CPU vs GPU
Computer Graphics Seminar 2018
Stanislav Belogrivov
SO, WHAT’S THIS ALL ABOUT?

• Theoretical comparison of CPU and GPU.
• What they do for video games?
• How far can you go (and when) to replace one with the other?
CPUs

- CPU processes the game’s instructions, reads player input...
- ... And distributes these tasks among so called bridges
- ... as well as sends tasks to the GPU (via Northbridge)
So CPU looks like this
So.. How to use it?

- A lot of games that want to perform physics simulations rely heavily on CPUs.
- Strategy games also favor CPU over GPU, since... AI and game logic > graphics.
Anything else?

• AI is the other thing that is handled by the CPU itself!
• As such, strategy games, especially turn-based ones, really prefer (over)using CPU than GPU (though do not hesitate to use the latter).
CPU is quite bad at handling graphics...or is it?

Find out soon!
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How about... now?
Yes, CPU is useable for graphics

• ...though not that well. CPUs have integrated graphics cards, which *can* run something simple.
• I.e. Minecraft
Yes, CPU is useable for graphics

• ...though not that well. CPUs have integrated graphics cards, which *can* run something simple.

• I.e. Minecraft

• Though... not always...

• WAY not always
GPUs

Soon, my precious graphics card, we shall play all the games in 4K resolution at max settings! Witcher 3, Battlefield 1, Siege, Doom, Crysis...

Oh boy that sounds like a lot of work.

Work, you call that work? How would you like to be in the mines?! I... I'd... like to play games in 4K now...

Yeah, I thought you might.
GPUs

• MTAT.03.015, MTAT.03.328, MTAT.03.305
• As follows from the name “Graphics Processing Unit”...
Still, some general info

• Has its own memory – VRAM, since GPU cannot directly access computer memory.

• GPU uses VRAM to store assets.

• Why open-world/high-texture-quality games need a lot of it.

• GPU by itself cannot do anything – “orders” are received from CPU.

• Any issues?
Yes, there is an issue!

- Since GPU cannot work without orders and does not do any game analysis by itself, all directives “draw this here” are passed from CPU.
- If CPU is too fast and the GPU is not (or the opposite)... we get a bottleneck issue!
CPU Bottleneck

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• Can be solved by..?
GPU Bottleneck

• Exactly the opposite: fast processor paired with a mediocre/old video card.
GPU Bottleneck

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How to spot a bottleneck?

• Usually visible during sudden scene changes (i.e. walking out of a dark room into sunlight or a ton of visual effects)
• Or a static decrease of frames (way harder to spot this).
• Either way, possible to monitor the GPU performance.
Example

- https://youtu.be/DAgpvWc4VBM?t=710
What to do?

• Change your games of choice.
• Change hardware.
• Lower graphics settings in-game.
Back to the GPU talk

• GPU is designed to process simple mathematical formulas extremely efficiently (which results in speed).
• Since all rendering and such is done via mathematical simulations... GPU excels at that.
How to apply it?

• Anything that has to do with 3D is a sphere of GPU.
• However, most modern “fancy” and “realistic” effects (both post-processing and rendering itself) are called only on specific occasions.
• Mainly, in Third Person Shooters and First Person Shooters.
The end?
The end?

• No, not really...
NVidia Shield
Nvidia Shield

• Does not have a spate GPU or CPU
• Tegra X1 System on a Chip (SoC), something similar to Raspberry Pi and such.
• Can easily support 4K HDR games without any visible issues.
Nvidia Shield

• When it has to run BIG games, it does not.
• Instead, it does the streaming – game by itself is computed somewhere on NVidia servers, then delivered to you as just “video”.
• Still handles user input.
• Runs on Android, supports both PC and Android.
Conclusion

• It really depends on what you want to get

• CPU is good for:
  • Accounting game physics, game logic, AI etc.
  • As such, for most games that focus on “gameplay”, strategies, simulators and such.

• GPU is good for:
  • Fancy effects and real-time computations.
  • As such, generally for FPS games, since those specifically try to imitate “human eye effects” (motion blur) or “camera effect” (lens flares).

• Whereas GPU allows you to get amazing real-time computations.

• Both work for non-real-time rendering (i.e. for cinematics or such), but CPU is generally way slower at rendering.
More conclusion

• Since there is a bottleneck issue (among other incompatibility issues), a very important idea:
  • Newer != Better!
  • Ideally, always think what the setup is intended for.

• Obviously, you can use CPU only mode for games and rendering, buut... you will get this
Keeping up with latest tech is... expensive

$1999
THANK YOU FOR YOUR ATTENTION!

And don’t forget to balance your CPU and GPU!
Materials

• Bitwit – Do You NEED a Graphics Card to Game?  
  https://www.youtube.com/watch?v=bMC5OG3gMZo

• Tegra X1 – The Powerful Processor Behind SHIELD  
  https://shield.nvidia.com/blog/tegra-x1-processor-and-shield

• Quora - What role does the CPU, GPU, and RAM play during gaming?  

• WePC – CPU and GPU Bottleneck: A Detailed Explanation  
  https://www.wepc.com/tips/cpu-gpu-bottleneck/

• Quora - Can we use GPU instead of CPU?  
  https://www.quora.com/Can-we-use-GPU-instead-of-CPU