

# Embedded Systems

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January 9, 2023

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# 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