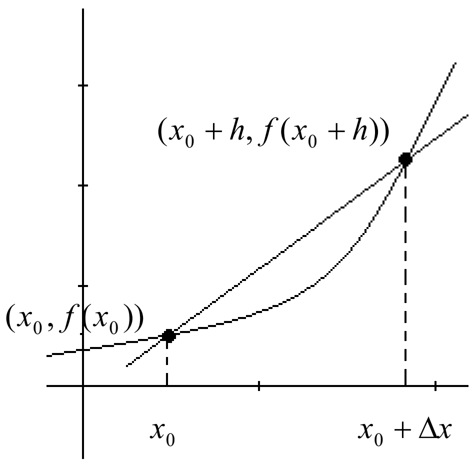
3.1 Defining the Derivative



If we want to find the slope of the line through the two points, we will need to use the slope formula, which is $m = \frac{y_2 - y_1}{x_2 - x_1}$. Using our notation we get: $m = \frac{f(x_0 + h) - f(x_0)}{(x_0 + h) - x_0}$. This simplifies to: $m = \frac{f(x_0 + h) - f(x_0)}{h}$. This is the difference quotient. Now we want to find the slope right at point x_0, so in order to this we will make h so small that both points are on top of each other at x_0. So we want h to go to zero. Sounds like a limit to me! This is what we are missing. So now we have our definition.

Definition for the slope of a tangent line at $x = x_0$: $\lim_{h \to 0} \frac{f(x_0 + h) - f(x_0)}{h}$

EXAMPLE: Find the equation of the tangent line at the point (2, 1) on the curve $f(x) = 5 - x^2$.

EXAMPLE: Find the equation of the tangent line at the point (-1, -9) on the curve $g(t) = t^3 - 8$.

EXAMPLE: Find the equation of the tangent line at the point (2, 2) on the curve $f(x) = \frac{8}{x^2}$.

EXAMPLE: Find the equation of the tangent line at the point (8, 3) on the curve $f(x) = \sqrt{x+1}$.

EXAMPLE: At what point(s) does the graph of $f(x) = 3x^2 - 6x + 1$ have a horizontal tangent?