Embedded Systems

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Contents

1 Embedded Systems

- A computer system embedded into another system
  - Constraints from external input/output
  - Application-specific
    - Diverse set of application areas
- Abstraction
  - Productivity enhancer — don't need to worry about details...
    - A car can be driven without the knowledge of how an internal combustion engine works
  - ...until something goes wrong
    - Where's the dipstick? What's a spark plug? Am I out of gas?
  - Important to understand the components and how they work together
- Hardware vs. Software
  - All computers, given enough time and memory, are capable of computing the same exact things
  - In theory, computers "compute" anything that's possible to compute
    - Given enough memory and time
  - In practice, "solving problems" involves computing under constraints
    - Time
      - Weather forecast, next frame animation, ...
    - Cost
      - iPod, automotive engine controller, ...
    - Power
      - Smartphone, tablet, ...
- Layers of Abstraction

Problems
Algorithms
Language
Instruction Set Architecture
Microarchitecture
Circuits
Devices

  - Problem Statement
    - Stated using "natural language"
    - May be ambiguous, imprecise
  - Algorithm
    - Step-by-step procedure, recipe, guaranteed to finish
    - Definiteness, effective computability, finiteness
  - Program
    - Express the algorithm using a computer language
    - High-level language, low-level language
  - Instruction Set Architecture (ISA)
    - Specifies the set of instructions the computer can perform
    - Data types, addressing mode, hardware/software interface
  - Microarchitecture
    - Detailed organization of a processor implementation
    - Different implementations of a single ISA
  - Logic Circuits
    - Combine basic operations to realize microarchitecture
  - Problem to algorithm is solved by software design, algorithm to program through programming, and program to instruction set architecture through compilation/interpretation
  - Instruction set architecture to microarchitecture is solved through processor design, microarchitecture to a circuit is solved through logic/circuit design, and a circuit to a device is solved through the engineering process and fabrication

- Basic Building Blocks
  - Electrons
  - Transistors
  - Logic Gates
  - Combinational Logic Circuits
  - Sequential Logic Circuits
    - Storage Elements and Memory
  - Cores
  - Memories
  - Caches

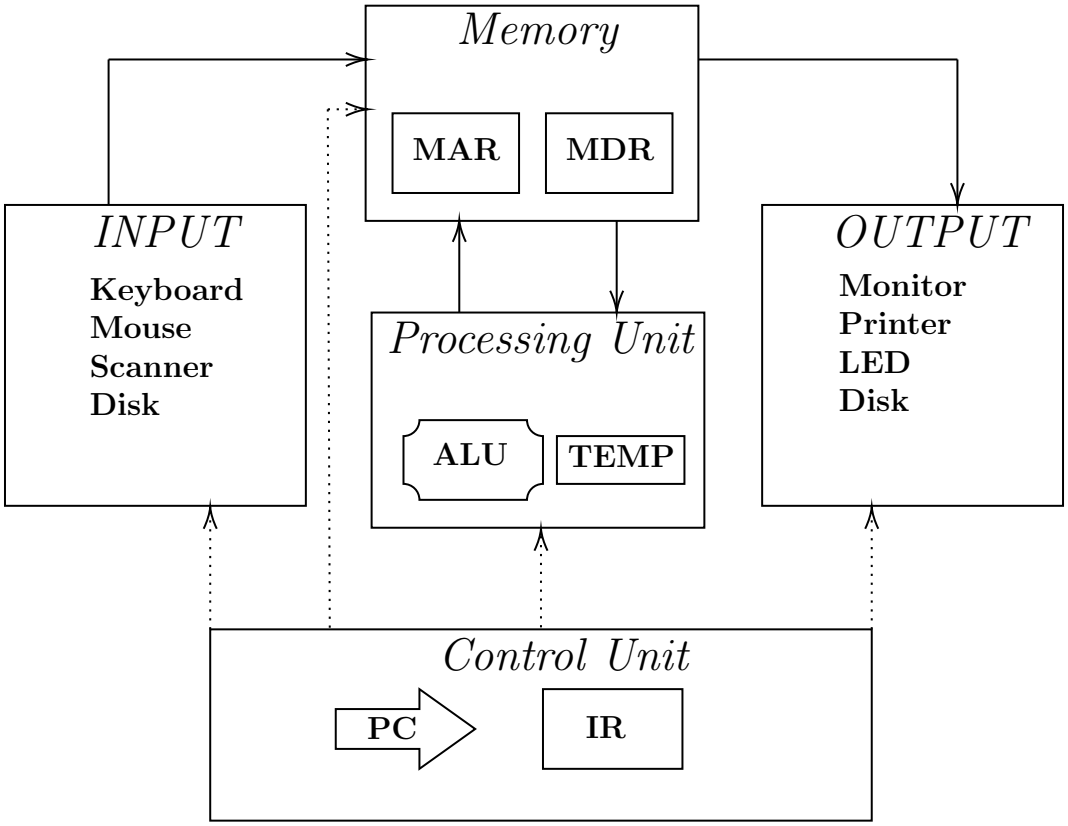

Figure 1: Processing System Flowchart