Introduction

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1 Administrivia

Today's Objectives

1. Describe the terms "computer architecture," "instruction set architecture," and "microarchitecture," and the relationship between them.

2. Describe the layers of the software/hardware hierarchy of a computing system.

3. Describe the steps in compiling a high-level language (HLL) representation of a program into an executable machine language program.

Next Time

Read 1.4–1.7.

1. Describe the concept of the stored program computer and its fundamental operation.

2. Demonstrate the binding between symbolic names and memory values and locations.

3. Describe the attributes of the memory hierarchy.

4. Discuss the properties of the bus.

2 Warm-Up

1. Which of the following do not apply when discussing computer architecture?

   (a) The word size in bits.

   (b) The organization of the I/O bridge.

   (c) The available addressing modes.

   (d) The size of the data cache.

   (e) The number of CPU functional units.

2. Which of the following do not apply when discussing instruction set architecture?

   1) The word size in bits.
   2) The available addressing modes.
   3) The size of the data cache.
   4) The number of CPU functional units.

   (a) 2

   (b) 4

   (c) 1 and 4

   (d) 3 and 4

   (e) They all apply.

3. Application programs can directly access I/O devices.

   True/False

4. The operating system can directly access I/O devices.

   True/False

5. The function of a compiler is to

   (a) Convert a source HLL program into assembly

   (b) Convert a modified source HLL program into assembly

   (c) Convert a source HLL program into an object program

   (d) Convert a source HLL program into an executable program

   (e) Convert an assembly program into an executable program

6. Linking is the process of combining source object files into an executable program.

   True/False

3 Problems

1. What is the difference between a computer's architecture and its organization? Can you think of systems other than computers that have both an architecture and an organization?

2. Using Internet resources, research the x86-64 architecture and recent x86-64 processors. Describe three features each of the x86-64 ISA and microarchitecture. Describe three characteristics of recent PCs that aren't a part of the x86-64 (or x86) architecture.

3. Where does virtualization software (Xen or VMware, for example — look these up in Wikipedia) fit into the software/hardware hierarchy?

4. With respect to the layers of the software/hardware hierarchy, in what layer would you place system programs such as compilers, assemblers, the linker, and libraries?

5. Using Wikipedia, research the Linux ELF file format. On the class home page, you'll find a PDF of an object dump of the standard "Hello world!" program. Answer these questions:

   (a) In what section is the "Hello world!" string found?

   (b) What are the first three instructions, and their operands, of the .text section?

6. In a computing system that uses static libraries, if a flaw is found in a library, the flaw must be corrected, the library re-compiled, and then every program using that library must be re-compiled. Is the same true in a computing system that uses dynamic libraries? (You may need to use the Internet to look up definitions for the terms "static library" and "dynamic library."