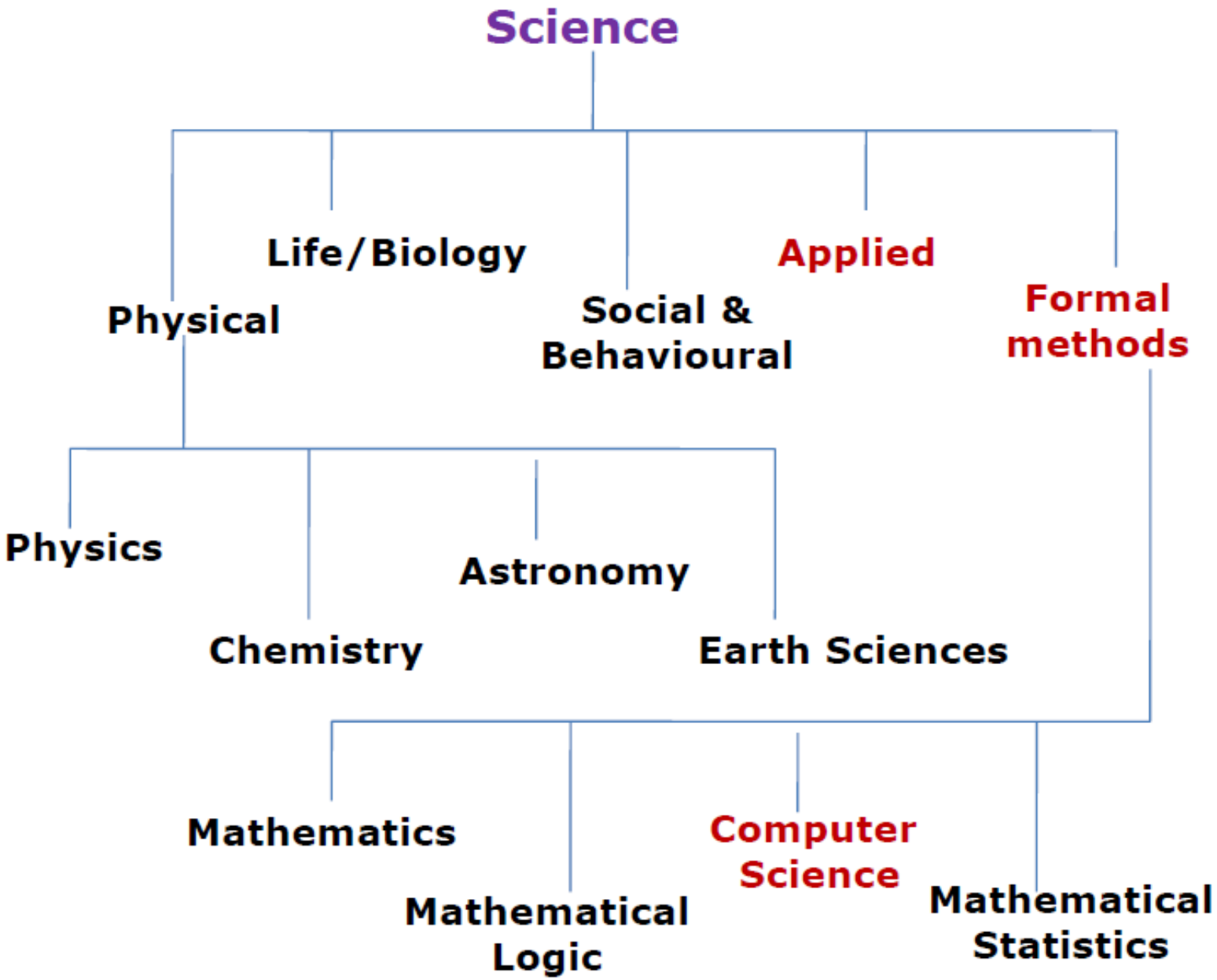

Science
Physical
Life/Biology
Social &
Behavioural
Applied
Formal
methods
Physics
Chemistry
Astronomy
Earth Sciences
Mathematics
Mathematical
Logic
Computer
Science
Mathematical
Statistics

A computer is a programmable machine designed to sequentially and automatically carry out a sequence of arithmetic or logical operations (computations).

The particular sequence of operations can be changed readily, allowing the computer to solve more than one kind of problem.

Science (Latin: scientia means "knowledge") is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the world.

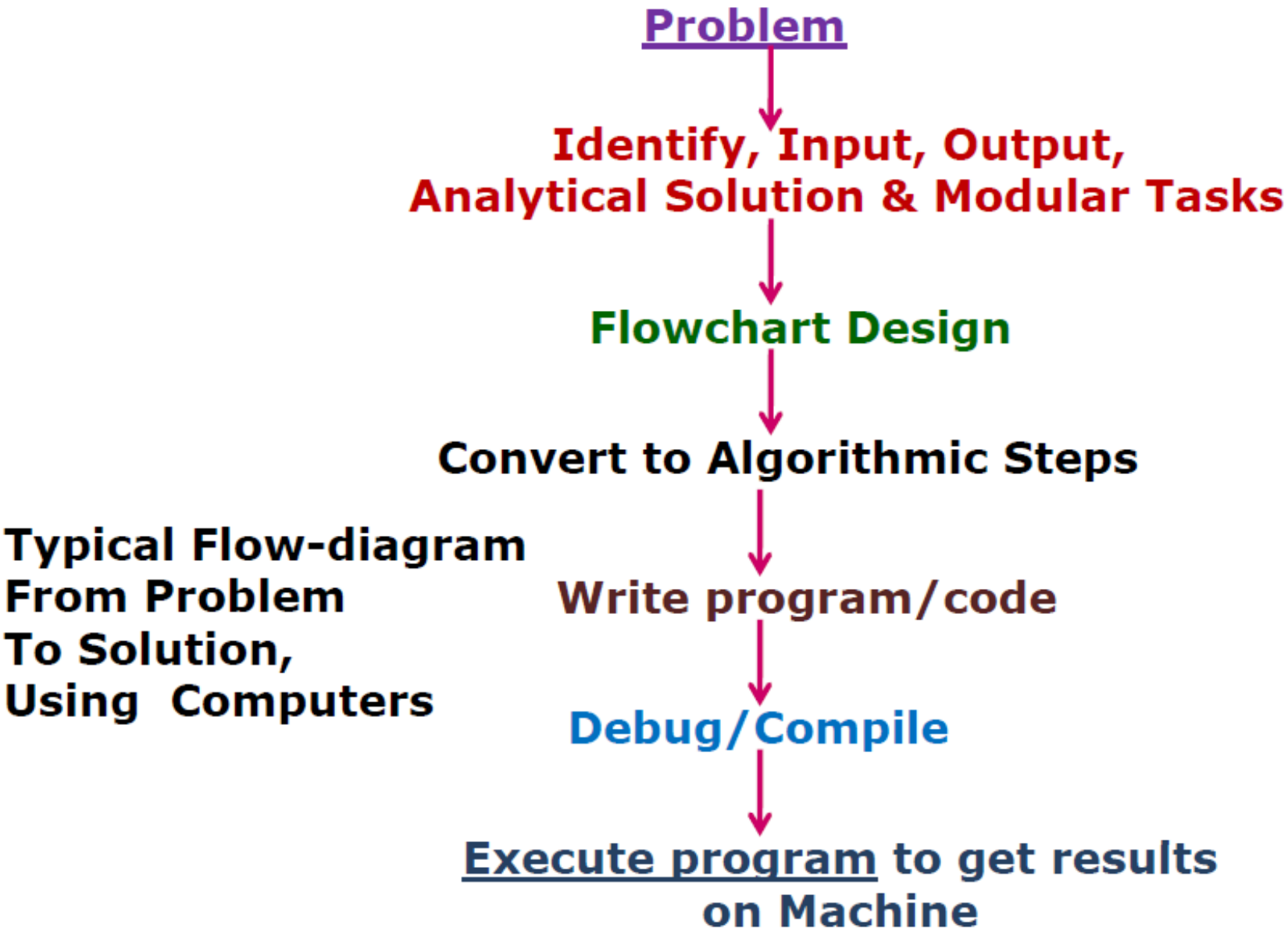
Scientific concepts is a body of reliable knowledge that can be logically and rationally explained.

Engineering is the discipline, art, skill and profession of acquiring and applying scientific, mathematical, economic, social, and practical knowledge, in order to design and build structures, machines, devices, systems, materials and processes that safely realize improvements to the lives of people.

It is a creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to forecast their behavior under specific operating conditions;

Terminology

- **Algorithm:** A set of steps that defines how a task is performed
- **Program:** A representation of an algorithm
- **Programming:** The process of developing a program
- **Software:** Programs and algorithms
- **Hardware:** Equipment



Typical Flow-diagram From Problem To Solution, Using Computers

History of Algorithms

- The study of algorithms was originally a subject in mathematics.
- Early examples of algorithms
  - Long division algorithm
  - Euclidean Algorithm
- **Gödel's Incompleteness Theorem**: Some problems cannot be solved by algorithms.

Figure 0.2 The Euclidean algorithm

Description: This algorithm assumes that its input consists of two positive integers and proceeds to compute the greatest common divisor of these two values.

Procedure:

Step 1. Assign M and N the value of the larger and smaller of the two input values, respectively.

Step 2. Divide M by N, and call the remainder R.

Step 3. If R is not 0, then assign M the value of N, assign N the value of R, and return to step 2; otherwise, the greatest common divisor is the value currently assigned to N.

Computer Science

- The science of algorithms
- Draws from other subjects, including
  - Mathematics
  - Engineering
  - Psychology
  - Business Administration
  - Psychology

The Early Period: Up to 1940

- 3,000 years ago: Mathematics, logic, and numerical computation
  - Important contributions made by the Greeks, Egyptians, Babylonians, Indians, Chinese, and Persians
- 1614: Logarithms
  - Invented by John Napier to simplify difficult mathematical computations
- Around 1622: First slide rule created

The Early Period: Up to 1940 (continued)

- 1672: The Pascaline
  - Designed and built by Blaise Pascal
  - One of the first mechanical calculators
  - Could do addition and subtraction
- 1674: Leibnitz's Wheel
  - Constructed by Gottfried Leibnitz
  - Mechanical calculator
  - Could do addition, subtraction, multiplication, and division

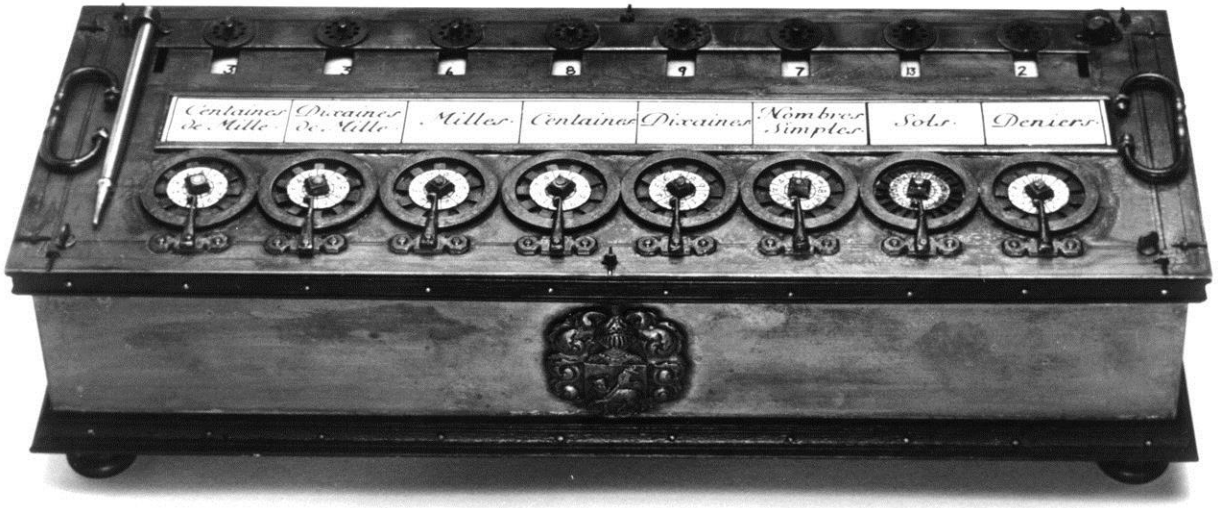


Figure 1.4
The Pascaline: One of the Earliest Mechanical Calculators

The Early Period: Up to 1940 (continued)

- 1801: The Jacquard loom
  - Developed by Joseph Jacquard
  - Automated loom
  - Used punched cards to create desired pattern
- 1823: The Difference Engine
  - Developed by Charles Babbage
  - Did addition, subtraction, multiplication, and division to 6 significant digits
  - Solved polynomial equations and other complex mathematical problems

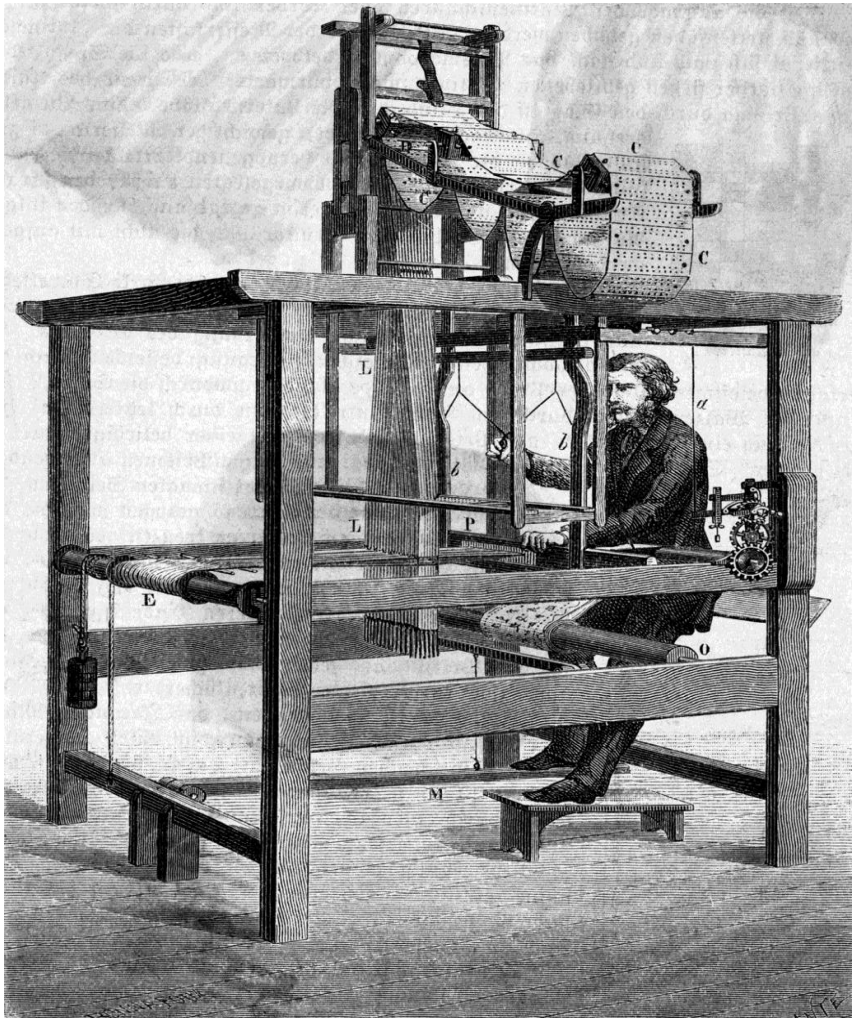


Figure 1.5
Drawing of the Jacquard Loom

The Early Period: Up to 1940 (continued)

- 1830s: The Analytic Engine
  - Designed by Charles Babbage
  - More powerful and general-purpose computational machine
  - Components were functionally similar to the four major components of today's computers
    - Mill (modern terminology: arithmetic/logic unit)
    - Store (modern terminology: memory)
    - Operator (modern terminology: processor)
    - Output (modern terminology: input/output)

The Early Period: Up to 1940 (continued)

- 1890: U.S. census carried out with programmable card processing machines
  - Built by Herman Hollerith
  - These machines could automatically read, tally, and sort data entered on punched cards

The Birth of Computers: 1940-1950

- Development of electronic, general-purpose computers
  - Did not begin until after 1940
  - Was fueled in large part by needs of World War II
- Early computers
  - Mark I
  - ENIAC
  - ABC system
  - Colossus
  - Z1

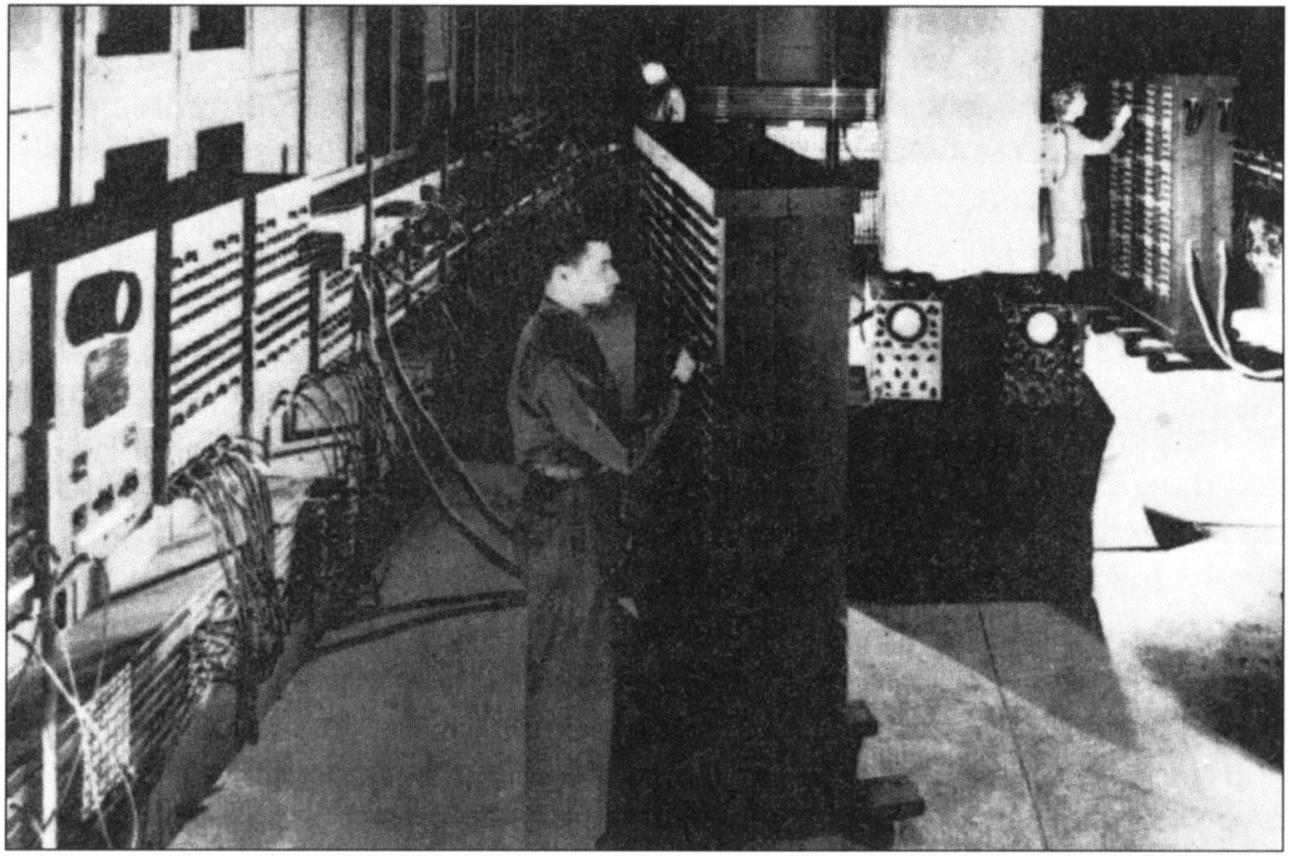


Figure 1.6
Photograph of the ENIAC Computer

The Birth of Computers: 1940-1950 (continued)

- Stored program computer model
  - Proposed by John Von Neumann in 1946
  - Stored binary algorithm in the computer's memory along with the data
  - Is known as the Von Neumann architecture
  - Modern computers remain, fundamentally, Von Neumann machines
  - First stored program computers
    - EDVAC
    - EDSAC

The Modern Era: 1950 to the Present

- First generation of computing (1950-1959)
  - Vacuum tubes used to store data and programs
  - Each computer was multiple rooms in size
  - Computers were not very reliable

The Modern Era: 1950 to the Present (continued)

- Second generation of computing (1959-1965)
  - Transistors and magnetic cores replaced vacuum tubes
  - Dramatic reduction in size
    - Computer could fit into a single room
  - Increase in reliability of computers
  - Reduced cost of computers
  - High-level programming languages
    - The programmer occupation was born

The Modern Era: 1950 to the Present (continued)

- Third generation of computing (1965-1975)
  - Integrated circuits rather than individual electronic components were used
  - Further reduction in size and cost of computers
    - Computers became desk-sized
    - First minicomputer developed
  - Software industry formed

The Modern Era: 1950 to the Present (continued)

- Fourth generation of computing (1975-1985)
  - Reduced to the size of a typewriter
  - First microcomputer developed
  - Desktop and personal computers common
  - Appearance of
    - Computer networks
    - Electronic mail
    - User-friendly systems (graphical user interfaces)
    - Embedded systems

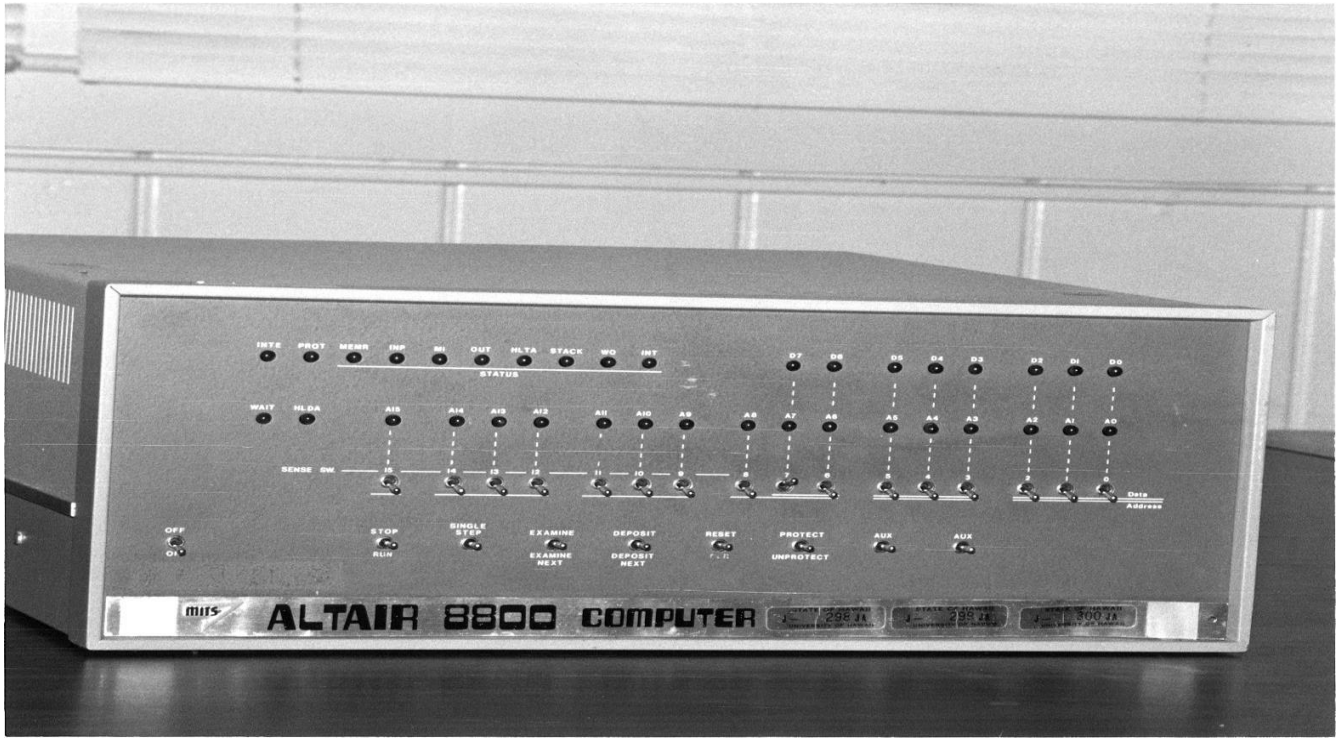


Figure 1.7
The Altair 8800, the World's First Microcomputer

The Modern Era: 1950 to the Present (continued)

- Fifth generation of computing (1985-?)
  - Recent developments
    - Massively parallel processors
    - Handheld devices and other types of personal digital assistants (PDAs)
    - High-resolution graphics
    - Powerful multimedia user interfaces incorporating sound, voice recognition, touch, photography, video, and television

The Modern Era: 1950 to the Present (continued)

- Recent developments (continued)
  - Integrated global telecommunications incorporating data, television, telephone, fax, the Internet, and the World Wide Web
  - Wireless data communications
  - Massive storage devices
  - Ubiquitous computing

Generation	Approximate Dates	Major Advances
First	1950–1957	First commercial computers First symbolic programming languages Use of binary arithmetic, vacuum tubes for storage Punched card input/output
Second	1957–1965	Transistors and core memories First disks for mass storage Size reduction, increased reliability, lower costs First high-level programming languages First operating systems
Third	1965–1975	Integrated circuits Further reduction in size and cost, increased reliability First minicomputers Time-shared operating systems Appearance of the software industry First set of computing standards for compatibility between systems

Figure 1.8
Some of the Major Advancements in Computing

Fourth	1975–1985	Large-scale and very-large-scale integrated circuits Further reduction in size and cost, increased reliability First microcomputers Growth of new types of software and of the software industry Computer networks Graphical user interfaces
Fifth	1985–?	Ultra-large-scale integrated circuits Supercomputers and parallel processors Laptops and handheld computers Wireless computing Massive external data storage devices Ubiquitous computing High-resolution graphics, visualization, virtual reality Worldwide networks Multimedia user interfaces

Figure 1.8
Some of the Major Advancements in Computing

Hardware	Software	Theory	Applications
Switching Theory and Digital Design	Computational Engineering	Discrete Mathematics for Computer Science	Introduction to Database Systems, Data Mining
Computer Organization	Paradigms of Programming	Mathematical Concepts for Computer Science	*AI, PR, CV*, SPEECH, ANN, DVP, AVP, SC, RL, MBS, CBR, ML...
Computer System Design	*Operating Systems*	*Principles of Communication*	*Computer Graphics; Multimedia*
	Language Translators	*Data Structures and Algorithms*	VLSI, Digital System Testing
	Principles of Software Engineering	Languages, Machines and Computations	Computer Networks, Optical Networks, Cloud Computing
		Cyptography & N/W Sec.; Unconv. Models of Computing	Modern Compilers

Common misconceptions about computer science :

- **Computer science is the study of computers**
- **Computer science is the study of how to write computer programs**
- **Computer science is the study of the uses and applications of computers and software**

The general public sometimes confuses computer science with careers that deal with computers (such as information technology), or think that it relates to their own experience of computers, which typically involves activities such as gaming, web-browsing, and word-processing.

However, the focus of computer science is more on understanding the properties of the programs used to implement software such as games, banking and web-browsers, and using that understanding to create new programs or improve existing ones.

Summary

- Computer science is the study of algorithms
- An algorithm is a well-ordered collection of unambiguous and effectively computable operations that, when executed, produces a result and halts in a finite amount of time
- If we can specify an algorithm to solve a problem, then we can automate its solution
- Computers developed from mechanical calculating devices to modern electronic marvels of miniaturization