

# Computing Systems

- Rapid pace of information technology is due to introduction of new microprocessors
- Most of us think of **desktop** computers
  - PC
  - Laptop
  - Mainframe
  - Server
- Maybe at most handheld computer (PDA)
- In this course, we will look at another type of computing system which is far more common that you ever imagined 😊



# Computer Classifications

- Classification of computers:
  - Servers:
    - Big, expensive, available 24x7 (read “24 by 7” or 24 hours a day, 7 days a week. Mainframes are old servers made by IBM.
  - Desktops:
    - computers on your desk
  - Laptops:
    - computers you carry in your bag
  - PDA (personal digital assistants):
    - computers you carry in your pocket
  - Embedded systems:
    - computers that don't look like computers!
- An embedded system is a type of computer

# Embedded Systems

- Account for >99% of new microprocessors
  - Consumer electronics
  - Vehicle control systems
  - Medical equipment
  - Sensor networks
- Desktop processors (Intel Core, AMD Athlon, PowerPC, etc) combined is only 1%



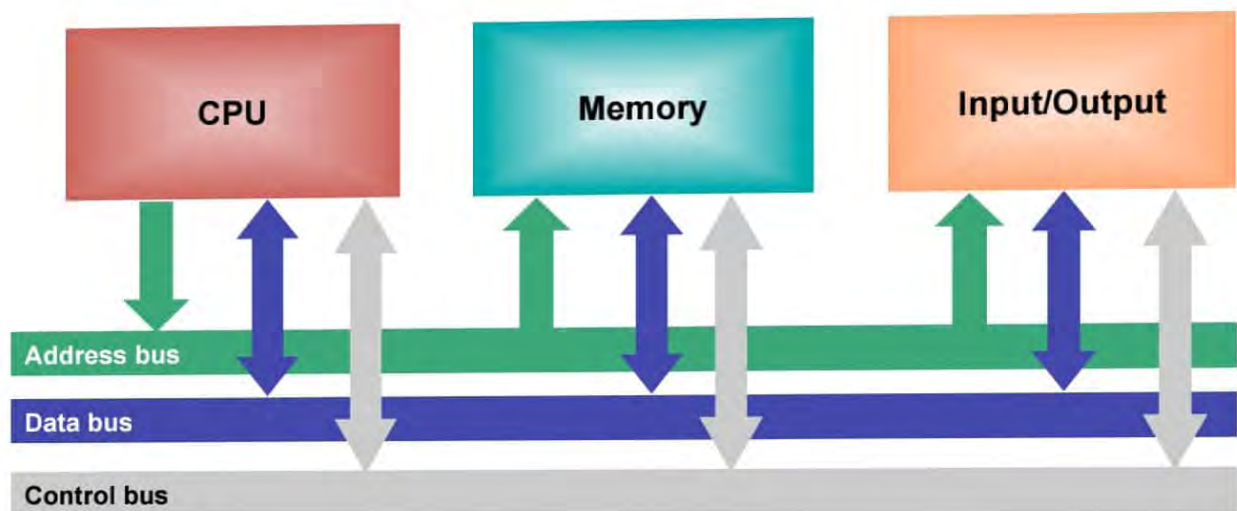
# Embedded Systems

- Simple definition: *Computing systems embedded within electronic devices*
- Nearly any computing system other than a desktop computer
- Designed to perform a specific function
- Billions of units produced yearly, versus millions of desktop units
- Take advantage of application characteristics to optimize the design
- As electrical or electronics engineers, you may be required to design an embedded system
  - But you BUY (not design) a general purpose computer

# General Purpose vs Embedded Systems

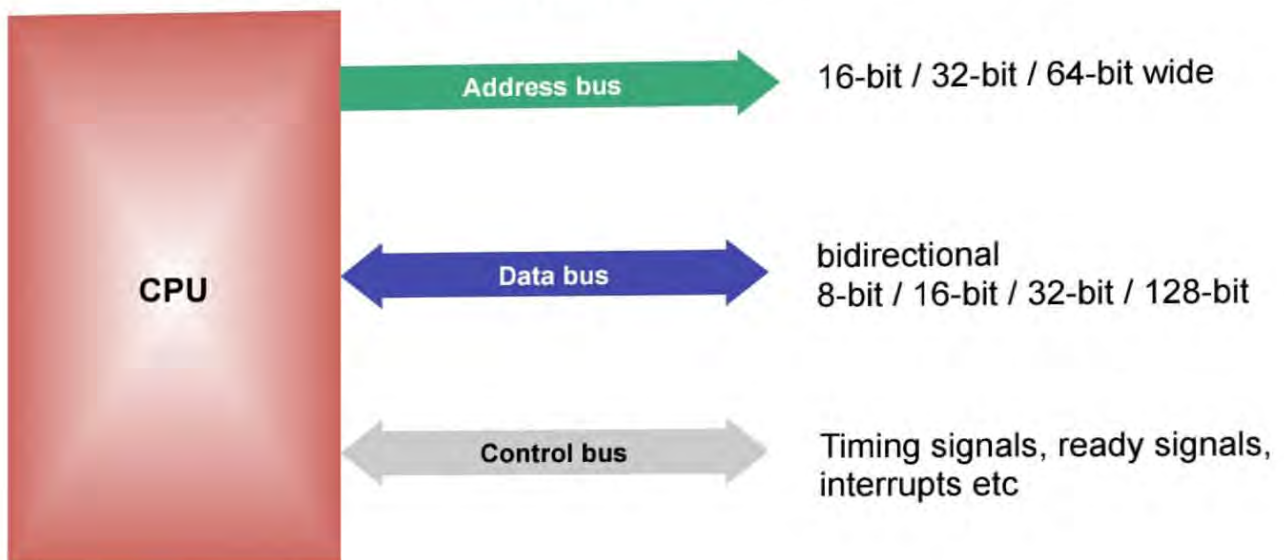
General Purpose	Embedded
Intended to run a fully general set of applications	Runs a few applications often known at design time
End-user programmable	Not end-user programmable
Faster is always better	Operates in fixed run-time constraints, additional performance may not be useful/valuable
Differentiating features: <ul style="list-style-type: none"><li>• Speed (need not be fully predictable)</li><li>• Software compatibility</li><li>• Cost (eg RM3k vs RM5k per laptop)</li></ul>	Differentiating features: <ul style="list-style-type: none"><li>• Power</li><li>• Cost (eg RM2 vs RM2.50)</li><li>• Size</li><li>• Speed (must be predictable)</li></ul>

# A Computer System – Simplified View



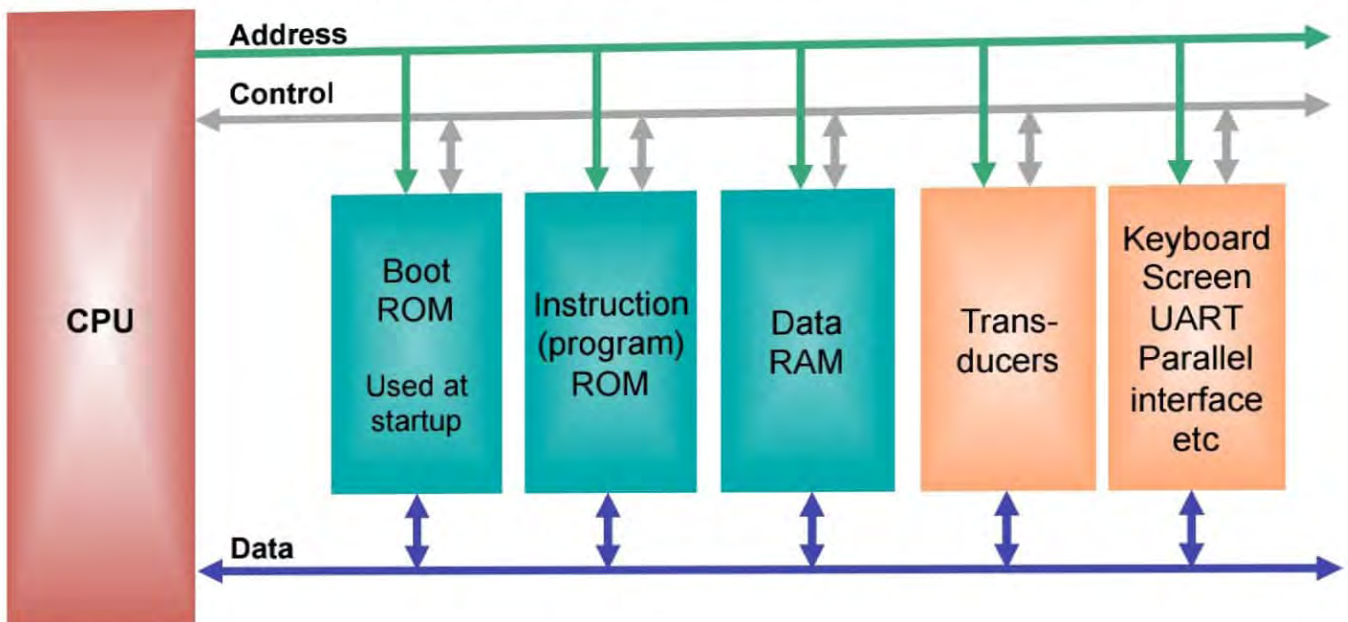
An embedded system also has the same structure but at a smaller size

# Microprocessor – Basic concept



Microprocessor, by-itself, completely useless – must have external peripherals to interact with outside world

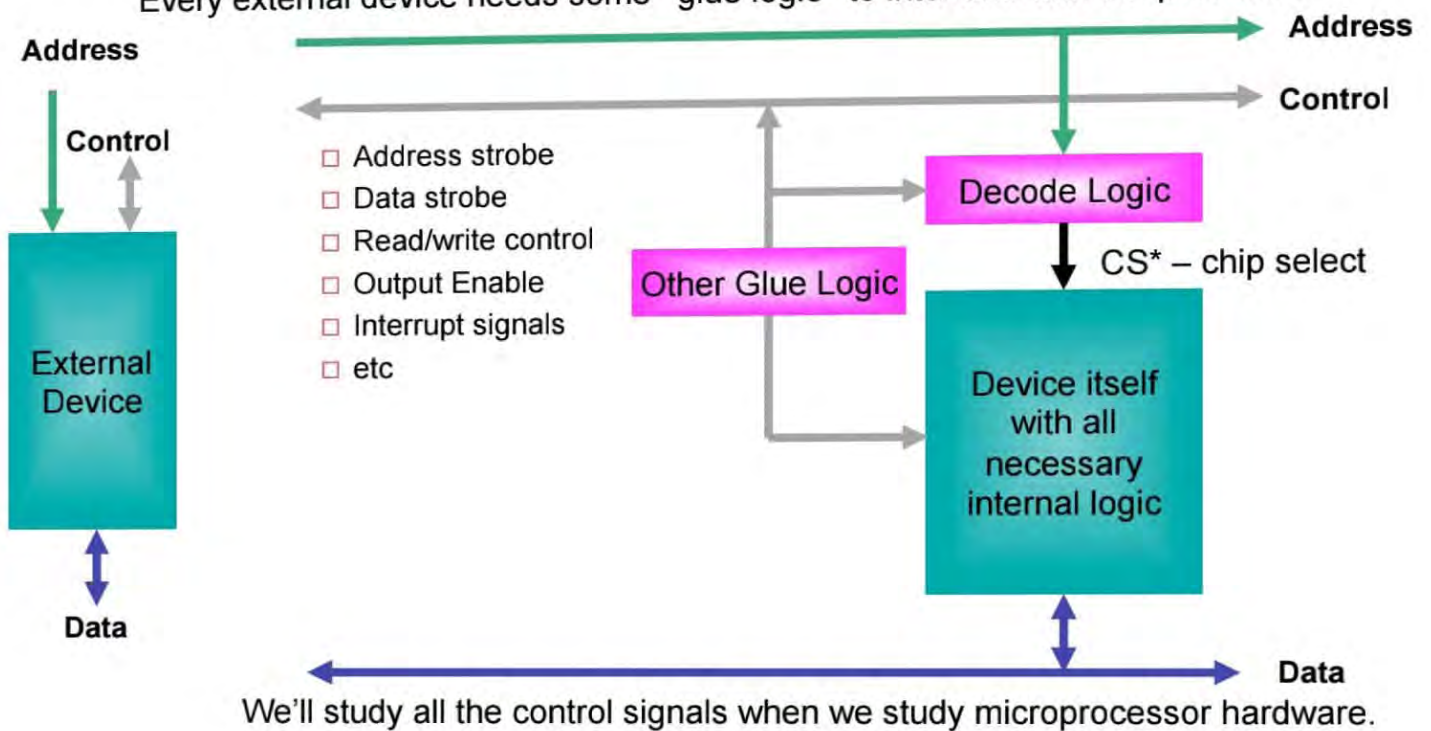
# Microprocessor – Basic Concept



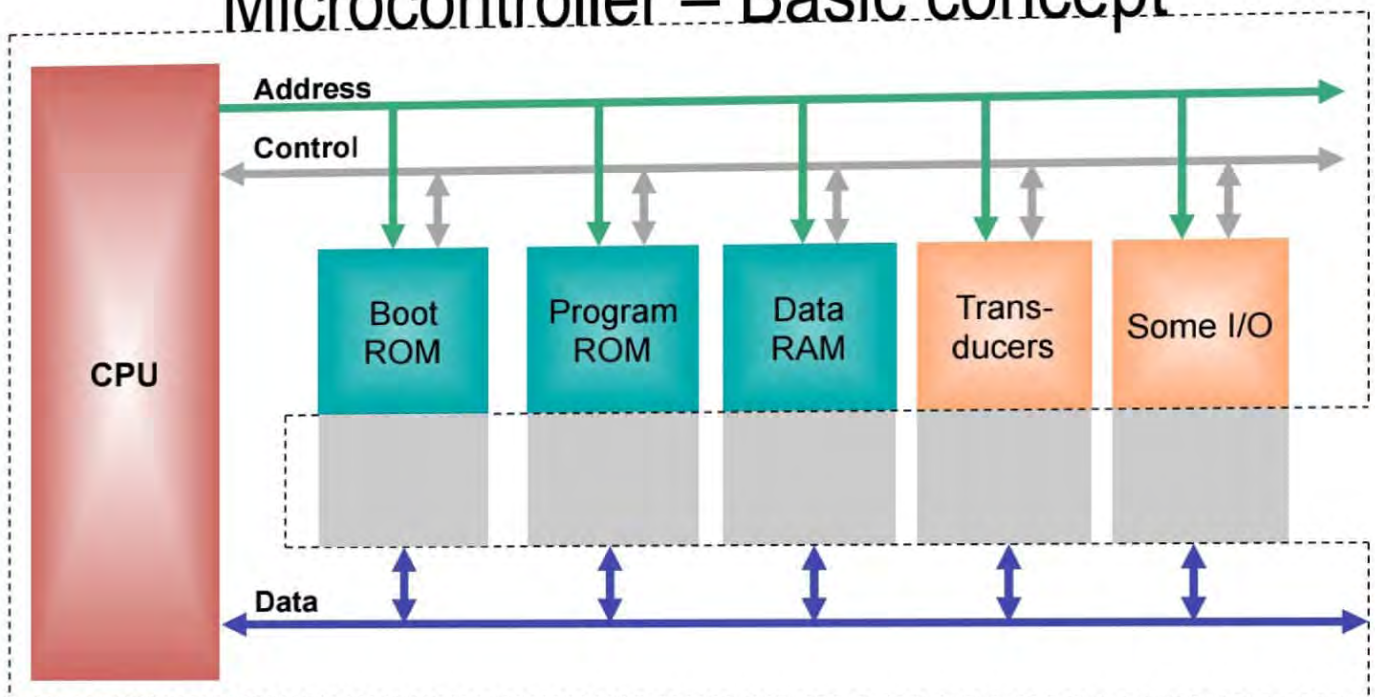
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# “Glue Logic”

Every external device needs some “glue logic” to interface with the processor.



# Microcontroller – Basic concept



Microcontroller - put a limited amount of most commonly used resources inside one chip

# Microprocessor vs Microcontroller

- Microprocessor:
  - A chip that contains only the processor
  - Need other chips to make a working system
  - More flexible
  - Can have very few I/O or many I/O devices using the same processor chip
- Microcontroller:
  - A chip that contains all the components of a computer – processor, memory and input/output
  - Less flexibility
  - Less component count in system
  - Less powerful

No matter what is the system size, the most important component is still the processor.

# Other Processors in Embedded Systems

- Embedded Controllers:
  - More powerful (32 bits) than microcontrollers (8 bits)
  - Normally contains only processor and input/output, memory is external
- Digital Signal Processors:
  - Embedded processors optimized for digital signal processing
  - Commonly found in handphones, modems, communications systems
- Graphics Processors:
  - Very powerful processors found in graphics cards of workstations
- Programmable Logic Controllers:
  - Microprocessor boards usually found in industrial applications