Accelerating High-Throughput Computing through OpenCL

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Overview

Introduction

Resources

Motivation

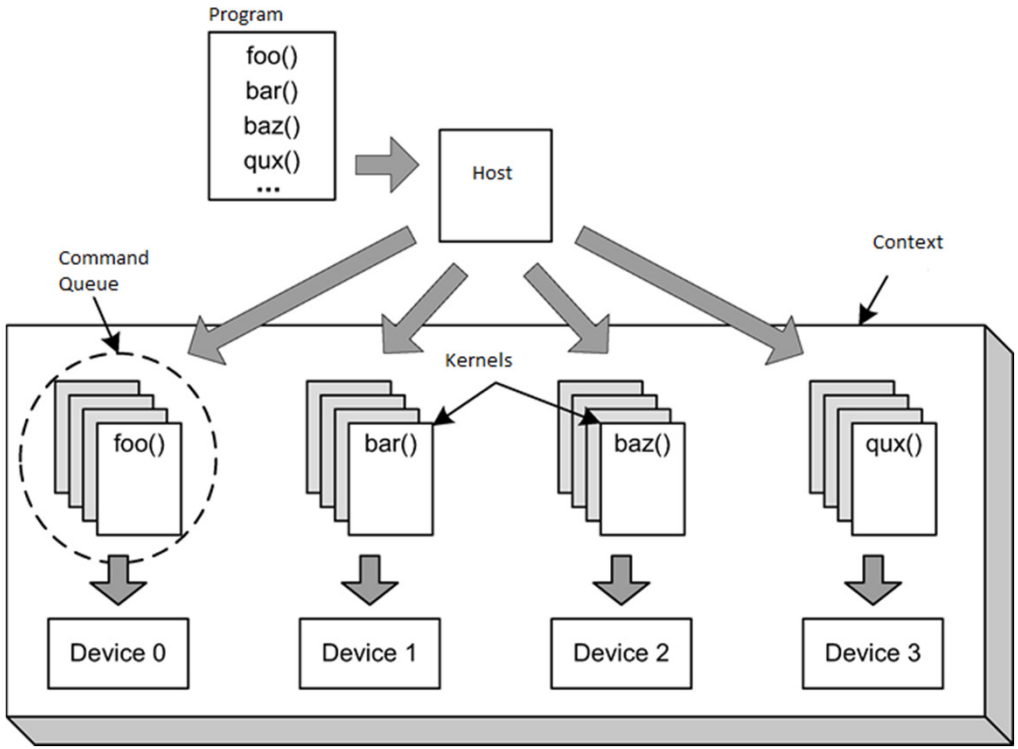
Experiment Design

Results and Performance

Conclusions

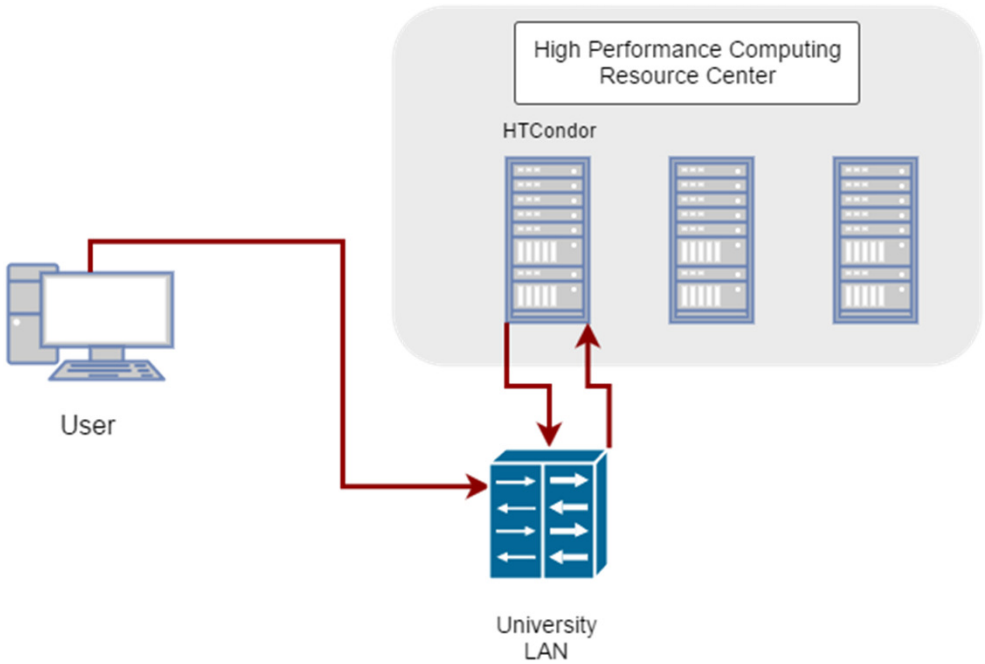
OpenCL

- OpenCL -> A programming framework for heterogeneous compute platforms
- Supports CPU, GPU, DSP, and other accelerators
- Programming API based on C/C++



Introduction

- High-Throughput Computing
- HTCondor
- QGGCondor



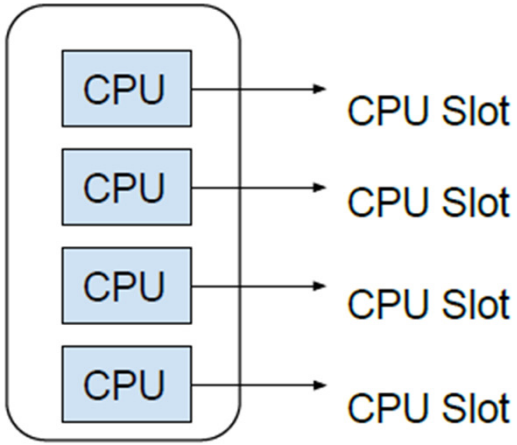
Aim of project

- To expand the capabilities of the QGGCondor.
- To evaluate the efficiency and flexibility of OpenCL for use within a heterogeneous HTC environment.
- To increase the visibility of GPGPU computing

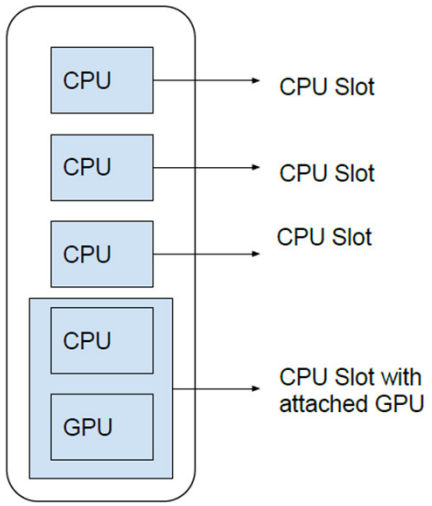
HTCondor Setup

ClassAdds, what are they ?

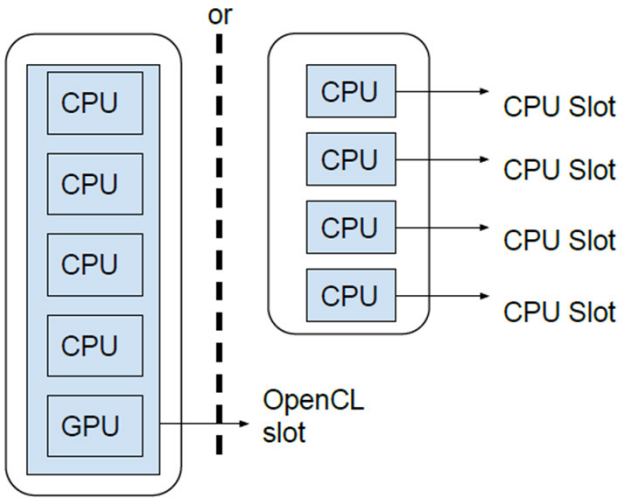
Old ClassAdd



HTCondor Proposed



New ClassAdd



Environment Setup

Reasoning:

- Unreliable environment for benchmarking purposes.
- Desire to execute benchmarks over the live system.

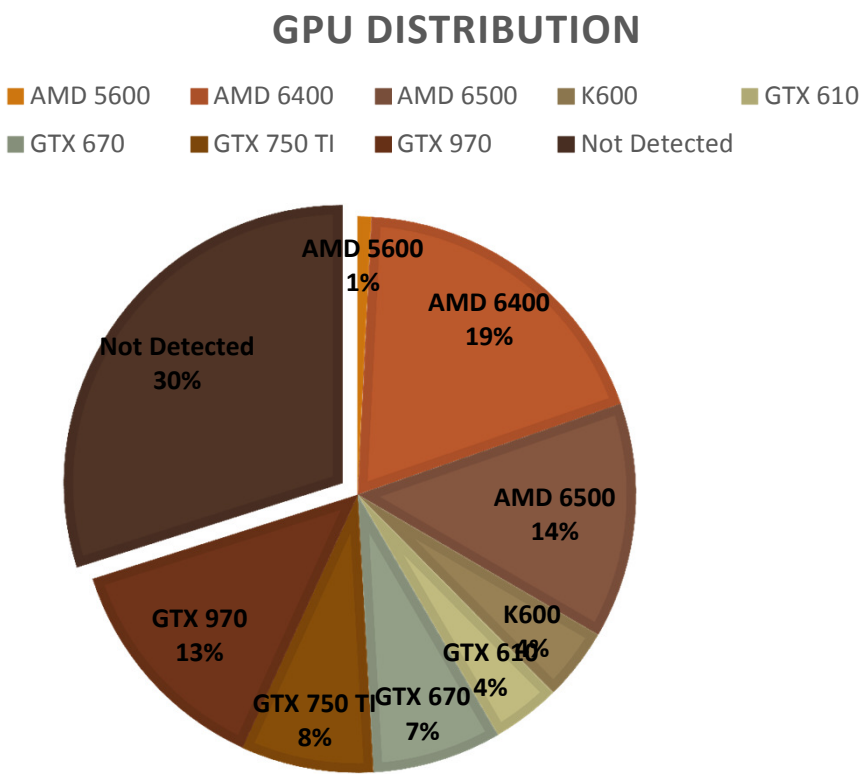
Method:

- Extracted hostnames of 1000 condor machines.
- Script based generation of jobs.

Resource Discovery

TABLE I
GPU LANDSCAPE

GPU	Nr
AMD 5600	8
NVIDIA Quadro K600	42
NVIDIA GTX 610	40
NVIDIA GTX 670	75
NVIDIA GTX 750 Ti	77
NVIDIA GTX 970	133
AMD 6500	137
AMD 6400	189
Not detected	299
Total	**1000**



Experiment Design

Fast-Fourier Transform

1000 iterations -> to ensure precision

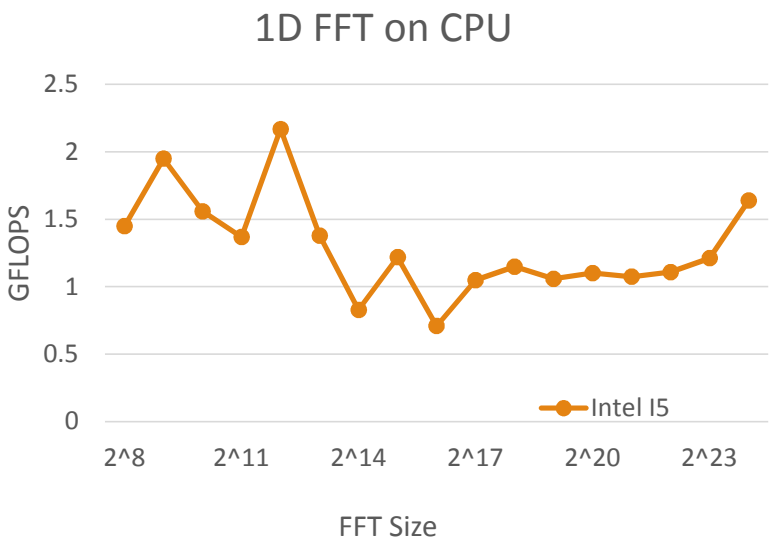
17 FFT sizes -> from 2^8 to 2^24

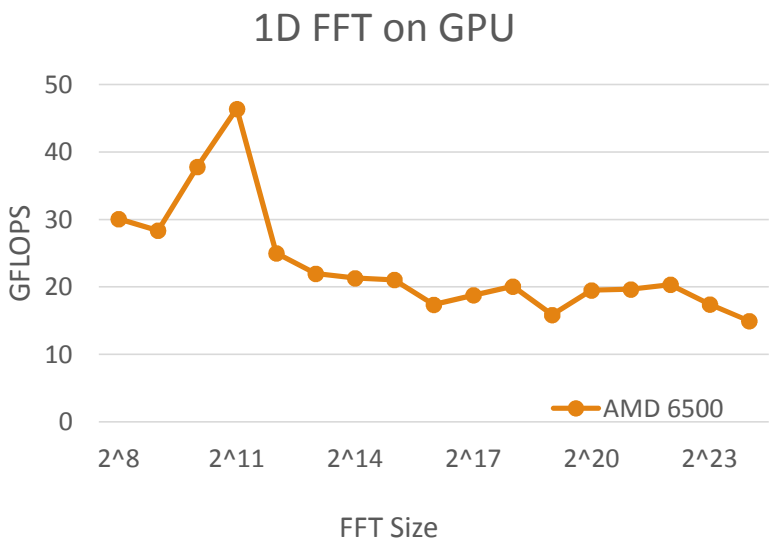
701 machines -> that reported GPUs

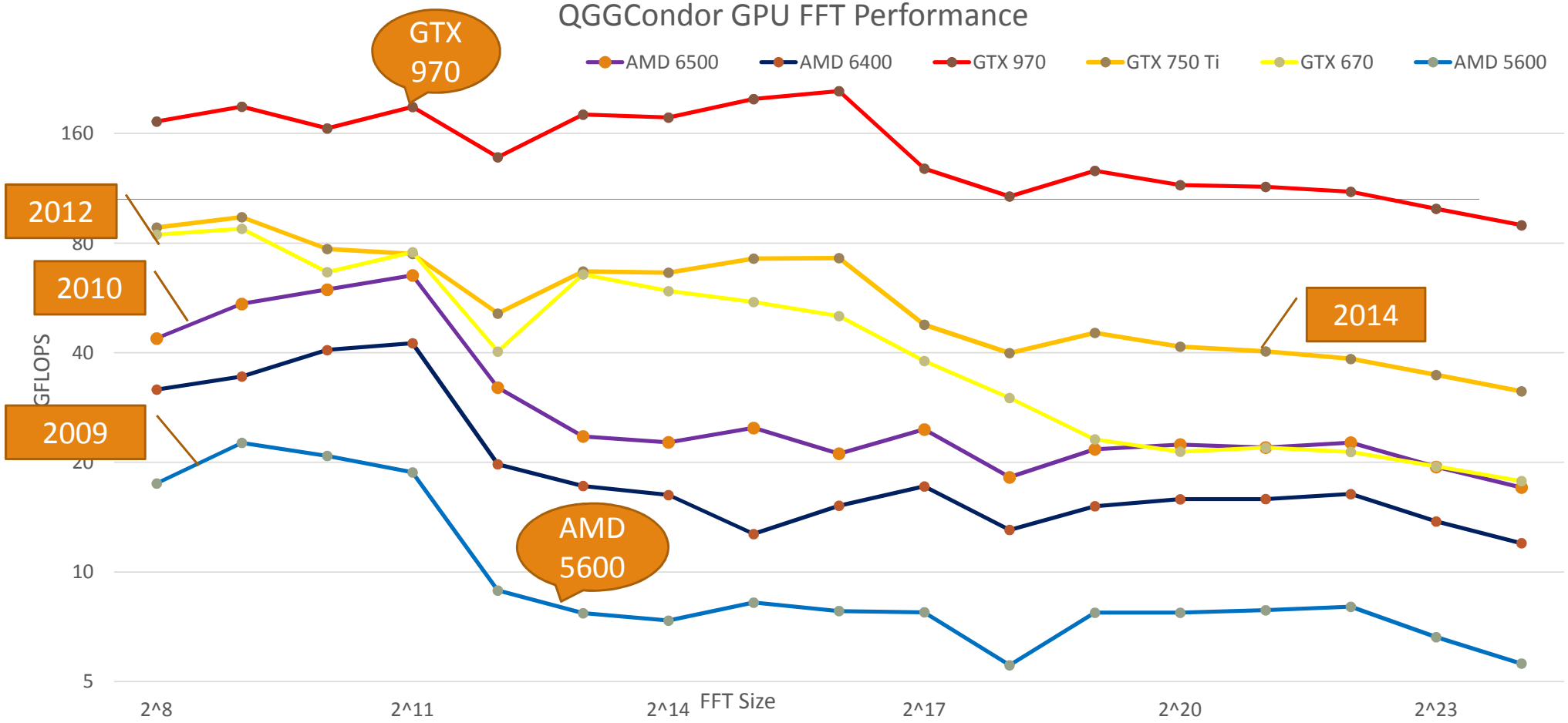
Resulting in:

- Aprox. 12 million FFT calculations
- Aprox. 28 thousand CPU hours

Results

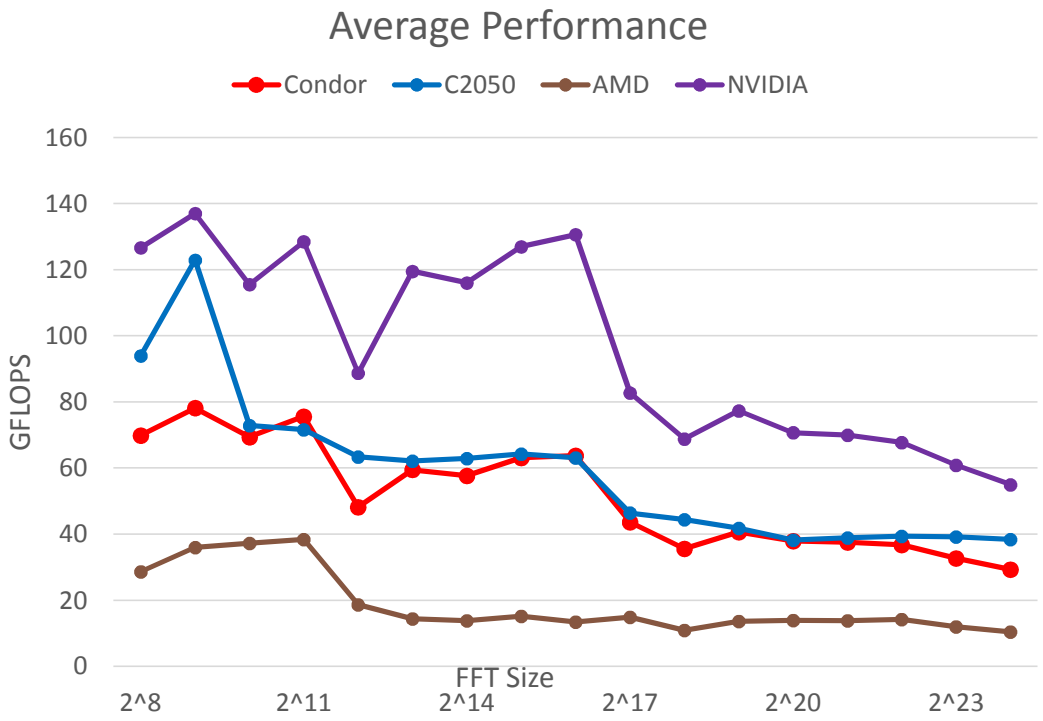

1D FFT on CPU
GFLOPS
2.5
2
1.5
1
0.5
0
2^8
2^11
2^14
2^17
2^20
2^23
FFT Size
Intel I5


1D FFT on GPU
GFLOPS
50
40
30
20
10
0
2^8
2^11
2^14
2^17
2^20
2^23
FFT Size
AMD 6500


QGGCondor GPU FFT Performance
AMD 6500
AMD 6400
GTX 970
GTX 750 Ti
GTX 670
AMD 5600
GTX 970
2012
2010
2009
2014
AMD 5600
160
80
40
20
10
5
GFLOPS
2^8
2^11
2^14
2^17
2^20
2^23
FFT Size

Comparison with GPU cluster

- On average, a single compute GPU is negligibly faster.
- Newer-gen GPGPUs outperform older compute counterparts.



P.S: NVIDIA C2050 was released in 2011

Conclusion

- HTCondor GPU integration was successful with single entity ClassAdd definition.
- OpenCL based implementations over HTCondor are straightforward (without specific optimizations) however machines need dedicated graphics drivers installed.
- QGGCondor GPU performance varies greatly however the average is marginally slower than that of a dedicated compute GPU.

Thank you for your attention

Questions ?