

# *LECTURE 11*

## *SOME DERIVATIVE RULES*

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# PLAN

1. Poll

2. linearity of differentiation

3. the power rule

4. the  $f$ - $f'$ - $f''$  program

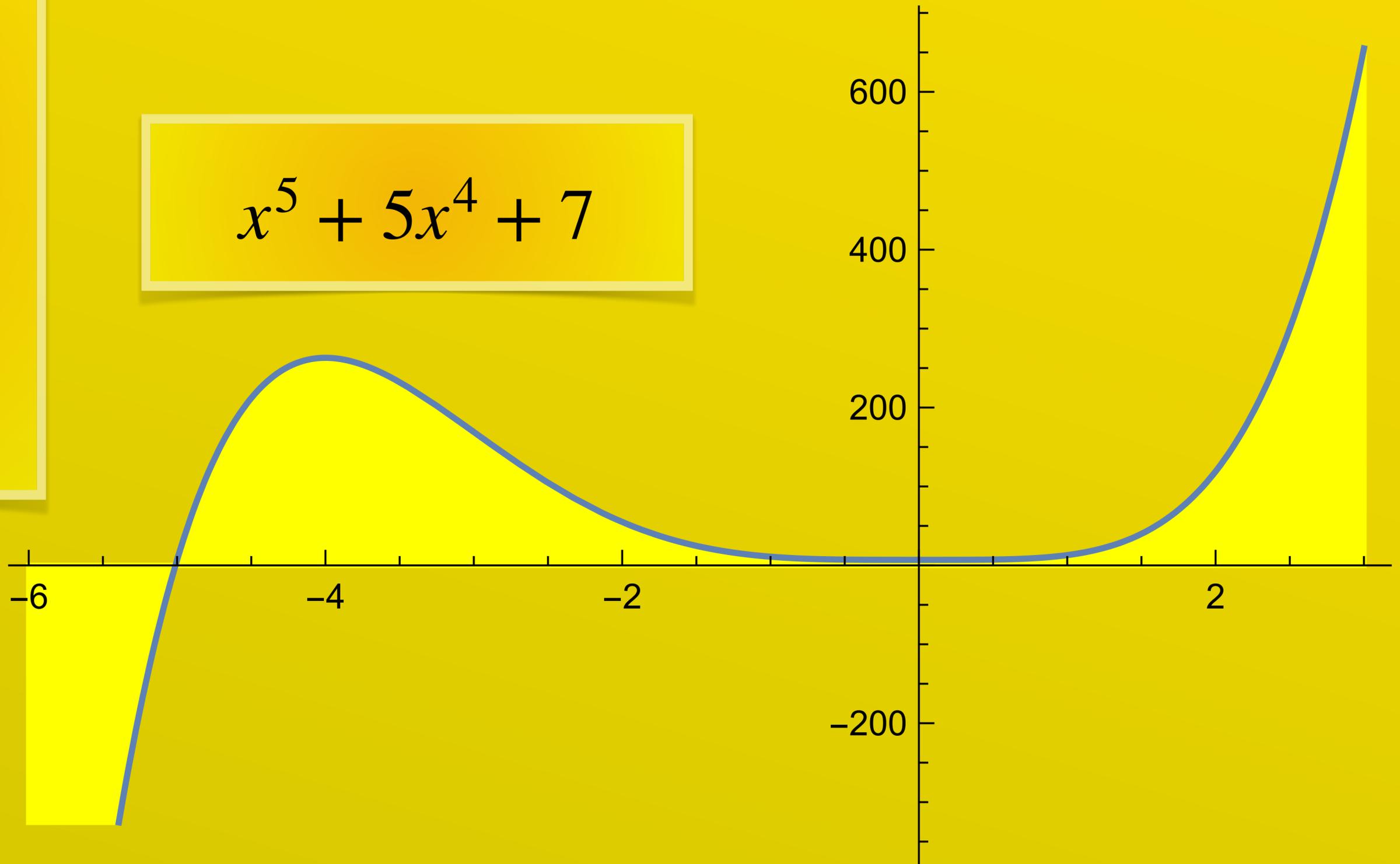
6.  $-x \log(x)$  entropy

6. Jam:  $x - \sqrt{|x|}$

7. Jam with CA

# POLL

$$x^5 + 5x^4 + 7$$

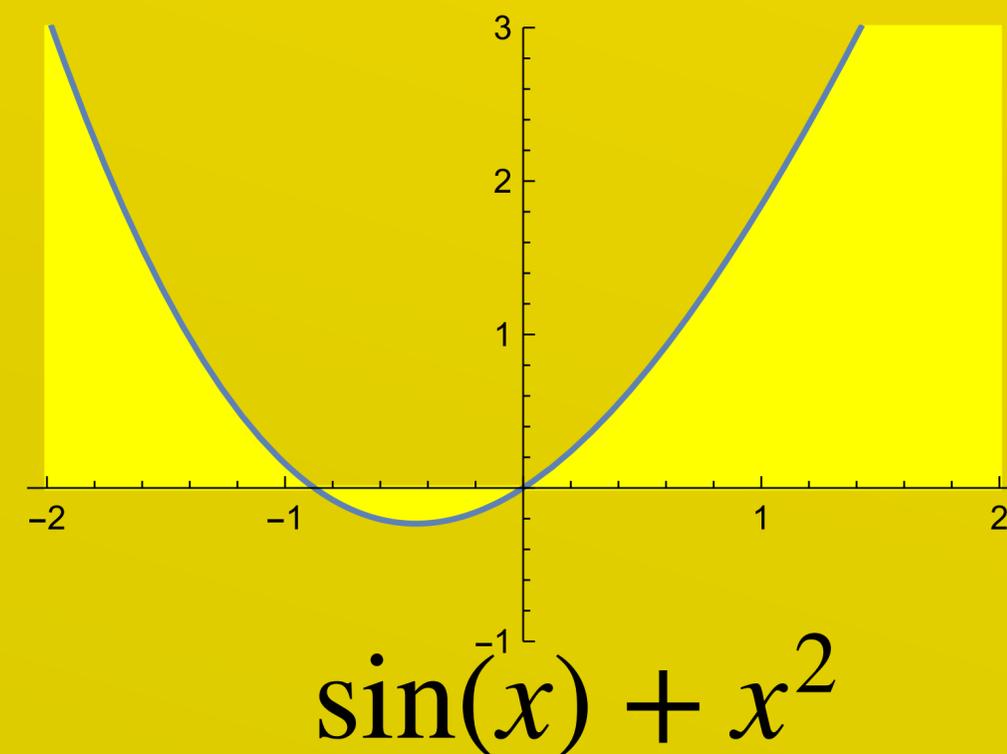
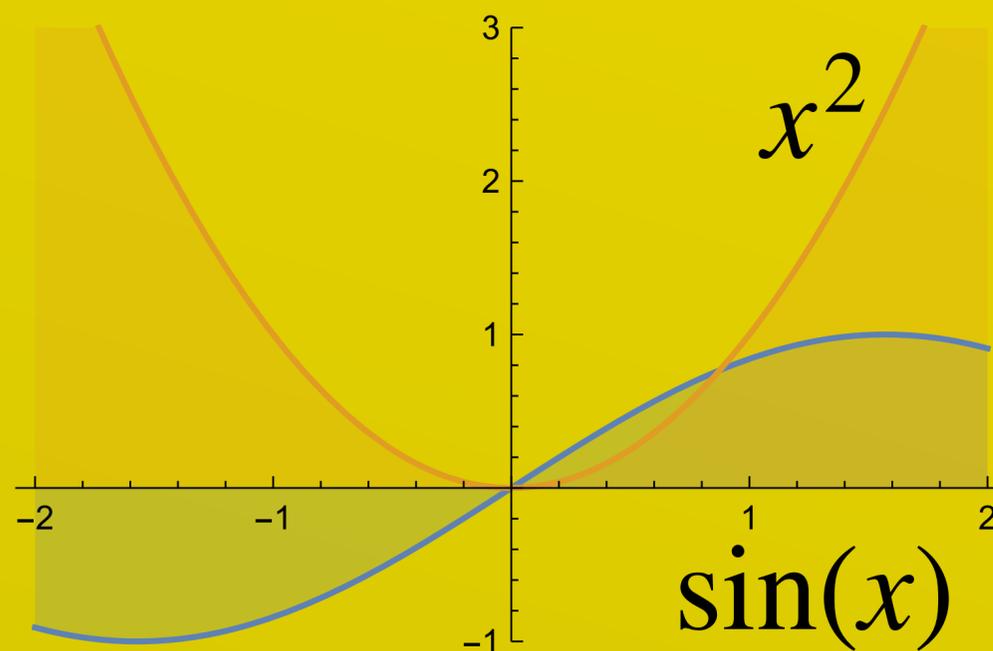
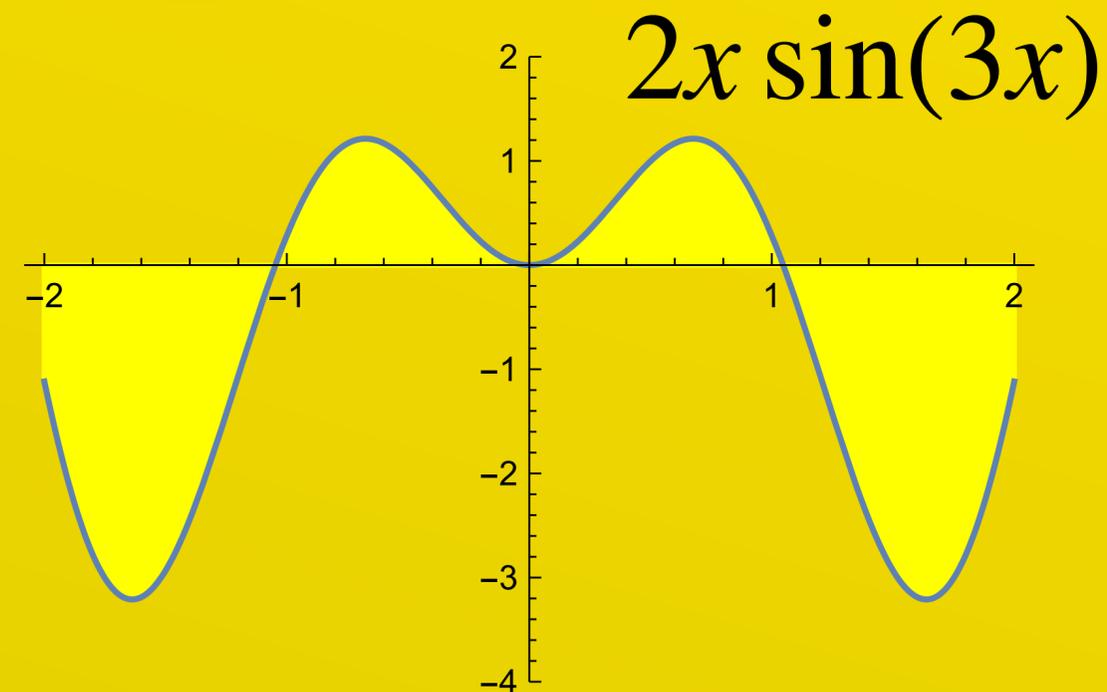
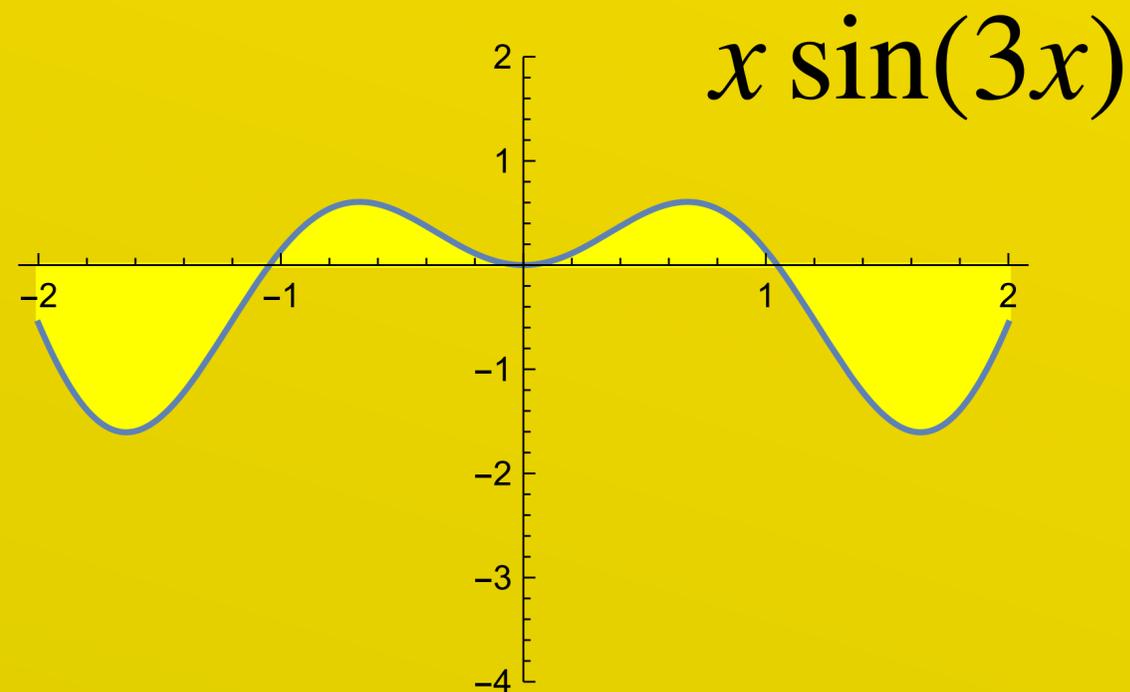


# LINEARITY

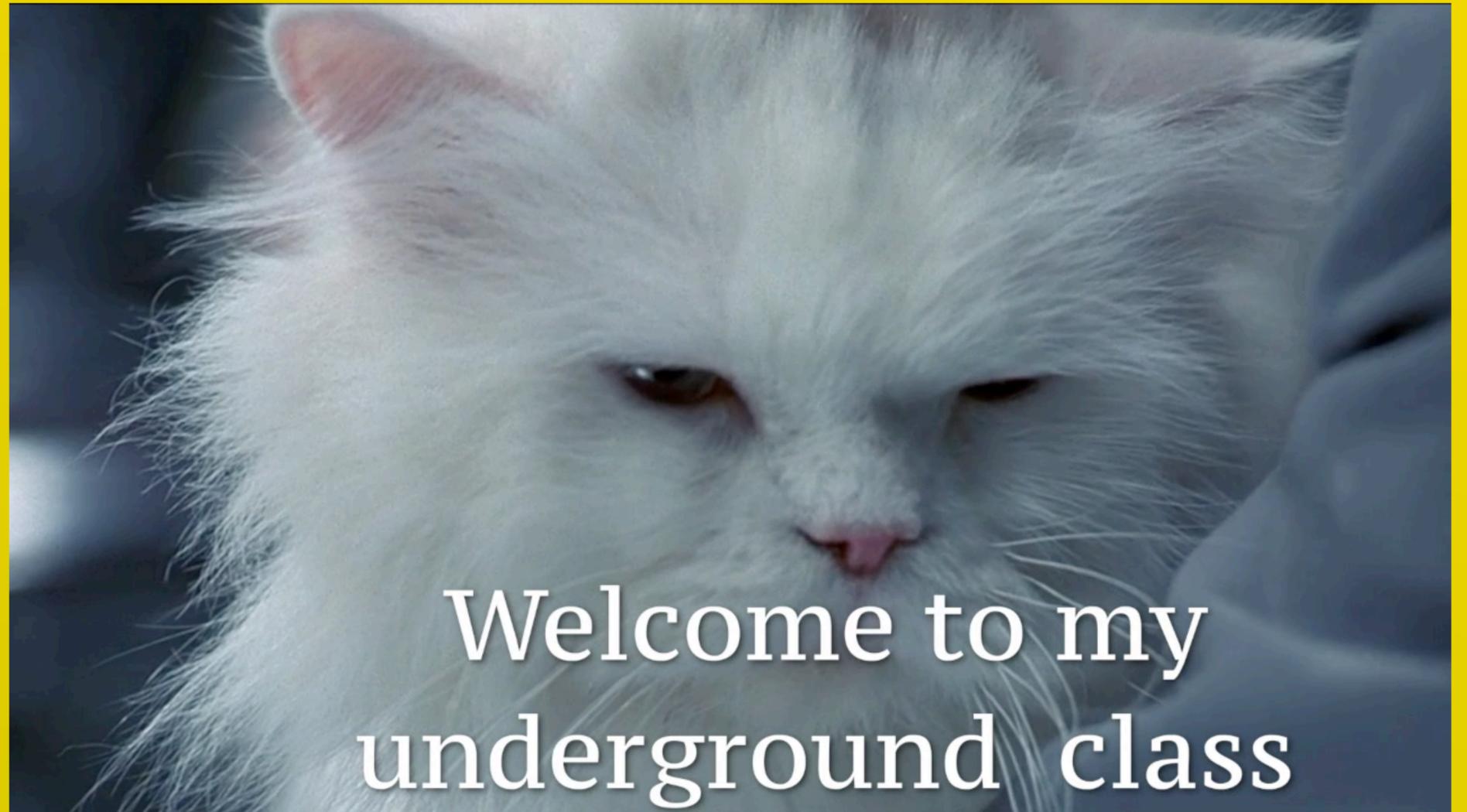
$$(cf)' = cf'$$

$$(f+g)' = f' + g'$$

constant  
multiple  
and sum  
rule



# *POWERS RULE*



Welcome to my  
underground class



1967

Somew

# POWER RULE

$$\frac{d}{dx} x^n = nx^{n-1}$$

$$\frac{(x+h)^n - x^n}{h} = \frac{x^n + nx^{n-1}h + \dots + h^n - x^n}{h}$$

# *POLYNOMIALS*

By linearity, we can  
now differentiate  
any polynomial

$$(3x^4 - 2x^2 + 5x)' = 12x^2 + 3x + 5$$

There are two errors in this computation. Can you spot them both?

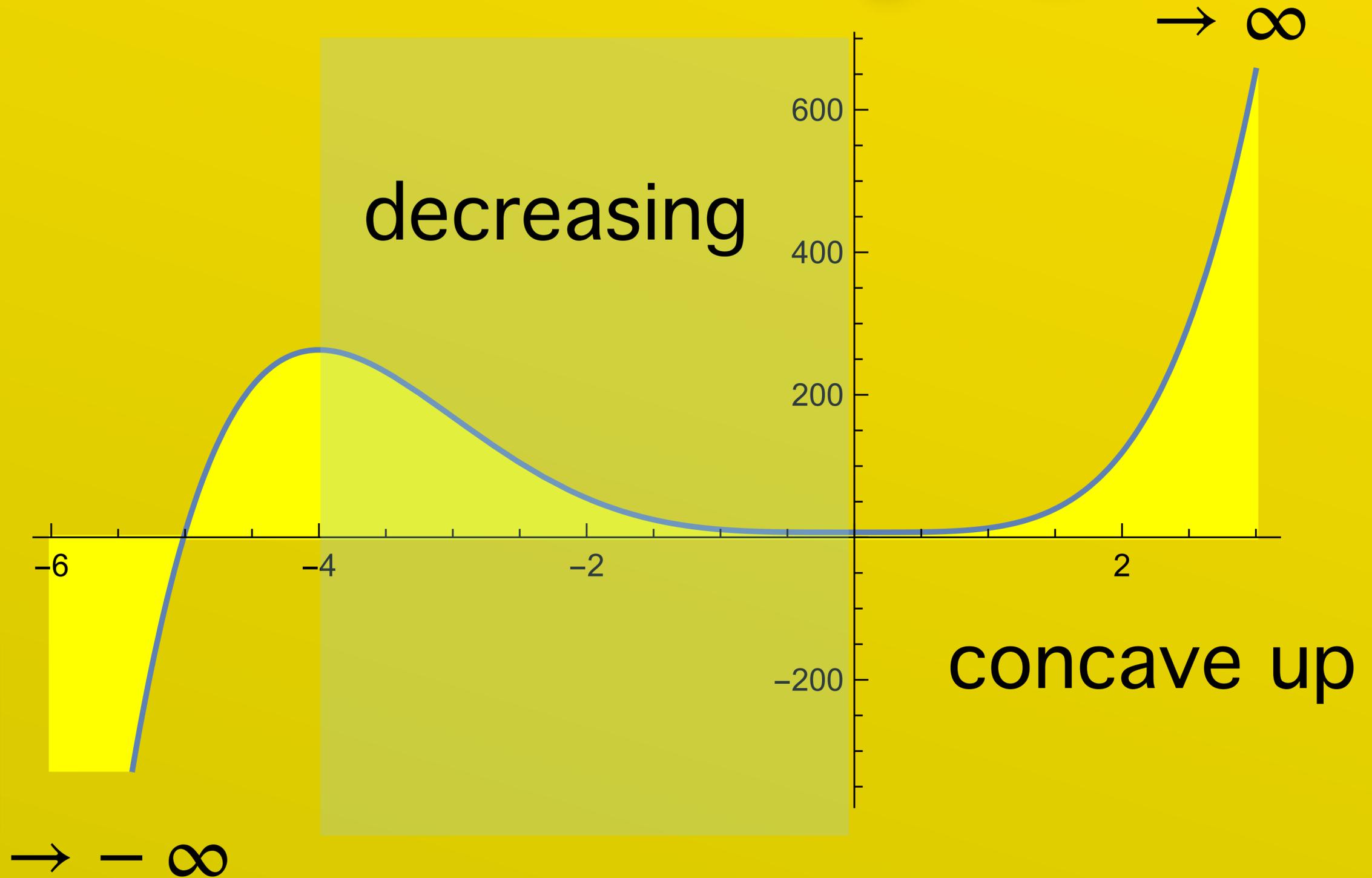
*POWERFUL!*



We must know  
the power rule!

# ANALYSIS OF GRAPHS

$$x^5 + 5x^4 + 7$$



# ANALYSIS OF GRAPHS

**f-f'-f''  
program!**

**f**

- Roots
- Asymptotes

**f'**

- Flat points
- Increasing, decreasing

**f''**

- Inflection points
- Concave up, concave down

# ENTROPY EXAMPLE

$$f(x) = -x \log|x|$$

$$f'(x) = -\log|x| - 1$$

$$f''(x) = -1/x$$

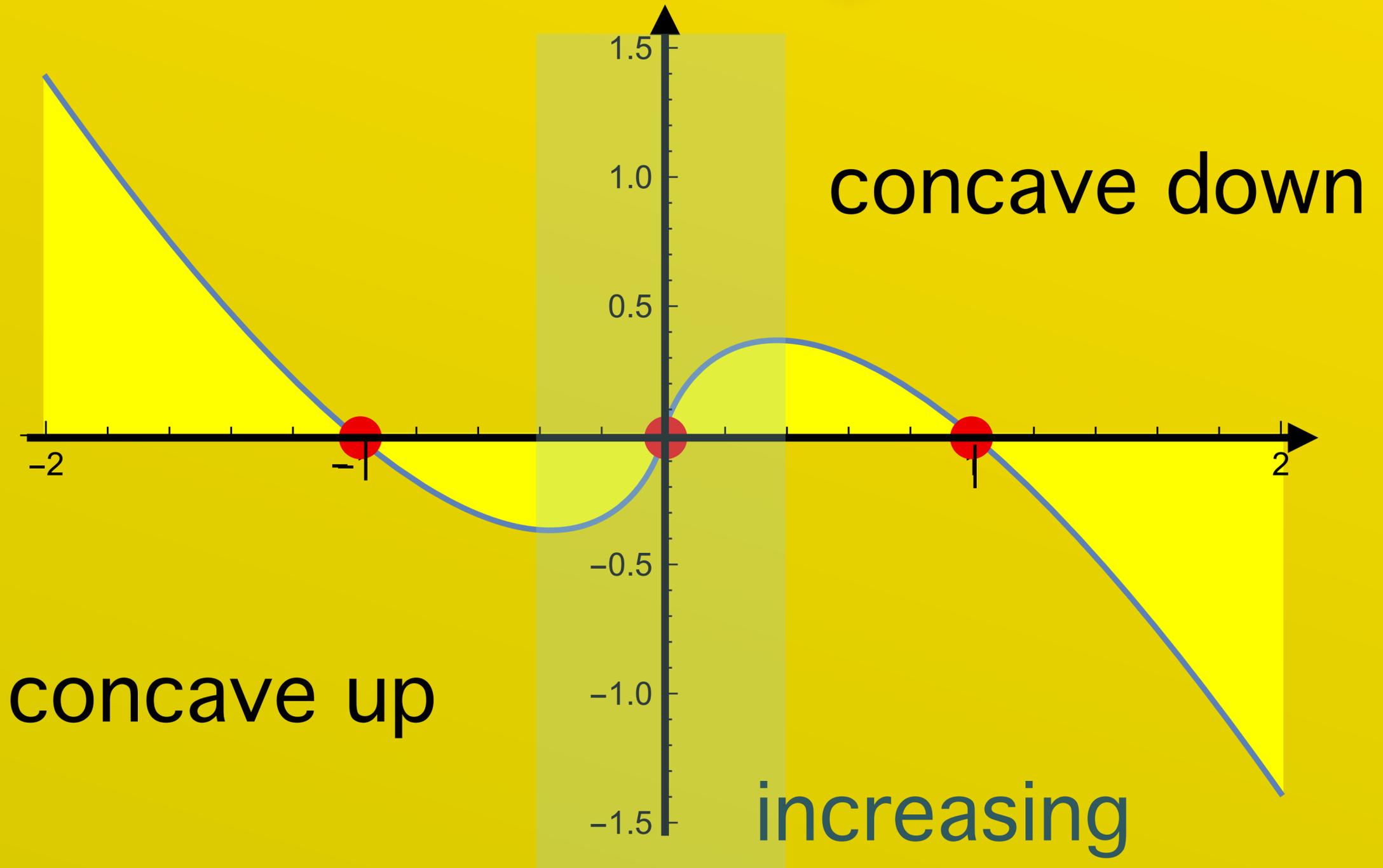


*DRAW THE GRAPH?*

$$f(x) = -x \log|x|$$

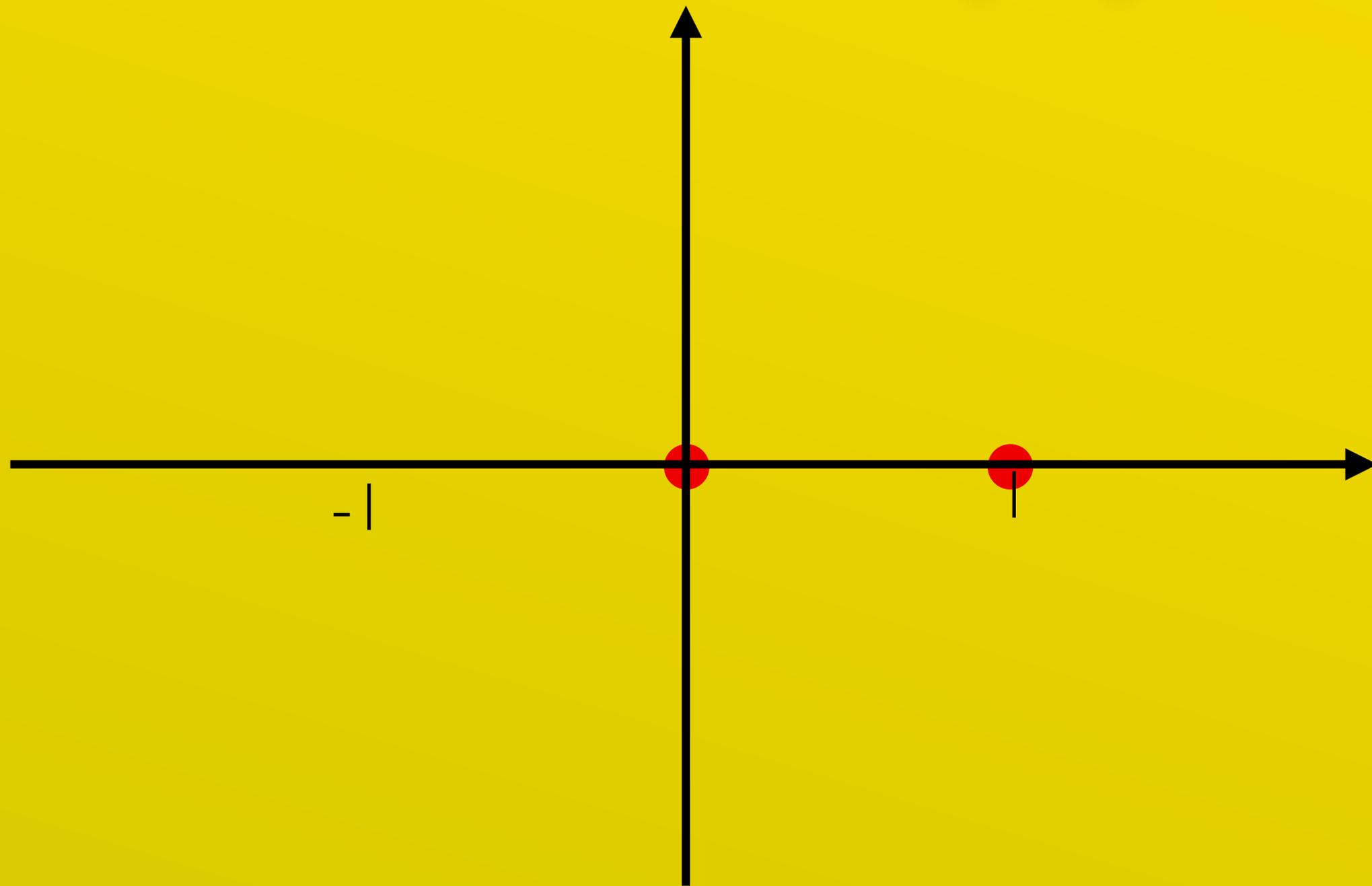
$$f'(x) = -\log|x| - 1$$

$$f''(x) = -1/x$$



*JAM*

$$JAM: E = \mathcal{X} - |\mathcal{X}|^{1/2}$$

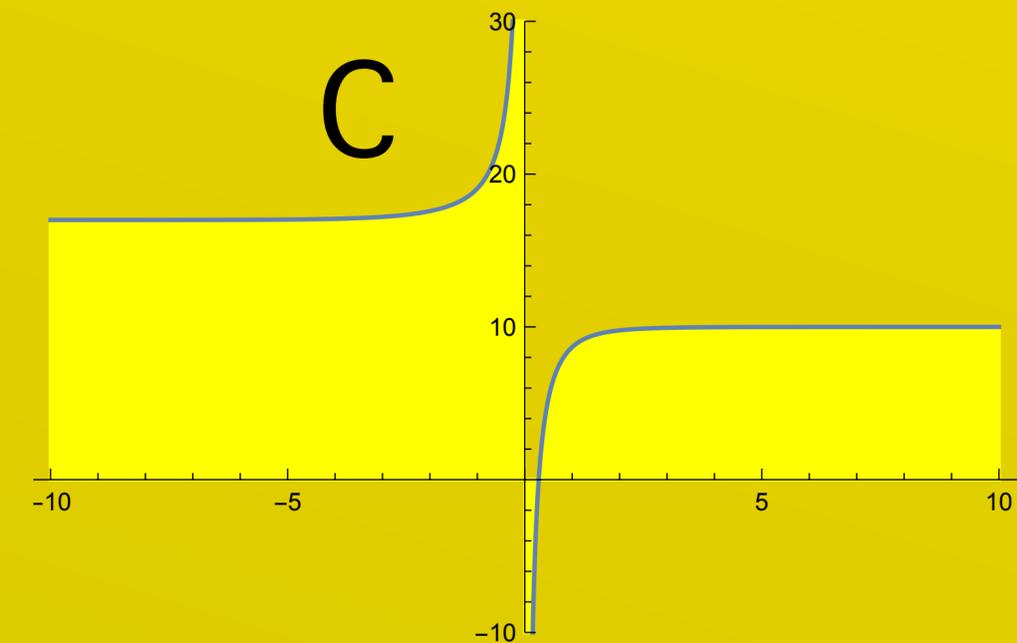
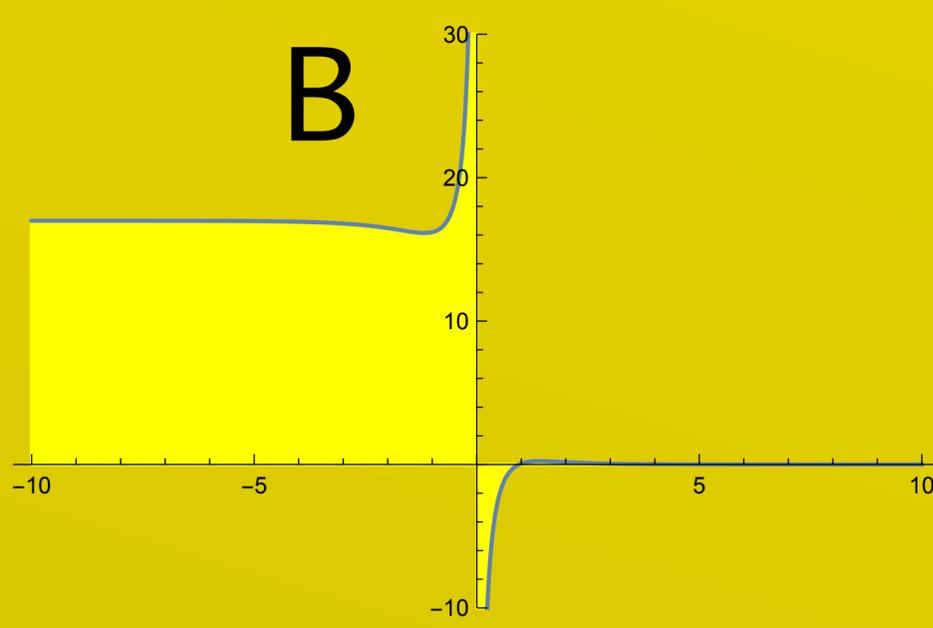
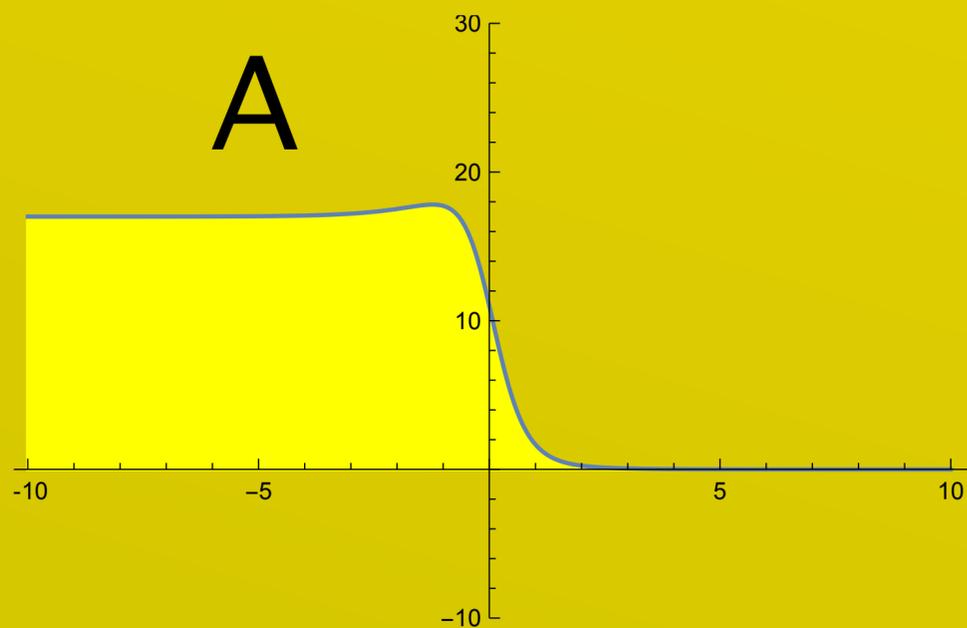


Draw the graph using the  $f$ - $f'$ - $f''$  program

*JAM*

$$f(x) = \frac{e^{2x} + 4e^x - 17}{e^{3x} - 1}$$

- 1) Classify discontinuities.  
(removable? Jump? Asymptote?)
- 2) Find horizontal asymptotes
- 3) Which is the right graph?



*THE END*