

# Multidisciplinary Computing Research and Education

Jim Foley

College of Computing  
Georgia Institute of Technology

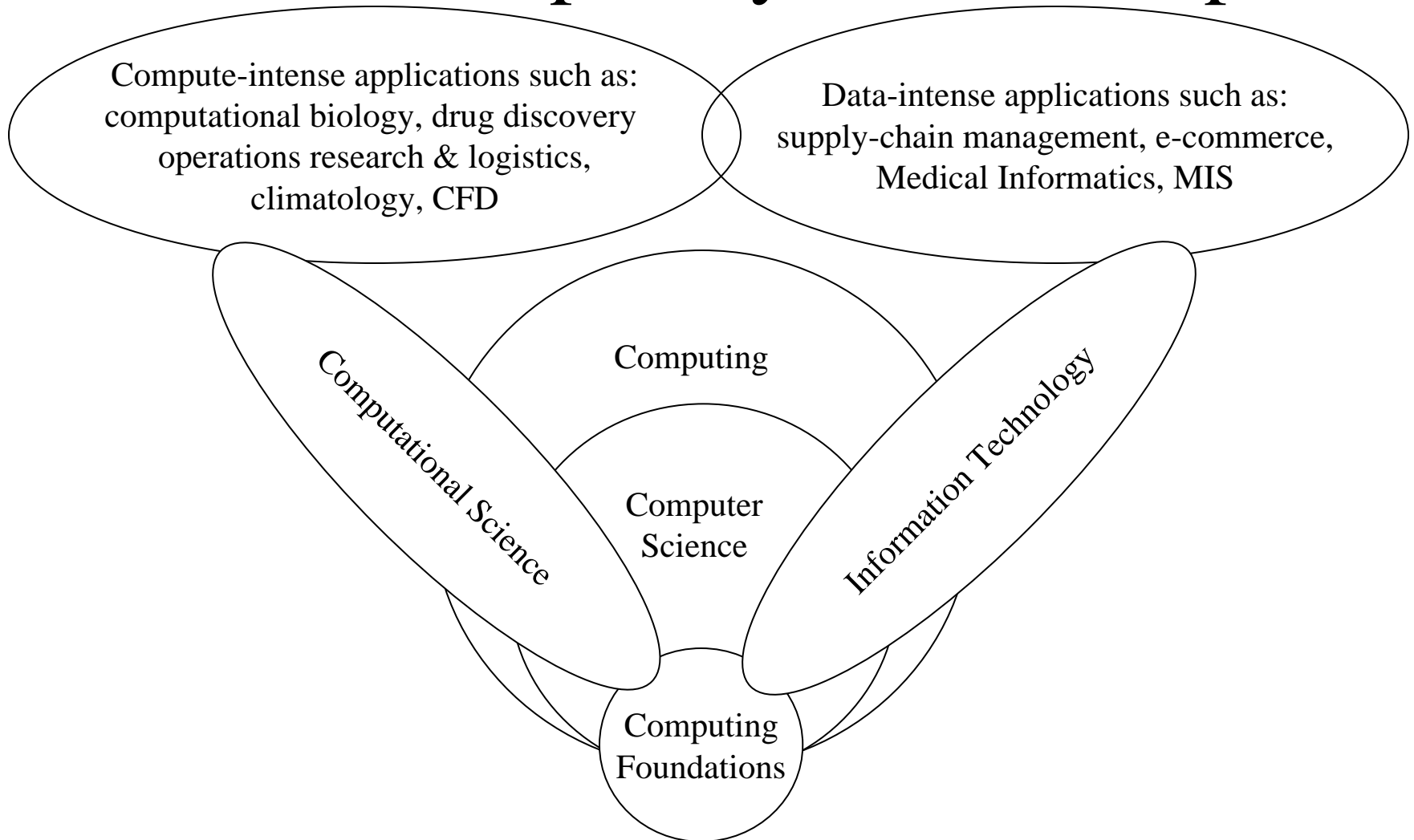
# Talk Outline

- Articulate a View of Interdisciplinary Relationships
- What is Interdisciplinary computing research?
- Use-motivated research - often interdisciplinary
- Re-thinking what we teach
- Evaluating interdisciplinary faculty
- Ways to get started
- Case studies in getting started
  - Georgia Tech Human-Centered Computing PhD
  - Georgia Tech HCI MS degree
  - Georgia Tech GVU Center

# Articulate a View of Interdisciplinary Relationships

- Provides high-level view of relationships
- Following example is one instance, there are many others
- Helps communicate with others

# A Computing-Centric View of Some Interdisciplinary Relationships



# Interdisciplinary Research

Contribution of Discipline X

Apply known knowledge      Develop & apply new knowledge

Computing in the service of discipline X	True interdisciplinary research
Routine application of current knowledge	Discipline X in the service of computing research

Apply known knowledge

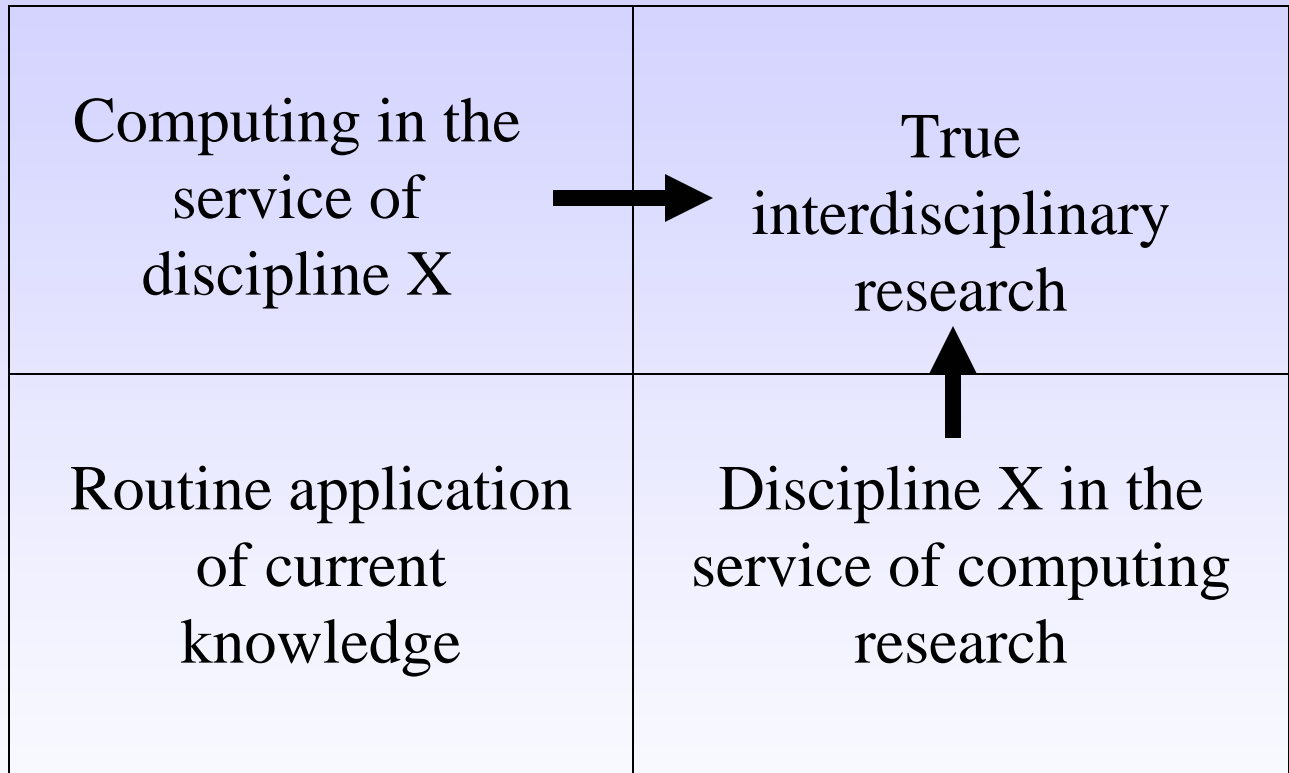
Develop & apply new knowledge

Contribution of Computing

# May Start Interdisciplinary Research “In the Service of” to get started

Contribution of Discipline X

Apply known knowledge  
Develop & apply new knowledge



Apply known knowledge

Develop & apply new knowledge

Contribution of Computing

# Fred Brooks The Computer Scientist as Toolsmith

Excellent  
discussion of the  
pragmatics and  
joy of  
interdisciplinary  
research

Frederick P. Brooks, Jr.

*Fred Brooks is the first recipient of the **ACM Allen Newell Award**—an honor to be presented annually to an individual whose career contributions have bridged computer science and other disciplines. Brooks was honored for a breadth of career contributions within computer science and engineering and his interdisciplinary contributions to visualization methods for biochemistry. Here, we present his acceptance lecture delivered at SIGGRAPH 94.*

## *The Computer Scientist as* **Toolsmith II**

**I**t is a special honor to receive an award named for Allen Newell. Allen was one of the fathers of computer science. He was especially important as a visionary and a leader in developing artificial intelligence (AI) as a subdiscipline, and in enunciating a vision for it.

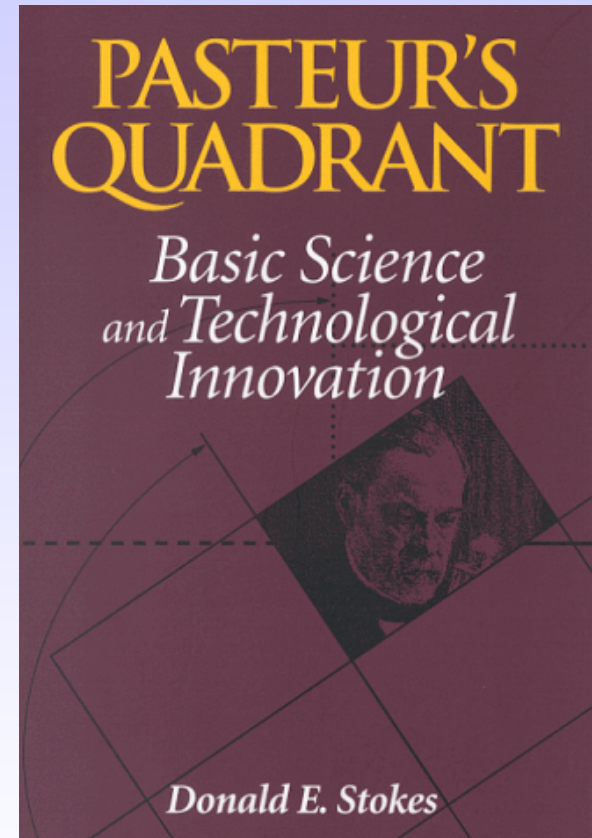
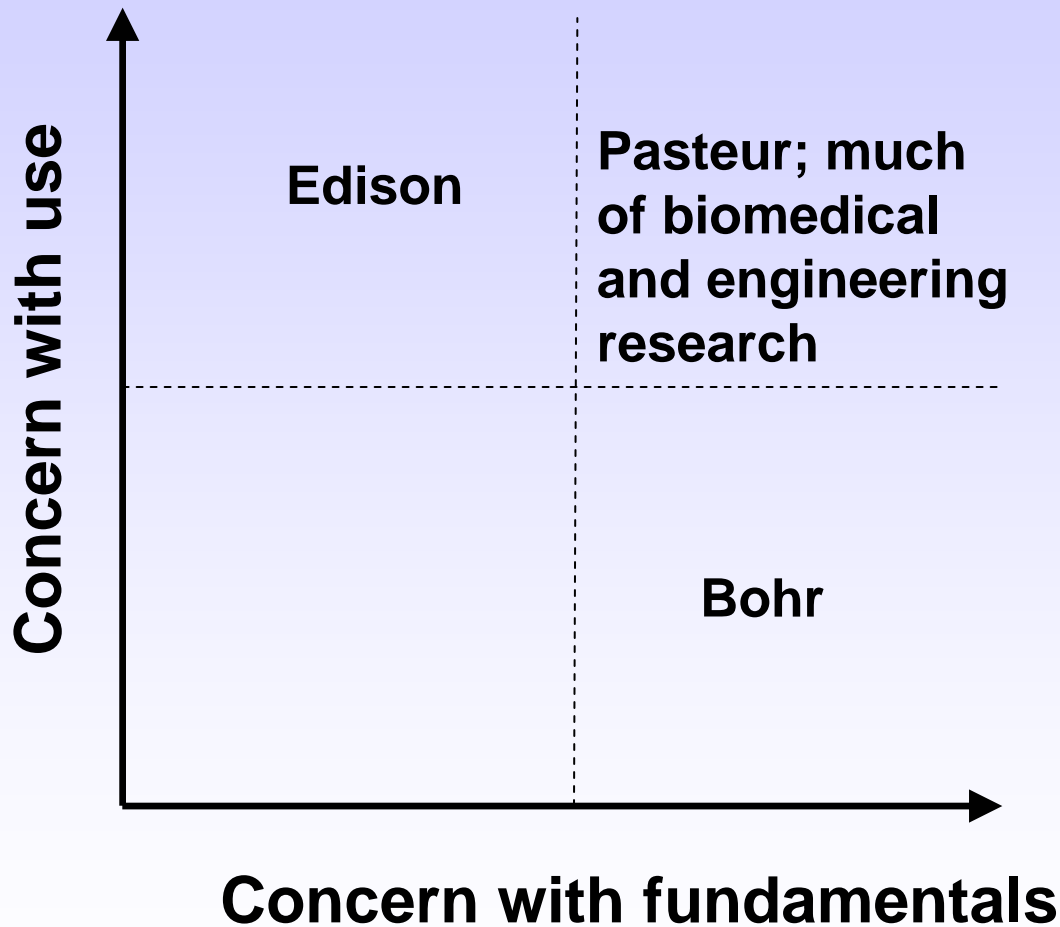
What a man *is* is more important than what he does professionally, however, and it is Allen's hum-

computer science. Another view of computer science sees it as a discipline focused on problem-solving systems, and in this view computer graphics is very near the center of the discipline.

### **A Discipline Misnamed**

When our discipline was newborn, there was the usual perplexity as to its proper name. We at Chapel Hill, following, I believe, Allen Newell and Herb

# Basic Research and Application-motivated Research are Compatible





# Rethinking What We Teach

- Connect computing with X
- X = people, biology, science, business, etc.
- Two of the PITAC topics do this
  - Health and IT, Computational Science
- Computing and IT  $\supset$  Computer Science
- “Customer Facing” knowledge and skills
- Dual Degree programs
- Computing minors for other majors
- Computing Literacy for all students

# Some Ways to Get Started

- Centers
- Joint degree programs

↓↓↓↓ lead to

- Departments/schools

# Evaluating Interdisciplinary Faculty

- Agree up front on criteria
- Agree up front on letter writers
- Agree up front on role of majority & minority “owners”
  - Georgia Tech model
    - No 50-50 appointments for junior faculty
    - Majority “owner” calls the shots
      - Minority dept sits on review committee of majority dept
    - Minority “owner” can relinquish their share without prejudice
      - Minority salary transferred to majority “owner”

# Case Studies from Georgia Tech

- HCI MS degree
- Human-Centered Computing PhD
- GVU Center

# Case Study – HCI MS Degree

- Jointly offered by College of Computing, Psychology, and Literature Communications and Culture
- Administered by GVU Center
- Students enter via one of three sponsoring depts
- Common set of core courses and project course
- Other courses within admitting department
- About 30 students per year, highly competitive, more women and minorities than in CS MS

# Case Study – HCC: The science of designing computational artifacts in support of human endeavors

## Human Concerns

Psychology  
 Human Factors  
 Perception  
 Cognitive Science  
 Learning Sciences  
 Graphic Design  
 Industrial Design  
 Sociology  
 Anthropology  
 Ethnography  
 Cultural, Social and Historical Studies  
 Political Science  
 Organizational Behavior  
 Sociology  
 Media and New Media Studies  
 Linguistics

## Human & Computing Concerns

CSCW & CSCL  
 LST  
 Human-Computer Interaction  
 Human-Robot Interaction  
 Ubicomp & Wearables  
 Software Engineering  
 Programming Language Design  
 Study of Programming and Debugging Process  
 API Design  
 Command Language Design  
 Visualization  
 Diagrammatic Representations of Processes and Activities  
 Societal Effects/impact  
 Organizational Effects  
 Individual Impact  
 Security Issues

## Computing Concerns

CS Theory  
 Algorithms  
 IS/AI  
 Systems  
 Architecture  
 InfoSec  
 Data Bases  
 Graphics  
 Networking  
 Programming Languages  
 Robotics  
 Computational Perception

# Incoming Students

- Diverse backgrounds
  - BS-CS, BA-CS
  - Cognitive Science
  - Psychology
  - Media studies
  - ISyE
  - Sociology
  - Industrial Design
  - Some with MS, including GT MS-HCI
- Diversity in gender and age
- Entry Criteria
  - Demonstrate excellence in a relevant discipline
  - Written statement – their HCC vision
  - Strong verbal/written communications skills
  - GREs / GPA comparable to CS PhD students

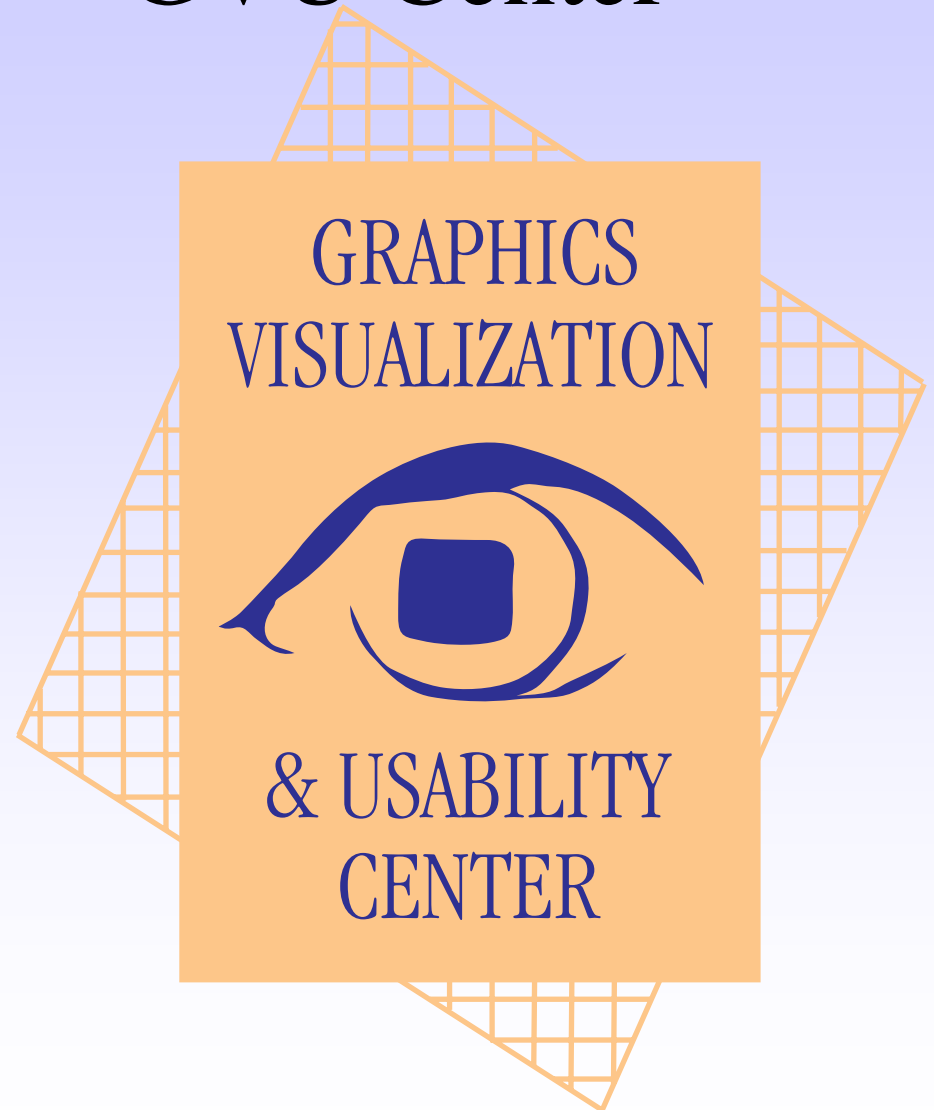
# Program of Study

- Three required courses
  - HCC Theory and Methods
  - Prototyping Interactive Systems
  - HCC Issues: Critical Analysis
- HCC seminars
- Three HCC Specialization courses
  - Such as HCI, LST, CogSci, AI, Soft Engr, InfoSec, Visualization
  - Focus on dissertation topic, but with some breadth
- Three minor courses
- Demonstrate four competencies
- Qualifying exam
  - Committee formed early, approves courses, tests competencies
- Research proposal
- Defense of research
  
- Note - awaiting final approval from Board of Regents



# Case Study – GVU Center

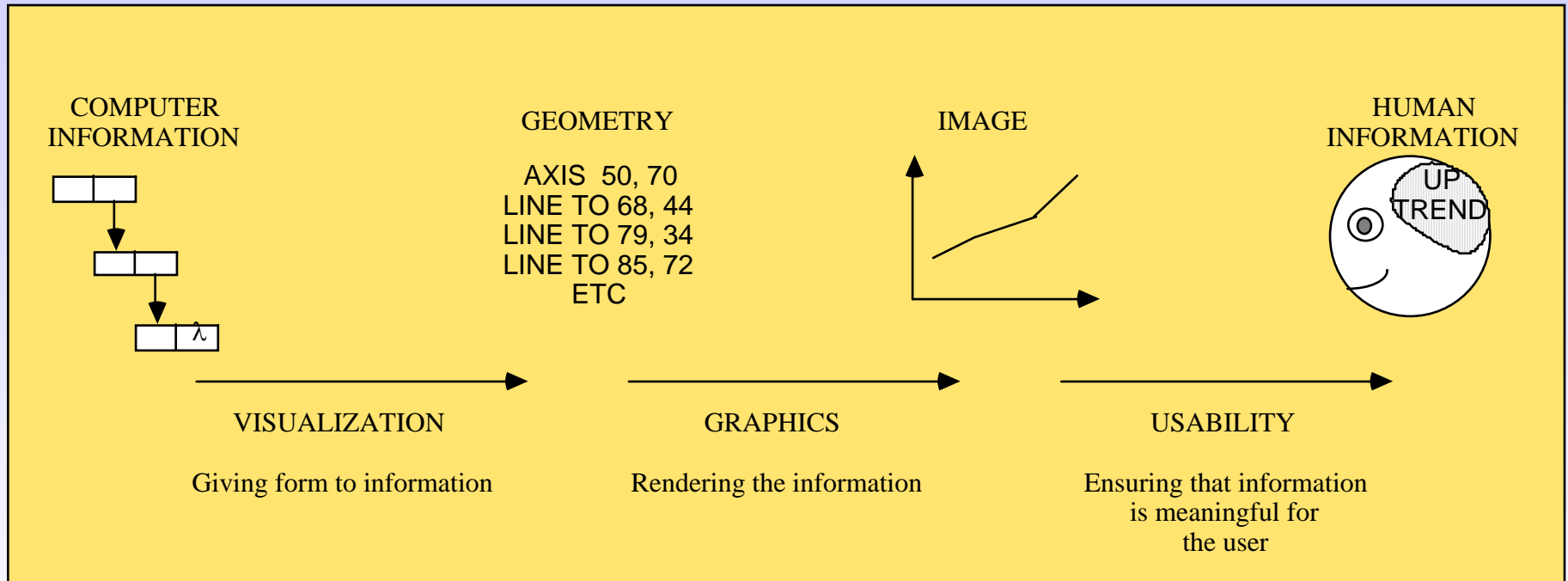
- Interdisciplinary
- In the College of Computing – CoC
- CoC is one of six Colleges:
  - Architecture
  - Business
  - Computing
  - Engineering
  - Policy & Lib Arts
  - Science



# GVU Vision: People perform Tasks with Computers

- Goal is to empower people using computers for work, study, entertainment

# G and V and U Belong Together



This is the GVU articulation of interdisciplinary relationships

# The GVU Center

- Faculty and students from multiple schools and colleges:
  - Computing, Psychology, Literature,
  - Communications & Culture, Electrical & Computer
  - Engineering, Industrial & Systems Engineering
- Administratively housed in College of Computing
- Line-item budget from Georgia Tech via CoC
  - Director, Associate Directors, admin staff
- About 30 faculty, 100 students
- Some central shared facilities

# GVU Center

- Founded in 1991
- Ranked #1 by US News and World Report in 1996
- This did not just happen by chance

# What Led to Creation of GVU Center?

- Leadership
  - Georgia Tech President Crecine – vision for GT & for CoC
  - CoC Dean Freeman – vision, strong support, resources
  - CoC Faculty – belief in the vision
  - A Vision for GVU
- Faculty seeking leadership and excitement
- Resources
  - Dollars for equipment, programs, staff, lab renovations
  - Six faculty slots in CoC
  - Space - always scarce - to avoid “space wars”

# Strategies... What Makes It Work

- People
- Distributed management
- Interdisciplinary education
- Interdisciplinary research
- Shared resources
- Community building
- Intellectual stimulation
- Fun!

# GVU Distributed Management

- Director, multiple Associate Directors
  - Industrial relations, education, outreach, computing
- Quarterly faculty meetings
- Bi-weekly informal faculty lunches



# GVU Interdisciplinary Education

- Interdisciplinary PhD minors with certificate
  - Computing, Psych, IE
- Most PhD committees are interdisciplinary
- HCI MS degree
  - Admitted into one of participating departments AND into HCI program (CoC, LCC, Psych)
  - Degree requirements vary with enrolling department
  - Administered by GVU Center
- Coming - HCC Ph.D. degree in CoC

# GVU Interdisciplinary Education

- Students from different schools in the classroom
  - Computing and psychology for user interface design course
  - Computing and multimedia for VR storytelling course
  - Computing and graphic design for computer games course
- Professors from different schools in the classroom
  - Such as MacIntyre (CoC) and Bolter (LCC)

# GVU Interdisciplinary Research

- Encouraged by
  - One-year “seed grant” support for grad student working with professors from two different departments
  - The interdisciplinary courses
  - Regular interactions between all GVU faculty

# GVU Shared Equipment Resources

- Scientific Visualization Lab - Silicon Graphics
- Usability Lab
- Aware Home
- Video / Animation Lab
- VR Lab
- Teaching Lab - Silicon Graphics, Alias, ...

# GVU Shared Locations - The Aware Home

- A Living Lab for ubiquitous computing in the home
- *Aging in place* theme
- Cameras, microphones, pressure sensors, networking



# GVU Community-Building

- Weekly brown-bag lunches
- Monthly demo day
- Distinguished Lecture series
- Web pages (pull); Newsletter (push)
- Industrial Affiliates Program
- Annual research review day
- Annual video sampler and program booklet
- Annual picnic
- Annual graduate student awards