Microcontroller and Embedded Systems

Embedded System Structure (Generic)

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Sensor ──► A-D ──► ┌─────────────┐ ──► D-A ──► Actuator
                   │ Processor & │
                   │ ASICs       │
                   └─────────────┘
                          ↕
                       Memory
```
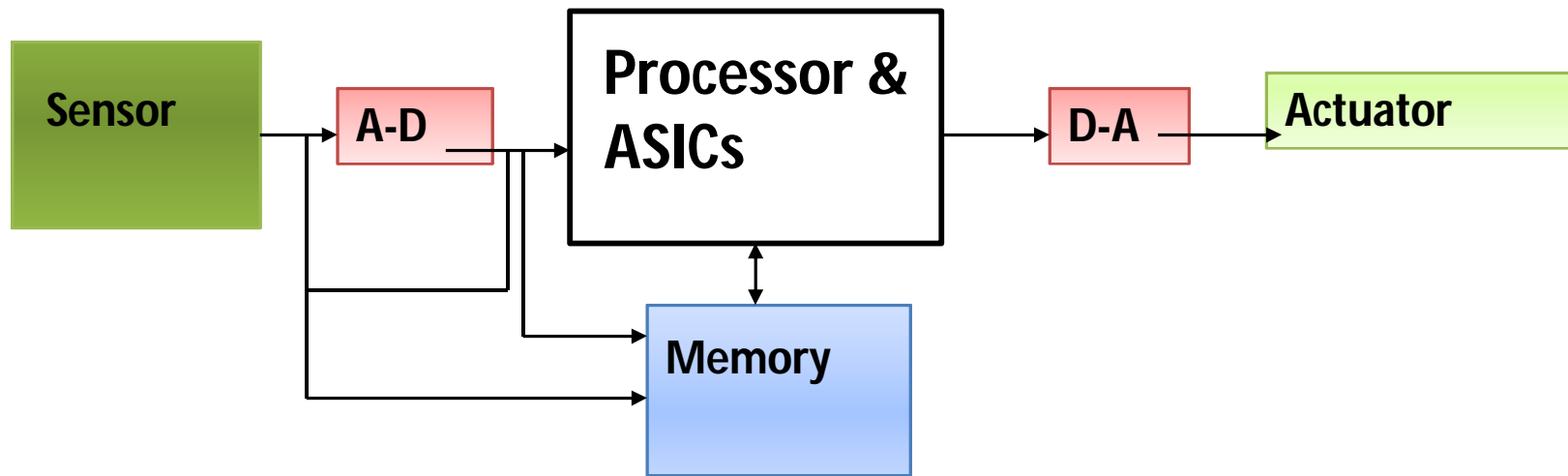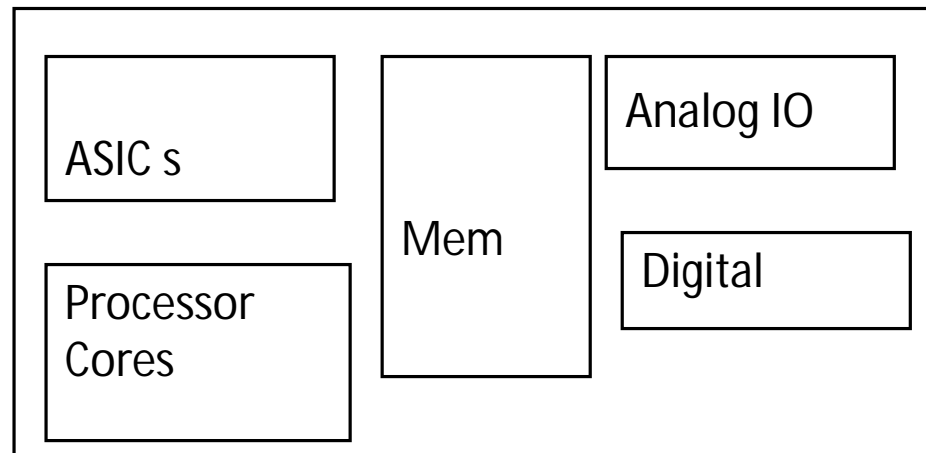
ES, MS and RTS

- All embedded systems are microprocessor based systems, but all microprocessor based systems may not be amenable to embedding (Area, Power, Cost, Payload parameters).

- Most of the embedded systems have real time constraints, but there may be ES which are not hard RTS (for example off line Palm tops)

- There may be RTS which are not embedded (e.g. Separate Process Control Computers in a network)

- Embedded Systems are not GPS; they are designed for dedicated applications with specific interfaces with the sphere of control

General Characteristics of Embedded Systems

- **Perform a single task**
  - Usually not general purpose
- **Increasingly high performance and real time constrained**
- **Power, cost and reliability** are important considerations
- **HW-SW systems**
  - Software is used for more features and flexibility
  - Hardware (processors, ASICs, memory etc. are used for performance and security

General Characteristics of Embedded Systems (contd.)

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┌──────────────────────────────────────────────┐
│  ┌──────────────┐   ┌─────────┐  ┌──────────────┐ │
│  │              │   │         │  │  Analog IO   │ │
│  │   ASIC s     │   │         │  └──────────────┘ │
│  │              │   │         │                   │
│  └──────────────┘   │  Mem    │  ┌──────────────┐ │
│  ┌──────────────┐   │         │  │  Digital     │ │
│  │  Processor   │   │         │  └──────────────┘ │
│  │  Cores       │   │         │                   │
│  │              │   └─────────┘                   │
│  └──────────────┘                                 │
└──────────────────────────────────────────────┘
```

ASIPs and ASICs form a significant component

- Adv: customization → lower power, cost and enhanced performance

- Disadv: higher development effort (debuggers, compilers etc.) and larger time to market