# MA 16010 Lesson 13: Higher order derivatives

Given a function $f(x)$, its derivative $f'(x)$ is yet another function. Taking the derivative of *this* function yields ______________________________.

other notation:

We can continue in this manner, to obtain other *higher order derivatives*:

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**Exercise:** Compute $f''(x)$ for $f(x) = x^4 + 3x^2 + 1$.

**Exercise:** Compute $f''(-1)$ for $f(x) = x^2 e^x$.

**Exercise:** Compute the third derivative of $f(x) = \sin(3x)$.

**Exercise:** Compute the second derivative of $y = \ln(x^2 + 1)$.

**Application: motion.** Recall that if $s(t)$ is the function of a position of an object depending on time, its rate of change $s'(t)$ is ____________________.
Similarly,if one takes the rate of change of the velocity, $v'(t)$, one obtains ___________________________________.

Altogether, we have:

**Exercise:** The position of a particle moving on a straight line is given by

$$s(t) = \sin(2t) + 7t^2$$

(in meters, where $t$ is time in seconds). What is the acceleration of the particle at $t = 5$ seconds? Round your answer to 3 decimal places.

**Exercise:** The velocity of a particle moving on a straight line is given by

$$v(t) = 3t^2 - 3$$

(in meters per second, where $t$ is time in seconds). What is the acceleration of the particle at $t = 2$ seconds?