


Released  
Sept 1975




# ECE401

## Perspectives In Electrical and Computer Engineering

### Lecture 2

<https://www.youtube.com/watch?v=P8ti1hnLiLw>



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## Last Time

- Introductions
  - Who are Armata Kumari and Chris Foster?
  - Who is Professor Messner?
- Classroom Rules
- Material Delivery Methods
- Syllabus Overview
- A personal story and some tips

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# Today

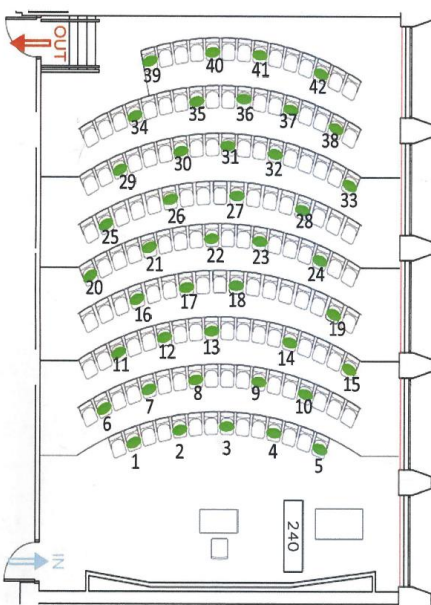
- Class seating issue
- ECE Engineering Programs at UNH
- Discussion Forum
  - Virtual Introductions
  - What will computers look like in the year 2060?
- A bit on Computer Evolution

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Slide 3

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PRINT NAME CLEARLY

| SEAT | STUDENT                 |
|------|-------------------------|
| 1    | Matt Hamilton           |
| 2    | Adnan Livadi            |
| 3    | Sam ARAVIO              |
| 4    | Joel Pentland (OLD CAB) |
| 5    |                         |
| 6    | Elijah Balsam           |
| 7    |                         |
| 8    |                         |
| 9    |                         |
| 10   | Amy Prondergast         |
| 11   |                         |
| 12   | Philip McKendall        |
| 13   | Savannah mato           |
| 14   | Zahira Candia           |
| 15   | Owen Gormley            |
| 16   | Nicholas Snyder         |
| 17   | Jeremiah Audette        |
| 18   | Kara Staples            |
| 19   | Michaela Power          |
| 20   | Sean Gannistrass        |
| 21   | Sara Shea               |
| 22   | Devin Eaton             |
| 23   |                         |
| 24   | Aaron Bateman           |
| 25   | Noah Grove              |
| 26   | Jalen Lacasse           |
| 27   | Michael Crawley         |
| 28   |                         |
| 29   | Liam Corbett            |
| 30   | Jared Jacobson          |
| 31   | Luke Syler              |
| 32   | Wyatt Thomsen           |
| 33   | Michael Nerve           |
| 34   | Hunter Wageling         |
| 35   | Sebastian Rohrer        |
| 36   | Alexander Belanger      |
| 37   |                         |
| 38   | Dale Lavoie             |
| 39   | Brooke Muller           |
| 40   | Jacob Bette             |
| 41   |                         |
| 42   | Timothy Onikijuluvu     |

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## Engineering Programs

- What Kind of Electrical and Computer Engineering Programs are available?
  - Electrical Engineering
  - Computer Engineering
  - Software Engineering

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## Electrical Engineering

- Electrical Engineering today is made up of two areas typically called:
  - Electrical Engineering
  - Computer Engineering
- An avalanche of technological advances in the area of digital (or if you prefer “Computer”) design over the years has forced the development of two distinct degree programs at many universities

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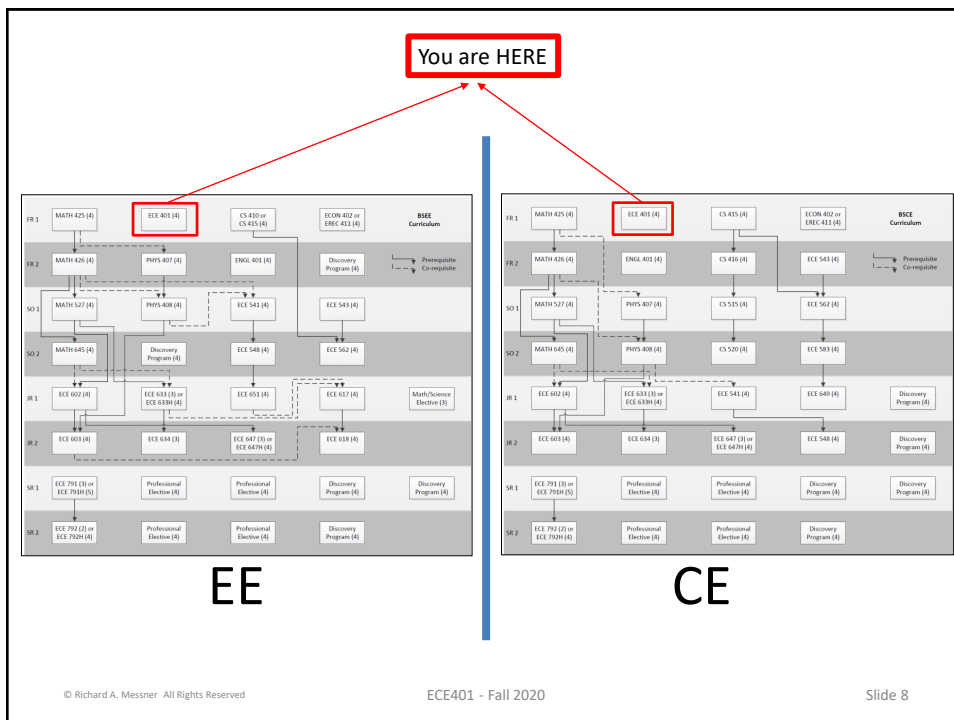
6

# Two Programs At UNH

EE – Electrical Engineering

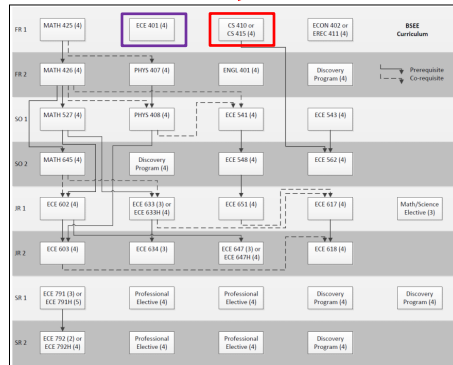
CE – Computer Engineering

7

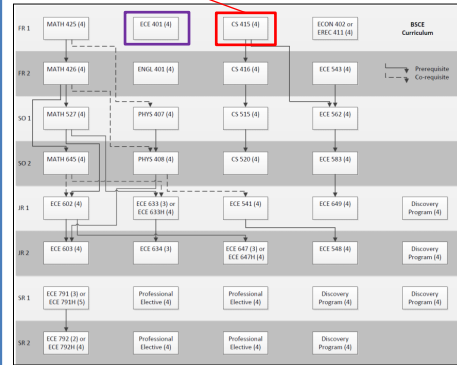


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If you are a EE and there is a possibility of you changing from CE you should take CS415 instead of CS410



EE



CE

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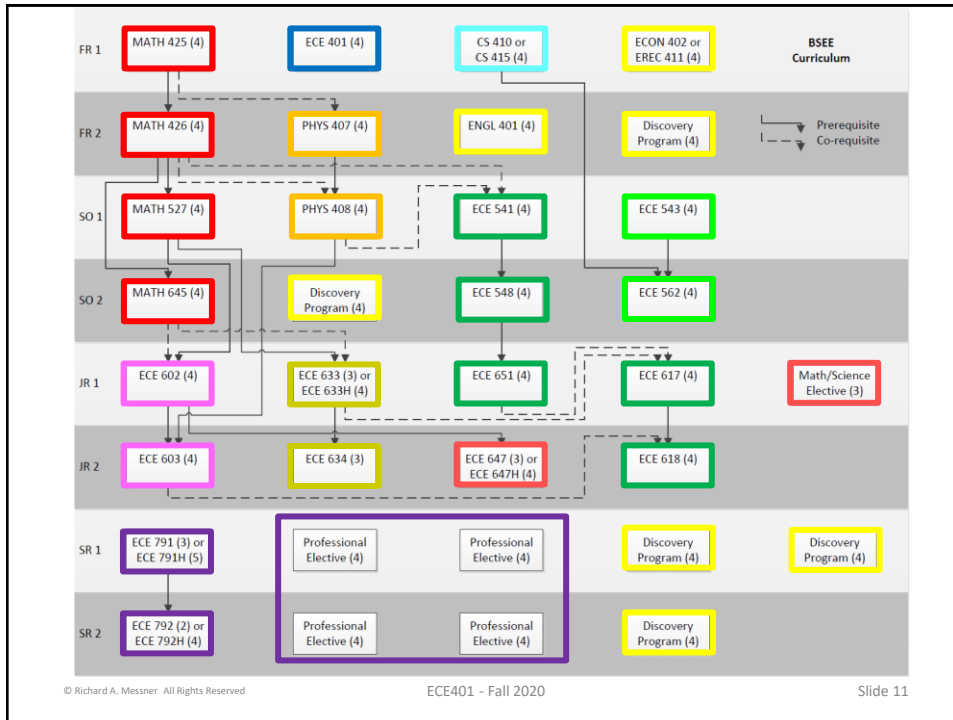
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# ELECTRICAL ENGINEERING

AT UNH

<https://ceps.unh.edu/electrical-computer-engineering/program/bs/electrical-engineering-major>

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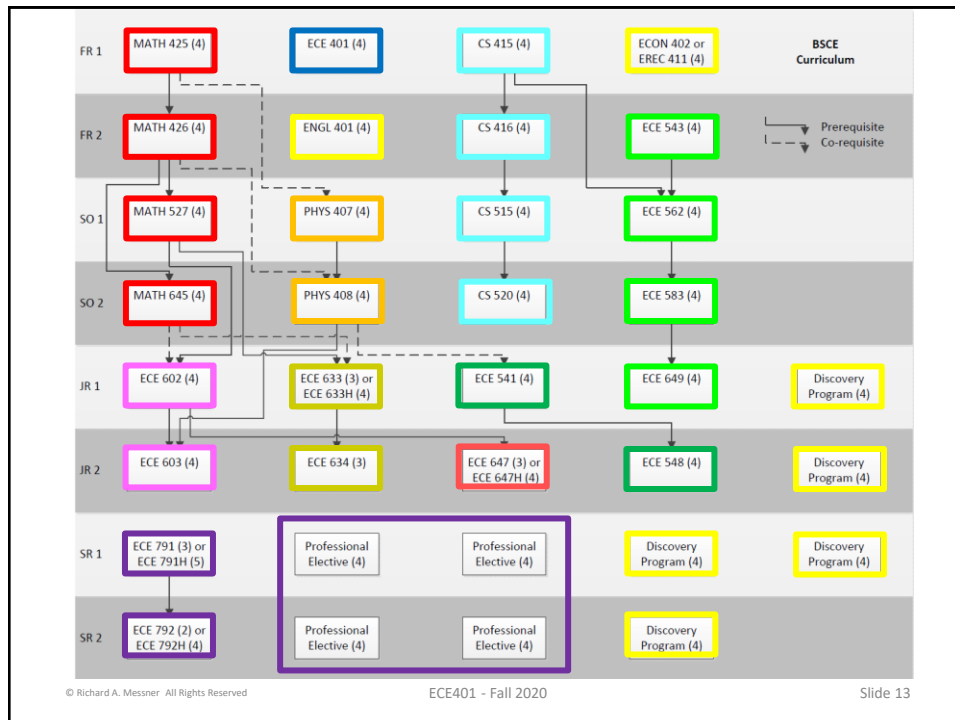
11

# COMPUTER ENGINEERING

AT UNH

<https://ceps.unh.edu/electrical-computer-engineering/program/bs/computer-engineering-major>

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## Engineering at UNH

- Now you know what Electrical Engineering is a UNH (well at least on paper)
  - The rest of this course is designed on the principles of “active learning” (i.e., the thought that students will learn better by doing than by merely sitting in class lectures)
  - This concept is what the ECE Department at UNH is all about. Learning by doing and being subjected to the practical realities of what a laboratory environment brings
  - NOTE
    - Theory does not always hold true in practice due to physical constraints and probabilistic variables

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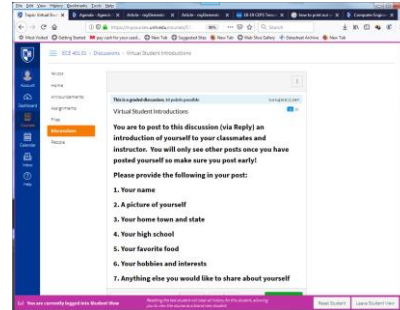
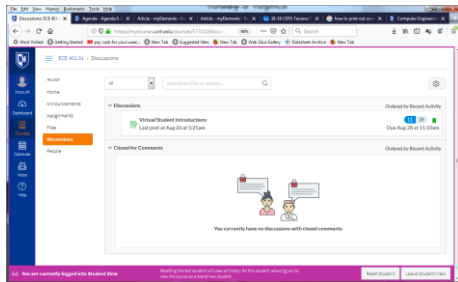
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## Discussion Forum 1

### Virtual Introductions

- As you know I had you post in the discussion section of Canvas some information about yourself



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## Discussion Forum 2

### Advances in Computer Technology

- You have been exposed to technology your whole life. However, computers have not always been what they are today. They have evolved over time.
- I had no idea as to what I would have on my desk today when I was first subjected to a computer way back in the Fall of 1975 when I was a Freshman at Clarkson College of Technology.
  - At that time, a computer took up a whole room and was behind a glass wall. I have been amazed at what has happened in those brief number of years.



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## Discussion Forum 2

### Advances in Computer Technology

- What I am asking you to do is perform a bit of research into how computers have evolved and then think "outside the box" and comment on what you feel computers will look like and how they will interface to people in the future
- This exercise is meant to stimulate discussion and debate regarding what might be the "look" of computer technology in 2060
  - You are **required** to make at least one post regarding this discussion and to respond to a minimum of 4 posts from other students in order to interject your thoughts and start a dialog
  - This Forum will be available all semester so that as we move forward you can revisit the discussion and reinforce or modify your view as you learn more about topics investigated in this course

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## Discussion Forum 2

### Advances in Computer Technology

- Historically one can look and see where things started (from the early days of fingers and toes) to today's world of electronic computing and the associated software operating systems and applications
- Extrapolation of this historical view to the future requires not only that you follow the trends of the past, but that you make use of your *imagination*
- Engineers and Scientists will drive the next generation of computing!
  - Such advances must be tempered by societal morals and proper governmental controls

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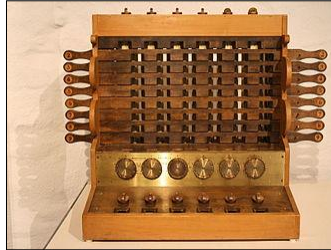
## A Historical Perspective on Digital Development and the Computer

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## Historical Development

- Generation Zero: Mechanical Calculating Machines (1642 - 1945)
  - Calculating Clock
    - Wilhelm Schickard (1592 - 1635)

German Professor of Hebrew and Astronomy



Replica of Schickard's Calculating Machine



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## Historical Development

- Generation Zero: Mechanical Calculating Machines (1642 - 1945)
  - Pascaline
    - Blaise Pascal (1623 - 1662)

French mathematician, physicist, inventor,  
and Catholic theologian



An early Pascaline



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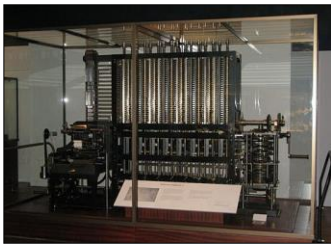
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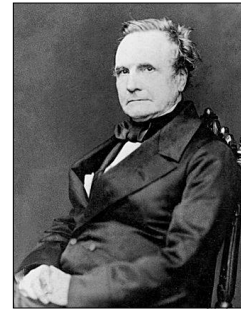
## Historical Development

- Generation Zero: Mechanical Calculating Machines (1642 - 1945)
  - Difference Engine
    - Charles Babbage (1791 - 1871), also designed but never built the Analytical Engine
    - Babbage originated the concept of a digital programmable computer



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English mathematician,  
philosopher, inventor  
and mechanical  
engineer



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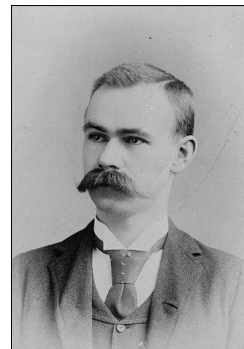
## Historical Development

- Generation Zero: Mechanical Calculating Machines (1642 - 1945)
  - Punched card tabulating machines
    - Herman Hollerith (1860 - 1929)

American inventor and Engineer



IBM 029 Card Punch Machine



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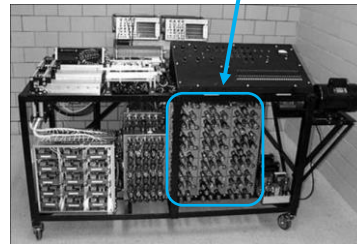
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## Historical Development

- First Generation Vacuum Tube Computers (1937-1963)
  - Atanasoff Berry Computer (1937 - 1938)  
solved systems of linear equations
  - John Atanasoff and Clifford Berry of Iowa State University



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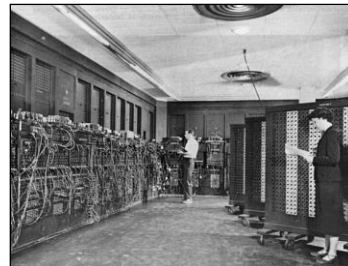
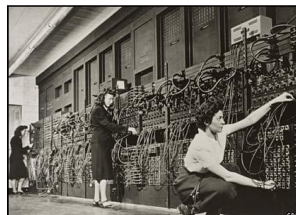
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## Historical Development

- The First Generation: Vacuum Tube Computers (1945 - 1953)
  - Electronic Numerical Integrator and Computer (ENIAC)
  - John Mauchly and J. Presper Eckert
  - University of Pennsylvania, 1946



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# Historical Development

- The First Generation: Vacuum Tube Computers (1945 - 1953)
  - The IBM 650 first mass-produced computer (1955)



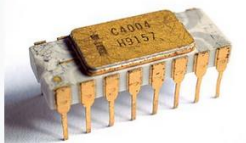
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## Intel 4004



White ceramic Intel C4004 microprocessor with grey traces

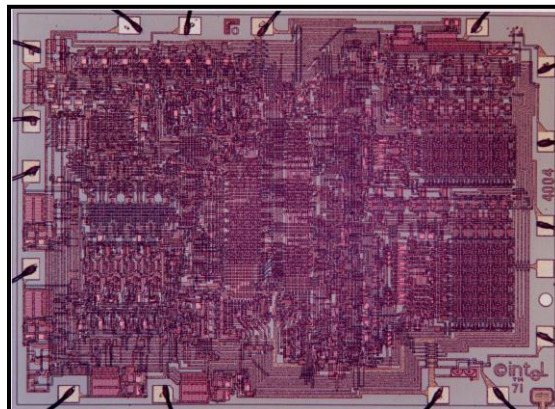
|                               |   |
|-------------------------------|---|
| <b>Produced</b>               | From late 1971 to 1981                      |
| <b>Common manufacturer(s)</b> | Intel                                       |
| <b>Max. CPU clock rate</b>    | 740 kHz                                     |
| <b>Min. feature size</b>      | 10 $\mu\text{m}$                            |
| <b>Instruction set</b>        | 4-bit BCD-oriented                          |
| <b>Transistors</b>            | 2300 <sup>[1]</sup>                         |
| <b>Data width</b>             | 4   |
| <b>Address width</b>          | 12 (multiplexed)                            |
| <b>Successor</b>              | Intel 4040                                  |
| <b>Application</b>            | Busicom calculator, arithmetic manipulation |
| <b>Package(s)</b>             | 16-pin DIP                                  |

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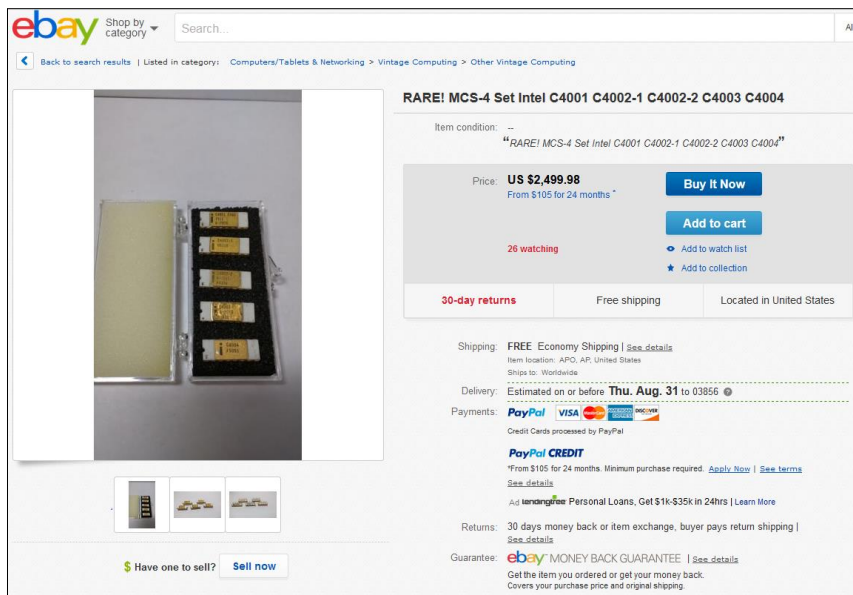
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## Intel 4004 Circa 1971 4 – bit microprocessor



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**Intel 8008**

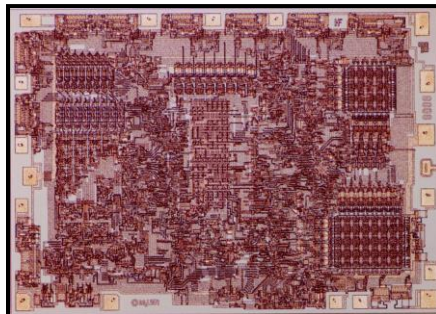
An Intel 8008

|                               |   |
|-------------------------------|---|
| <b>Produced</b>               | From mid 1972 to 1983 <sup>[1]</sup>  |
| <b>Common manufacturer(s)</b> | Intel   |
| <b>Max. CPU clock rate</b>    | 0.2 MHz to 0.8 MHz  |
| <b>Min. feature size</b>      | 10 μm   |
| <b>Instruction set</b>        | 8008  |
| <b>Successor</b>              | Intel 8080  |
| <b>Application</b>            | Computer terminals, calculators, bottling machines, 1970s <a href="#">ASEA industrial robots</a> <sup>[2]</sup> (IRB 6), simple computers, etc. |
| <b>Package(s)</b>             | 18-pin DIP  |

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## Intel 8008 Circa 1972

### 8 bit microprocessor

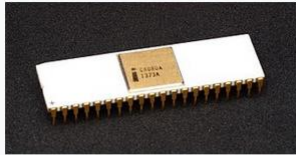


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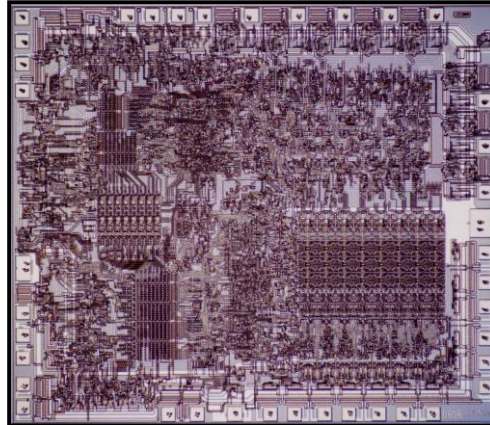
30

## Intel 8080



An Intel C8080A processor

|                               |  |
|-------------------------------|--|
| <b>Produced</b>               | April 1974; 44 years ago               |
| <b>Common manufacturer(s)</b> | Intel                                  |
| <b>Max. CPU clock rate</b>    | 2 MHz to 3.125 MHz                     |
| <b>Min. feature size</b>      | 6 $\mu\text{m}$                        |
| <b>Instruction set</b>        | 8080                                   |
| <b>Predecessor</b>            | Intel 8008                             |
| <b>Successor</b>              | Intel 8085<br>Intel 8086<br>Intel 8088 |
| <b>Package(s)</b>             | 40-pin DIP                             |

Intel 8080 Circa 1974  
8 - bit microprocessor

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IMSAI 8080  
Circa 1975

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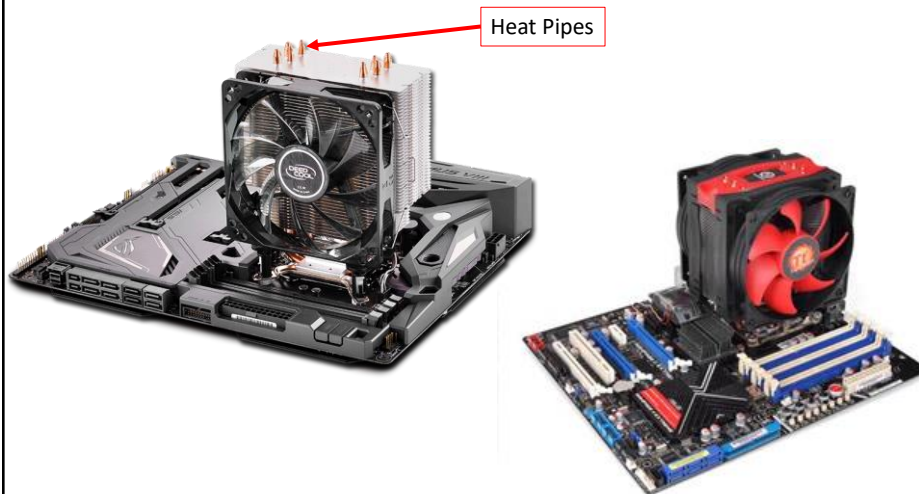
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## Contemporary Motherboards



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## Liquid Cooling



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## Early Intel Pentium Processors

| Core p    | Process            | Clock rates | L1 cache | FSB       | Socket   | Release date                 |
|-----------|--------------------|-------------|----------|-----------|----------|------------------------------|
| P5        | 0.8 $\mu\text{m}$  | 60–66 MHz   | 16 KB    | 60–66 MHz | Socket 4 | March 1993                   |
| P54C      | 0.6 $\mu\text{m}$  | 75–120 MHz  | 16 KB    | 50–66 MHz | Socket 5 | October 1994                 |
| P54CS     | 0.35 $\mu\text{m}$ | 133–200 MHz | 16 KB    | 60–66 MHz | Socket 7 | June 1995                    |
| P55C      | 0.35 $\mu\text{m}$ | 120–233 MHz | 32 KB    | 60–66 MHz | Socket 7 | January 1997 <sup>[12]</sup> |
| Tillamook | 0.25 $\mu\text{m}$ | 166–300 MHz | 32 KB    | 66 MHz    | Socket 7 | August 1997                  |

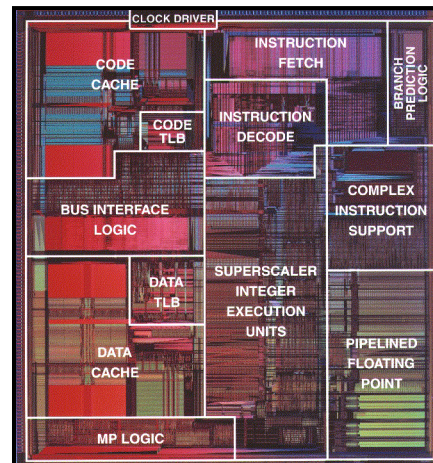
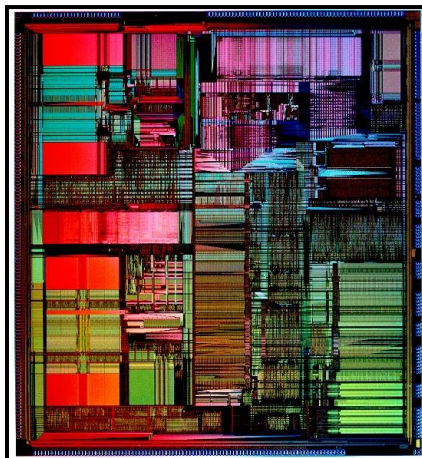
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## Intel Pentium Circuit Circa 2000



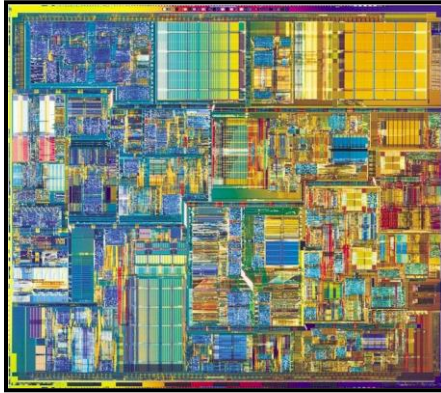
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## Pentium 4 Processor Circa 2000-2008



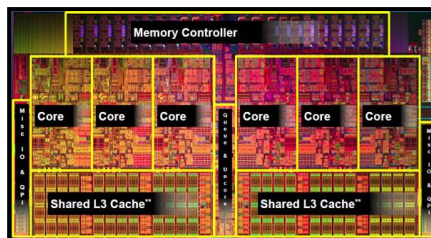
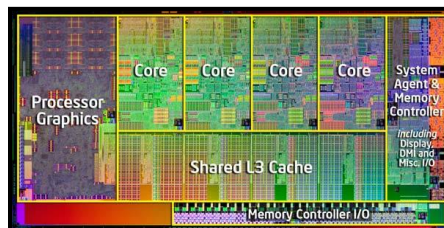
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## Circa 2011-Present



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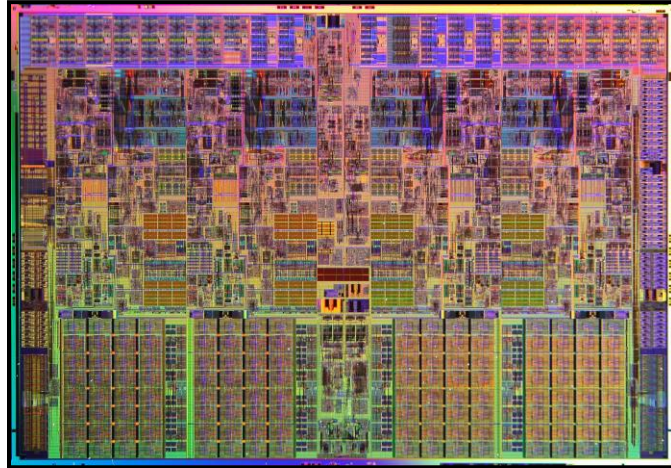
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## Intel i7 Sandy Bridge die (silicon) Circa 2011



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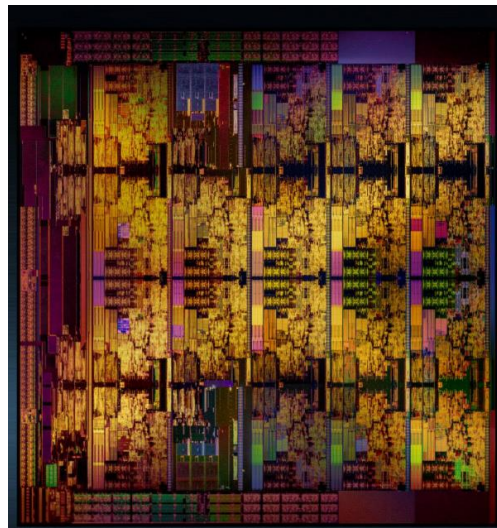
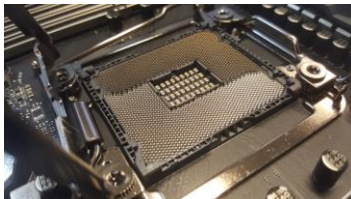
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18 core  
Core i9 – 7980XE

## Skylake-X



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My Current office Intel i7 System

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| Processor #0: Intel Core i7 3930K (Sandy Bridge-E)            |       |                    |      |
|---|-------|--------------------|------|
| Select CPU: Processor #0   6 Core(s)   12 Thread(s)           |       |                    |      |
| Processor Information: <a href="#">Check for BIOS Updates</a> |       |                    |      |
| Model: Intel Core i7 3930K (Sandy Bridge-E)                   |       |                    |      |
| Platform: LGA 2011 (Socket R)                                 |       |                    |      |
| Frequency: 3399.63MHz (99.99 x 32.0)                          |       |                    |      |
| VDD: 1.355V v   |       | Voltage: 1.355V    |      |
| Revision: C2  |       | Lithography: 32 nm |      |
| CPUID: 0x206D7  |       | TDP: 130.0 Watts   |      |
| Processor #0: Temperature Readings                            |       |                    |      |
| Power:  | 32.5W | 15.9W              | N/A  |
| Tj Max:   | 92°C  | Min.               | Max. |
| Core #0:  | 46°C  | 55°C               | 19%  |
| Core #1:  | 46°C  | 43°C               | 11%  |
| Core #2:  | 44°C  | 41°C               | 11%  |
| Core #3:  | 43°C  | 45°C               | 8%   |
| Core #4:  | 47°C  | 44°C               | 7%   |
| Core #5:  | 46°C  | 43°C               | 12%  |

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## Some Important Events in Computer History

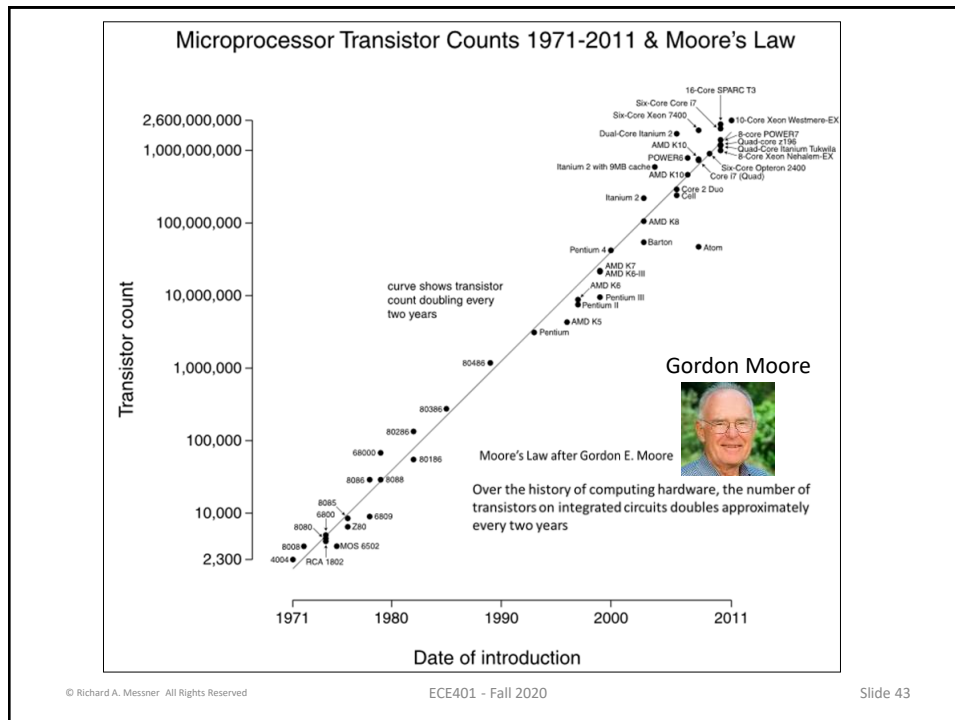
|                  |           |   |
|------------------|-----------|---|
| T<br>I<br>M<br>E | B.C.      | Fingers and toes, abacus  |
|                  | A.D.      | Stonehenge, quipu   |
|                  | 1650      | Mechanical two function calculator (Pascal)                                     |
|                  | 1690      | Multiplying calculator (Leibnitz)   |
|                  | 1800      | Loom controlled by punched cards (Jacquard)                                     |
|                  | 1823      | Difference Engine (Babbage)   |
|                  | 1850      | Analytical Engine design (Babbage)  |
|                  | 1890      | U.S. Census-punched cards (Hollerith)   |
|                  | 1900      | Printing business calculators (Burroughs)                                       |
|                  | 1920-1960 | Unit record equipment (IBM, NCR, etc.)  |
|                  | 1939      | Electronic computer prototype (Atanasoff)                                       |
|                  | 1943      | Colossus vs. Enigma (Turing)  |
|                  | 1944      | MARK I electromechanical, plug board computer (Aiken)                           |
|                  | 1946      | ENIAC electronic computer (Eckert, Mauchly)                                     |
|                  | 1950's    | First generation-tubes (eg IBM 701, STRETCH, 650)                               |
|                  | 1960      | Second generation-transistors, compilers (eg IBM 401)                           |
|                  | 1965      | Third generation-IC's, operating system; minicomputers (eg IBM 360, DEC pdp8)   |
|                  | 1970      | LSI memory (Intel)  |
|                  | 1972      | Microprocessor (Ted Hoff-Intel 4004) later 8008, 8080, 8086, 80286, 80386, etc. |
|                  | 1978      | VLSI - Very Large Scale Integration   |
|                  | 1979      | Programmable Logic Device Appears   |
|                  | 1979      | Single Chip Digital Signal Processing Chip introduced by Bell Laboratories      |
|                  | 1985      | ULSI - Ultra Large Scale Integration  |
|                  | 1990's    | Wafer Scale Integration   |
|                  | 2000's    | System on Chip and 3D Integrated Circuits                                       |

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## Major Driving Force of Computers is Technology

### • Moore's Law

#### – Technology for Switching

- Mechanical Relay     $\sim 0.01$  seconds or  $10^{-2}$
- Vacuum Tube         $\sim 0.00001$  seconds or  $10^{-5}$
- Transistor             $\sim 0.000001$  seconds or  $10^{-6}$
- Integrated Circuit     $\sim 0.00000001$  seconds or  $10^{-8}$
- Ultra Large-Scale IC  $\sim 0.000000001$  seconds or  $10^{-9}$



Future: 3D Integrated Circuits  
Molecular Computing  
Quantum Computing

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