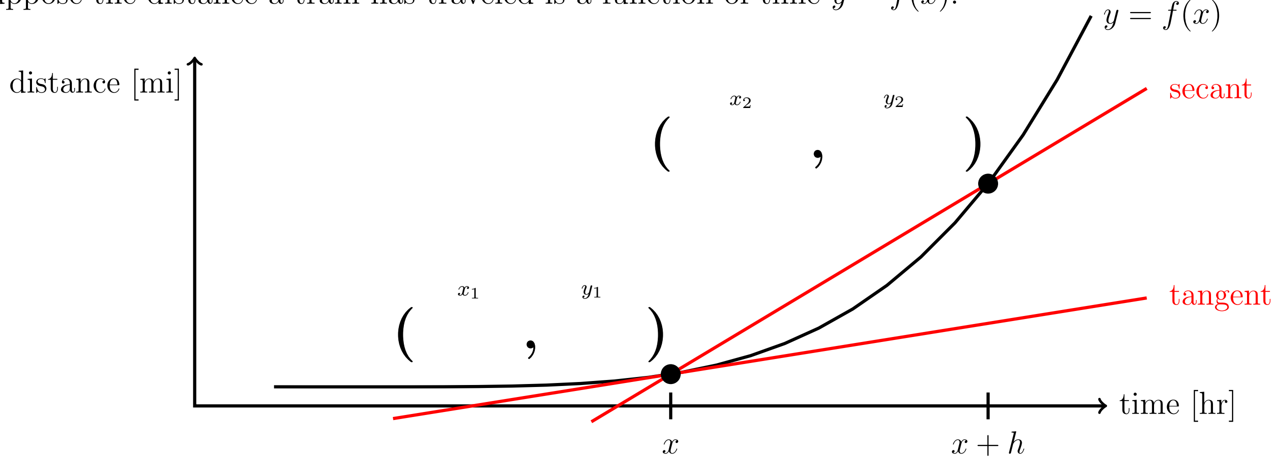

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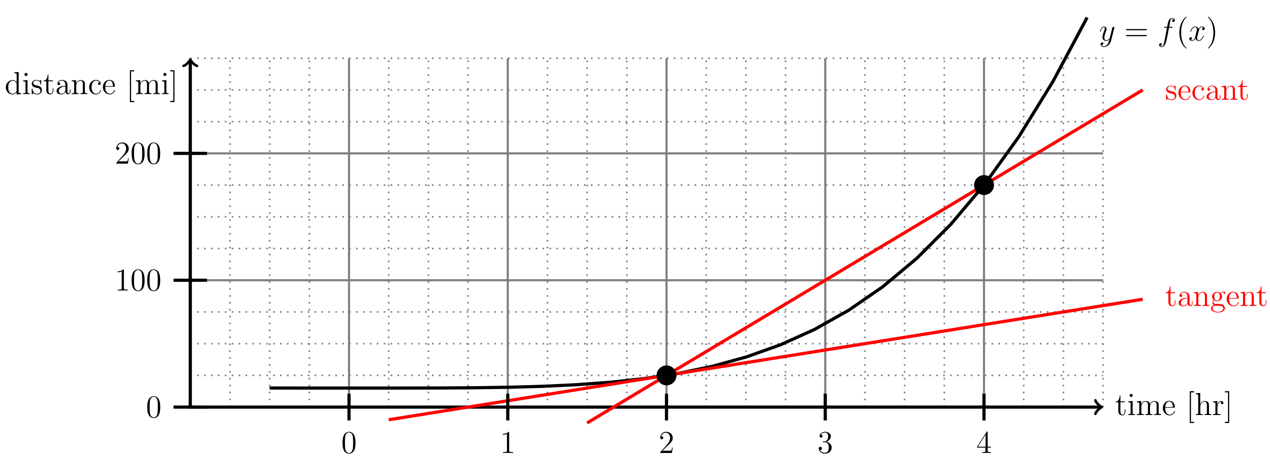

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