**ARM Cluster**

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**Abstract**

The initial purpose of this project was to build an ARM cluster of 6-12 homogeneous single board computers to make it the fastest and most efficient in cost and energy under the supervision of the client and budget of $1,200.00.

Three types of single board computers were tested to determine which would best perform in our metric: Raspberry Pi 2B, PcDuino, and ODROID XU4. PcDuino was immediately dropped due to technical difficulties as well as the price of each PcDuino of $160. Therefore, it was inferred that the computer wouldn’t excel in the tests.

To benchmark each of the computers, an Open Multi-Processing (OpenMP) program was installed on each of the computers in order for the benchmark to run various mathematic equations on all cores. In the results of the benchmark, the Raspberry Pi performed best with 0.000217 Gigaflops/Dollar/Watt compared to ODROIDs 0.000203 Gigaflops/Dollar/Watt. However, the ODROID XU4 was chosen because the speed outdid the Raspberry Pi 7.4 GFLOPS times faster.

The eight ODROIDs were assembled in a star topology, each connect to a switch using an Ethernet cord. LINPACK, a software that performs numerical linear algebra, was used to perform the initial benchmarking on the speed of the cluster. However, there wasn’t a LINPACK benchmarking software on an ARM cluster. One open source code was taken and adjusted to perform on the ARM architecture. This success of this led to a side goal to release the ARM version of the LINPACK testing.

LINPACK was tested with Message Passing Interface (MPI) code, software to run in parallel on all cores and computer, testing all combinations of the number of cores and matrices. The code was designed to fill as much available memory on the eight devices as possible, and use all eight cores on each. The results of the initial benchmarking with the communication of the Ethernet cords were a maximum of 13.38 GFLOPS using all eight cores on all eight devices. A standard computer I7 desktop was also benchmarked to compare to the cluster, and was able to operate at about 47.5 GFLOPS.

The next stage of this project is to test the results from the Ethernet connection to connection using the other ports, specifically the Universal Serial Bus (USB) and General-Purpose Input/output (GPIO).

The purpose of this project has drifted into using the cluster as an education tool to answer questions such as how computers work, how to set up networks in Linux, and how to communicate between the computers and test the speed of it.