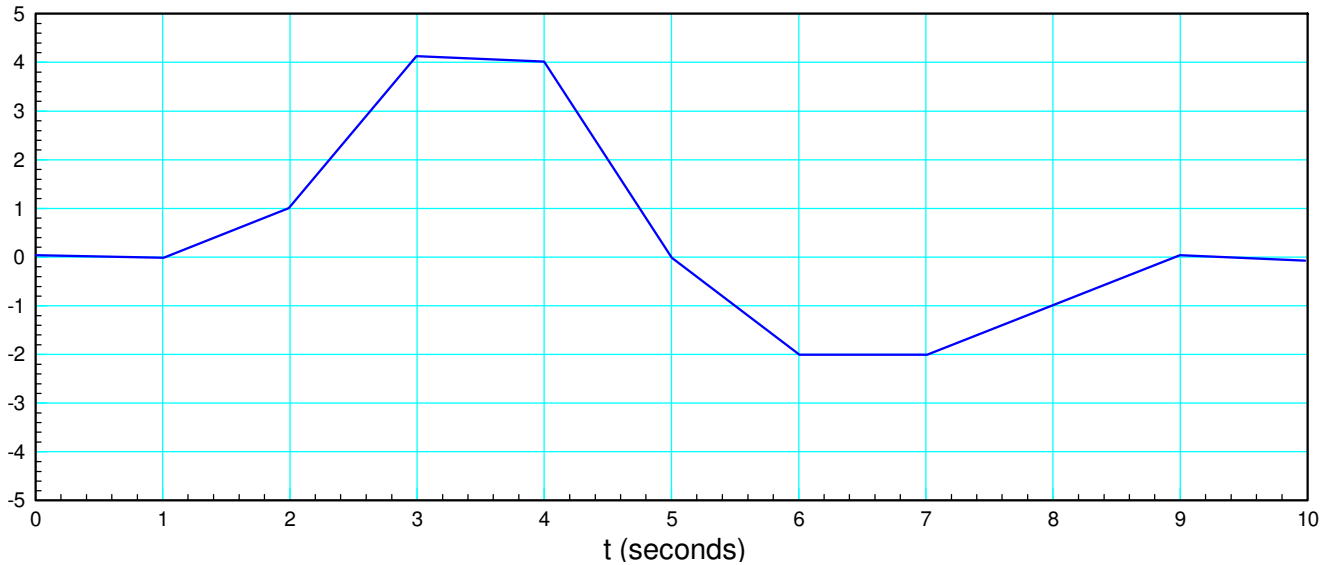


ECE 111 - Homework #6:

Math 165: Differentiation

1) Sketch the derivative of the following function

If this is the balance of your checking account, how much money are you adding (positive) or withdrawing (negative) for the balance to be as shown?



Numerical Differentiation:

2) Use numerical methods to determine the derivative of y:

$$y = \exp\left(\frac{-x^2}{10} + \sin(2x)\right)$$

$$z = \frac{d}{dx}(y)$$

for $-10 < x < 10$. (a plot is sufficient).

3) Use numerical methods to determine the derivative of y:

$$y = \sin(x) + 0.1 \cos(7x)$$

$$z = \frac{d}{dx}(y)$$

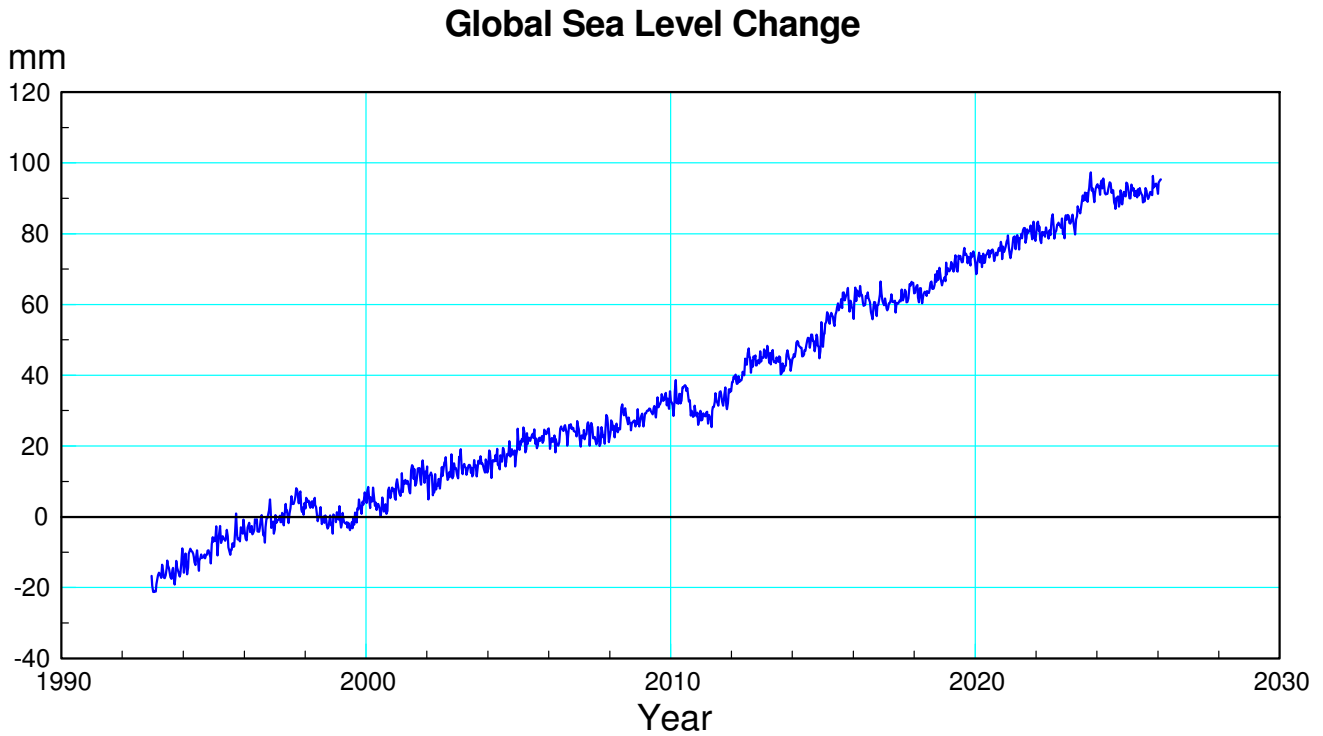
for $-10 < x < 10$. (a plot is sufficient).

Differentiation with Real Data

4) Global sea levels are measured every ten days since 1992:

Compute and plot the derivative to see the change in sea level in units of mm / year

- note: it will probably be a really noisy graph. Differentiation amplifies noise.

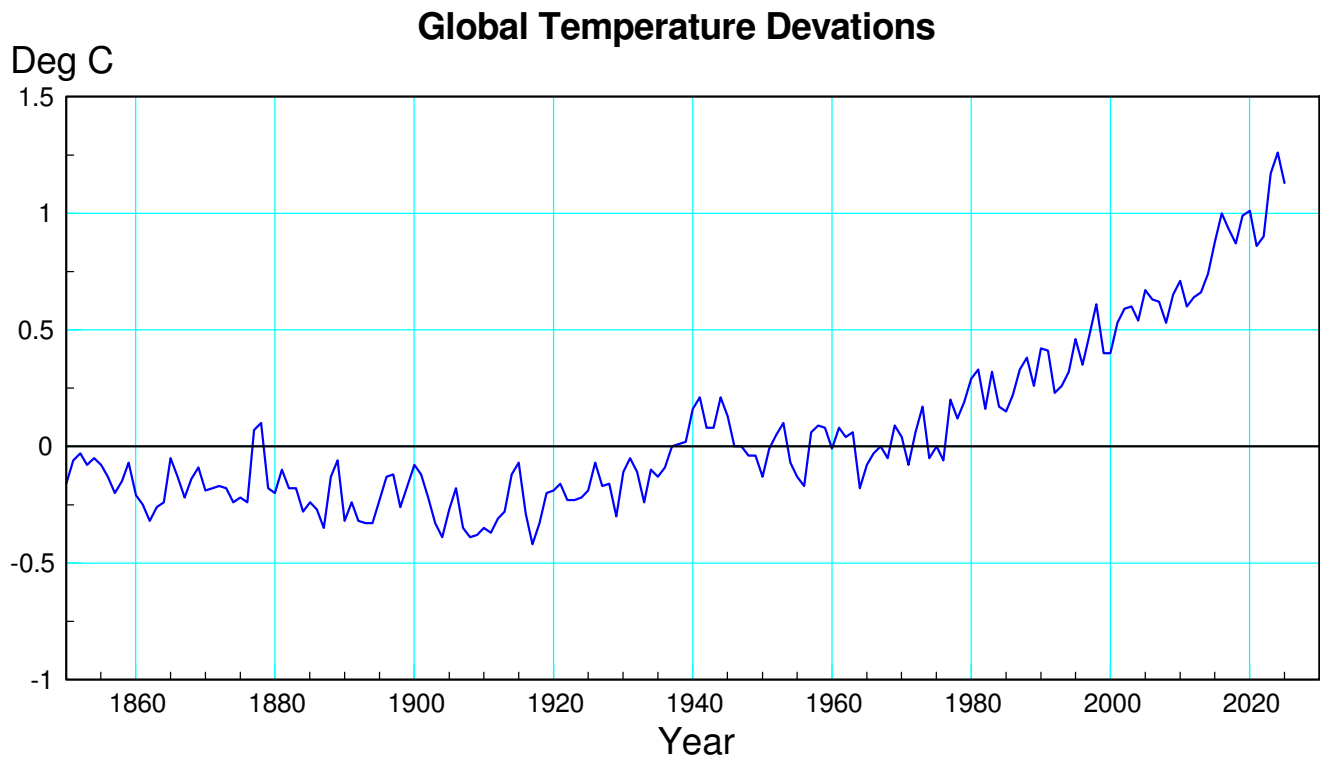


<https://www.bisonacademy.net/ECE111/Code/4%20Sea%20Level.txt>

5) Global temperatures have been measured since 1850

Compute and plot the derivative to see the change in temperature on a year-by-year basis

- note: it will probably be a really noisy graph. Differentiation amplifies noise.



<https://www.bisonacademy.net/ECE111/Code/4%20Temperature%20Deviation.txt>

Path Planning

6) Assume a motor's angle is as follows:

$$\theta = \begin{cases} 0 & t < 0 \\ t/5 & 0 < t < 5 \\ 1 & t > 5 \end{cases}$$

Calculate and plot using Matlab and numerical differentiation:

- The velocity vs. time (i.e. the voltage to the motor), and
- The acceleration vs. time (i.e. the current to the motor).

7) Assume a motor's angle is as follows:

$$\theta = \begin{cases} 0 & t < 0 \\ \frac{1}{2} - \frac{1}{2} \cos\left(\frac{1}{5}\pi t\right) & 0 < t < 5 \\ 1 & t > 5 \end{cases}$$

Calculate and plot using Matlab and numerical differentiation:

- The velocity vs. time (i.e. the voltage to the motor), and
- The acceleration vs. time (i.e. the current to the motor).