ECE 101, Lecture 2:

History, Map, and Keywords in Computing

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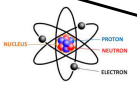
History, Map, and Keywords in Computing

Time



- We will travel through time:
- Starting from electricity and signals to today's self driving cars …
- Our goal is to get a bird's eye-view of the whole course

History, Map, and Keywords in Computing

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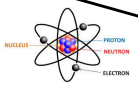
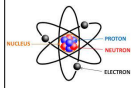
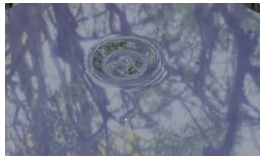


- We will travel through time:
- Starting from electricity and signals to today's self driving cars …
- Our goal is to get a bird's eye-view of the whole course
  - We will meet the computer and the Internet …
  - And many other important milestones in the path
  - So, let's get started.

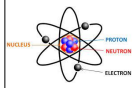
Time



- Electricity can be thought of as waves (like ripples on water)
- When you speak, your throat creates such ripples in the air
  - Your ear senses the air vibrations (your ear-hairs vibrate)
  - They in turn create another form of waves in your nerves
  - These are electro-magnetic signals that reaches your brain
  - You brain interprets the electricity as sound and speech



Time



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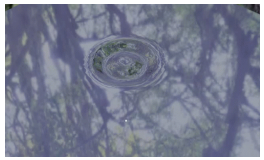
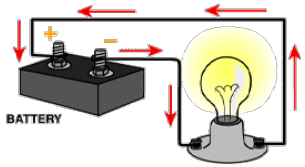


- The same electricity can also flow through wires …
- and give us light or charge our phones
- Electricity often called electrical signals



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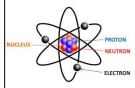

- Electric signals can be thought of as waves (like ripples in water)
- When you speak, your throat creates such ripples in the air
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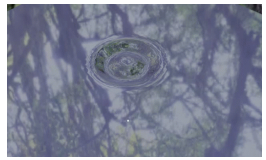
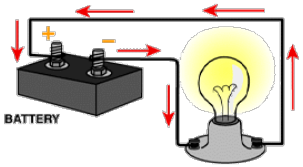
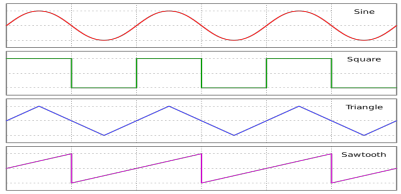


- Electricity also flows through wires …
- Lights up our homes or charges our phones
- Electricity often called electrical signals



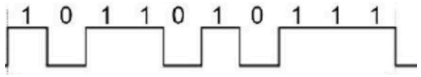
- Henceforth, when we think of signals, let's picture this:



- From lecture #1, we wanted to express information as bits
- We understand the concept of bits … but how do we physically realize them?

- So here is one idea:
- Let's express bits through signals

- Specifically:
  To represent bit = 1 … let signal be HIGH
  To represent bit = 0 … let signal be LOW

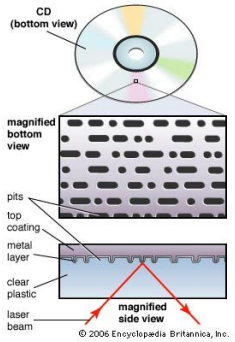


- So, now let's transmit the bit sequence: **1 0 1 1 0 1 0 1 1 1**

- Now suppose someone sends you this signal.
- What bit sequence is she communicating to you?

Communicated bit sequence =

- I know how to send bits … but where do I store them?
- How about find some natural persisting shape that can be modified
  - Pretend some shape is Bit=1 and some shape is Bit=0
- Store the full bit sequence by modifying the shape
- That means you have "bit memory"



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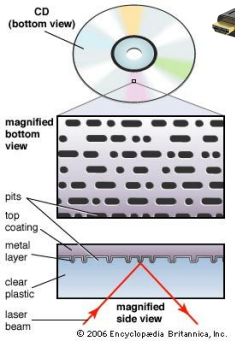
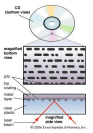
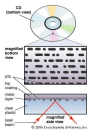


Communicated bit sequence = 0011010011



Communicated bit sequence = 0011010011

- But how does the TV know what to do with the received bits?
- That is, where are the instructions (like, when this happens, do this, else that)



Communicated bit sequence = 0011010011

- But how does the TV know what to do with the received bits?
- That is, where are the instructions (like, when this happens, do this, else that)

Instructions (aka code) can also be expressed in bits … and stored in TVs … and this code can receive bits of data and display on screen

Digital Revolution

Time

Signals → bits → code

memory →

Digital Revolution

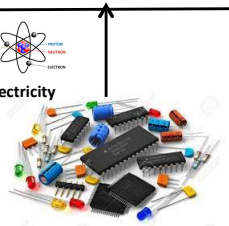
Time

Signals → bits → memory → code

Digital Revolution

Lego building blocks

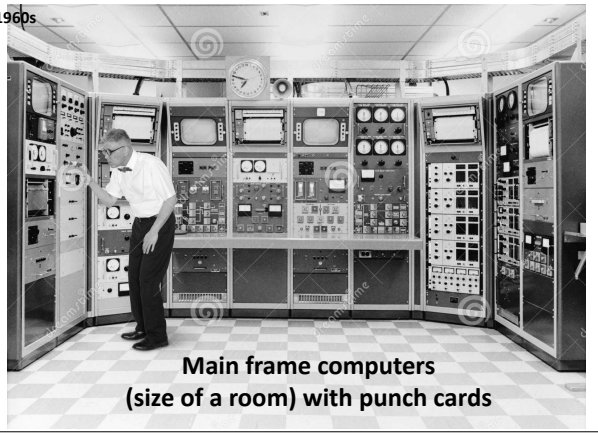
Time



Electricity

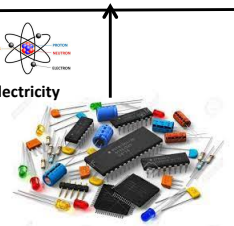
Electronics

1960s



Main frame computers
(size of a room) with punch cards

Time



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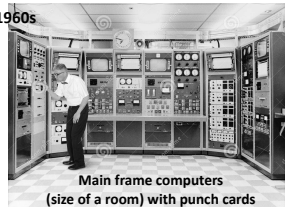
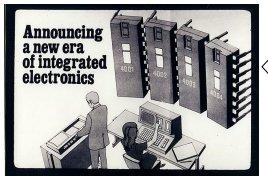
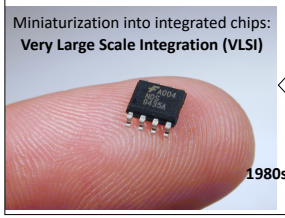


Main frame computers
(size of a room) with punch cards

1970s

Apollo guidance computer





Time

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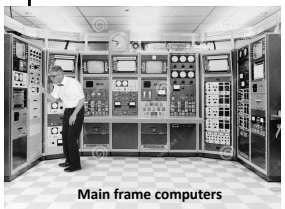

Main frame computers

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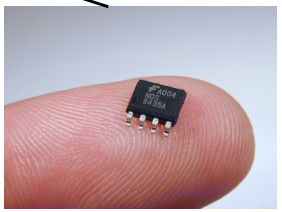


Very Large Scale Integration (VLSI)

Time

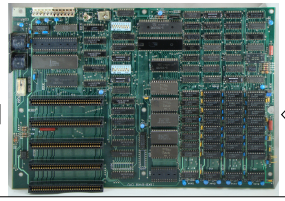
Electricity

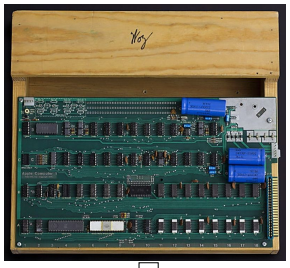
Electronics

VLSI

Main frames

Personal Computers (PCs)





Time

Electricity

Electronics

VLSI

Main frames

PC

Time

Electricity

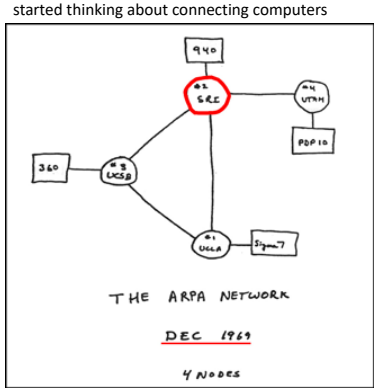
Electronics

VLSI

Main frames

PC

While all this was happening, in parallel, humans started thinking about connecting computers



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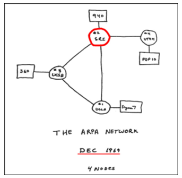
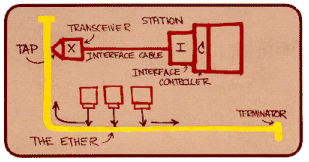




Ethernet: Connecting computers via wires

Channel or medium and access control

1976

Computer Systems — G. Bell, S. Fuller and D. Stewart, Editors

Ethernet: Distributed Packet Switching for Local Computer Networks

Robert M. Metcalfe and David R. Boggs
Xerox Palo Alto Research Center

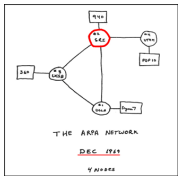
1. Background

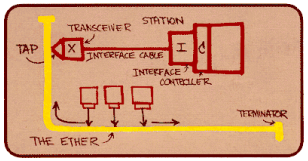
20 milestones in Ethernet's first 40 years

The idea of protocols/code for communication

But why stop at connecting few computers in a lab?

While all this was happening, in parallel, humans started thinking about connecting computers





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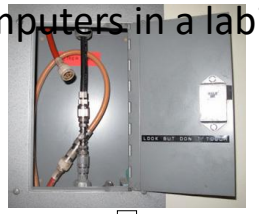
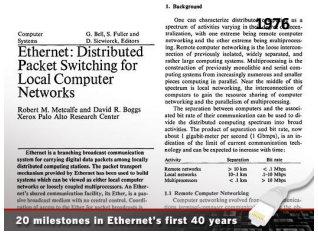


Channel or medium and access control



The idea of protocols/code for communication

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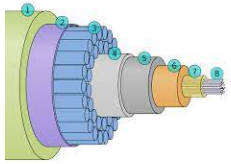
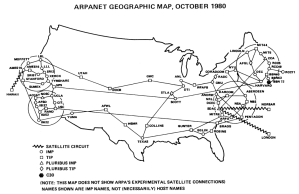
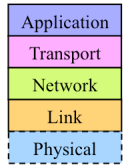
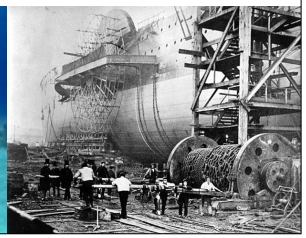
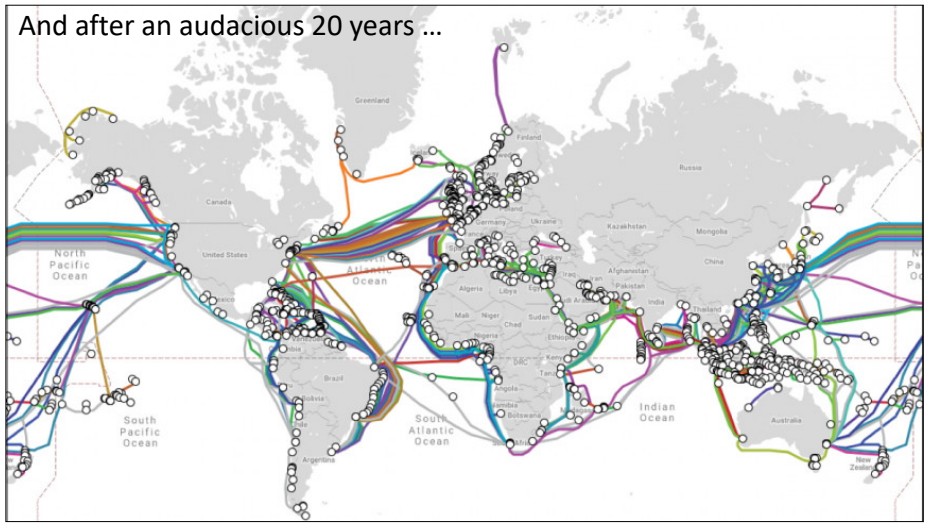


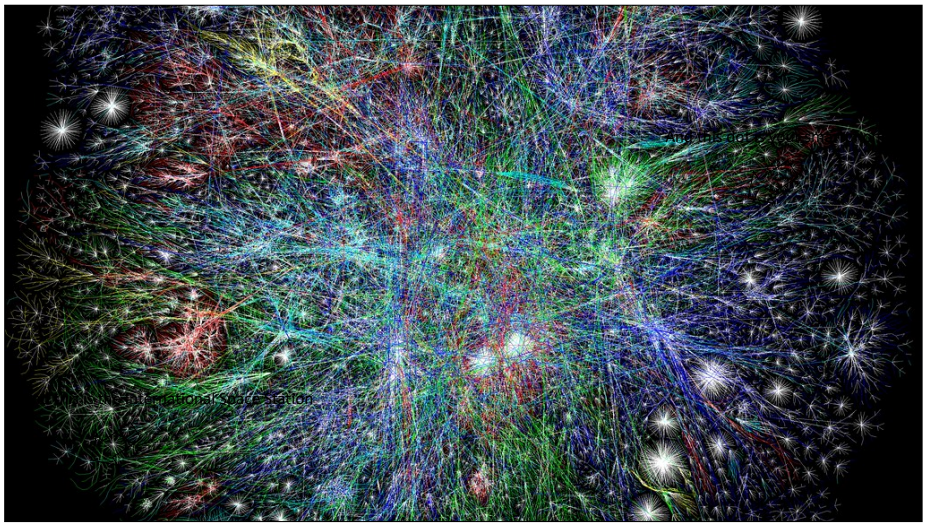


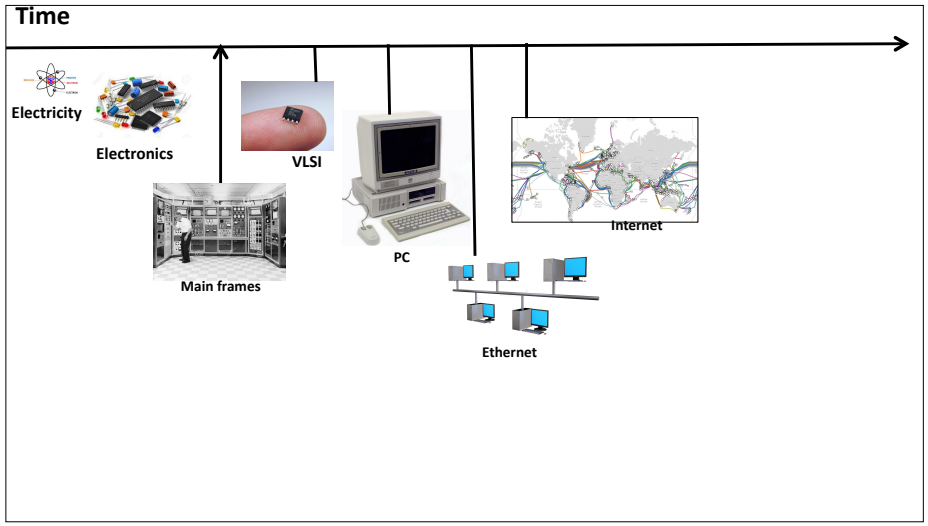


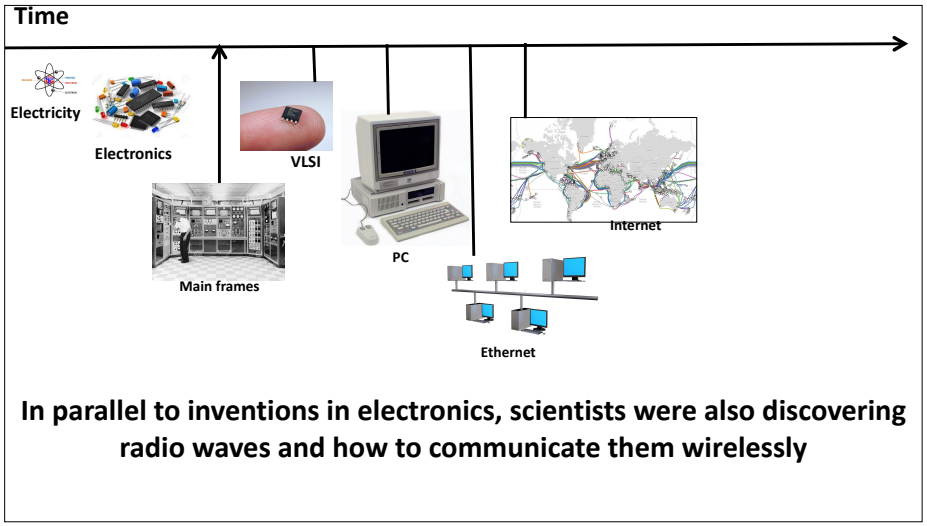


And after an audacious 20 years …






Time
Electricity
Electronics
VLSI
Main frames
PC
Internet
Ethernet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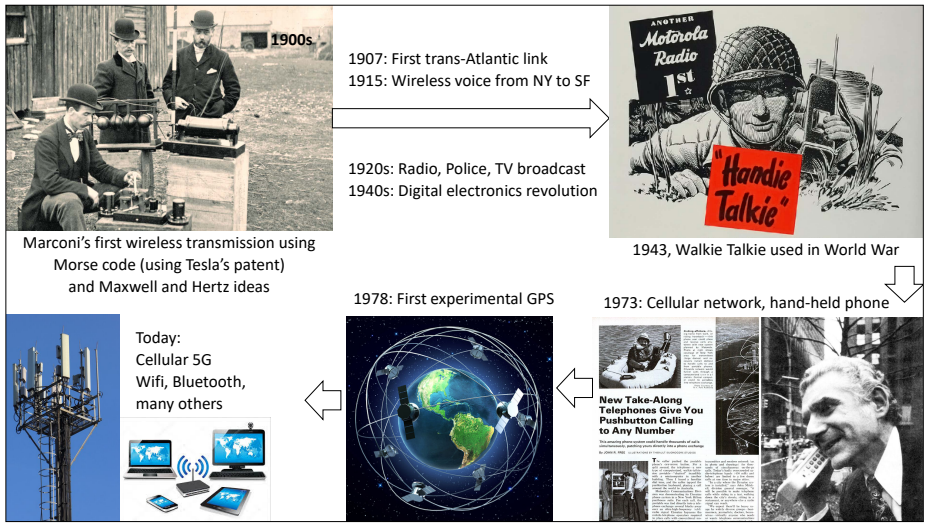
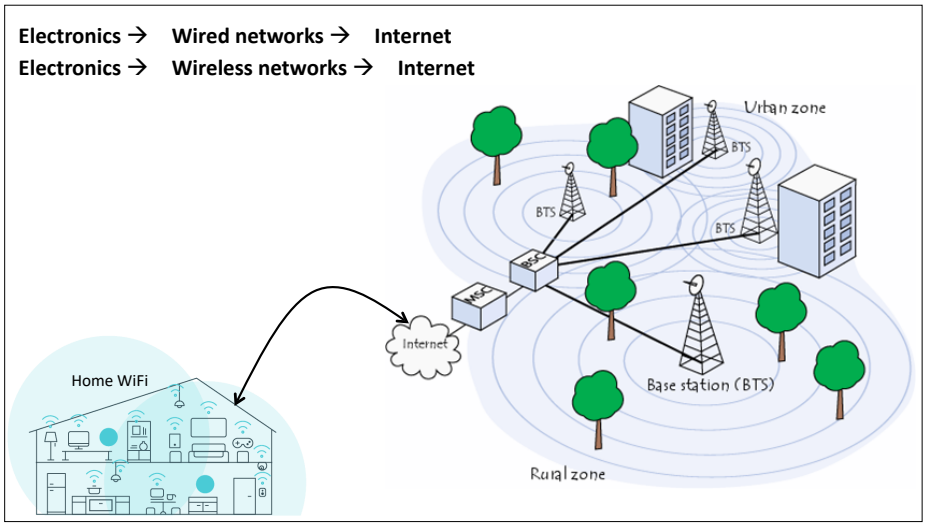
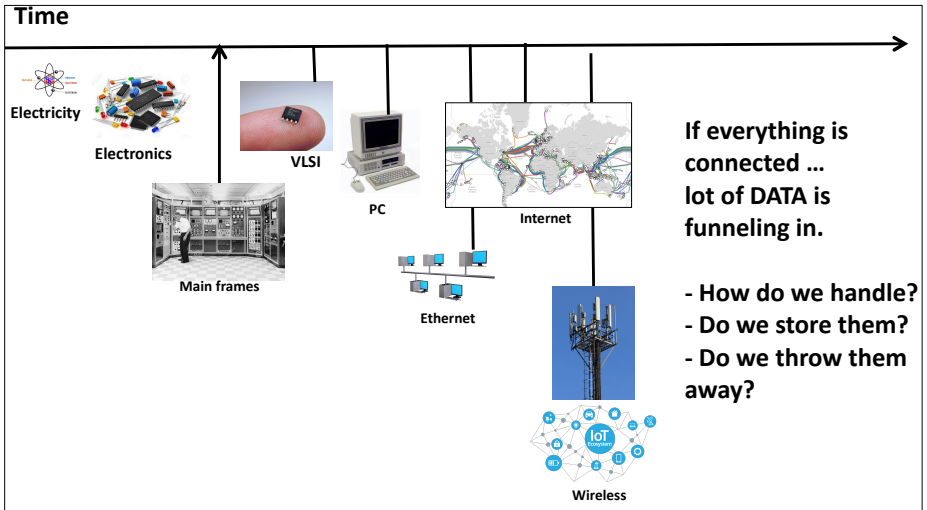
In parallel to inventions in electronics, scientists were also discovering radio waves and how to communicate them wirelessly


1900s
Marconi's first wireless transmission using Morse code (using Tesla's patent) and Maxwell and Hertz ideas
1907: First trans-Atlantic link
1915: Wireless voice from NY to SF
1920s: Radio, Police, TV broadcast
1940s: Digital electronics revolution
Motorola Radio 1st
"Handie Talkie"
1943, Walkie Talkie used in World War
1973: Cellular network, hand-held phone
New Take-Along Telephones Give You Pushbutton Calling to Any Number
1978: First experimental GPS
Today:
Cellular 5G
Wifi, Bluetooth,
many others


Electronics → Wired networks → Internet
Electronics → Wireless networks → Internet
Urban zone
BTS
BTS
BTS
MSC
Internet
Base station (BTS)
Rural zone
Home WiFi

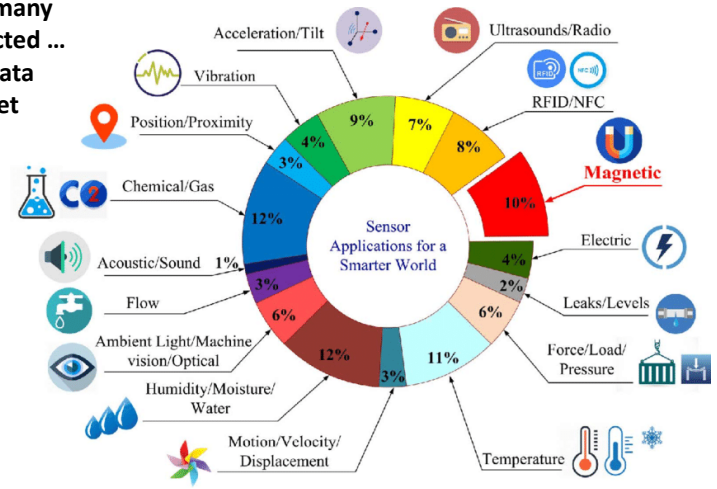
Electronics → Wired networks → Internet
Electronics → Wireless networks → Internet
Which means everything is connected via the Internet: Internet of Things (IoT)



If everything is connected … lot of DATA is funneling in.

- How do we handle?
- Do we store them?
- Do we throw them away?

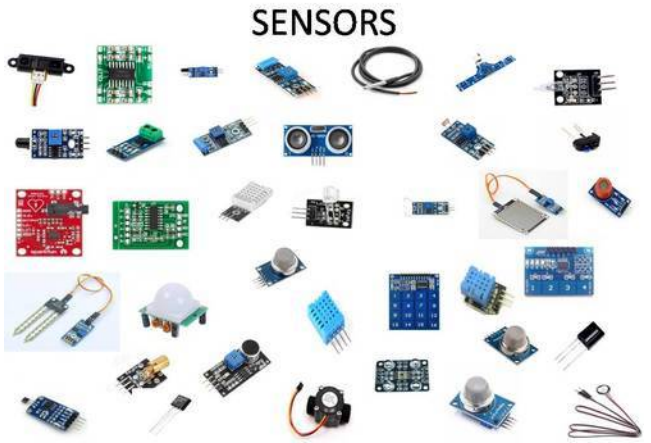
IOT has many many sensors connected … all streaming data into the Internet

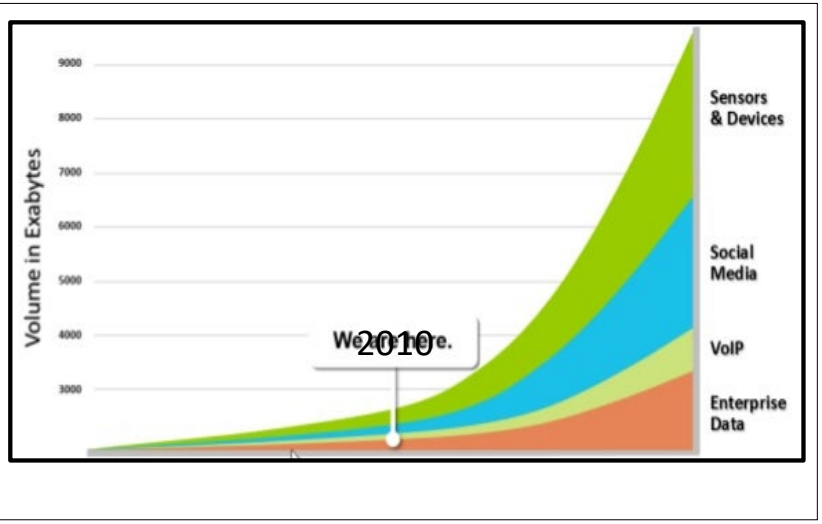


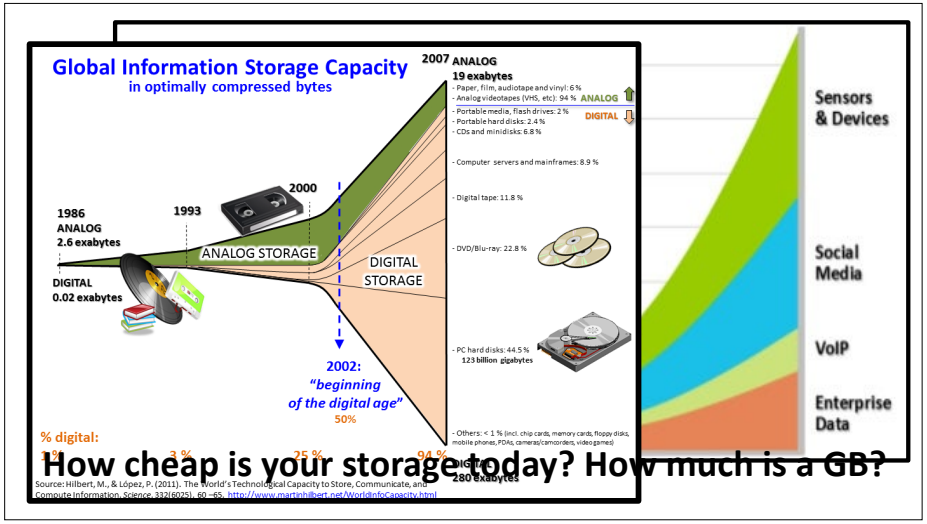
IOT has many many sensors connected … all streaming data into the Internet

Again, VLSI and advance battery technology helping.

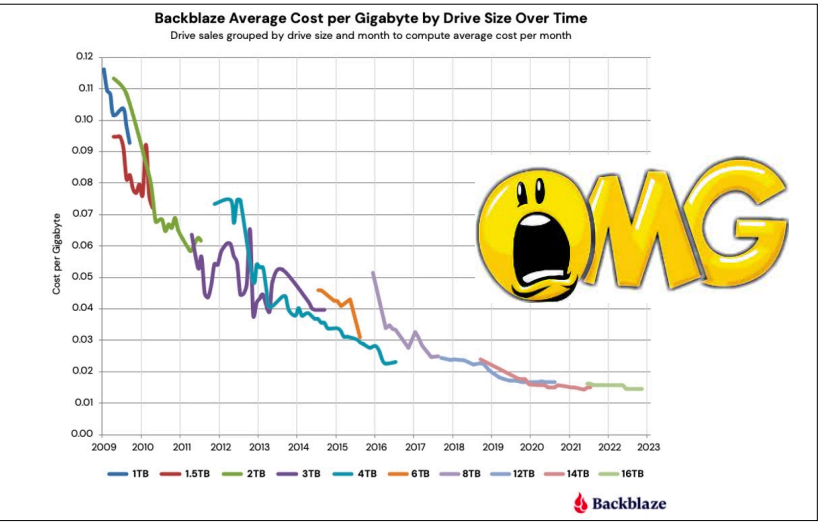
Wireless allowing sensed data to be sent to Internet

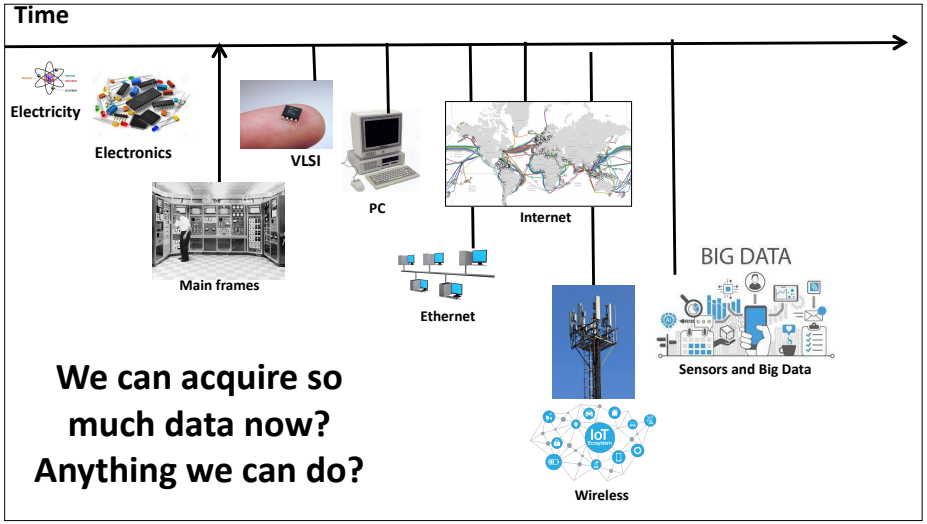






How cheap is your storage today? How much is a GB?





One idea: Can data help computers get smarter?
Consider the task of a computer recognizing a face in a picture

How would you make the computer recognize a face?

Past approaches:
Specify the rules to identify a face
Make the computer look for these rules (or "Features")

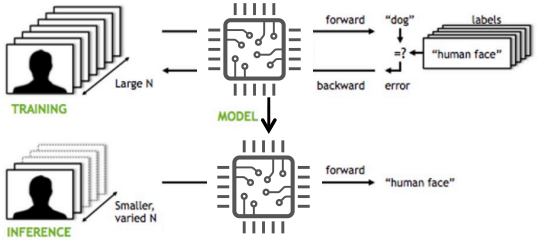
Rules could be:
1. two symmetric black curves (eyebrows)
2. two black dots below the curves (iris)
3. two small dots close to the middle (nostrils)
...
1000. slight darkness below the chin (shadow)

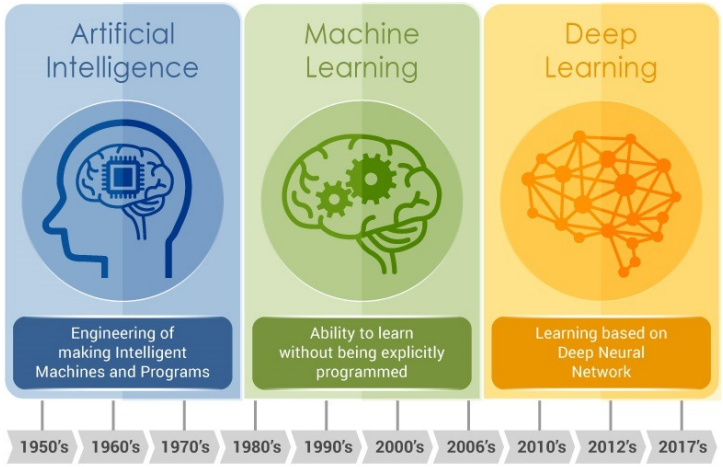
Does this work?

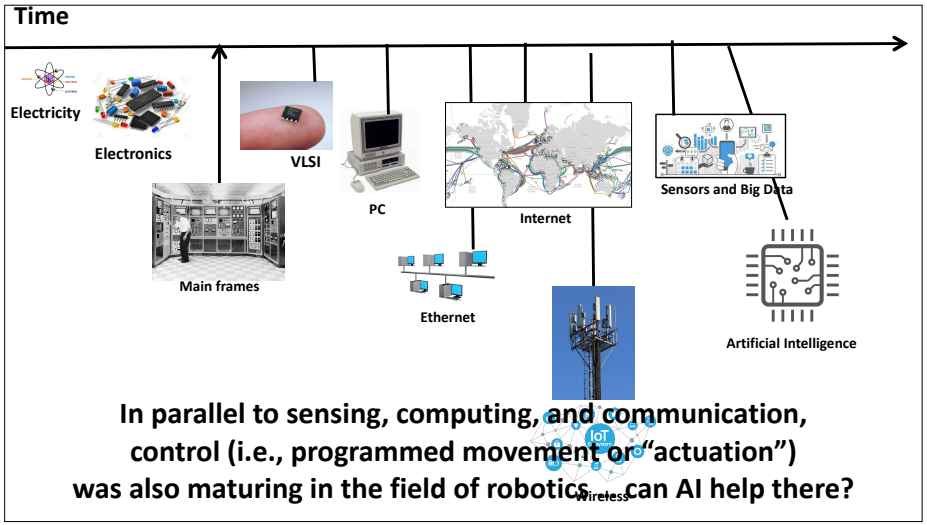
One idea: Can data help computers get smarter?
Consider the task of a computer recognizing a face in a picture

But say you have lots of facial pictures

1. Let the computer figure out which patterns are common across thousands or millions of faces (training data)
2. Remember those patterns (model)
3. When a new face picture (test data) comes, apply those patterns to check if it is a face. Output yes or no.

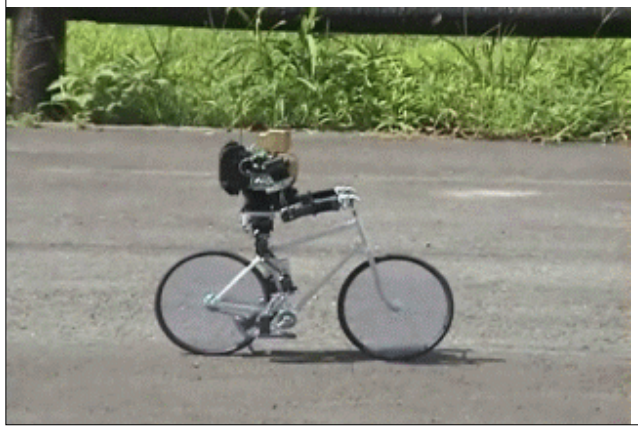






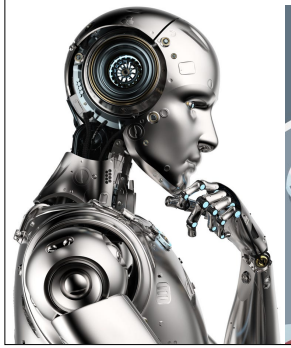
In parallel to sensing, computing, and communication, control (i.e., programmed movement or "actuation") was also maturing in the field of robotics. can AI help there?

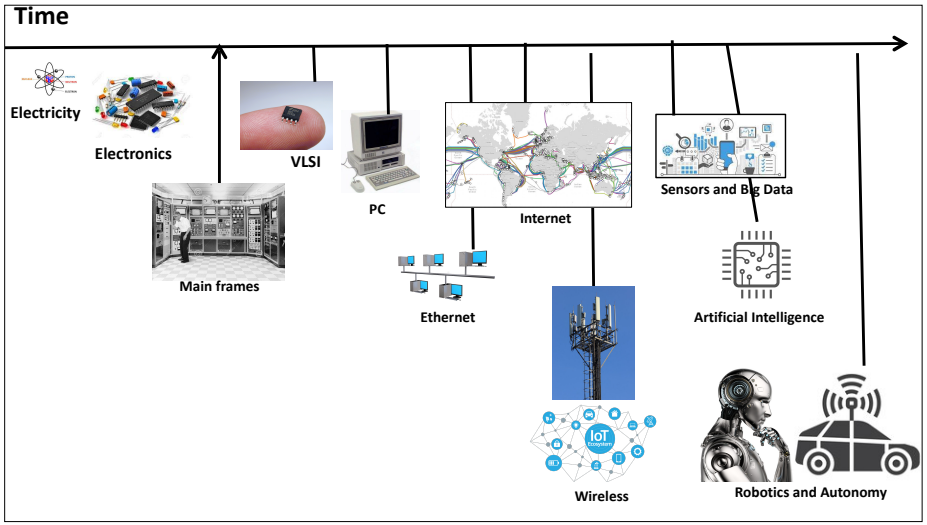
Yes, AI particularly effective when humans don't know why they do what they do (so its hard to teach a computer) …



Yes, AI particularly effective when humans don't know why they do what they do (so its hard to teach a computer) …

And this is where we are today … convergence of
Sense + Compute (AI) + Communicate + Control
using machines that can do things that we cannot explain.
This is the new age of "autonomous systems".





Of course, you are NOT supposed to remember all this …

The goal was to show you the landscape for this ECE 101 course …
and why this could be exciting and relevant to students
of all departments in the campus.

Questions? Comments?