Outline

Grid Search on a GPU using OpenCL

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Outline

Why using GPUs

- Higher FLOPS and Bandwidth
- Lots of Execution Units
- SIMD Paradigm

2 OpenCL

- Principles
- Code Example

GridSearch Implementation

- Running Code
- Planned Optimizations

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Why using GPUs	OpenCL 000	GridSearch Implementation	Questions
Outline			

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 Why using GPUs
 OpenCL
 GridSearch Implementation
 Questions

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Higher FLoating point Operations Per Second



GPUs nowadays has higher theoretical computing performance



Why using GPUs	OpenCL	GridSearch Implementation	Questions
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Higher Memory Bandwidth



GPUs nowadays has higher memory bandwidth



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Why using O ○○●○	GPUs	OpenCL 000	GridSe 000	earch Implementation	Questions

Most of the transistors for the execution units



More transistors dedicated to the execution units and less dedicated to flow control and caching



OpenCL

GridSearch Implementation

Questions

Single Instruction Multiple Data Paradigm



• Pros:

High Parallelism, Scalable.

Cons:

Not applicable to all algorithms and if applicable, algorithms have to be re-implemented.

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GridSearch Implementation

Questions

Open Computing Language Specification

- Open industry standard (API)
- Managed by the non-profit consortium Khronos Group
- Apple, AMD, IBM, Intel and Nvidia



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OpenCL is a framework for writing programs that execute across heterogeneous platforms consisting of CPUs, GPUs, and other processors.

OpenCL ○●○ GridSearch Implementation

Questions

Processing flow in the GPU



OpenCL ○○● GridSearch Implementation

Questions

OpenCL kernel code example

Add two vectors cell by cell in the GPU

_kernel void VectorAdd(__global int* c, __constant int* a, __constant int* b) {

// Index of the elements to add

int n = get_global_id(0);

// Sum the n'th element of vectors a and b and store the result in $\ensuremath{\mathsf{c}}$

c[n] = a[n] + b[n];



Why using	GPUs

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GridSearch Implementation 000

OpenCL GridSearch kernel code

```
kernel void GridSearch( constant char* lMask,
                        __constant short* pSsAmplitude,
                        __constant float* fMetrics,
                        _____constant short* fBasis,
                        __constant size_t* fBasisOffsetsGPU,
                        _____global GridResults* local result,
                        int netChSeq.
                        int rt.
                        int time first,
                        int time last,
                        int samp first.
                        int sTime,
                        int sSamp,
                        int NTIME,
                        int NCHAN.
                        int NMETRIC2)
  constant float *metrics = fMetrics + (size t)NMETRIC2;
  int iPts = get global id(0);
  int chi2 = \hat{0};
    for(int iSeam=0: iSeam<NCHAN: iSeam++) {</pre>
         constant short* baseTrace = fBasis + fBasisOffsetsGPU[netChSeq] + (size t)(iPts * NCHAN * NTIME) + (size t)(iSegm * NTIME);
        int iSamp = samp first;
        int iTime = iTime0;
        for( : iTime <= iTime1: iTime += sTime, iSamp += sSamp) {</pre>
          chi2 += metrics[pSsAmplitude[(iSegm*NTIME)+iSamp] - baseTrace[iTime]];
  local result[iPts] = chi2:
```



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Why using GPUs	OpenCL 000	GridSearch Implementation ○●○	Questions
Performances			

Is this code as fast as expected?

The code is actually running on a *NVIDIA Quadro FX 1700* as fast as it would on the CPU of a "Narval Pizza Box".



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OpenCL

GridSearch Implementation

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Questions

Optimization to remove flow control overhead



25% of GPU time can be saved

OpenCL

GridSearch Implementation

Questions

Thank you for your attention...

