Optimization of GPUs and CPUs

(in physics engines)

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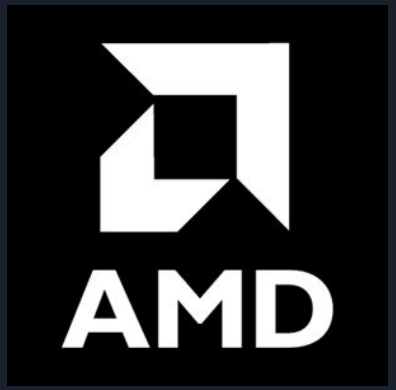
What is a CPU and its job ?

- CPU - Central Processing Unit
  - Brain of the computer
  - Job is to execute instructions and perform calculations
- Processes data by executing instructions to change and calculate values
- Manages memory, internal clock, and I/O operations
- CPUs are designed support multitasking and multithreading



What is a GPU and its job?

- GPU - Graphics Processing Unit
- Play a crucial role in a machine's performance
  - Graphics Rendering
  - 3D Graphics
  - Image and Video editing/playback
- The GPU is responsible for rendering both 2D and 3D graphics, environments, and interfaces in games or simulations
- Also handles textures, lighting, and shading

CPUs and GPUs coexisting in a PC

- The GPU and CPU work together in a computer system to optimize performance and efficiency
  - Useful during general or heavy duty processing
- Graphics Rendering
  - CPU: Handles tasks like scene setup and control
  - GPU: Rendering of models, textures, lighting, shading
- Compute Workloads
  - GPUs assist CPU in computive-intensive workloads
  - Ex: Crypto mining and AI
- Data Transfer via PCIe
- Multithreading
- Memory Management
  - CPU has RAM
  - GPU has VRAM

How does this effect Physics Engines?

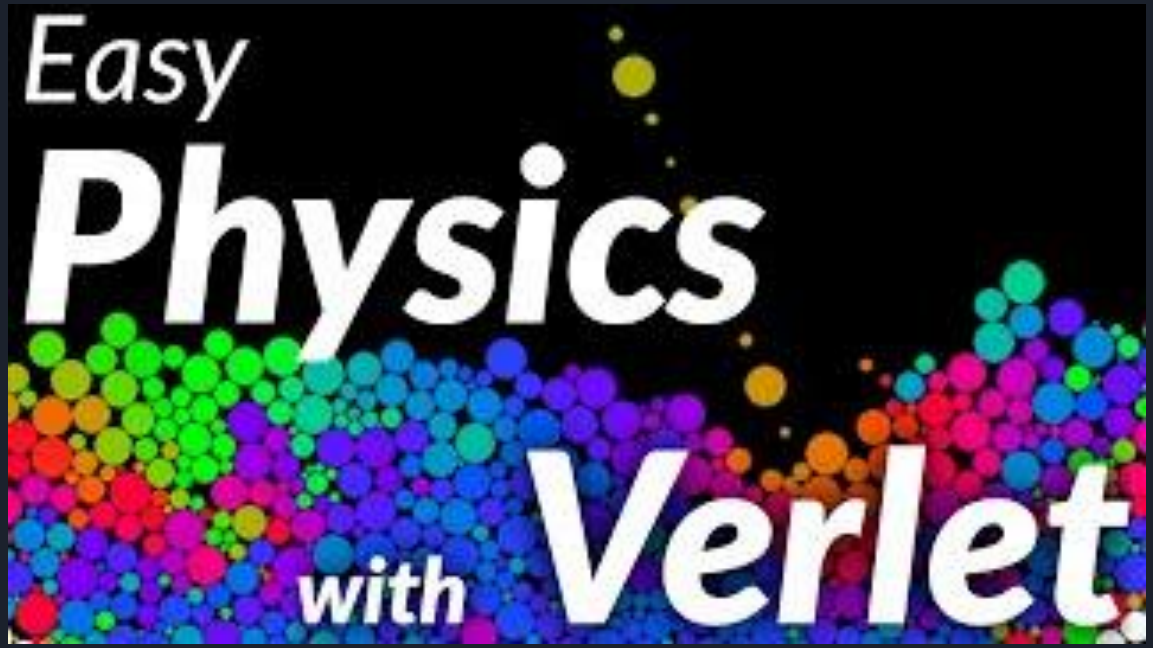
CPU:

- Handling of high-level game logic/physics simulation
- Collision Detection
- Multithreading
- Interaction with aspects of the game engine (AI and audio)

GPU:

- Particle Simulation
- Clothes/hair/body simulation
- Simulation of fluids
- Rendering objects within the plane

Example of a Physics Engine



How can we optimize this?

- All about balance
- Important to spread out and properly manage threads and computations
  - Certain tasks are well-suited for a specific part
- Make sure that work is evenly distributed to avoid bottlenecks
- Important to benchmark and record any necessary data
- Most importantly, your individual components must be powerful enough to be suited to your needs

Sources

https://www.researchgate.net/publication/234798672_A_new_physics_engine_with_automatic_process_distribution_between_CPU-GPU

https://developer.nvidia.com/gpugems/gpugems3/part-v-physics-simulation