Compound interest future value.

\$5000, account at 4% APR compounded monthly for 5 yrs.

$A = Pe^{rt}$

$= 5000\left(1+\frac{.04}{12}\right)^{12(5)} = \$6104.98$ (monthly)

or $5000\left(1+\frac{.04}{52}\right)^{52(5)} = \$6106.54$ (weekly)

$5000\left(1+\frac{.04}{365}\right)^{365(5)} = \$6106.95$ (daily)

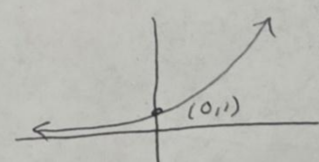
$\left(1+\frac{1}{n}\right)^n$ $\quad$ Y = (1+1/X)^X

Table: enter in large x values...

$\rightarrow 2.718\ldots$ exponential base

$A = 5000e^{0.04(5)} = \$6107.01$

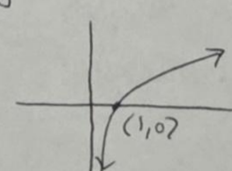
$y = e^x$ exponential function:



$f(x) = e^x$

$f'(x) = e^x$

$y = \ln x$ "natural logarithm"



$f(x) = \ln x$

$f'(x) = \frac{1}{x}$

$f(x) = e^{3x^2}$

$f'(x) = 6x\,e^{3x^2}$

$f(x) = e^{2x^2+5x}$

$f'(x) = (4x+5)e^{2x^2+5x}$

$f(x) = \ln x^2$

$f'(x) = \frac{2x}{x^2} = \frac{2}{x}$ ☺

$f(x) = \ln(3x+5)$

$f'(x) = \frac{3}{3x+5}$ ☺

February 17

$f(x) = x^3 + 3x^2 - 9x - 13$

MAX @ $(-3, 14)$
MIN @ $(1, -18)$

$f'(x) = 3x^2 + 6x - 9$

set $= 0$:

$3x^2 + 6x - 9 = 0$

$3(x^2 + 2x - 3) = 0$

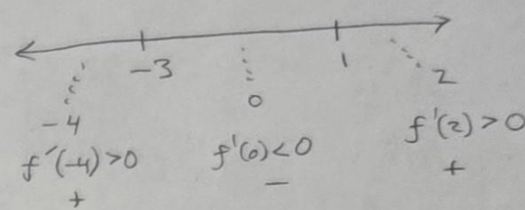
$x^2 + 2x - 3 = 0$

$(x - 1)(x + 3) = 0$

$x - 1 = 0 \quad \vdots \quad x + 3 = 0$

$x = 1 \qquad x = -3$

increasing: $(-\infty, -3) \cup (1, \infty)$
decreasing: $(-3, 1)$



$+ \; -$ $\cap$ MAX

$- \; +$ $\cup$ MIN

$f(x) = e^{2x} - e^x$

min @ $(-.69315, -.25)$

$f'(x) = 2e^{2x} - e^x$

Set to 0:

$2e^{2x} - e^x = 0$

$\underbrace{e^x}_{\text{no sol.}}\underbrace{(2e^x - 1)} = 0$

$2e^x - 1 = 0$

$2e^x = 1$

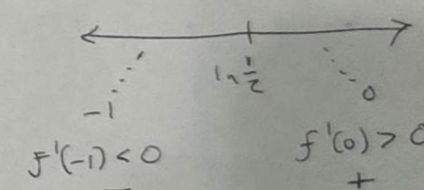
$e^x = \frac{1}{2}$

$x = \ln\left(\frac{1}{2}\right) = -0.69315\ldots$ min

c.v.

no max.

increasing: $\left(\ln\left(\frac{1}{2}\right), \infty\right)$
decreasing: $\left(-\infty, \ln\left(\frac{1}{2}\right)\right)$



February 17

2^{nd} derivative

$f(x) = x^3 + 4x^2 - 6x + 1$

$f'(x) = 3x^2 + \cancel{4}\,8x - 6$

$f''(x) = 6x + 8$

How? First derivative of the first derivative.

What is it? describes concavity:

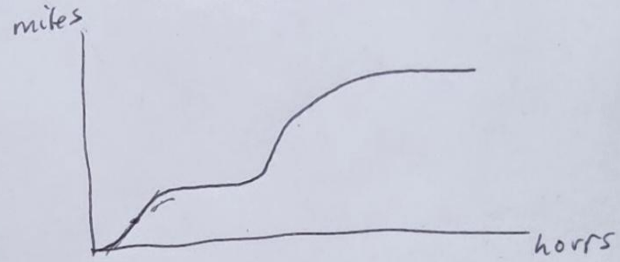
$f''(x) > 0$: concave up 

$f''(x) < 0$: concave down 

Example: Suppose $f(x)$ is the miles you have driven after x hours.

$f'(x)$ describes... rate of change! "miles per hour" (velocity)

$f''(x)$ describes change in velocity. "acceleration".



Suppose a graph has a point $(a, f(a))$ such that $f'(a) = 0$ and $f''(a) > 0$.

What conclusion can you make?

$(a, f(a))$

$(a, f(a))$ must be a minimum!

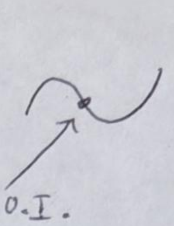
$\rightarrow$ $(a, f(a))$, $f'(a) = 0$, $f''(a) < 0$.

so $(a, f(a))$ is a maximum.

February 19, 2026

point of inflection: ① $f''(x) = 0$

② change in concavity



point of inflection is the location where the first derivative is min/max

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$$y = x^2 e^x$$

Find all min, max

intervals of inc/dec

Locate the P. of. Inflection.

$$y' = x^2 e^x + e^x(2x)$$
$$= x^2 e^x + 2xe^x$$

Set to 0: $x^2e^x + 2xe^x = 0$

$$xe^x(x+2) = 0$$

$x = 0$ ⋮ ~~e^x~~ ⋮ $x + 2 = 0$

$x = -2$

$(0, f(0))$ min $\qquad (-2, f(-2))$ max

$$y'' = x^2e^x + \underline{e^x(2x) + 2xe^x} + e^x(2)$$
$$= x^2e^x + 4xe^x + 2e^x = 0$$
$$\Rightarrow e^x \underbrace{(x^2 + 4x + 2)}_{} = 0$$

Use the Quad formula to find the roots ⇒ P.O.I.