COSC 462

CUDA Introduction

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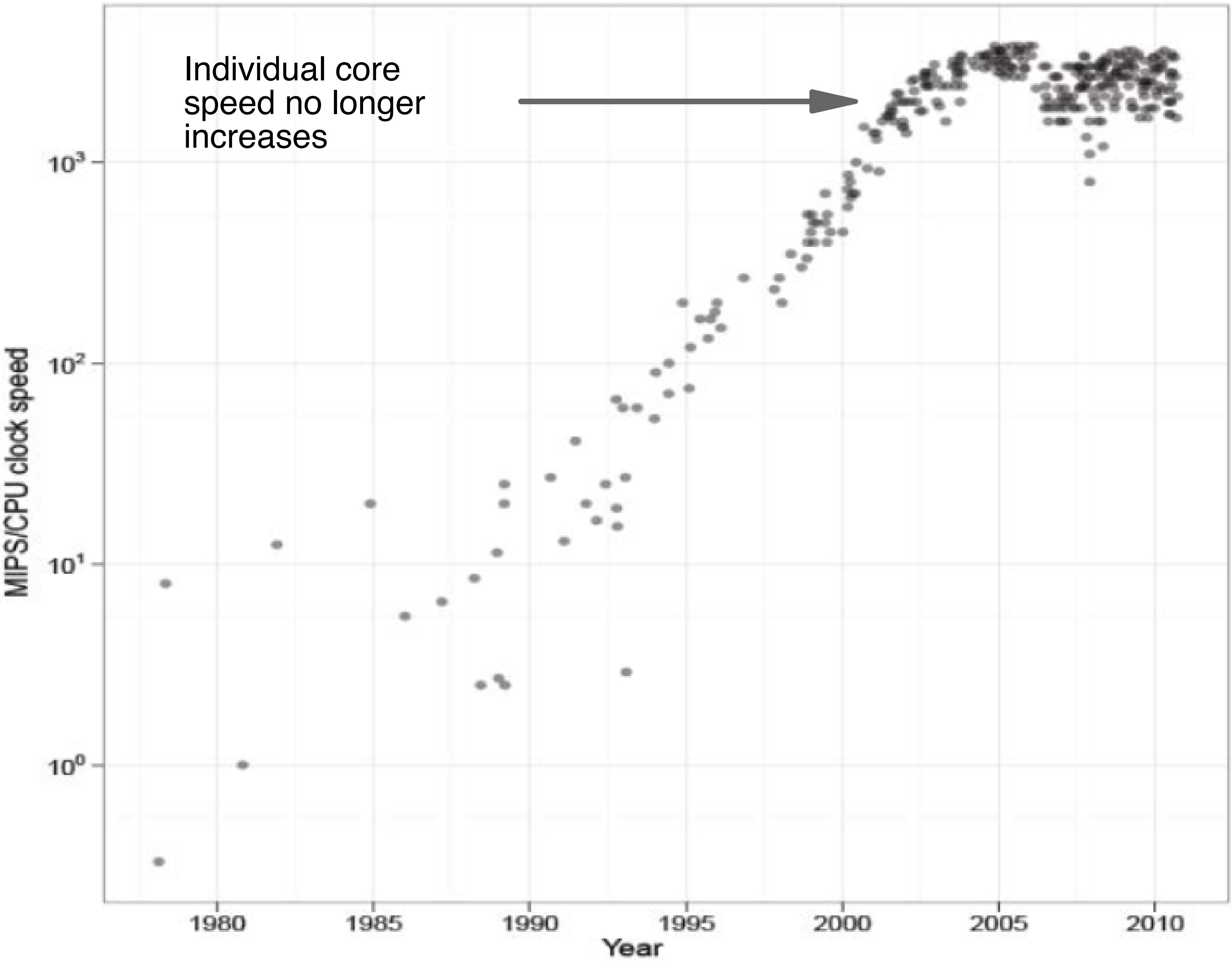
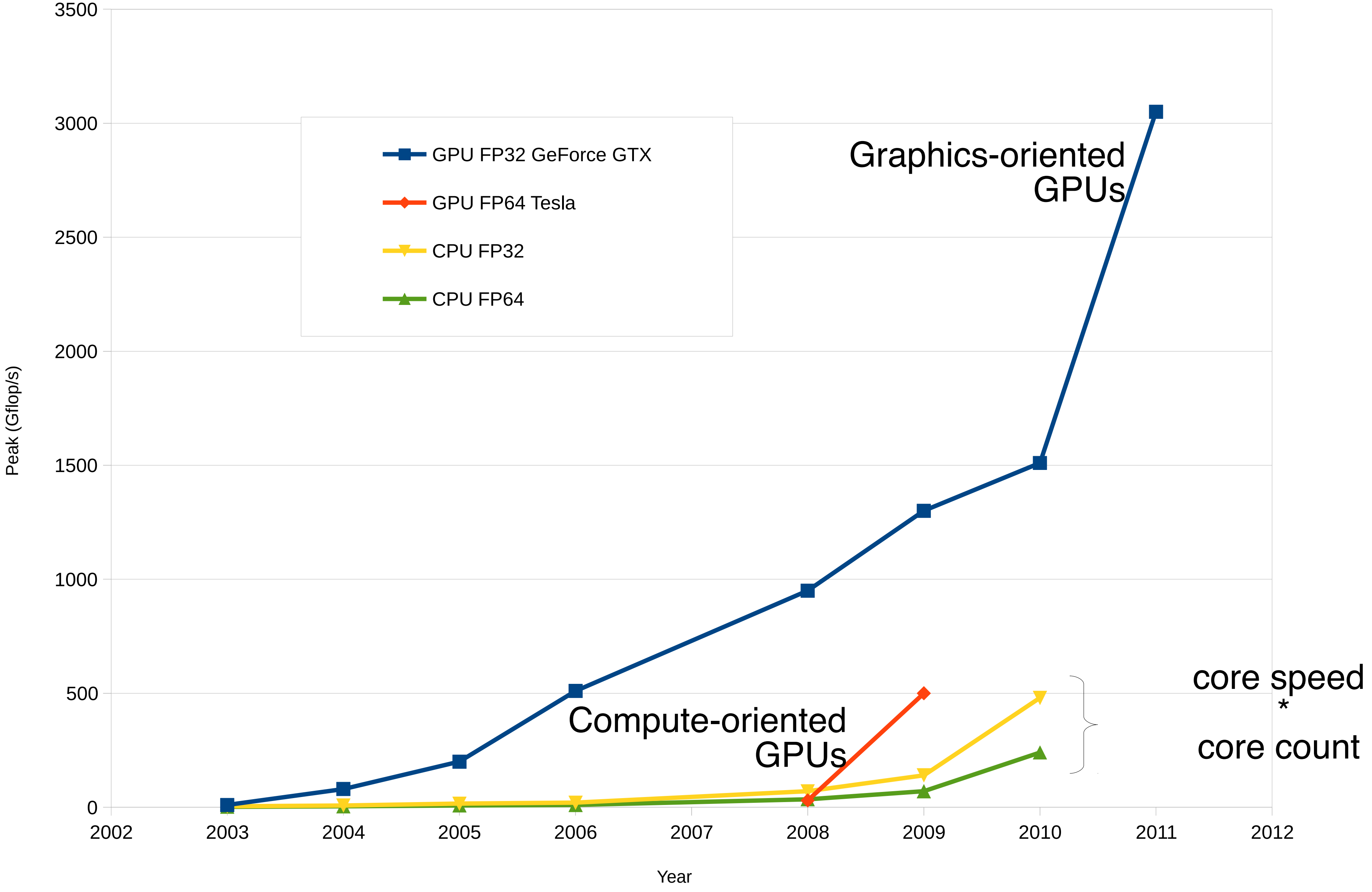
Per-Core Performance



Individual core speed no longer increases

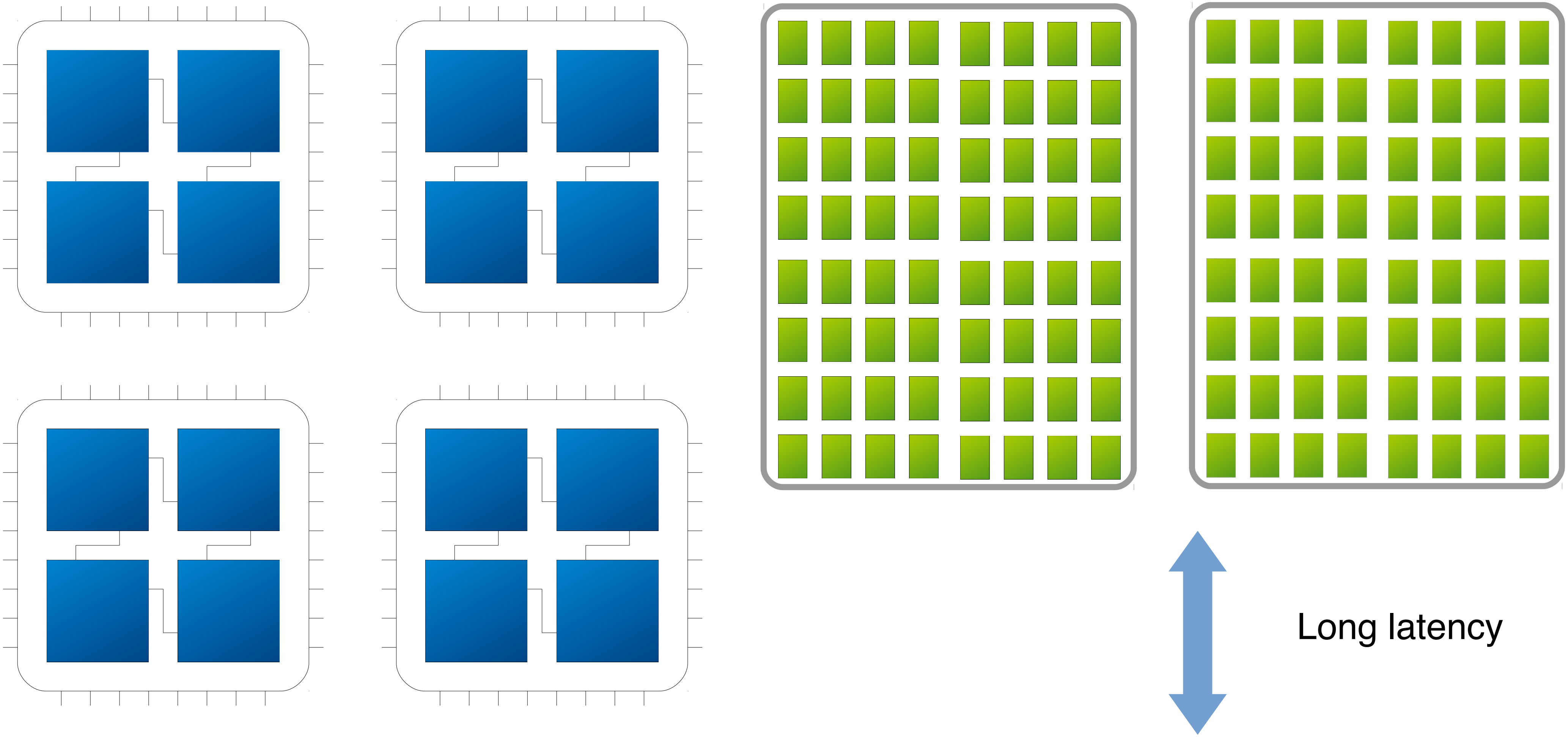
GPU vs. CPU Performance over Years



GPU and GPGPU: Origin Story

- Programmable graphics pipeline
  - GLSL
- Interpolation vs. dynamic range
  - Colors in graphics look better in floating-point
- Early attempts at programming
  - Cg, Brook, …
- Modern standards or de facto standards
  - CUDA (currently 8)
    - Compute Unified Device Architecture
  - OpenCL (currently 2)
- High-level languages
  - OpenMP 4
  - OpenACC

Hardware: CPU vs. GPU

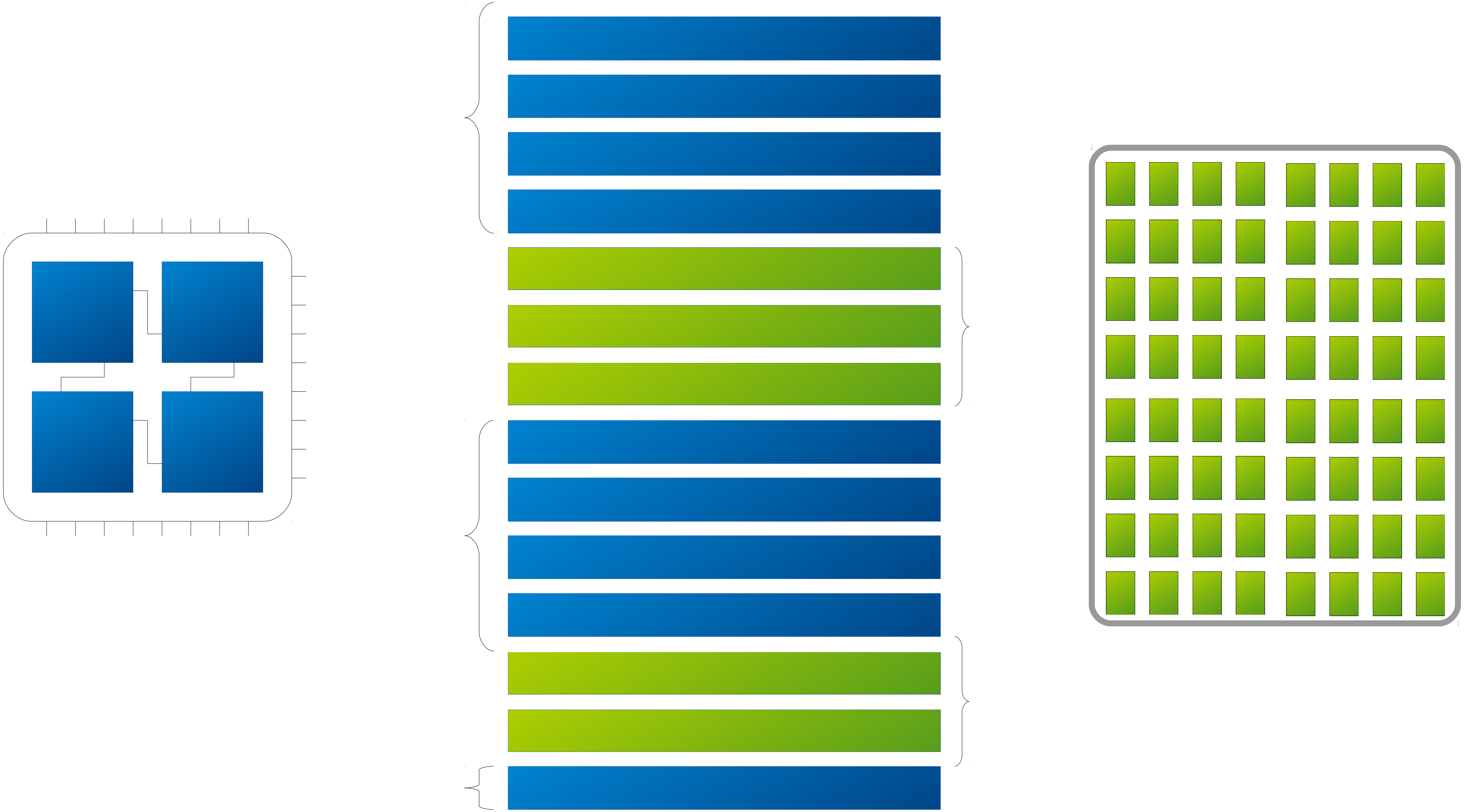


Main Memory RAM: DDR3 or DDR4
Size: ~100 GiB
Speed: ~50 GB/s

PCIexpress

GPU Memory RAM: GDDR5
Size: ~10 GiB
Speed: ~200 GB/s

Software: CPU + GPU



Minimal Code Example

```
__global__ void sum(double x, double y, double *z) {
  *z = x + y;
}
int main(void) {
  double *device_z;

  cudaMalloc( &device_z, sizeof(double) );

  sum<<<1,1>>>(2, 3, device_z);

  cudaMemcpy( &host_z, device_z, sizeof(double),
              cudaMemcpyDeviceToHost );

  printf(“%g\n”, host_z);

  cudaFree(device_z);

  return 0;
}
```

```
$ nvcc sum.cu -o sum
$ ./sum
5
```