Challenges of Cyber Security Education at the Graduate Level

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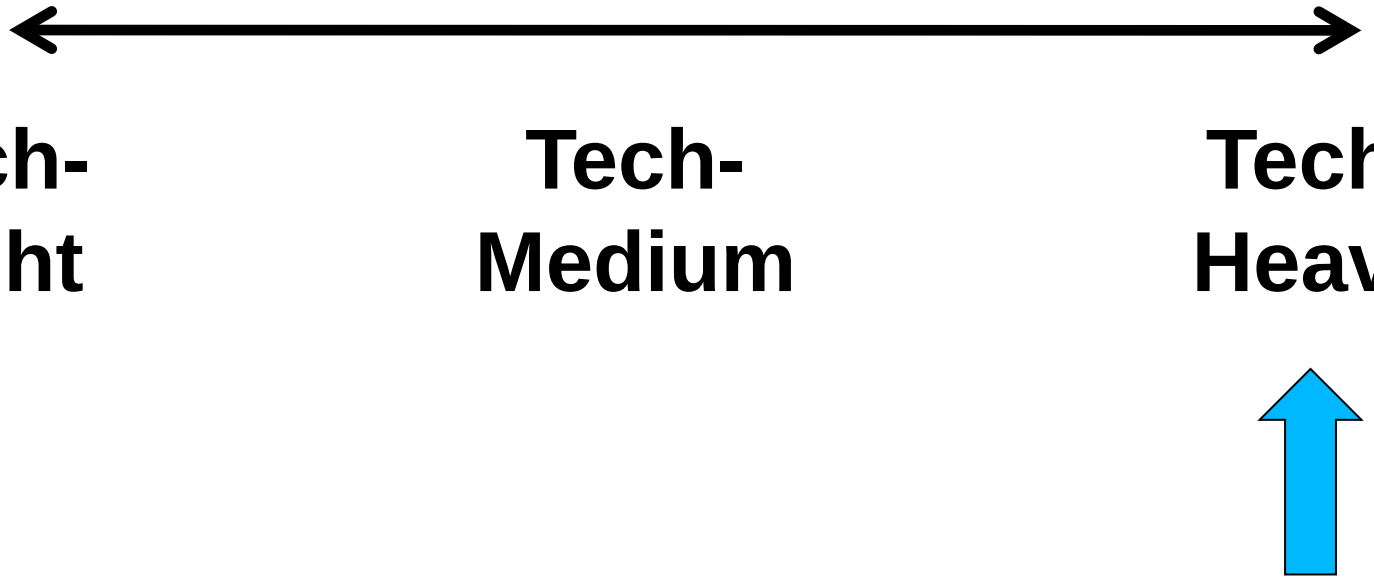
Cyber Security Status

- Cyber technologies and systems have evolved

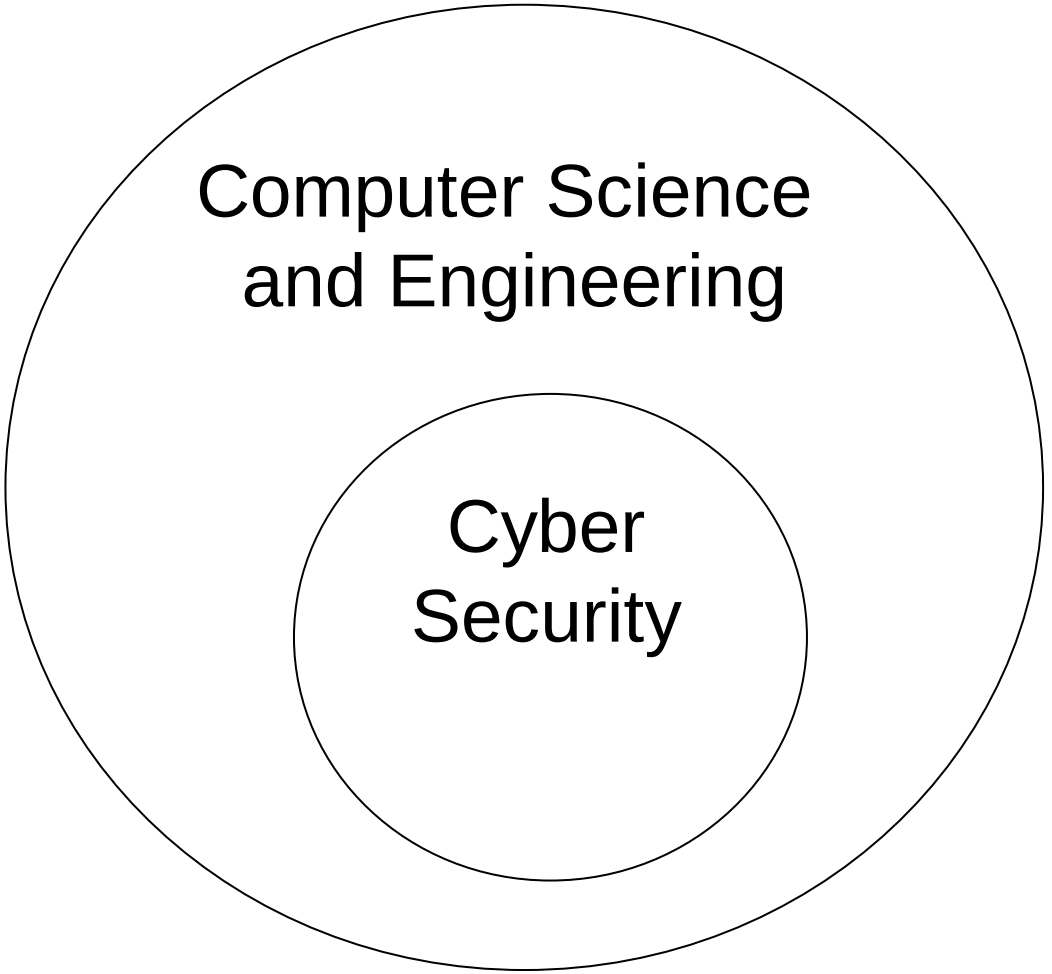
- Cyber security goals have evolved
  - Computer security
  - Information security = Computer security + Communications security
  - Information assurance
  - Mission assurance

- Cyber security research and practice are loosing ground

Graduate Cyber Security Education



Cyber Security as a Discipline



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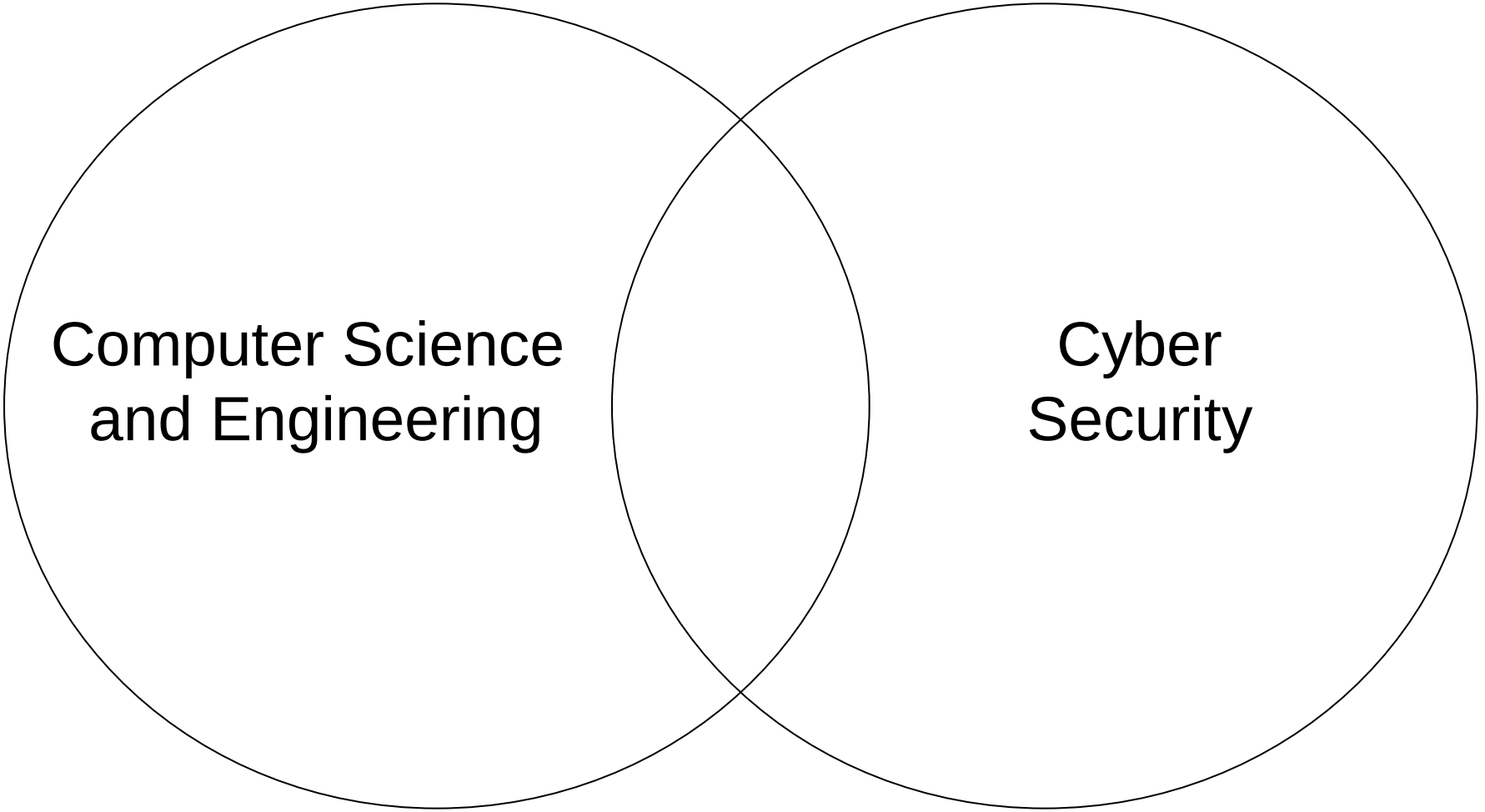


Fundamental Challenge I

- Too much material to teach
- Growing faster than teachers can keep up
  - Computer science theory
  - Computer system principles and practice
  - Cyber security theory
  - Cyber security system principles and practice
  - Statistics, sociology, organizational theory, economics, psychology, game theory ….
  - Laws, regulations, compliance ….
  - Privacy ….
  - History, successes and failures
  - …..

The packaging challenge

Fundamental Challenge II

- Immature field
- What is fundamental to cyber security?
- Where are the boundaries of a cyber system?
- What are the goals of cyber security?

The discipline challenge

Cyber Security Goal

- Enable system designers and operators to say:

  This system is secure

Cyber Security Goal

- Enable system designers and operators to say:

  This system is secure

  Not attainable

- There is an infinite supply of attacks

Cyber Security Goal

- Enable system designers and operators to say:

  This system is secure enough

Many successful examples

The ATM Paradox

- The ATM (Automatic Teller Machine) system is
  - secure enough
  - global in scope
- Not attainable via current cyber security science, engineering, doctrine
  - not studied as a success story
- Similar paradoxes apply to
  - on-line banking
  - e-commerce payments

Cyber Security Goal

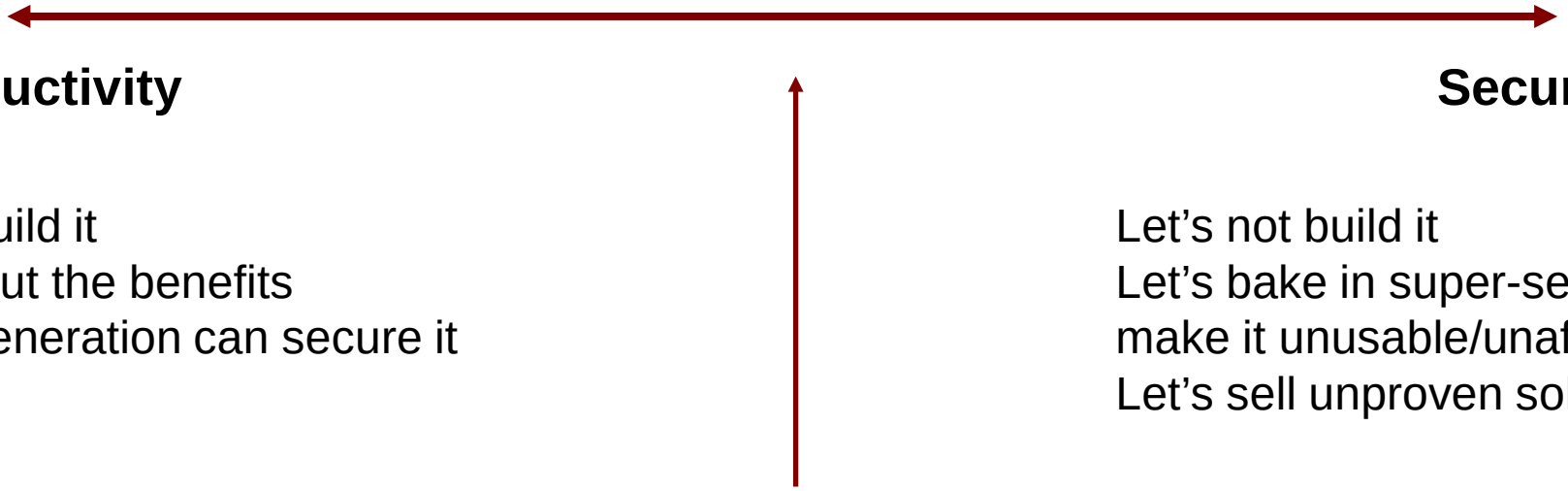
- Enable system designers and operators to say:

  This system is secure enough

- In an innovative ecosystem the innovation drive will ensure that the bar for enough will be fairly low

Productivity-Security

- Cyber Security is all about tradeoffs



Let's build it
Cash out the benefits
Next generation can secure it

Let's not build it
Let's bake in super-security to make it unusable/unaffordable
Let's sell unproven solutions

There is a middle ground
We don't know how to predictably find it

Grand Challenges

- Develop a scientific discipline
  - to predictably find the sweet spots for different application and mission contexts
  - to predictably find, incentivize and deploy microsec that leads to desirable macrosec outcomes
  - that can be meaningfully taught in Universities at all levels: BS, MS, PhD

- Prognosis
  - we shall succeed (we have no choice)
  - but we need to change to succeed

ICS Projects

- Secure information sharing
- Social network security
- Secure data provenance
- Attribute based access control
- Botnet and malware analysis
- Smart grid security
- Hardware security
- Future internet