# Introduction to GPU programming

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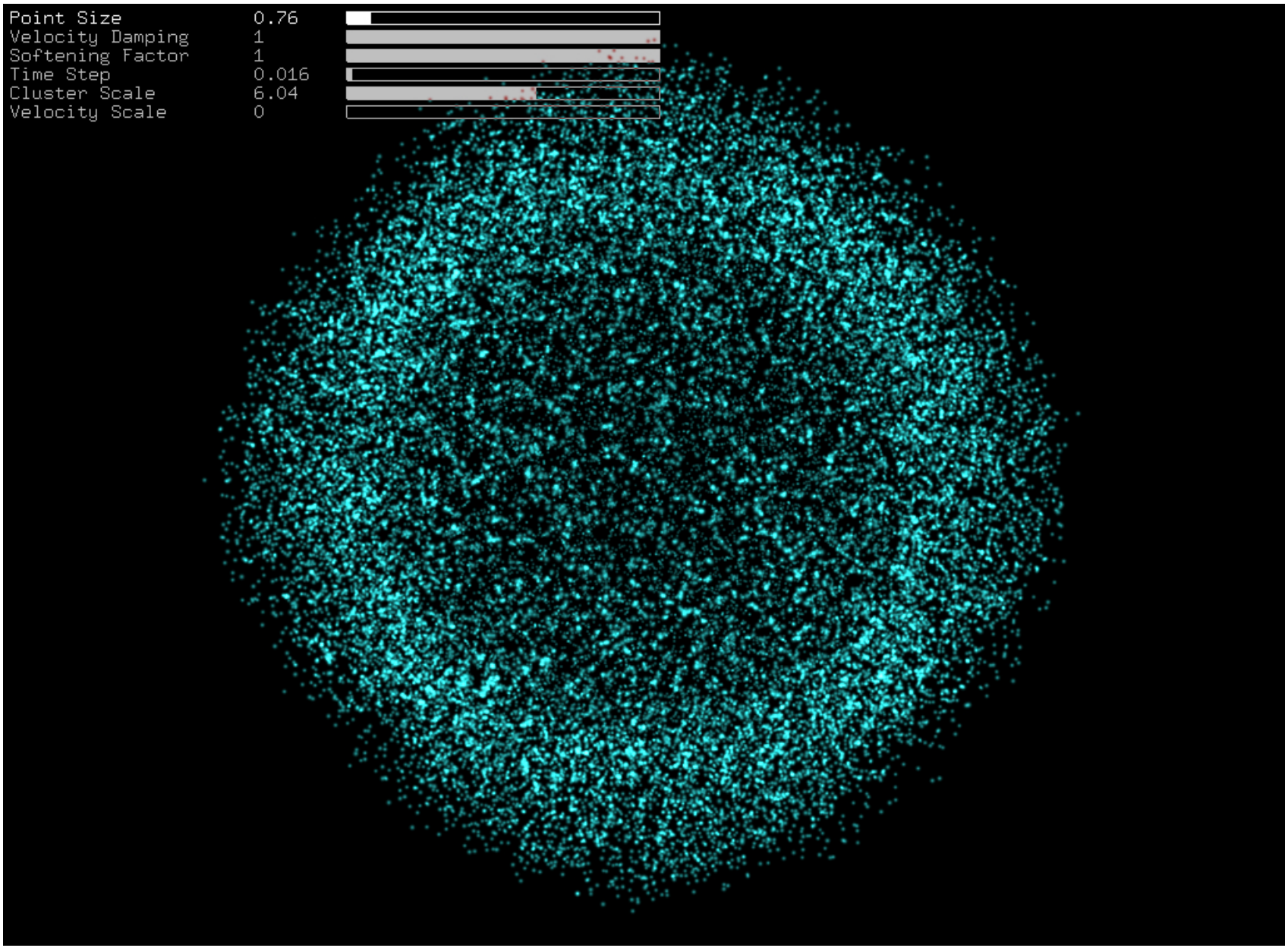
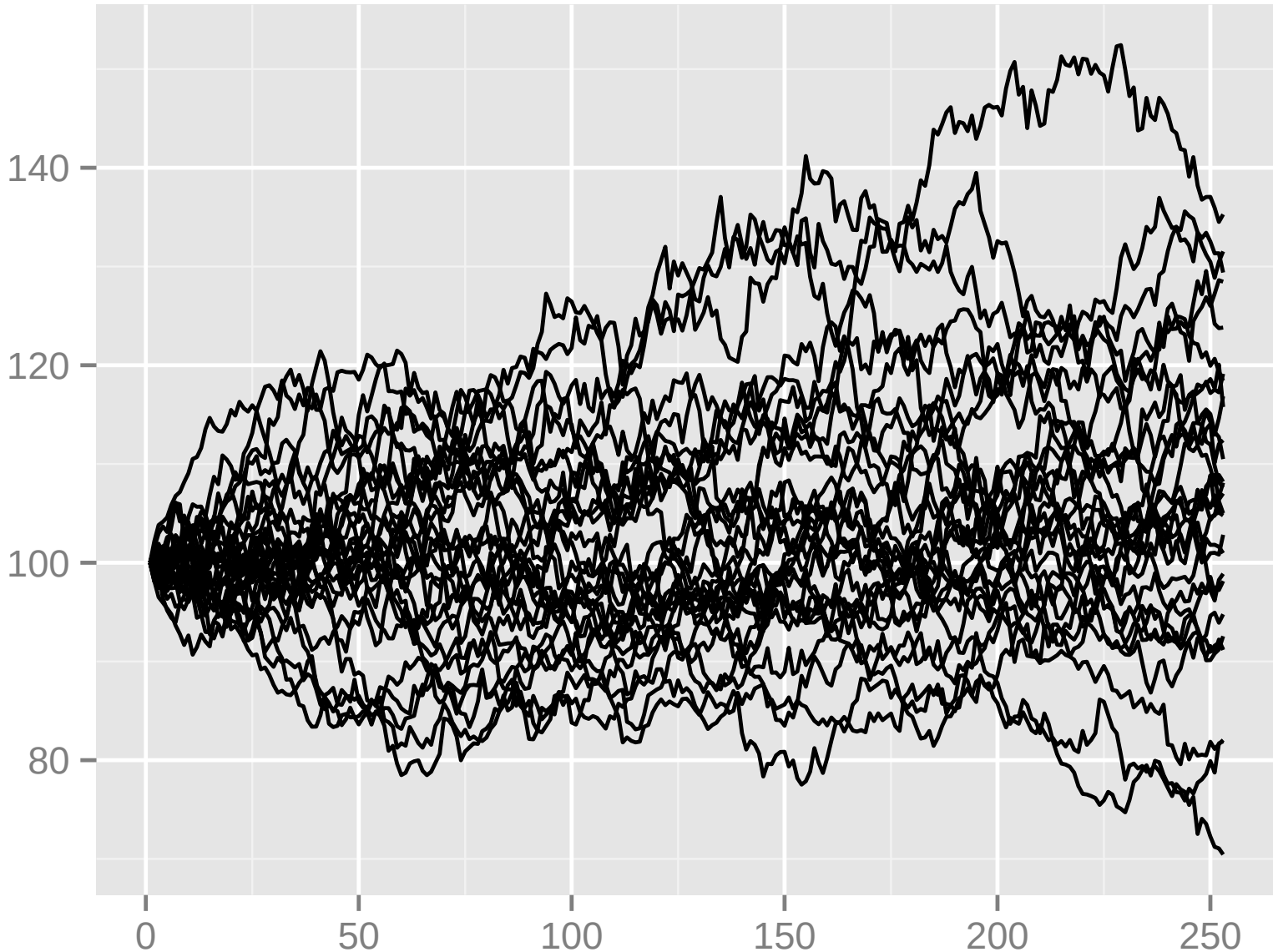
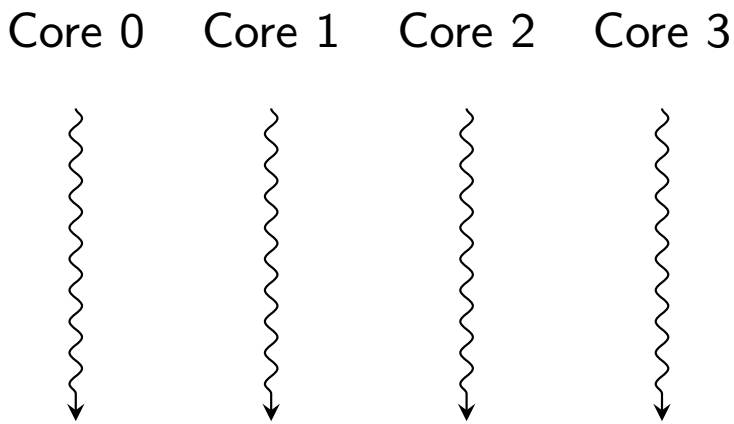
# Physics simulation



# Financial simulation



# Standard CPU



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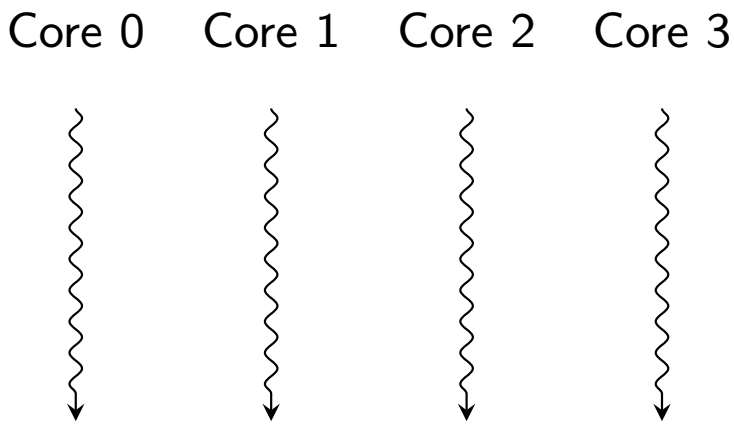
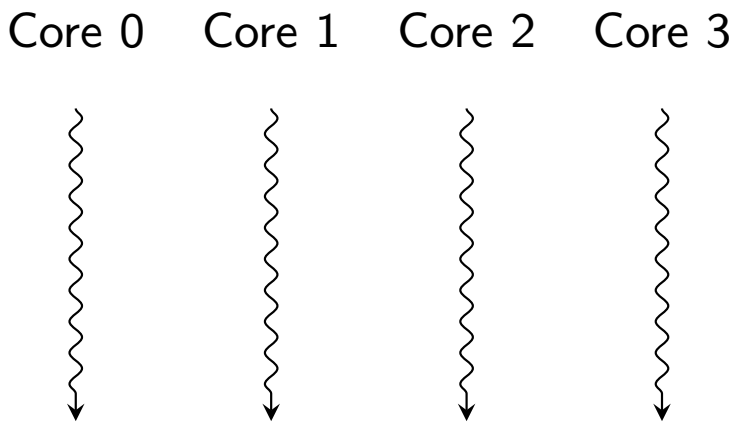



- One operation at a time

# Standard CPU




- One operation at a time
- Few compute units (cores)

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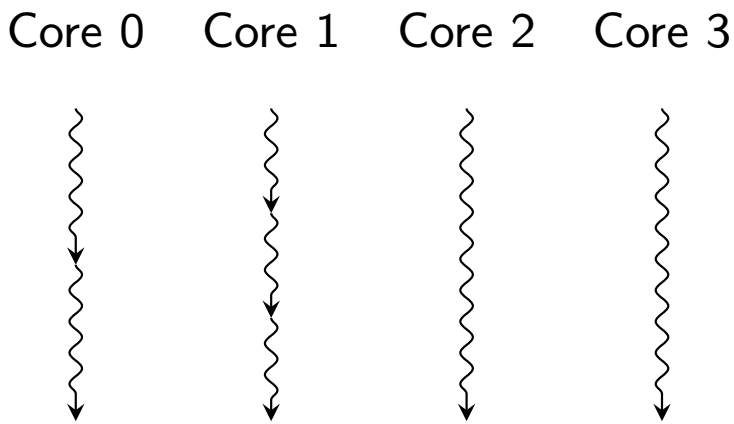
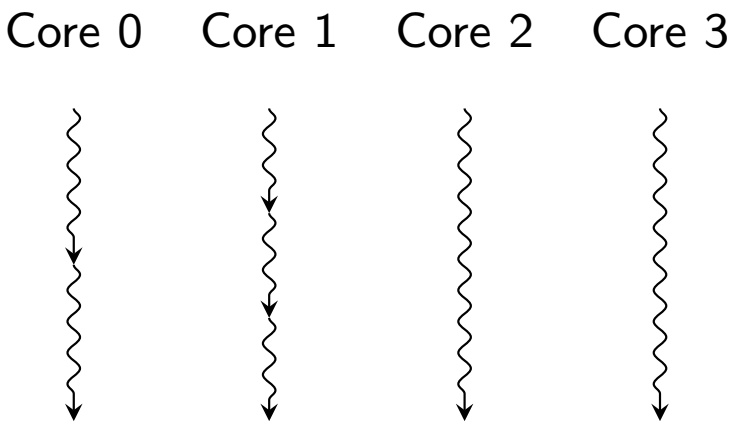
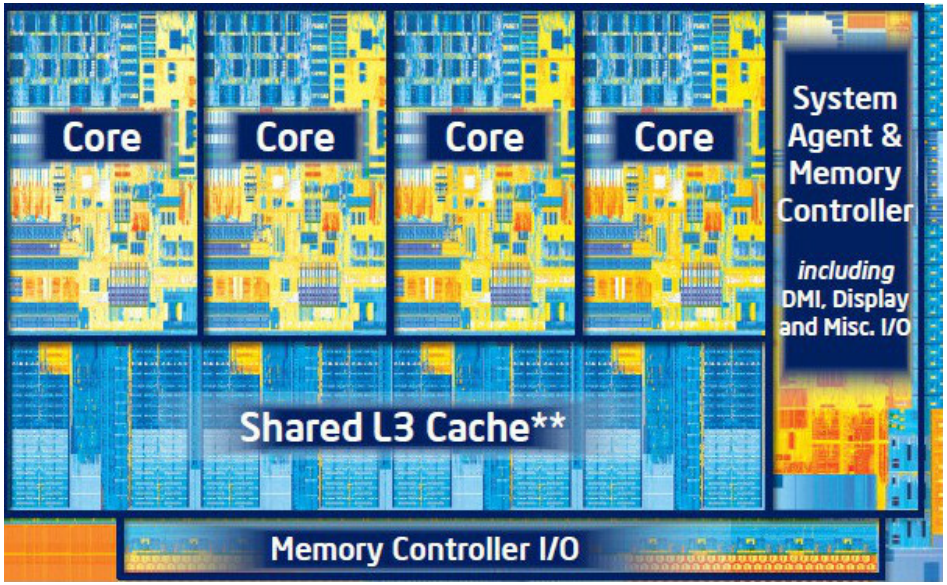



- One operation at a time
- Few compute units (cores)
- Fast at switching between tasks

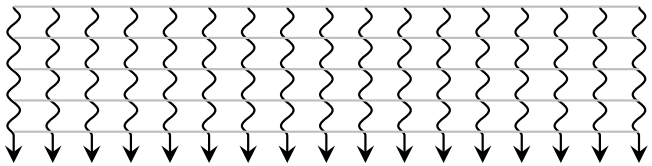
# Standard CPU

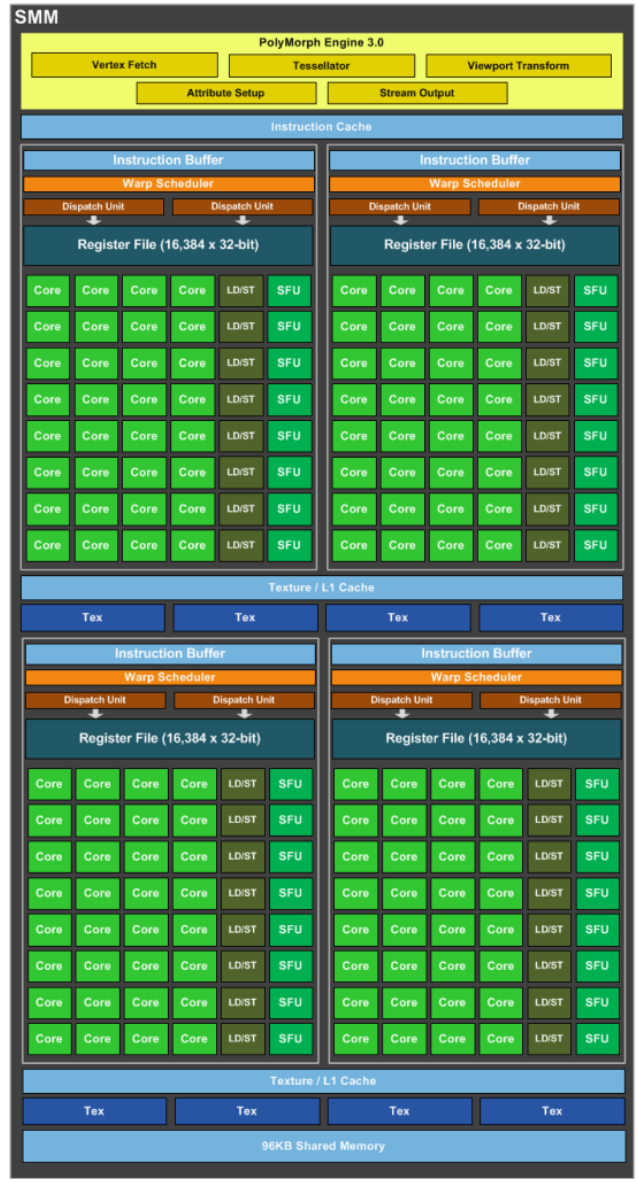


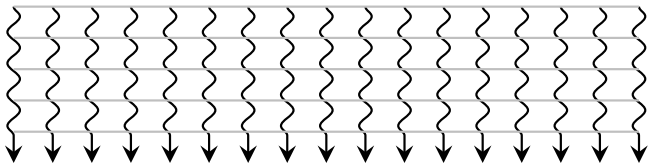

- One operation at a time
- Few compute units (cores)
- Fast at switching between tasks
- Most transistors used for “recalling”

# GPU

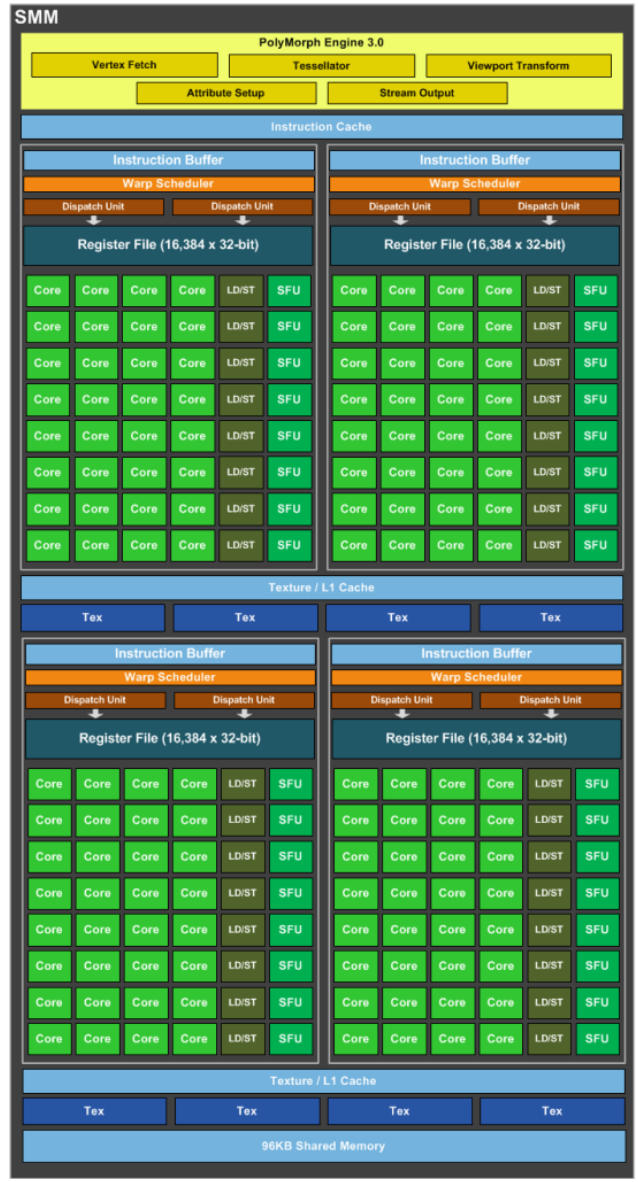



SMM
PolyMorph Engine 3.0
Vertex Fetch
Tessellator
Viewport Transform
Attribute Setup
Stream Output
Instruction Cache
Instruction Buffer
Warp Scheduler
Dispatch Unit
Register File (16,384 x 32-bit)
Core
LD/ST
SFU
Texture / L1 Cache
Tex
96KB Shared Memory

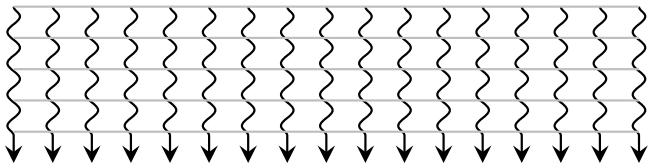
# GPU



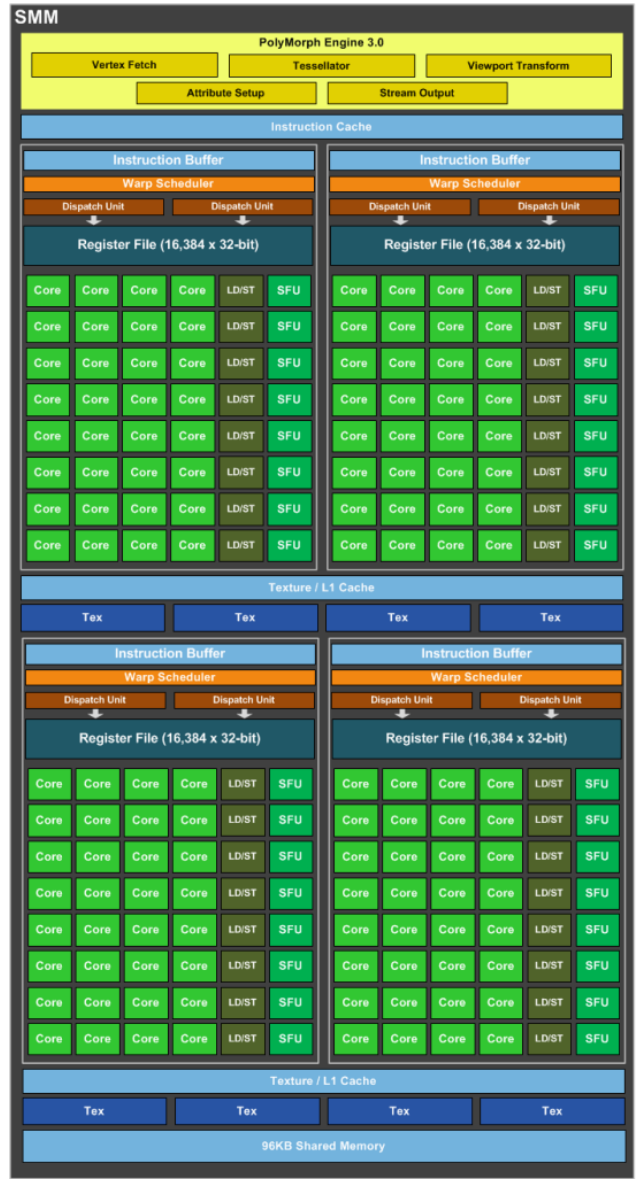
- Identical operations on diff. data



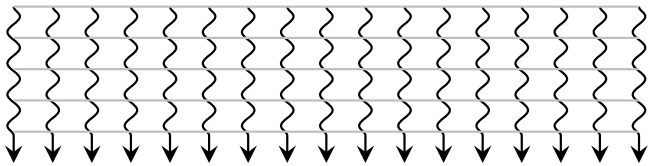
# GPU



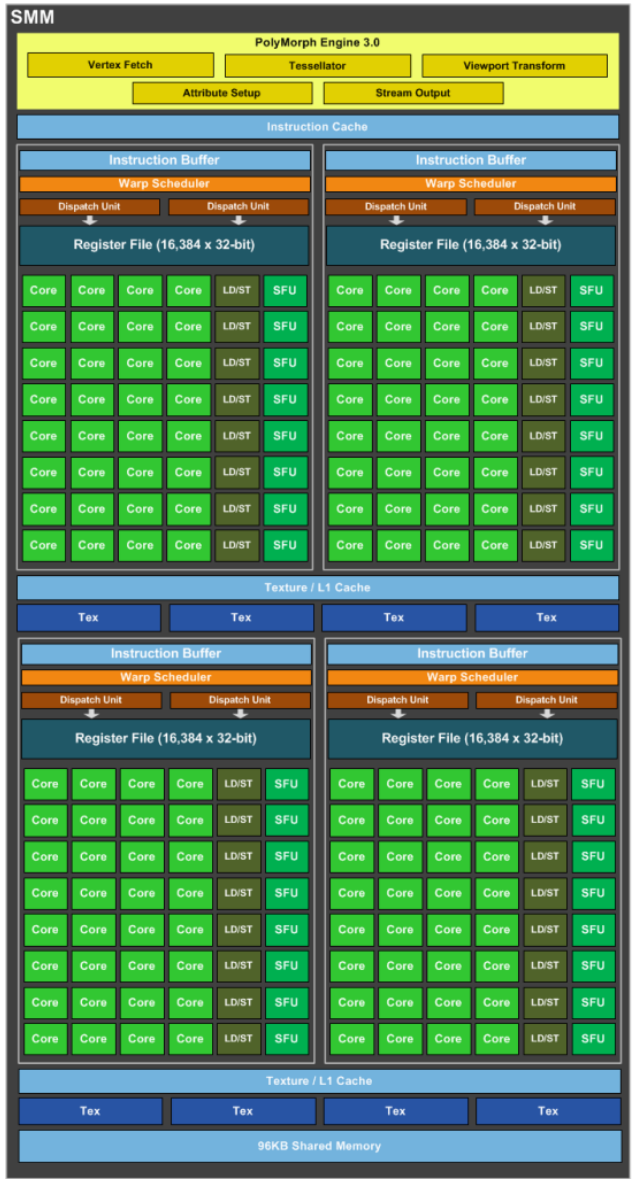
- Identical operations on diff. data
- Thousands of compute units (cores)



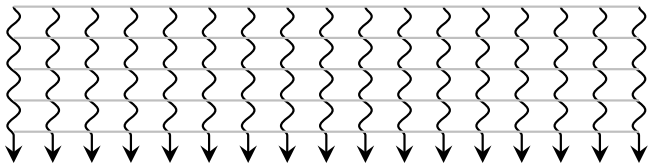
# GPU



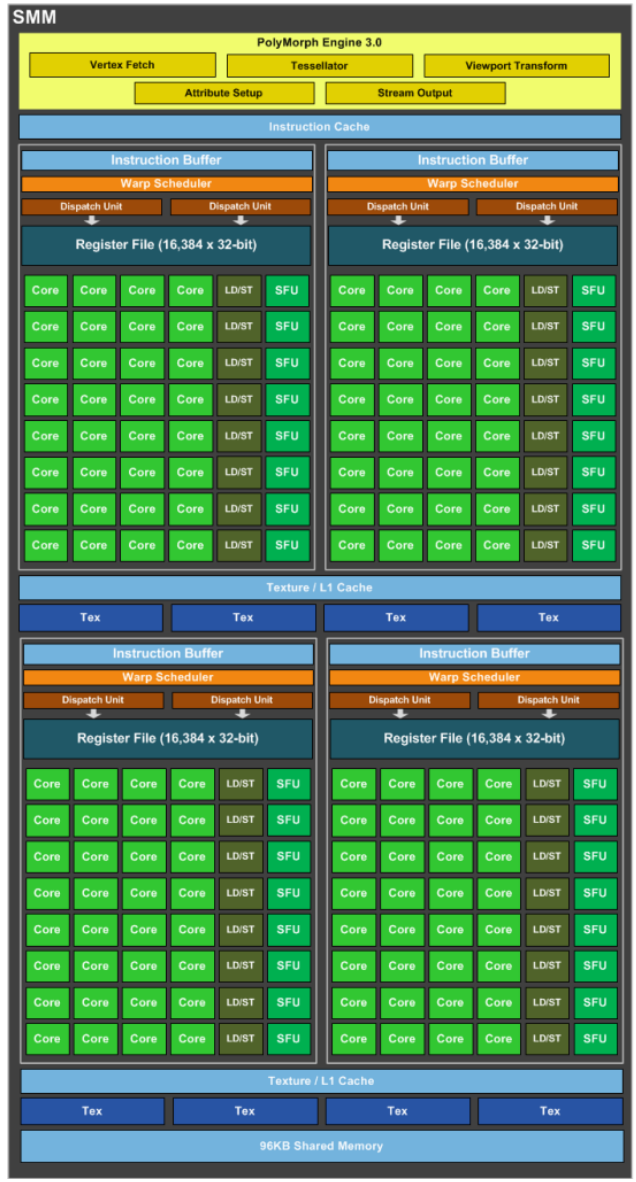
- Identical operations on diff. data
- Thousands of compute units (cores)
- Tasks executed in order (queued)



# GPU



- Identical operations on diff. data
- Thousands of compute units (cores)
- Tasks executed in order (queued)
- Most transistors used for computing



# CPU vs. GPU programming

CPU programming

```
5+9
      14
14+3
      17
17+22
      39
```

GPU programming

```
(2 4 6 8 10) + 100
      102 104 106 108 110

(102 104 106 108 110) * 2
      204 208 212 216 220
```

# GPU programming

Problem:

- GPU cores are bad at “recalling”
- manual control of “scratch pad”

# Fusion

```
((2 4 6 8 10) + 100) * 2
      204 208 212 216 220
```

# Summary

- GPUs require many similar computations on different data
- GPUs require attention to memory transactions (fusion)
- GPU programming: as hard as programming CPUs in the 60s/70s