Introduction to ARM (Advanced RISC Machine)

What is ARM?

ARM stands for **Advanced RISC Machine**. It is a family of **RISC (Reduced Instruction Set Computer)** architectures used in processors that are **power-efficient**, **high-performance**, and **widely used in embedded systems** and mobile devices.

Originally developed by **Acorn Computers Ltd.** in the 1980s, ARM architecture is now designed by **ARM Holdings** (a part of SoftBank Group, UK-based).

Key Features of ARM:

- **RISC Architecture** – Simplified instruction set for faster execution
- **Low Power Consumption** – Ideal for battery-powered devices
- **High Performance per Watt**
- **Scalable Design** – Used from microcontrollers to smartphones to servers
- **Load/Store Architecture** – Only load and store access memory
- **32-bit and 64-bit support** (e.g., ARMv7 = 32-bit, ARMv8 = 64-bit)

Applications of ARM Processors:

Area	Example
Mobile Devices	Android smartphones, tablets
Embedded Systems	IoT devices, Smart TVs
Automotive	Infotainment, ADAS systems
Wearables	Smartwatches, fitness bands
Networking	Routers, gateways
Servers	ARM-based cloud servers (e.g., AWS Graviton)

Why is ARM Popular?

- **Used in 90%+ of smartphones**
- **Licensing Model** – ARM licenses IP to companies like Apple, Qualcomm, Samsung, etc., who customize it
- **Energy Efficiency** – Critical for portable and embedded systems

ARM vs Other Architectures

Feature	ARM	x86

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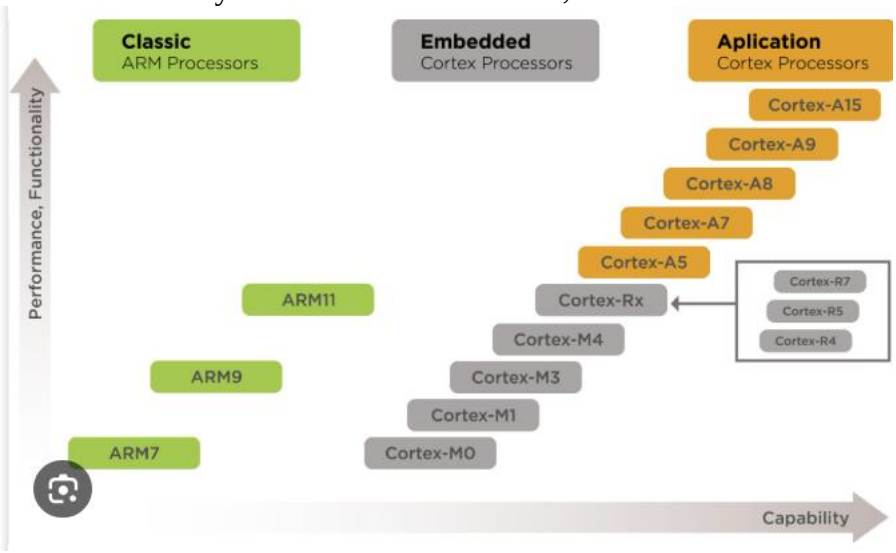
Instruction Set	RISC	CISC
Power Usage	Low	High
Performance	Good (per watt)	High (absolute)
Use Cases	Mobile/Embedded	Desktops/Laptops

Popular ARM Families

- **ARM7** – Legacy 32-bit
- **ARM9/11** – General-purpose embedded
- **Cortex-M** – Microcontrollers (low power)
- **Cortex-R** – Real-time systems
- **Cortex-A** – Application processors (smartphones)
- **Neoverse** – Server-class

ARM Holdings offers users the following types of processors:

- **Cortex-A:** built for advanced operating systems and exhibits the highest possible performance;
- **Cortex-R:** caters perfectly to the needs of real-time applications and provides its users with the fastest response times;
- **Cortex-M:** mainly built for microcontrollers;



ARM in Embedded Systems

- Used with **microcontrollers** like STM32, NXP, and LPC
- Works with **RTOS** like FreeRTOS, RTX
- Programmed using C/C++, Keil MDK, STM32CubeIDE, etc.