Computer Architecture and Organization

CS 115

Lecture 1

Instructor: **Gerald John M. Sotto**

Last Updated: August 16, 2025

Agenda

Unit 1: Introduction to Computer Development, Component and Organization

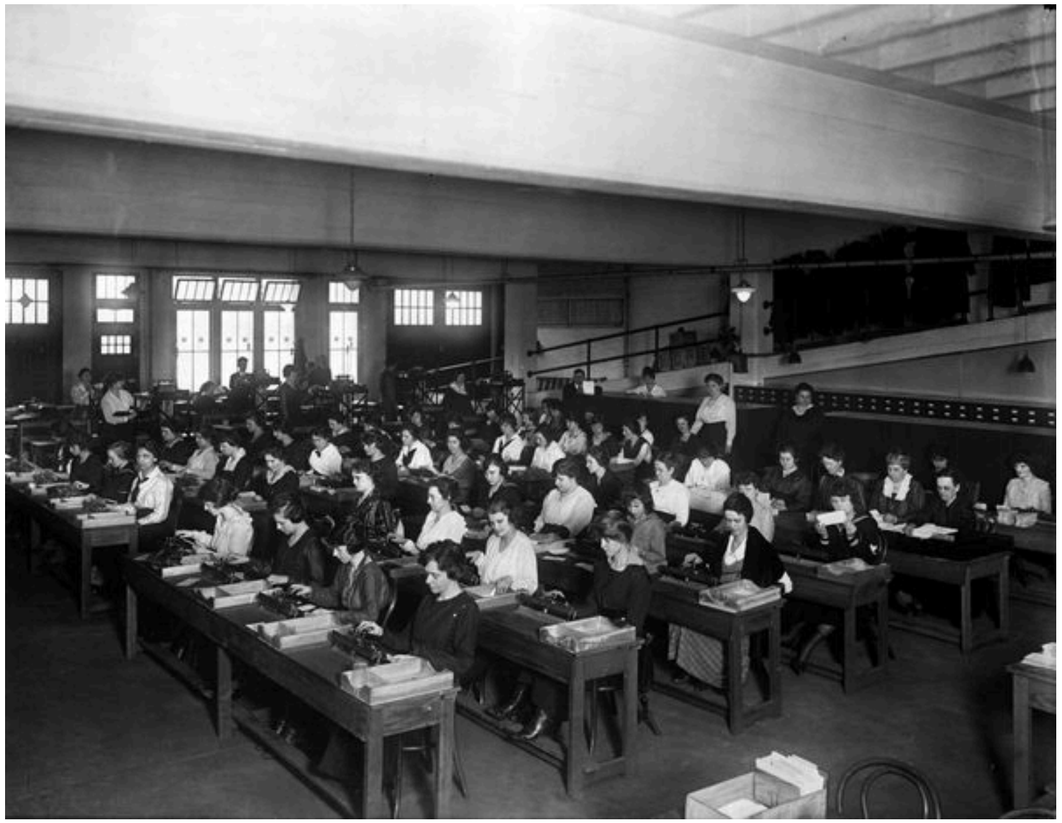
- Introduction to Computer System
- Components of the Computer
- Historical Development

Introduction to Computer System

Introduction to Computer System

Computer

- Origin: The term "computer" **originally referred to a person who performed calculations.**



Introduction to Computer System

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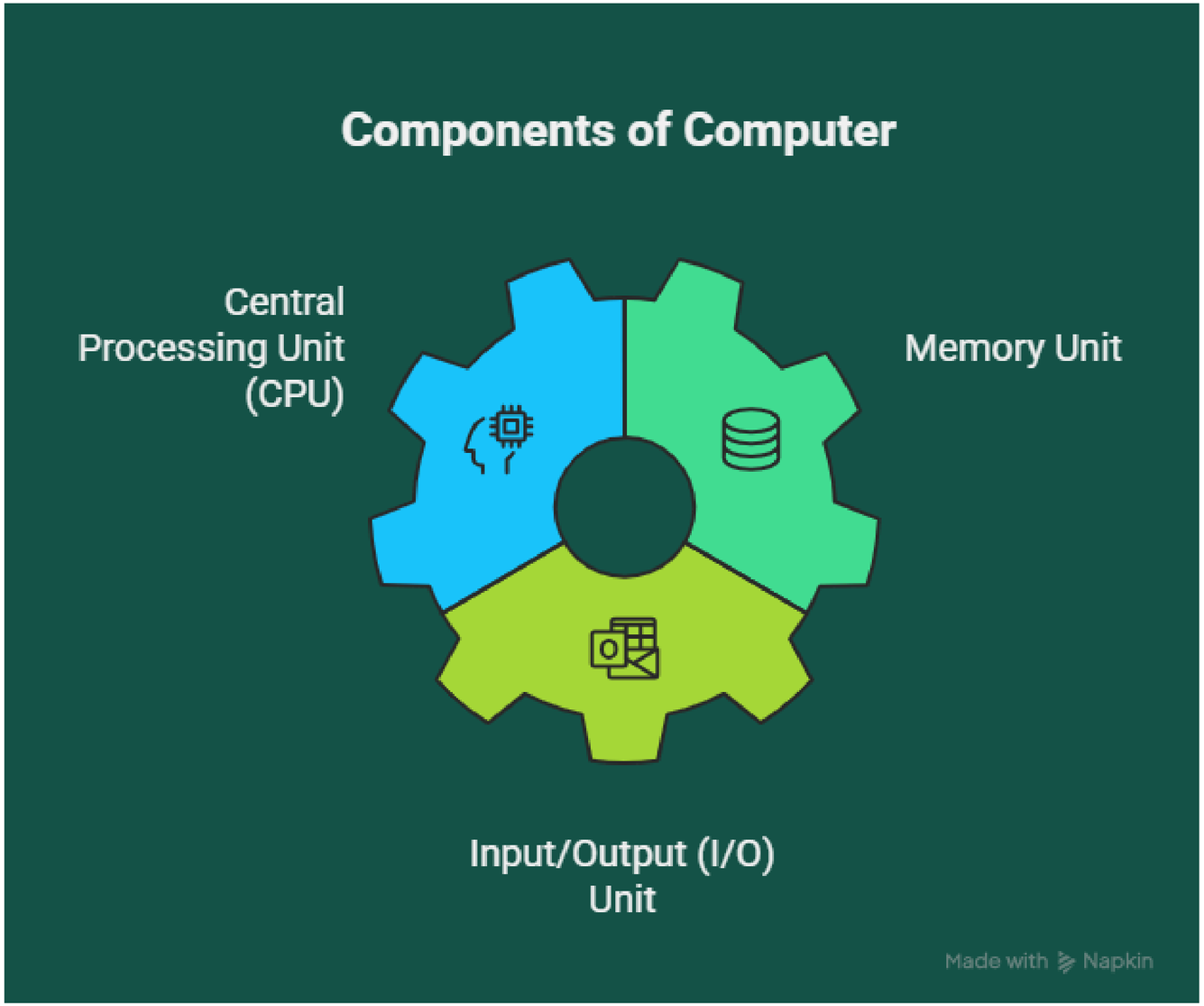
- It **includes not just the hardware**—the physical parts you can touch—**but also the software**, which is the set of instructions that tells the hardware what to do.
- A **combination of hardware and software** that works together to perform tasks.

Components of the Computer

Components of the Computer



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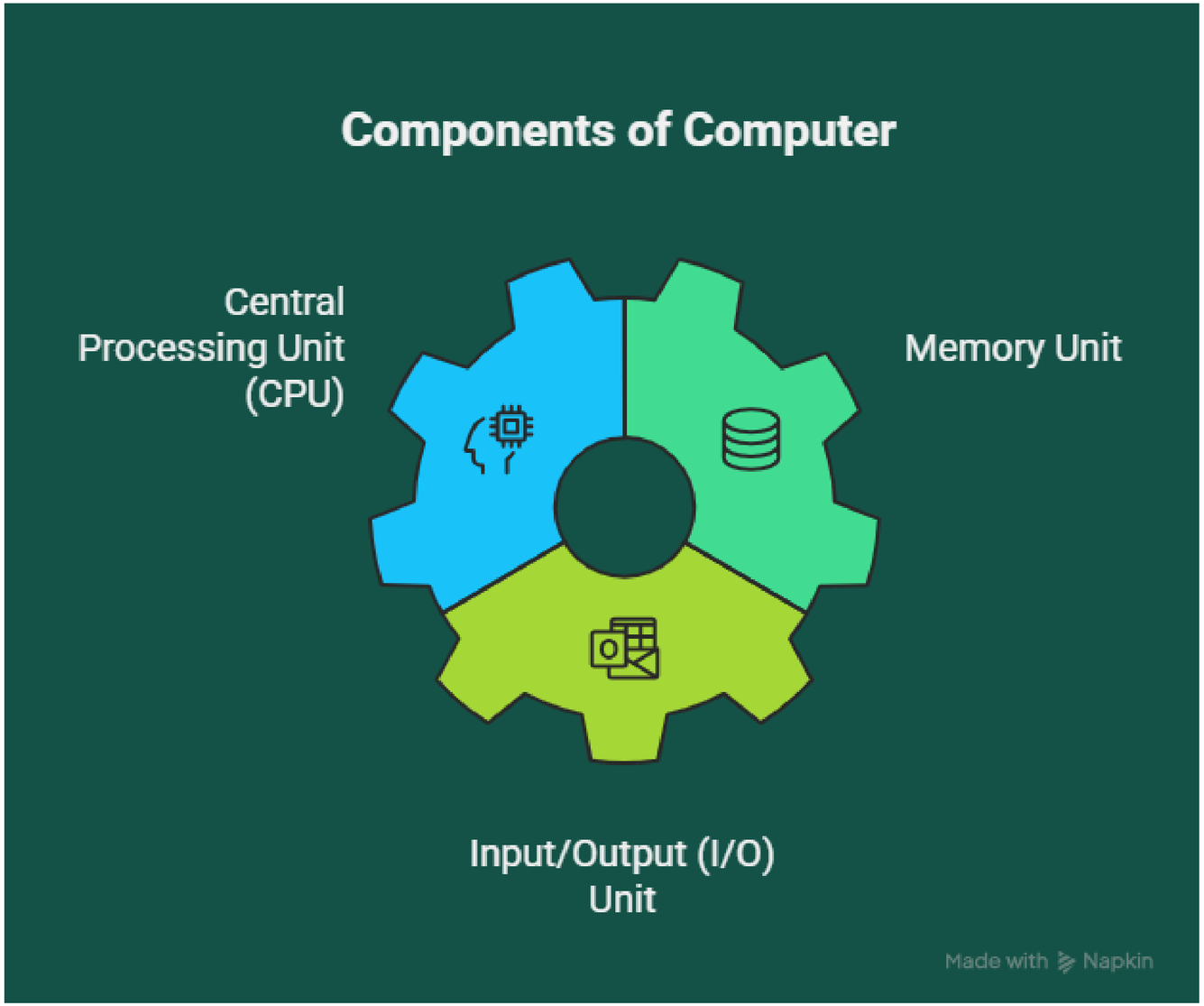
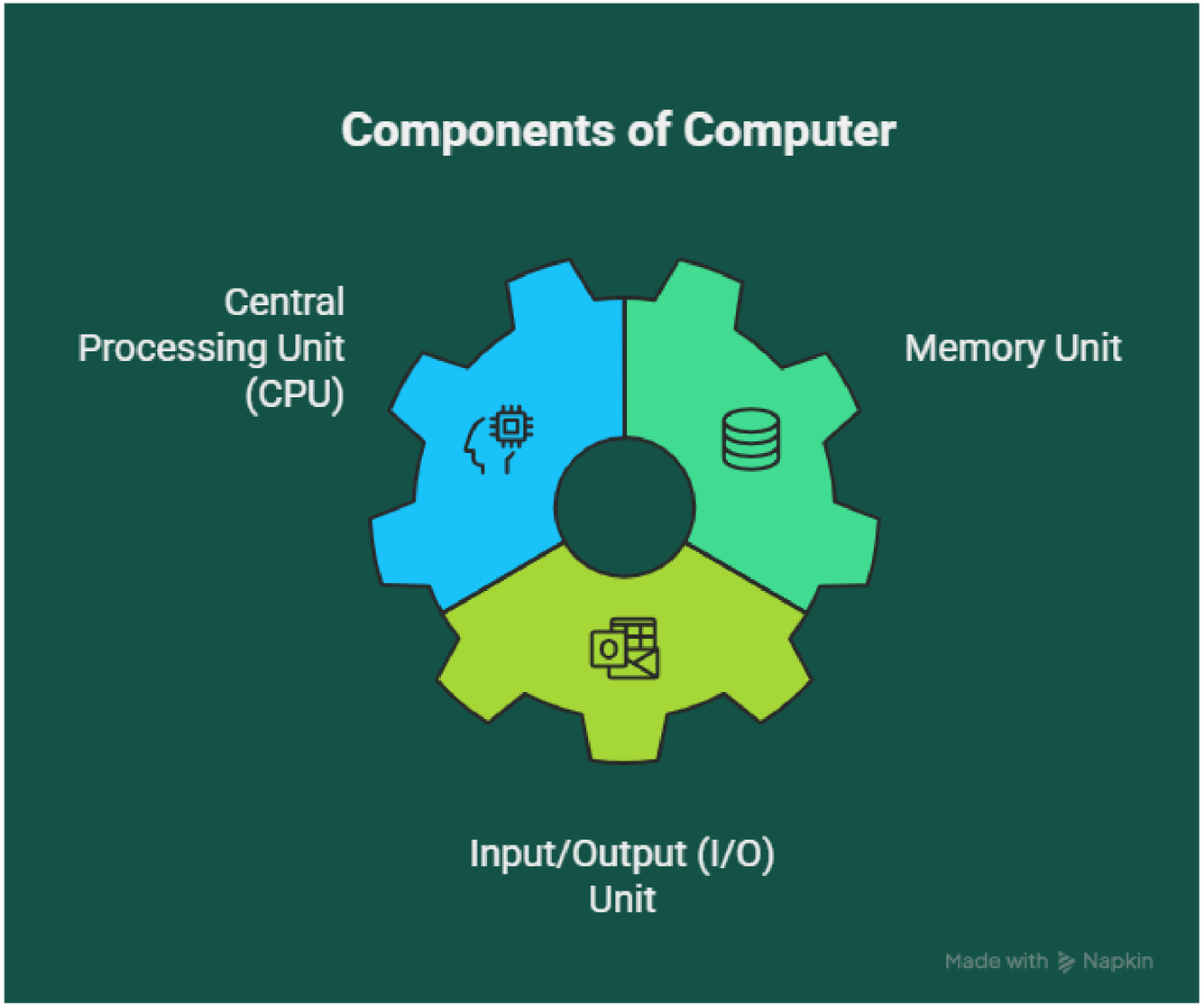


- These components are typically described in a high-level, functional block diagram, **showing how data and instructions flow between them.**
- They are not just the physical parts you can see but also the **logical units that perform specific tasks.**

Components of the Computer



The three main logical components of a computer, as defined by the classic von Neumann architecture, are:

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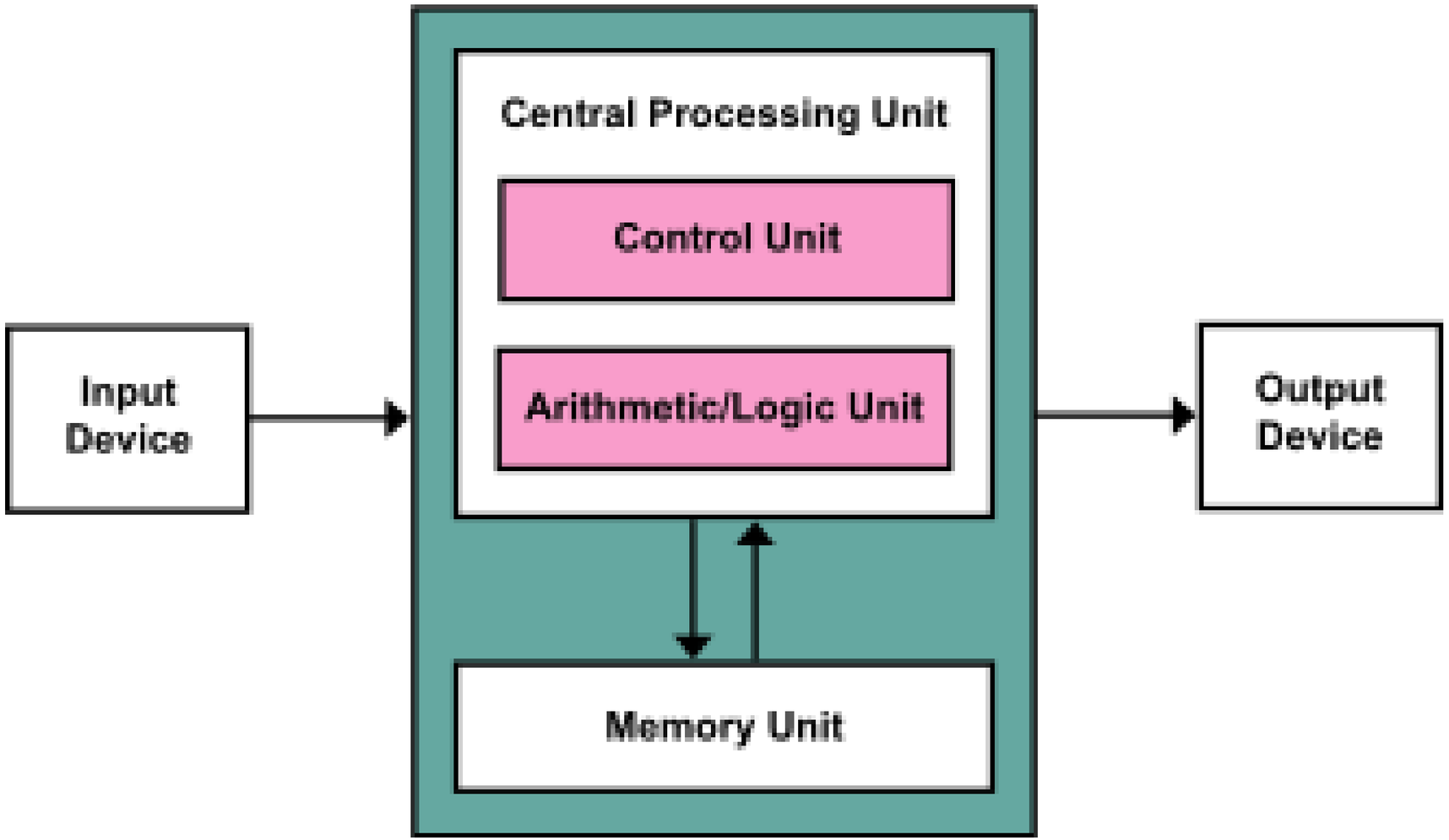
Components of the Computer



Components of the Computer

- **Central Processing Unit (CPU):** Often called the "brain" of the computer, the CPU executes program instructions and performs calculations. It consists of three primary sub-components:
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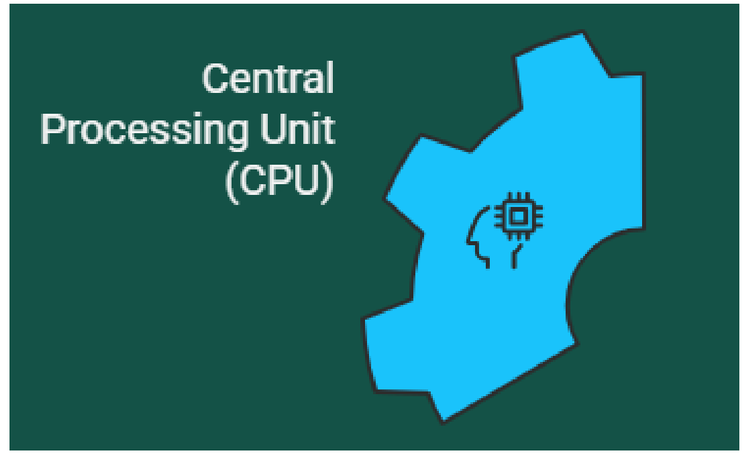
  - **Control Unit (CU):**
  - **Registers:**



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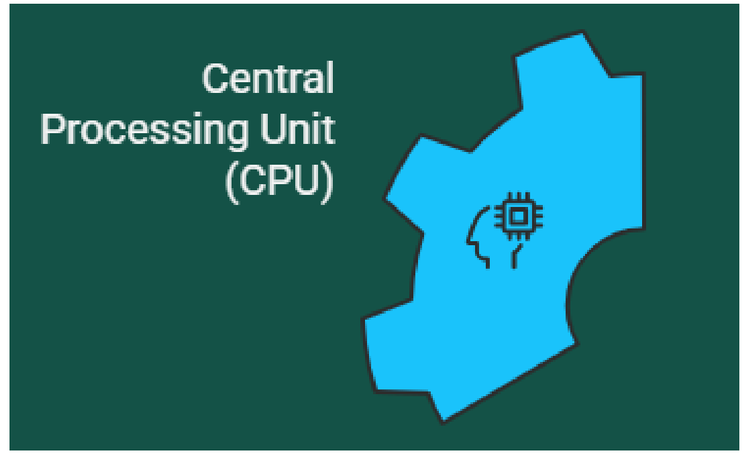

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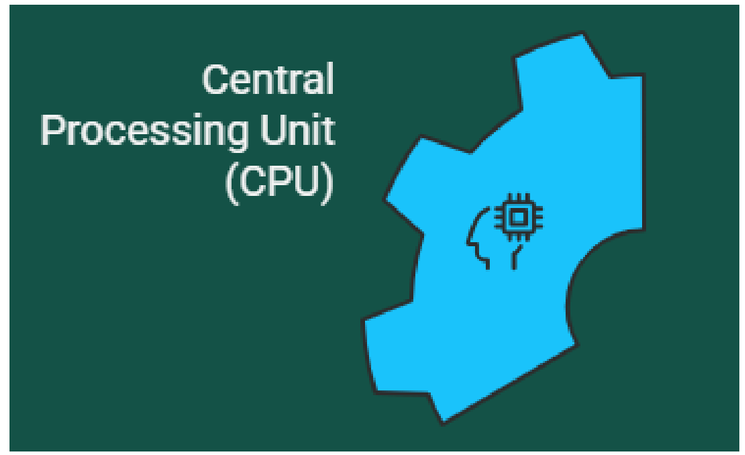

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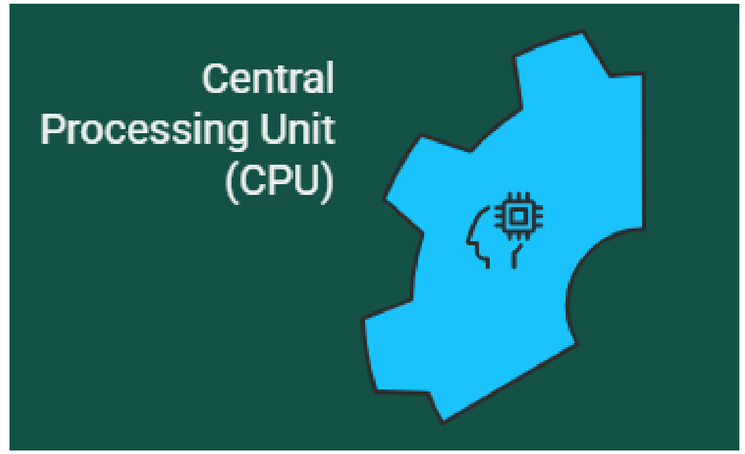

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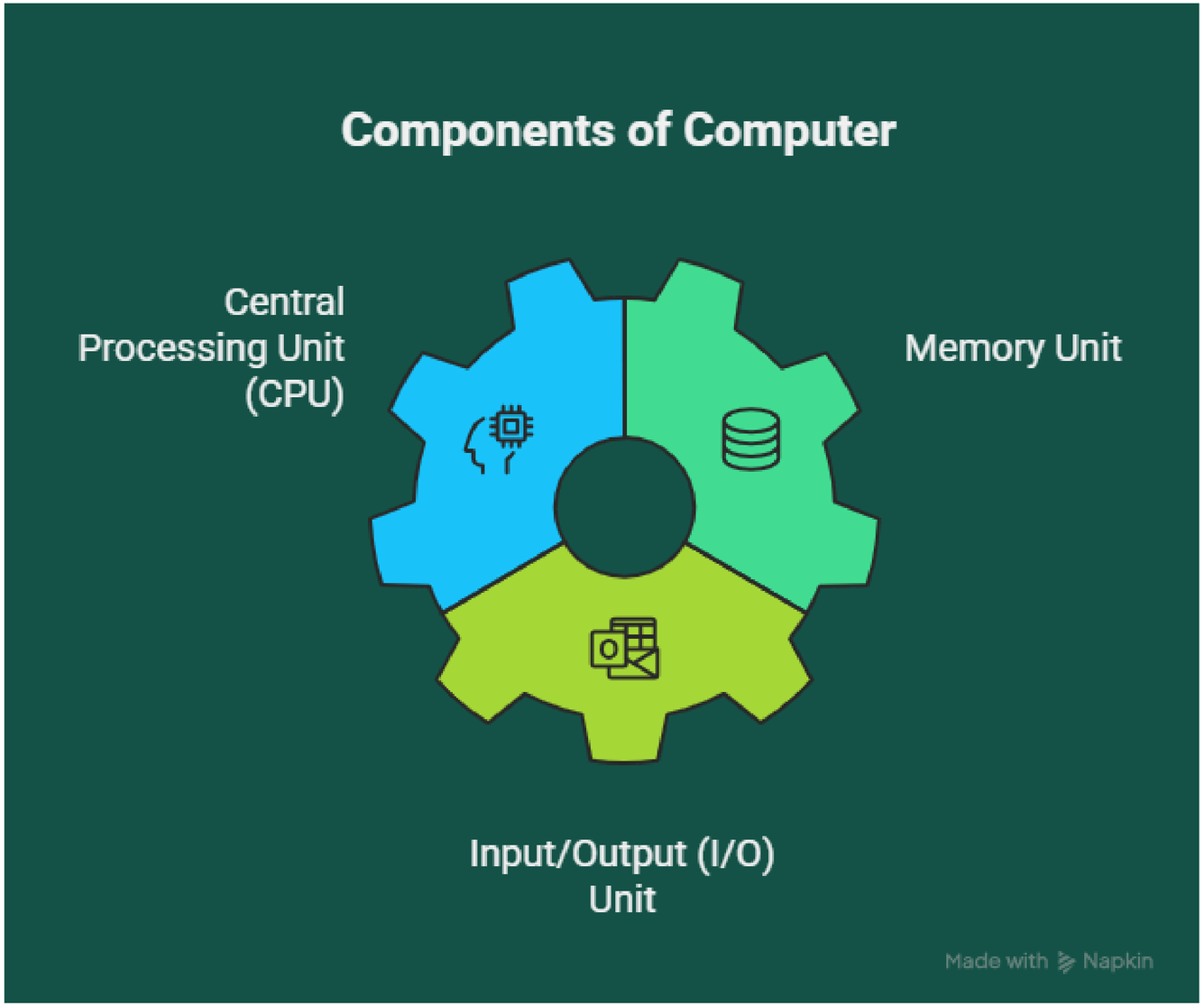

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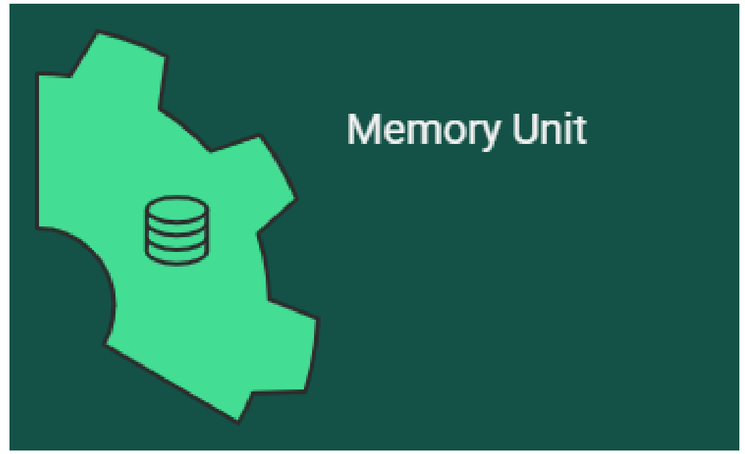
  - **Main Memory (RAM):**
  - **Secondary Memory:**



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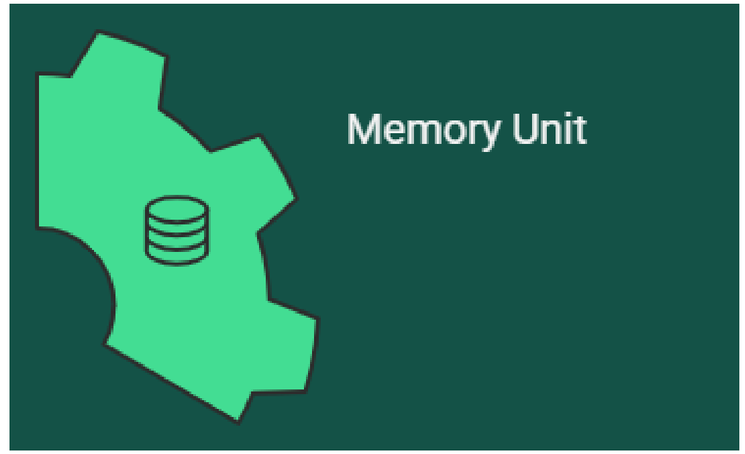

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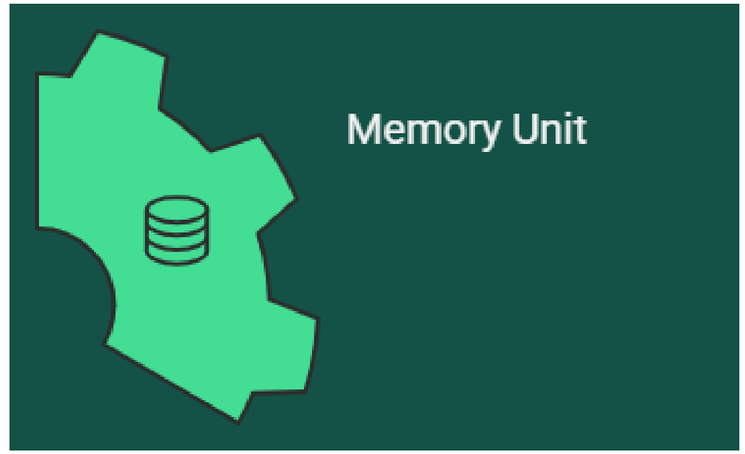
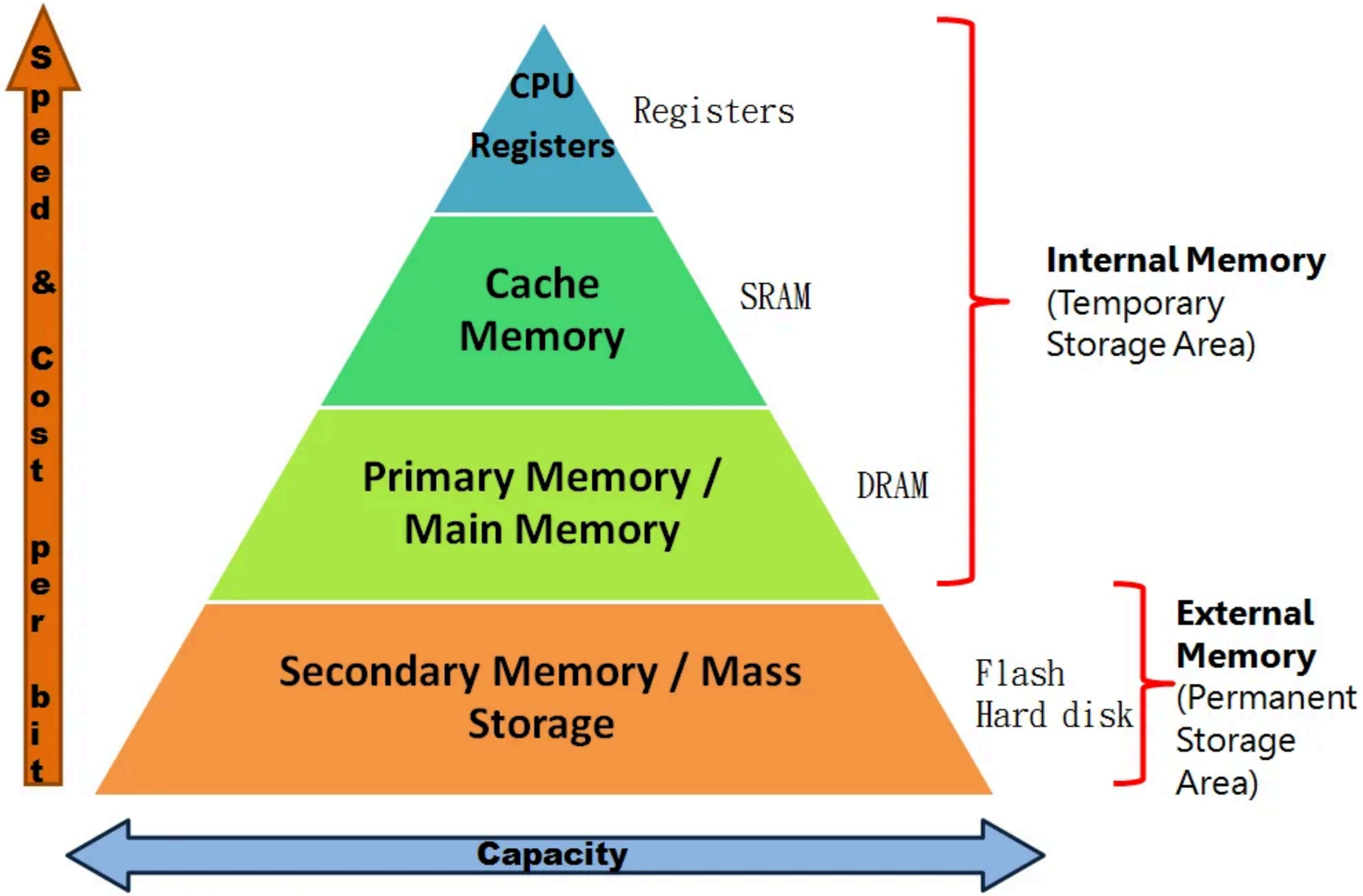


  - **Main Memory (RAM):** The primary, volatile storage that the CPU can access directly and quickly. It holds the programs and data that are currently being used.
  - **Secondary Memory:** Non-volatile storage like a hard drive (HDD) or solid-state drive (SSD). It is slower than main memory but has a much larger capacity and is used for long-term storage of files and programs.

Components of the Computer



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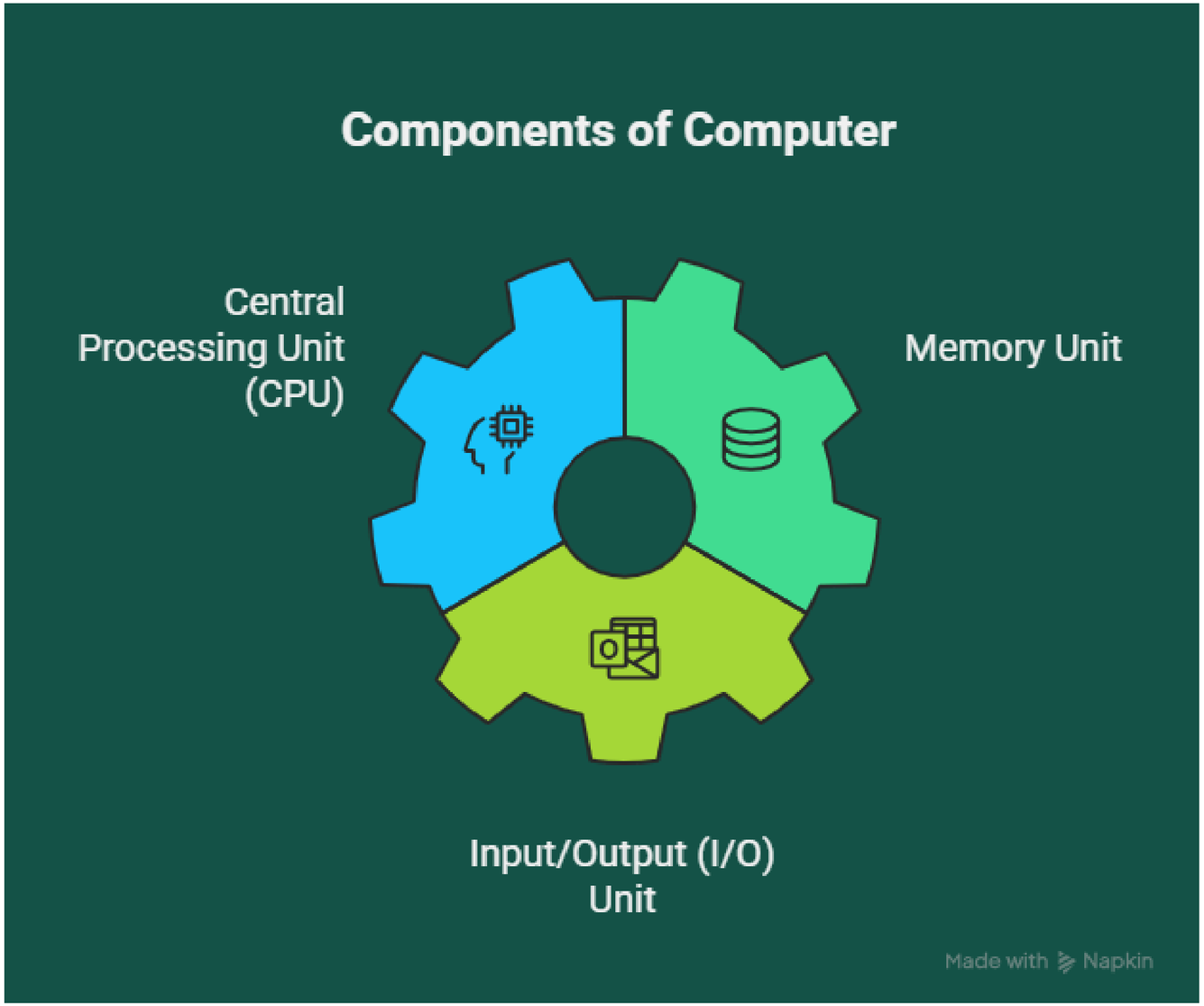

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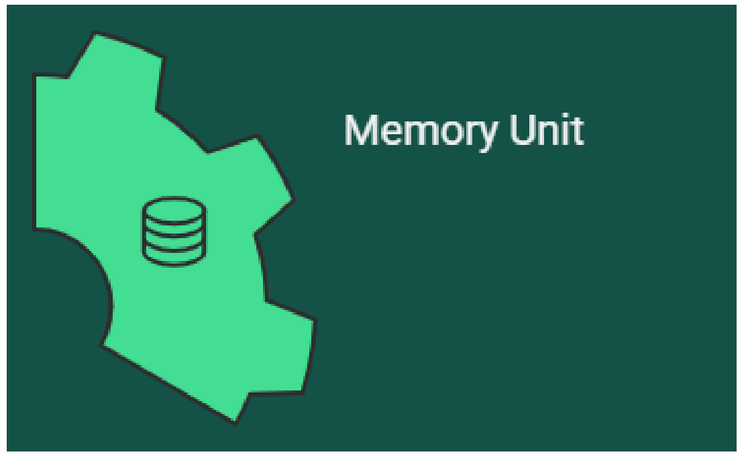

- **Input Unit:**
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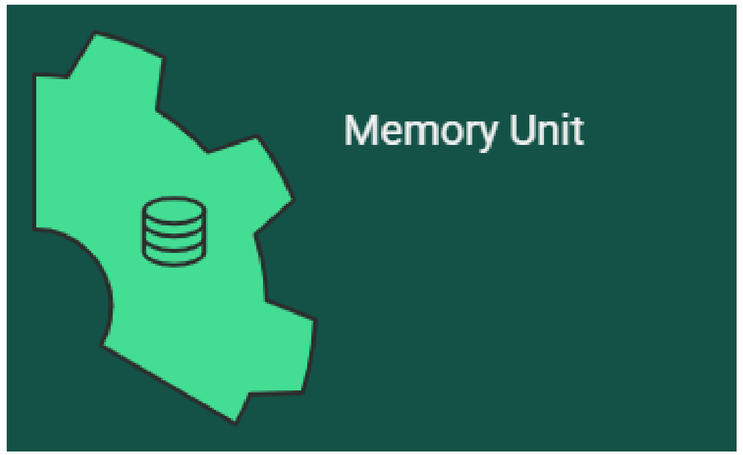
- **Input/Output (I/O) Unit:** This component is the interface between the computer and the outside world. It manages the flow of data to and from peripheral devices.

Components of the Computer



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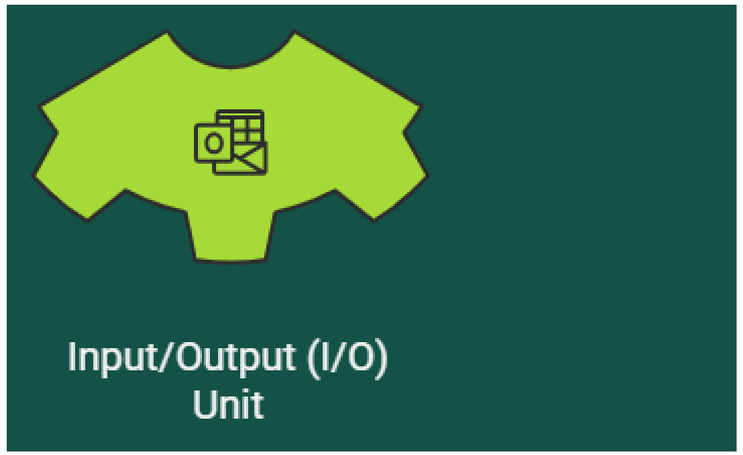

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    - **Output Unit:** Components that display or present data from the computer (e.g., monitor, printer, speakers).

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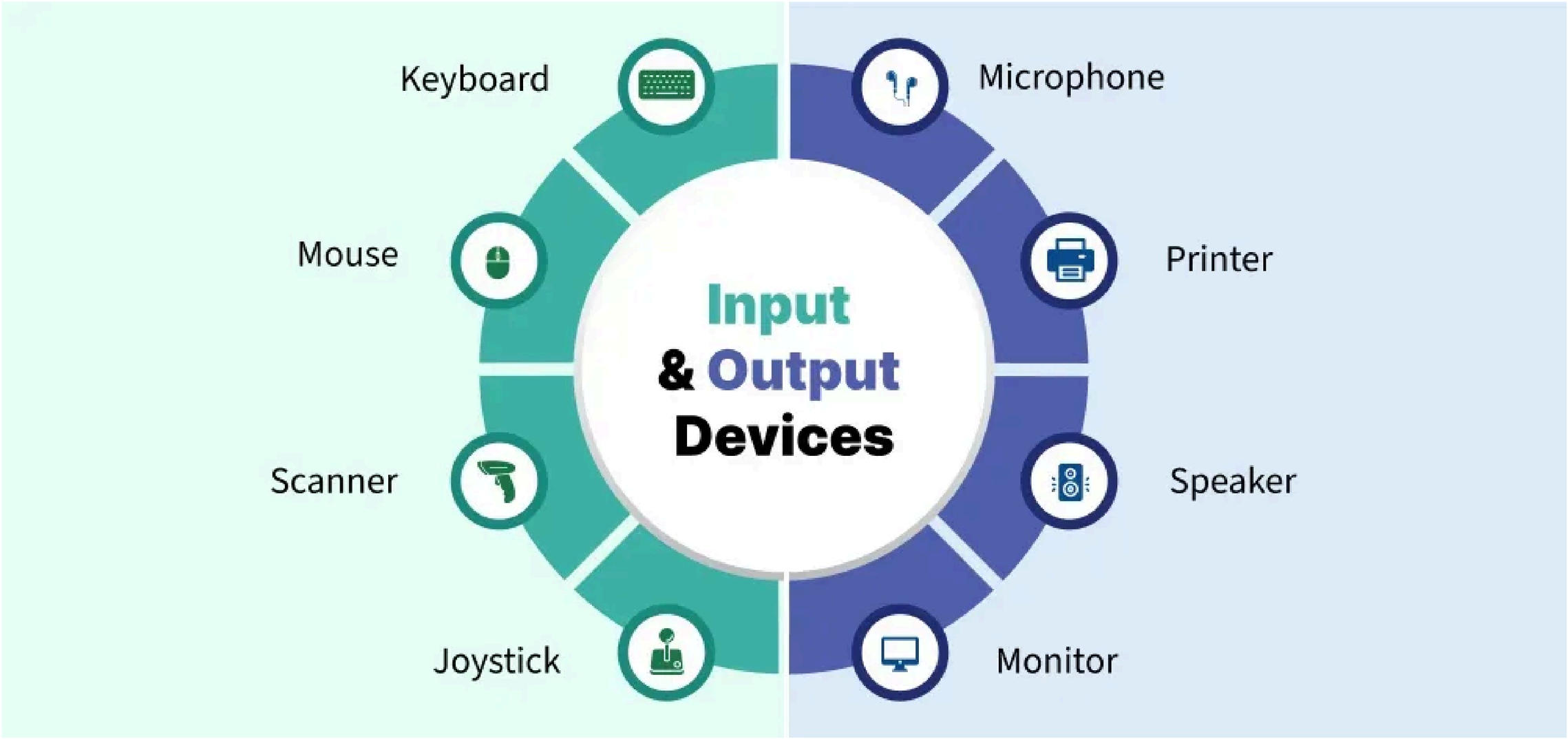

Historical Development

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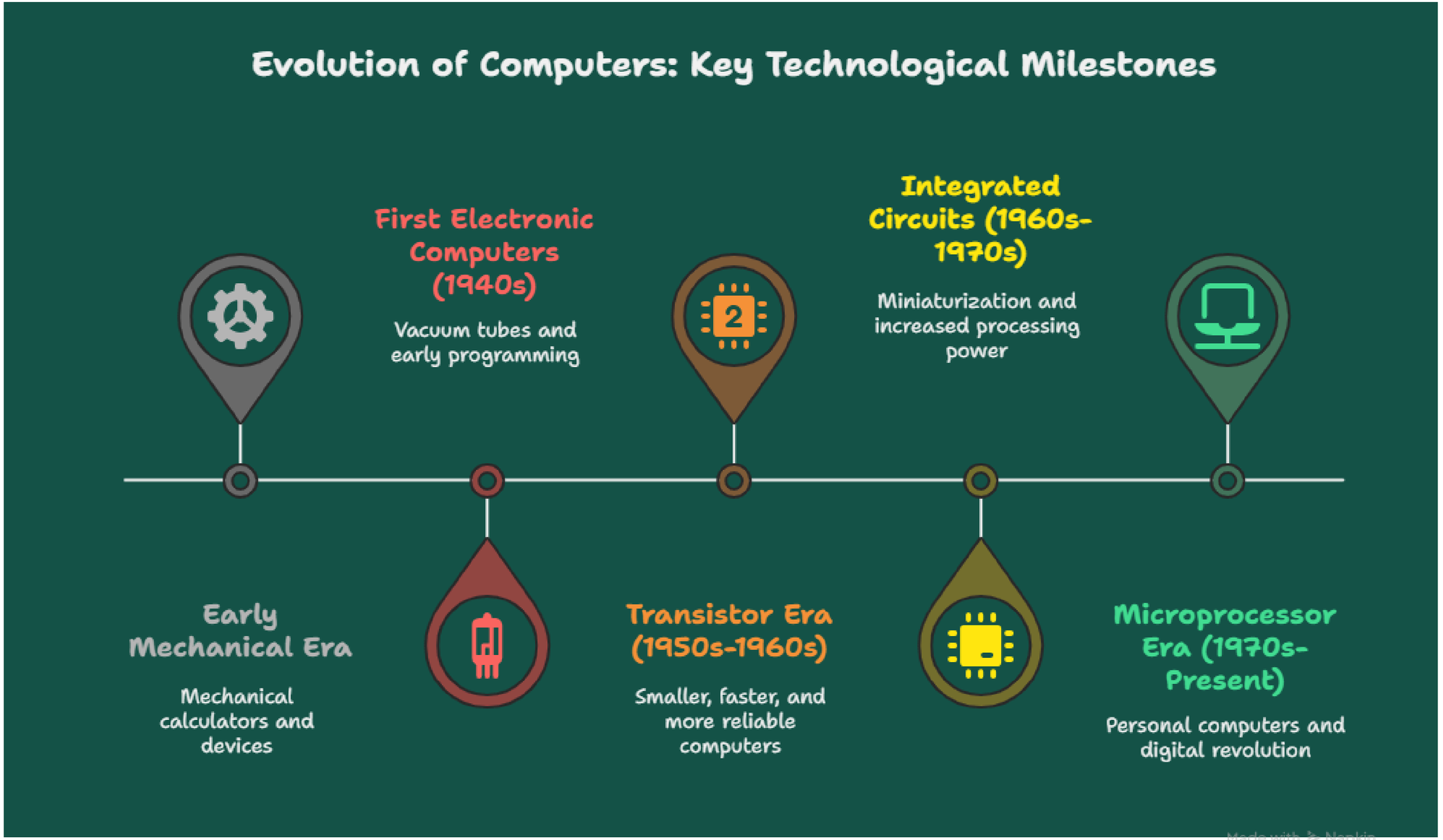
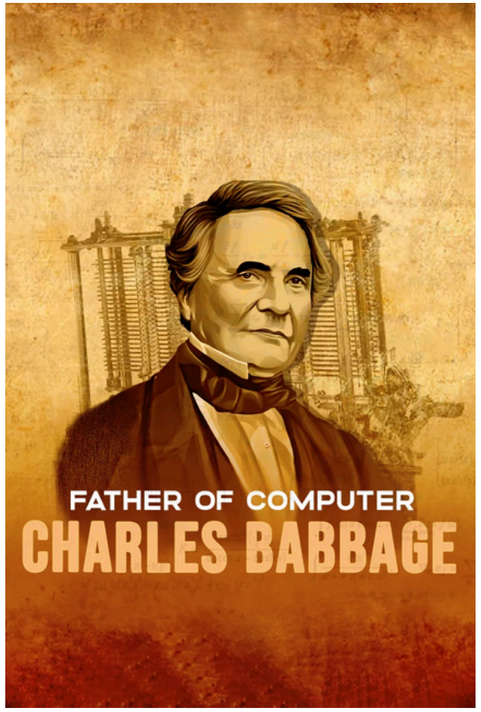
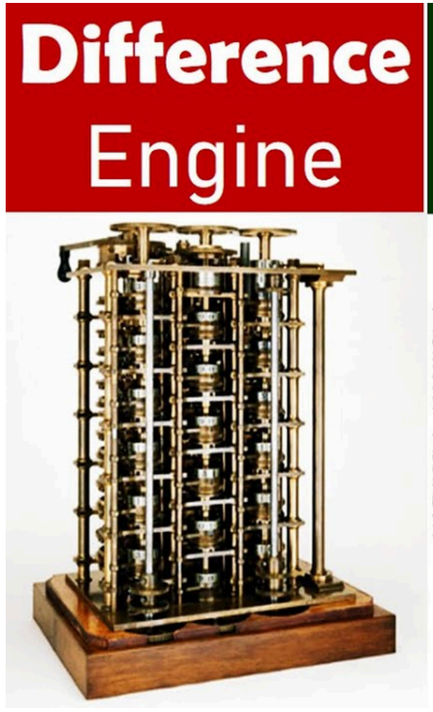
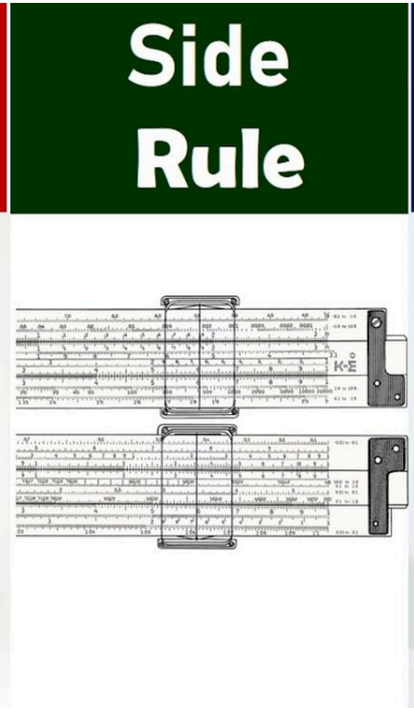


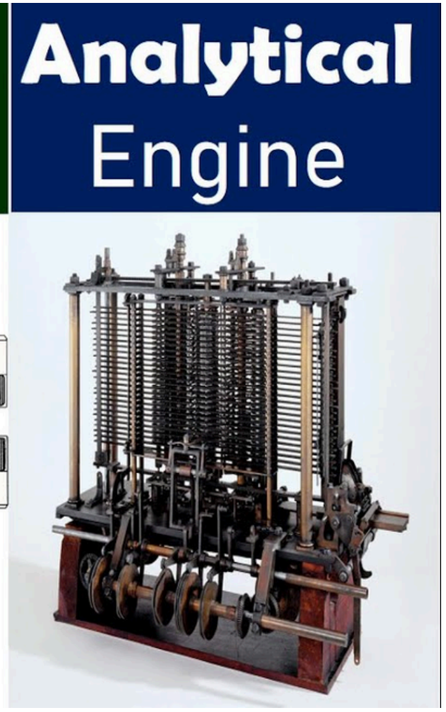
Historical Development

- **Early Mechanical Era:** Devices like the **abacus**, and later the **difference engine** and **analytical engine** designed by Charles Babbage in the 19th century, were early attempts at automated computation.









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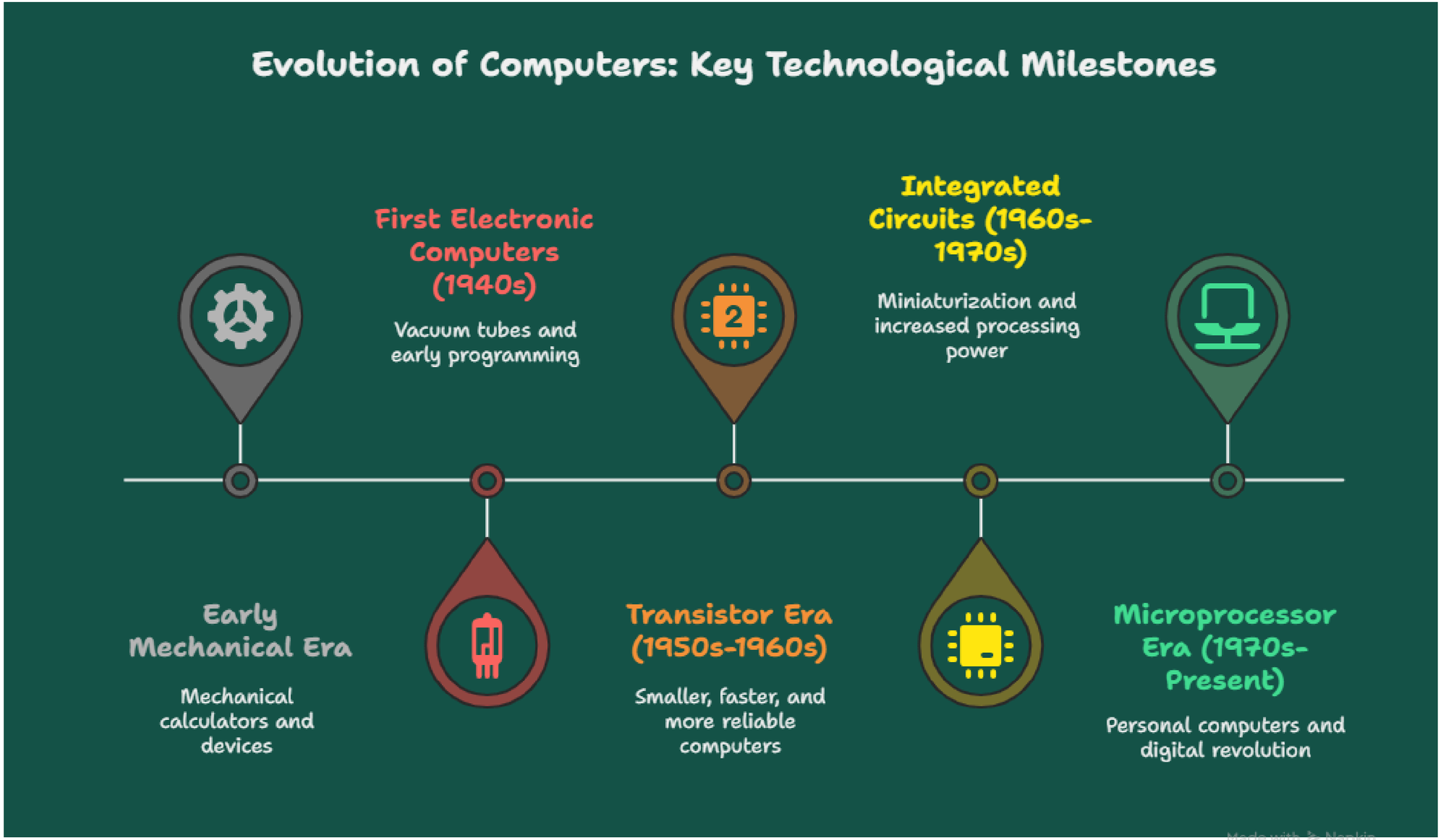
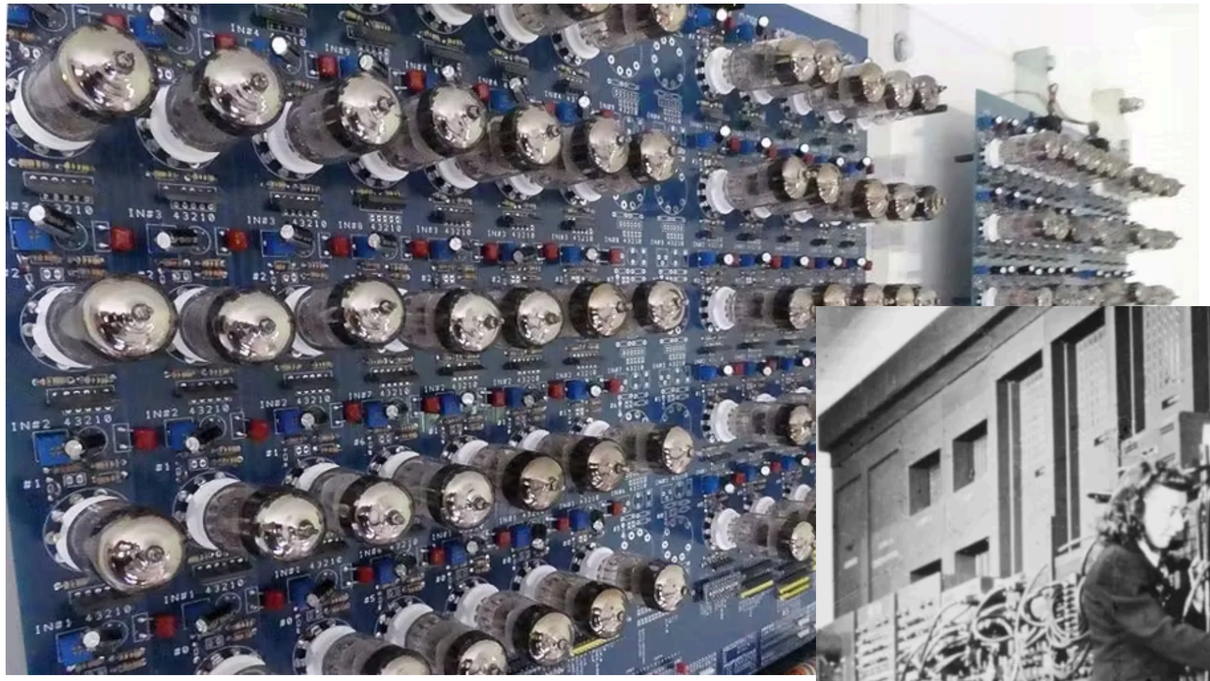
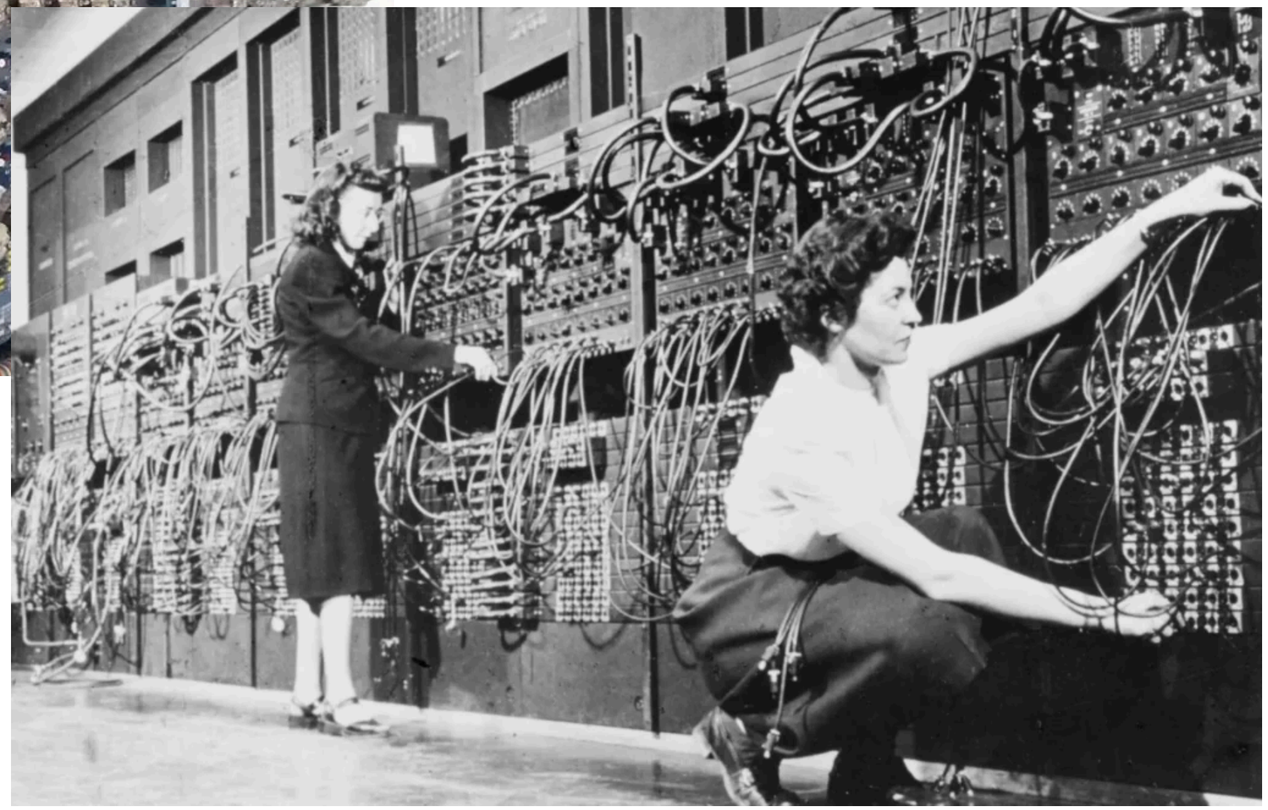


Historical Development

- **First Electronic Computers (1940s):** The invention of the **vacuum tube led** to the first large-scale electronic computers, such as the ENIAC (Electronic Numerical Integrator and Computer). These machines were massive, consumed huge amounts of power, and were difficult to program.

Historical Development





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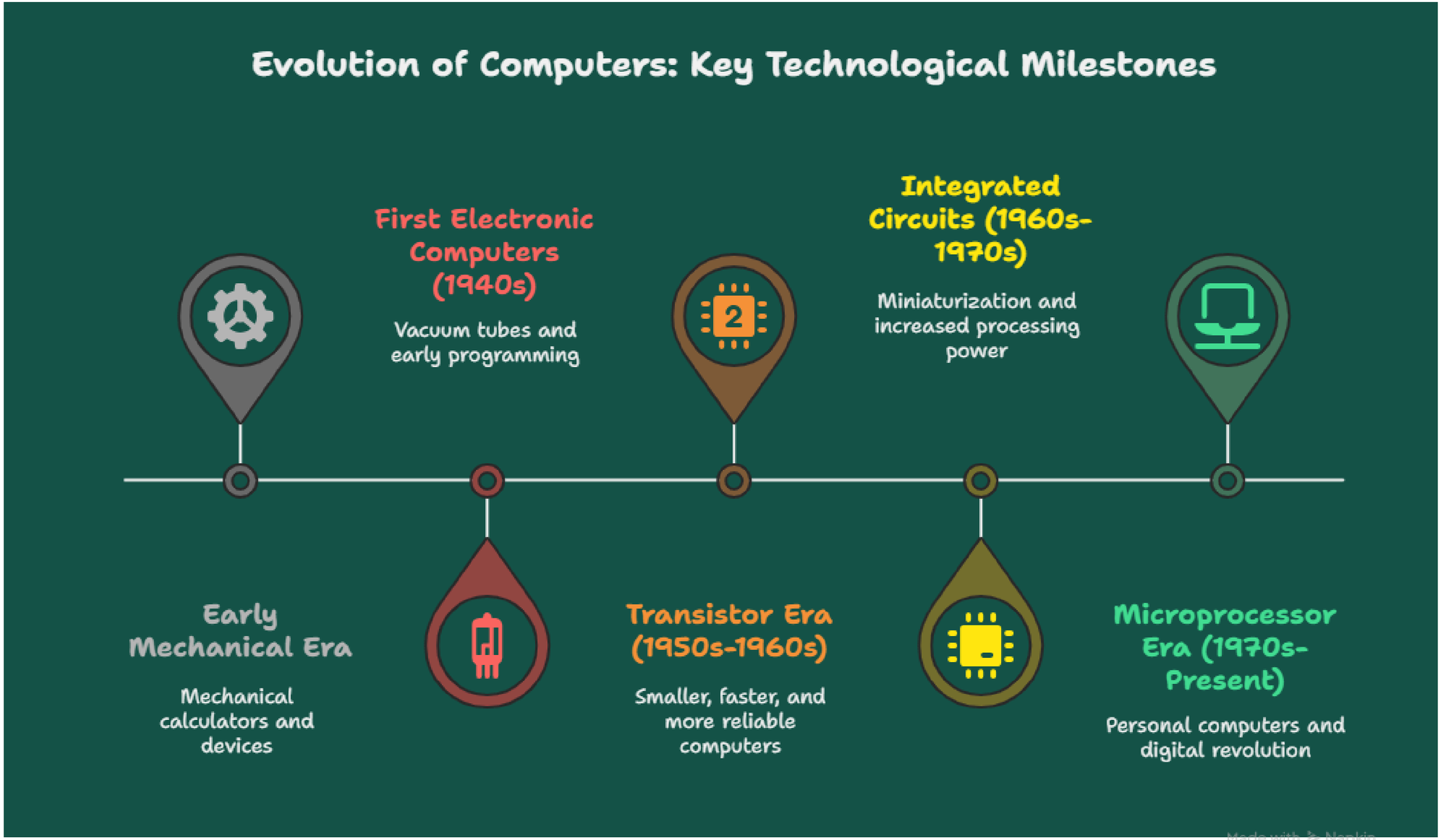
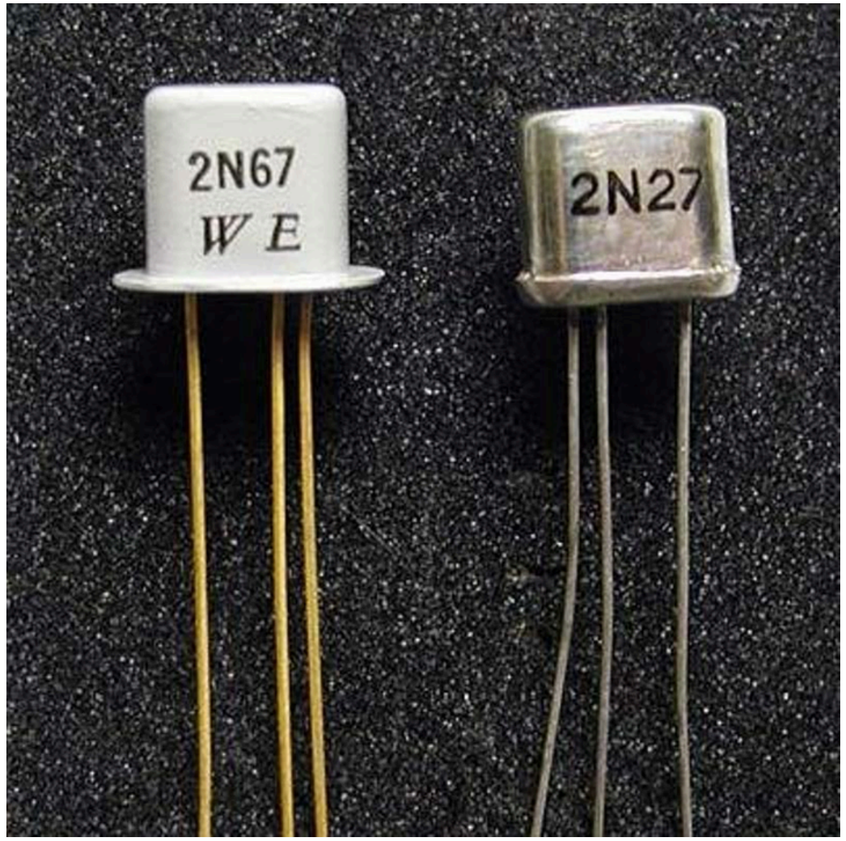


Historical Development

- **Transistor Era (1950s–1960s):** The invention of the transistor led to smaller, more reliable, and more energy-efficient computers. This marked the second generation of computers.



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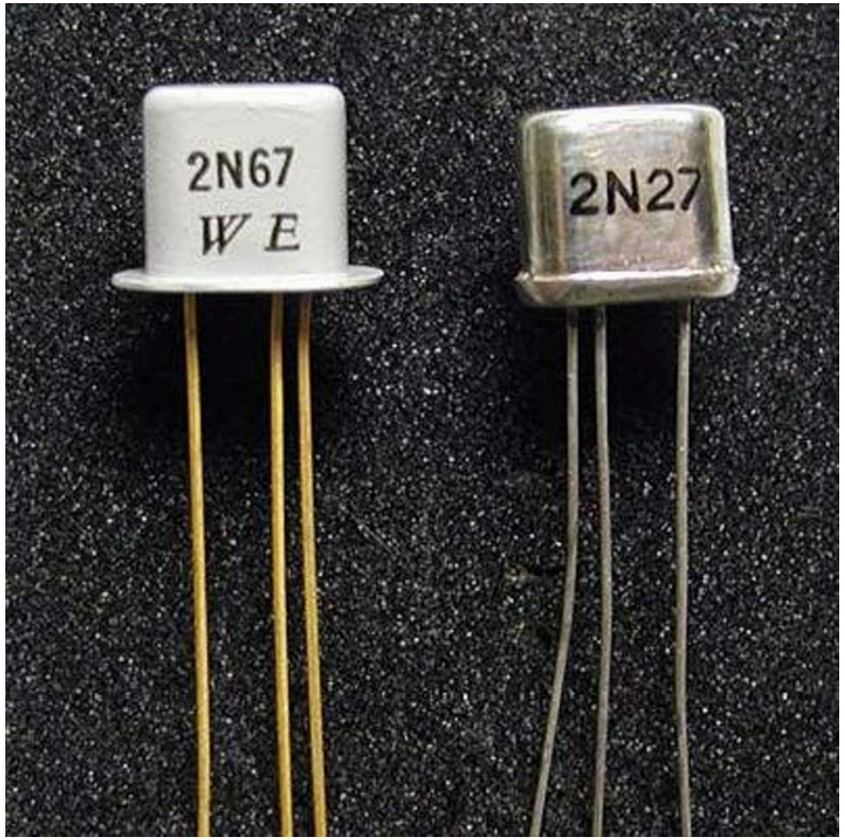

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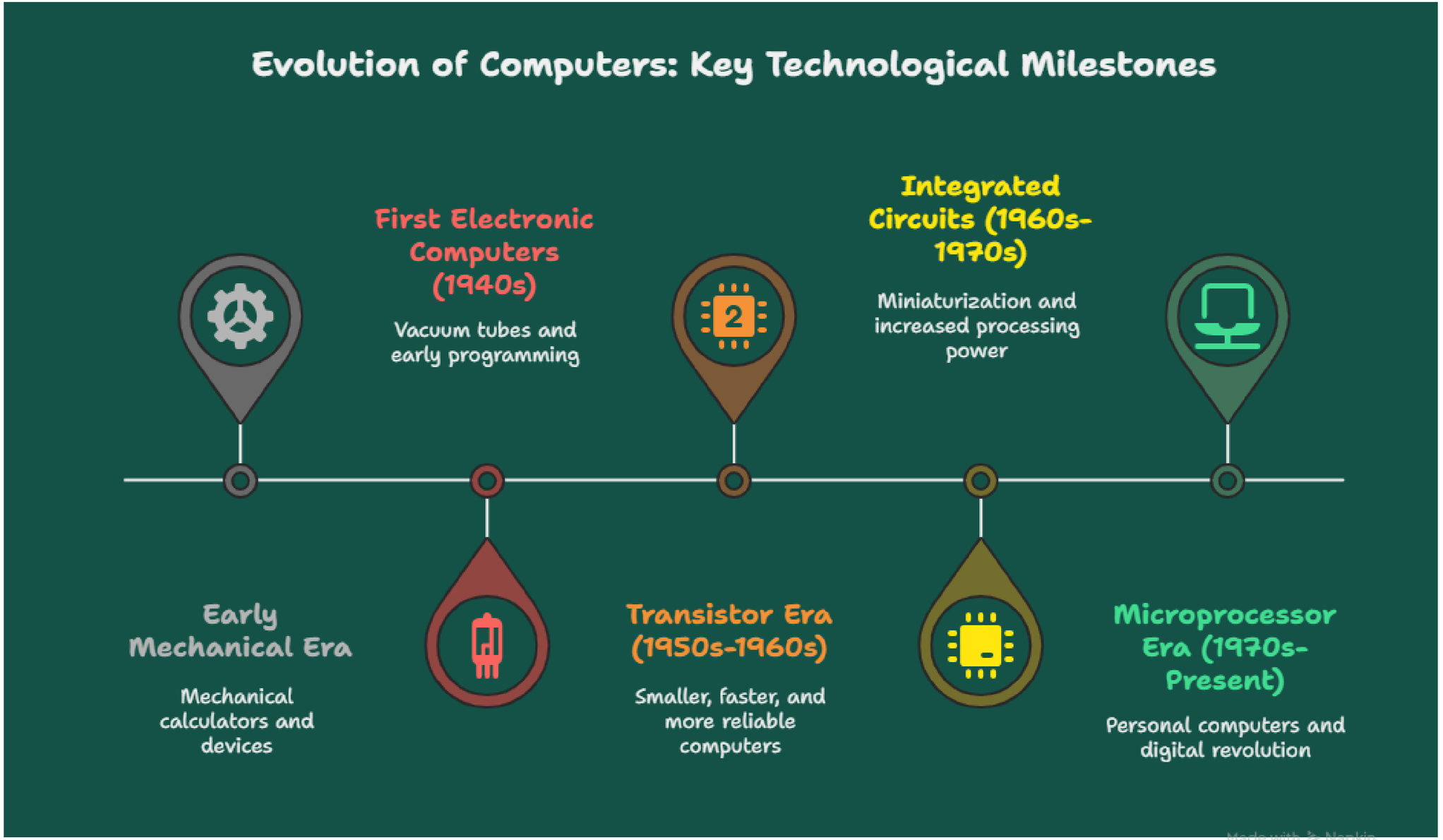
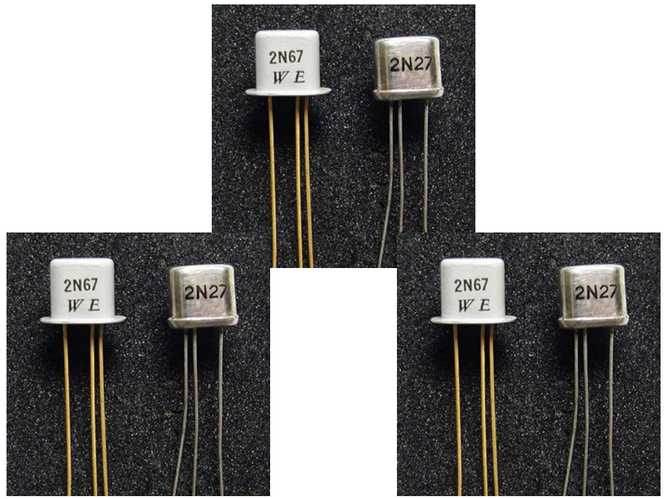
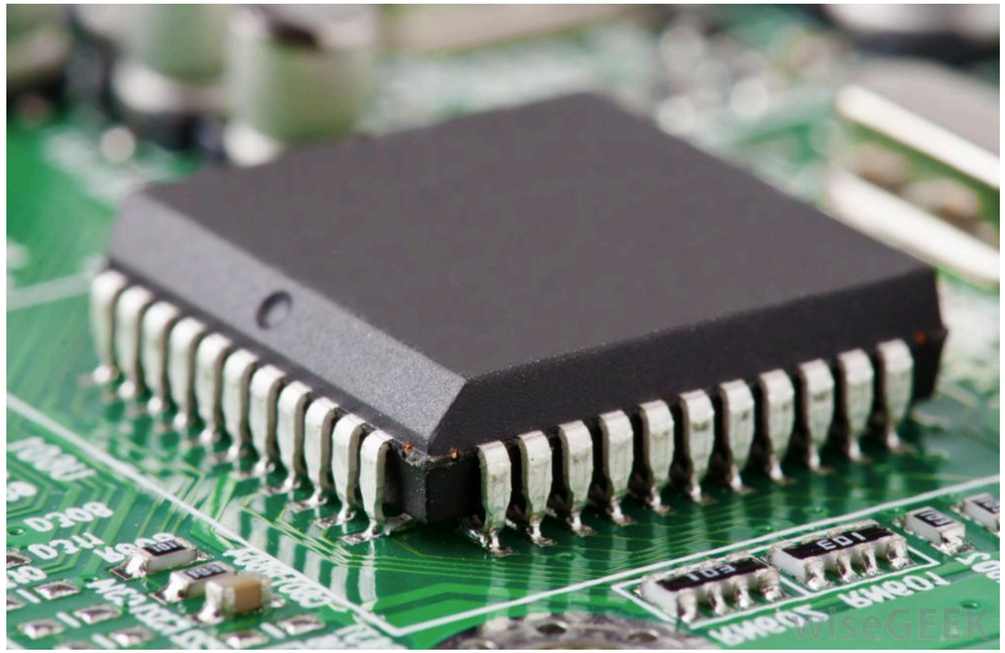


Historical Development

- **Integrated Circuits (1960s–1970s):** Placing **multiple transistors on a single chip**, known as an integrated circuit (IC), ushered in the third generation. This led to a significant reduction in size and cost.





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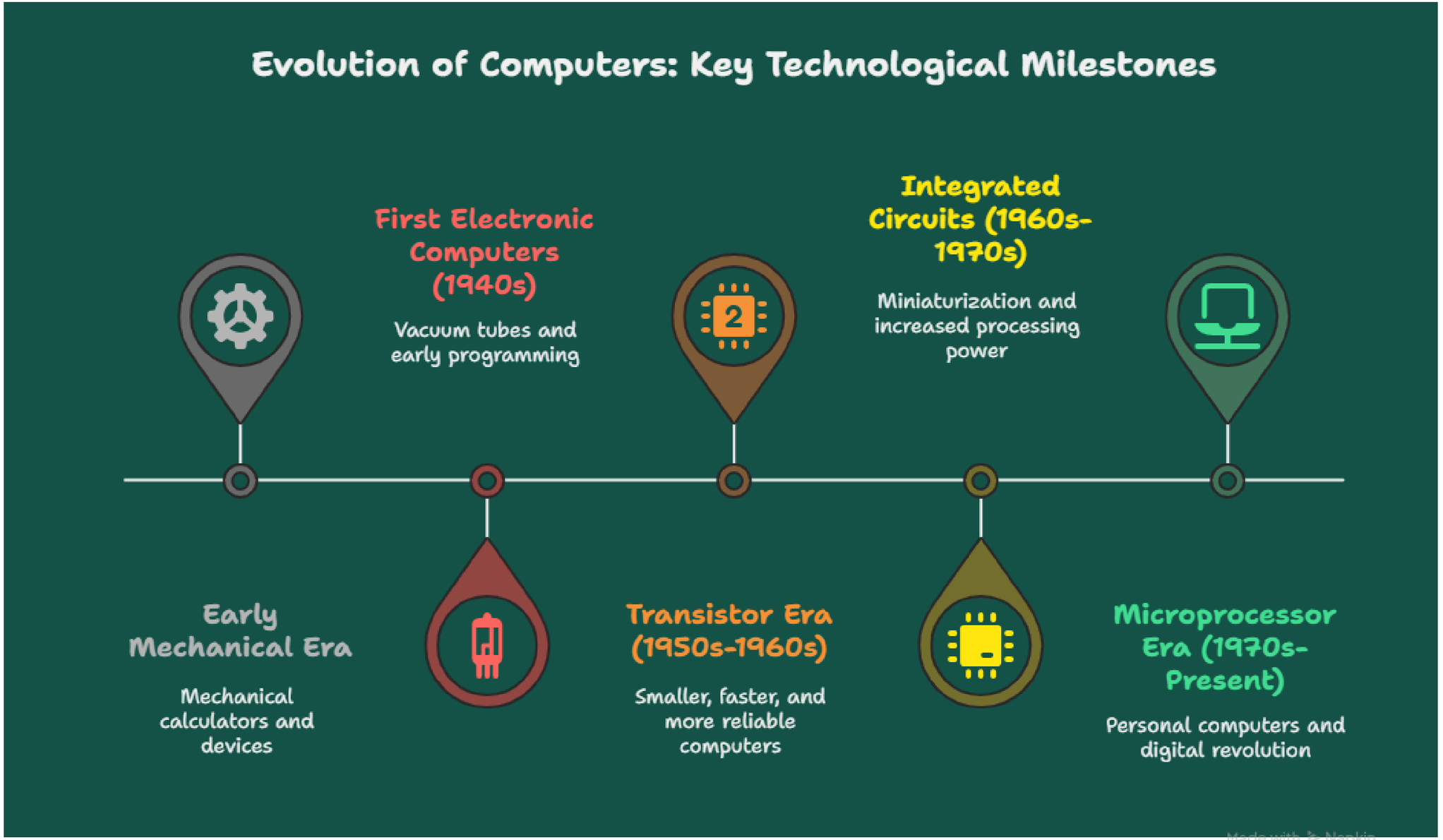

Historical Development

- **Microprocessor Era (1970s–Present):** The creation of the microprocessor, which **put the entire CPU on a single chip**, paved the way for the personal computer revolution. This is the fourth generation of computers, which continues to evolve with advancements in multi-core processors, parallelism, and artificial intelligence.

Historical Development

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- While the "nanometer" designation for process nodes (like 2nm or 3nm) is **a marketing term and not a direct physical measurement** of the entire transistor, the critical components within these transistors are indeed atom-sized.

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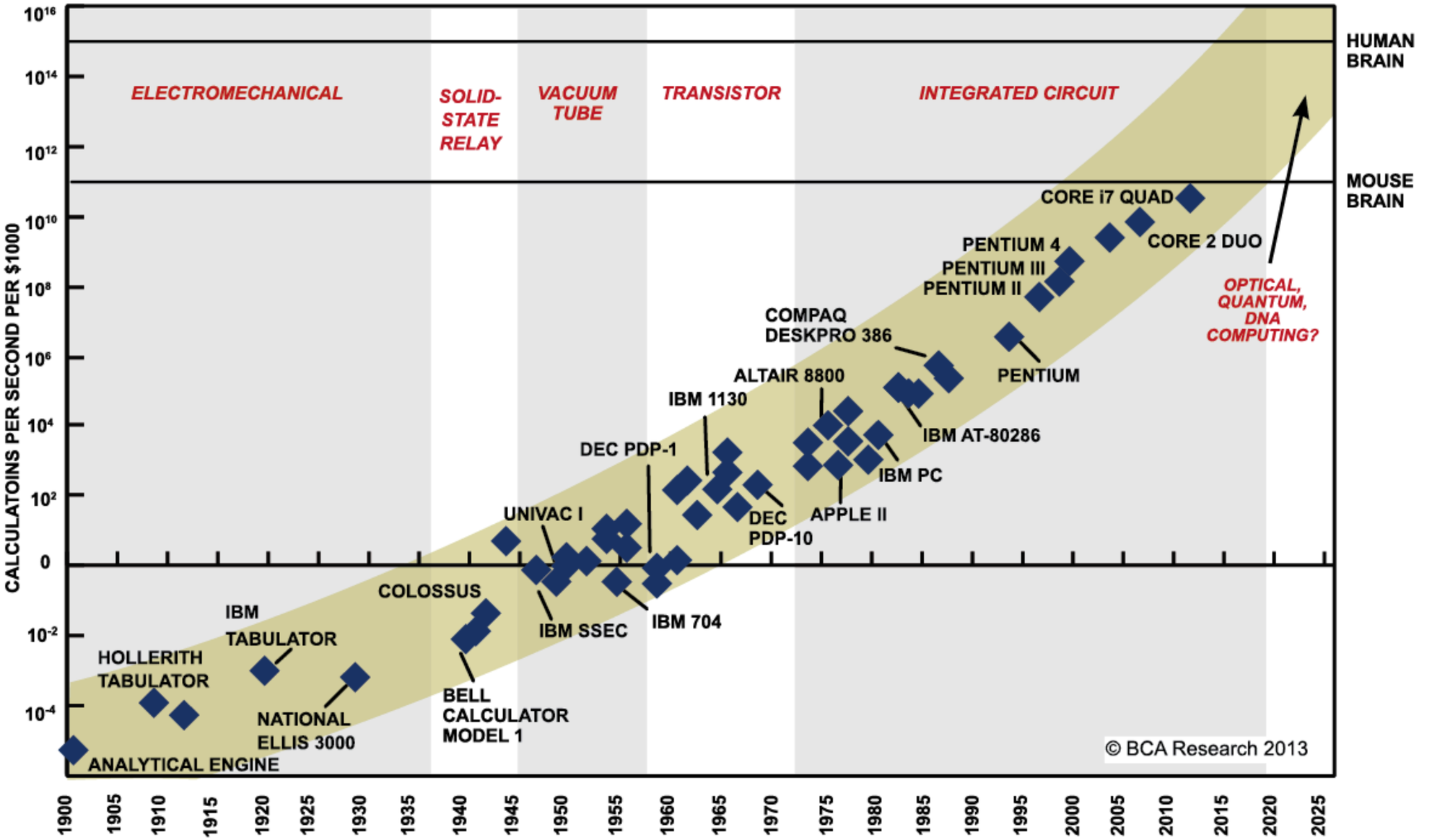
- To give you a sense of scale, **a silicon atom**, a fundamental building block of these transistors, has a diameter of about **0.235 nanometers**.



SOURCE: RAY KURZWEIL, "THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY", P.67, *THE VIKING PRESS*, 2006. DATAPOINTS BETWEEN 2000 AND 2012 REPRESENT BCA ESTIMATES.

End of Presentation

Questions...?