



Illinois Informatics Institute
Invent Imagine Innovate

Computer & Information Science & Engineering – What's All This?

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www.informatics.uiuc.edu

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:** most investment is in intangibles; IP has become main “means of production”; you may not believe it, but world consumes less oil per unit of product.

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

And it has just started: it will be done when “brain-thought” becomes as quaint as “hand-made”



Computing & Information Science & Engineering

Order, Family or Genus?

Engineering

CE

SE

Science

CS

IS

IT

Professional

MIS

LIS

X-Informatics

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.”

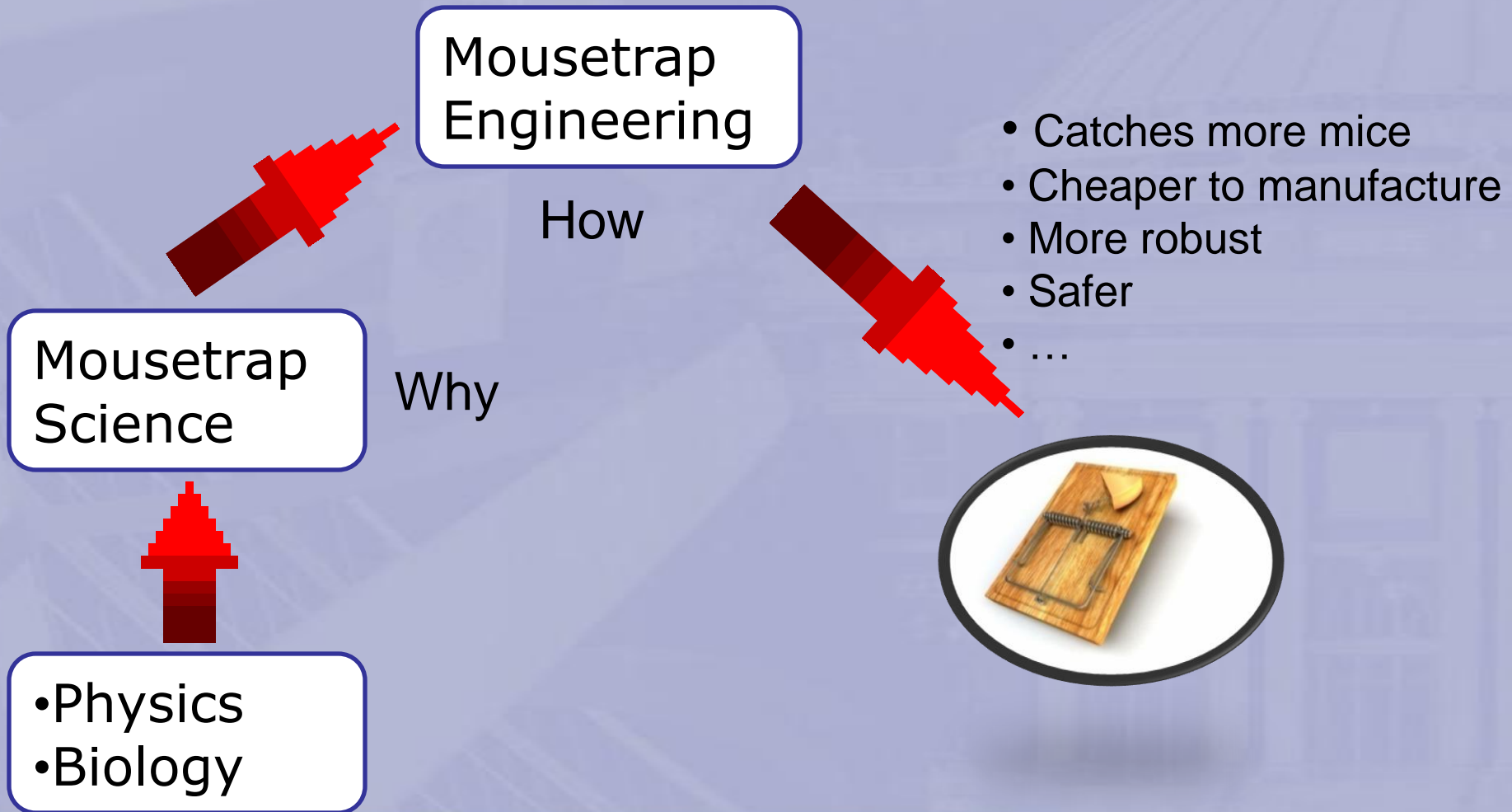
Closer to (Hyper)reality

- **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

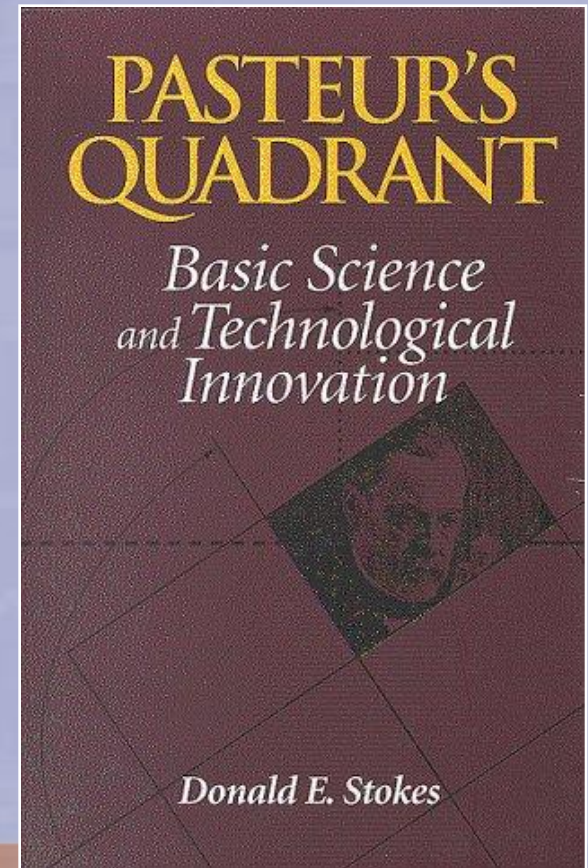
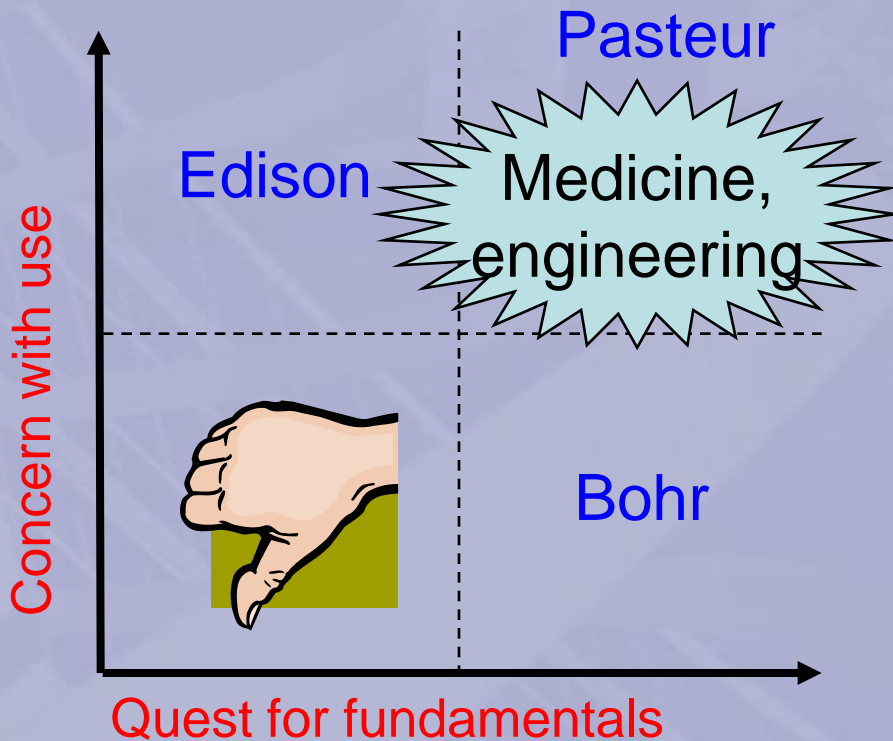


Engineering: Building a Better Mousetrap



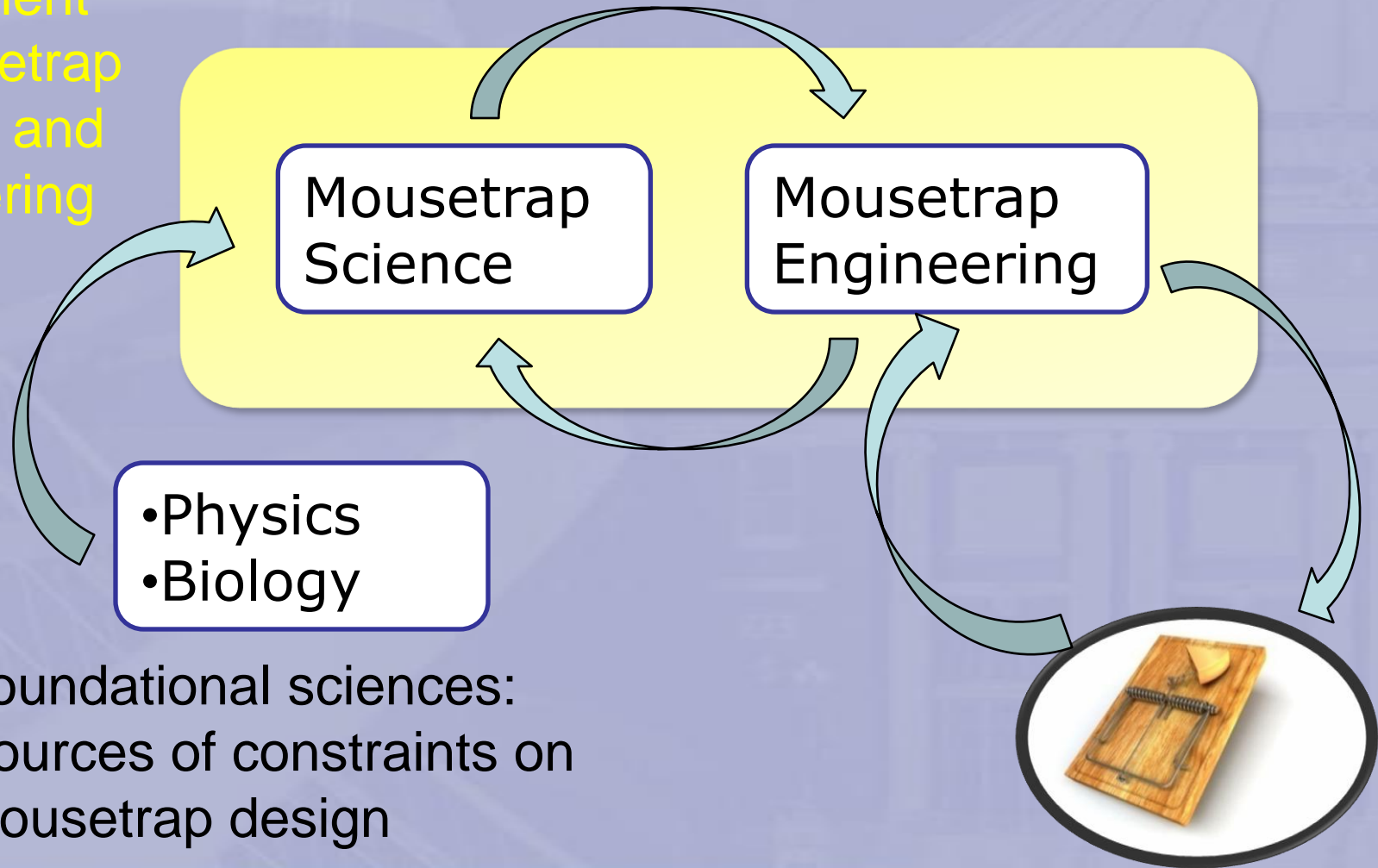
What is Engineering Research?

Alternative View



Engineering: A Modern View

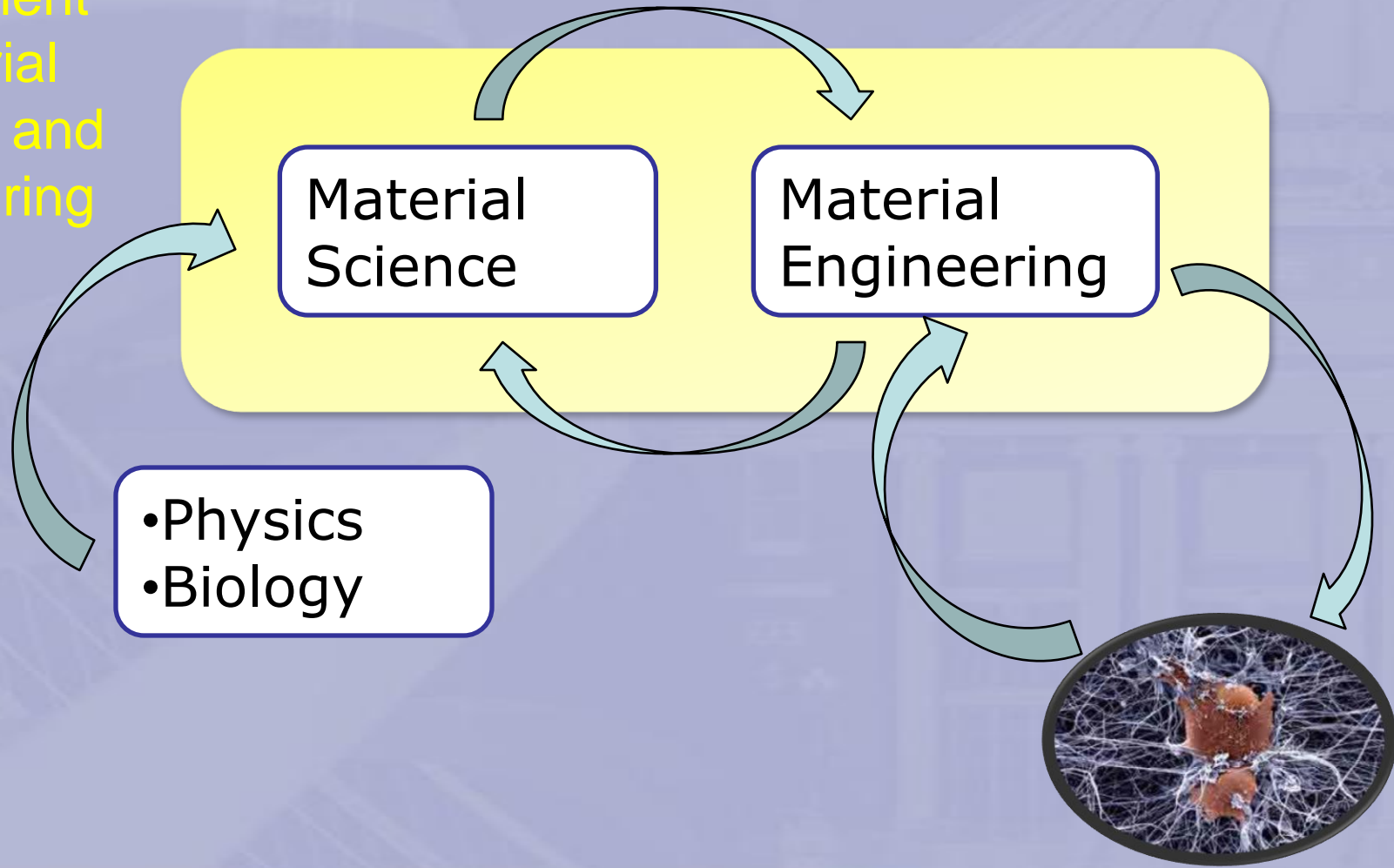
Department
of Mousetrap
Science and
Engineering
(MSE)



Foundational sciences:
Sources of constraints on
mousetrap design

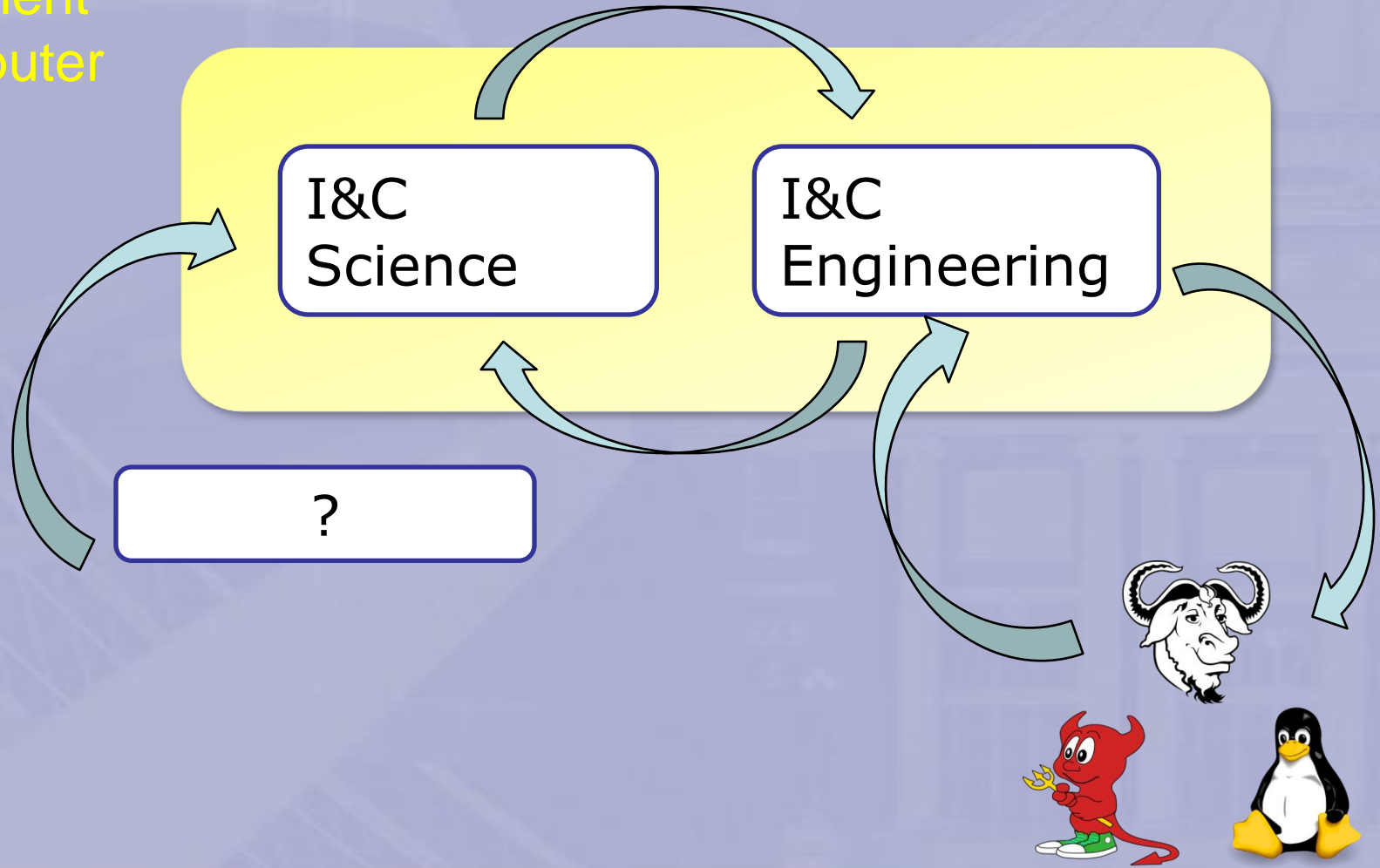
Engineering: A Modern View

Department
of Material
Science and
Engineering
(MSE)



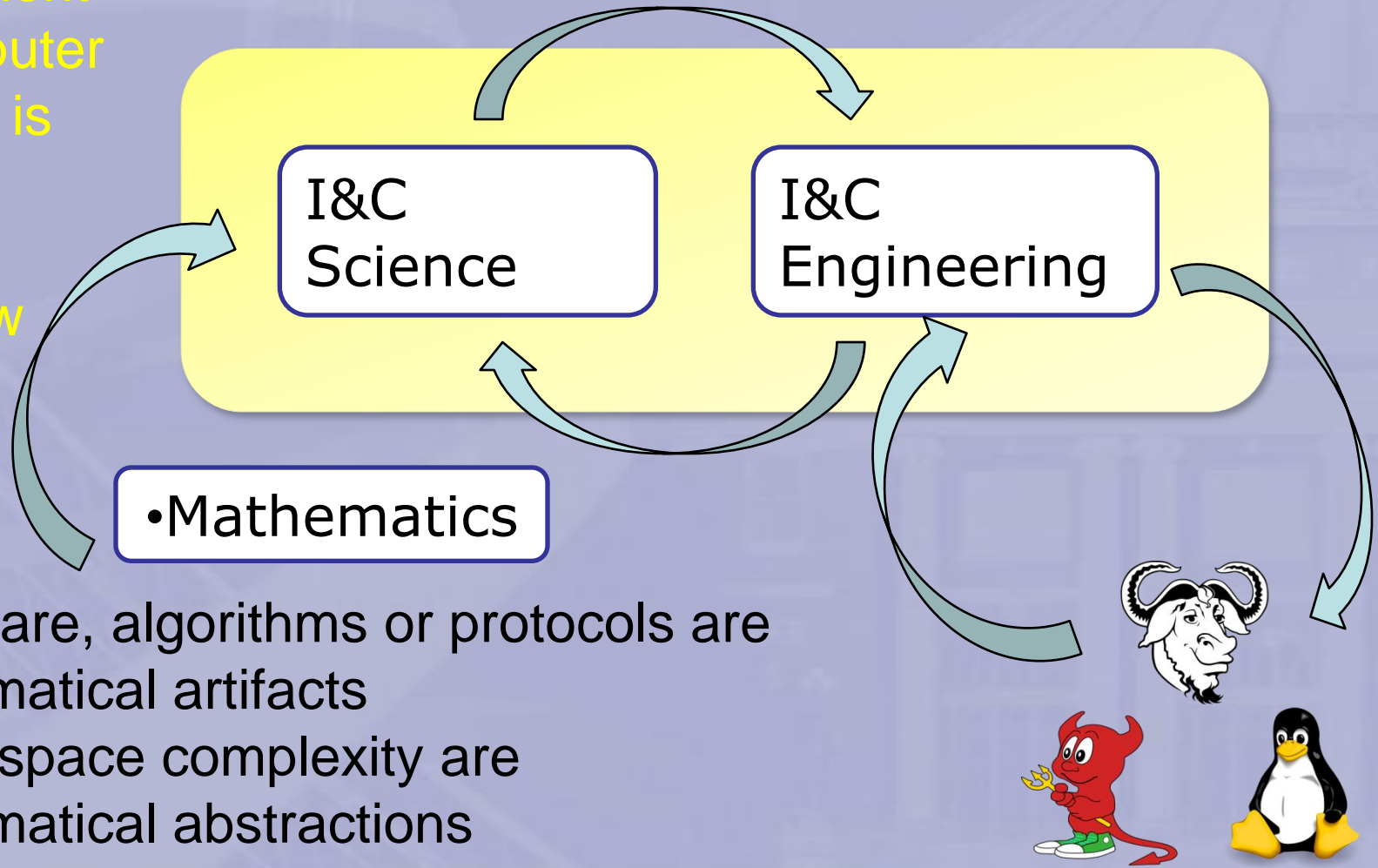
Information and Computation Engineering

Department
of Computer
Science



Information and Computation Engineering

Department of Computer Science is about building better sw widgets



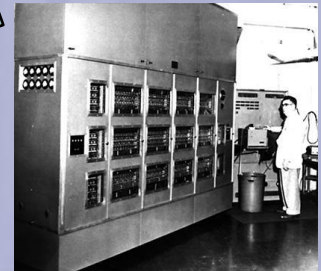
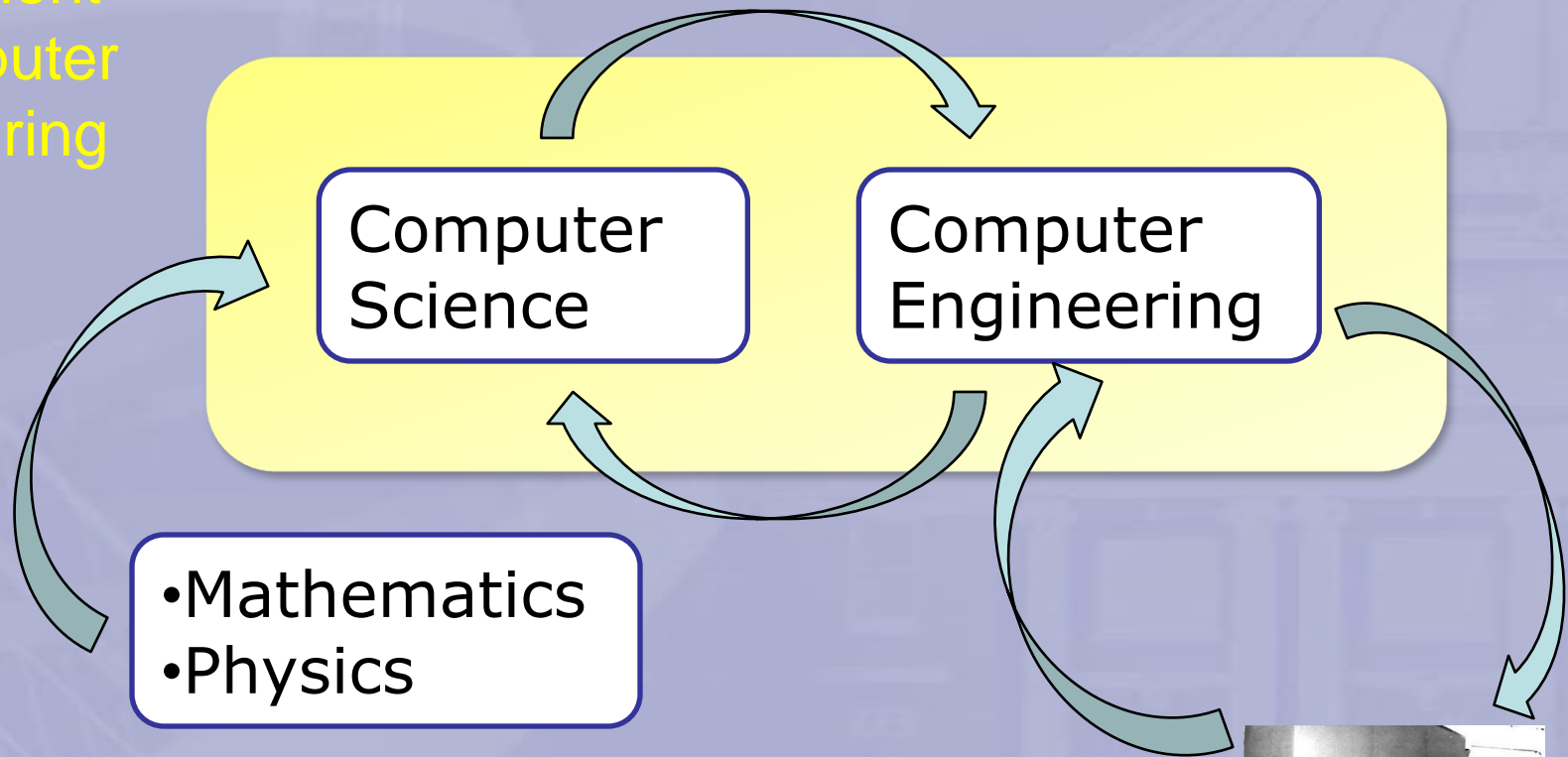
•Mathematics

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



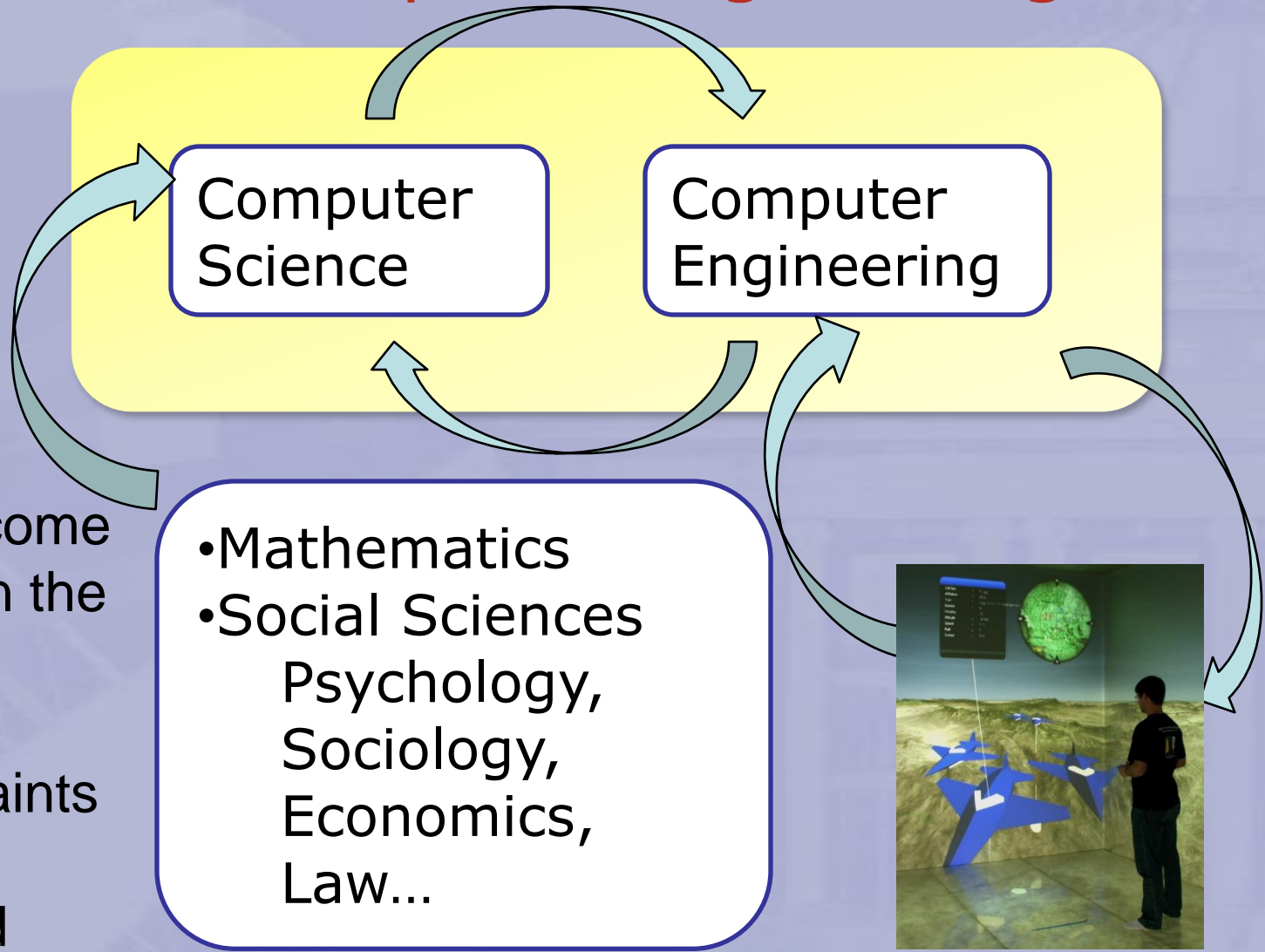
“Classical” Computer Engineering

Department
of Computer
Engineering



“Modern” Computer Engineering

Department
of ??



- Constraints come from human in the loop (user, programmer)
- Many constraints are not mathematized



“Modern” Computer Engineering

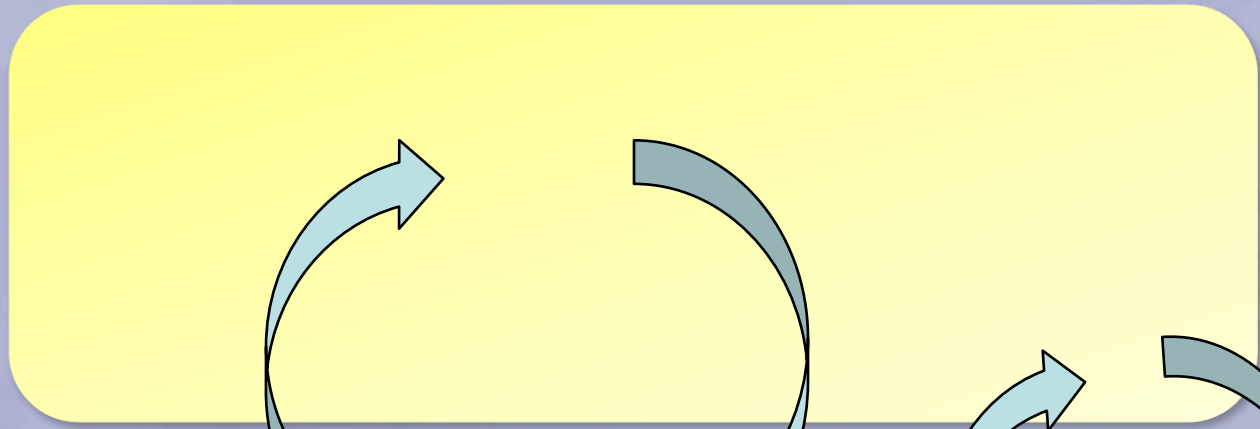
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of ??



Constraints

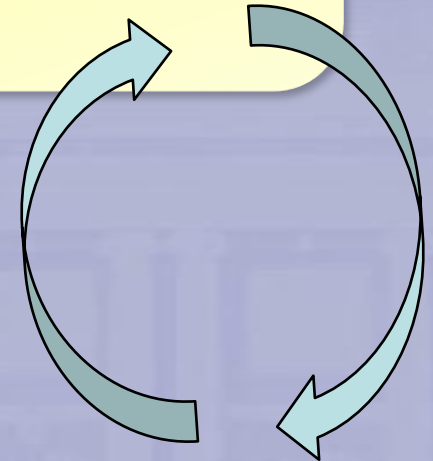
- Mathematics
- Social Sciences

CS is malleable –
Affected by apps



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”
 - Strong background in social sciences needed for HCI, social computing, software engineering...
 - Background in application area needed for applied informatics

How Should CISE be Organized, Academically?

- CS+ECE – focus of “old” CSE Department
- “New” Computer & Information School:
 - “Hard CS” – mathematized systems (CSE)
 - “Soft CS” – human in the loop (CS+Social Sciences)
 - *May require qualitative science*
 - IS – data organization and retrieval
 - Applied informatics – impact of applications

First Approach:

- “Natural” clusters



SOCIAL COMPUTING

**LIFE-SCIENCES
INFORMATICS**

**COMPUTATIONAL
INFORMATICS**

COMPUTER SCIENCE

**COMPUTER
ENGINEERING**

society

users

interfaces

data analysis

applications

**life-sciences
applications**

services

**operating
systems**

networks

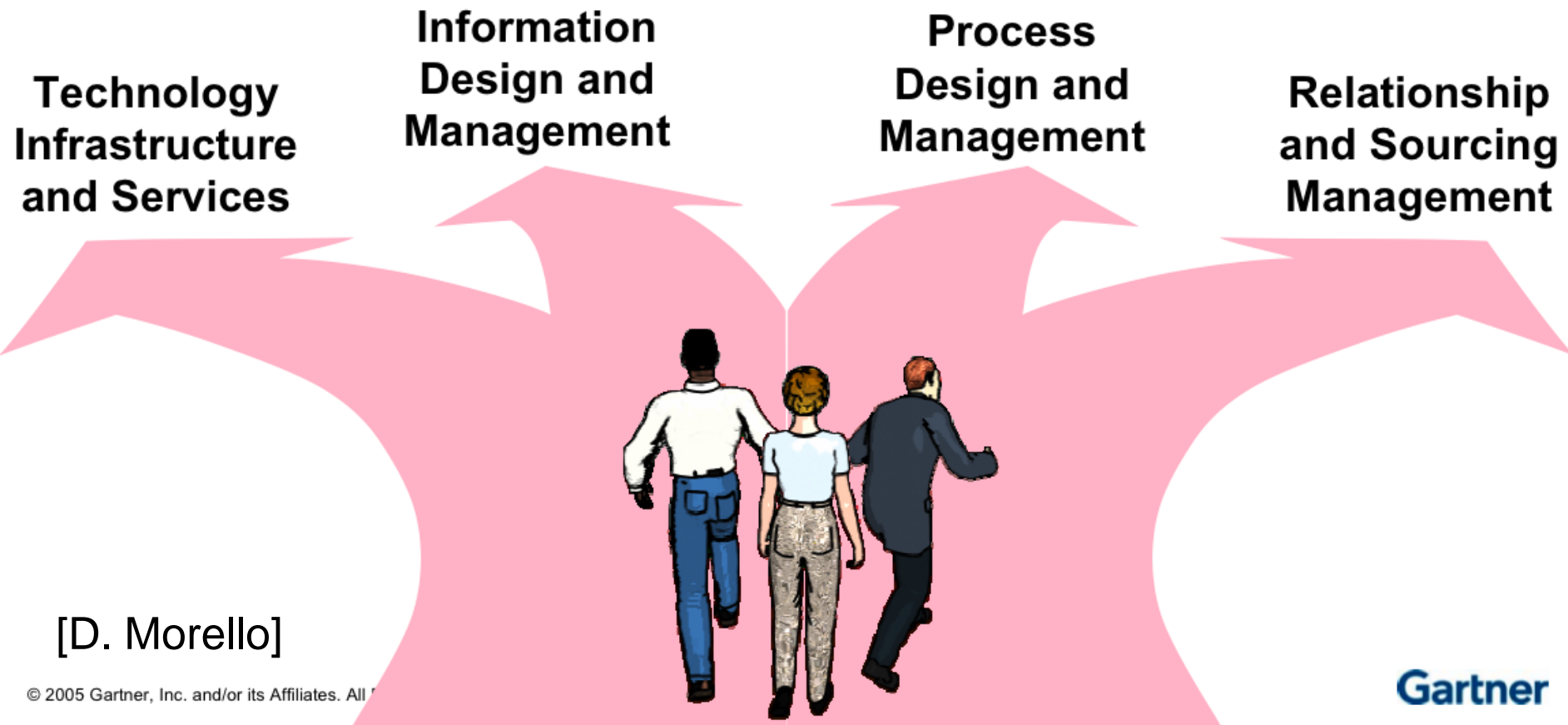
hardware

**INFORMATION
ANALYSIS**

[M. Pollack]



Second Approach: Professional Specialization



[D. Morello]

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Gartner



Third Approach: Everything Goes

- Georgia Tech: 2 (out of 8) threads, one role
- Threads:
 - Computational modeling, Embodiments, Foundations, Information Internetworks, Intelligence, Media, People, Platforms
- Roles:
 - Master practitioners, Entrepreneurs, Innovator, Communication

Organization Principles

- Internal:
 - Common core – **CS fundamentals**
 - *A must if we believe we are one discipline*
 - Secondary split according to
 - *fundamental sciences needed: physics, discrete math, cognitive science, sociology, economy, biology...*
 - *Professional formation: computer engineer, software engineer...*
 - **Tension between the two organizing principles**
- External:
 - Overall responsibility for teaching/propagating computational thinking on campus (the paradigm of computing and information system used to understand natural or social systems)

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”
- **Radically Changes the Information Economy**
- **Except academia**
 - IT is the main tool for improving the productivity of services
 - IT increases productivity when processes are changed
 - How should we change the University processes?



Informatomics at Illinois

- **Illinois Informatomics Institute:**
 - Takes a broad view of informatomics, 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



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



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!

