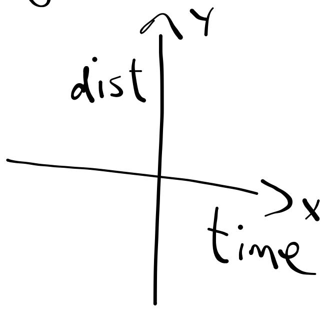
Using the Derivative

If the function $y = 5x^3 - 6x^2 + 8x - 4$ represents a dist / time graph,

then $y' = 15x^2 - 12x + 8$ (velocity)

and $y'' = 30x - 12$ (acceleration)

and $y''' = 30$ (jerk)



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Other notations:

$y' \qquad y'' \qquad y''' \quad \ldots \quad y^{n}$ ← Roma numera

$f'(x) \qquad f''(x) \qquad f'''(x) \quad \ldots \quad f^{n}(x)$

$\dfrac{dy}{dx} \qquad \dfrac{d^2y}{dx^2} \qquad \dfrac{d^3y}{dx^3} \quad \ldots \quad \dfrac{d^ny}{dx^n}$

$D_x y \qquad D_x^2 y \qquad D_x^3 y \quad \ldots \quad D_x^n y$

ex) Given $y = \sqrt{x} + 4x$ find $D_x^2 y$ (2nd deriv.)

$$y = x^{1/2} + 4x$$

$$y' = \frac{1}{2}x^{-1/2} + 4$$

$$y'' = -\frac{1}{4}x^{-3/2}$$

What does $y(1)$ mean?

$y(1) = 1^{1/2} + 4(1) = 5$

$(1,5)$ is a <u>point</u>.

What does $y'(1)$ mean?

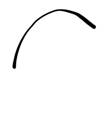
$y'(1) = \frac{1}{2}(1)^{-1/2} + 4 = 4\frac{1}{2}$

Slope of tangent is $4\frac{1}{2}$ at $x = 1$.

What does $y''(1)$ mean?

$y''(1) = -\frac{1}{4}(1)^{-3/2} = -\frac{1}{4}$

Slope is decreasing gradually since y'' is a small neg. #
(concave down)



ex) Given $p(x) = \frac{1}{x^3} + x^2$, find $p(1), p'(1), p''(1)$

$p(x) = x^{-3} + x^2$ $\quad p(1) = 2 \quad (1,2)$

$p'(x) = -3x^{-4} + 2x$ $\quad p'(1) = -1$ Slope of tangent at $(1,2)$ is -1

$p''(x) = 12x^{-5} + 2$ $\quad p''(1) = 14$ Slope is increasing quickly (concave up) ex) Given $y = 5x^2 + 2x^{1.4}$ find $\left.\frac{dy}{dx}\right|_{x=1}$.

$$\frac{dy}{dx} = 10x + 2.8x^{0.4}$$

$$\left.\frac{dy}{dx}\right|_{x=1} = 10(1) + 2.8(1)^{0.4} = 12.8$$

Slope of tangent is +12.8 at $x=1$.

Finish pg. 101-103 #7-17 try #18

(more on 2nd & 3rd derivatives later...)

Read pg. 119 and do pg. 120 #1-10