

GPUs in Distributed Computing

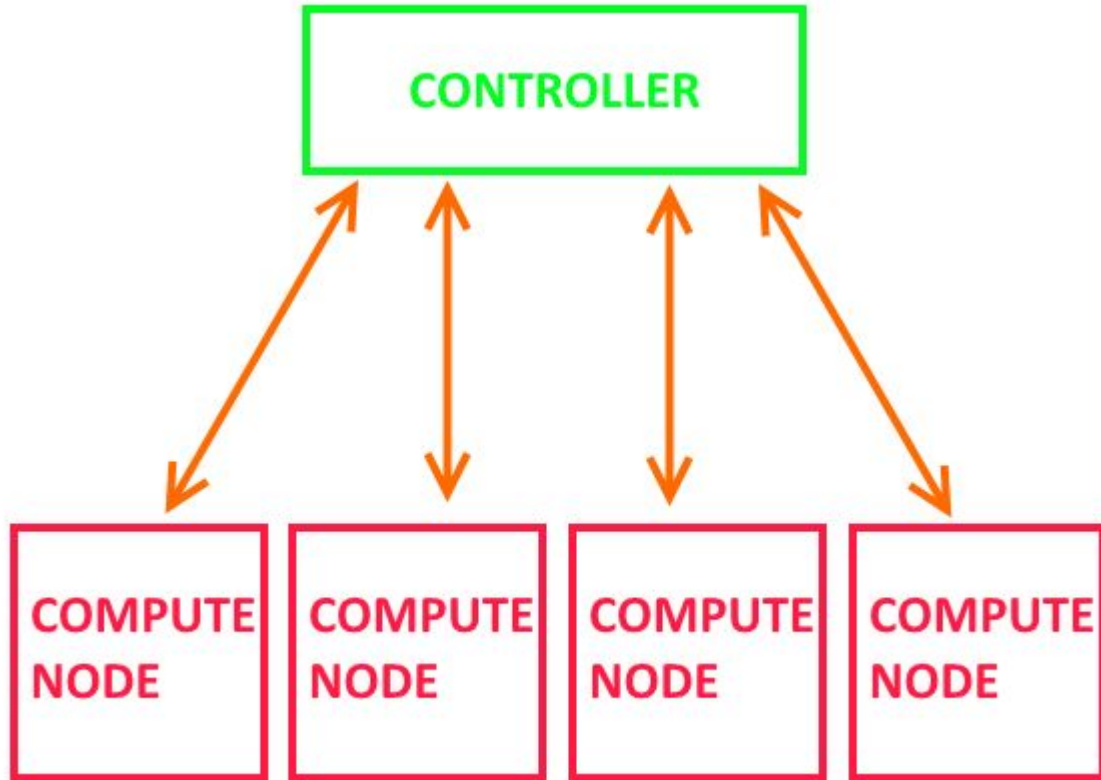


Article Summary

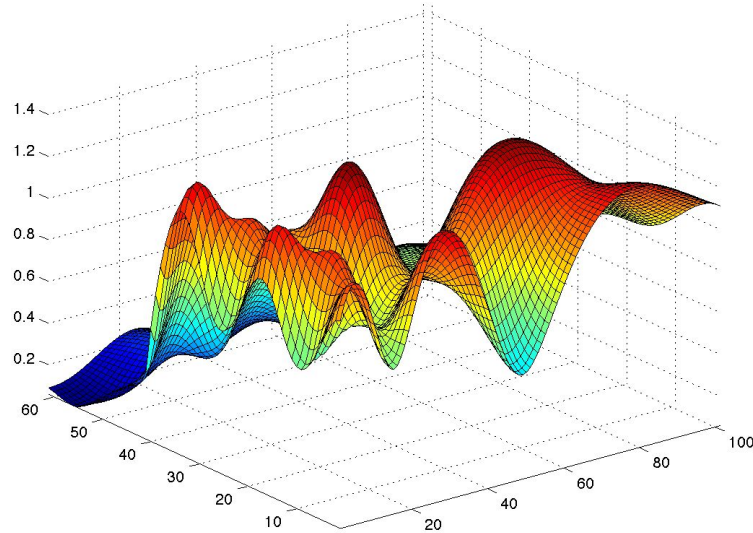
Use a GPU to Turn a PC into a Supercomputer, IEEE Spectrum
2016

- GPUs in Distributed Computing
- Use Cases

Distributed Computing



Computer Simulations



Ultrasound Beam Simulation (with MATLAB, running on GPUs),
<https://www.informatik.uni-leipzig.de/~hlawit/SimBeam/>

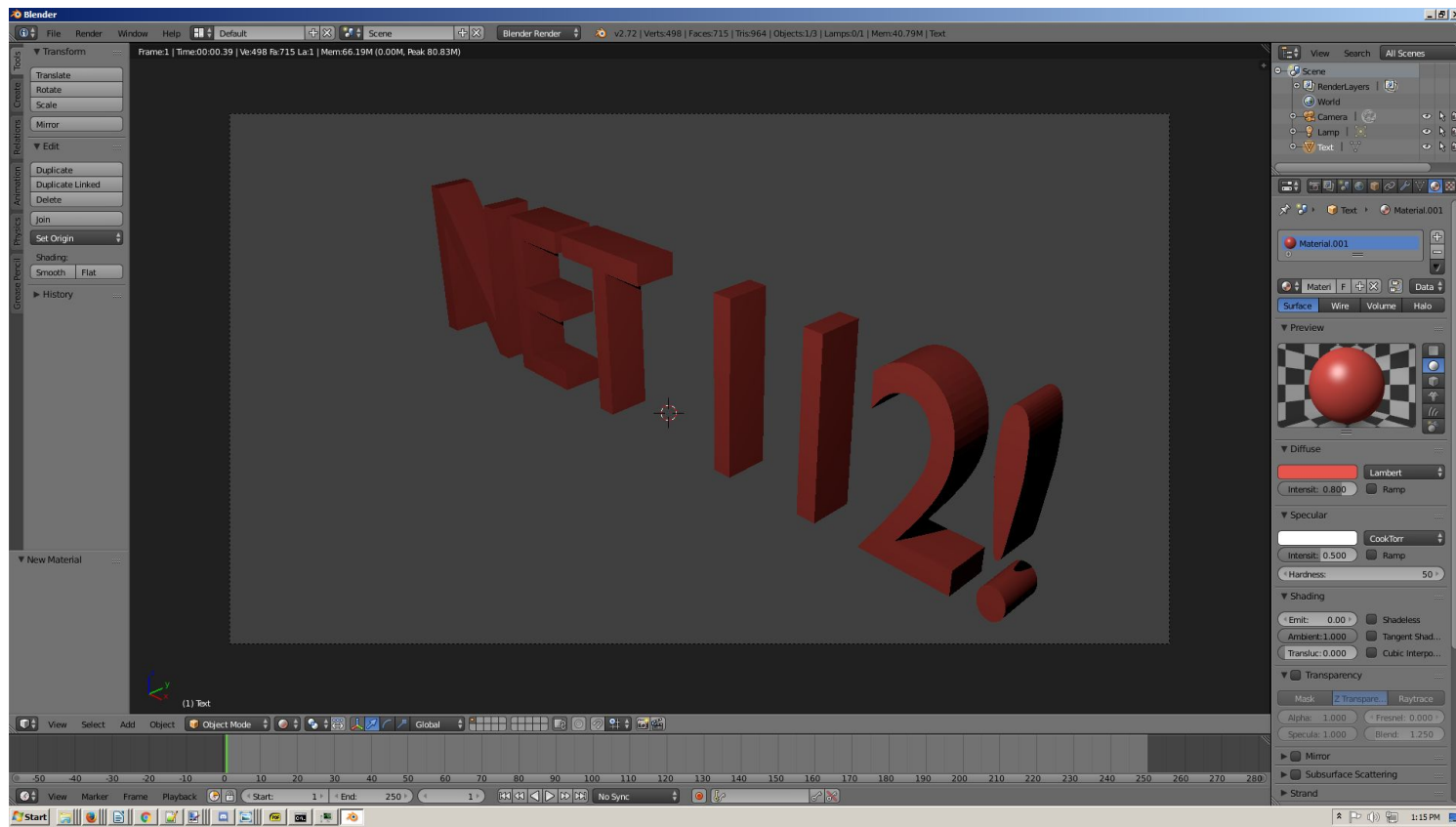
Computer Simulations

$$F = G \frac{m_1 m_2}{r^2}$$



Pleiades Supercomputer, <https://www.nas.nasa.gov/hecc/resources/pleiades.html>

Rendering

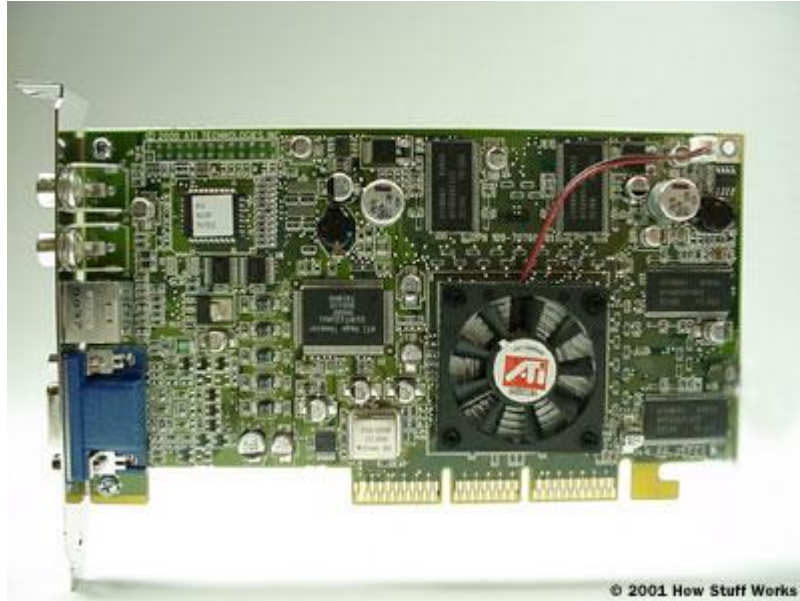


Render Farms

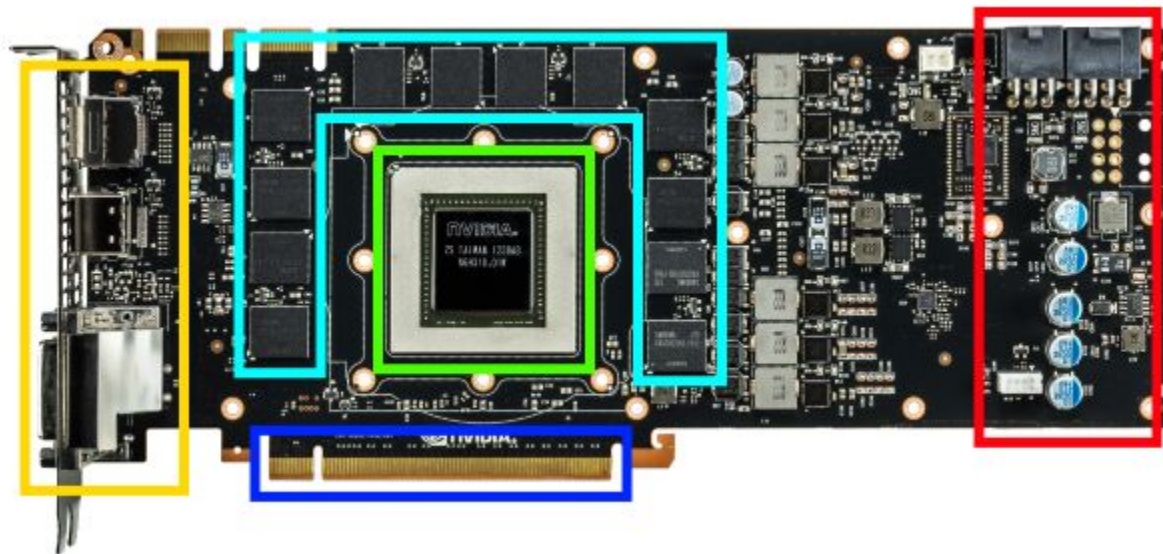


Pixar renderfarm, <http://www.slashfilm.com/cool-stuff-a-look-at-pixar-and-lucasfilms-renderfarms/>

Graphics Cards



Graphics Card Layout



Shader Languages

- GLSL (Open GL)
- HLSL (Microsoft)
- CG, “C for Graphics” (Nvidia)

Pixel Shaders

```
float4 PixelShaderFunction(float2 coords: TEXCOORD0) : COLOR0
{
    return float4(1, 0, 0, 1);
}
```

2D Pixel Shaders (with HLSL), <https://gmjosack.github.io/posts/my-first-2d-pixel-shaders-part-1/>

Pixel Shaders

1920 * 1080 = 2 073 600 pixels @ 60 frames per second

Shaders, examples



Wind Waker Graphics Analysis,

<https://medium.com/@gordonnl/wind-waker-graphics-analysis-a0b575a31127#.2tjsxt6a7>

Shaders, examples



Crysis 3 @ 8K (7200x3000px) album,

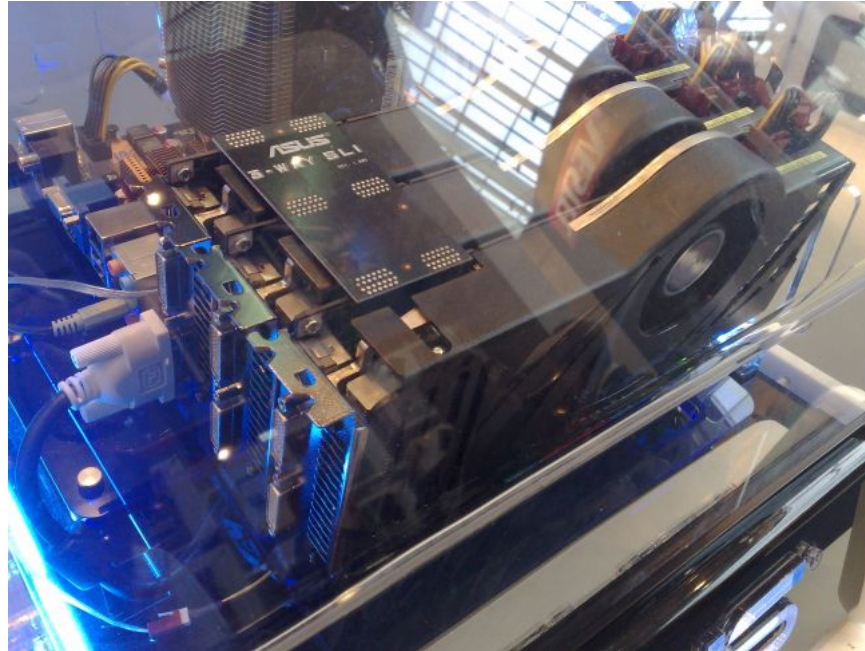
https://secure.flickr.com/photos/k_putt/13963233755/in/album-72157644191959442/

Numbers

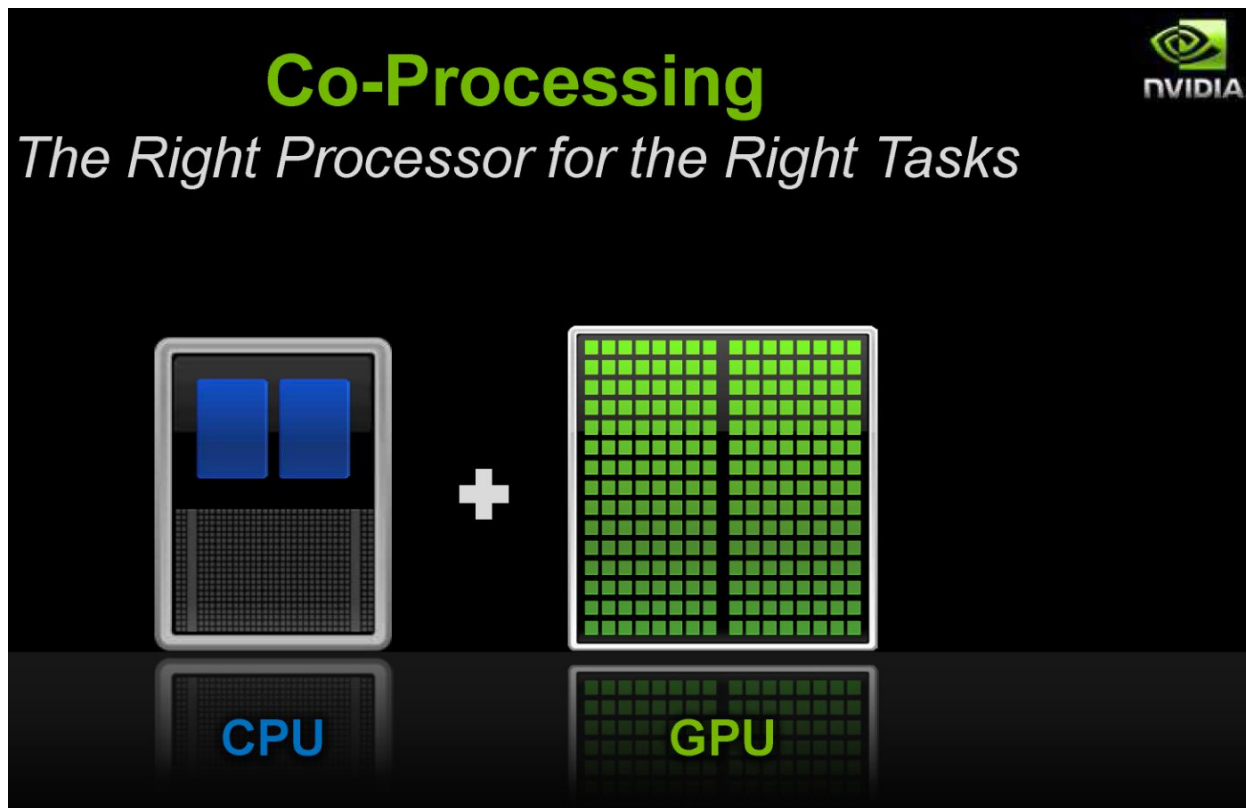
- 1000+ GPU (CUDA etc...) Cores
- 512 to 4096 bit width memory

Graphics Cards in Parallel

- SLI (Nvidia)
- CrossFire (AMD)



GPUs, the difference



Performance implications

Huge Speed-Ups Across Many Fields



Algorithm	Field	Speedup
2-Electron Repulsion Integral	Quantum Chemistry	130X
Lattice Boltzmann	CFD	123X
Euler Solver	CFD	16X
GROMACS	Molecular Dynamics	137X
Lattice QCD	Physics	30X
Multifrontal Solver	FEA	20X
nbody	Astrophysics	100X
Simultaneous Iterative Reconstruction Technique	Computed Tomography	32X

Use Cases

- Affordable (off the shelf components)
- Open Hardware
- No large contracts needed

USAF/DARPA's PS3 Computer



USAF initial test cluster,

<http://arstechnica.com/gaming/2010/05/how-removing-ps3-linux-hurts-the-air-force/>

MD5 Hash

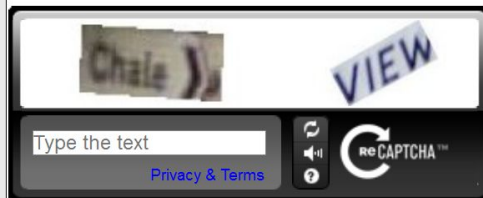
“password” -> “5f4dcc3b5aa765d61d8327deb882cf99”



Free Password Hash Cracker

Enter up to 20 non-salted hashes, one per line:

5f4dcc3b5aa765d61d8327deb882cf99



Crack Hashes

Supports: LM, NTLM, md2, md4, md5, md5(md5_hex), md5-half, sha1, sha224, sha256, sha384, sha512, ripeMD160, whirlpool, MySQL 4.1+ (sha1 sha1_bin), QubesV3.1BackupDefaults

Hash	Type	Result
5f4dcc3b5aa765d61d8327deb882cf99	md5	password

AMD cracking cluster (8*2 GPUs)



AMD Cluster,

<http://arstechnica.com/security/2012/12/25-gpu-cluster-cracks-every-standard-windows-password-in-6-hours/>

CryptoCurrencies



1 BTC = \$1005.30 (CAD)

CryptoCurrency Miner



Mining Rig, <http://www.thinkcomputers.org/insane-crypto-currency-mining-rigs/>

ASICs

Application Specific Integrated Circuit

