

# Evolution of Microprocessors

## Introduction

The microprocessor has undergone remarkable evolution over the last century, transforming from mechanical calculators to modern multi-core chips powering AI and advanced computing systems. Below is an overview of its development.

## Early Developments

- **1930s:** Mechanical calculating devices, used mechanical relays.
- **1950s:** Vacuum tubes, later replaced by transistors.
- **1960s:** Introduction of minicomputers.
- **1970s:** Introduction of personal computers.

## Generations of Microprocessors

### 1st Generation (1971–1973)

- Serial instruction processing.
- 4-bit Intel 4004 (Busicom & Intel), 2300 transistors, 108 kHz.
- Used PMOS technology (low cost, slow, low output currents).
- Intel 8008, 8080 (8-bit).

## 2nd Generation (1974–1978)

- Efficient 8-bit processors: Intel 8085, Motorola 6800/6809, Zilog Z80.
- Used NMOS technology (higher speed, higher density).

## 3rd Generation (1978–1980)

- Intel 8086, Zilog Z8000.
- 16-bit processors, pipelined instruction processing.
- 250,000 transistors, high-density MOS (HMOS).

## 4th Generation (1981–1995)

- $\geq 1$  million transistors.
- 32-bit processors: Intel 80386, Motorola 68020/30.
- High-density CMOS (HCMOS).

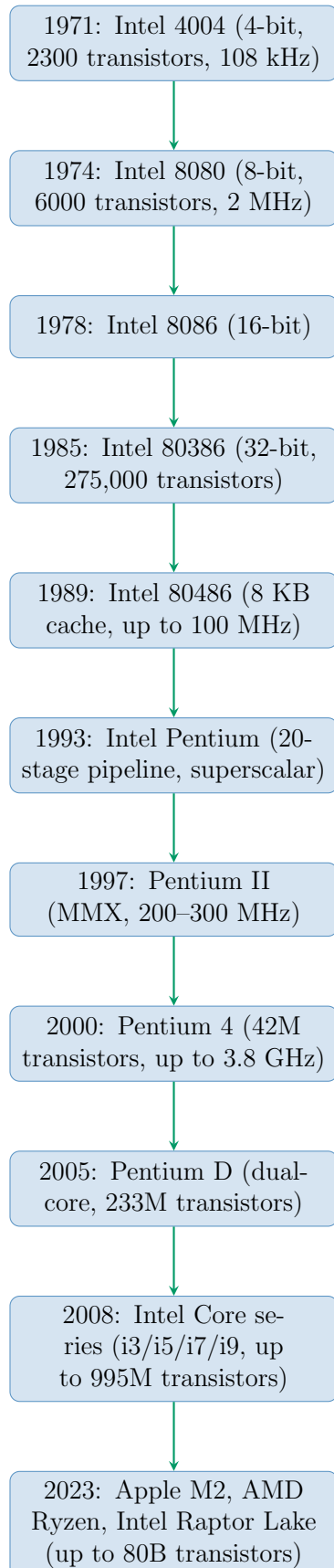
## 5th Generation (1996–2000)

- Superscalar processing,  $\geq 10$  million transistors.
- On-chip functionality, high-speed memory and I/O.
- 64-bit: Intel Pentium, AMD Athlon.

## 6th Generation (2000–Present)

- Multi-core: Intel Core i3/i5/i7/i9, AMD Ryzen, Apple M1/M2.
- Advanced pipelining, parallel execution.
- AI acceleration, GPU integration, 5nm–7nm fabrication.

## Timeline of Key Microprocessors



## Technological Improvements

1. Wider data/address buses.
2. Increased clock speeds.
3. Miniaturization and higher capabilities.
4. Rising transistor counts and integration.
5. External peripheral development.
6. Larger and faster memory units.
7. On-chip cache memory (L1, L2, L3).
8. Lower power consumption.
9. Multi-core and parallel architectures.
10. Integration of GPU cores and AI accelerators.