

Component 4: Introduction to Information and Computer Science

Unit 1: Basic Computing Concepts, Including History

Lecture 4

BMI540/640

Week 1

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The First "Computers"

- The word "computer" was first recorded in 1613
- Referred to a person who performed calculations
- Evidence of counting is traced to at least 35,000 BC



Ishango Bone Tally Stick:
Science Museum of Brussels

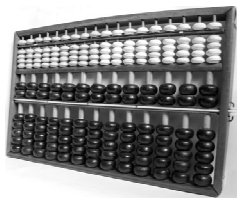
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2

Abacus—The First Calculator

- Invented by Babylonians in 2400 BC — many subsequent versions
- Used for counting before there were written numbers
- Still used today




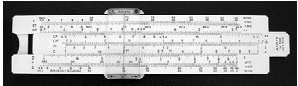

The Chinese Lee Abacus
<http://www.ee.ryerson.ca/~elf/abacus/>

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3

Slide Rules

John Napier William Oughtred


- By the Middle Ages, number systems were developed
- John Napier discovered/developed logarithms at the turn of the 17th century
- William Oughtred used logarithms to invent the slide rule in 1621 in England
 - Used for multiplication, division, logarithms, roots, trigonometric functions
 - Used until early 70s when electronic calculators became available

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Mechanical Computers


- Use mechanical parts to automate calculations
- Limited operations
- First one was the ancient Antikythera computer from 150 BC
 - Used gears to calculate position of sun and moon

Fragment of Antikythera mechanism

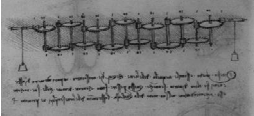



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Leonardo da Vinci 1452-1519, Italy


 Leonardo da Vinci

- Two notebooks discovered in 1967 showed drawings for a mechanical calculator
- A replica was built soon after

Leonardo da Vinci's notes and the replica
The Controversial Replica of Leonardo da Vinci's Adding Machine.
<http://192.220.96.166/leonardo/leonardo.htm>

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Blaise Pascal 1623-1662, France

Blaise Pascal

- Arithmetic machine based on the technology of gears
- Output achieved by observing position of gears
- Built to perform only addition
- ~ 50 machines created to add sums of money



Pascaline machine
http://en.wikipedia.org/wiki/File:Arts_et_Metiers_Pascaline_dsc03869.jpg

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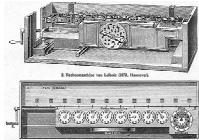
7

Gottfried von Leibniz 1646-1716, Germany



Von Leibniz

- Stepped Reckoner
- A variety of arithmetic operations
- Algorithms were embedded in the hardware/architecture



Stepped Reckoner
http://en.wikipedia.org/wiki/File:Leibniz_Stepped_Reckoner_drawing.png

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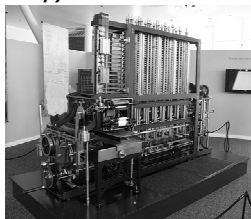
8

Charles Babbage 1792-1871, England



Charles Babbage

Difference Engine (demonstration model only)



Difference Engine model at the Computer History Museum in Mountain View, California

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9

Analytical Engine

Analytical Engine

- designed to read instructions in the form of holes in paper cards. i.e. programmable
- based on Jacquard's punched cards for weaving



Analytical Engine Mill
© Marcin Wichary



Jacquard Loom

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10

First Programmer

- Ada Byron (Lady Lovelace) wrote the first computer programs for this machine
- Would have been able to compute a mathematical sequence known as Bernoulli numbers



Ada Byron (Lady Lovelace)

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11

National Library of Medicine

- Started at this time in 1836 as Library of Surgeon General
- Early leader, John Shaw Billings, took over in 1865
 - Grew the collection
 - Began to organize and classify the collection
 - Started Index Medicus (online version now is MEDLINE)

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12

Electromechanical Computers

- Electricity was developed in the 19th century
- Information could now be represented by electrical impulses
- Computers were created to use electricity along with mechanical gears

Herman Hollerith 1860-1929, USA



- Created the tabulating machine for the 1890 Census with prompting by John Shaw Billings
- Started the Tabulating Machine Company in 1896
- Sold it to TJ Watson in 1914
- Became part of IBM

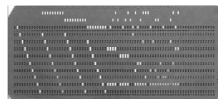


Woman using Tabulating Machine
<http://www.census.gov/history/img/HollerithMachine.jpg>

Punched Cards



Pantograph for creating punched cards for the Tabulating Machine
<http://www.census.gov/history/img/pantograph.jpg>



Punched Card

First Generation General Purpose Computers

Based on electronically controlled mechanical gears (relays)

- 1930 Vannevar Bush, Differential Analyzer
- 1937 Bell labs, George Stibitz, Model K
- 1941 Konrad Zuse, Germany, Z1, Z3, Z4
- 1944, Harvard, Howard Aiken and IBM engineers, Mark 1

Bugs! First Computer Bug!

Handwritten notes on graph paper detailing computer operations and a bug. The notes include:

- 9/9
- 0800 Action started
- 1000 stopped - action ✓
- 1100 1st MP - ne
- 1200 2nd MP - ne
- 1300 3rd MP - ne
- 1400 4th MP - ne
- 1500 5th MP - ne
- 1600 6th MP - ne
- 1700 7th MP - ne
- 1800 8th MP - ne
- 1900 9th MP - ne
- 2000 10th MP - ne
- 2100 11th MP - ne
- 2200 12th MP - ne
- 2300 13th MP - ne
- 2400 14th MP - ne
- 2500 15th MP - ne
- 2600 16th MP - ne
- 2700 17th MP - ne
- 2800 18th MP - ne
- 2900 19th MP - ne
- 3000 20th MP - ne
- 3100 21st MP - ne
- 3200 22nd MP - ne
- 3300 23rd MP - ne
- 3400 24th MP - ne
- 3500 25th MP - ne
- 3600 26th MP - ne
- 3700 27th MP - ne
- 3800 28th MP - ne
- 3900 29th MP - ne
- 4000 30th MP - ne
- 4100 31st MP - ne
- 4200 32nd MP - ne
- 4300 33rd MP - ne
- 4400 34th MP - ne
- 4500 35th MP - ne
- 4600 36th MP - ne
- 4700 37th MP - ne
- 4800 38th MP - ne
- 4900 39th MP - ne
- 5000 40th MP - ne
- 5100 41st MP - ne
- 5200 42nd MP - ne
- 5300 43rd MP - ne
- 5400 44th MP - ne
- 5500 45th MP - ne
- 5600 46th MP - ne
- 5700 47th MP - ne
- 5800 48th MP - ne
- 5900 49th MP - ne
- 6000 50th MP - ne
- 6100 51st MP - ne
- 6200 52nd MP - ne
- 6300 53rd MP - ne
- 6400 54th MP - ne
- 6500 55th MP - ne
- 6600 56th MP - ne
- 6700 57th MP - ne
- 6800 58th MP - ne
- 6900 59th MP - ne
- 7000 60th MP - ne
- 7100 61st MP - ne
- 7200 62nd MP - ne
- 7300 63rd MP - ne
- 7400 64th MP - ne
- 7500 65th MP - ne
- 7600 66th MP - ne
- 7700 67th MP - ne
- 7800 68th MP - ne
- 7900 69th MP - ne
- 8000 70th MP - ne
- 8100 71st MP - ne
- 8200 72nd MP - ne
- 8300 73rd MP - ne
- 8400 74th MP - ne
- 8500 75th MP - ne
- 8600 76th MP - ne
- 8700 77th MP - ne
- 8800 78th MP - ne
- 8900 79th MP - ne
- 9000 80th MP - ne
- 9100 81st MP - ne
- 9200 82nd MP - ne
- 9300 83rd MP - ne
- 9400 84th MP - ne
- 9500 85th MP - ne
- 9600 86th MP - ne
- 9700 87th MP - ne
- 9800 88th MP - ne
- 9900 89th MP - ne
- 10000 90th MP - ne

Relay 70 Panel F (NOT) in relay.

First actual case of bug being found

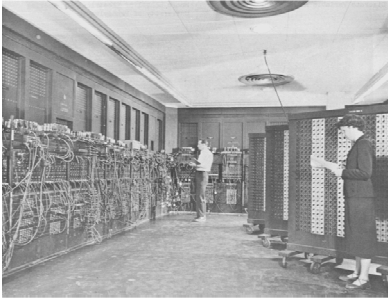
Grace Hopper
Photo Courtesy of Hagley Museum and Library

First Generation General Purpose Computers, contd.

Based on vacuum tubes

- 1937-1941: Atanasoff-Berry at Iowa State
- 1940s: Colossus: secret German code-breaker
- 1940s: *Electronic numerical integrator and computer* (ENIAC): Mauchly & Eckert at U. of Penn.

ENIAC



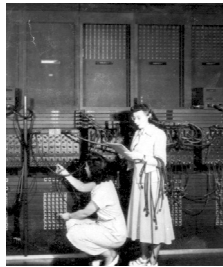
ENIAC Computer
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19

Women Were the First Programmers!

- Computers were used to calculate ballistics tables during WWII
- Men were off at war
- Women were hired to program the computers



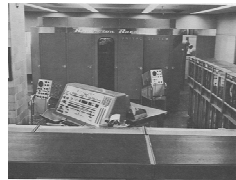
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20

Universal Automatic Computer (UNIVAC I)

First commercially available computer, 1951, Remington Rand
At this same time, Robert Ledley started using computers for dental records at National Bureau of Standards



UNIVAC I

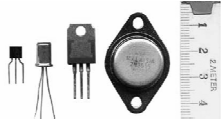
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21

Second Generation: Transistors

- First transistor 1947, Bell laboratories, germanium
- Silicon transistors soon followed
- Smaller, used less power, generated less heat than vacuum tubes
- IBM 1401 used transistors



Transistors
<http://www.at-mix.de/transistor.htm>

Third Generation: Integrated Circuits and Minicomputers

- Robert Noyce and Jack St. Clair Kilby invented the integrated circuit
- Large mainframes used integrated circuits to increase processing speed and storage
- Minicomputers, such as the PDP and VAX computers could be smaller because of the integrated circuit

Fourth Generation: Microcomputers

- Intel released first microprocessor chip: the 4004 in 1971 for desktop calculators

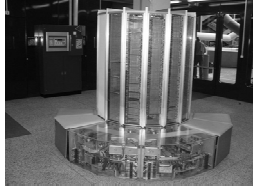
Intel 4004



- Intel 8080 was released in 1974, 4500 transistors – first general purpose microprocessor
- Microcomputers not meant to replace minicomputers

Supercomputers

- Supercomputers at the time used integrated circuits
- Cray Supercomputers started in 1976
- Still in business
- Used vector processors to do operations in parallel



Cray 1 computer at EPFL at Lausanne

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25

Early Electronic Medical Records

- At this time, early EMRs were developed
- Dr. Morris Collen began storing patient data at Kaiser Permanente in the late 1960s
- COSTAR was developed at Massachusetts General in 1968
- Health Evaluation through Logical Processing (HELP) was started at LDS Hospital in 1967
- The concepts and plans that eventually became VA VistA were developed in 1970s

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26
