Programming Languages Foundations

Computer Science III

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Outline

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Babbage Machine

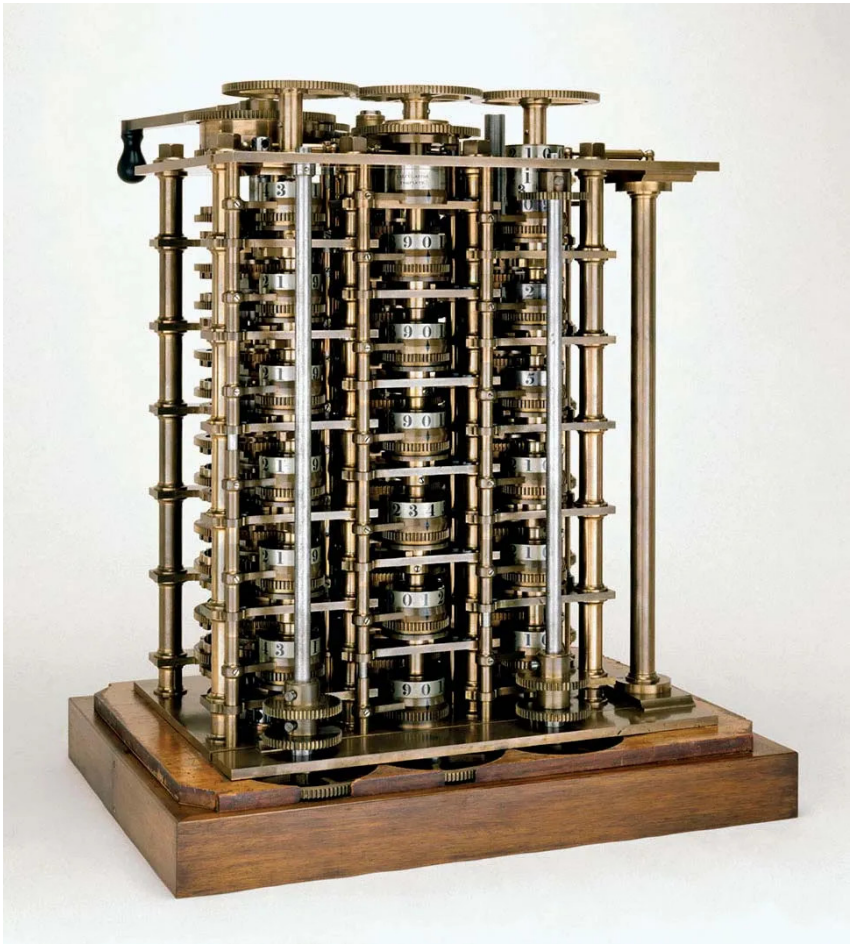


Figure: Analytical Machine

- **Charles Babbage** (1791 — 1871) was an English mathematician, philosopher, inventor, and mechanical engineer.
- He originated the **concept** of a digital programmable computer.
- Considered the "father of the computer". He creates the Analytical Engine.
- The **Analytical Engine** was a general-purpose mechanical computer.

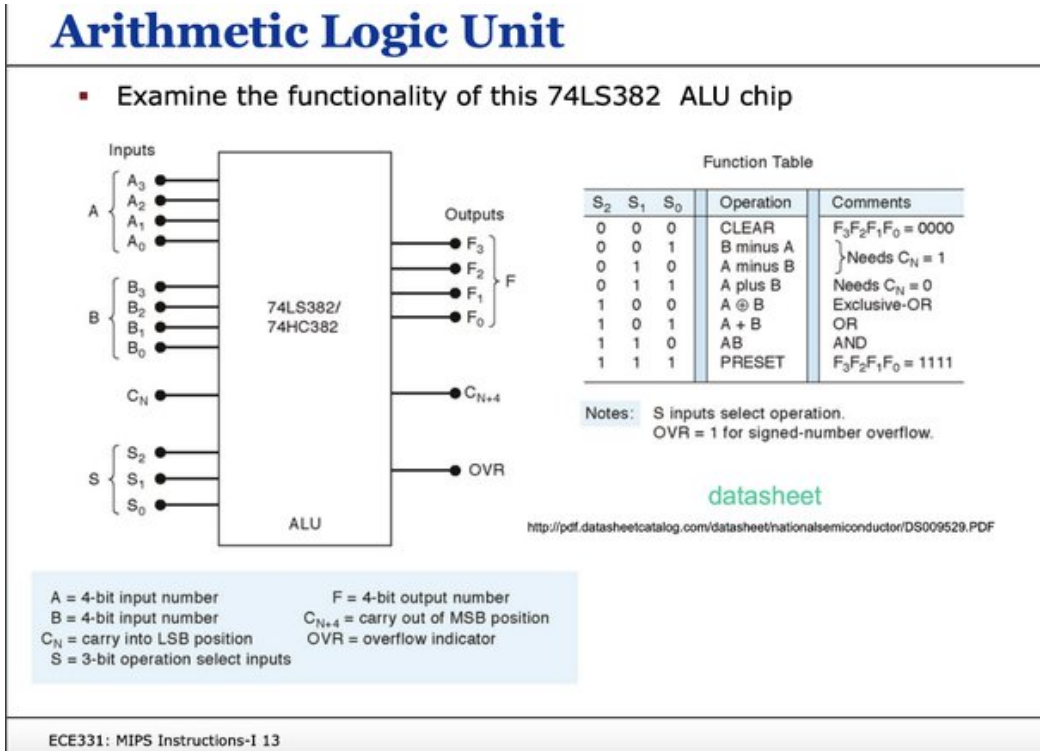
Ada Lovelace

- **Ada Lovelace** (1815 — 1852) was an English mathematician and writer.
- She is known for her work on Charles Babbage's early mechanical general-purpose computer, the Analytical Engine.
- She was the **first** to recognize that the machine had applications beyond pure calculation, and to have published the first algorithm intended to be carried out by such a machine.

Figure: Ada Lovelace

Physical Binary Language

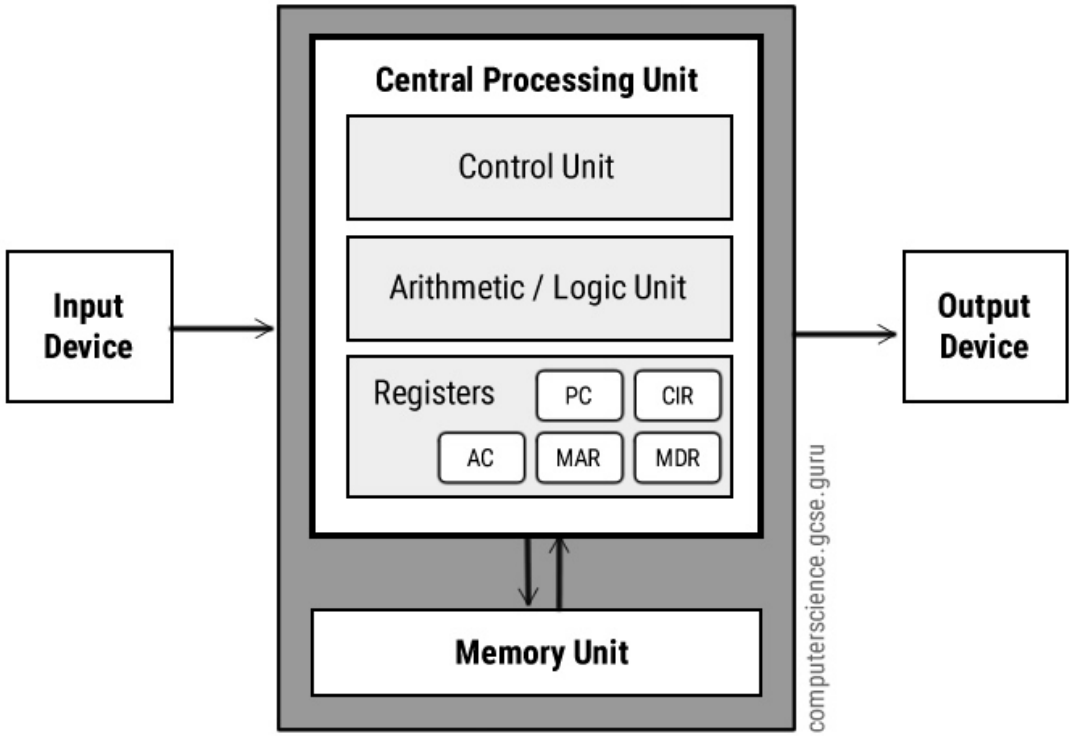
- **Binary** is a base-2 number system. It uses only two symbols: typically 0 (zero) and 1 (one).
- The **bit** is the basic unit of information in computing and digital communications.



Bits and Bytes

Von Neumann Architecture

- The **Von Neumann Architecture** is a computer architecture based on the stored-program computer concept.
- The **design** is based on the concept of an instruction set.
- The **program** and **data** are both stored in the same memory unit.



Memory and Bit Storage

Machine Programming Language

Bit Operations

- **Bitwise operations** are operations that directly manipulate bits.
- They are used in low-level programming for performing calculations, file processing, and data compression.

Assembly Programming Language

```
1  ; Example of a basic conditional structure in x86 assembly
2
3  cmp eax, 10     ; Compare the value in eax with 10
4  je equal_label  ; Jump to equal_label if eax is equal to 10
5
6  ; Code for not equal case
7  jmp end_label   ; Jump to end_label to avoid executing the equal case code
8
9  equal_label:
10 ; Code for equal case
11
12 end_label:
13 ; Continue execution
14
```

Listing 1: Basic Conditional Structure in Assembly

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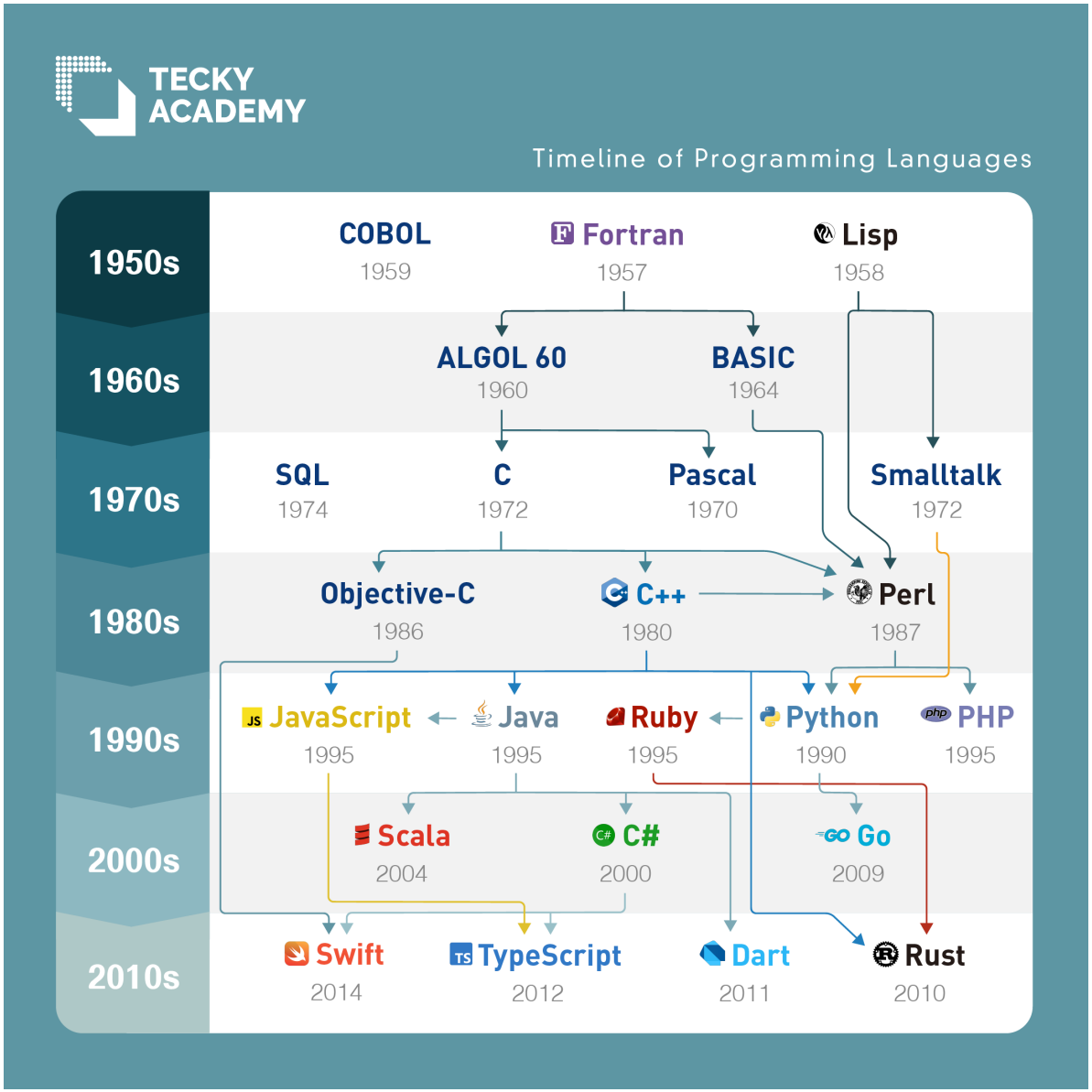
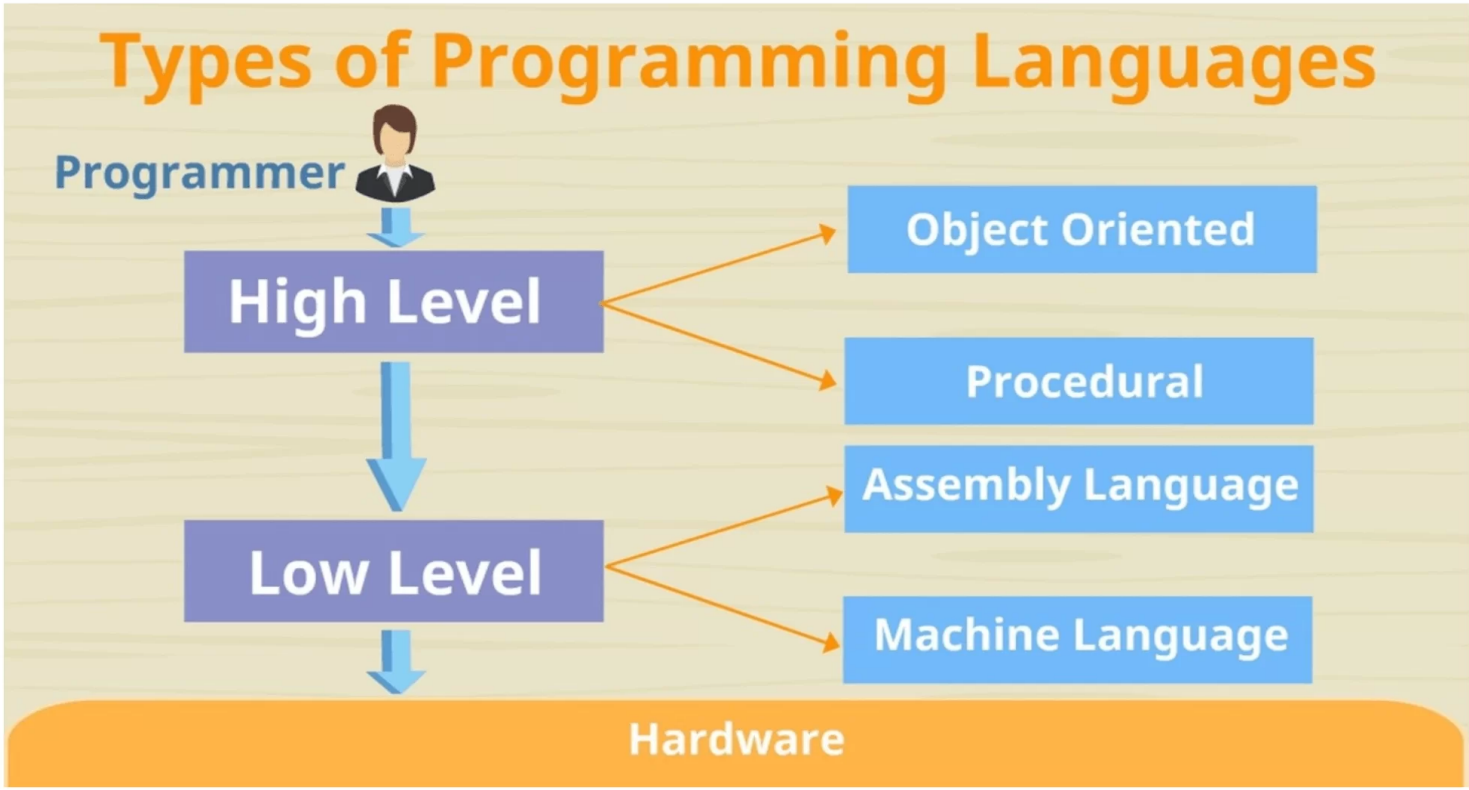
History of Programming Languges



High-Level Programming Languages I

High-Level vs Low-Level



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High-Level Programming Languages II

Purpose of High-Level Languages

Ease of Use

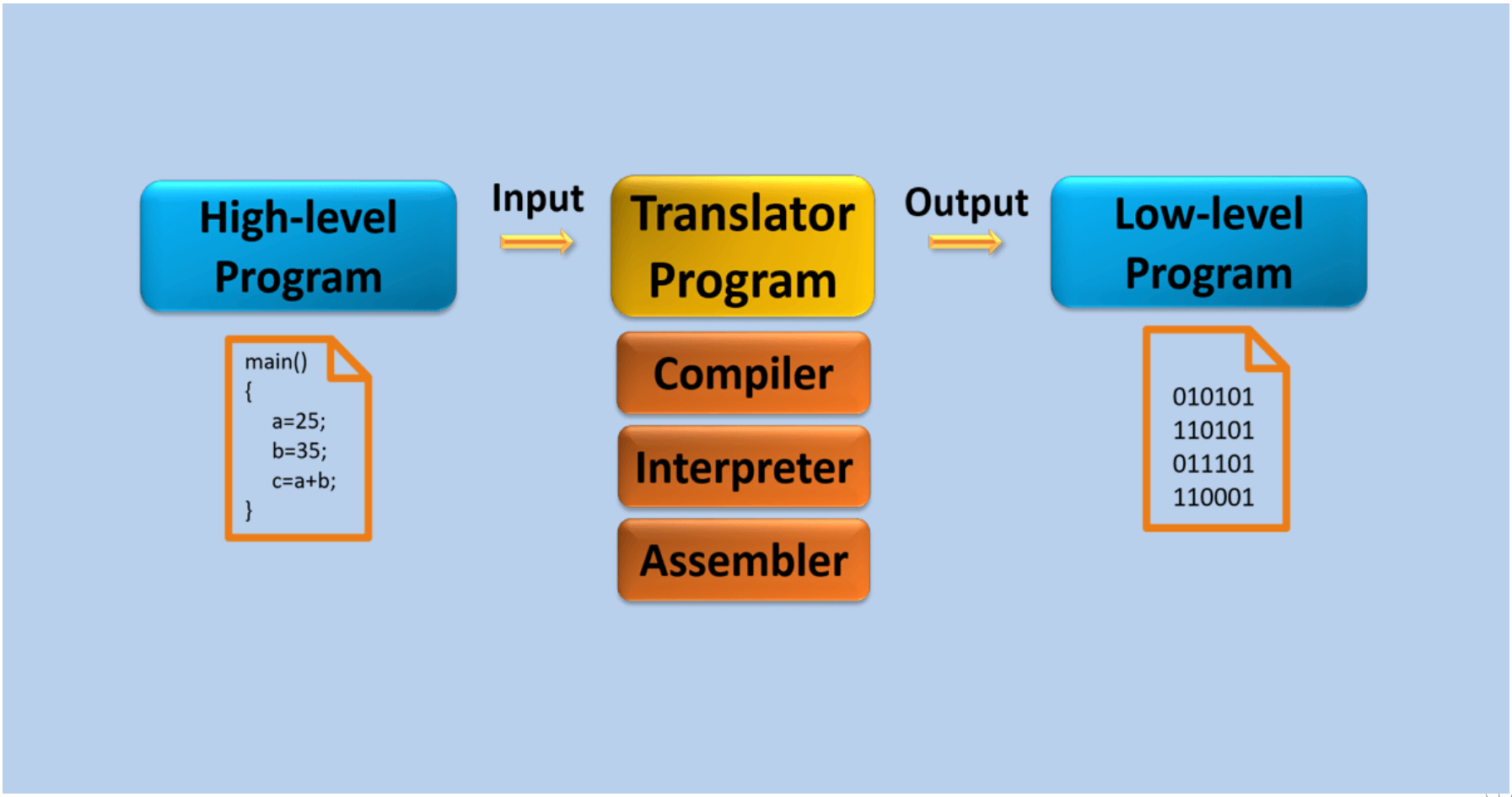
- Simplifying programming
- Minimizing learning curve
- Enhancing productivity
- Automated memory management
- Clear syntax
- Readability and maintainability

Portability Across Systems

- Cross-platform compatibility
- Utilization of compilers and interpreters
- Seamless execution on various platforms
- Reduction of platform-specific modifications
- Enhanced flexibility across environments

Techopedia

Translation Process



Efficiency and Readability

- **Efficiency** is the ability to avoid wasting materials, energy, efforts, money, and time in doing something or in producing a `desired result`.
- **Readability** is the ease with which a human reader can understand the purpose, control flow, and operation of `source code`.

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Finite State Machines

- A **finite-state machine** (FSM) is a mathematical model of computation.
- It is an abstract machine that can be in exactly one of a finite number of states at any given time.
- The FSM can change from one state to another in response to some external inputs.
- The FSM is defined by a list of states, a list of inputs, a list of transitions, and a list of outputs.

“ ”

.

Turing Master

Finite Automata: Union, Kleene Star

Regular Expressions

Strings Processing

Alan Turing

- **Alan Turing** (1912 — 1954) was an English mathematician, computer scientist, logician, cryptanalyst, philosopher, and theoretical biologist.
- He is widely considered to be the **father of theoretical computer science** and **artificial intelligence**.
- He was highly influential in the development of theoretical computer science, providing a formalization of the concepts of algorithm and computation with the Turing machine.

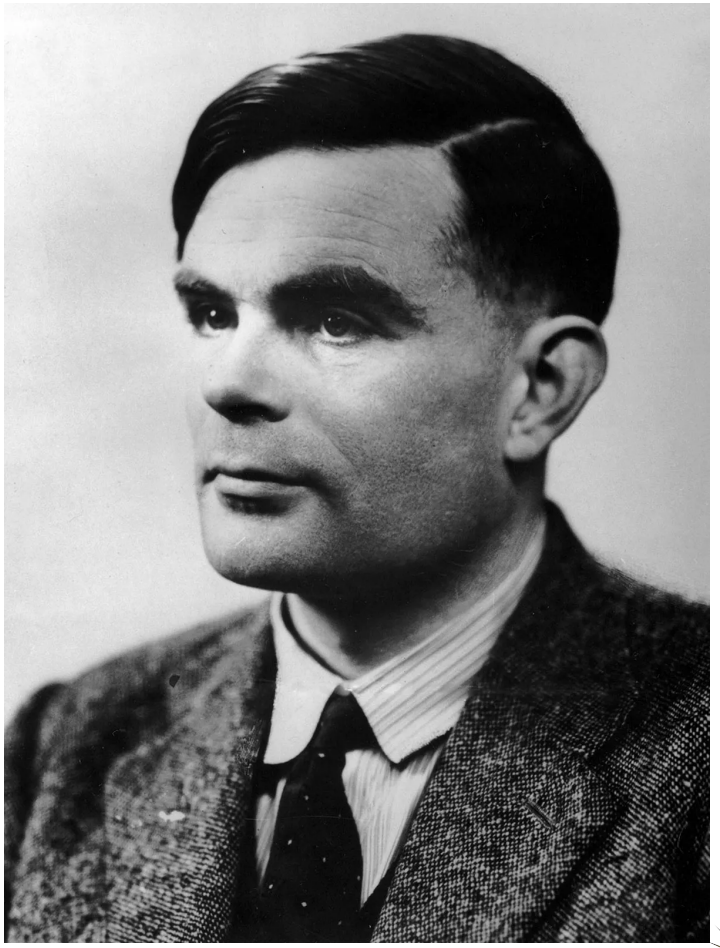

Figure: Alan Turing

Turing Machine

Universal Turing Machine

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Noam Chomsky

- **Noam Chomsky** (1928 —) is an American linguist, philosopher, cognitive scientist, historian, social critic, and political activist.
- He is considered the **father of modern linguistics**.
- He introduced the **Chomsky hierarchy**, a classification of formal languages.

Figure: Noam Chomsky

Natural Processing Language

Formal Languages

Grammars Foundations

Chomsky Formal Norm

Regular Expressions

Equivalence between Gramma and Finite Automatas

Grammars Example

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Thanks!

Questions?

Repo: *https://github.com/EngAndres/ud-public/tree/main/courses/computer-science-iii*

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