IC150
Computation & Data Science

An Introduction to
Problem Solving using Computers

Timothy A. Gonsalves

IC150 Lecture 1
Course Overview
Intro to Computers

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Course Outline

- Problem solving using computers
  - Computation
  - Data science
- Exercises and examples from engineering and sciences
- Tools: Python, OpenOffice Calc, Linux

Learning styles

- Deductive: from principles to examples
- Inductive: figure out principles by oneself

Learn how to learn

Professionalism

IIT BTech ➔ a proficient professional

Characteristics:

- See situations holistically
- See what is most important in a situation
- Perceive deviations from the normal pattern
- Quick decision-making
- Use maxims for guidance, whose meanings vary according to the situation

Requirements:

- Deep knowledge
- Broad and diverse knowledge
- Practical experience
- Punctuality
- Neatness
- Good English
- Respect for others
- Self-discipline

No Cellphone Use in Class

Taking Notes

- An essential part of learning
- Receive info, think about it and write it
  ==> it is firmly cemented in your brain
- What to record?
  - Headings
  - Repetition
  - Underlined, boldface, red, circled
  - Your own understanding
  - Questions to look up after class
- Use shorthand, abbreviations, quick diagrams

Notebook for each course
Write date on every page

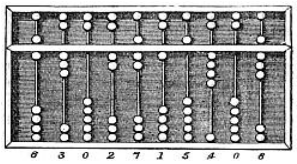
What is IC152 about?

- Computer and its components
- Computing – personal, cloud, high-performance
- Problem Solving and Limitations of a Computer
- Programming Languages

What are common uses of a computer?

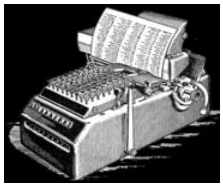
Early Computing Hardware

The Slide rule



The Chinese Abacus

The gear replaced the beads in early mechanical calculators



"History of computing hardware"
From Wikipedia, the free encyclopedia

Dictionary definition of "Computer":
(noun) a person who makes calculations, especially with a calculator

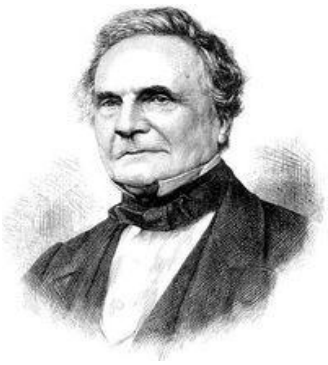
Jaquard looms

Used *punched cards* to weave *different patterns*

What IS a computer?

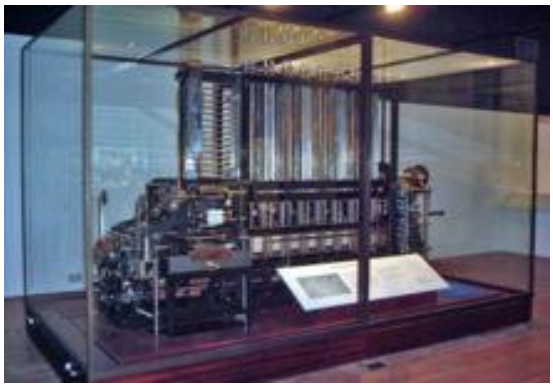
- A computer is a *flexible machine*
- Its behaviour is controlled by a *program*
- Programs reside in the *memory* of the machine
  - *Charles Babbage (1791-1871):*

    "The stored program concept"



The Difference Engine

Part of Babbage's difference engine, assembled after his death by Babbage's son, using parts found in his laboratory.



The London Science Museum's replica Difference Engine, built from Babbage's design.
25,000 parts, 15 tons, 8 ft high

Charles Babbage's Analytical Engine

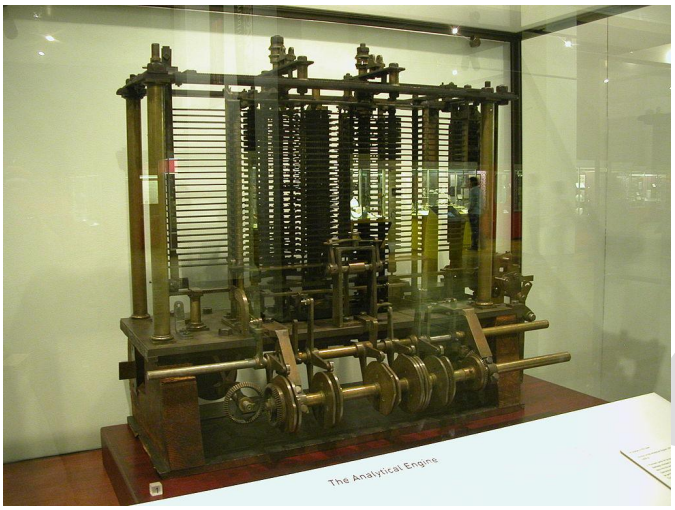


Photo by Bruno Barral

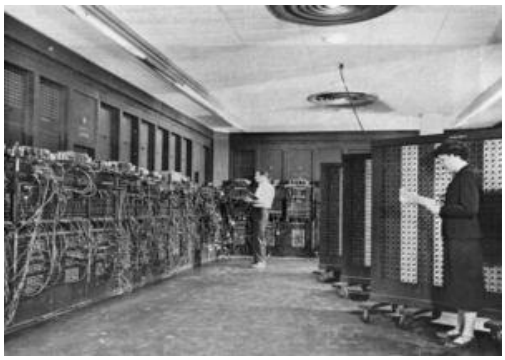
- The London Science Museum's replica Analytical Engine.
- Input of data and programs on punched cards
- Arithmetic unit for +, -, *, /, square root, comparisons
- Memory: 1,000 numbers each 40 digits (16KB)
- Turing complete

The First Programmer

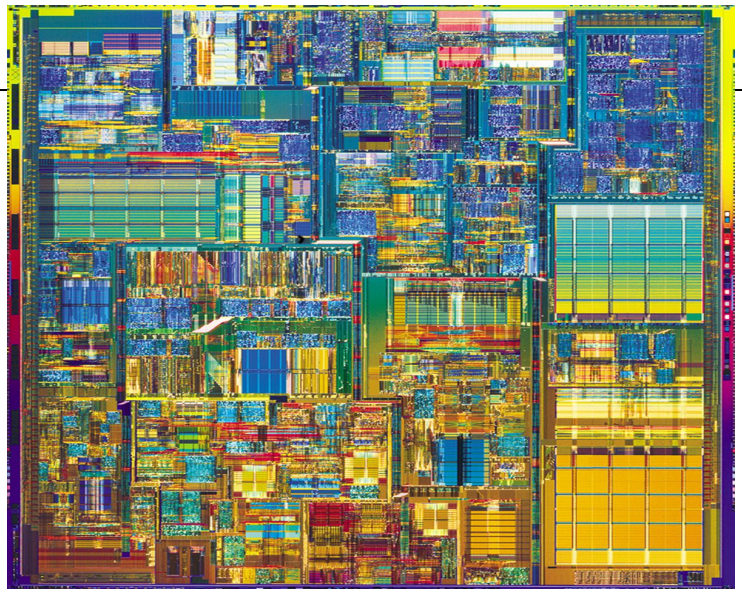
Augusta Ada King, Countess of Lovelace (December 10, 1815 – November 27, 1852), born **Augusta Ada Byron**, is mainly known for having written a description of Charles Babbage's early mechanical general-purpose computer, the analytical engine.

The programming language ADA is named after her

ENIAC – the first electronic computer

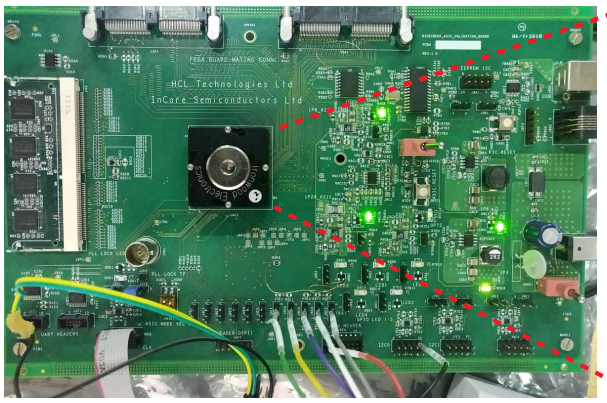


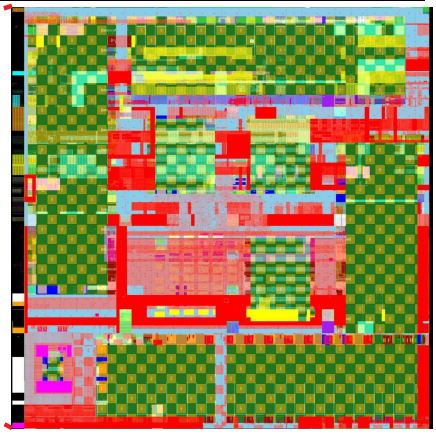
ENIAC was massive compared to modern PC standards:
17,468 vacuum tubes, 7,200 crystal diodes, 1,500 relays, 70,000 resistors, 10,000 capacitors, about 5 million hand-soldered joints.
Weighed 27 tons, 2.4 m by 0.9 m by 30 m, 167 m² floor space
150 kW of power



2000: Intel Pentium 4 Processor
Clock speed: 1.5 GHz
Transistors: 42 million
Technology: 0.18µm CMOS
Size: 1.22 cm square

Shakti Processor: IIT-Madras





Team Leader: **Prof. V. Kamakoti**
Designers: **Rahul Bodduna**
BTech, IIT Mandi
(doing MS at IIT-M)
+ many others

2018: IIT-M Shakti Risecreek CPU
Clock speed: 330 MHz
Transistors: 15 million
Technology: 22 nm FINFET
Size: 4 mm x 4 mm

Common uses of a Computer

- Storing and retrieving information
  - Information regarding students entering IIT
- Providing services to customers
  - Online shopping, banking, train reservations
- A intelligent calculator capable of complex operations
  - Designing electrical circuit layouts
  - Designing structures eg. bridges, buildings
- Communication and entertainment
- An intelligent controller
  - "Wheeling" electricity across the grid, matching supply & demand
  - Flying an aeroplane