Carnegie Mellon University

The Computer Science Ph.D. Program

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Director of Graduate Programs

(thanks to Jeannette Wing!)

Open House

March 17, 2005

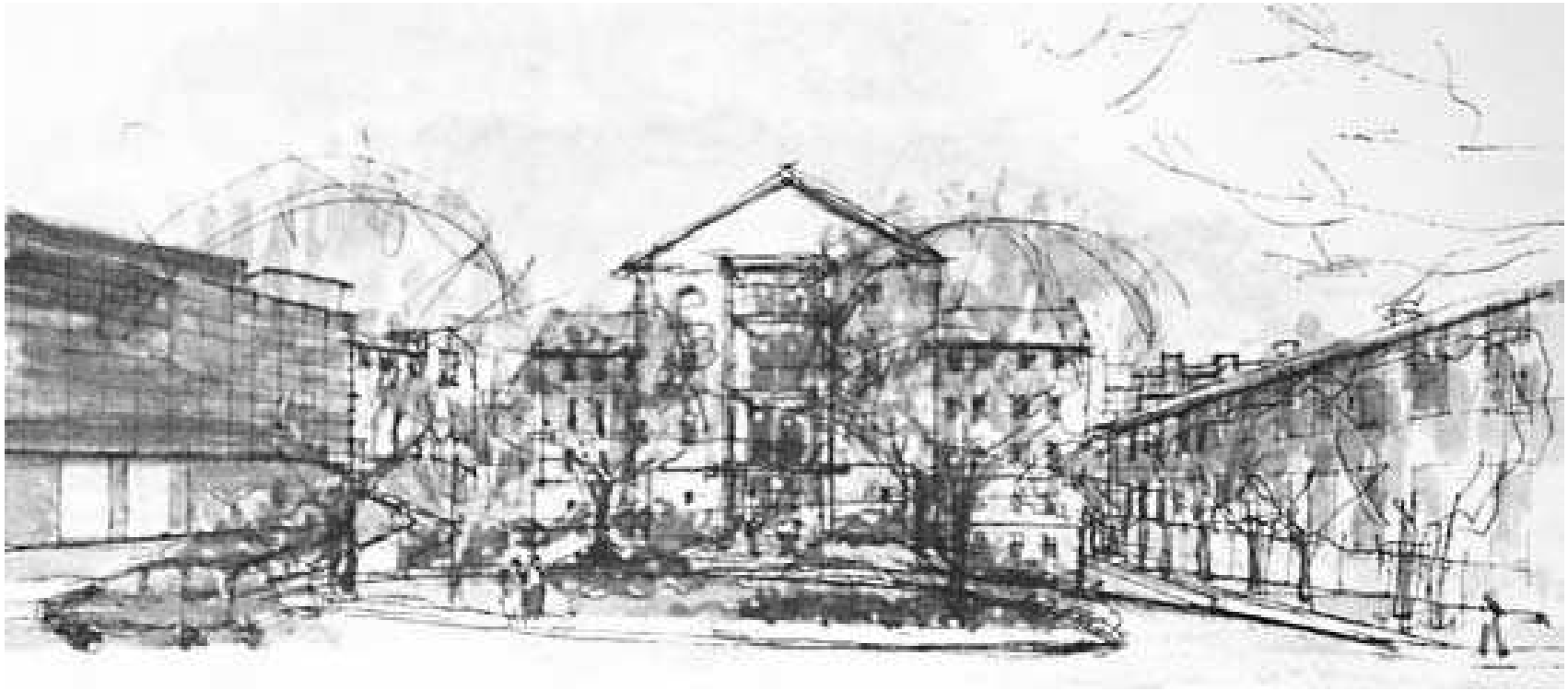
What Does it Mean to Get a Ph.D. at CMU?

- To learn to how to do high-quality research
  - Opportunity to explore new territory with an expert guide
  - Transition from
    - Problems with answers in the back of the book
  - To
    - Problems where you don't know whether there is an answer
    - Areas where asking the right question is difficult
- To make a long-term investment in your future
  - To prepare for a career in technical leadership
    - Industry or academia
    - Set directions that others follow

Congratulations! You Are a Select Group

- We admitted 70 students. (676 applied.)
  - We want all of you here!
- Threshold is set by capacity
  - We rejected many qualified applicants.
  - We want to ensure quality advising for each of you.
  - We provide financial support for each of you.

What's so Special About CMU?



Artists Conception of the Gates Center for Computer Science

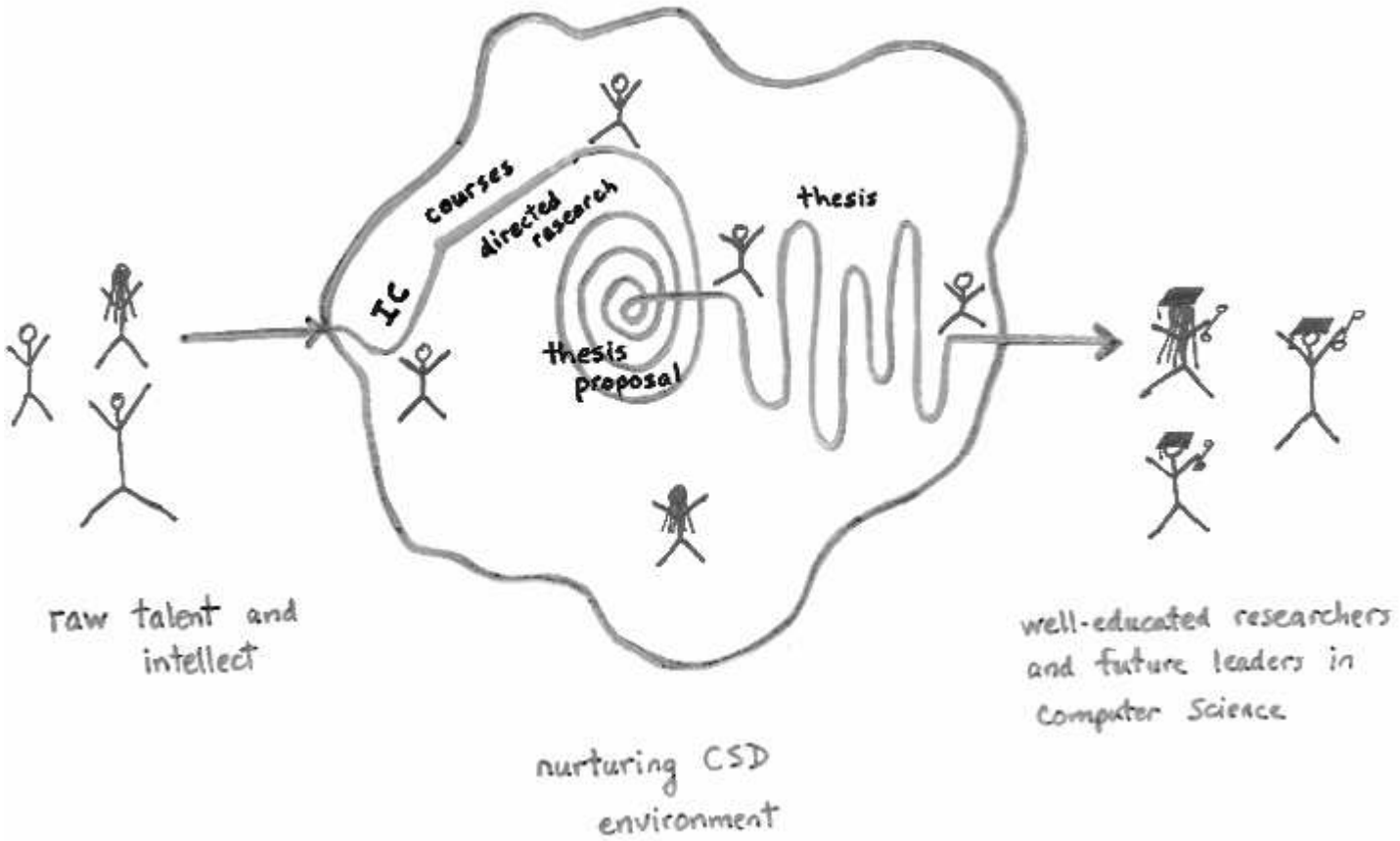
Distinguishing Principles of Our Ph.D. Program

- Research is a high priority activity.
  - Research from Day 1.
  - Interdisciplinary, collaborative, hands-on
- Students choose their advisors based on mutual research interests, not funding.
  - Learn by apprenticeship.
  - Peer-to-peer, not client-server interaction.
- Admitted students are expected to finish.
  - No further hurdles: no MS requirement, no qualifying exams.
  - Historically, ~75% finish.
- The Ph.D. Program is flexible.
  - We treat students as individuals.

Components of the Program

- Getting Started
  - Admissions, Open House (you are here)
  - Immigration Course (IC)
  - Getting an advisor
- Course Work
  - 5 Area Courses
  - 3 Elective Courses (or V-unit!)
- Other Activities
  - 2 Teaching Assignments
  - Skills: oral and written communication
- Research
  - Directed Research
  - Thesis Proposal
  - Thesis

A Student's Life Pictorially



Immigration Course

- Two weeks in the fall to see entire range of research and educational activities
- Overall understanding of research and culture of CSD
- Students and faculty get to know each other

Getting an Advisor

- Policies
  - Any SCS faculty member can be your advisor
    - Not just those in CSD
  - Some non-SCS faculty also have advising privileges
    - ECE, Biology, Business
  - Can change advisors due to shifting interests & research styles
- "Handshake": Matching students with advisors
  - Near end of September, everyone assigned advisor
  - Based on mutual interest of faculty and students
    - We work hard to make matches that are desirable for both students and faculty

Courses

- 8 Courses Required
  - 5 for breadth, spanning range of computer science
  - 3 for depth in specific area or breadth within and beyond computer science
  - Not all courses are courses
- Features
  - Typically completed in first two years
    - At 50% time effort
  - Most courses are targeted to Ph.D. students
    - Intense, thought-provoking

Five Area Star Courses

- Algorithms and Complexity
  - Algorithms
  - Complexity Theory
- Artificial Intelligence
  - Advanced AI Concepts
  - Machine Learning
- Computer Systems
  - Computer Architecture
  - Optimizing Compilers for Modern Architecture
- Programming Languages
  - Type Systems for Programming Languages
  - Programming Language Semantics
- Software Systems
  - Advanced Operating Systems and Distributed Systems
  - Networking
  - Database Management Systems

Other Educational Activities

- Teaching
  - Two semesters
  - Serve as integral part of our very successful undergraduate program
  - Being a TA is a learning process, not a financial necessity
- Skills Requirements
  - Writing
  - Speaking

Black Friday

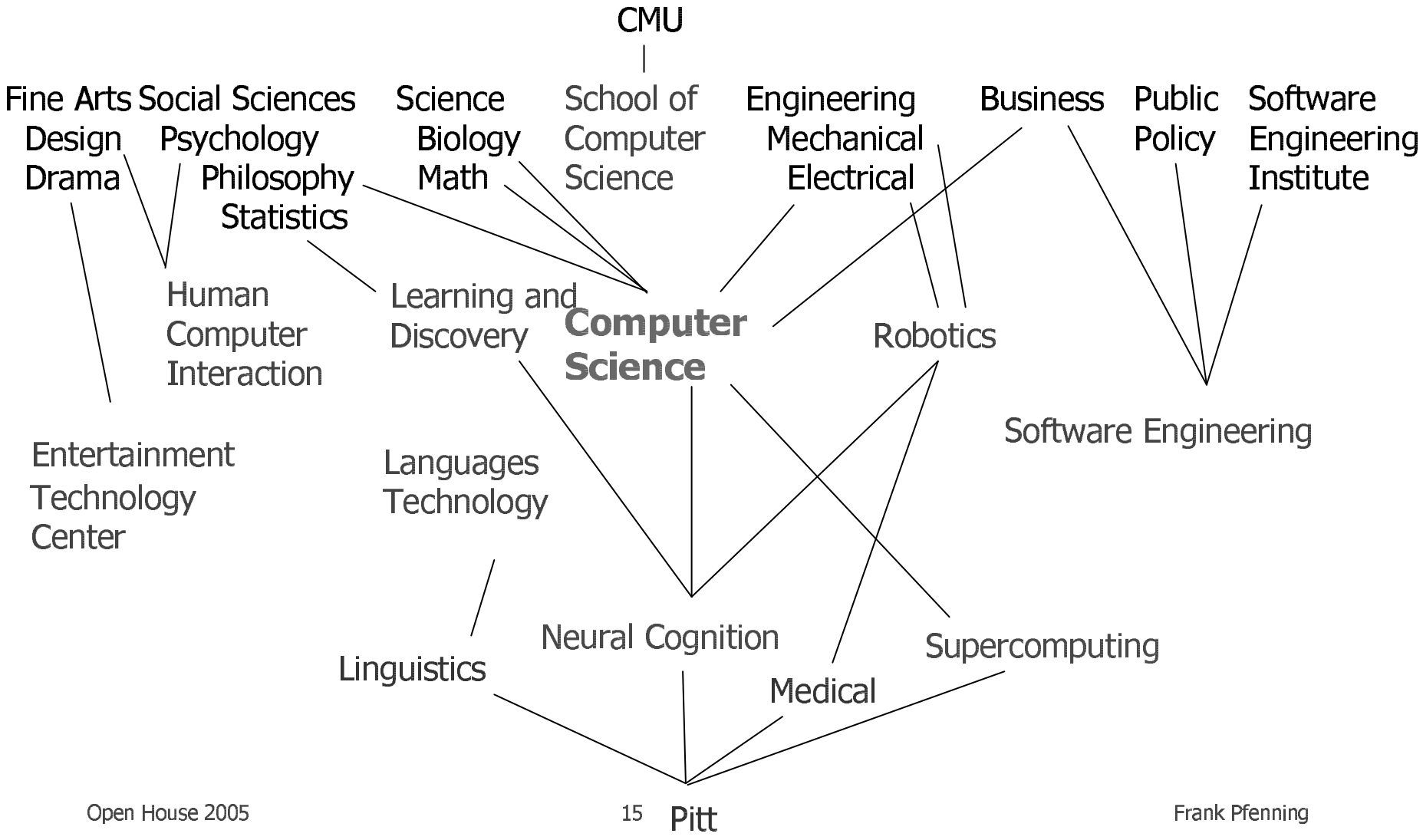
- Progress of every student evaluated twice a year
  - By entire CS faculty
  - Progress through program
  - What kind of work is he/she doing

- Benefit for students
  - Uniform calibration of students across program
  - Review of advisor as well as the student
  - Cooperative effort to have all students succeed

Financial Support

- We provide financial support while you are in good standing in the program.
- How does this work?
  - Mostly paid out of faculty research grants
    - Your advisor has a vested interest in your success!
  - External fellowships
    - Solicited by student
      - NSF, etc. We will supplement.
    - Through department
      - Intel, Microsoft, IBM, …
  - Departmental funds
    - While you are teaching
    - Special cases
      - Advisor has funding gap
      - Faculty just starting up

Computing at Carnegie Mellon



School of Computer Science

- People
  - 190 faculty
  - 200+ courses offered
  - 370 doctoral students in 7 Ph.D. programs
  - 300 masters students in 10 MS programs
  - 540 bachelors students in 1 BS program
- Units
  - **Computer Science Department**
  - Center for Automated Learning and Discovery
  - Robotics Institute
  - Human-Computer Interaction Institute
  - Institute for Software Research, International
  - Languages Technology Institute

- CSD
  - 80 faculty
  - 160 Ph.D. students
  - 157 staff

Our Ph.D. Programs

- Ph.D. in Computation, Organizations and Society – ISRI
- Ph.D. in Computational and Statistical Learning – CALD
  - Ph.D. in Computational and Statistical Learning (Neural Basis of Cognition) - CALD & CNBC
- Ph.D. in Computer Science – CSD
  - Ph.D. in Computer Science (Algorithms, Combinatorics, and Optimization) - CSD & Math & GSIA
  - Ph.D. in Computer Science (Neural Basis of Cognition) - CSD & CNBC
  - Ph.D. in Computer Science (Pure and Applied Logic) - CSD & Math & Phil
- Ph.D. in Human-Computer Interaction – HCII
- Ph.D. in Language and Information Technologies – LTI
- Ph.D. in Robotics – Robo
  - Ph.D. in Robotics (Neural Basis of Cognition) - Robo & CNBC
  - M.D./Ph.D. in Robotics - Robo & Pitt
- Ph.D. in Software Engineering – ISRI

- Interdisciplinary Ph.D. Program (self-defined) – SCS

Research Paradigms in CSD

- Theory
  - Formulate underlying principles
  - Create mathematical basis
  - The principle and its applicability is the end product
- System Building
  - Construct medium to large scale systems
  - Evaluate and measure
  - The artifact is the end product
- AI
  - Attempt to mimic human thought process
  - Display of intelligence is the end product
- Crosscutting research and projects

Your Research Career at CMU

We support many different styles according to student, advisor, and research area.

- Initial
  - Actively participate in research right from beginning
  - Often part of multi-student project
- Transition
  - Develop own ideas and research agenda
  - Write papers, attend conferences, etc.
- Thesis
  - PhD proposal (typically in 4th year)
  - Research (usually ~2 years)
  - Defense: Present to committee & public

Interdisciplinary Work

- Value
  - Push frontiers by seeking new problems and finding new approaches to old problems
- Traditional strength for all of Carnegie Mellon
  - History of expanding boundaries of computer science through interdisciplinary collaboration
    - robotics, psychology, language technology, data mining, …
  - Environment where people with different backgrounds work together

Collaboration: How We Encourage It

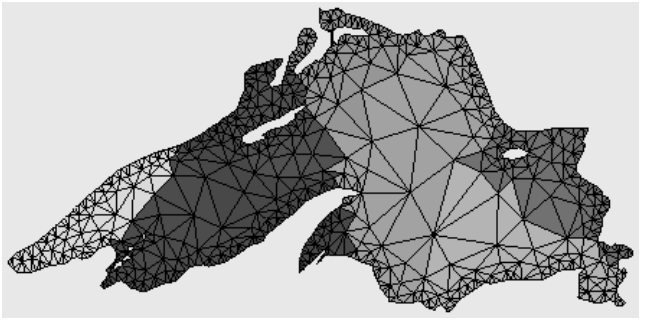
- Mixing office space: among student/faculty & among disciplines
- ~25% of students have joint advisors
- Advising by faculty from other parts of university
  - Rest of SCS
  - ECE, Biology, …
- Attitudes
  - Willingness to share credit with others
  - Respect for ideas of others

Example

- In 1999/2000 I advised 4 graduating Ph.D. students
  - Roberto Virga, Department of Mathematics
    - Postdoc at Princeton, now back in Italy
  - Carsten Schürmann, Department of Computer Science
    - Assistant Professor, Yale, moving to ITU Copenhagen
  - Alberto Momigliano, Department of Philosophy
    - Research Fellow, University of Edinburgh
  - Gerald Penn, Language Technologies Institute
    - Assistant Professor, University of Toronto
    - Winner of E.W.Beth Dissertation Award in Computational Linguistics
- 3 Schools (SCS, MCS, H&SS), 4 Departments

Profile #1: Jonathan Shewchuk

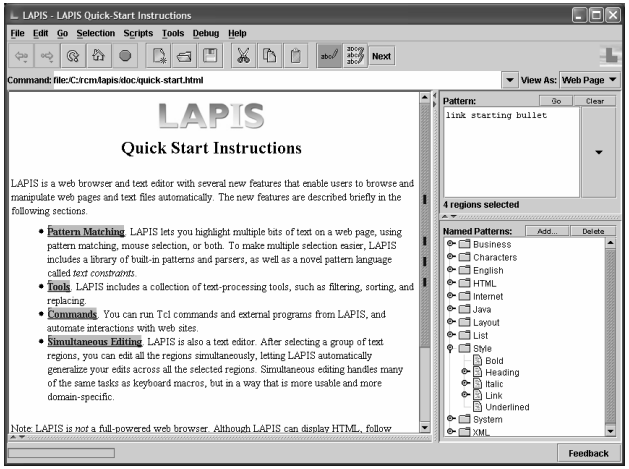
- Life History
  - B.Sc. in Physics and CS 1990, Simon Fraser
  - Ph.D. 1997, CMU
  - Now on faculty at Berkeley
- Research
  - Efficient generation of high-quality meshes
    - Sophisticated algorithms
    - Hard to get all of the details right
  - Triangle Program
    - In regular use worldwide



- Collaboration
  - Algorithms: Gary Miller
  - Systems: Dave O'Hallaron
  - Application: Ground modeling project in Civil Engineering

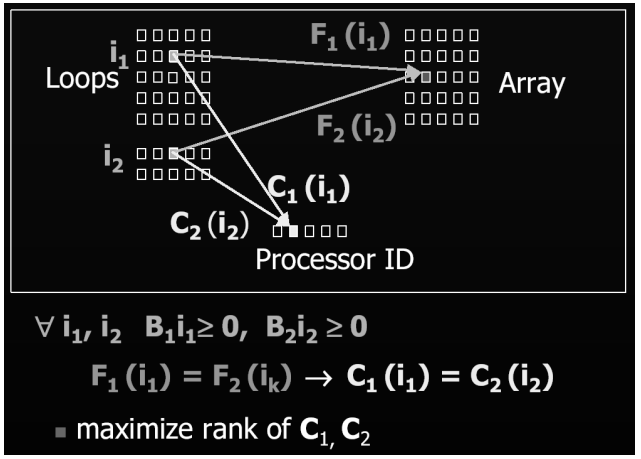
Profile #2: Rob Miller

- Life History
  - S.B. and M.Eng 1995, MIT
  - Ph.D. 2002, CMU
  - Now on faculty at MIT
- Research
  - Combines programmable architectures, machine learning, and effective visualizations and interaction techniques to produce powerful, usable user interfaces
- Research Style
  - Produce new style of user interface
  - Evaluate with user studies



Profile #3: Monica Lam

- Life History
  - B.S. Univ. of British Columbia, 1980
  - CMU PhD, 1987
  - Now Full Professor at Stanford
- Research
  - Compiler infrastructure for locality optimizations and interprocedural parallelization
  - Program analysis for finding bugs
- Research Style
  - Compilation techniques for improving the performance and reliability of programs



Living in Pittsburgh

- Big enough to be interesting
- Small enough to be livable

Lifestyle Issues

- Housing
  - Affordable housing within walking (and DSL) distance
    - Shadyside, Squirrel Hill
  - Some graduate students buy their own houses
- Things to Do
  - Interesting restaurants, places to go
    - Shadyside, Strip District, South Side
  - Good cultural activities
    - Museums, Symphony, Renaissance & Baroque, Dance
  - Easy reach of outdoor recreation
    - Biking, hiking, skiing, white water
- Advice
  - Talk to current students. You'll find they like the academic and social environment

Why You Should Get a Ph.D. at CMU

- Breadth of opportunities
  - Interpret "Computer Science" in the broadest terms
  - World class research in many disciplines
- Unique environment
  - Close student/advisor relationship
  - Collaboration and breadth are encouraged
  - Funding issues are not a concern for students

Distinguishing Characteristic of Our Environment

- Reasonable Person Principle
  - Assume that others around you are competent and reasonable
    - Smart
    - Ethical
    - Concerned for welfare of others and of organization
  - You are obligated to be reasonable as well

Some Questions You Should Ask

- Programmatic
  - What steps must I take before I qualify as a Ph.D. student?
- Financial
  - What happens when my first-year fellowship runs out?
  - What happens if my advisor's research contract gets cancelled?
- Research
  - How often do advisors typically meet with students?
  - What is the student/advisor ratio?
  - Is it common to work with students from different areas and having different advisors?

Resources: Reading Material

- The Ph.D. Document
- The Faculty Research Guide
- Web pages
  - SCS *http://www.cs.cmu.edu/scs/scs.html*
  - CSD *http://www.cs.cmu.edu/csd/csd.html*
  - PhD *http://www.cs.cmu.edu/csd/phd.html*

Resources: People

- Sharon Burks
  - Associate Department Head
  - sharon.burks@cs.cmu.edu
- Frank Pfenning
  - Director of Graduate Programs, CSD
  - fp@cs.cmu.edu
- Jeannette Wing
  - Department Head, CSD
  - wing@cs.cmu.edu
- Randy Bryant
  - Dean, SCS
  - randy.bryant@cs.cmu.edu
- Martha Clarke
  - Graduate Admissions
- All students and other faculty and staff