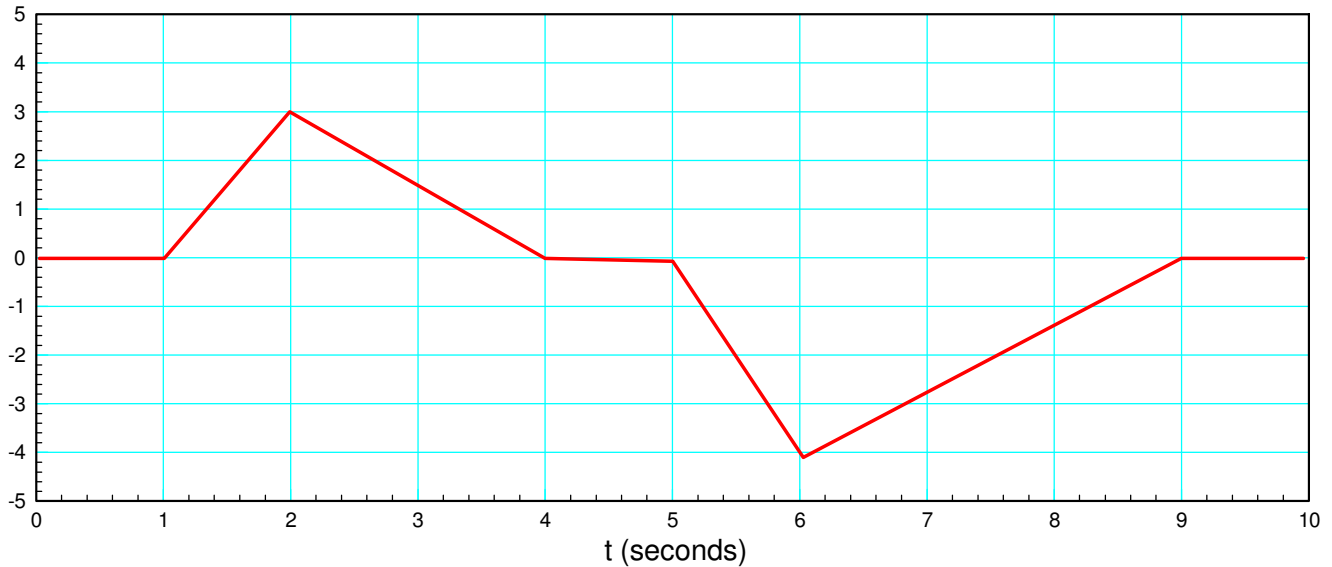


ECE 111 - Make-Up Homework #6:

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:

$$y = \left(\frac{\sin(2x)}{x^2+1} \right)$$

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

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

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

$$y = \sin(x) + \frac{1}{3} \sin(3x) + \frac{1}{5} \sin(5x)$$

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

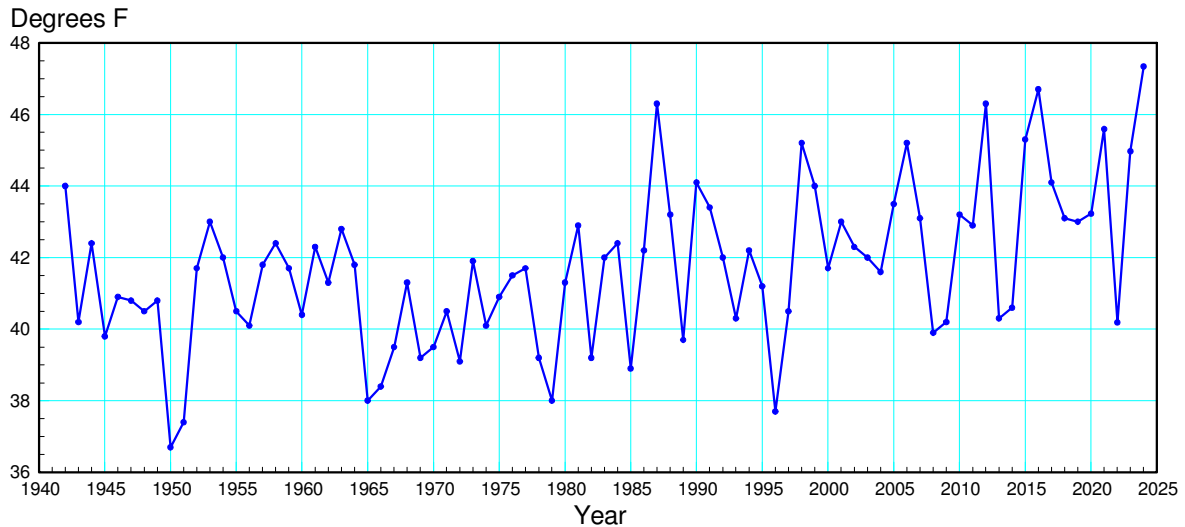
for $-10 < x < 10$. (a plot is sufficient).

Differentiation with Real Data

4) The average yearly temperature in Fargo has been measured since 1942:

Compute and plot the derivative to see the change in temperature on a yearly basis

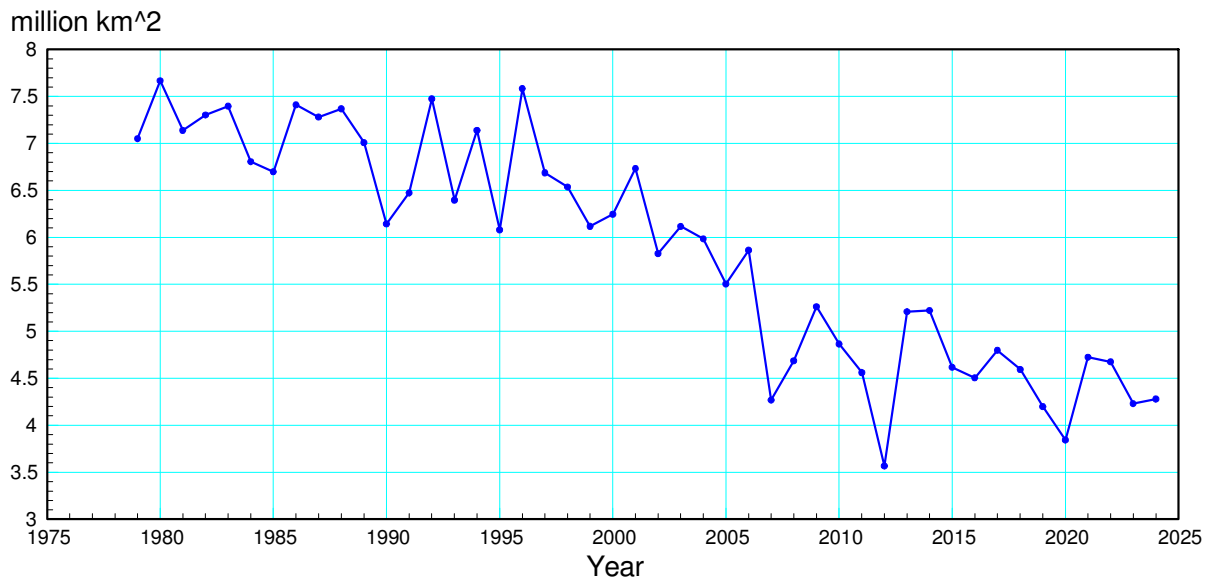
- note: it will probably be a really noisy graph. Differentiation amplifies noise.



Average Yearly temperature in Fargo
https://www.bisonacademy.net/ECE111/Code/Fargo_Weather_Monthly_Avg.txt

5) Arctic Sea Ice: Compute and plot the derivative to see the change in Arctic sea ice coverage on a year-by-year basis

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



<https://www.bisonacademy.net/ECE111/Code/SeaIce.txt>

Path Planning

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

$$\theta = \begin{cases} 0 & t < 0 \\ t/6 & 0 < t < 6 \\ 1 & t > 6 \end{cases}$$

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:

$$\theta = \begin{cases} 0 & t < 0 \\ \frac{1}{2} - \frac{1}{2} \cos\left(\frac{1}{6}\pi t\right) & 0 < t < 6 \\ 1 & t > 6 \end{cases}$$

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).