# Building a small Computing Cluster

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## Introduction

### High Performance Computing

*High-performance computing (HPC) is the use of parallel processing for running advanced application programs efficiently, reliably and quickly.* [3]

HPC is used to solve problems that can't be solved by a single computer in a reasonable amount of time. Examples of HPC problems include [2] :

- Weather forecasting
- Chemical engineering
- Bio-sciences and the human genome
- Computer aided engineering (CAE)

A local example of an HPC system is the Saw cluster at Sharcnet which contains 2712 Intel Xeon processors across 336 computers, 16GB of RAM per computer and 127TB of attached storage.

### The Raspberry Pi

- Designed by the Raspberry Pi foundation to get children excited about computers and programming
- The size of a credit card, retails for $\approx$ $35
- Version 3.0 Specs :
  - SoC: Broadcom BCM2837
  - CPU: 4ARM Cortex-A53, 1.2GHz
  - GPU: Broadcom VideoCore IV
  - RAM: 1GB LPDDR2 (900 MHz)
  - Networking: 10/100 Ethernet, 2.4GHz 802.11n wireless
  - Bluetooth: Bluetooth 4.1 Classic, Bluetooth Low Energy
  - Storage: microSD
  - GPIO: 40-pin header, populated
  - Ports: HDMI, 3.5mm analogue audio-video jack, 4 USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)

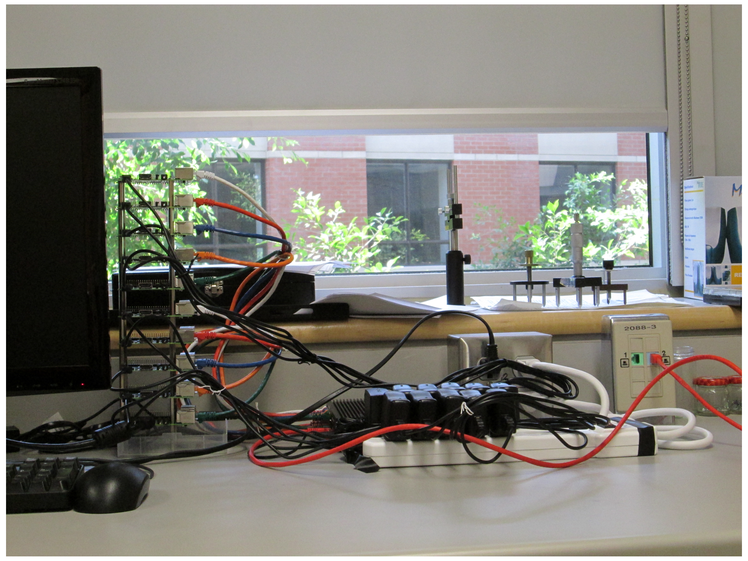
## Research Objective

To build a small Raspberry Pi compute cluster.

## Cluster Design

We based our implementation on the tutorial written by Dr. Simon Cox at the University of Southampton. In particular we used 10 Raspberry Pi 2.0 running Rasbian Wheezy on 8GB class 10 SD cards connected via a 16 port Ethernet switch

## Result



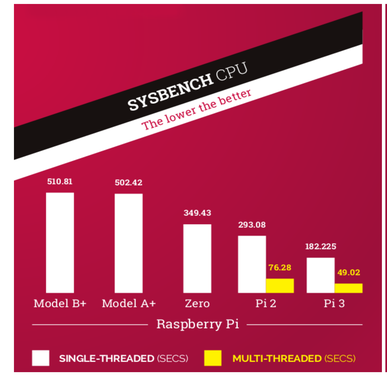
## Conclusions

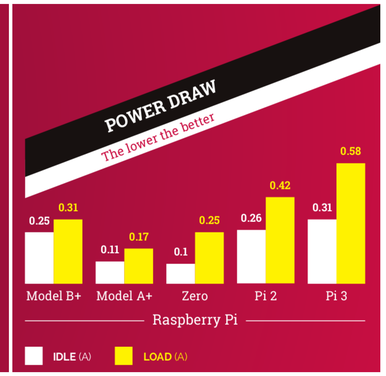
We successfully designed and built a small Raspberry Pi Compute Cluster. Although it doesn't have the same performance ($ per watt or FLOPS per $) as a traditional HPC cluster it is sufficient for testing and educational purposes and offers tangible access to HPC.

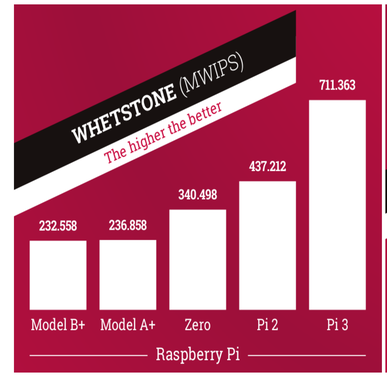
## Future Research

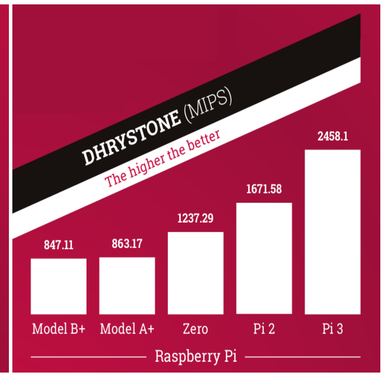
- Running benchmarks (computational, thermal, power)
- Improving Cluster layout and performance
- Finding problems that are suitable for the Cluster to run

## Single Raspberry Pi Performance

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## Acknowledgments

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