

# Performance Evaluation of a Supercomputer Made from Discarded PCs

# PHYS025T

## Physics and Astronomy

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Computer simulations play a fundamental role in the field of science. However, the necessary calculations require serious computing power, a facility which is often confined to well-funded institutions. If these computing power can be replicated for low budget, it would open a wide range of possibilities to students. Therefore, we investigated the feasibility of building a high-performance cluster from discarded PCs.

We made a cluster consisting of fifteen third-generation Core i5 and thirty-two Core 2 Duo, before testing its performance using a simple MPI program that calculates pi. We then moved on to prove that the cluster can execute a practical application by running a resource-consuming “GADGET-2” – a standard N-body simulation code used in the field of astronomy.

The time it took to execute the pi program became 97% shorter compared to the time taken by a single core. Further tuning led to a hardware execution efficiency (actual increase in performance / theoretical increase in performance) of 54.7% which gave the measured performance of 644 GFLOPS (Floating-point Operations Per Second). A sample program of GADGET-2 was executed in 10 minutes, significantly faster than the 1.5 hours it took for a laptop to complete the calculation.

Even though discarded PCs may not have enough computing power on their own, when assembled into a cluster, they gain the ability to calculate at a speed equivalent to that of today’s high-end PCs. This implies that the students can construct their own high-performance cluster locally, hence the acceleration and divergence of their scientific research.

1. In this research project, the student directly handled, manipulated, or interacted with (check ALL that apply):

<input type="checkbox"/> human participants	<input type="checkbox"/> potentially hazardous biological agents
<input type="checkbox"/> vertebrate animals	<input type="checkbox"/> microorganisms
	<input type="checkbox"/> rDNA
	<input type="checkbox"/> tissue

2. I/we worked or used equipment in a regulated research institution or industrial setting (Form 1C): YES  NO

3. This project is a continuation of previous research (Form 7): YES  NO

4. My display board includes non-published photographs/visual depictions of humans (other than myself): YES  NO

5. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year’s work only:  YES NO

6. I/we hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.  YES NO

*The stamp or embossed seal attests that this project is in compliance with all federal and state laws and regulations and that all appropriate reviews and approvals have been obtained including the final clearance by the Scientific Review Committee.*

