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Embedded System Design

- Introduction (Cont.)
- Reactive Systems

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A Common Misconception

- **Misconception:**
  - **The study of embedded systems is simply a combination of some of the well-known areas such as:**
    - **Dependability**
    - **Real-time systems**
    - **Low power design**
    - **etc.**

Challenges for Embedded Systems

- Although the study of embedded systems is an interdisciplinary area of study, it has its own challenges:
  - Interplay of different design objectives
  - Challenges in system specification, design, and verification
  - Special features of embedded systems
    - weight efficient, Cost efficient, Code-size efficient, Diskless systems

Interplay of Design Objectives

- **Design objectives:**
  - **Fault tolerance (Dependability)**
  - **Energy efficiency**
  - **Real-time**
  - **Cost efficient**
- **The design objectives are at odds:**
  - **Example: Fault tolerance requires some types of redundancy and redundancy leads to energy consumption.**

Reactive Systems

- **Typically ES are reactive systems.**

  “A reactive system is in continual interaction with its environment and executes at a pace determined by that environment.”

Reactive Systems (Cont.)

- Reactive Systems = Event-based Systems
- The traditional paradigms of programming (i.e. model of computable functions) are inappropriate.
  - Model of computable functions
    - Von Neumann paradigm
    - Sequential computing
- Suitable model for reactive systems:
  - Automata-based programming paradigm

Automata-Based Programming

- **Automata-Based Programming is a programming paradigm whose defining characteristic is the use of finite state machines to describe program behavior.**
- **The transition graphs of a state machines are used in all stages of software development**
  - **Specification**
  - **Implementation**
  - **debugging**
  - **documentation**