ECE 101, Lecture 2:

History, Map, and Keywords in Computing

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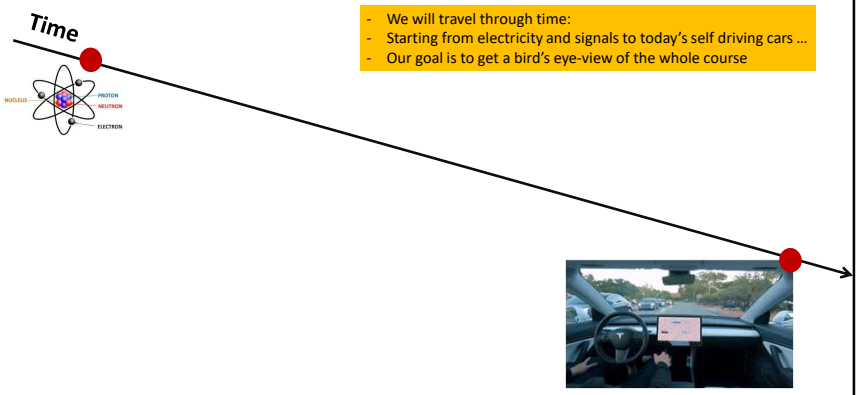
1

History, Map, and Keywords in Computing



- 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

2

History, Map, and Keywords in Computing

- 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.

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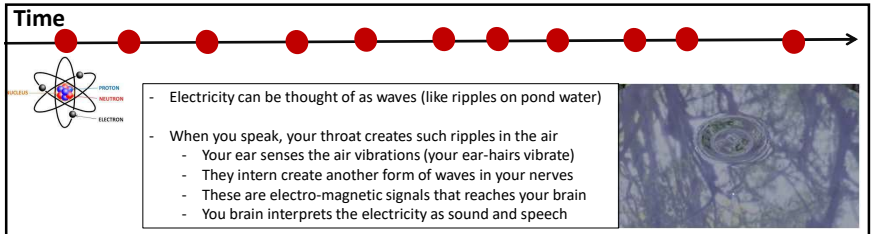
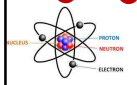


- Electricity can be thought of as waves (like ripples on pond water)
- When you speak, your throat creates such ripples in the air
  - Your ear senses the air vibrations (your ear-hairs vibrate)
  - They intern create another form of waves in your nerves
  - These are electro-magnetic signals that reaches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

4

Time



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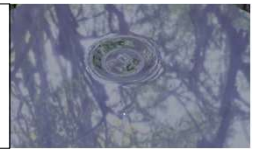
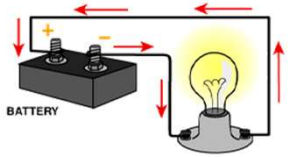


- The same electricity can also flow through wires …
- and give us light or charge our phones
- Electricity often called electrical signals



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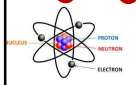
Time



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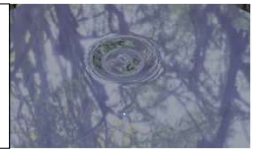

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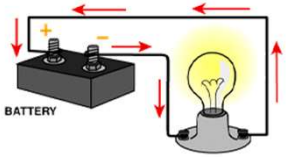
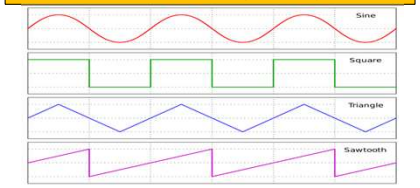


- Henceforth, when we think of signals, let's picture this:



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- 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

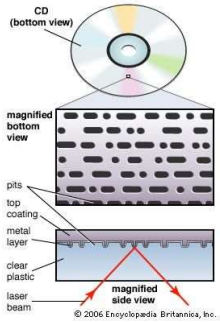
- So, now let's transmit the bit sequence: **1 0 1 1 0 1 0 1 1 1**

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

Communicated bit sequence =

7

- 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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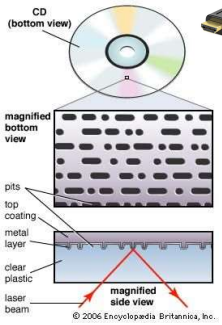

Communicated bit sequence = 0011010011

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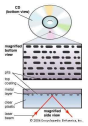

Communicated bit sequence = 0011010011

- 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)

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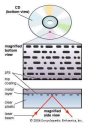


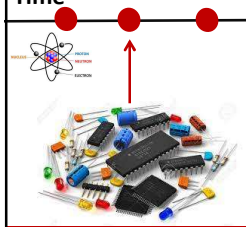
Communicated bit sequence = 0011010011

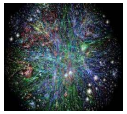
- But how does the TV know what to do with the received bits?
- That is, where are the instructions (like, when this happens, do this, else that)

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

11





Time

Signals → bits → memory → code

Digital Revolution

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Time
Signals → bits → memory → code
Digital Revolution
Lego building blocks

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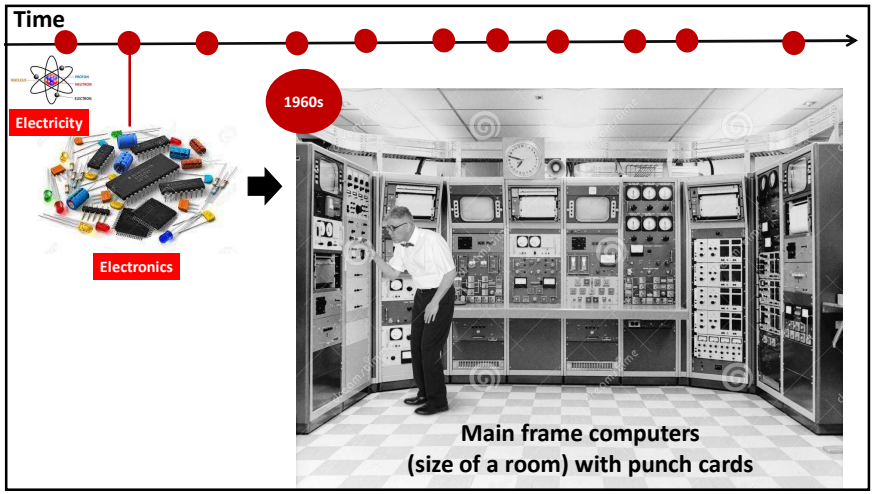
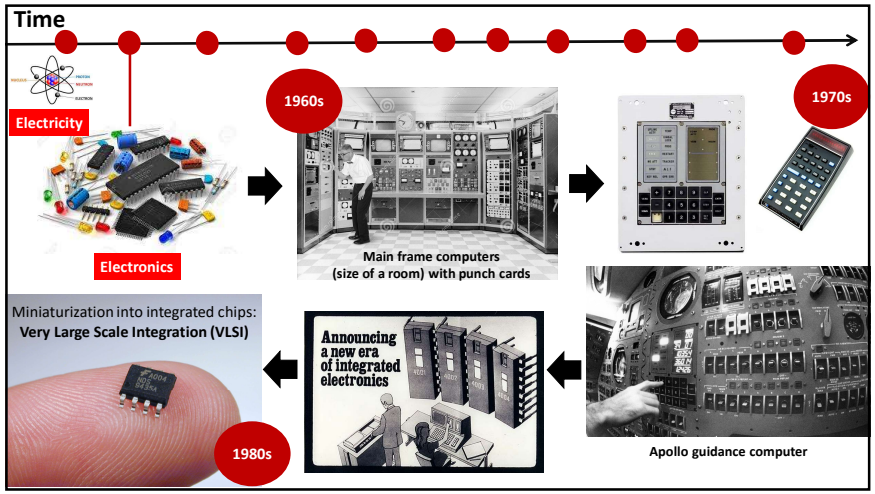

Time
Electricity
Electronics
1960s
Main frame computers
(size of a room) with punch cards

14


Time
Electricity
Electronics
1960s
Main frame computers
(size of a room) with punch cards
1970s
Apollo guidance computer
Announcing a new era of integrated electronics
Miniaturization into integrated chips:
Very Large Scale Integration (VLSI)
1980s

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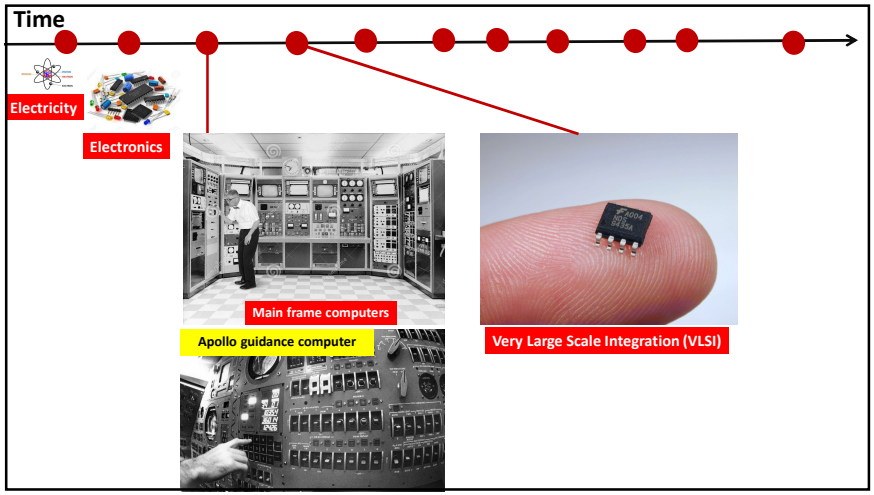
Time
Electricity
Electronics
Main frame computers
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Very Large Scale Integration (VLSI)

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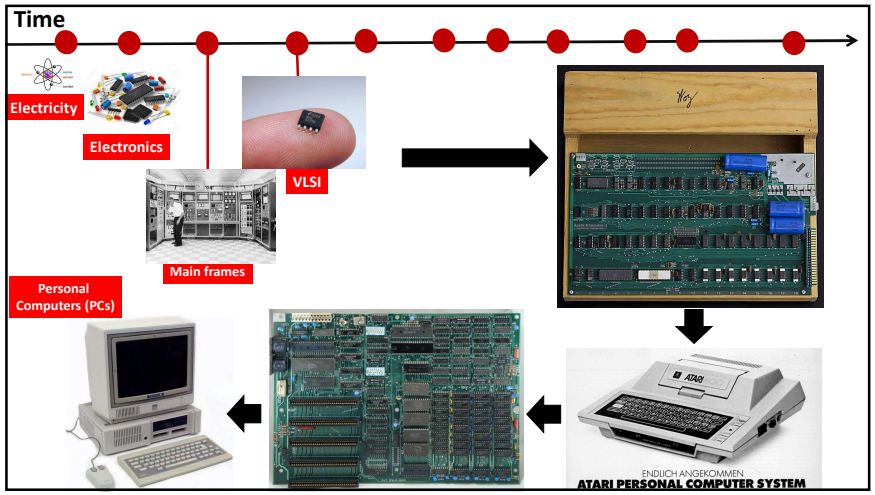
Time
Electricity
Electronics
VLSI
Main frames
Personal Computers (PCs)
ENDLICH ANGEKOMMEN
ATARI PERSONAL COMPUTER SYSTEM

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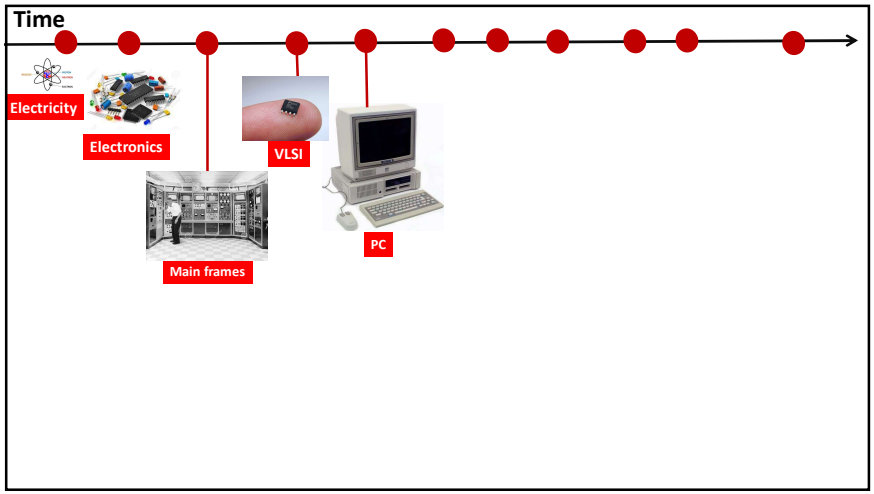
Time
Electricity
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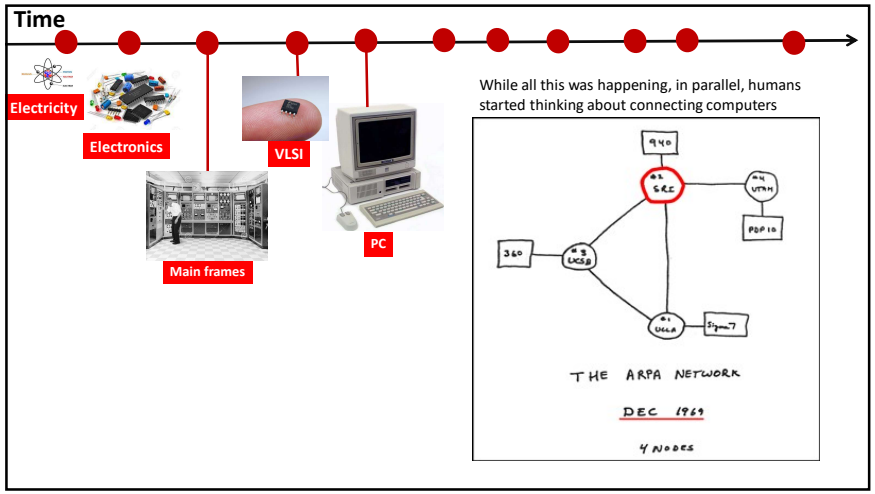
Time
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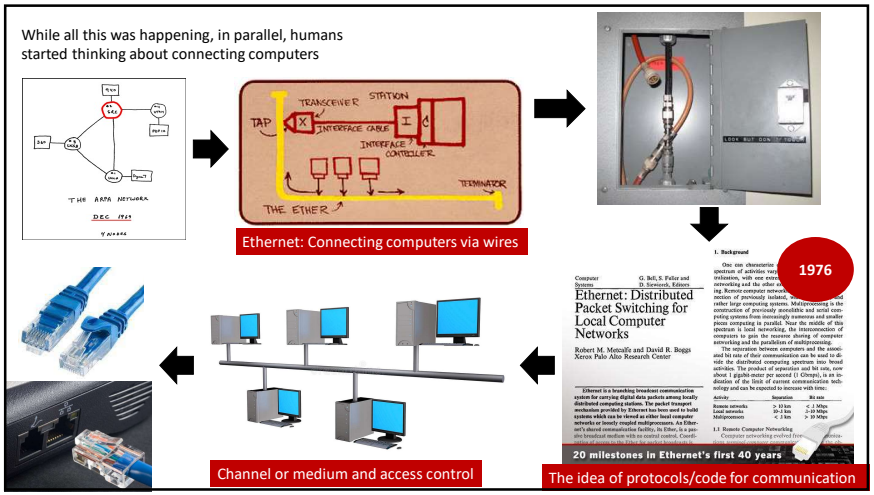
Main frames
While all this was happening, in parallel, humans started thinking about connecting computers
THE ARPA NETWORK
DEC 1969
4 NODES

19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THE ARPA NETWORK
DEC 1969
4 NODES
TRANSCEIVER
STATION
TAP
INTERFACE CABLE
INTERFACE CONTROLLER
TERMINATOR
THE ETHER
Ethernet: Connecting computers via wires
1976
Ethernet: Distributed Packet Switching for Local Computer Networks
Robert M. Metcalfe and David R. Boggs
Xerox Palo Alto Research Center
20 milestones in Ethernet's first 40 years
Channel or medium and access control
The idea of protocols/code for communication

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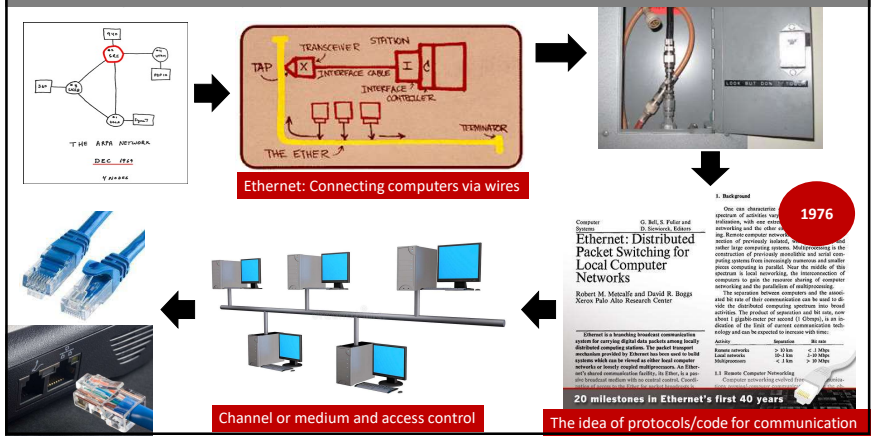
But why stop at connecting few computers in a lab?



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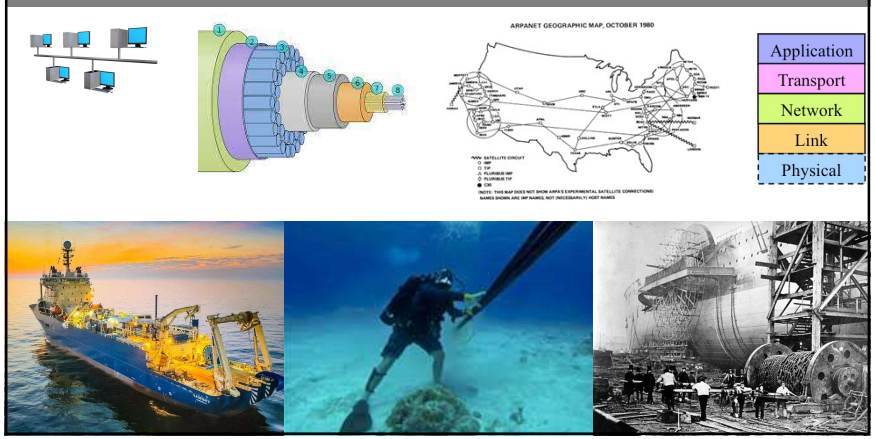

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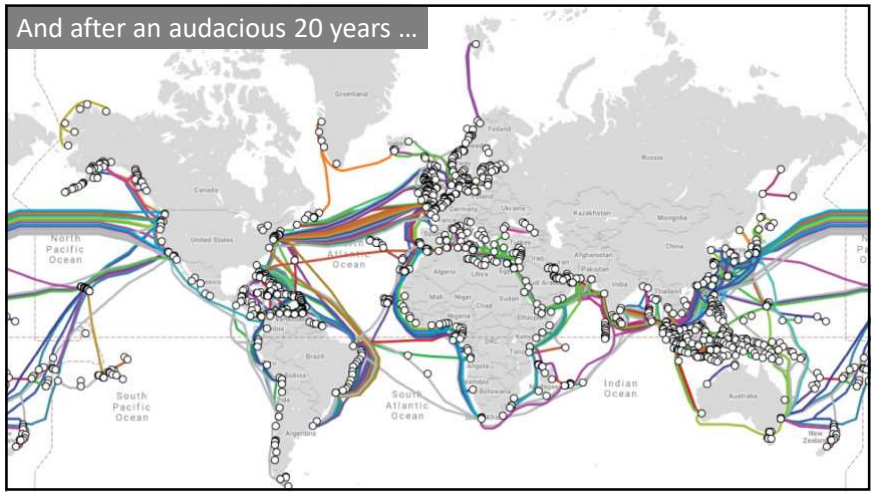
And after an audacious 20 years …



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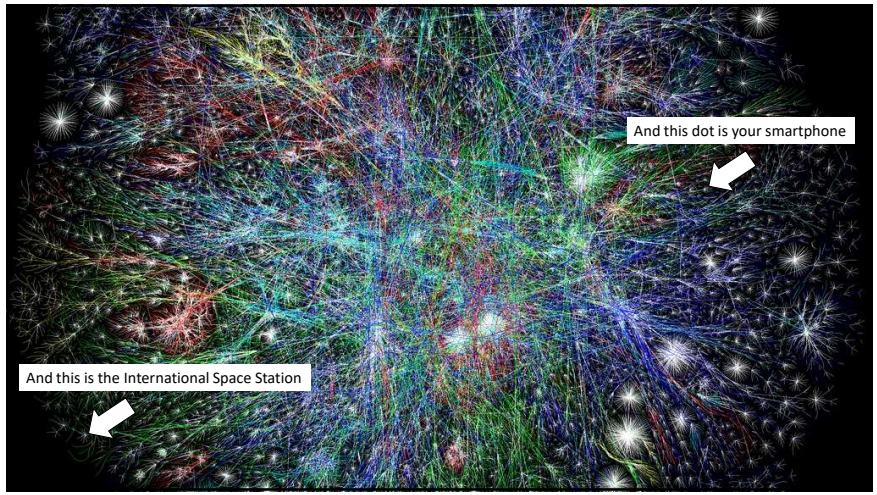

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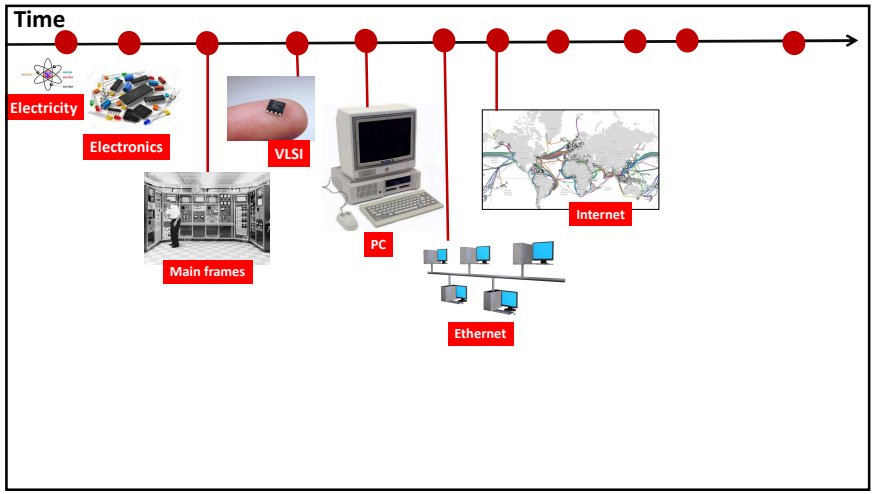

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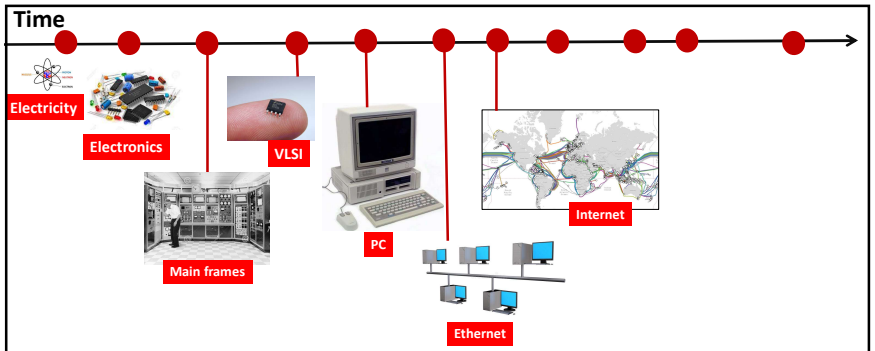

In parallel to inventions in electronics, scientists were also inventing radio waves and how to communicate them wirelessly

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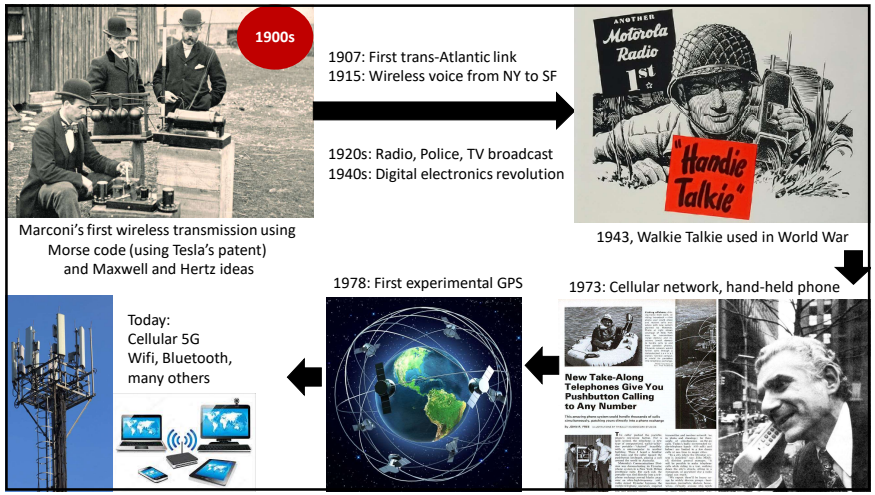

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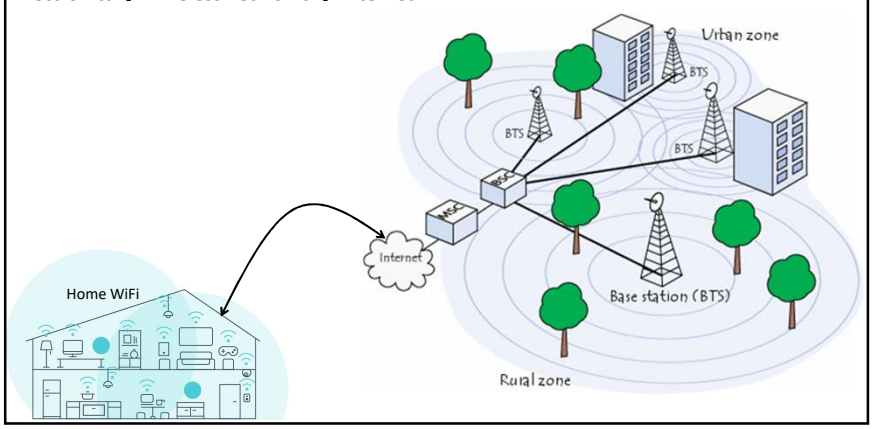
Electronics → Wired networks → Internet
Electronics → Wireless networks → Internet



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

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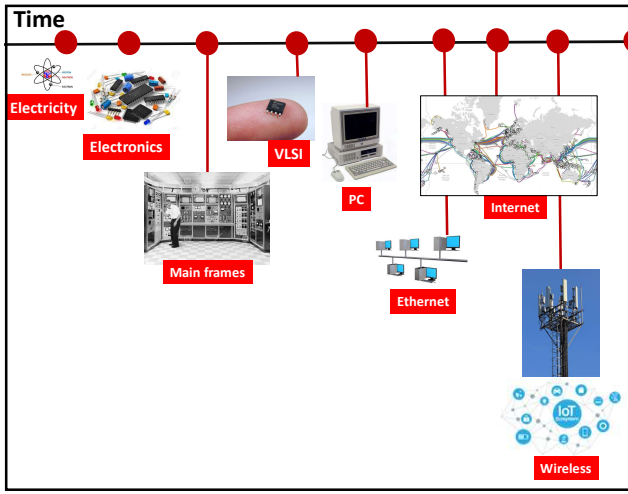
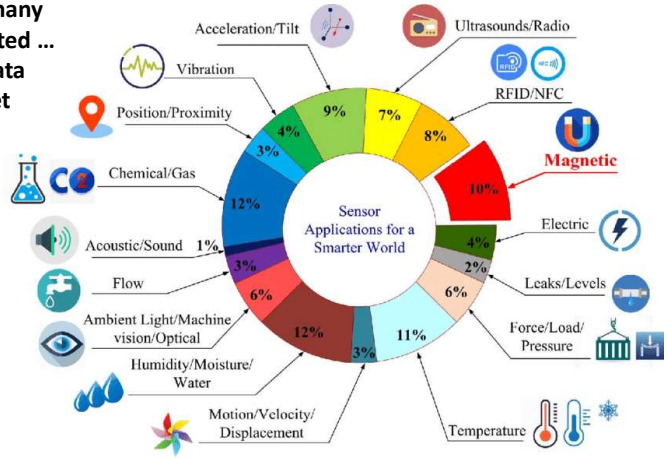


If everything is connected … lot of DATA is funneling in.

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

30

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



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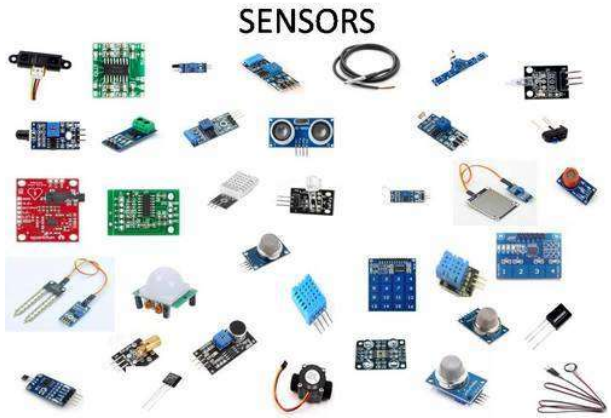
IOT has many many sensors connected … all streaming data into the Internet

Again, VLSI and advance battery technology helping.

Wireless allowing sensed data to be sent to Internet



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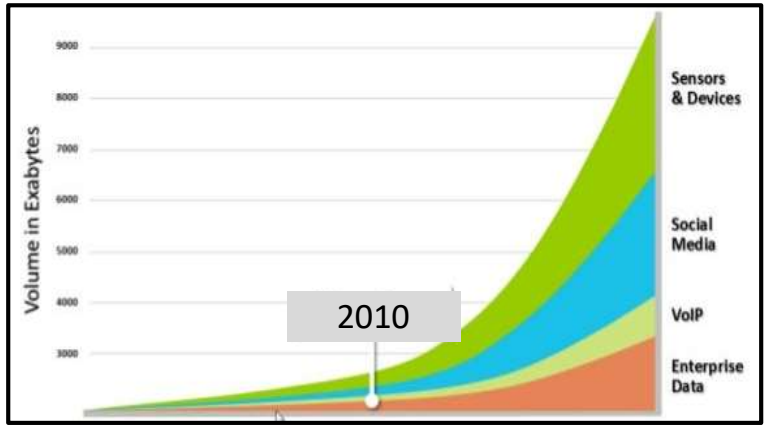

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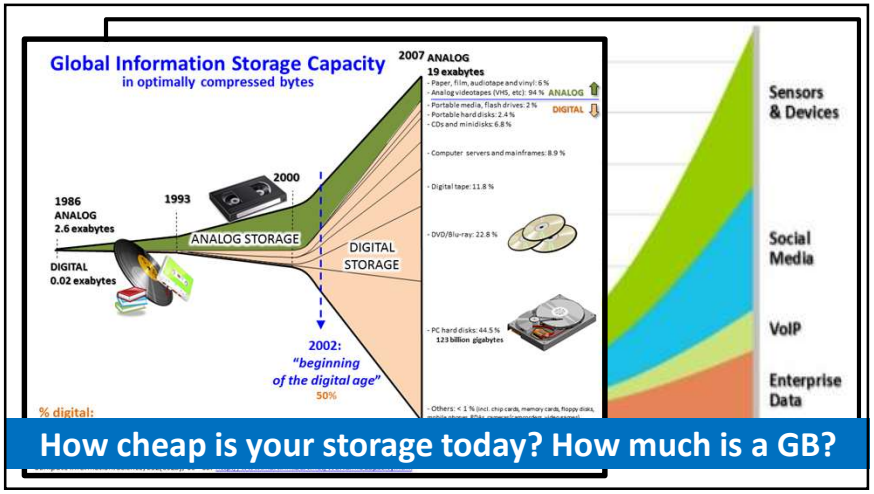
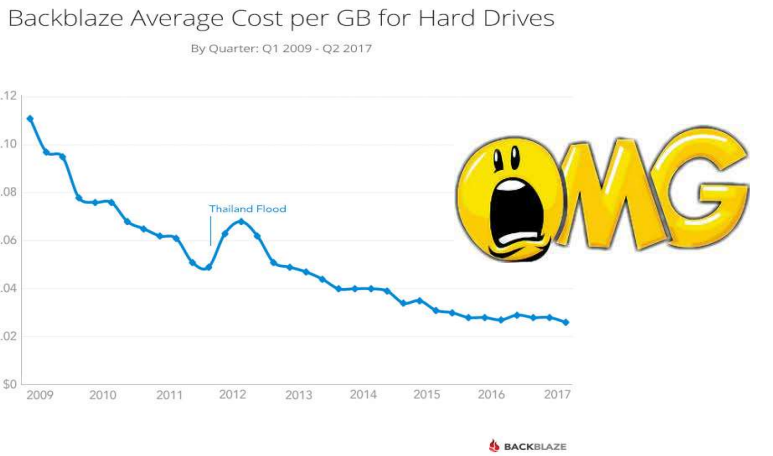


How cheap is your storage today? How much is a GB?

34



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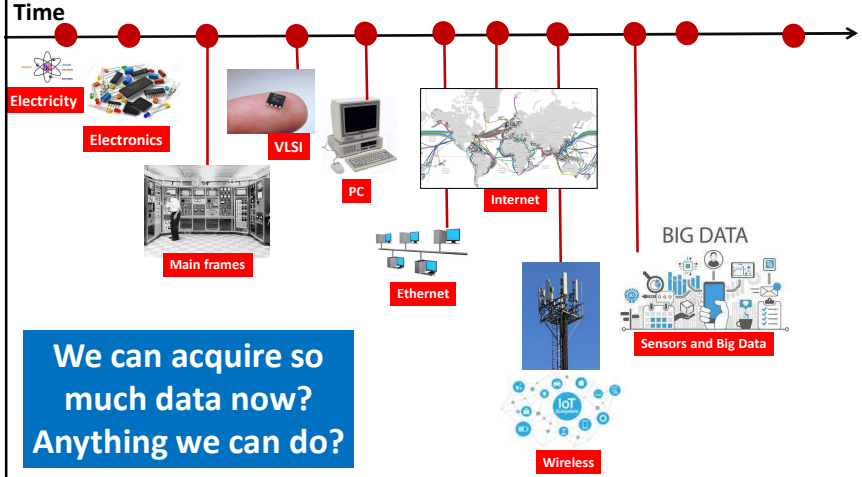

We can acquire so much data now? Anything we can do?

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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?

37

One idea: Can data help computers get smarter?
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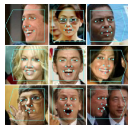
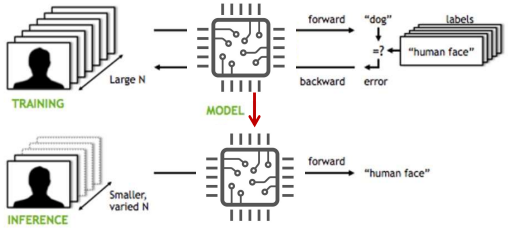


But say you have lots of facial pictures

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.



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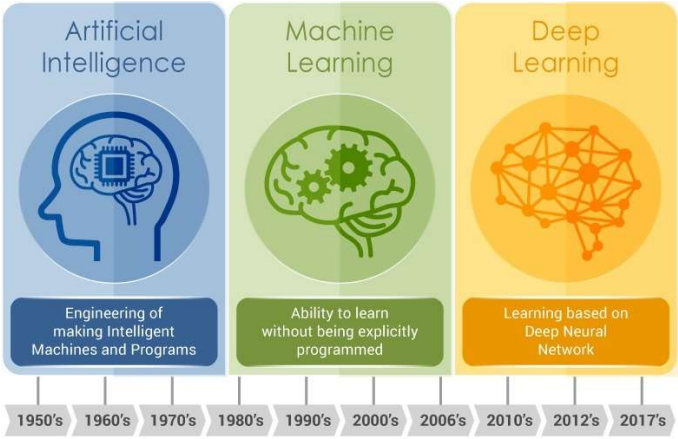

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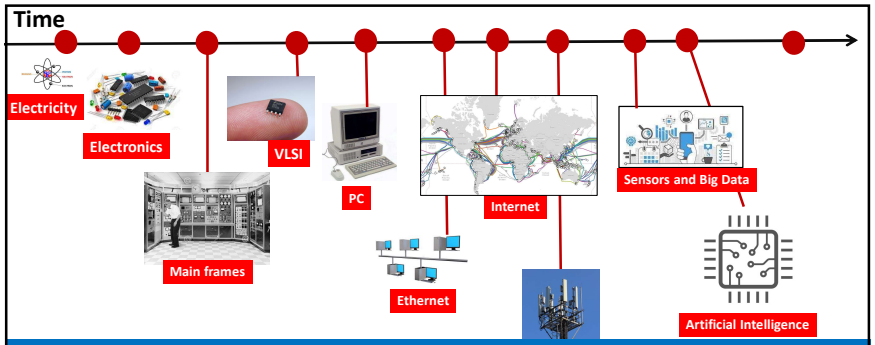

In parallel to sensing, computing, and communication, control (i.e., programmed movement or "actuation") was also maturing in the field of robotics … can AI help there?

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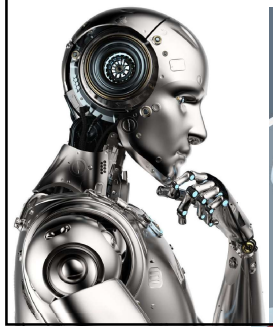
Yes, AI particularly effective when humans don't know why they do what they do (so its hard to teach a computer) …

41

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

42

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".



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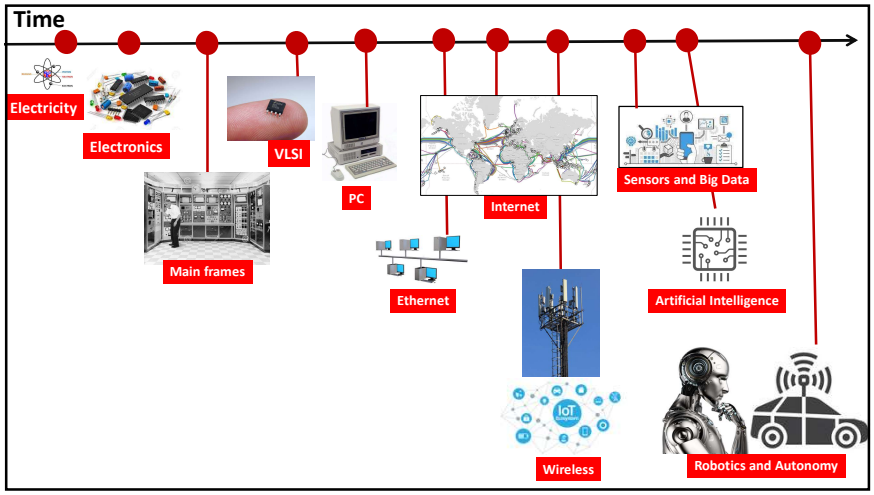

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Of course, you are NOT supposed to remember all this …

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.

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Questions? Comments?

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Slide Junkyard Beyond This Point

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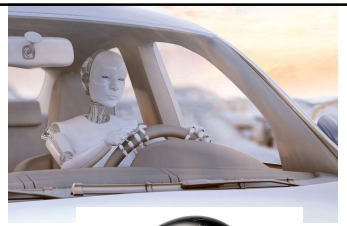

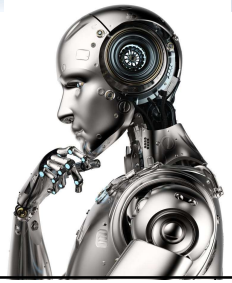

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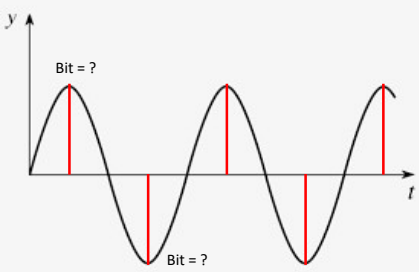
- From lecture #1, we wanted to express information as bits
- So here is one idea:
  When signal > 0 … let's pretend Bit = 1
  When signal < 0 … let's pretend Bit = 0

- Now let's sample the signal periodically. What do we get?

- What would be the signal for this bit sequence: 01100



Communicated bit sequence = ?????