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GPGPU

General Purpose computation on Graphics Processing Units

Mark Harris, 2002

Perform demanding calculations on the GPU instead of the CPU!

At first, appeared to be a wild idea, but is now a very serious technology! Results were highly varied in the early years, but the GPU advantage has grown bigger and bigger.



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Key components of the GPGPU trend

High processing power in parallel

Programmability: Introduction of shader programs, much more flexible, programmable for any problem.

Floating-point buffers: Vital! Initially with poor precision. 32-bit floating-point decent... but not really impressive.



GPGPU approaches

- **Using fixed pipeline graphics**
 - **Shader programs**
 - **CUDA**
 - **OpenCL**
 - **Compute shaders**



Fixed pipeline GPGPU

Reformulate a problem to something that can be done by standard graphics operations.

Limited success 1999/2000. Not of any practical interest!



Shader-based GPGPU

Portable! All GPUs can use shaders, no need for extra software, run using standard software/drivers.

All modern shader languages (GLSL, Cg, HLSL) are similar and easy to program in.

Requires a re-mapping of data to textures.

Very good results already in 2005: 8x speedups overall reported!



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CUDA-based GPGPU

Only works on NVidia hardware.

Requires extra software - which isn't very elegant.

Nice integration of CPU and GPU code in the same program.

Excellent results! 100x speedups are common - before optimizing! Even low-end GPUs give significant boosts.



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OpenCL-based GPGPU

Works on various hardware - not only GPUs.

Developed by Khronos Group, pushed by Apple.

Harder to get started, software looks pretty much like programming shaders.



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Compute shaders

Built into OpenGL

Similar to OpenCL

Good portability



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Use the source, Luke!

Three trivial examples:

Hello World! for CUDA

Hello World! for OpenCL

Hello World for GLSL



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In the Southfork lab

GTX660Ti

Kepler! Still respectable!

1300 cores!

Good mid-range board, about half the performance of a GTX 980. Great price/performance, lots of parallelism to play with, and pretty nice power consumption.



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In the Multicore lab

GTX560Ti

Fermi! Good computing performance!

512 cores - but can still match a Kepler!

Alas, Fermi lacks some important feature of the Kepler. Thus, it is starting to feel a bit old.



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That's all, folks!

Next time: Introduction to CUDA