Data Science - Lab 1

Given

$f(x) = 3x^2 + 2x$

first order derivative :-

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x-h)}{2h}$$

Second derivative

$$f''(x) = \lim_{h \to 0} \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}$$

1) $$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x-h)}{2h}$$

$$= \lim_{h \to 0} \frac{(3(x+h)^2 + 2(x+h)) - (3(x-h)^2 + 2(x-h))}{2h}$$

$$= \lim_{h \to 0} \frac{6xh + 2h - (-6xh + 2h)}{2h}$$

$$= \lim_{h \to 0} 12xh / 2h$$

$$= \lim_{h \to 0} 6x \Rightarrow 6x.$$

$$\boxed{f'(x) = 6x}$$

$$f''(x) = \lim_{h \to 0} f(x+h) - 2f(x) + f(x-h) / h^2$$

$$= \lim_{h \to 0} (3(x+h)^2 + 2(x+h)) - 2(3x^2 + 2x) + (3(x-h)^2 + 2(x-h)) / h^2$$

$$= \lim_{h \to 0} \frac{(3x^2 + 6xh + 3h^2 + 2x + 2h) - 2(3x^2 + 2x) + (3x^2 - 6xh + 3h^2 + 2x - 2h)}{h^2}$$

$$= \lim_{h \to 0} \frac{6xh + 3h^2 - 6xh + 3h^2}{h^2}$$

$$= \lim_{h \to 0} 6h^2 / h^2$$

$$= 6$$

$$f''(x) = 6$$