COMPUTER ENGINEERING

UIT
TRƯỜNG ĐẠI HỌC
CÔNG NGHỆ THÔNG TIN

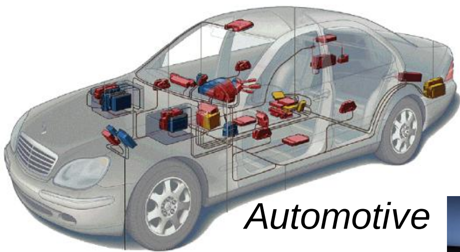
EMBEDDED SYSTEM DESIGN
Course Introduction

10/15/2021

Cyber-Physical Systems: Full of Contradictory Requirements

It's not just information technology anymore:

- Cyber + Physical
- Computation + Dynamics
- Security + Safety



Automotive

Energy

Biomedical

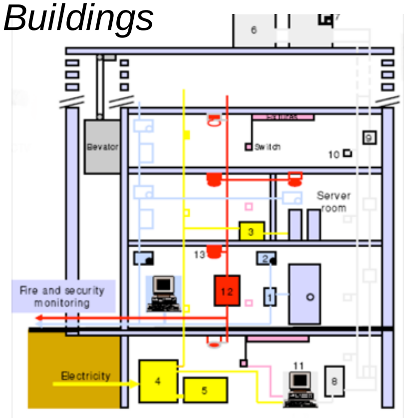
Avionics

Military

Contradictions:

- Adaptability vs. Repeatability
- High connectivity vs. Security and Privacy
- High performance vs. Low Energy
- Asynchrony vs. Coordination/Cooperation
- Scalability vs. Reliability and Predictability
- Laws and Regulations vs. Technical Possibilities
- Economies of scale (cloud) vs. Locality (fog)
- Open vs. Proprietary
- Algorithms vs. Dynamics

Manufacturing

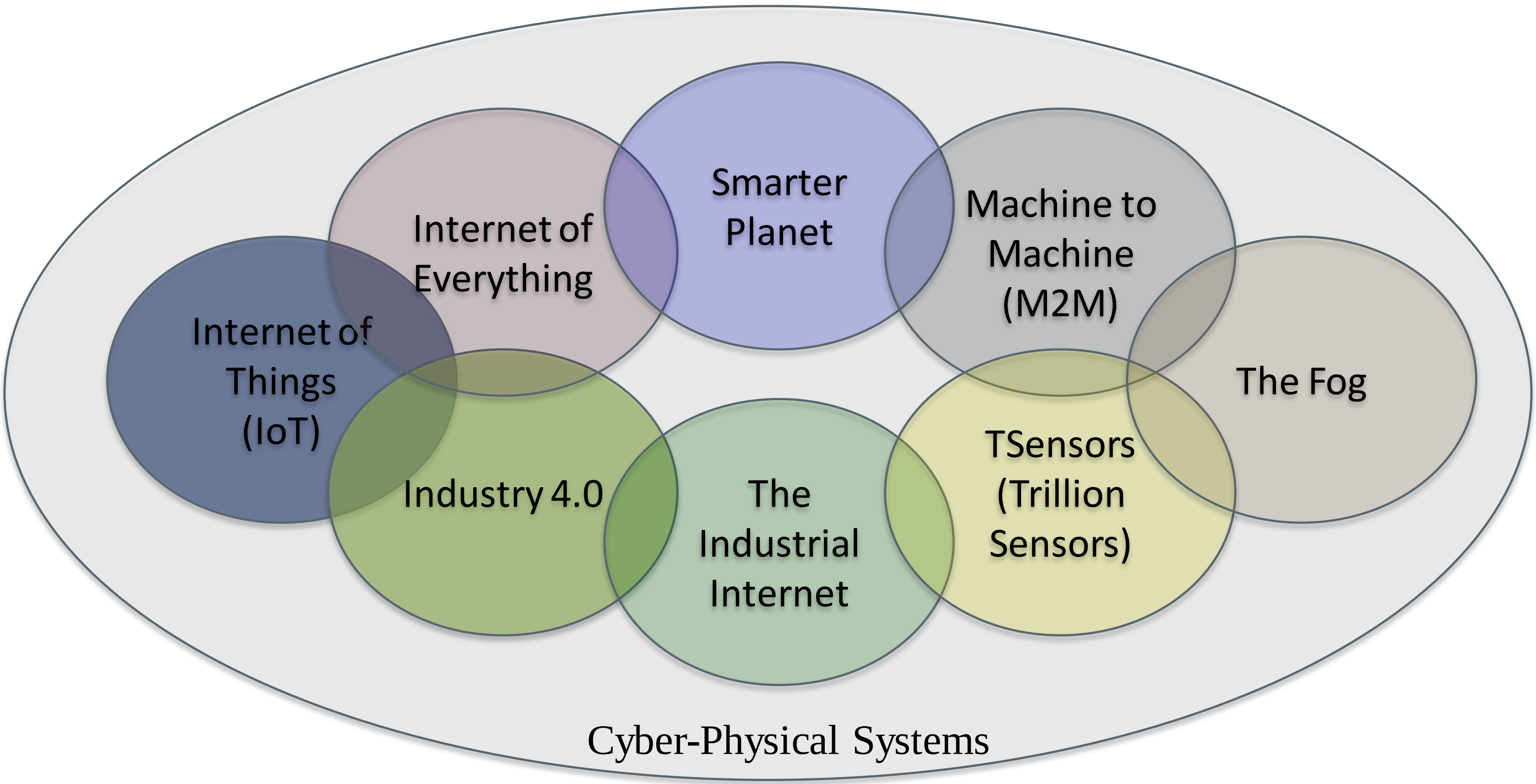


Buildings

Innovation:

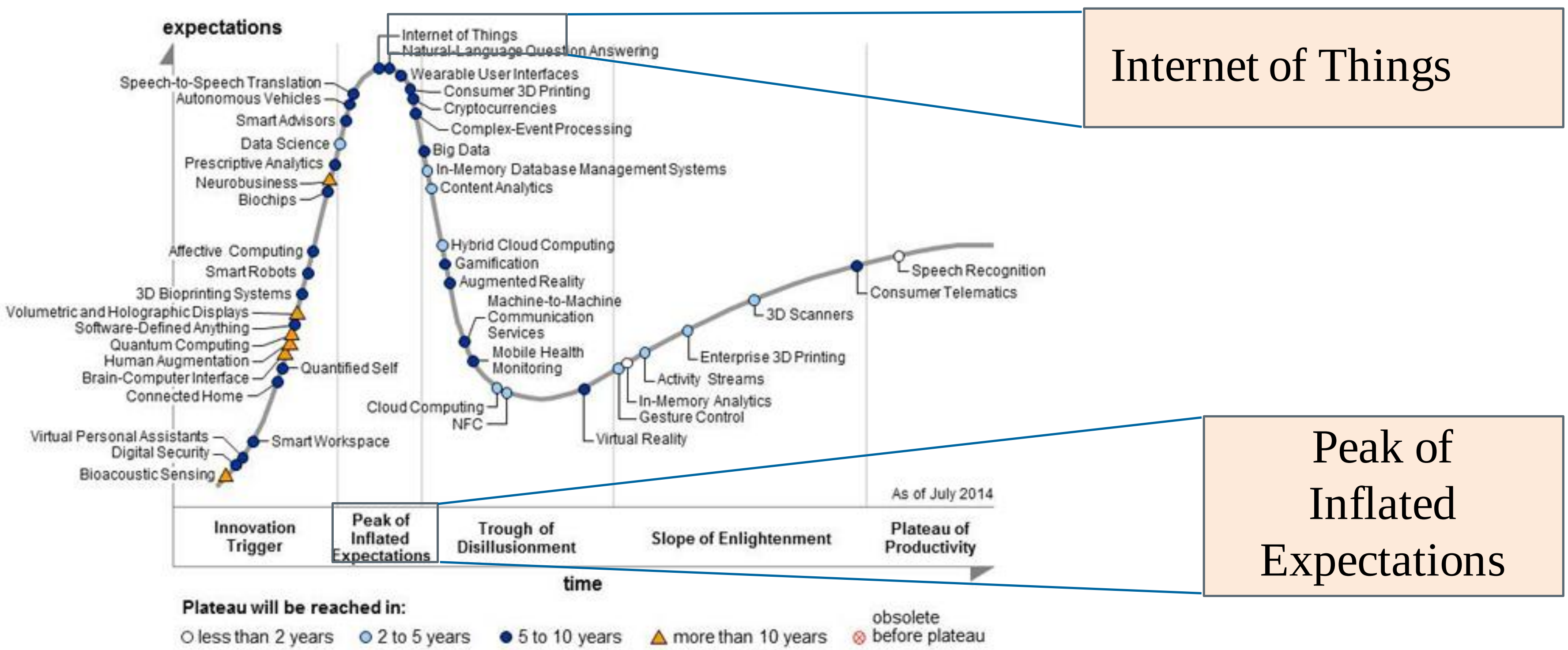
Cyber-physical systems require new engineering methods and models to address these contradictions.

Out of Many, One



The Hype Around The Internet of Things

Using Internet technology to connect physical devices ("things").



http://www.gartner.com/technology/research/hype-cycles/

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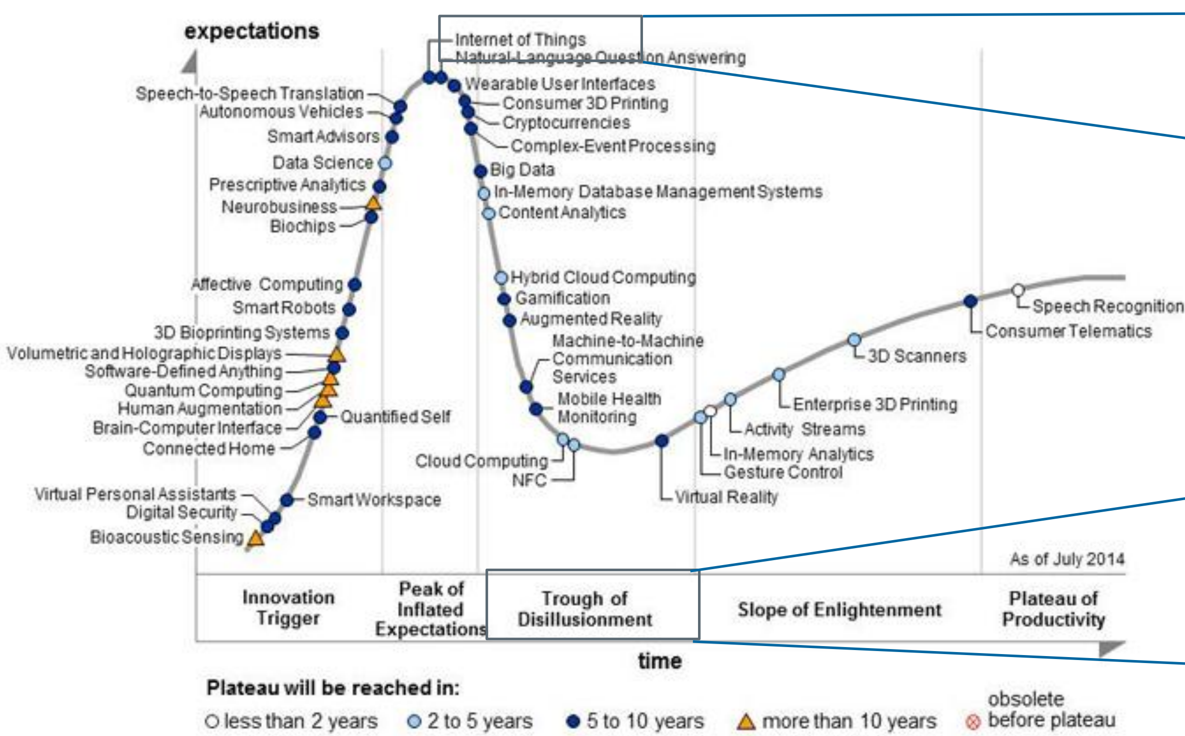


Internet of Things

Trough of Disillusionment

http://www.gartner.com/technology/research/hype-cycles/

IoT is the use of Internet technology for Cyber-Physical Systems

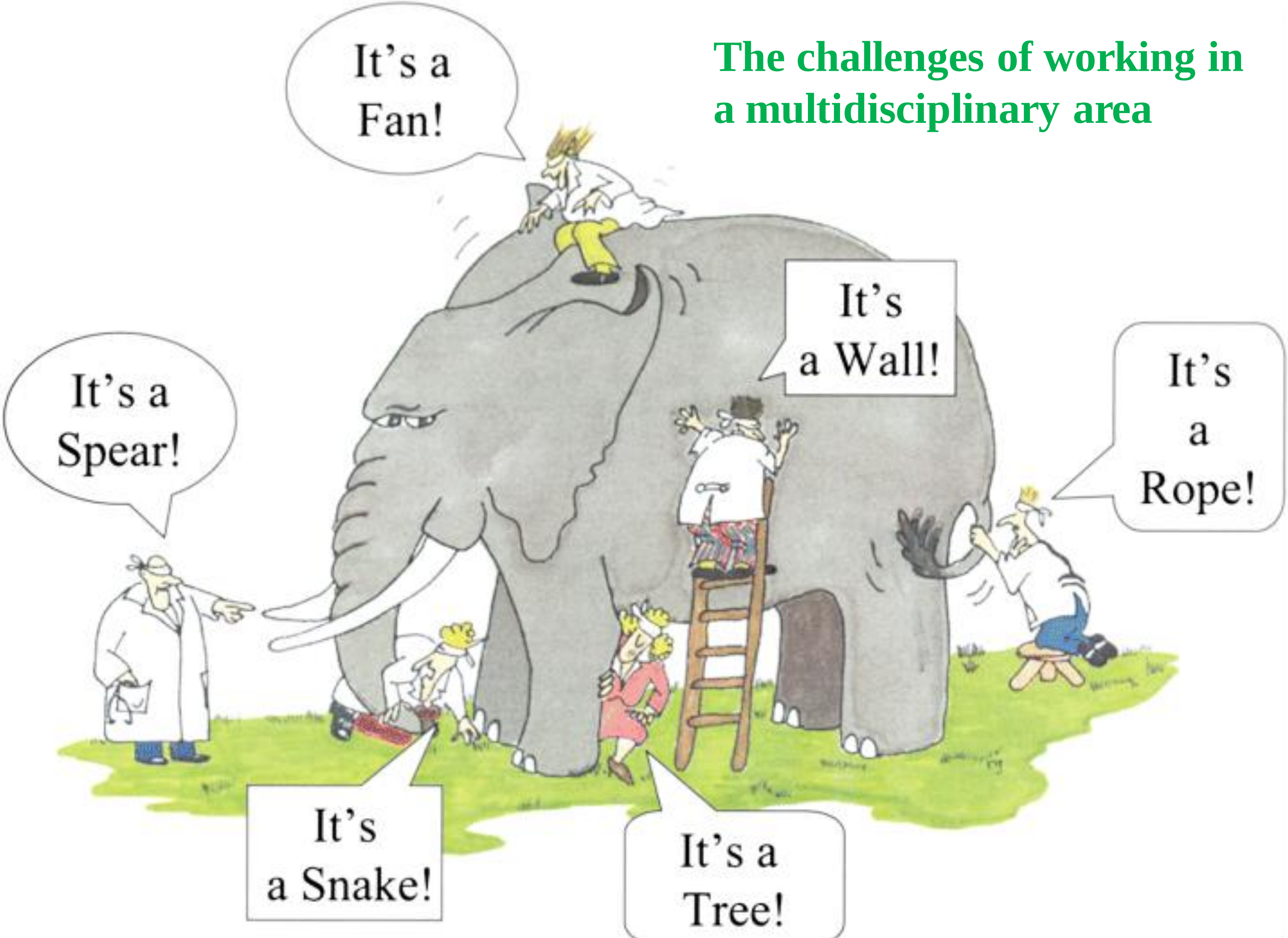
Industrial automation: Industrial Revolu
4.0.

The term "IoT" inclu
the technical solu
"Internet technolog
the problem stater
"connect things".

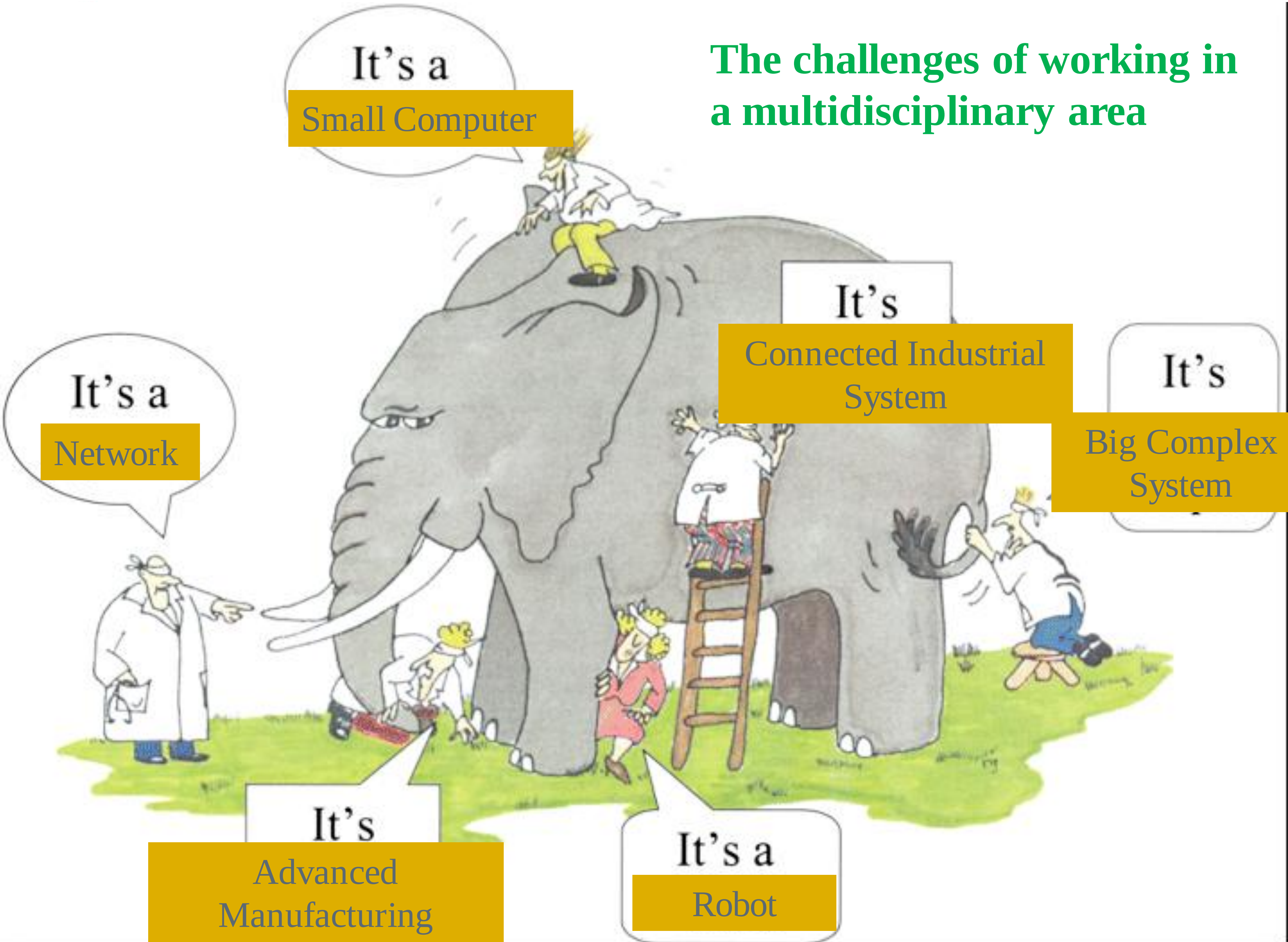
The term CPS does

CPS Challenge Problem: Prevent This

The challenges of working in a multidisciplinary area

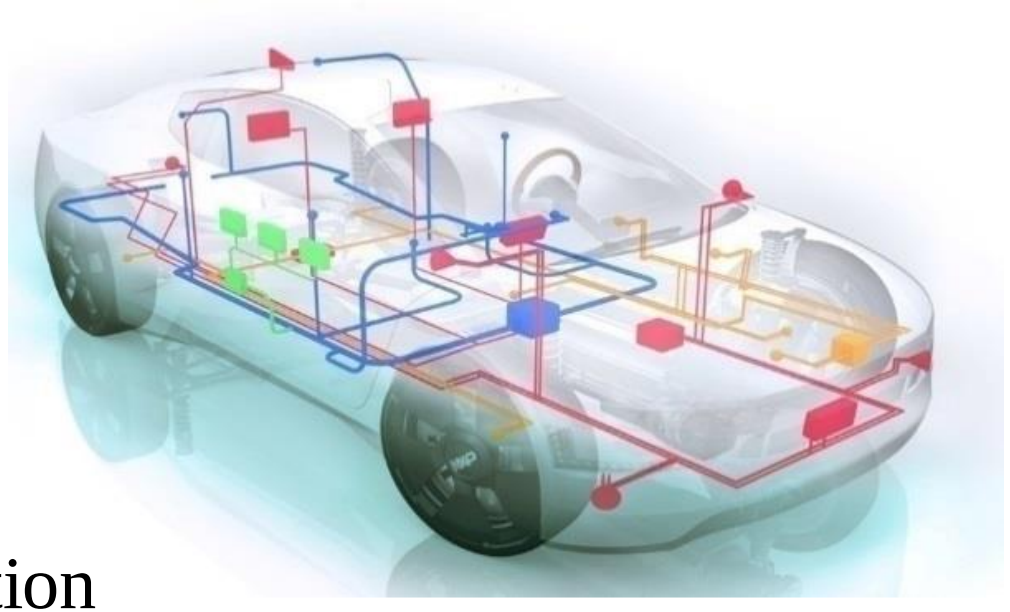


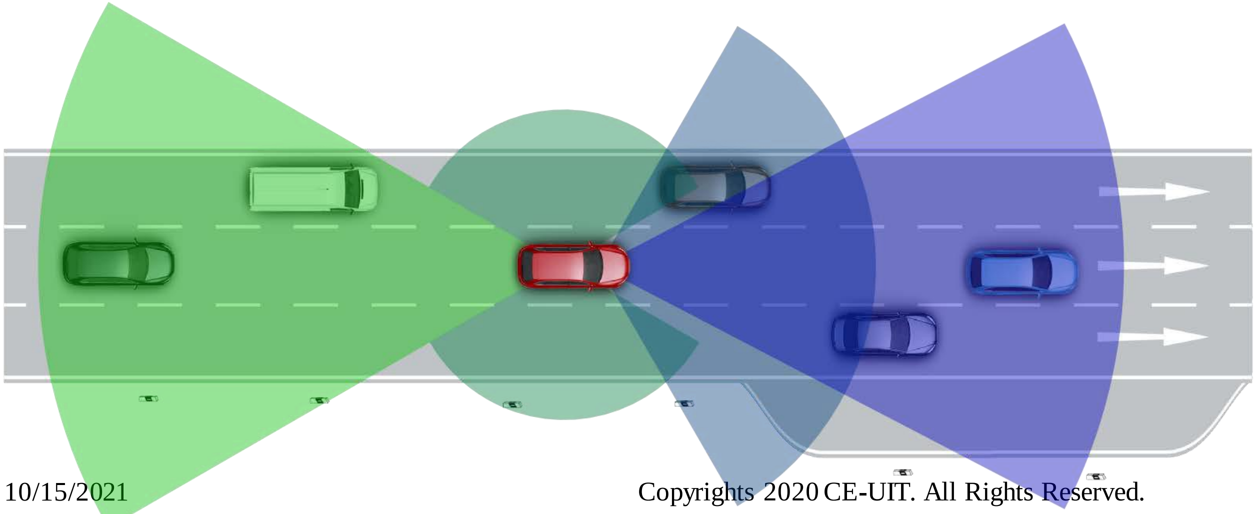
The challenges of working in a multidisciplinary area



Automotive CPS and Societal Challenges

- Safer Transportation
- Reduced Emissions
- Smart Transportation
- Energy Efficiency
- Climate Change
- Human-Robot Collaboration





Disruptive technologies is changing the world

… with major CPS components

Twelve potentially economically disruptive technologies

Mobile Internet	Increasingly inexpensive and capable mobile computing devices and Internet connectivity
Automation of knowledge work	Intelligent software systems that can perform knowledge work tasks involving unstructured commands and subtle judgments
The Internet of Things	Networks of low-cost sensors and actuators for data collection, monitoring, decision making, and process optimization
Cloud technology	Use of computer hardware and software resources delivered over a network or the Internet, often as a service
Advanced robotics	Increasingly capable robots with enhanced senses, dexterity, and intelligence used to automate tasks or augment humans
Autonomous and near-autonomous vehicles	Vehicles that can navigate and operate with reduced or no human intervention
Next-generation genomics	Fast, low-cost gene sequencing, advanced big data analytics, and synthetic biology ("writing" DNA)
Energy storage	Devices or systems that store energy for later use, including batteries
3D printing	Additive manufacturing techniques to create objects by printing layers of material based on digital models
Advanced materials	Materials designed to have superior characteristics (e.g., strength, weight, conductivity) or functionality
Advanced oil and gas exploration and recovery	Exploration and recovery techniques that make extraction of unconventional oil and gas economical
Renewable energy	Generation of electricity from renewable sources with reduced harmful climate impact

Economic Potential

	The Internet of Things	**300%** Increase in connected machine-to-machine devices over past 5 years **80–90%** Price decline in MEMS (microelectromechanical systems) sensors in past 5 years	**1 trillion** Things that could be connected to the Internet across industries such as manufacturing, health care, and mining **100 million** Global machine to machine (M2M) device connections across sectors like transportation, security, health care, and utilities	**$36 trillion** Operating costs of key affected industries (manufacturing, health care, and mining)
	Cloud technology	**18 months** Time to double server performance per dollar **3x** Monthly cost of owning a server vs. renting in the cloud	**2 billion** Global users of cloud-based email services like Gmail, Yahoo, and Hotmail **80%** North American institutions hosting or planning to host critical applications on the cloud	**$1.7 trillion** GDP related to the Internet **$3 trillion** Enterprise IT spend
	Advanced robotics	**75–85%** Lower price for Baxter[3] than a typical industrial robot **170%** Growth in sales of industrial robots, 2009–11	**320 million** Manufacturing workers, 12% of global workforce **250 million** Annual major surgeries	**$6 trillion** Manufacturing worker employment costs, 19% of global employment costs **$2–3 trillion** Cost of major surgeries
	Autonomous and near-autonomous vehicles	**7** Miles driven by top-performing driverless car in 2004 DARPA Grand Challenge along a 150-mile route **1,540** Miles cumulatively driven by cars competing in 2005 Grand Challenge **300,000+** Miles driven by Google's autonomous cars with only 1 accident (which was human-caused)	**1 billion** Cars and trucks globally **450,000** Civilian, military, and general aviation aircraft in the world	**$4 trillion** Automobile industry revenue **$155 billion** Revenue from sales of civilian, military, and general aviation aircraft

Google and Facebook

Artist's rendering of Titan's Solara 50, which in theory at least, can stay aloft for years.

Wall Street Journal:

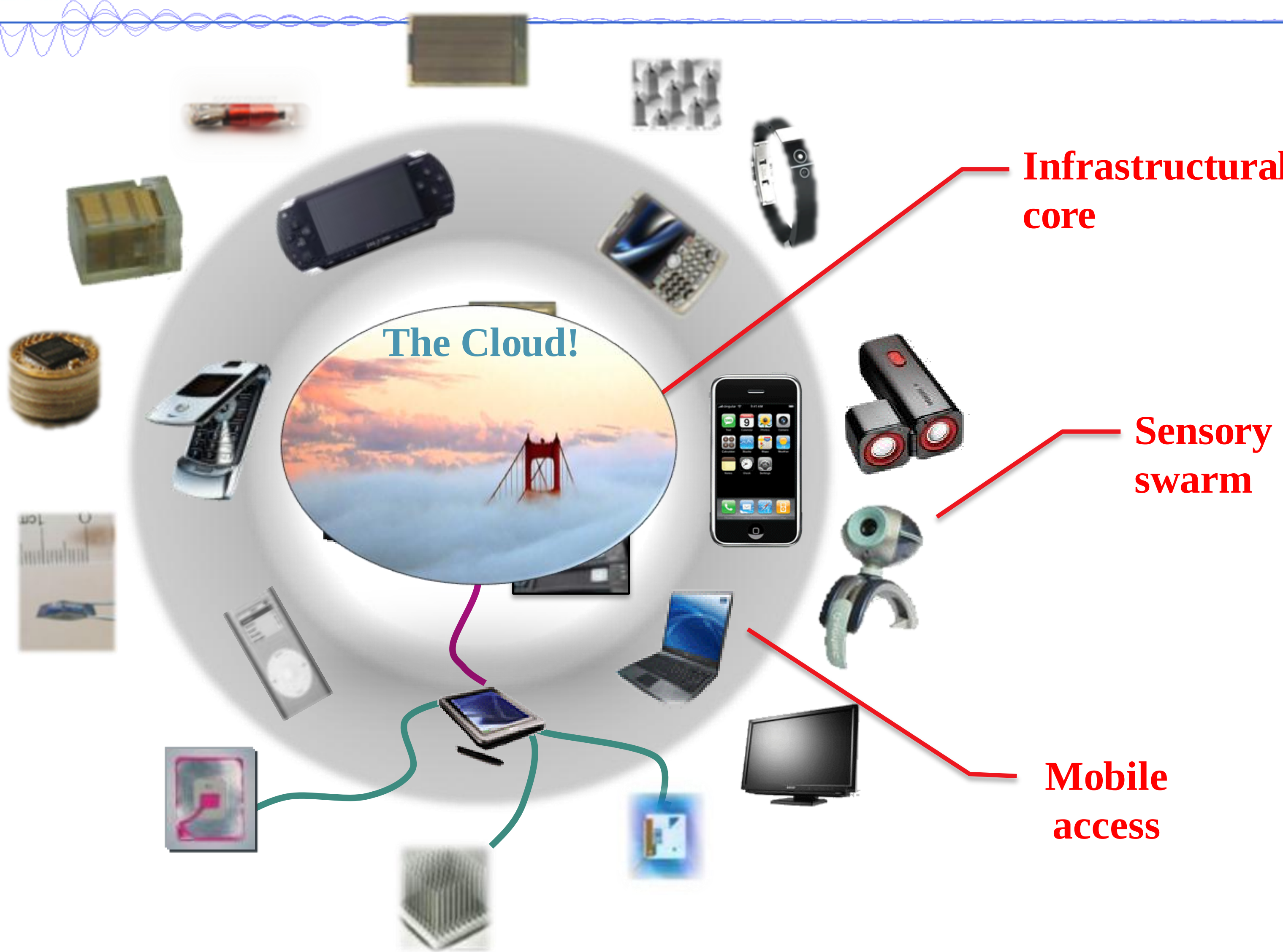
By Alistair Barr and Reed Albergotti
April 14, 2014

Google Inc. on Monday acquired a maker of solar-powered drones—a startup that Facebook Inc. had also considered acquiring—as the technology giants battle to extend their influence and find new users in the far corners of the earth.

Apple iCar?

Macworld, Aug. 10, 2016:
Reports suggest that Apple is developing an electric iCar to rival Tesla. With reports that Apple is negotiating with BMW, and poaching Samsung employees (especially battery specialists) and reassigning large numbers of staff for its Project Titan, is Apple manufacturing an iCar, and when will the iCar be launched?

The Emerging IT Scene




The oven is pre-heating to 350° F.
Ready in: 5:42
OK
CANCEL

What this course is about…

A principled, scientific approach to designing and implementing embedded systems

Lời tự thú của hacker Việt sau 7 năm ngồi tù ở Mỹ

Ở đỉnh cao "sự nghiệp" t[illegible]ạm mạng, hac[illegible]ó biệt danh Hieupc kiếm được 125.000 USD mỗi thán[illegible]nh cắp danh tính người dùng.

Ngô Minh Hiếu, sinh năm 1[illegible]ó biệt danh Hieupc, vừa ra tù tại Mỹ sau hơn 7 năm bị bắt g[illegible] kể lại c[illegible] sa lầy trong thế giới ngầm của mình cho nhà báo chuyê[illegible] viết về tội phạm mạ[illegible]g Brian Krebs, chủ trang *KrebsOnSecurity*, với mong muốn cảnh báo những người khác đừng đi theo vết xe đổ của mình.

Not just hacking!!

Hacking can be fun, but it can also be very painful when things go wrong…

Class Information

- Lecturer:
  - Lecture: Đoàn Duy, Ph. D.
    - Email: **duyd@uit.edu.vn**
  - Laboratory: Trần Hoàng Lộc, B.E.
    - Email: **locth@uit.edu.vn**

- Students:
  - Code: CE224.L12.MTCL
  - Total: 26 Students

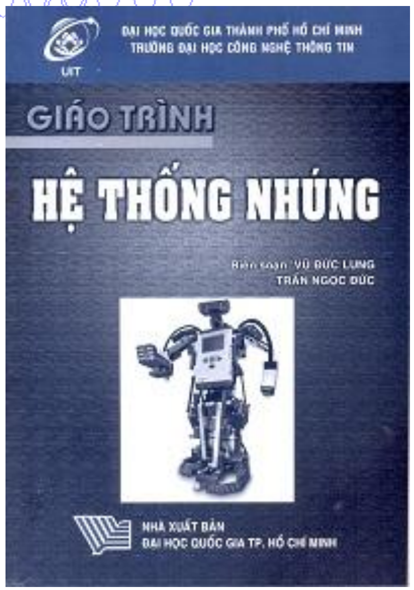
Time Slice and Score

- Timing:
  - Lecture: 45 lecture hours /15 weeks
  - Laboratory: 30 lecture hours / 6 weeks
- Score:
  - Mid-term test: **15%** (Multiple choice, writing)
  - Project (in group): **15%** (presentation, report)
  - Laboratory: **20%**
  - Final test: **50%** (Multiple choice, writing)

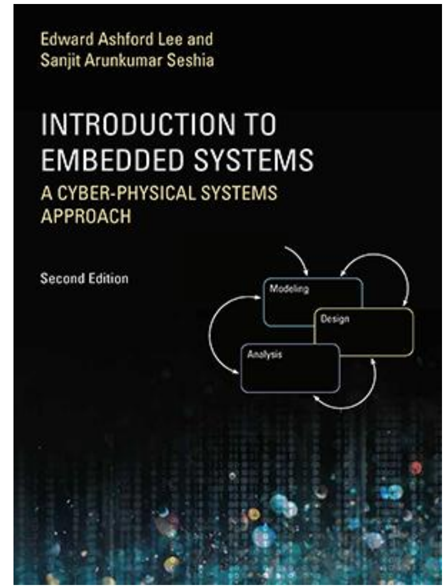
Objectives/Learning Outcome

- Analyzing and designing solution for problems related to ESD;
- Having idea and solution implementation for ESD and CE;
- Acquiring technical terms for future learning and working;
- Having the right moral understanding for research and work.

Textbook and References



Vũ Đức Lung - Trần Ngọc Đức,
Nhà xuất bản ĐHQG-HCM, 2016



E. A. Lee and S. A. Seshia,
Second Edition, MIT Press, 2017

[1] Edward A. Lee, "**Embedded System**," UC Berkeley, EECS 149/249A

[2] Steve Heath, "**Embedded System Design**," Second Edition, Newnes, Elsevier Science, Linacre House, Jordan Hill, Oxford, 2003.

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Course's content

Week	Content	Presenter/In Charge
Week 1	- Course Introduction	Lecturer
Week 2	Model Based Design	Lecturer
Week 3	Discrete Dynamics Systems	Lecturer
Week 4-5	Extended and Time Automata	Lecturer
Week 6	State machine: Composition and Hierarchical	Lecturer
Week 7	Sensor Actuator and Network	Lecturer
Week 8	Review for Midterm test	Lecturer
Week 9	Input/Output/Memory (1)	Lecturer
Week 10	Input/Output/Memory (2)	Lecturer
Week 11	Multitasking	Lecturer
Week 12	RTOS	Lecturer
Week 13	Testing and Verification of EDS	Lecturer
Week 14	Project Report	**Student**
Week 15	Review for Final test	Lecturer

Class regulations

- Starting time: 7:45 AM.
- Lecturer and students must present at class on time.
- Active discussion between Lecturer and Students.
- Discussion and advice outside of class:

1:30 – 3:30 PM every Monday at E6.4

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Q&A