

# Adaptive Scheduling Across a Distributed Computation Platform

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# Outline

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- ♦ Introduction
- ♦ Distributed Platform
- ♦ Heterogeneity
- ♦ Topology
- ♦ Scheduling
- ♦ Projects
- ♦ Conclusion
- ♦ Future Work



# Introduction

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- ♦ Science has many problems which require a lot of processing power
- ♦ Most desktop PC's underutilised



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# Earth Simulator

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Cost \$350,000,000

# Our Solution

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- ♦ General Purpose distributed system
- ♦ Multiple problems in parallel
- ♦ Free computing power!



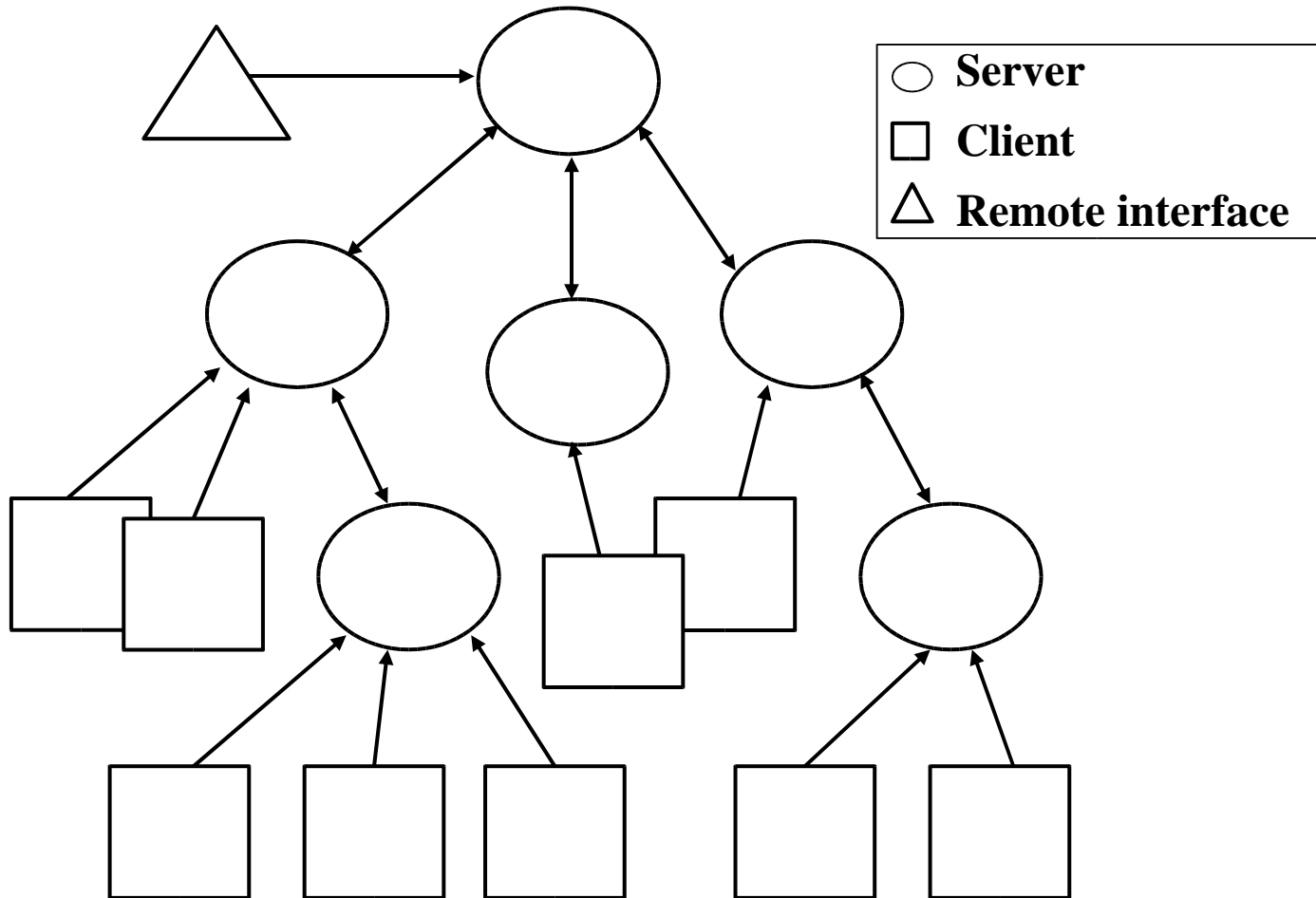
# Distributed Platform

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- ♦ Client-server model
  - ♦ Anonymous clients
  - ♦ Scalable
- ♦ Easy to setup & use
- ♦ Easily parallelisable problems
- ♦ Platform Independent - Java
- ♦ Heterogeneous
- ♦ Open Source - GPL

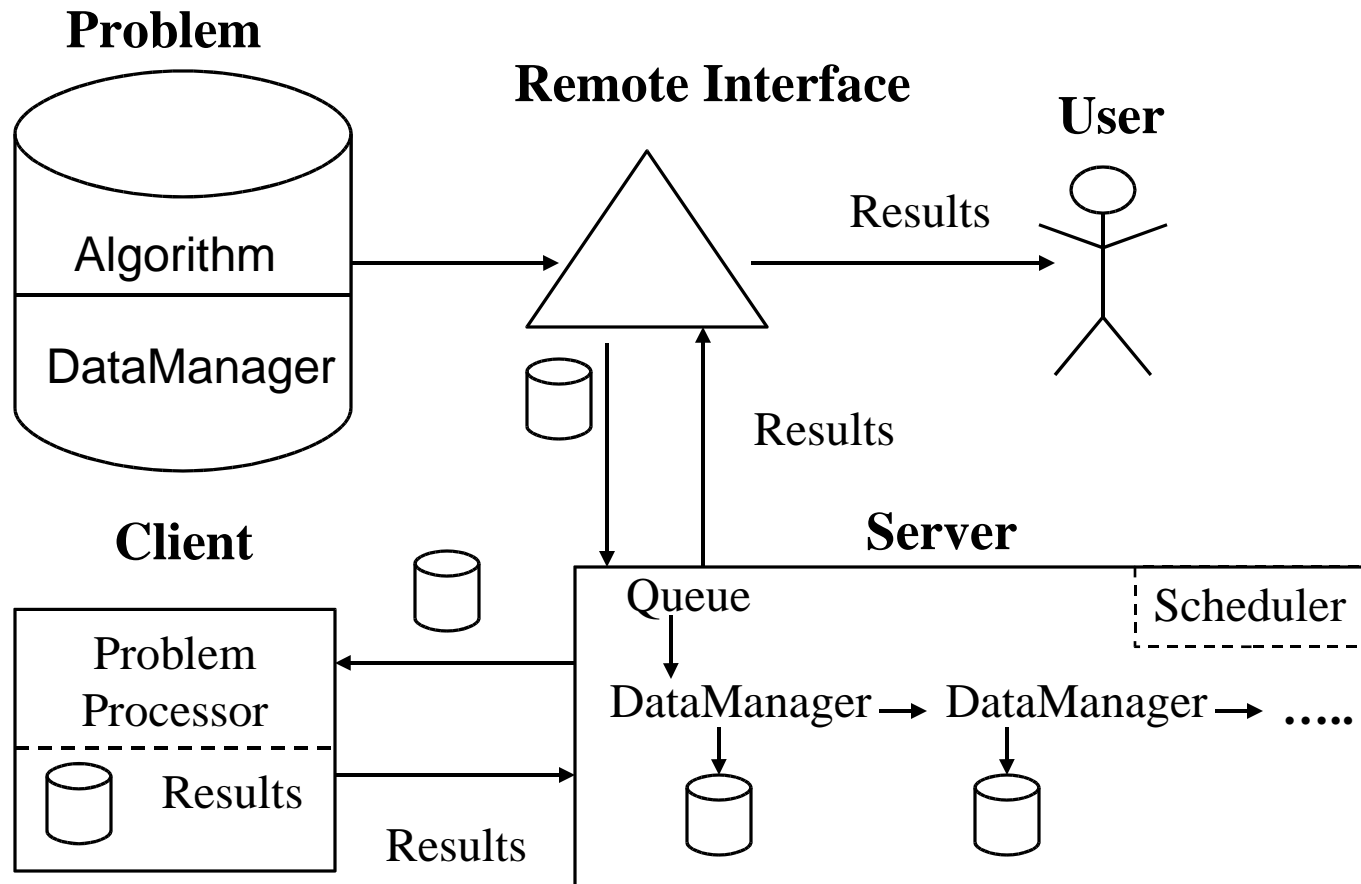


# Topology





# How the system works





# Matching & Scheduling

- ♦ Each job has a priority and memory requirement
- ♦ Servicing value  $S_i$
- ♦ Aim to minimise

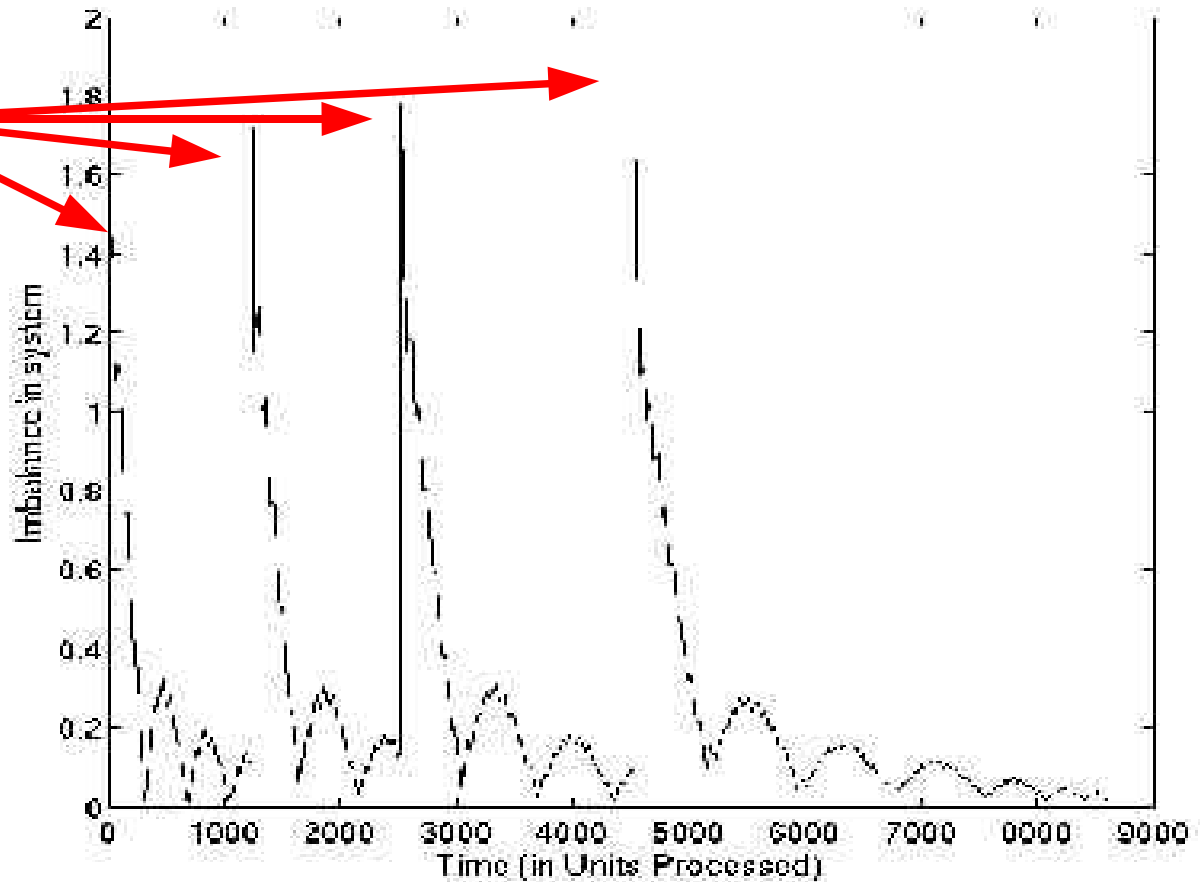
$S_i = \text{Desired of resources} - \text{Actual of resources}$

$$\sum_{i=1}^N |S_i|$$



# Dynamic rebalancing

New jobs added





# Heterogeneity

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- ♦ Running in Computer Science, Biology, and Electronic Engineering
- ♦ Currently running on 300+ computers
  - ♦ 100 PIII 600MHz
  - ♦ 50 PIII 1GHz
  - ♦ 92 P4 2.4GHz
  - ♦ 32 Node Dual Processor Cluster (PIII 1GHz x 2)
- ♦ Hardware
  - ♦ Intel, AMD, HP (PA-RISC), Sun, Apple



# Heterogeneity

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- ♦ Operating Systems
  - ♦ Windows: 98/NT/2000/XP
  - ♦ Linux: Redhat, Fedora, Debian, Gentoo, Mandrake
  - ♦ Sun Solaris
- ♦ Peak performance: 17 Billion Floating Point Operations Per Second



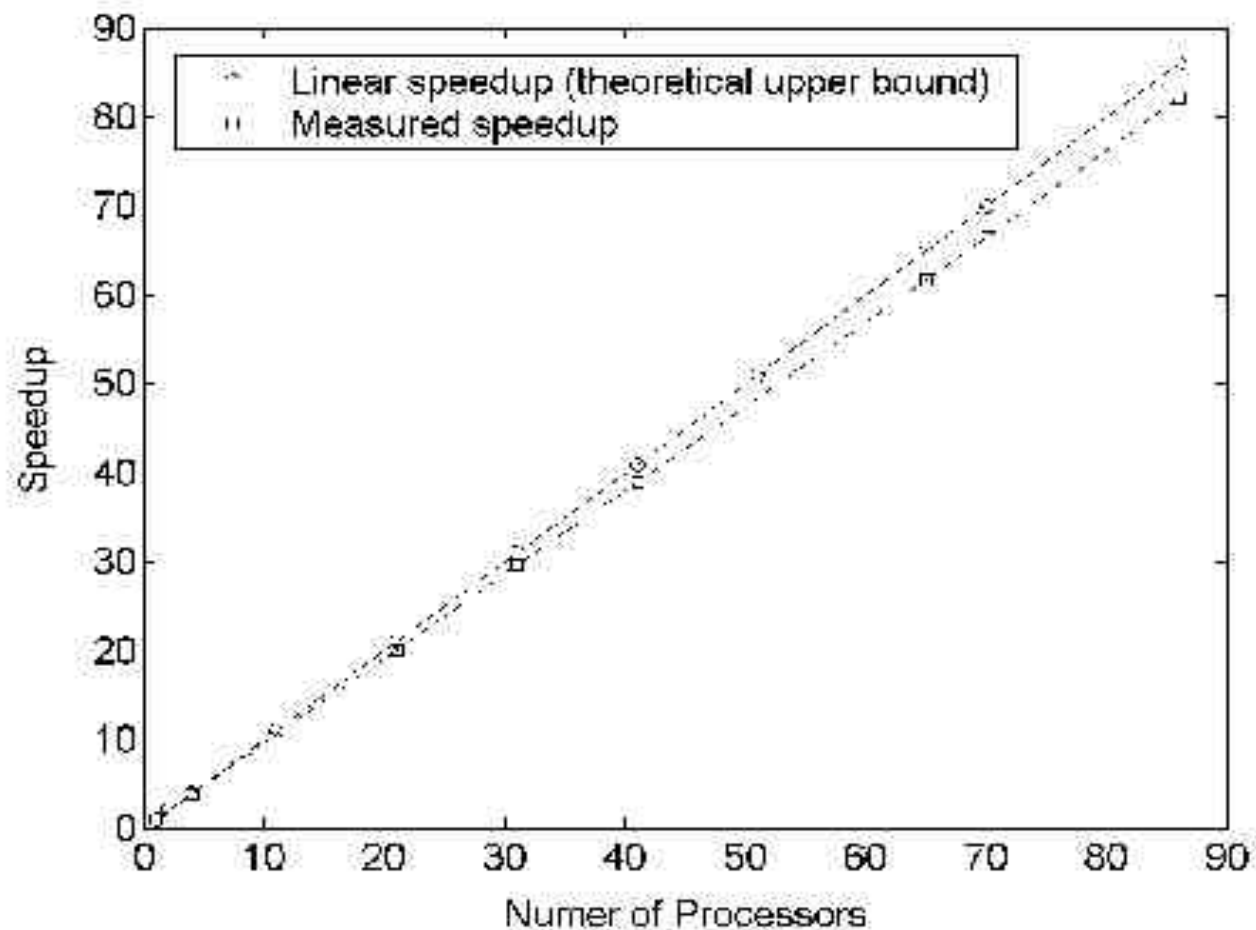
# Projects

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- ♦ Bioinformatics
  - ♦ Building huge Phylogenetic trees - HIV
  - ♦ Smith Waterman DNA Analysis
- ♦ Biomedical Engineering
  - ♦ Modeling path of Photons through Tissue
- ♦ Computer Science
  - ♦ Cryptography, testing ElGamal strength
  - ♦ Travelling Salesperson Problem



# Speedup - TSP





# Conclusion

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- ♦ Free computing
- ♦ Heterogeneous
- ♦ Adaptive scheduling
- ♦ Multiple successful applications



# Future Work

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- ♦ Plan to roll out across NUIM & Internet
  - ♦ Still millions of underutilised machines
- ♦ Collaborate with more research groups
- ♦ Evolutionary scheduling algorithms
  - ♦ Genetic Algorithms, Tabu, Ant Colony, etc...

# Contact Us



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