

Date: March 28th, 2019
To: Professor Qasem
From: William Brooks, Amber Guevara, Cody Wright
Subject: Proposal for Term Project

Purpose

The purpose of this proposal is to submit our intended term project of “Performance Testing a Cluster of Raspberry Pi’s”.

Problem Description

We have chosen to build a cluster of Raspberry Pi’s because it will allow us to implement several lessons we have learned in CS 3339. These include testing benchmarking programs, Linux terminal performance measuring, exploiting resources using parallelization, Amdahl’s Law, speedup, and other core course concepts. We have three main learning goals for this project: the assembly of the cluster, the choosing and writing of various benchmarks, and looking at how the system is able to take advantage of the extra resources. We hypothesize that we will need to use parallelization to really see any effect of the added resources. This reflects the direction that both processing and programming is headed with the increase in the number of cores and the dependency on threaded applications to take advantage of the cores.

Methodology

Task 1. Gathering Resources & Assembling Cluster

All three team members currently have access to and experience with Raspberry Pi’s. In this phase of the project we will pool our resources and decide on additional hardware, such as an ethernet hub, power hub, or Pi housing stack. We anticipate possibly needing to purchase an additional Pi. Once we have the necessary hardware we will interface the Pi’s together following a tutorial such as the following <https://www.raspberrypi.org/magpi/cluster-computer-raspberry-pi-3/>.

Task 2. Choosing Benchmarks

Here we will choose an array of benchmarks to test on both a single Raspberry Pi as a control, and the cluster of Pi’s. We will test our hypothesis that parallelization will be needed to see any performance speedup by testing both parallel applications and sequential applications. We also want to attempt writing our own benchmark specifically for the cluster.

Task 3. Performance Testing

This step will implement lessons learned from the class in performance testing using the Linux terminal and perf stats. This will give us data measurables that will be used to determine speedup and the number of processing cores used by the system. We are also interested in how the cluster now handles the system processes across the four Pi's, and if the Raspbian OS is able to exploit the extra resources.

Task 4. Analysis

Using the data gathered from testing we will begin to calculate and chart performance using the performance equations $Execution\ Time = (Instruction\ Count \times CPI) / (Clock\ Rate)$ and

$$Speedup = \frac{Perf_A}{Perf_B}$$

Task 5. Preparing the Presentation and Technical Report

We will organize our methodology and findings in a PowerPoint presentation and technical report. This presentation will also contain instructions in order to repeat our project, teach how a cluster works, and demonstrate how to make use of such a system. The report will summarize our hypothesis, methodology, and experimental results and analysis.

Timeline

Number	Task	Week 10	Week 11	Week 12	Week 13	Week 14
1	Gathering & Assembly	Cody				
2	Choosing Benchmarks	Will	Will			
3	Performance Testing		Will / Cody	Will / Cody		
4	Analysis			Amber	Amber	
5	Presentation & Report				Amber	Amber

Note: Each team member is assigned a task to manage, but it does not mean they will necessarily be working on it alone; however, they are responsible for seeing it through. All members will have working knowledge in all tasks completed.