Component 4: Introduction to Information and Computer Science

Unit 1: Basic Computing Concepts, Including History

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

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/

John Napier

Slide Rules

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 rude in 1621 in England
  - Used for multiplication, division, logarithms, roots, trigonometric functions
  - Used until early 70's when electronic calculators became available

Mechanical Computers

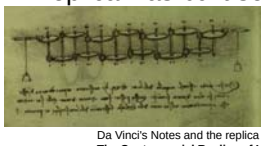
- Use mechanical parts to automate calculations
- Limited operations
- First one was the ancient Antikythera computer from 150 BC
  - Used gears to calculate position of sun and moon

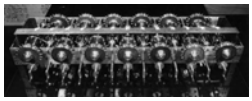
Fragment of Antikythera mechanism

Leonardo da Vinci 1452-1519, Italy

Leonardo da Vinci

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





Da Vinci's Notes and the replica

The Controversial Replica of Leonardo da Vinci's Adding Machine. http://192.220.96.166/leonardo/leonardo.html

Blaise Pascal

Blaise Pascal
1623-1662, France

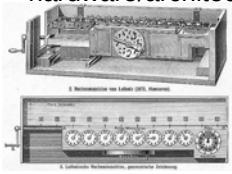
- Arithmetic machine based on the technology of gears
- Output achieved by observing position of gears
- Built to perform only addition
- ~ 50 machines created to add sums of money

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

Gottfried von Liebniz
1646-1716, Germany

Von Liebniz

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



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

Charles Babbage
1792-1871, England

Charles Babbage

Difference engine (demonstration model only)

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

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

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)

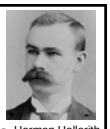
National Library of Medicine

- 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)

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


Herman Hollerith

- 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

First Computer Bug!

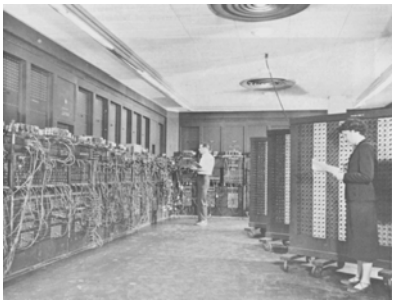
Grace Hopper
Photo Courtesy of Hagley Museum and Library

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

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

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

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

Early Electronic Medical Records

- At this time, early EMRs were developed
- Dr. Morris Collen began storing patient data at Kaiser Permanente in the late 1960's
- 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 1970's