

Computers are Becoming a Necessary Extension of our Brain

- **Extend our cognitive capabilities:** Captures, stores, communicates and analyzes massive amounts of information
- **Extend our senses:** Increasingly mediates our interactions with the physical world and with other people
- **Change our perception of the world:** create new virtual worlds (simulation; games) that enhance or replace reality; abolish distances in time and space.
- **Create a new economy of intangibles:** much more than half of our GDP is in bits, not in tangible products and services (embedded software, finance, communication, entertainment, education...)

This is more significant than the industrial revolution that merely extended our physical capabilities

And it has just started



Computing & Information Science & Engineering

Order, Family or Genus?

Engineering

CE

SE

Science

CS

IS

X-Informatics

IT

Professional

MIS

LIS

X= astro, bio, business, chem, community, eco, geo, health, medical, social...

X= art, media, games



Some Views

- “Computer Science is no more about computers than astronomy is about telescopes” (Dijkstra)
- “Computer Science meets every criterion for being a science, but has a self-inflicted credibility problem.” (Denning)
- “Any discipline with 'science' in the name isn't.”



Closer to (Hyper)reality

- **Engineering:** The Science of Building Useful Stuff Using Science (i.e., applying Applied Science to applied technology)
- **Mathematics:** Physics of Hyperreality
- **Computer Science:** Engineering of Hyperreality
- **Computer Engineering:** Combination of the Engineering of Hyperreality (architecture, software, architecture-level hardware) with the Engineering of Reality (physical-level hardware).
- **Computer Programming:** Construction work to implement Computer Engineering.

Jonathan Quince



Engineering: Building a Better Mousetrap

Mousetrap
Engineering

How

- Catches more mice
- Cheaper to manufacture
- More robust
- Safer
- ...

Mousetrap
Science

Why

- Physics
- Biology



Engineering: A Modern View

Department
of Mousetrap
Science and
Engineering
(MSE)

Mousetrap
Science

Mousetrap
Engineering

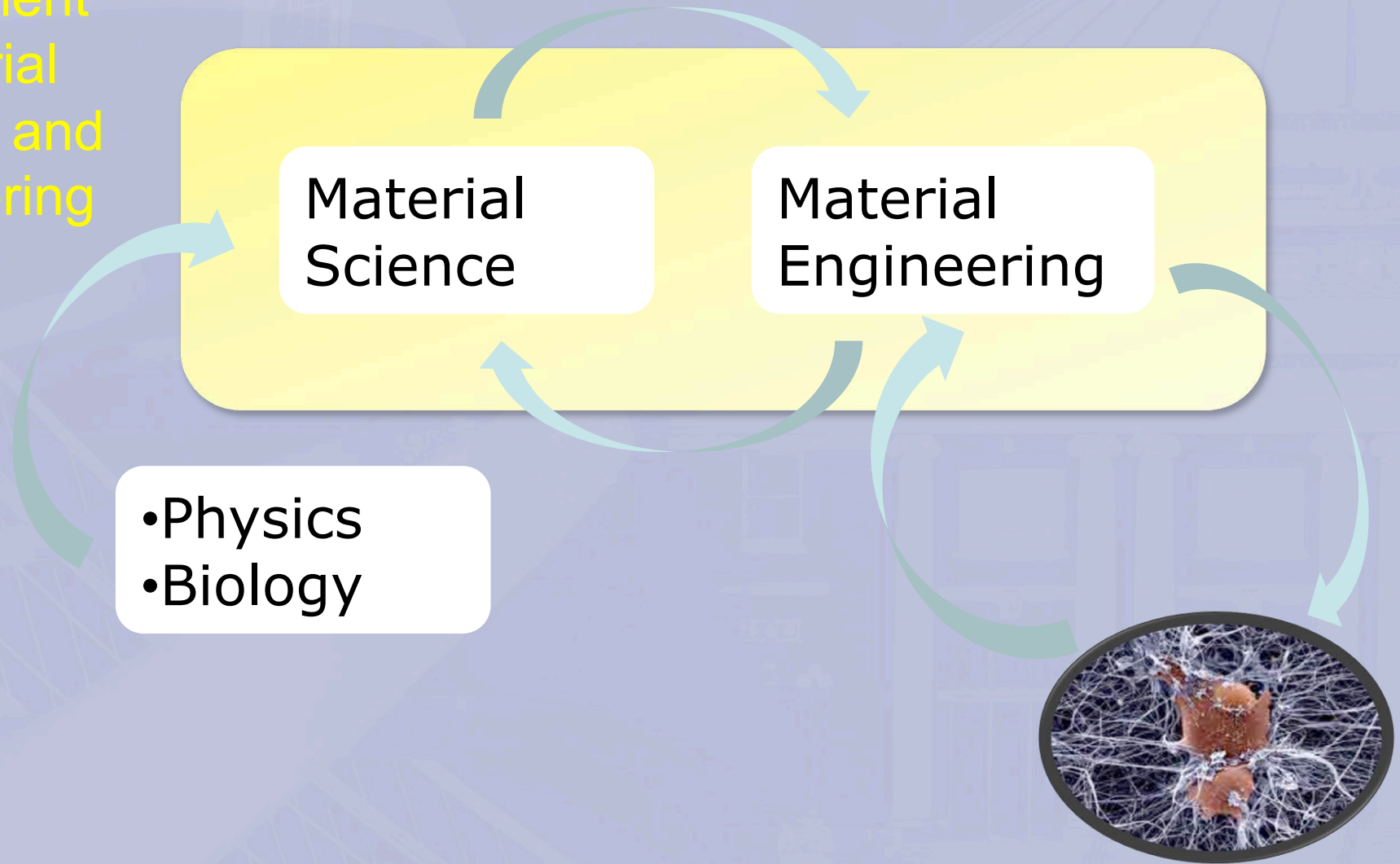
- Physics
- Biology

Foundational sciences:
Sources of constraints on
mousetrap design



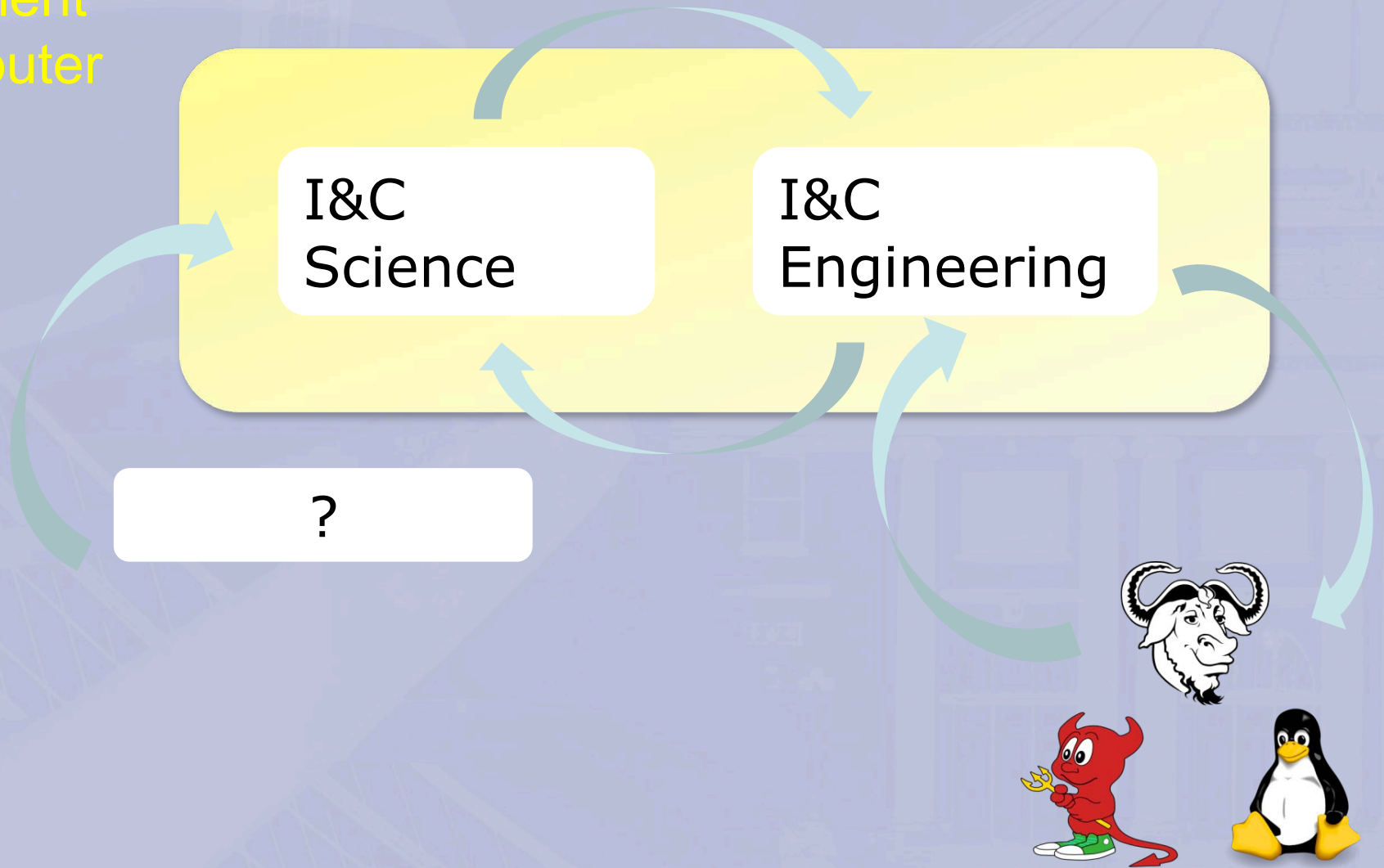
Engineering: A Modern View

Department
of Material
Science and
Engineering
(MSE)



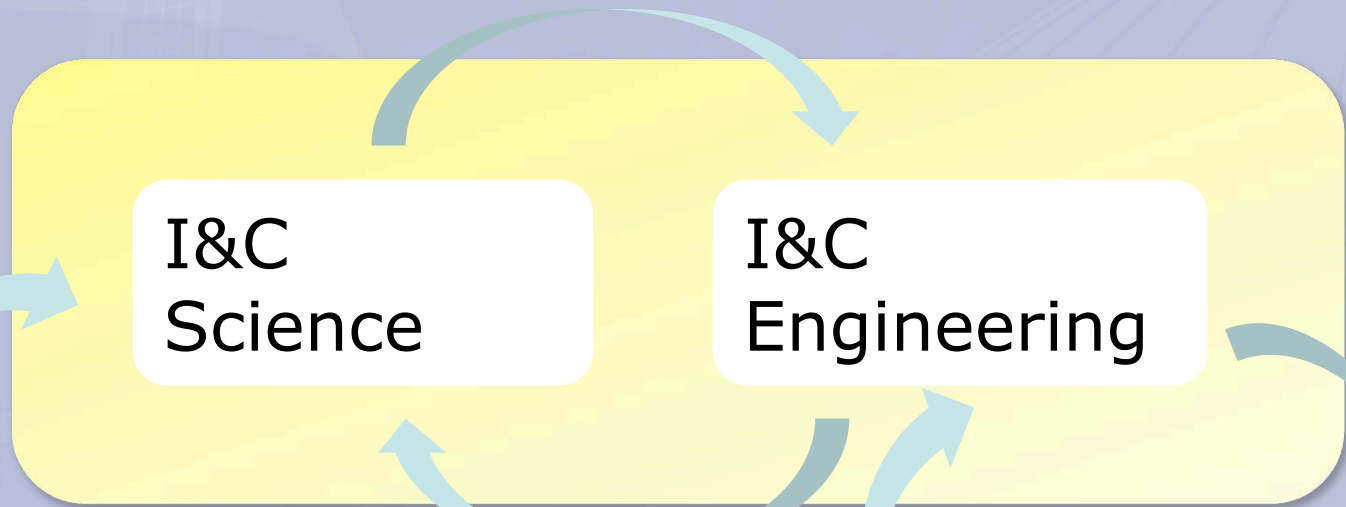
Information and Computation Engineering

Department
of Computer
Science



Information and Computation Engineering

Department of Computer Science is about building better sw widgets



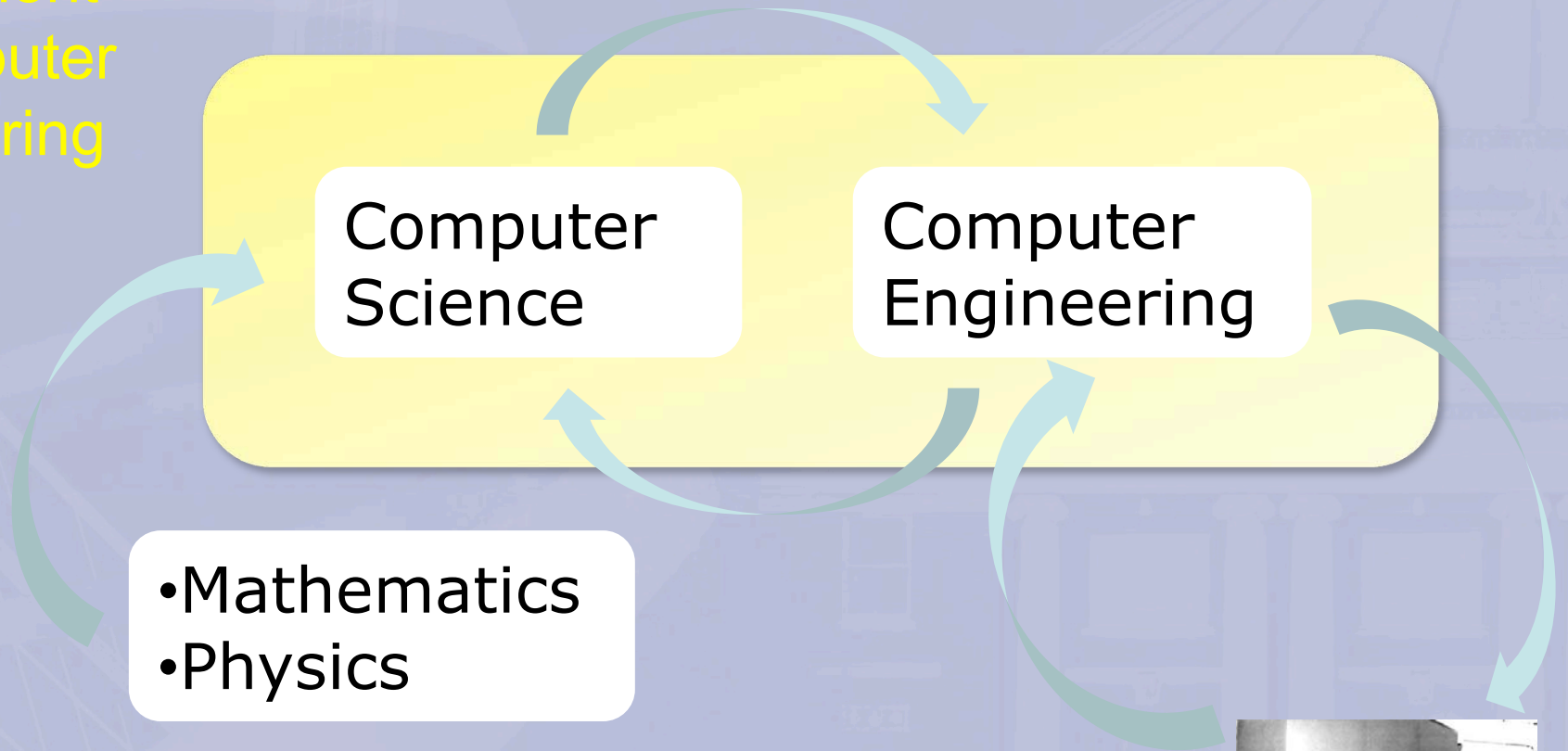
• Mathematics

- Software, algorithms or protocols are mathematical artifacts
- Time/space complexity are mathematical abstractions



“Classical” Computer Engineering

Department
of Computer
Engineering



“Modern” Computer Engineering

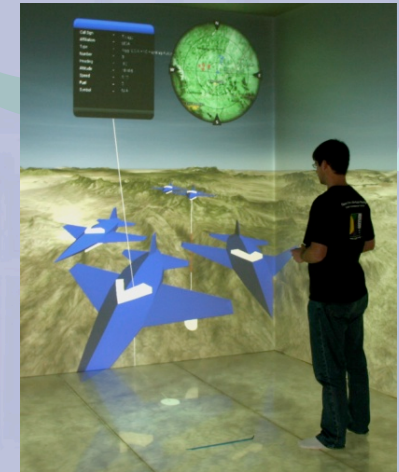
Department
of ??

Computer
Science

Computer
Engineering

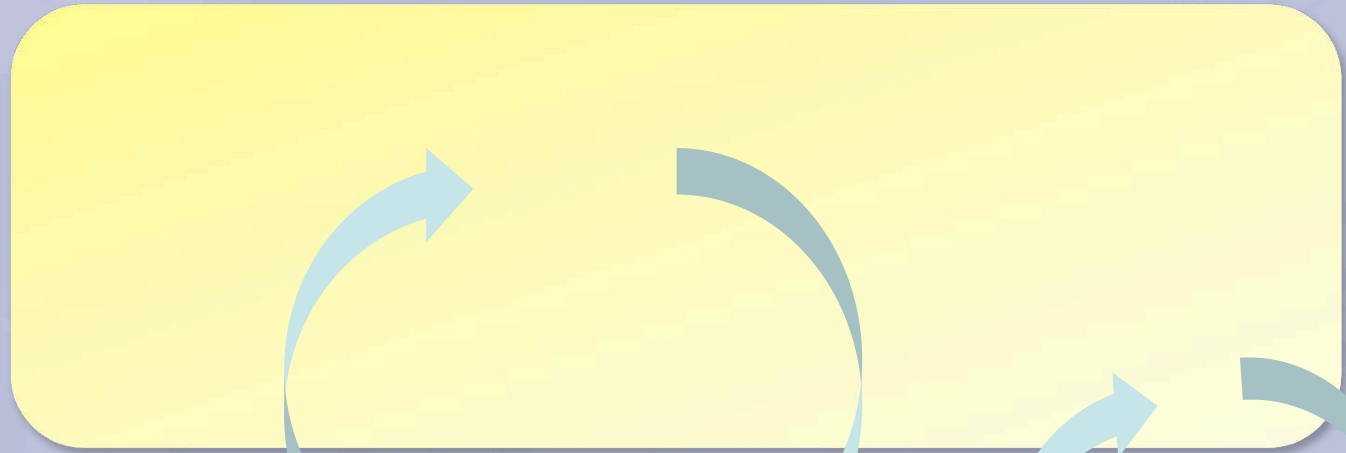
- Constraints come from human in the loop
- Many constraints are not mathematized

- Mathematics
- Social Sciences
Psychology,
Sociology,
Economics,
Law...



“Modern” Computer Engineering

Department
of ??



Constraints

- Mathematics
- Social Sciences

Application Domains

- Sciences
- Humanities
- Arts
- Business

•Products



Computer and Information Science and Engineering

- Engineering of mathematical artifacts that enhance our cognitive capabilities
- Constrained by
 - Mathematics
 - Constraints of the human in the loop
 - Needs of applications
- Quite different from “physics driven engineering”
 - We may not have right curricula and accreditation requirements
- Much more influenced by and influencing other disciplines (interdisciplinarity is us)



How Should CISE be Organized, Academically?

- CS+ECE – focus on “old” Computer Engineering
- “New” Computer Engineering School =
 - “Hard CS” – mathematized systems
 - “Soft CS” – human in the loop
 - Applied informatics – impact of applications
- This may still be too modest!
 - Overall responsibility for “computational thinking on campus education.
 - Engaging with islands of informatics research that appear in most departments



The Information World

- New flat, flexible, dynamic, reflexive, intelligent, distributed virtual organizations
- Free and open access to information
- Ambiguous relations between agents: competitor/partner, academic/commercial/artistic, teacher/student/partner
- “Pull”, not “push”
- **Will radically change the academic enterprise in the coming decades.**
 - IT is the main tool for improving the productivity of services
 - IT increases productivity when processes are changed
- CISE should be at the forefront of such change



Informatics

- **Informatics** studies the structure and behavior of systems that store, process and communicate information and develops the technologies needed to implement such artificial systems
- **Illinois Informatics Institute:**
 - Takes a broad view of informatics, to encompass all of CISE
 - *But does not aim to replace or constrain existing units*
 - Attempts to maintain strong interaction between research, education and technology services



I³ Mission

- Short-term mission:
 - Change research and education in computing and information science
 - Infuse computing and information science in the research and education of all units on campus
 - Pilot a new type of organization on campus
- Mid-term mission:
 - Change the University
- Long-term mission
 - Change the world



Dimensions

- *Intellectual Scope:* broad definition of informatics
- *Culture:* The boundary breaking Internet culture
- *Cultural impact:* aims at infecting departments with the Internet culture
- *Short term research and education scope:* see next
- *Infrastructure:* virtual organization “without walls”, and with no faculty lines (can move fast and can afford to fail)
- *Organization:* participation is voluntary

Model is unique and distinct from emerging schools of information – will test our ability to work across boundaries; if successful, will have broader impact



Current Education Scope

- Undergraduate informatics minor
 - started in Spring
 - 3 core courses + 3 electives (tracks)
- Interdisciplinary informatics majors
 - Work in progress
- Doctoral informatics program
 - proposal to be submitted in the fall
- Bioinformatics graduate program
 - working on the coordination/integration of existing programs



Initial Research Scope

- CHASS: Computing in the humanities, arts and social science
- CII: Community Informatics Initiative
- Medical informatics
- **Initiator, incubator, catalyst for new research initiatives in informatics**
- **Development and promotion of better informatics tools to help campus work (Faculty help thyself)**
 - **Closed loop of developer, user, evaluator**
- **Study of I³ as a new organization model**



Organization and Resources

- Director reporting to Provost
- Small administrative and technical cadre
 - Working on better leverage of existing resources
- Steering, advising, education committees
- Affiliated faculty
- Startup funding to cover operations, limited amount of research funding and cluster hires



Summary

- IT is changing the world
- CISE researchers should be at the forefront of this change
- This is not only (not mainly) an about what we teach and research, but also about how we teach and research and how we organize to do so



Thank You!

