

## Tutorial-1: Real-Time Computer Systems and Architecture

- Q 1.** What, in general terms, is the distinction between computer organization and computer architecture?
- Q 2.** What, in general terms, is the distinction between computer structure and computer function?
- Q 3.** List and briefly define the main structural components of a computer.
- Q 4.** List and briefly define the main structural components of a processor.
- Q 5.** What is an embedded system? Give examples.
- Q 6.** What are the main considerations for designing an embedded system in terms of environmental, performance, economic and consequential aspects?
- Q 7.** For each of the following examples, determine whether this is an embedded system, explaining why or why not.
- a) Are programs that understand physics and/or hardware embedded? For example, one that uses finite-element methods to predict fluid flow over airplane wings?
  - b) Is the internal microprocessor controlling a disk drive an example of an embedded system?
  - c) I/O drivers control hardware, so does the presence of an I/O driver imply that the computer executing the driver is embedded.
  - d) Is a PDA (Personal Digital Assistant) an embedded system?
  - e) Is the microprocessor controlling a cell phone an embedded system?
  - f) Are the computers in a big phased-array radar considered embedded? These radars are 10-story buildings with one to three 100-foot diameter radiating patches on the sloped sides of the building.
  - g) Is a traditional flight management system (FMS) built into an airplane cockpit considered embedded?
  - h) Are the computers in a hardware-in-the-loop (HIL) simulator embedded?
  - i) Is the computer controlling a pacemaker in a person's chest an embedded computer?
  - j) Is the computer controlling fuel injection in an automobile engine embedded?
- Q 8.** What is the definition for a real-time system?
- Q 9.** What are the types of real time system? Briefly explain their characteristics. Give examples?
- Q 10.** What are the categories of real time applications? Briefly explain their characteristics. Give examples.

- Q 11.** List and briefly define some of the techniques used in contemporary processors to increase speed.
- Q 12.** Explain the differences among multicore systems, MICs, and GPGPUs.
- Q 13.** List the desirable characteristics of a benchmark program.
- Q 14.** Suppose we have two implementations of the same instruction set architecture. Computer A has a clock cycle time of 250 ps and a CPI of 2.0 for some program, and computer B has a clock cycle time of 500 ps and a CPI of 1.2 for the same program. Which computer is faster for this program and by how much?

- Q 15.** A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts:

	CPI for each instruction class		
	A	B	C
CPI	1	2	3

For a particular high-level language statement, the compiler writer is considering two code sequences that require the following instruction counts:

Code sequence	Instruction counts for each instruction class		
	A	B	C
1	2	1	2
2	4	1	1

Which code sequence executes the most instructions? Which will be faster? What is the CPI for each sequence?

- [illegible]

**Q 22.** The memory content of ARM register R0 shows an unsigned integer with the following value:

**C5700000<sub>16</sub>**

- a) If it is an unsigned integer number, what is its decimal value?
- b) If it is a signed integer number, what is its decimal value?