Before we start...

- This is technically a ‘members-only’ event (for student org. purposes.)
- Luckily, we count anyone in our Discord a member!

http://puhack.horse/discord

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Workshop structure:

- **~10 minutes**: theory.
-
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guided coding: you'll write a matrix multiplication kernel.

hacking: write some other kernels. maybe convolution.

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Hi! Rules for this presentation:

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Ask me a question right now.

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Another.

Introduction to GPU Programming

Kartavya Vashishtha

February 26, 2026

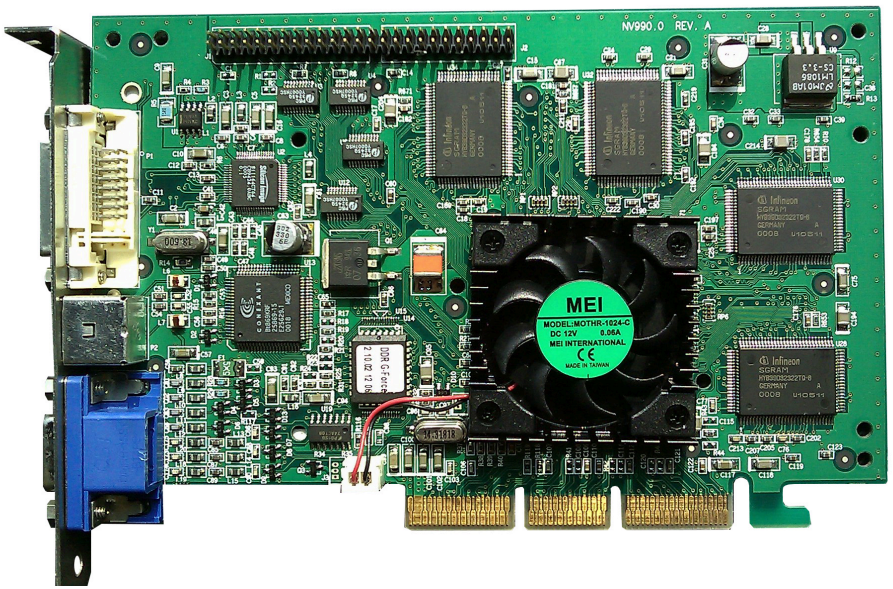
A GPU from a thousand feet away

A GPU from a thousand feet away

where is it?!

A GPU from a thousand feet away

A GPU from a few inches away



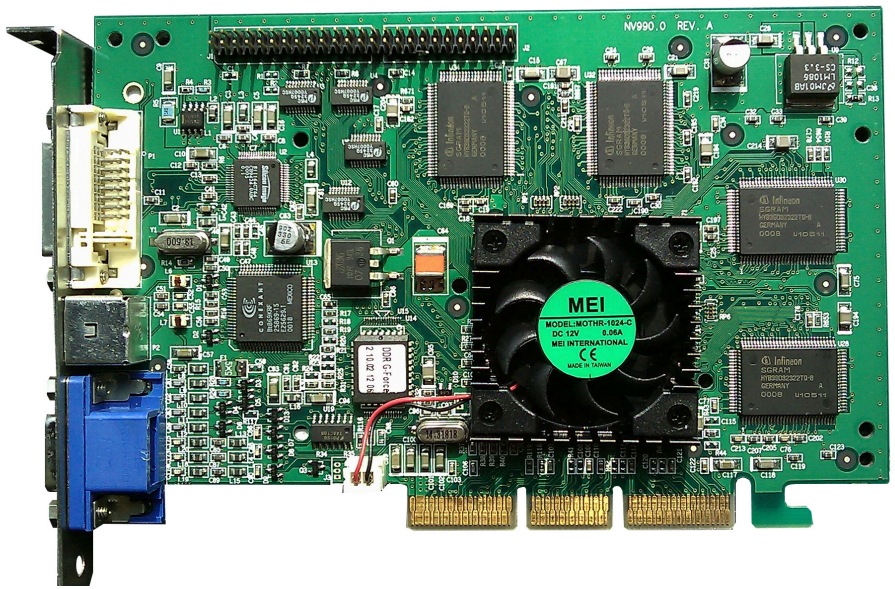
120 MHz Nvidia GeForce 256

- **not** a CPU
-

A GPU from a few inches away

- **not** a CPU
- trades single-thread speed for many-thread throughput

  (more on this later!)



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A History of GPU Usage

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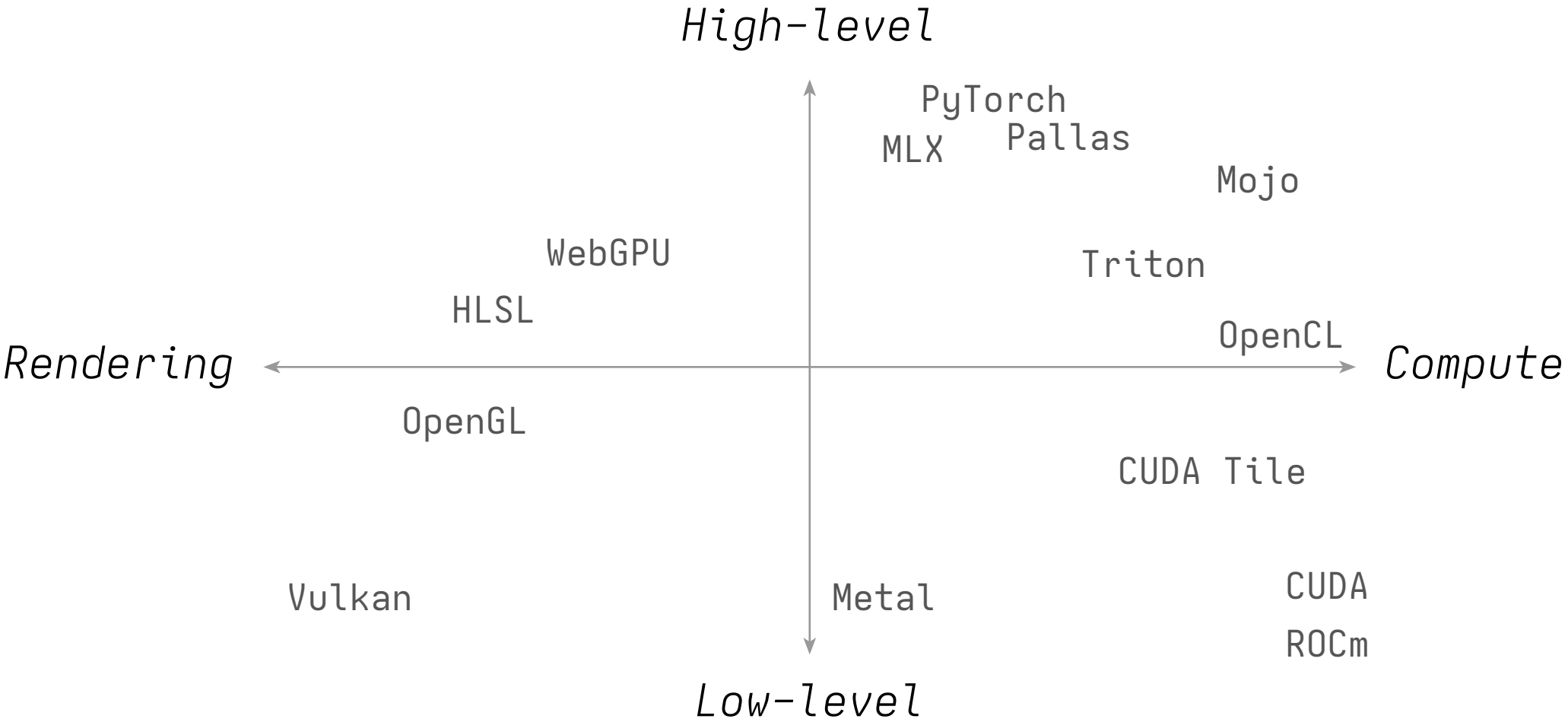
3. **2010s:** people start running machine learning on them.

Many ways to program a GPU



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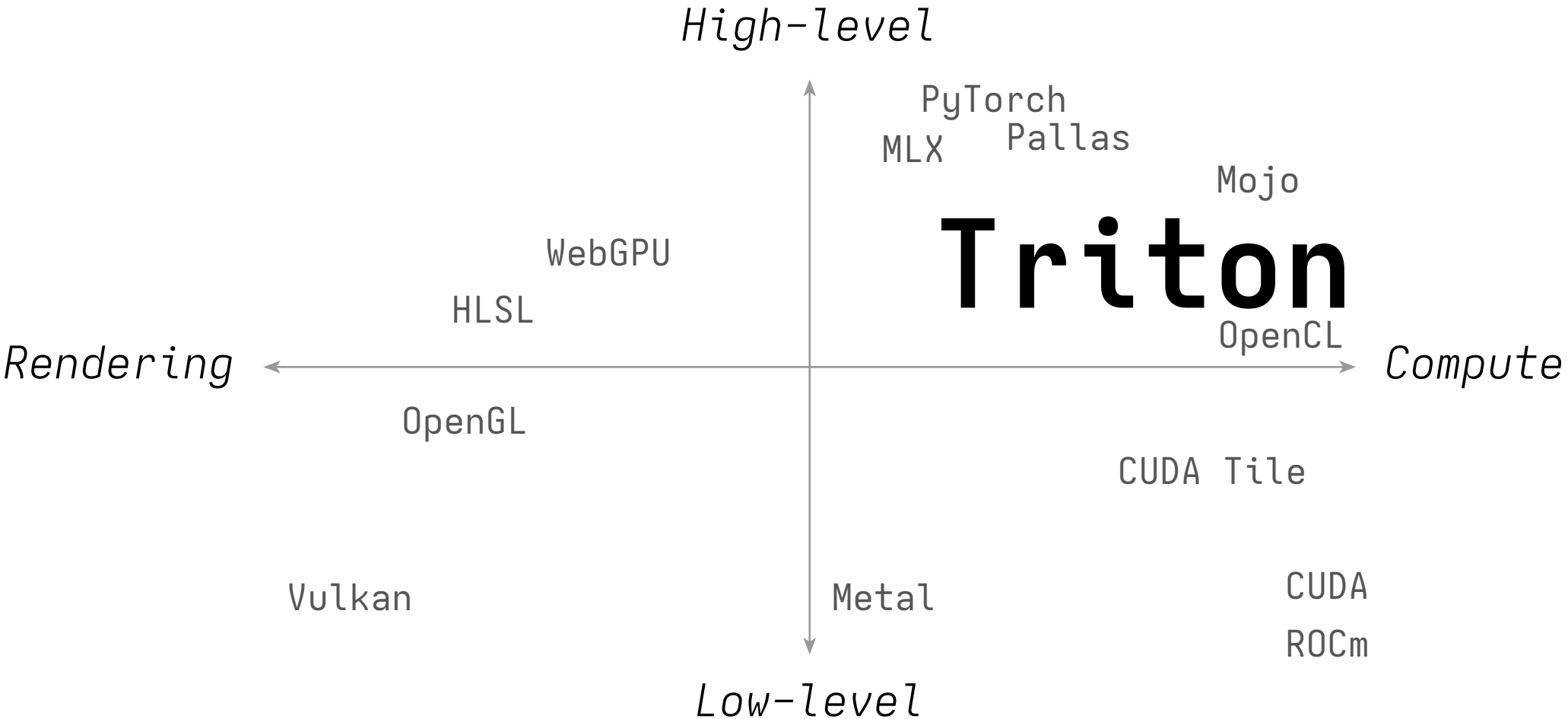
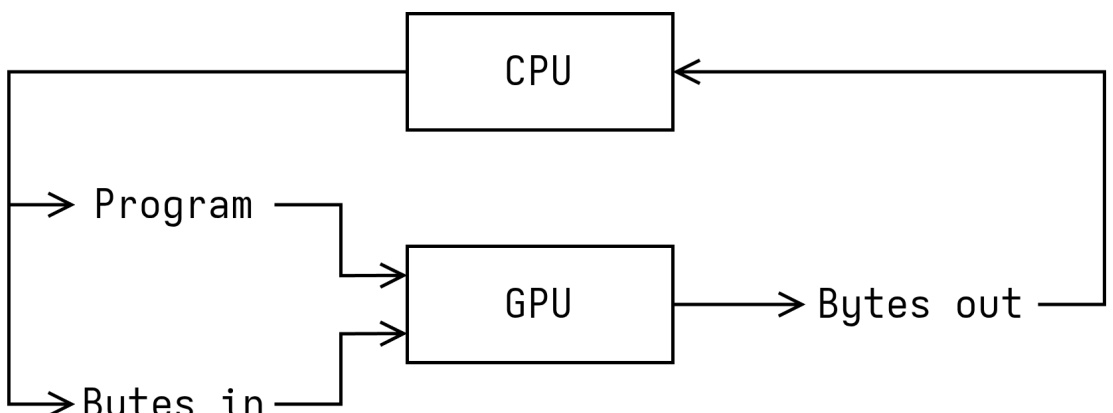
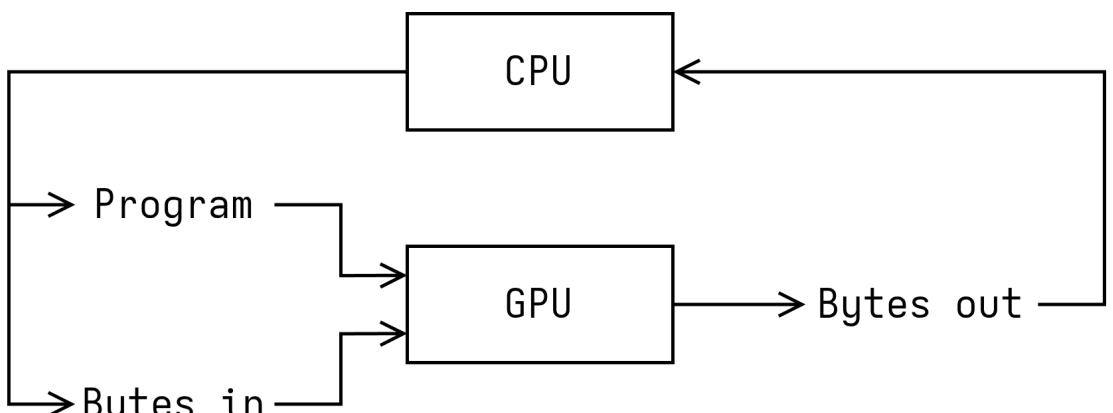


A simple model



An (overly) simple model



Switching gears: time to write ReLU!

Recall, or learn very quickly,

$$\mathrm{ReLU}(x) = \begin{cases} x & \text{if } x > 0 \\ 0 & \text{else} \end{cases}$$

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```

For an array:

```
def relu_array(arr):
  return [max(x, 0) for x in arr]
```

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- question: ***how do you divide work between these threads?***

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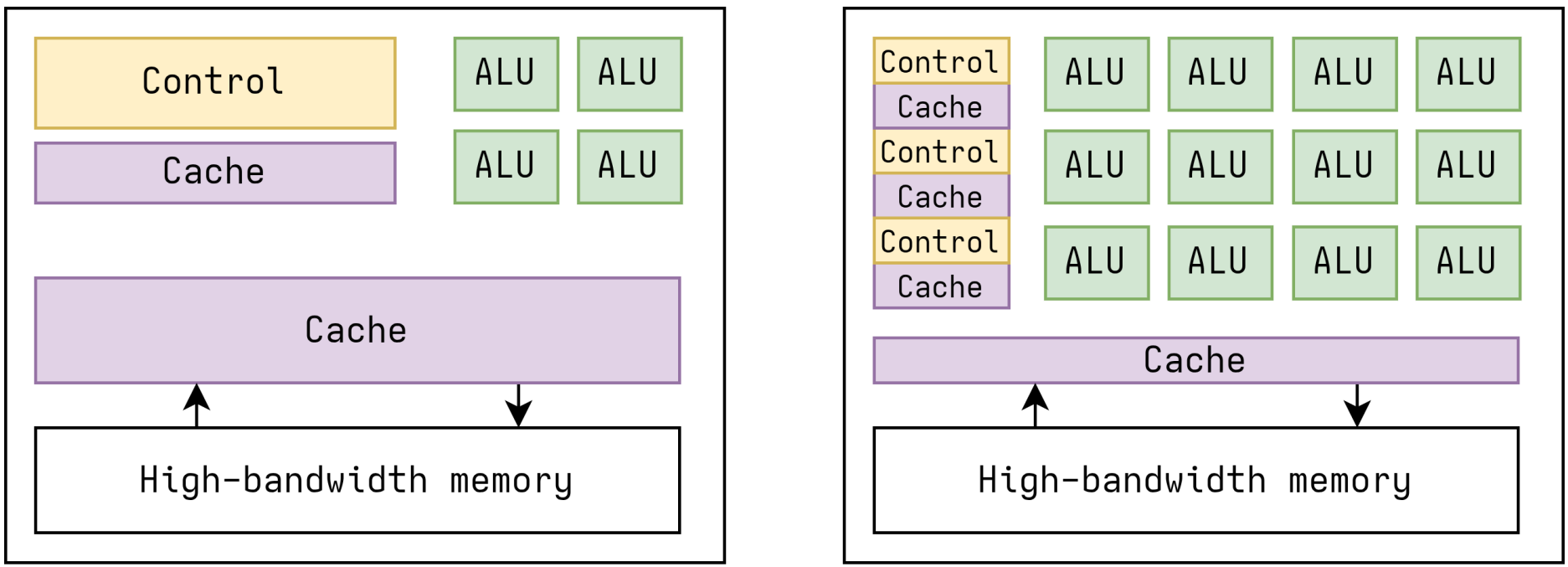
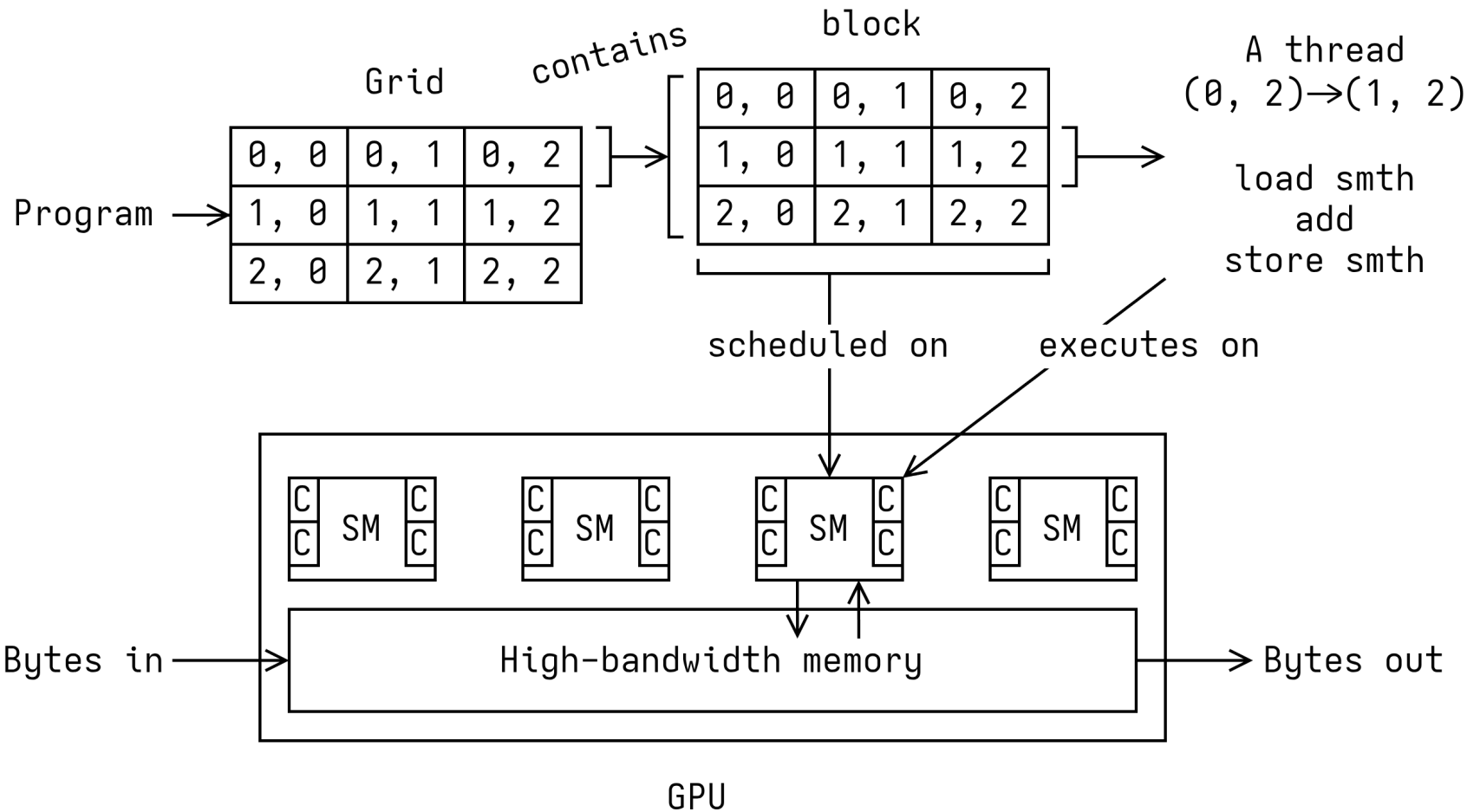
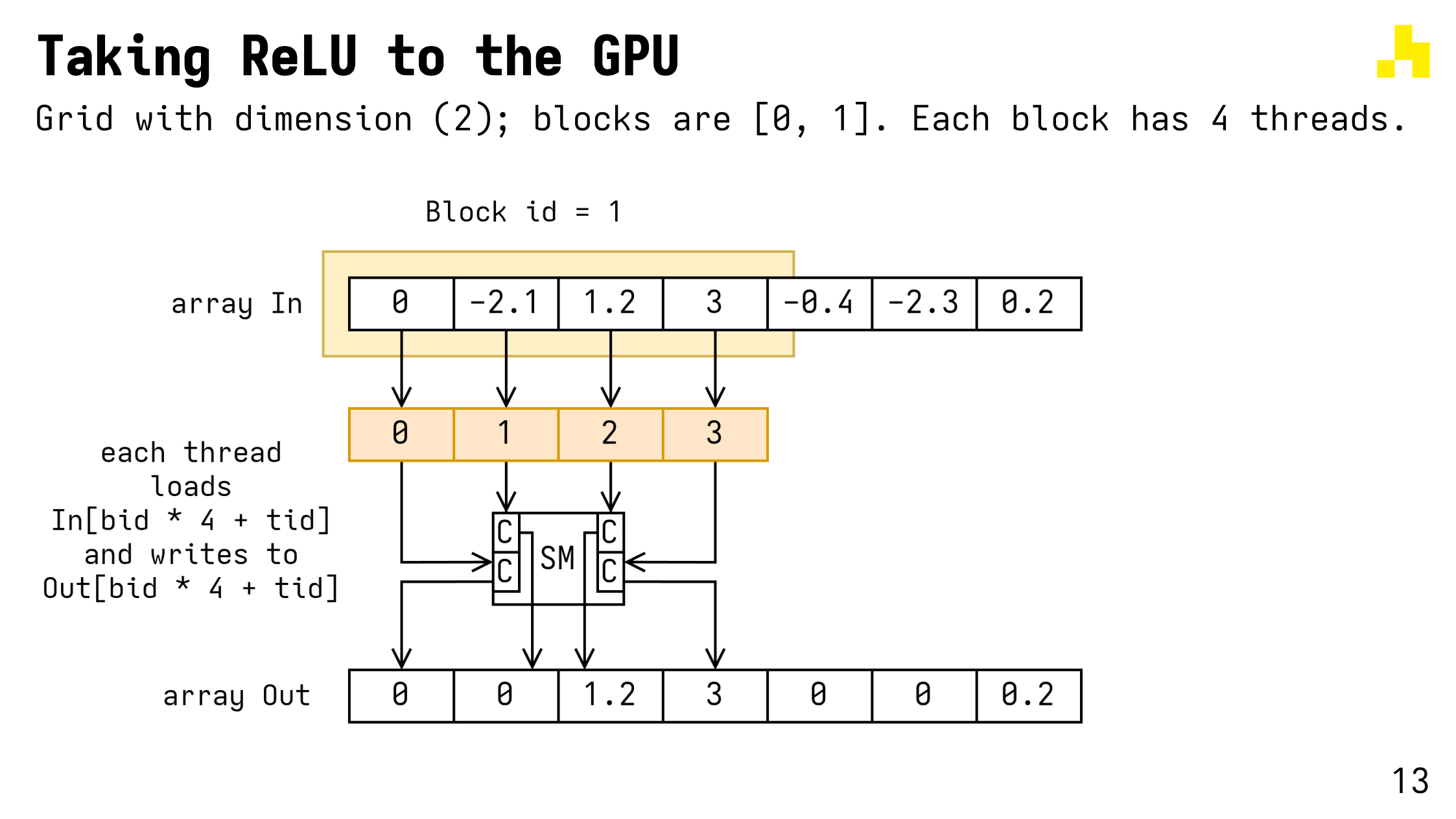


A simple model for a GPU



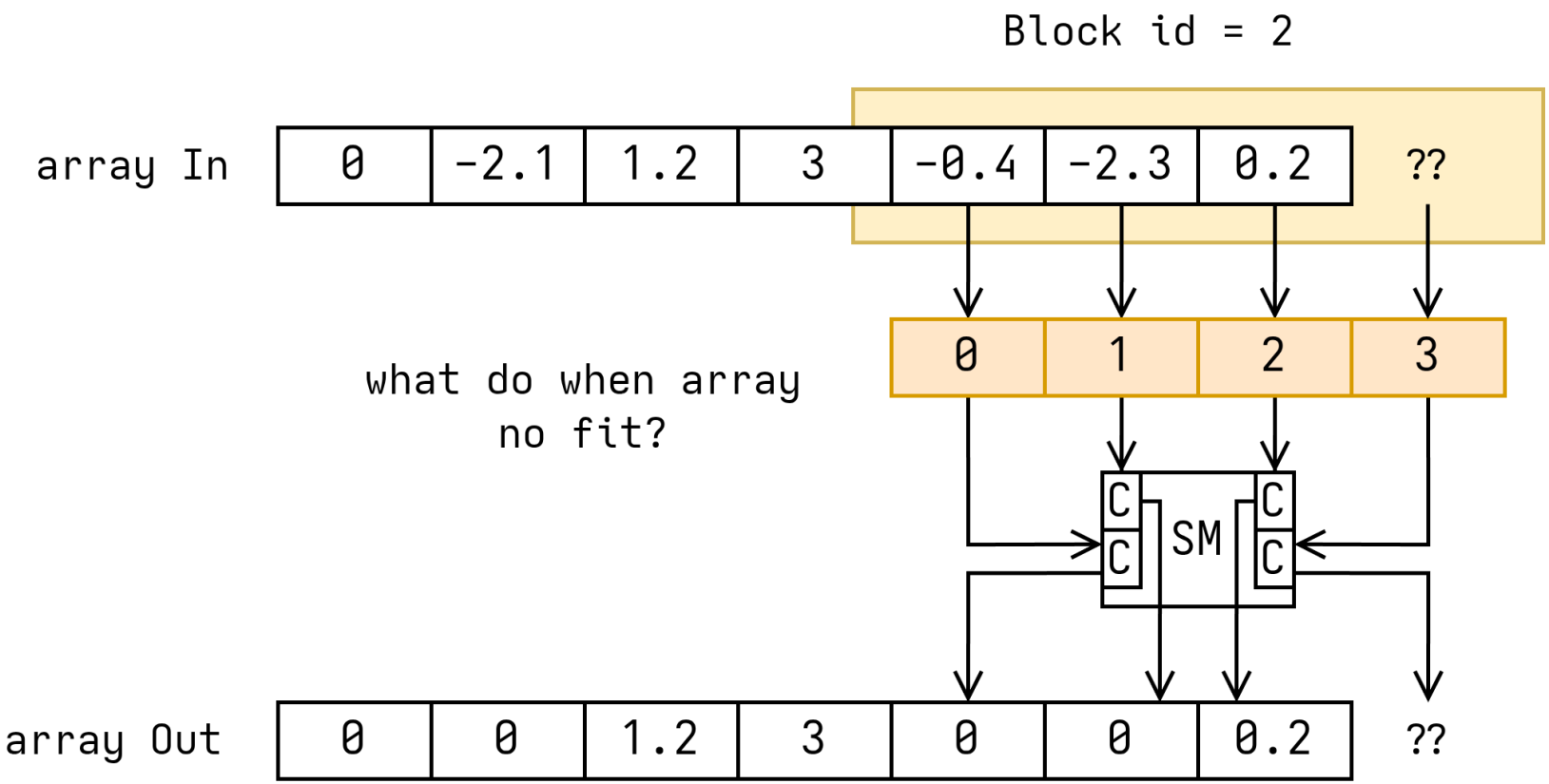
Taking ReLU to the GPU



Grid with dimension (2); blocks are [0, 1]. Each block has 4 threads.

Taking ReLU to the GPU

What happens at block 1?



Time to move over to writing code!!

- go to https://puhack.horse/gpu-colab
- click ‘Copy to Drive’ in top bar.

An example problem decomposition

Hm. What sort of problems can be broken into parallel chunks?

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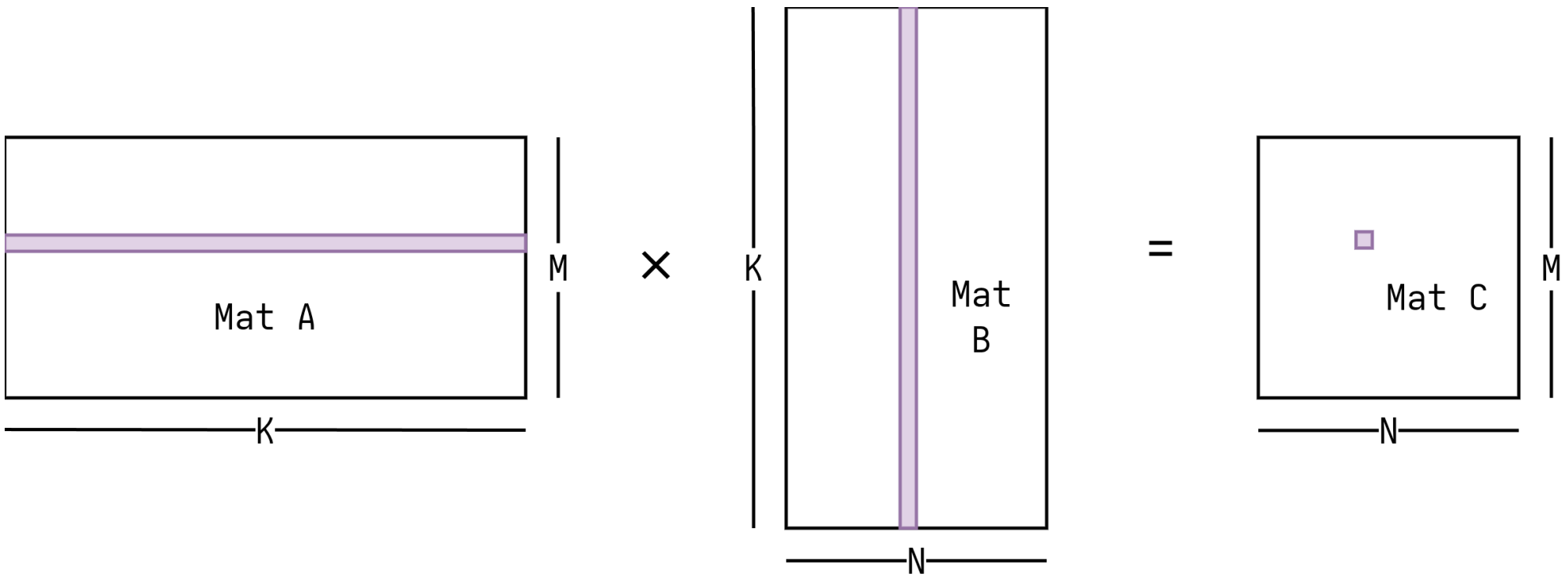
Enter the humble matmul.



The humble matmul


```
for i in range(M):
    for j in range(N):
        for k in range(K):
            C[i, j] += A[i, k] * B[k, j]
```

- Imagine one thread per (i, j) index:
  - Thread (0, 0) loads **A[0, k]** and **B[k, 0]**
  - Thread (0, 1) loads A[0, k] and **B[k, 1]**
  - Thread (1, 0) loads **A[1, k]** and B[k, 0]
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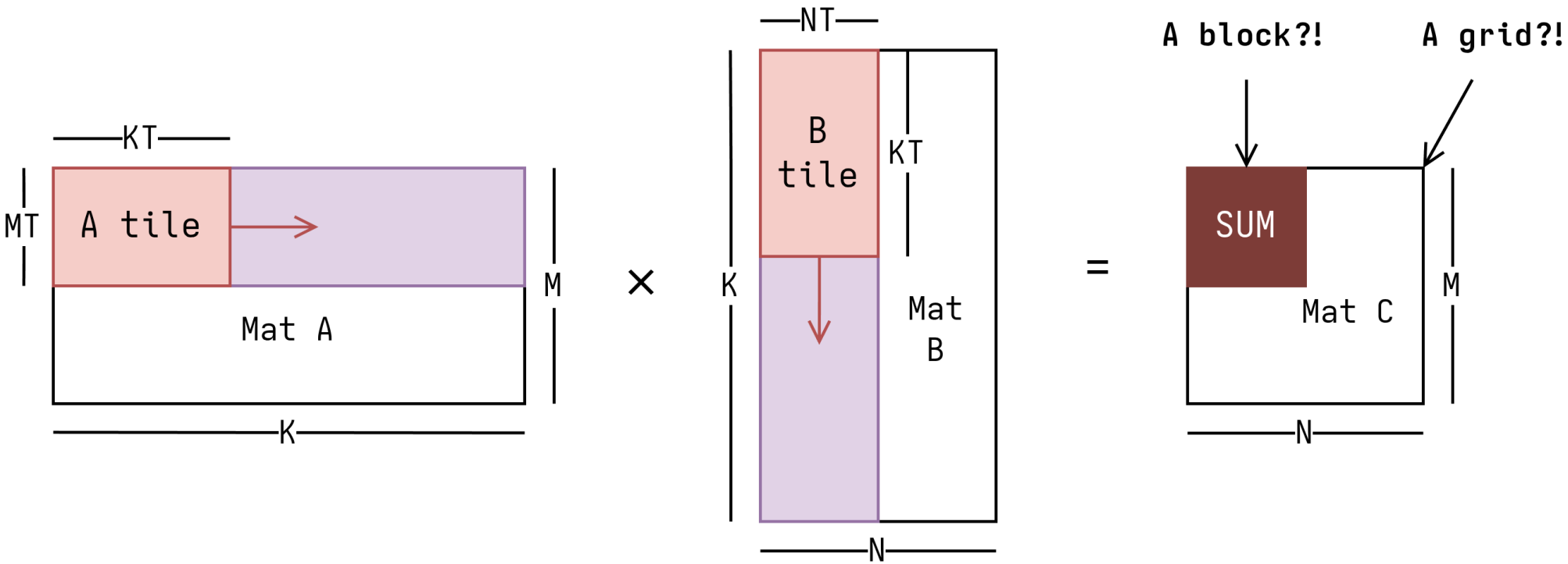
- This compute unit *has very fast memory*.
- Sharing these accesses is *good*.
- So let's write this with tiles!

Presenting: the tiled matmul



Tiled matmul pseudocode


```
def matmul_kernel(A, B, C, M, N, K):
    c_m, c_n = program_id(0), program_id(1)
    accumulator = zeros((MT, NT))

    for k in range(0, K, KT):
        tile_A = A[c_m * MT : (c_m + 1) * MT,        k : k + KT        ]
        tile_B = B[       k : k + KT        , c_n * NT : (c_n + 1) * NT]

        accumulator += dot(tile_A, tile_B)

    C[c_m * MT : (c_m + 1) * MT, c_n * NT : (c_n + 1) * NT] = accumulator
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```

CODING TIEM!! ← so excited I cna't spell

Hacking Section!

You can:

- go to https://tensara.org/

or

- go to https://puhack.horse/gpu-colab-conv