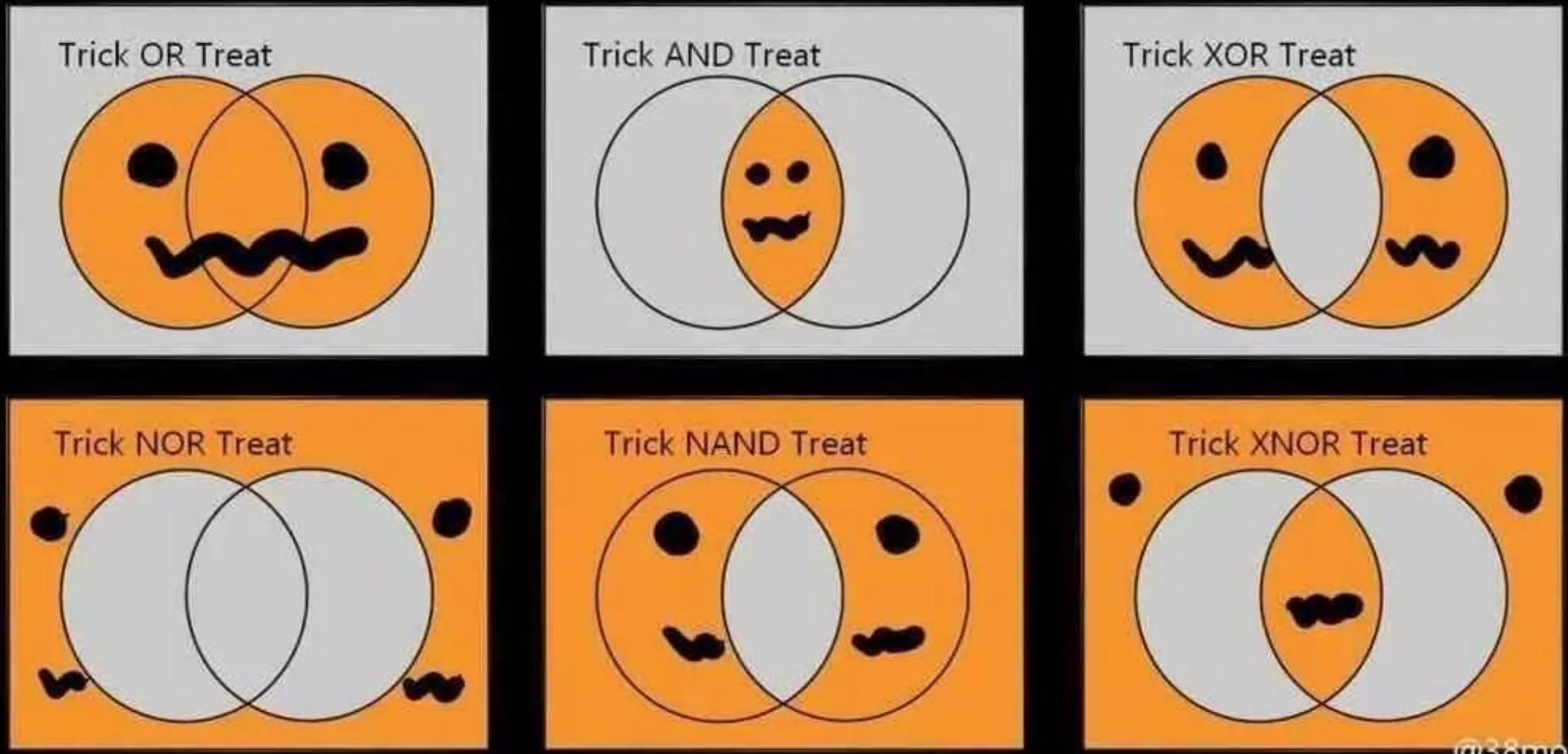
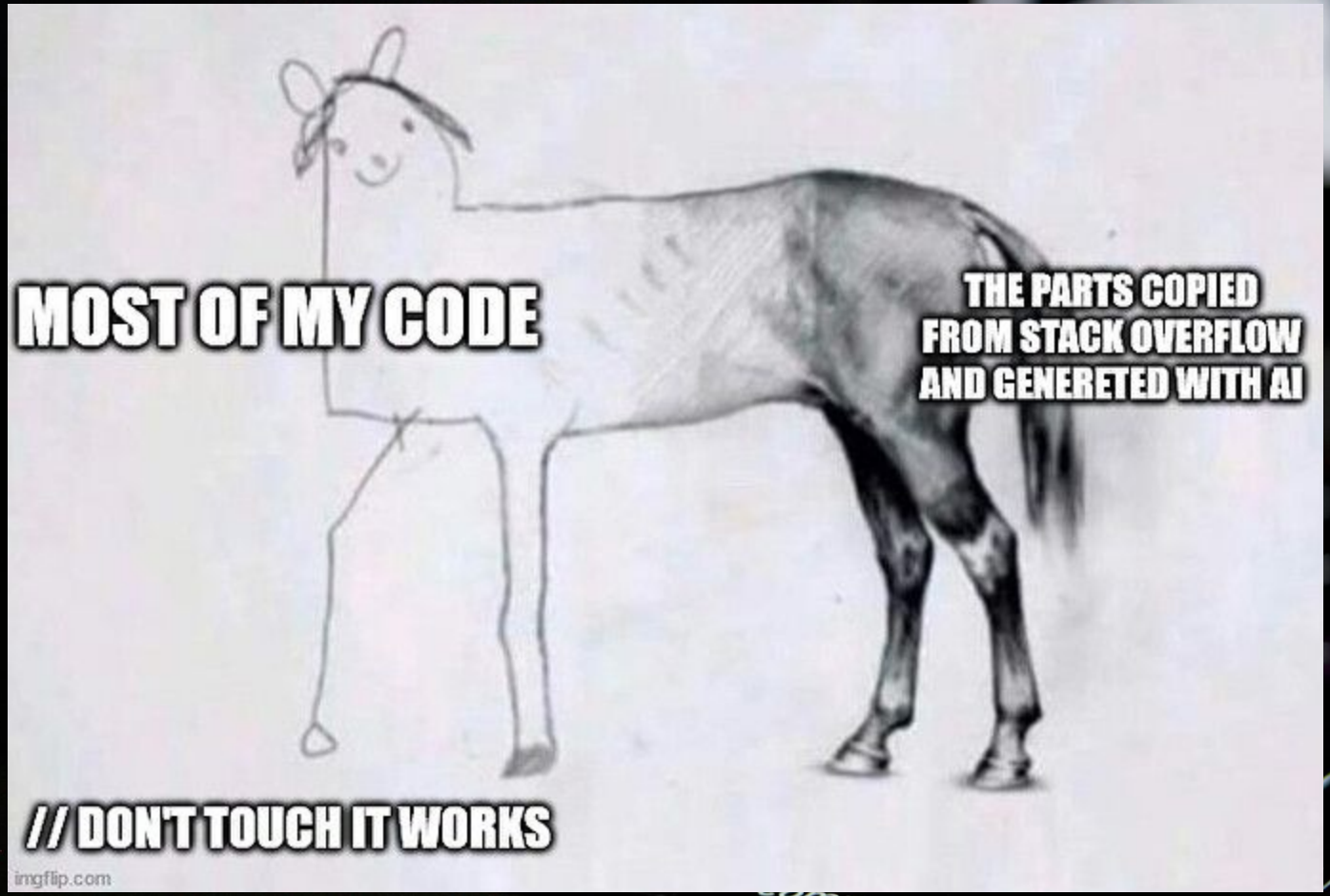
Welcome!

GM **#8** | HHS CS



DAY1 OF PROGRAMMING

10 YEARS OF PROGRAMMING


MOST OF MY CODE
THE PARTS COPIED FROM STACK OVERFLOW AND GENERETED WITH AI
// DON'T TOUCH IT WORKS
imgflip.com

> When do we meet?

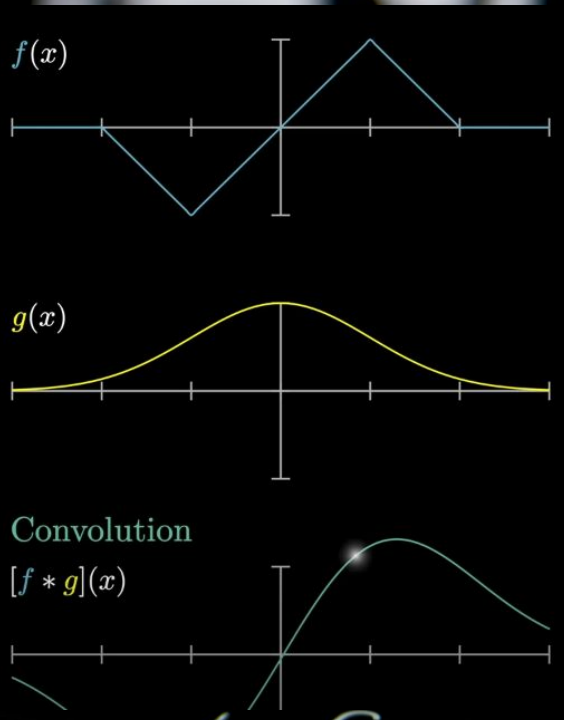
Every **Tuesday**

At lunch **(1:30-2:10)**

in **i5** (here!)

> What are Convolutions?

- Is a mathematical function between two functions that produces a third function
- Simply put, it expresses how the shape of one function is modified by a different function



> Mathematical Definition

- Now this is pretty complicated, but I'm not going to expect you to understand what this is/how this works!

$$(f * g)(t) \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} f(\tau)\, g(t-\tau)\, d\tau$$

> Visual Explanation (3Blue1Brown)

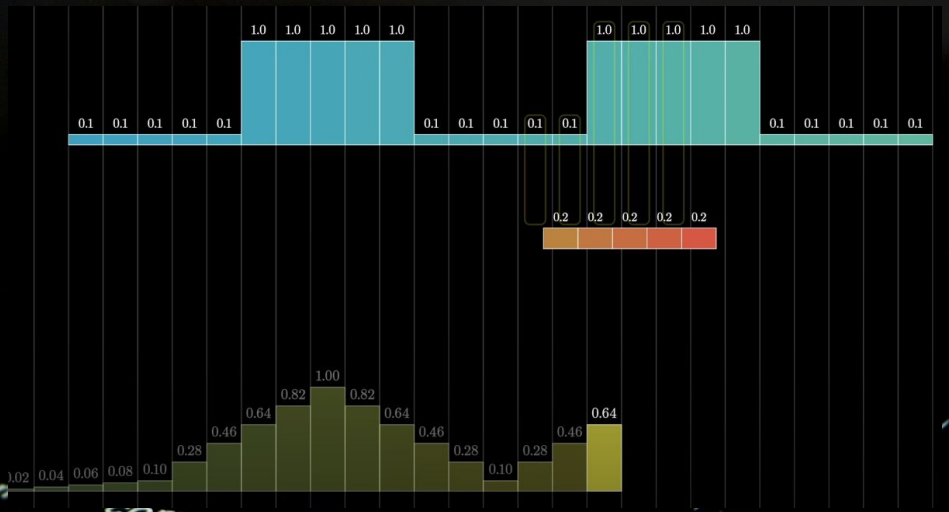
https://youtu.be/KuXjwB4LzSA?t=242

Here we are doing a convolution with 2 1d arrays to get a 3rd 1d array that is the convolution of these 2 1d arrays.

> Convolutions (ctd)

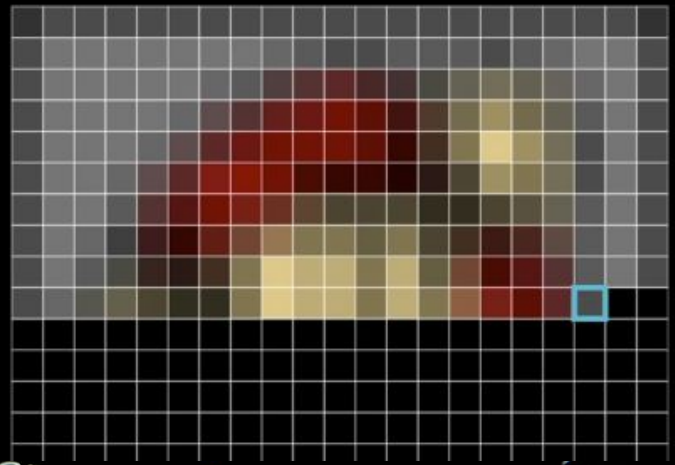
- Seems decently simple right!
- Here's an example for doing a moving average with these two arrays.

$$(a * b)_n = \sum_{\substack{i,j \\ i+j=n}} a_i \cdot b_j$$



> 2D Convolutions (blurring)

- For 2D Images, this relates as we can apply a kernel (this 3x3 array) to do things to images. This is a blurring kernel.

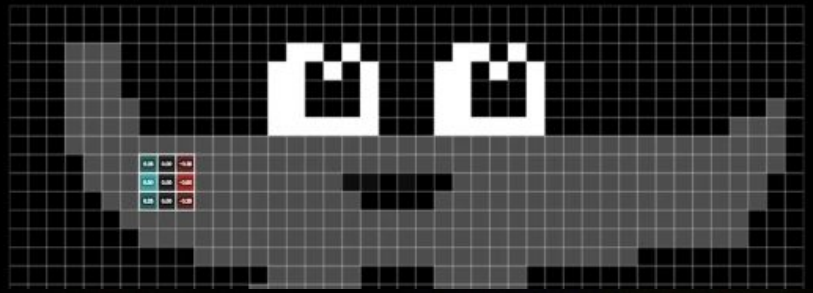


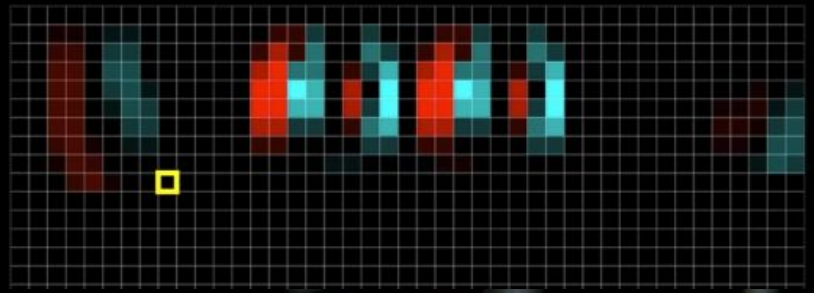
> 2D Convolutions (cool gif)

- For 2D Images, this relates as we can apply a kernel (this 3x3 array) to do things to images. This is a blurring kernel.

> 2D Convolutions (Edge Detection)

- Another type of kernel is one that can do edge detection.





- Sideways edge detection kernel!

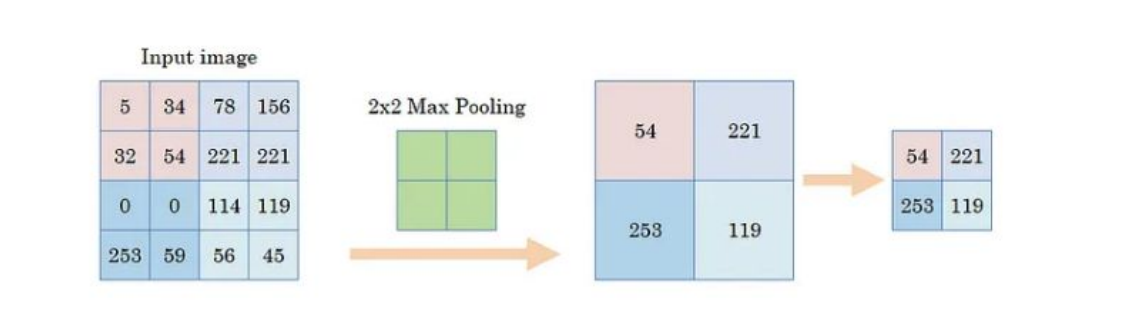
0.25	0.00	−0.25
0.50	0.00	−0.50
0.25	0.00	−0.25

> Convolutions take a lot of time :(

- So how can we make it faster?
- Two ways (that we are going to cover today): pooling & fast fourier transforms

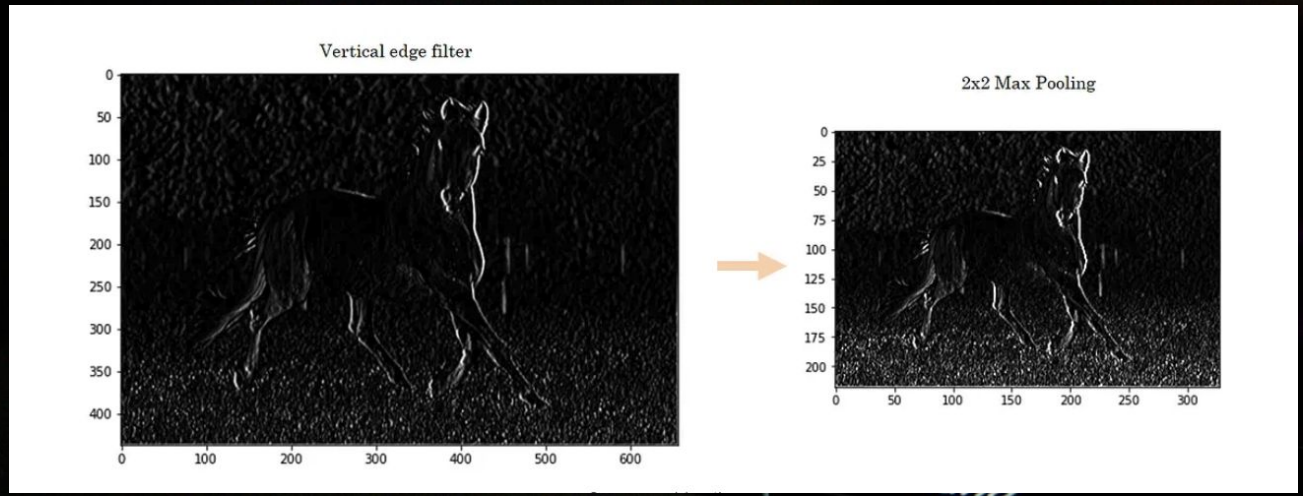
> Pooling

- Essentially is extracting the important features from the image; Shrinking down the resolution to care only about the important things
- Max pooling (below) vs average pooling



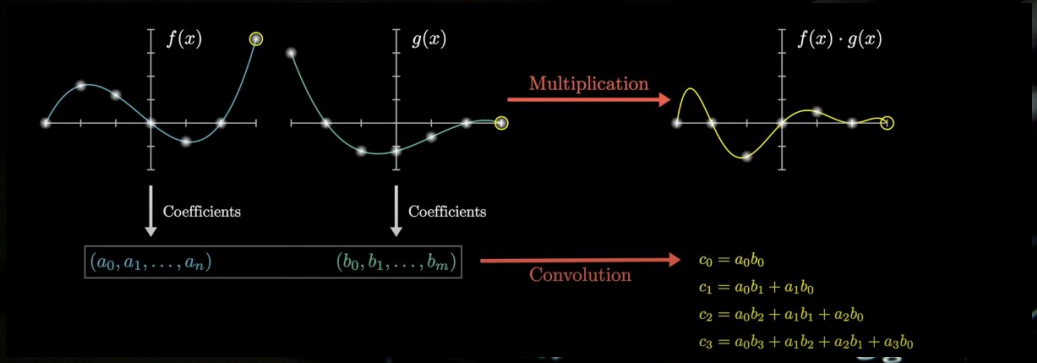
> Pooling

- After that max pool, this is what an image will look like
- Notice resolution shrunk by two
- This stuff is useful for CNN's so try to get it down!



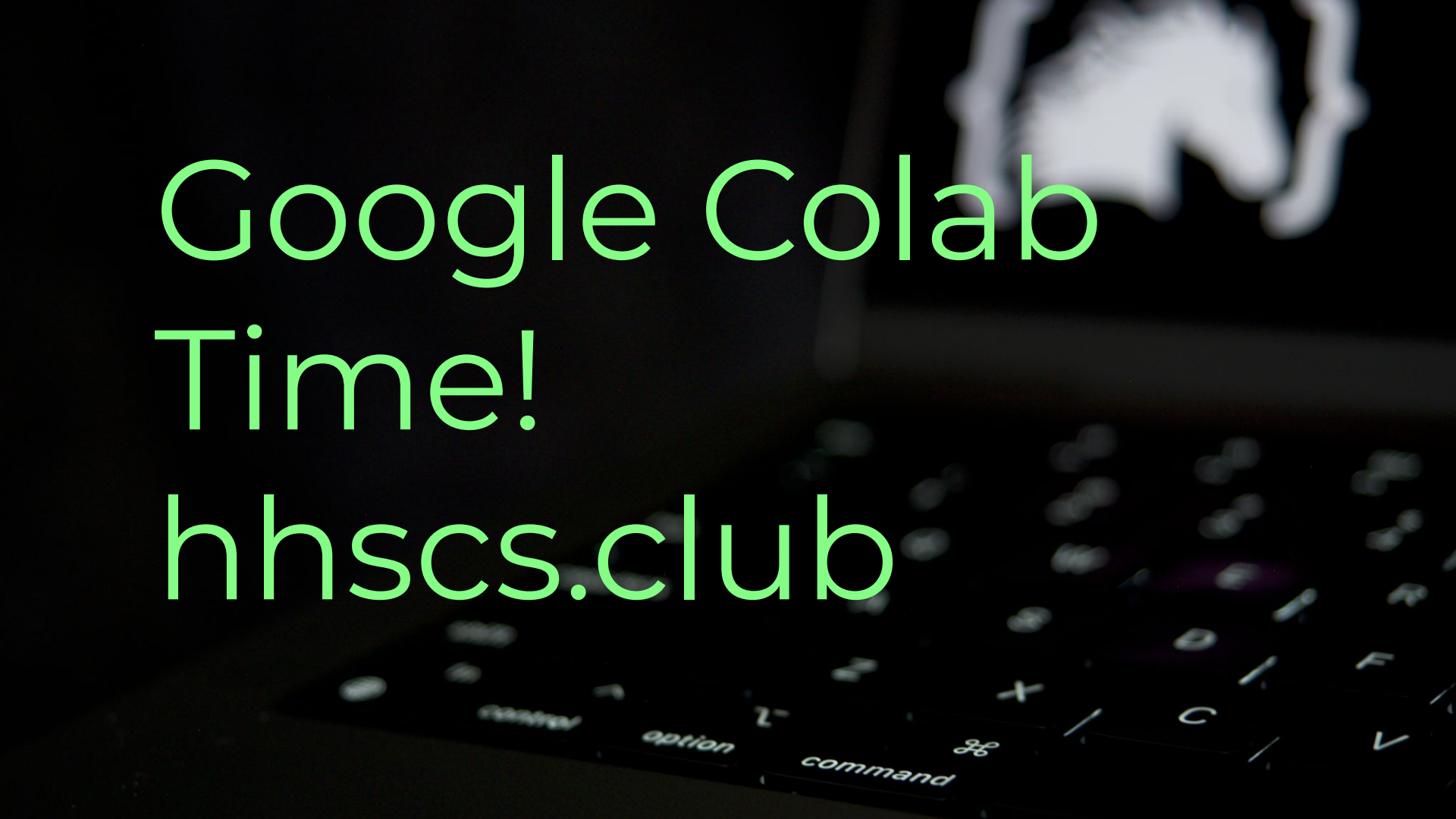
> Fast Fourier Transforms

- It’s a whole whole whole bunch of complicated calculus!
- But essentially… it means that I can extract the important sample coefficients from a simple multiplication for a convolution.



> Fast Fourier Transforms

- So then you're left with a system of equations to solve for these coefficients (which will take O(n^2) to solve)
- A discrete fast fourier transform can take a finite sample of points and find the function that it takes in O(n log n).
- This is a very very important algorithm in today's world (used in telephone lines to convert digital to analog).



Google Colab Time!

hhscs.club

> Socials

Website: hhscs.club

Email List:

Insta:

@hhscomputerscience

Discord:

Next Meeting:

Tuesday (11/7) Lunch