Technological Advancement and Productivity

Asia Pacific College

Engineering Students Seminar

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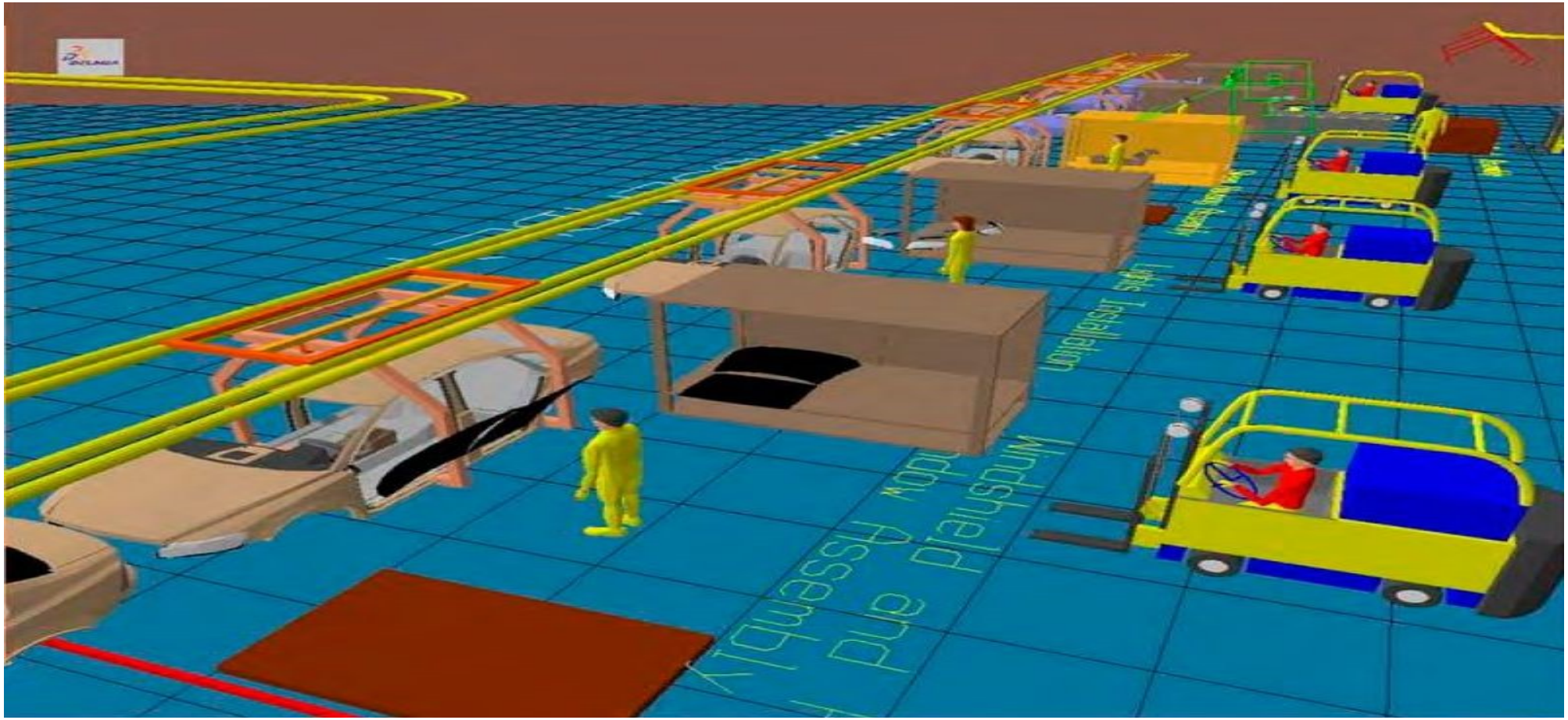
What we may take from here

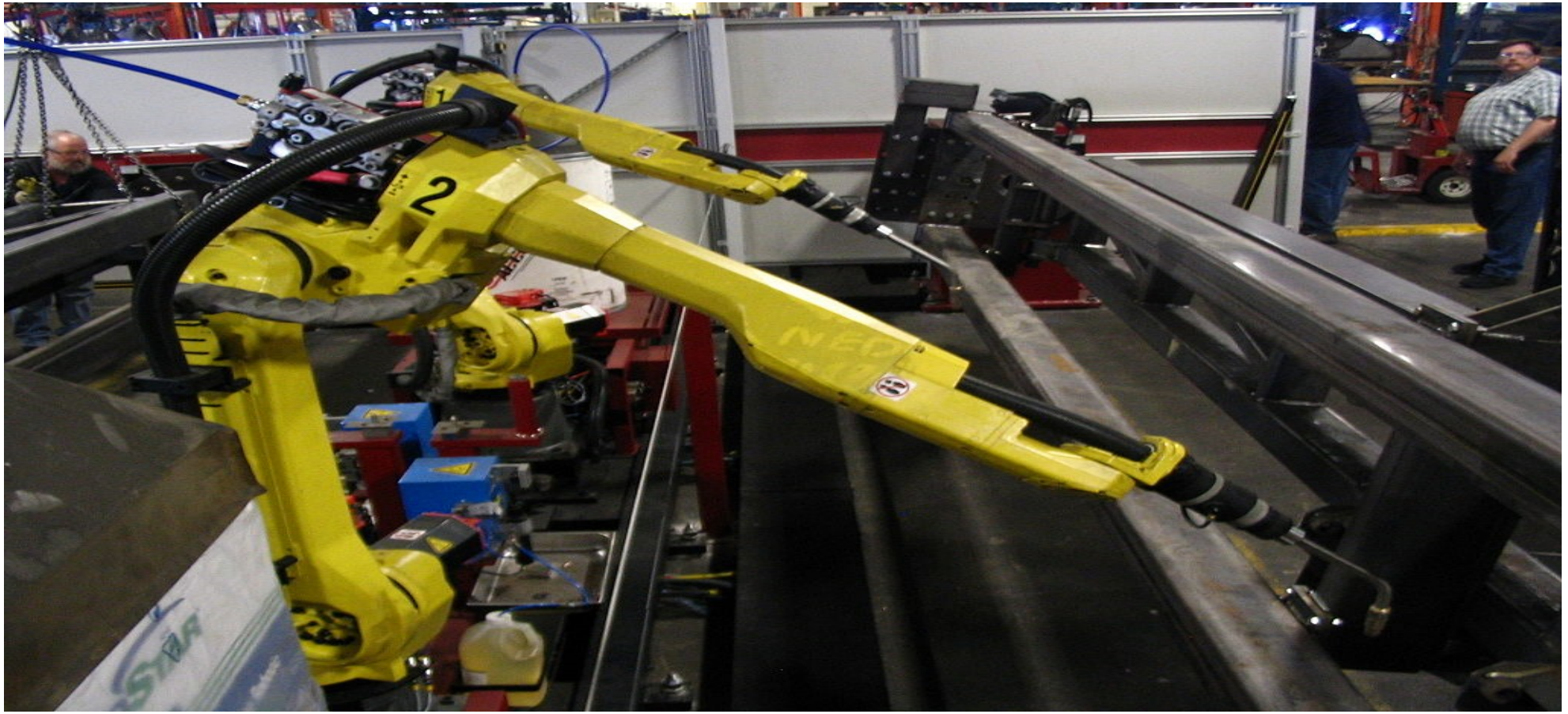
- Technology (“X”) fundamentals and skills
- Internet and communication technologies (especially existing/primitive ones) intersection
- Computing facilities i.e. organizational efficiency
- Knowledge economy, computing and data

What do you want to be?

Have you seen yourself working here[1]



Have you seen yourself working here[2]



Have you seen yourself working here[3]

How about you as a kid[1,2]

Game“X”

Let’s play!

“X” + acts

- Computer Engineer (CE) to pick their Electronics Engineer (EE) partner
- As partner engineers in spite of the differences of your field think what both of you can produce, the result of you working together
  - Before start working you both must know what each other would like to do, must be specific or closely relevant to your field
  - Don’t forget to take note how did you manage to start working together

Think “X” as

- Anything that matters with and that may result to an output with the application of science, **engineering** and technology
  - Computers
  - Electronics
  - Electricity
  - Nuclear
  - Manufacturing
  - Marine
  - Agriculture
  - Health
  - And so on…

Let’s move on

Keep the game rolling in your head, but your attention still with me, while we continue…

Technological is

Based in scientific and industrial progress[1].

Cause by technical advance in production methods[2].

Technology must facilitate efficient data and straightforward actions.

Productivity is

(Duties of everyday life includes: family, education, business, leisure, travel, etcetera)

The quality of being productive or having the power to produce.

Meaning of productivity to

- Commercial enterprises
- Associations and sectaries
- Individuals and practitioners
- Governments and agencies

“X (is big ?)” fundamentals and skills

- Engineering disciplines
  - Electronics
  - Computer
- Computer Science
- Information Technology

The “X” and factual evidence, distinction and definition

- Science
- Engineering
- Technology

What is Tony Stark + J.A.R.V.I.S.?

- Scientist?
- Engineer?
- Technologist?
- All of the above!

Science

The reasoned investigation or study of phenomena, aimed at discovering enduring principles among elements of the phenomenal world by employing formal techniques such as the scientific method.

Engineering

The goal-oriented process of designing and making tools and systems to exploit natural phenomena for practical human means, often (but not always) using results and techniques from science.

Technology

- The consequence of science and engineering — although technology as a human activity precedes the two fields.

Computer engineering[1]

- A discipline that integrates several fields of electrical engineering and computer science required to develop computer hardware and software.

- Computer engineers usually have training in electronic engineering (or electrical engineering), software design, and hardware-software integration.

- Considered a subset of electronic engineering and computer science[2].

Specialty areas and H|SW (or systems) integration[CE1]

Specialty areas	Systems (applications)
Communications and wireless networks	PSTN, CDMA, GSM, 3/4G
Computer networks, mobile computing and distributed systems	IP, Ethernet, HDLC, PPP, ATM, LTE/WiMAX
Computer systems: architecture, parallel processing and dependability	i386 32-bit, x64, zEnterprise, HPC, HA
Embedded systems	Internet of Things, Smarter Planet, Home and Office Automation

Electronic engineering[1]

- A discipline where non-linear and active electrical components such as electron tubes, and semiconductor devices, especially transistors, diodes and integrated circuits, are utilized to design electronic circuits, devices and systems, typically also including passive electrical components and based on printed circuit boards.

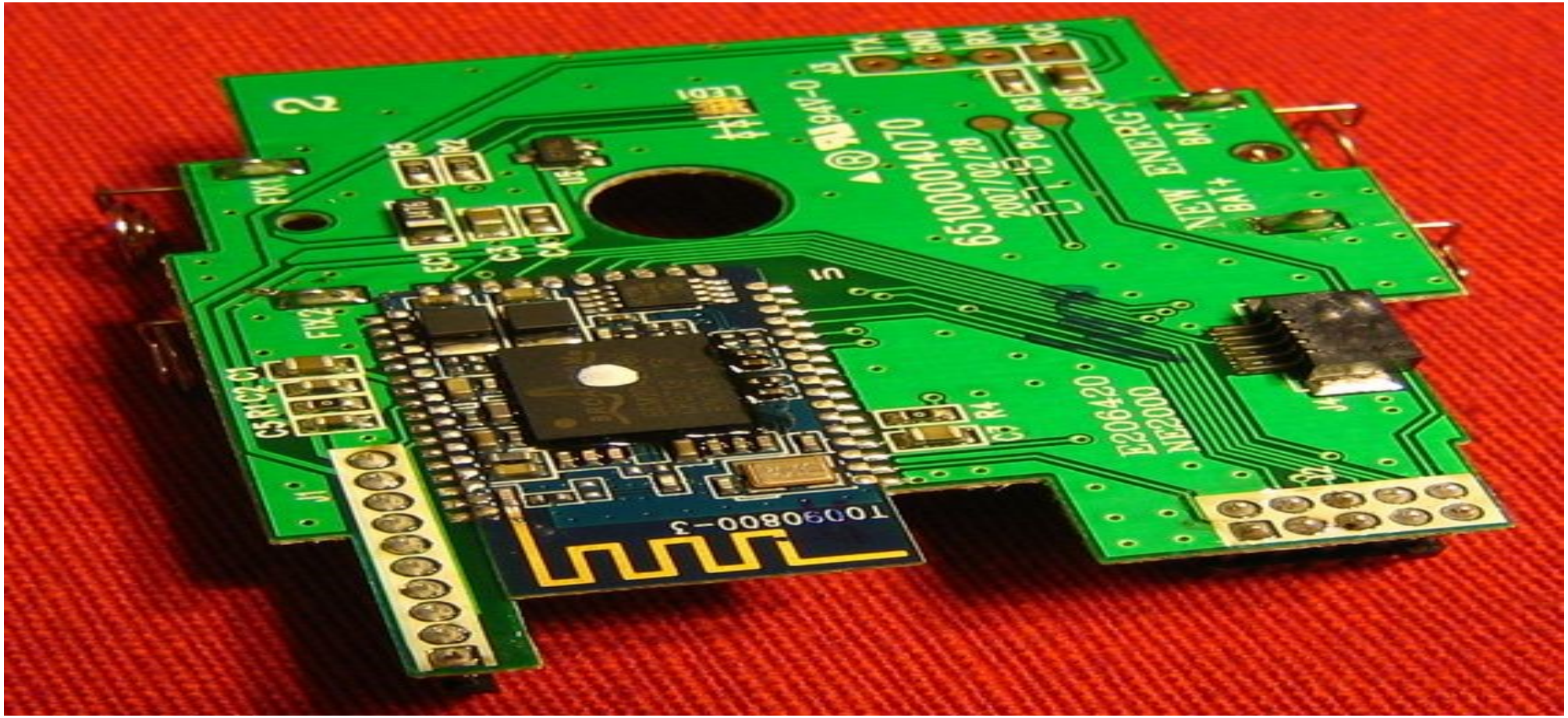
Electronic engineering concentrations[EE1]

Subfields	Applications
Analog electronics Digital electronics Consumer electronics Embedded systems Power electronics	Solid-state physics Radio engineering Telecommunications Control systems Signal processing Systems engineering Computer engineering Instrumentation engineering Electric power control Robotics And many others

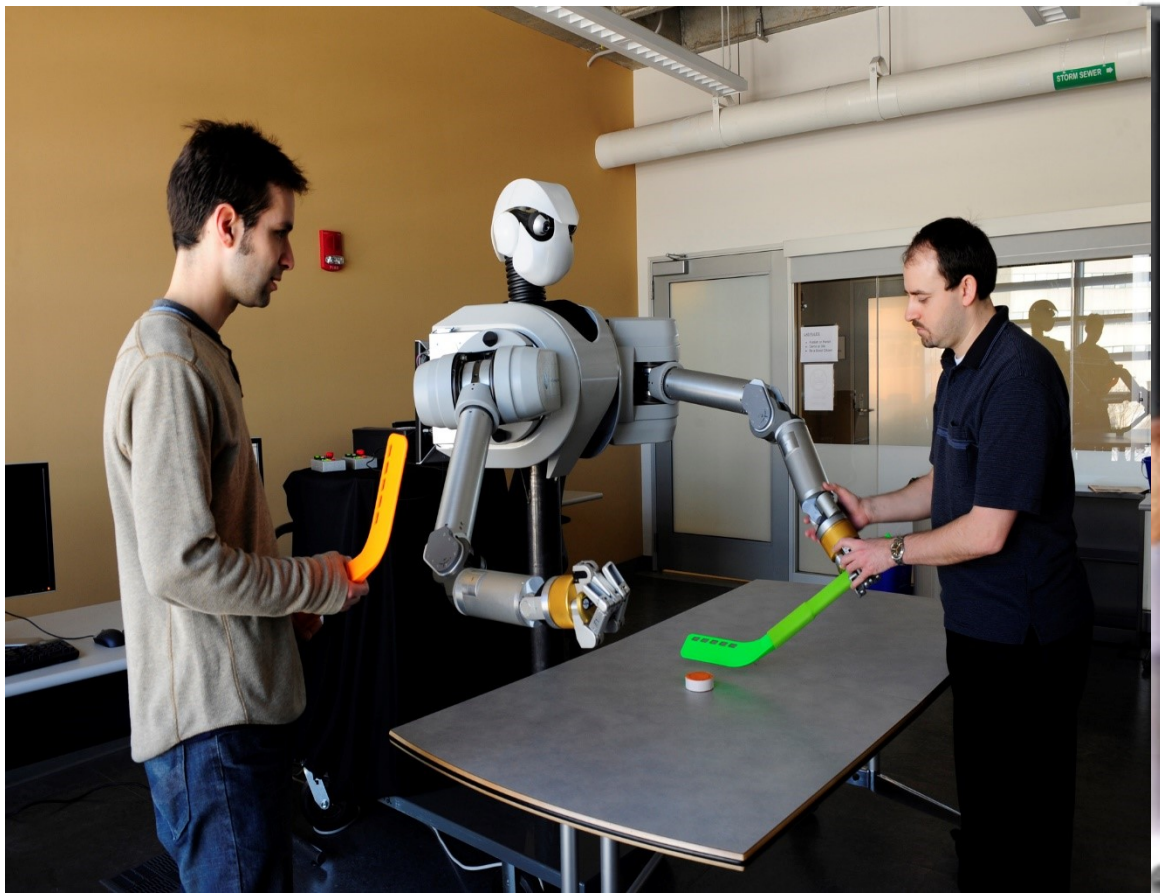
What do you like to do?

A bit in this environment[1]

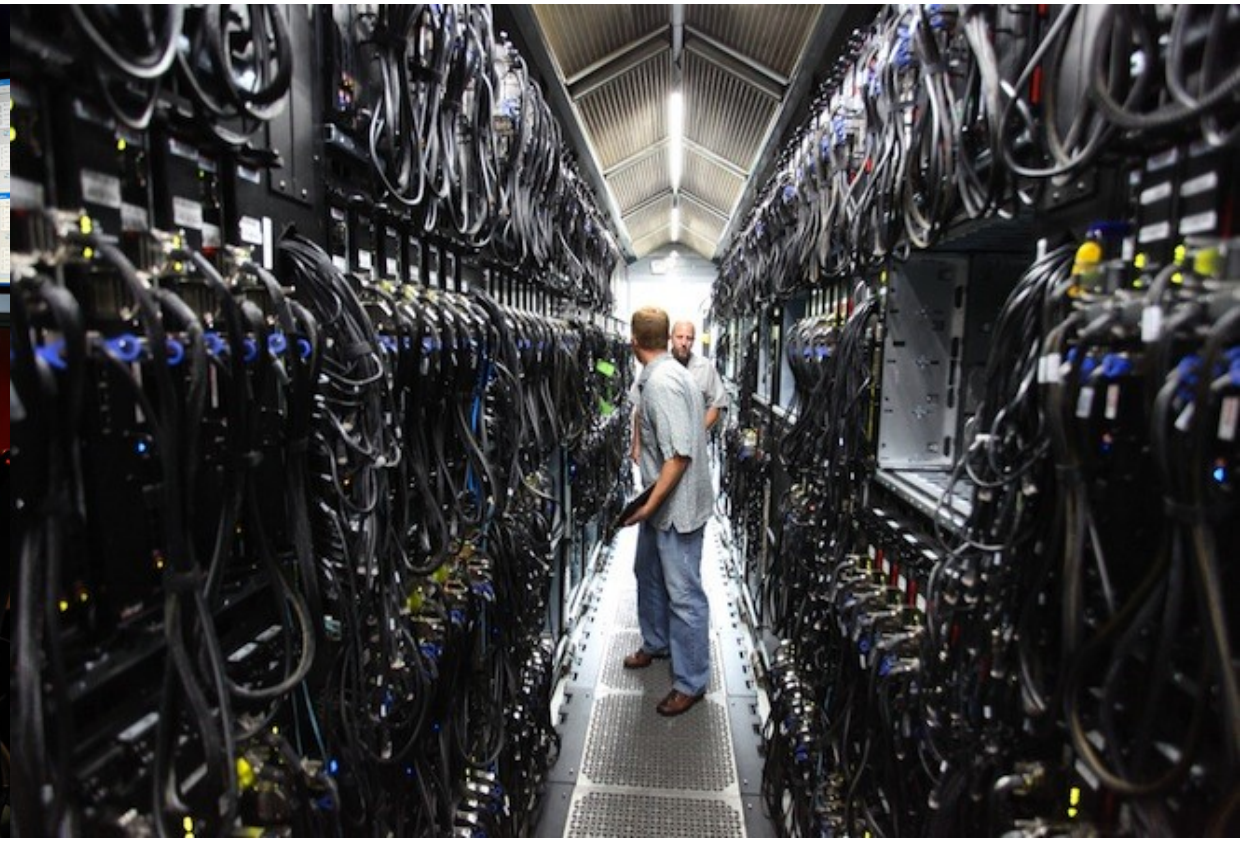
A more focus work[2]



Research and inventing[3,4]



Administering an enterprise system and infrastructure[5,6]



What makes up a system^

Processors, memory, controllers, bus	PLs, OSs	Systems, applications
x64 et al Intel AMD		Computer and embedded systems
Intel Galileo Raspberry Pi		Embedded and home/office automation
DASD, HDD/SSD, Optical, Tape		Data processing and storage
InfiniBand Cray Ethernet		Interconnect, supercomputing, high throughput

Computer and embedded systems[1]

- Computer
  - General purpose computer system, capable of multi-tasking and is flexible

- Embedded
  - Functions dedicated, capable of specific task and controls many devices,
    - Integrated large device and perform a single role i.e. ATM, arcade machines

Embedded and home/office automation user interface[1]

- Non-user interface
- Complex user interface
  - GUI – graphic and character LCDs, touch sensing or screen edge button
  - Remote interface – RS232, Ethernet, USB, web server on IP camera

Embedded and home/office automation processors[E&H/O1]

- Broad categories
  - Ordinary microprocessors – use separate integrated circuits for memory and peripherals
    - Require more support circuitry than microcontrollers
  - Microcontrollers – have on-chip peripherals which reduces power consumption, size and cost
    - Generally for embedded system use
- RISC and non-RISC
- Word lengths, 4, 64-bit, beyond
  - Most typical, 8/16-bit

Embedded and home/office automation form factor[0] and OSs[E&H/O1]

Boards	RTOS[4]
x86-based i.e. PC/104[2], EPIA[3]	Linux Embedded Windows CE

Embedded and home/office automation SoC[E&H/O1]

- Common array of configuration for very-high-volume embedded systems
  - Contains complete systems consisting of multiple processors, multipliers, cache and interfaces on single chip.
- Can be implemented as
  - ASIC[1]
  - FPGA[2]

Embedded and home/office automation ASIC[1] SoC[E&H/O1]

- Often termed as SoC, customized for particular use e.g. high-efficiency bitcoin miner
  - Sizes shrank
  - Design improved
  - Complexity grown from 5k to 100M gates
  - Modern includes entire microprocessors, memory blocks ROM, RAM, flash
  - Designers of digital use hardware description language (HDL) e.g. Verilog or VHDL

Embedded and home/office automation FPGA[2] SoC[E&H/O1]

- An IC designed to be configured by customer or a designer after manufacturing
- Configuration is generally specified using HDL similar to that of ASIC
- Contemporary, have large resources of logic gates and RAM blocks for complex digital computations
- Employs very fast
  - I/Os
  - Bidirectional data buses
    - A challenge to verify correct time of valid data within setup and hold time unless there is floor planning[3], schematic representation of tentative placement of ICs major functional blocks

Embedded and home/office automation FPGA[2] modern development

- System on a programmable chip – combines
  - Logic blocks
  - Interconnects
  - Traditional FPGA with embedded microprocessors

Data processing (computing) and storage

Tabulation, Programmable, Cognitive[1]	Storage
Text, Graphics low and high-res, Transactional, Motion and entertainment 2/3D, Real-time/streaming voice/video,	Tape, Optical, DASD, HDD, SSD, SAN/NAS/Arrays, Clustered, Cloud or Online

Interconnect, supercomputing and high throughput^

- Industry advances and standards that were and are popular interconnect
- Infiniband, computer network communications link used in HPC with very high throughput[1]
- 100GbE, computer networking technologies for transmitting Ethernet frames at rates of 100 and 40 gigabits per second[2]

Interconnect and industry advances

- From Telegraph
  - Optical, electrical, oceanic, facsimile, wireless
- Intervening technologies: radio and television, videotelephony, satellite
- To Computer networks and Internet
  - Nodes include computers (workstations and servers), routers and switches
  - Communications protocol includes TCP/IP suites; Ethernet 802s (dot3, 11, 1Q-VLAN, 1X-NAC, etcetera); 3/4G (WAP, EDGE, HSPA, LTE, WiMAX); X.25; FR; ATM; T1/E1; MPLS

Interconnect, supercomputing and high throughput, Infiniband[1]

- Switch fabric network topology
- Industry-standard specification that defines an I/O architecture used to interconnect servers, communications infrastructure equipment, storage and embedded systems
- A true fabric architecture that leverages switched, point-to-point channels with data transfers today at up to 120 gigabits per second, both in chassis backplane applications as well as through external copper and optical fiber connections
- Network nodes interconnect via one or more network switches particularly crossbar—connects multiple inputs to multiple outputs in a matrix manner
- Very fast because it spread network traffic across multiple physical links

Interconnect, supercomputing and high throughput, Infiniband advantages[1]

- **Superior performance:** 40Gb/s host connectivity and 120Gb/s switch to switch links
- **Low-latency:** Measured delays of 1μs end to end, greatly accelerate many data center and high performance computing (HPC) applications
- **High-efficiency:** Direct support of advanced reliable transport protocols such as Remote Direct Memory Access (RDMA) to enhance the efficiency of customer workload processing
- **Cost effectiveness:** InfiniBand Host Channel Adapters (HCAs) and switches are very competitively priced and create a compelling price/performance advantage over alternative technologies

Interconnect, supercomputing and high throughput, Infiniband advantages[1] cont'n

- **Fabric consolidation and low energy usage:** Can consolidate networking, clustering, and storage data over a single fabric which significantly lowers the overall power, real estate and management overhead required for servers and storage
- **Reliable, stable connections:** Perfectly suited to meet the mission-critical needs of today's enterprise by enabling fully redundant and lossless I/O fabrics, with automatic path failover and link layer multi-pathing abilities to meet the highest levels of availability
- **Data integrity:** Enables the highest levels of data integrity by performing cyclic redundancy checks (CRCs) at each fabric hop and end to end across the fabric to ensure the data is correctly transferred
- **Rich, growing ecosystem:** Center of an ecosystem that includes open-source software distribution from the OpenFabrics Alliance, innovative and cost-effective cabling, and long-haul solutions that reach outside the data center and across the globe
- **Highly interoperable environment**: Compliance testing conducted by the IBTA, combined with interoperability testing conducted by the OpenFabrics Alliance, benefits end users in terms of product choice and vendor independence

Interconnect, supercomputing and high throughput, 100GbE[1]

- Computer networking technologies for transmitting Ethernet frames
- High speed compared to current Ethernet's signaling rate
- 100Gb/s physical layer and management parameters on backplanes and twinaxial copper cable
- Operates on extended reach >10km with single mode fiber optic cable
- Operates at 40Gb/s on balanced twisted pair copper cabling with current MAC
- Supports both endpoint and link aggregation requirements
- Options with Energy Efficient Ethernet for 40&100Gb/s over backplanes and copper cables

Going back to game X

How would your work output impact the other(s)?

Students and practitioners

How do you use computer and Internet to be better at classroom and workplace?

Students

- No more failing grades
- There will be high level classroom participation
- May all be on top of the class

Practitioners

- Get deeper understanding of a particular task
- They can be effective in multiple assignments if not jobs
- May have better appreciation to their work assigned to them
- Question overlaps within the organizations, if leaders aren't insecure
- Can help advance the bottomline, profit especially

Technological feat, expectations and contributions

- Smarter Planet
- Internet of Things
- Home and Office Automation

Smarter Planet[1]

Internet of Things[1]

Sea, air, land and cyberspace

How do we deal with such an environment

- A qualified leader, first and foremost incorruptible also intelligent at picking its advisor(s) where their interest is to the society, people and the next generation—our children
- What must be done: stringent design, specifications, implementation and management
  - Good start may be is that there is no ifs and buts esp for proponents i.e. governments, enterprises, individuals, aliens, etcetera
  - Develop and follow directions
- Obvious to people and their concern will be: utility (reliable, it must be there when they want or need it) & safety (resilient and protected all the time)

Why computing facility not otherwise

- Think what you would like to do to your computing systems
  - As an individual practitioners e.g. developer, engineer, integrator
  - As contributor of your organization
- Your computing system facilitates
  - Businesses and activities e.g. processes on pre- and current-electronic era
    - Must be straightforward, not crooked

EQ on computing systems

- Efficiency Quotient
  - Must be higher than those that do not see/realize it
  - Continue to improve processes
  - Efforts must be productive, proponents, sometimes if not always, have to incur additional expense
  - Benefit is outright to the people and their company

What is not EQ

- When computers add to the organizations problem
- Computers are understood to be cost center
- Processes are not so different from those of pre-electronic era
- Computers as merely word processing and spreadsheet devices
- Key people are not ready to deal with their organization's need with computers
- The boss is not so good at coordinating the logic behind computing systems
- Computers not aiding the business and activity required by the people, workplace and their organization
- Computing systems are disperse, no coherent purpose to the stakeholders

One thing of my IT/cyberstrategy and consultancy work is 8Ps & AIM requirements

Purpose (Initiative)
People (Strategy and Specification)
Product (Architecture and Technology)
Policy (Standard, Rule and Law)
Process (Action)
Procurement (Acquisition) → Implementation / Management
Period (Time)
Produce (Successful Goal)

Information society[1]

- A significant economic, political, and cultural activity where there is creation, distribution, use, integration and manipulation of information.
- Gaining competitive advantage internationally, through using **information technology** (IT) in a **creative and productive** way.

Information technology[1]

- The application of computers and telecommunications equipment to store, retrieve, transmit and manipulate data often in the context of a business or other enterprise.
- It also encompasses other information distribution technologies such as television and telephones.
- Several industries are associated with information technology, including computer hardware, software, electronics, semiconductors, internet, telecom equipment, e-commerce and computer services.

IT categories[1]

- Techniques for processing
- The application of statistical and mathematical methods to decision-making
- The simulation of higher-order thinking through computer programs

Worldwide IT spending forecast ($BN)[1]

Category	2012 spending	2013 spending
Devices	627	666
Data center systems	141	147
Enterprise software	278	296
IT services	881	927
Telecom services	1,661	1,701
Total	3,588	3,737

Q&A

Thanks for listening.

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or the shorter bit.ly/bitsandticks