# ECSE 426
# Microprocessor Systems


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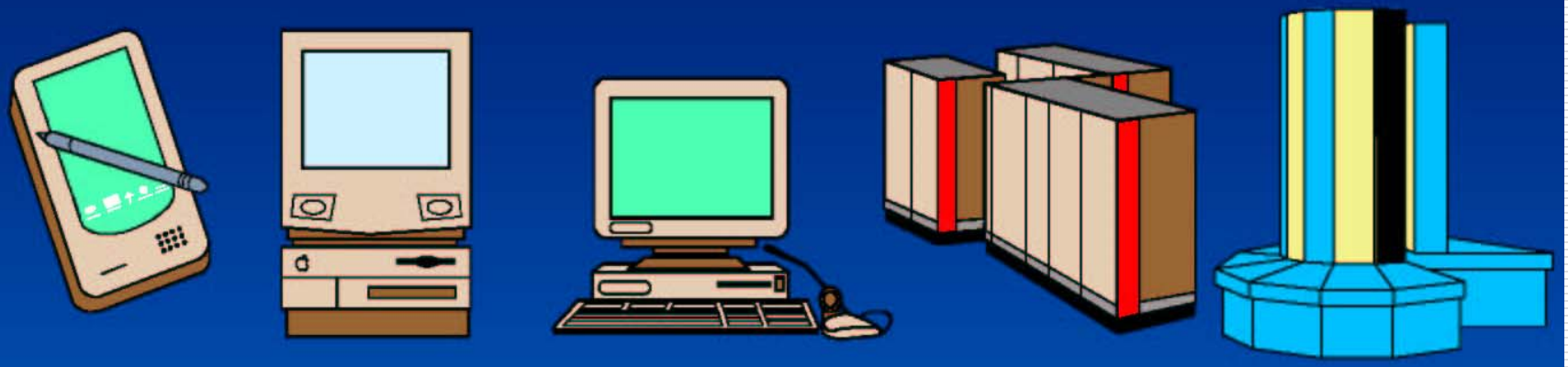
# Microprocessors

- Enabling technology for general purpose computers and embedded systems
  - Really, lots&lots of things nowadays
- Foundation for software-intensive systems
- Data processor - arithmetic, logical, symbolic or application-specific operations
  - Architectural view: ALUs, registers, etc.
  - Circuit view: registers, interfaces, buses
  - Programmer's view: assembler instructions

# Computer System Types

General Purpose Computers

PCs, Workstations, Mainframes, Supercomputers.



Embedded Systems (everything else)

Games, PDAs, Medical, Industrial, Aerospace, Military

Real-Time Systems

# Computers and Applications

- Deciding factors:
  - Cost
  - Size
  - Power
  - Quantity

| Type | Price ($) | Example application |
|---|---|---|
| Disposable computer | 1 | Greeting cards |
| Embedded computer | 10 | Watches, cars, appliances |
| Game computer | 100 | Home video games |
| Personal computer | 1K | Desktop or portable computer |
| Server | 10K | Network server |
| Collection of Workstations | 100K | Departmental minisupercomputer |
| Mainframe | 1M | Batch data processing in a bank |
| Supercomputer | 10M | Long range weather prediction |

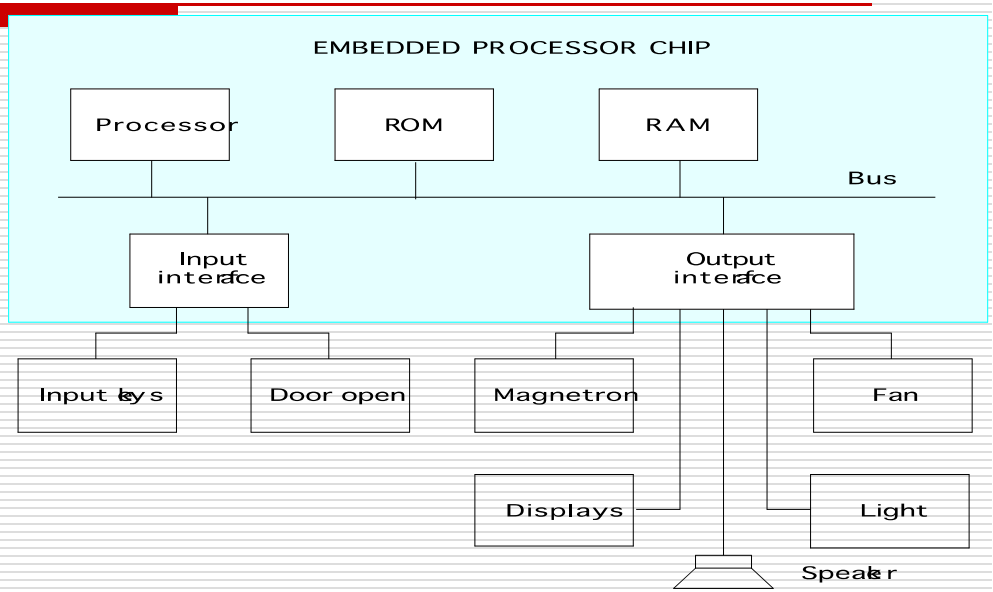
# Embedded System Importance

- Ubiquitous processor-based control systems
- Development easier than with alternative technologies

- Makes products competitive: features AND price
- Enabling technology for many new products
- Likely source of jobs for ECE graduates

# Embedded Systems

- They are just about everywhere
  - From toothbrush to space shuttle
- Incarnations of generic computer systems
  - Often, specialized Input/Output

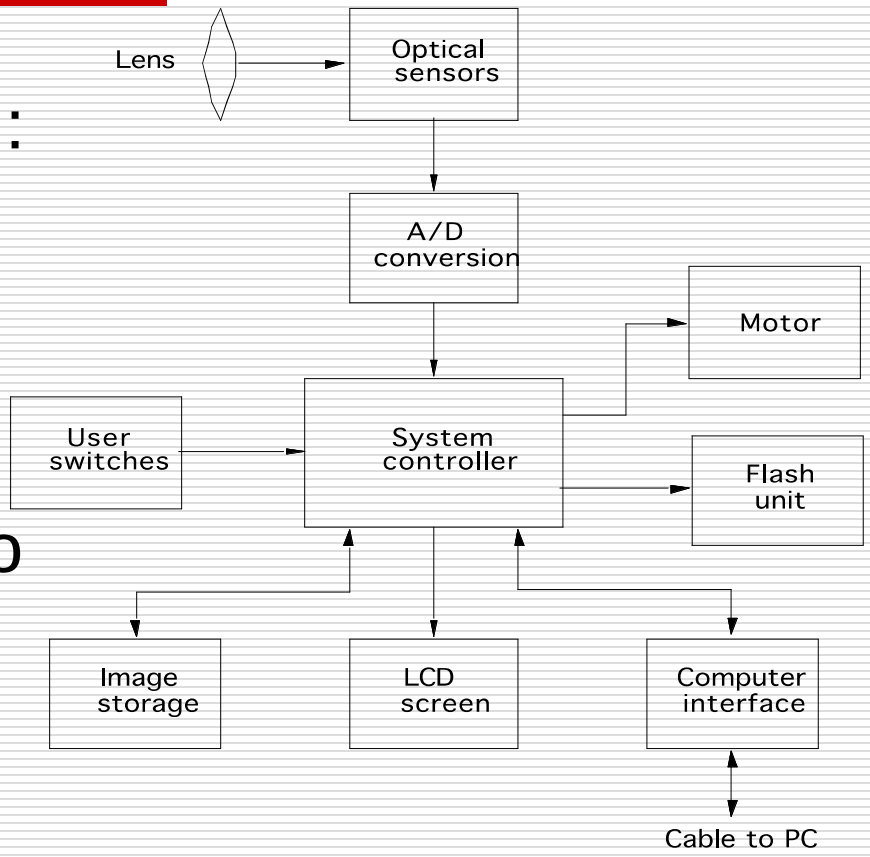



What is this diagram showing?

Microwave Oven

# Another Example - Camera

- Computer system with:
  - Image control
  - Hardware (lenses, motors)
  - Interfaces
- Added sophistication to consumer electronics
  - Expandability (of functions)
  - Connectivity

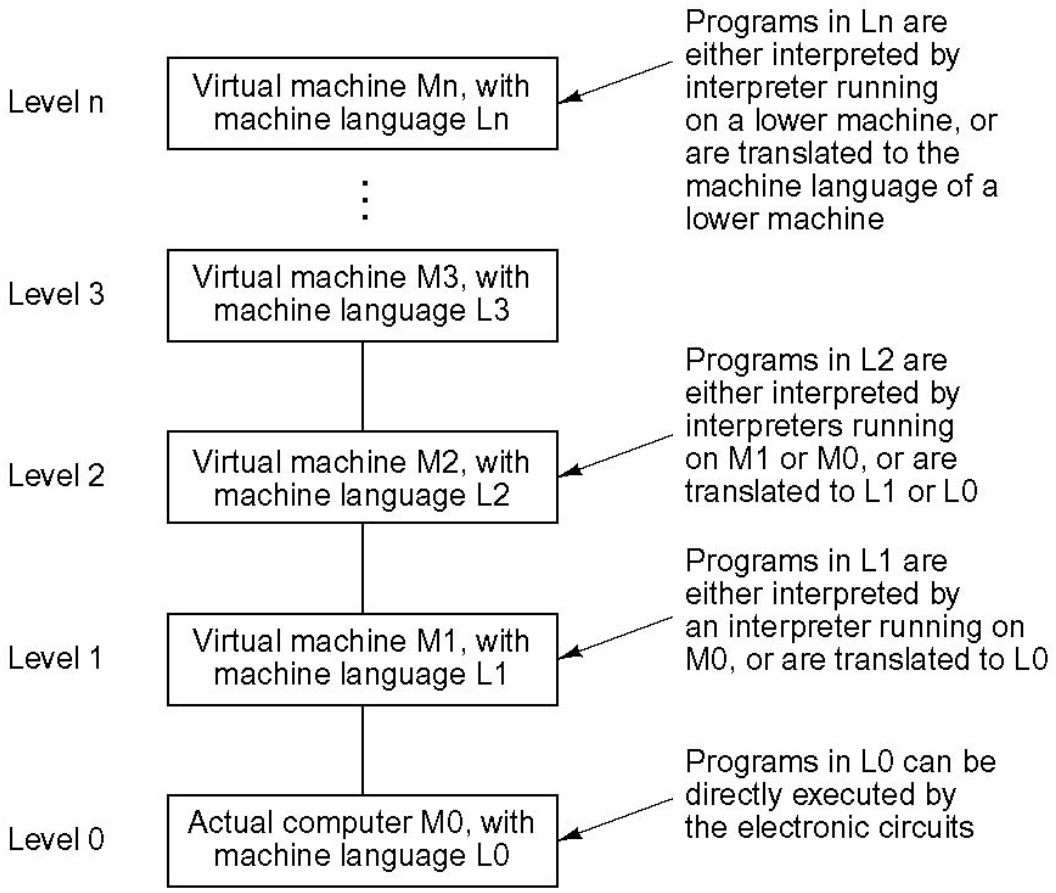


# Views of Computer Systems

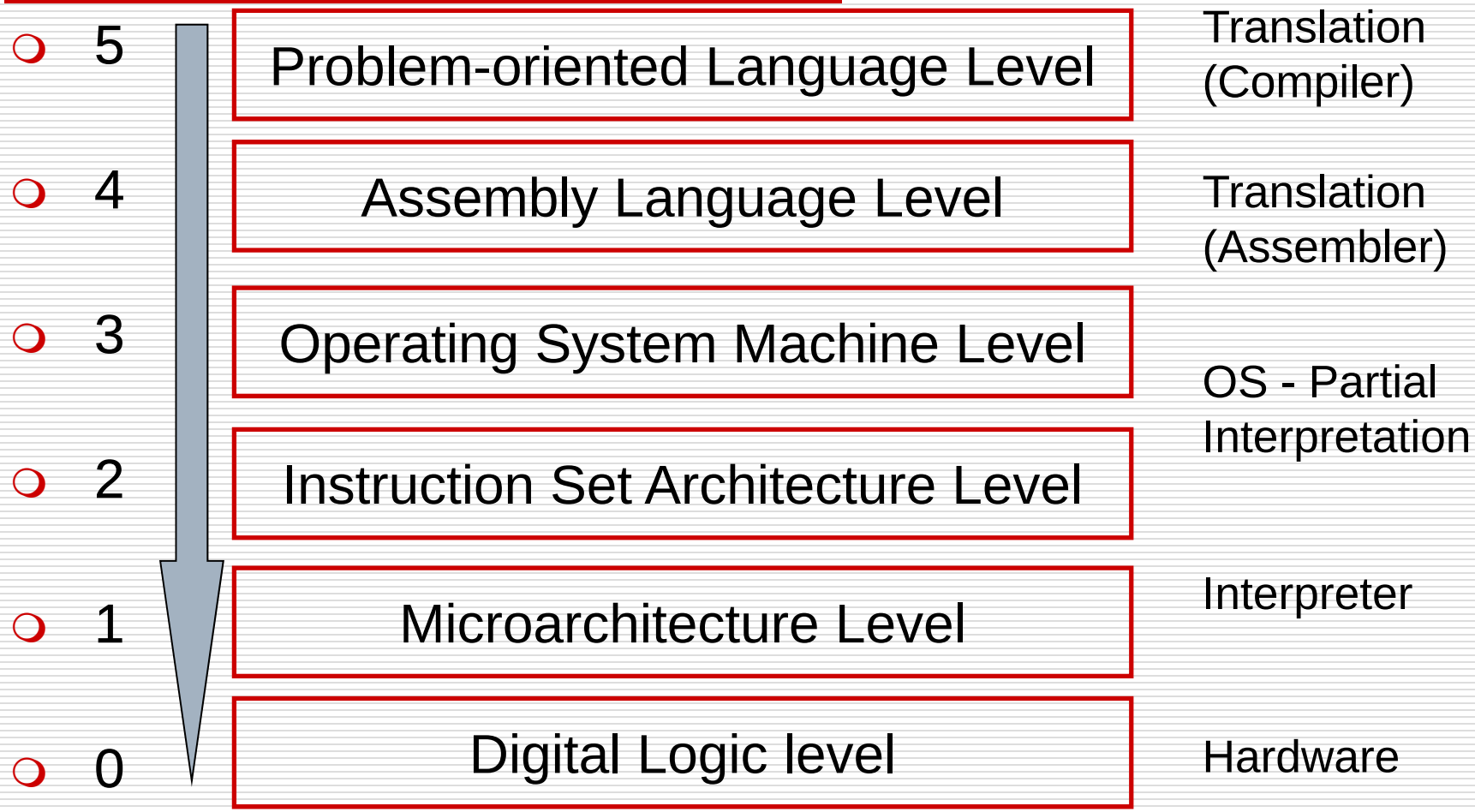
- Levels of abstraction
  - Logic Level - Circuits
    - Logic functions implemented by gates
  - Architectural Level - Microarchitecture
    - Operations performed by resources
  - Instruction Set Level - Instructions
    - Program execution
  - Operating System Level - Complete system
    - System operation

# Layered Computer Architecture

- Concept necessary for complex systems
  - e.g., networking, large software systems etc.
- Abstraction – major tool

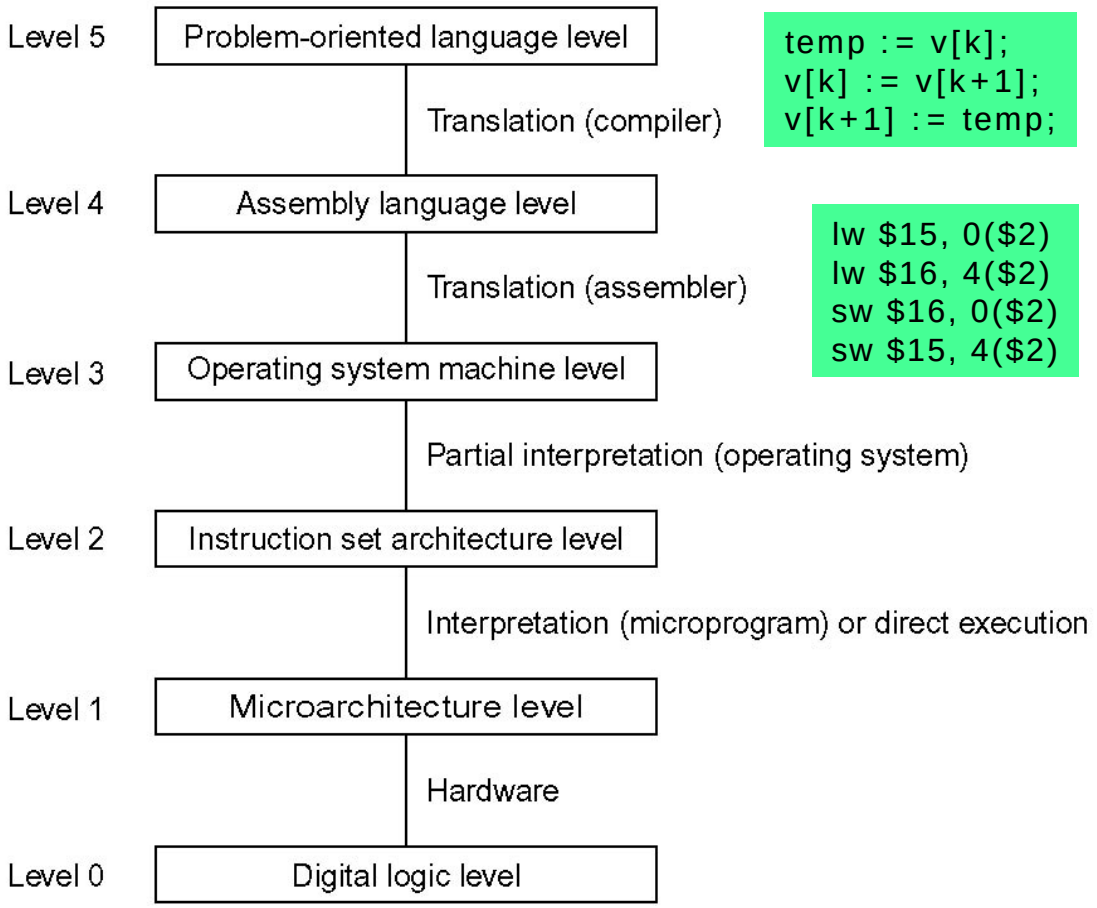


# Contemporary Multilevel machines



# Layered Computer Systems

- Includes hardware and software
  - User programs
  - Operating system
  - Instruction Set
  - Architecture
  - Hardware




```
0000 1001 1100 0110 1010 1111 0101 1000
1010 1111 0101 1000 0000 1001 1100 0110
1100 0110 1010 1111 0101 1000 0000 1001
0101 1000 0000 1001 1100 0110 1010 1111
```

# Course Organization

- Top-down approach to microprocessor programming and design.
- Lectures focus on structured computer organization, and progress through “layers” :
  - Instruction set architecture
  - Assembly language level + problem-oriented language level (embedded C)
  - Microarchitecture
  - Operating system level
- Application of design principles on state-of-art architecture
  - ARM Cortex M processor family
- The course focuses primarily on experimental work.
  - Each lecture: 45 minutes on basics/theory and 30 minutes on how it applies to your hardware device and experiments.

# Course Basics

- **Prerequisites:** ECSE-323 and EDEC-206
- **Instructor:** Prof. Zeljko Zilic
  Room 546, McConnell
  (Ph) 398-1834, Fax: 398-4470
  e-mail: zeljko.zilic@mcgill.ca

- **Office Hours**: Tue: 11:30-12:30, by appointment (after lectures).

- **Teaching Assistants:** Ashraf Suyyagh, Majid Janidarmian, Steve Ding and Chuangsheng Dong