The Invisible Hand and Hidden Markets of the BOINC Community Platform

An Economic Perspective

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The Foundation for Computational Learning & Science

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- Brief history of distributed computing
- Distributed computing in the marketplace
- Why We BOINC
- Historical Analysis
- The 400 lbs Gorilla in the Room
- And Then there was BOINC
- Making sense of the Data
- The Road Ahead

A Brief History of Distributed Computing

- GIMPS

The Great Internet Mersenne Prime Search

- Among first multi-node distributed computer middleware.
- Designed for speed in calculating very large prime numbers
- Assumed Trusted network
- Protocol and middleware designed solely for GIMPS project; no modular design

- Distributed.net

- Single project designed to break a portion of the RC5-56 RSA secret key challenge
- Protocols and middleware designed entirely for the purpose of testing cryptography
- Lacked data verification mechanism
- Protocol and middleware designed solely for DCTI project; no modular design

Common Themes of GIMPS and Distributed.net

- Bringing together individuals with the power of peer-2-peer computation
- Projects assume common level of interests and atypical technical knowledge
- The power of idle machines networked in common computation is a very powerful resource
- Participation occurs because participants are interested in the science and any human benefit thereof

Distributed Computing in the Broader Context

- As the internet developed, so did several business models around it
- The evolution of the internet was largely shaped by the standardization of chipsets, operating systems, and communication protocols
- Adoption of distributed computing parallels the trend of greater number of internet users until more interactive internet participation becomes available

The Internet as a Service Model

- Traditional client-server relationships evolved into peer networks once standardizations enabled media rich content and ease of interactive use.
- GUI rich chat and message boards replaced IRC
- Ease of use paralleled adoption and upwards trend of increased user interaction in dissemination of news, and community development

The Next Big Thing…You

- With increasing adoption of the internet, the fervor of a new frontier excited Wall Street. The Dot.Com era began with a boom but e-business was not yet understood
- Several internet based businesses began; notable to our topic today, distributed computing was considered a viable business
- Businesses included:
  - Popular Power
  - United Devices
  - Entropia

The Failure of Distributed Computing

- Distributed computing did not become a viable market entity due to a variety of reasons:
  - Intellectual property liabilities from unencrypted memory and un-trusted networks
  - Like many things Dot.Com, there was more marketing hype than positive cash-flow
  - Firms offering distributed computing resources fundamentally misunderstood their audiences

The Next Evolution

- Failure of distributed computing as a business entity led to a new paradigm of distributed networks.
- Services became the new paradigm of computing for profit

Current Day Examples Include:

- Amazon Compute Cloud(EC2)
- Sun Cluster Compute
- IBM business services
- Google Web services

The Web Service Model

- Assumes trusted network
- Often used for web applications such as business accounting
- Does not require secondary verification of results
- Not appropriate for user participation or volunteer paradigms

Why We BOINC

- BOINCers participate because we believe that it is a good cause.
- Participation is not entirely dependant on specialization of knowledge; general interests is sufficient
- Most people want to be involved in changing the world in a positive fashion

Ideas and the Marketplace

- Adam Smith believed that good ideas that become reality do so because they become an economic entity

- Natural philosophy and free market economics dictate that any good invention or service will become an economic entity; absent overwhelming competition, cartels, and law barring entrance to market

How Good Ideas get to Market

- Military application
- Institutional application
- Market need driven
- Academic interests
- ‘Cool factor’

Classic Examples

- Military-Computers and Alan Turing
- Institutional- Apple, IBM, Microsoft
- Market need- Various internet search engines
- Academic interests- DNA technologies
- Cool factor- peer network file sharing and Youtube

The 400 lbs gorilla in the room..but no one can see him because he blends in with the couch

- **Unlike tangible technologies, distributed computing can't be touched, felt, or emotionally related with…..yet**
- **There is value-added in peer scientific participation.**
- **The user base though largely decentralized and confederated represents a pool of new ideas and potential solutions to grand challenge problems (Bolt, Bossa)**
- **More synergy among project participants and project development may create positive feedback mechanism of greater community participation**

Gorilla in the room...continued

- **More communication between project directors and client members may lead to development of marketable intellectual property.**
- **There is minimal start-up and maintenance cost in hosting a project. Greater centralized participation towards the development of models has potential huge benefits.**
- **The community can keep their open source and altruistic objectives while building positive feedback mechanisms for bringing computational research into the marketplace for greater human consumer use**

A step-wise approach to enabling BOINC to realize its potential

- Comparing it to commercial enterprises
- Utilizing the Scheduler
- Analyzing Incentive for Outsourced Computation
- Deploying projects around human behavior
- General Population Motivation
- Making BOINC affordable and adoptable

Commercial Enterprises as compared to BOINC

- Sun Java Enterprise Solutions
- Amazon Ec2 cloud computing
- Google Services
- Hewlett-Packard grid services

  - Private trusted network, Sun provides hardware and software support
  - Too expensive for non-funded projects
  - Different costs models

Distinctions of the Commercial Grid

- There are no standards of pricing schemes caused by large differences in units traded
- Level of project support can vary
- Not peer-review oriented

- Relevant research "A Pricing Information Service for the Grid" Alexandru Caracas IBM Research Labs, Zurich ACM Online

Utilizing the Scheduler

- The Scheduler is an economically efficient mechanism
- Evolutionary algorithms ensure that relevant work units are distributed to most capable nodes
- Efficiency in data exchange makes economic $cents$
- Relevant research “A Distributed Evolutionary Method to Design Scheduling Policies for Volunteer Computing ” Trilce Estrada, Olac Fuentes, Michela Taufer et al. ACM Online

Analyzing Incentive for Outsourced Computation

- Reasons for people to participate vary, but in human nature competition makes some people cheat.
  - Without reward there is no incentive for participants to do work. Even with reward there is not incentive for users to contribute faithfully
  - Credit System can create classic prisoners dilemma
  - Currently credit system does not have built-in incentive to prevent cheating
  - Creating a central accounting authority would enable transparency among credits and place for disposition of credit conflicts
    - Relevant research “Incentivizing Outsourced Computation” M Belenkiy, J. Jannotti, M. Chase, A. Kupcu, C. Erway, A. Lysyanskata ACM Online

Deploying projects around natural human behavior

- Users must be rewarded for their participation
- The rewards should not come at the cost of a high learning curve
- Build for ease of use and make a GUI
- Information is a commodity, trade it.

Creating General Population Motivation

- Boot-strapping with VM
  - Large datasets pre-packaged with a VM
- Currently participants have no incentive to persuade their friends.
- Overcoming these problems
  - Lottery Trees

Using Lottery Trees

- A lottery tree is a mechanism that employs a lottery to probabilistically compensate people who participate.
- Compensation also achieved from referring others to the project and establishing a Parent-Child Relationship
- Credit and compensation must be controlled by a central accounting authority

Relevant research “Lottery Trees: Motivational Deployment of Networked Systems”
J Douceur , T. Moscibroda Microsoft Corporation ACM Online

Making BOINC affordable and adoptable

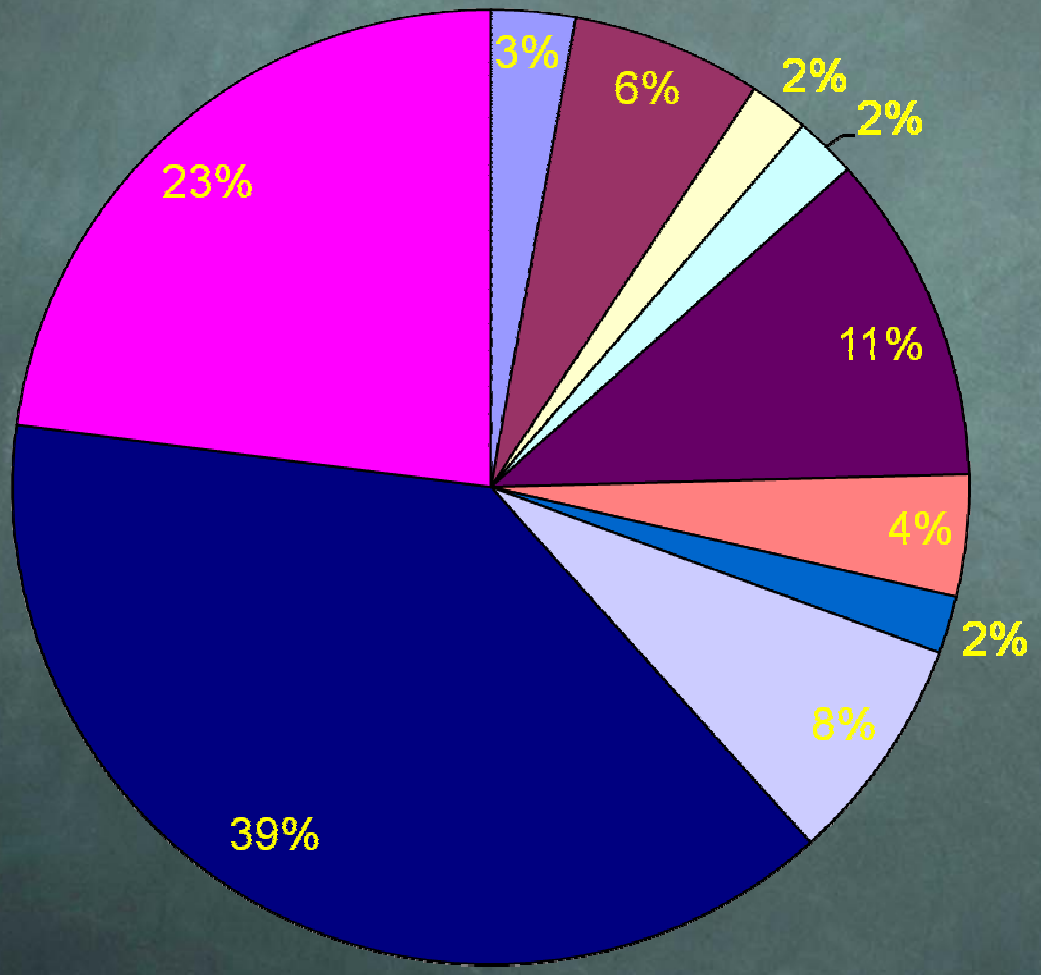
- Central Credit distribution and accounting can be achieved by tax rewards to participants
- Tax incentives do not cost money to project hosts
- If BOINC becomes more emotionally established with the general population and the client becomes more GUI rich, general population adoption will very likely increase

What the data tells us

- Preliminary survey data indicates that motivations for BOINC participation exceed the current credit system
- Participants seek to become more involved in all aspects of development
- Proportional collaborations between nonprofit institutions and the now decentralized community may offer potentially huge benefits to all parties

Survey Nationalities

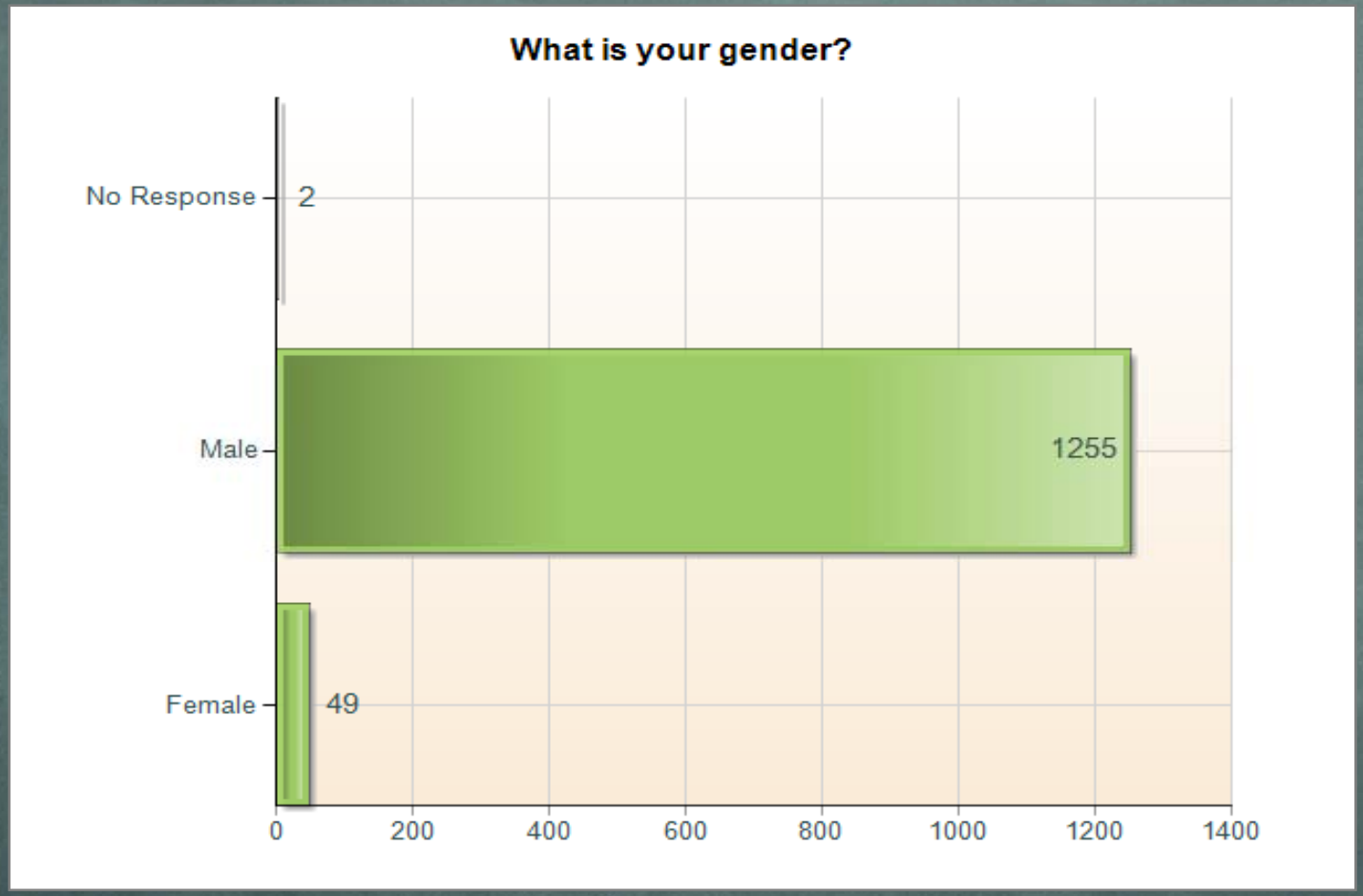
N=2332



- Australia
- Canada
- Czech Republic
- France
- Germany
- Italy
- Netherlands
- United Kingdom
- United States
- Other

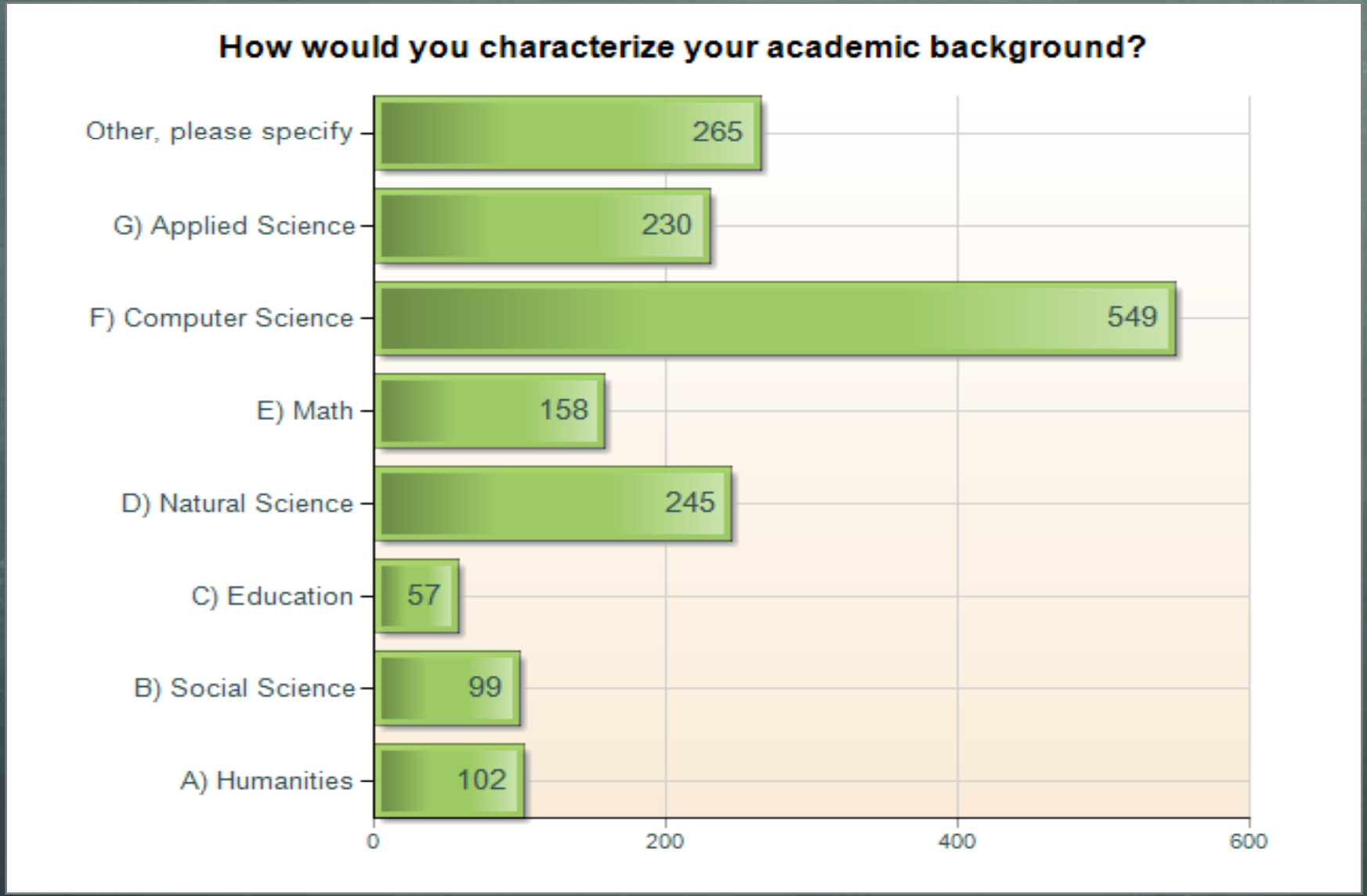
The Foundation for Computational Learning & Science BOINC Client Survey:

Survey Population and Gender

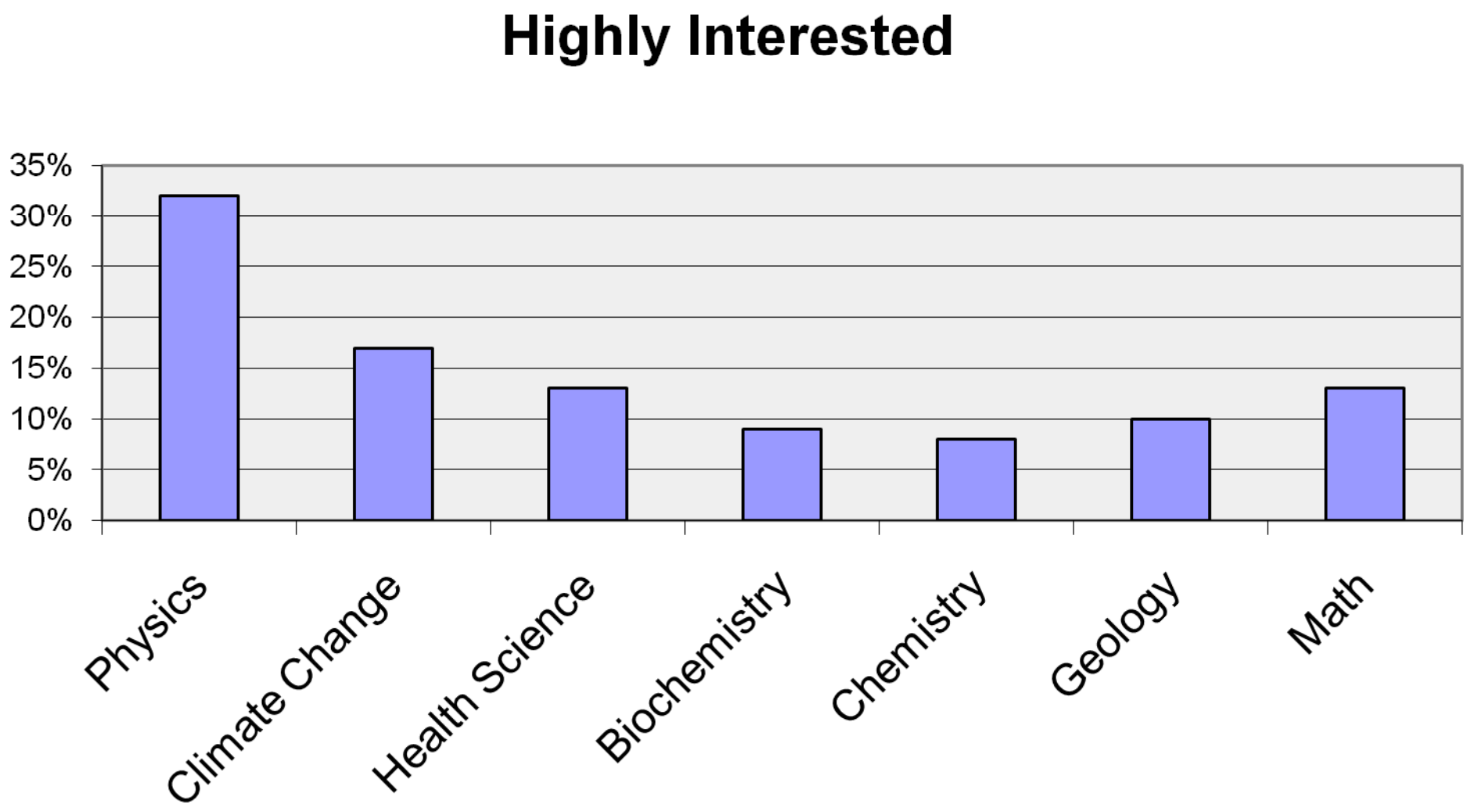


The Foundation for Computational Learning & Science BOINC Client Survey:

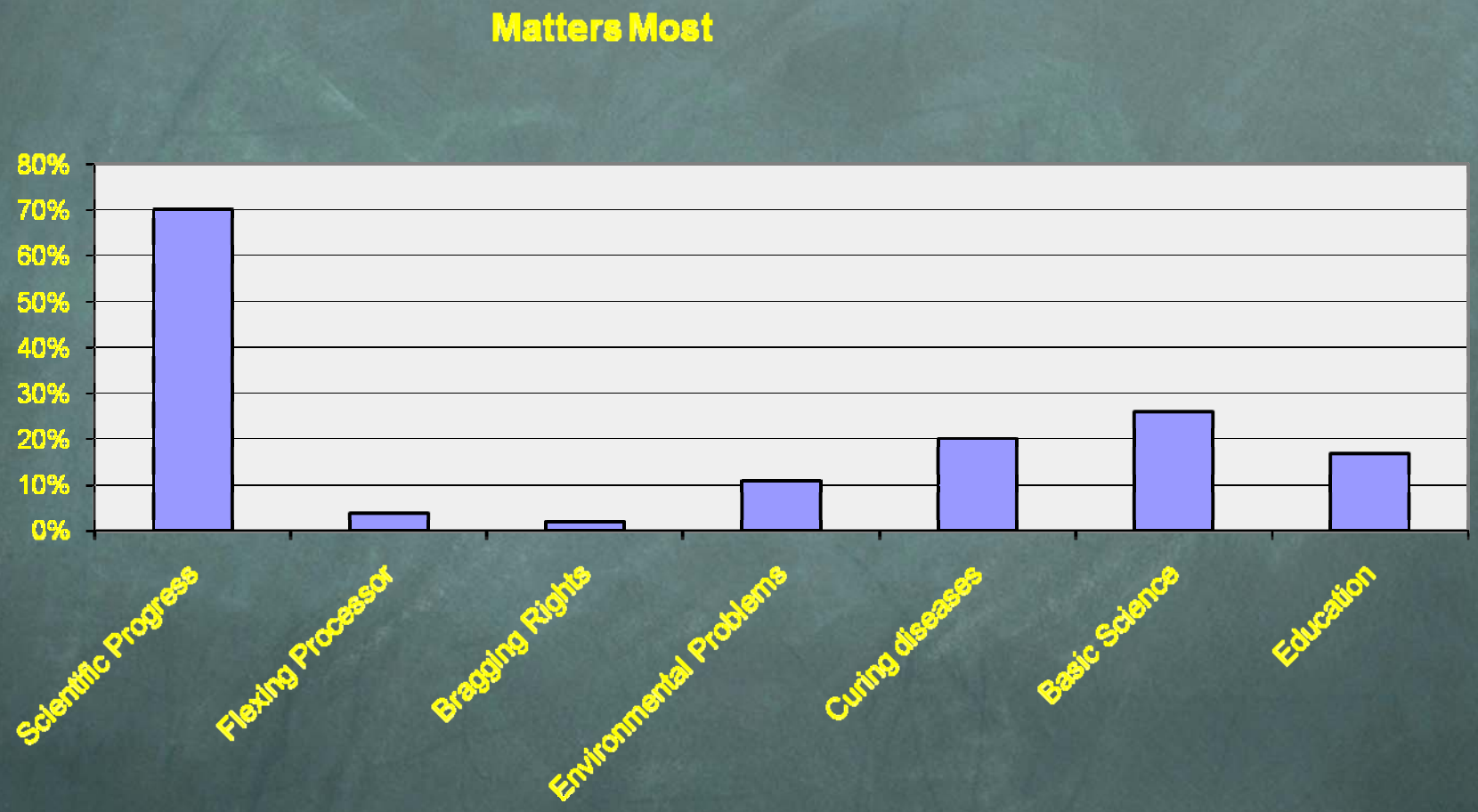
How would you characterize your academic background?



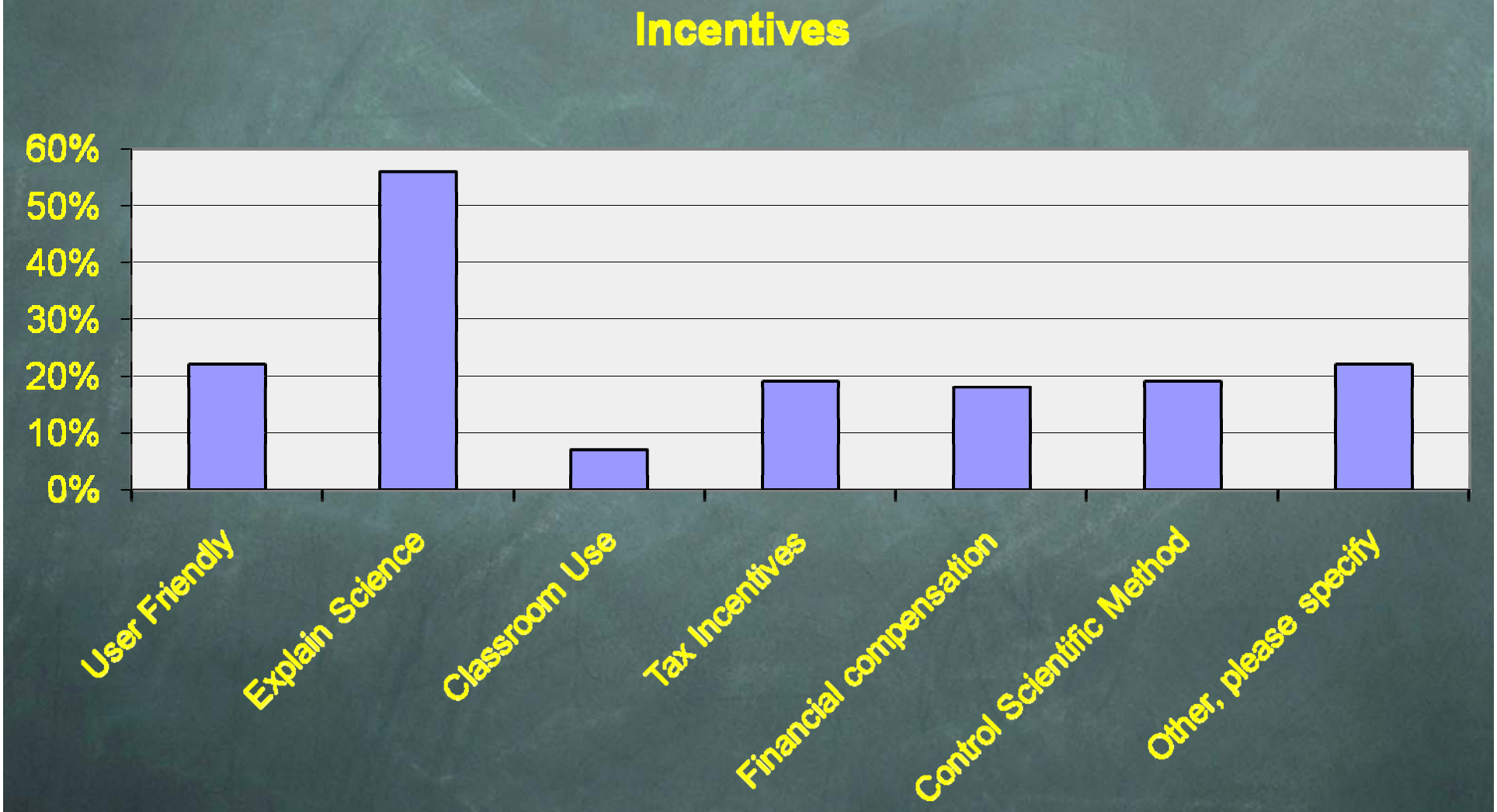
Scientific Topic



Motivates Participation



What Incentives Motivate You?



Moving Forward

- The time is right to invigorate the community
- With the impending crises humanity now faces in many areas of science, population, climate change, and depletion of resources, BOINC may be the appropriate next evolution towards reconciling many of these problems
- Expanding BOINC for the sake of itself and the world population at large will require further market analysis, and a broader appeal similar to the evolution of standards that computer operating systems took.

Thank You!