Basic Concepts

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Book Chapter

- “Assembly Language for x86 processors”
- Author “Kip R. Irvine”
- 6th Edition
- Chapter 1
  - Section 1.1
  - Section 1.2

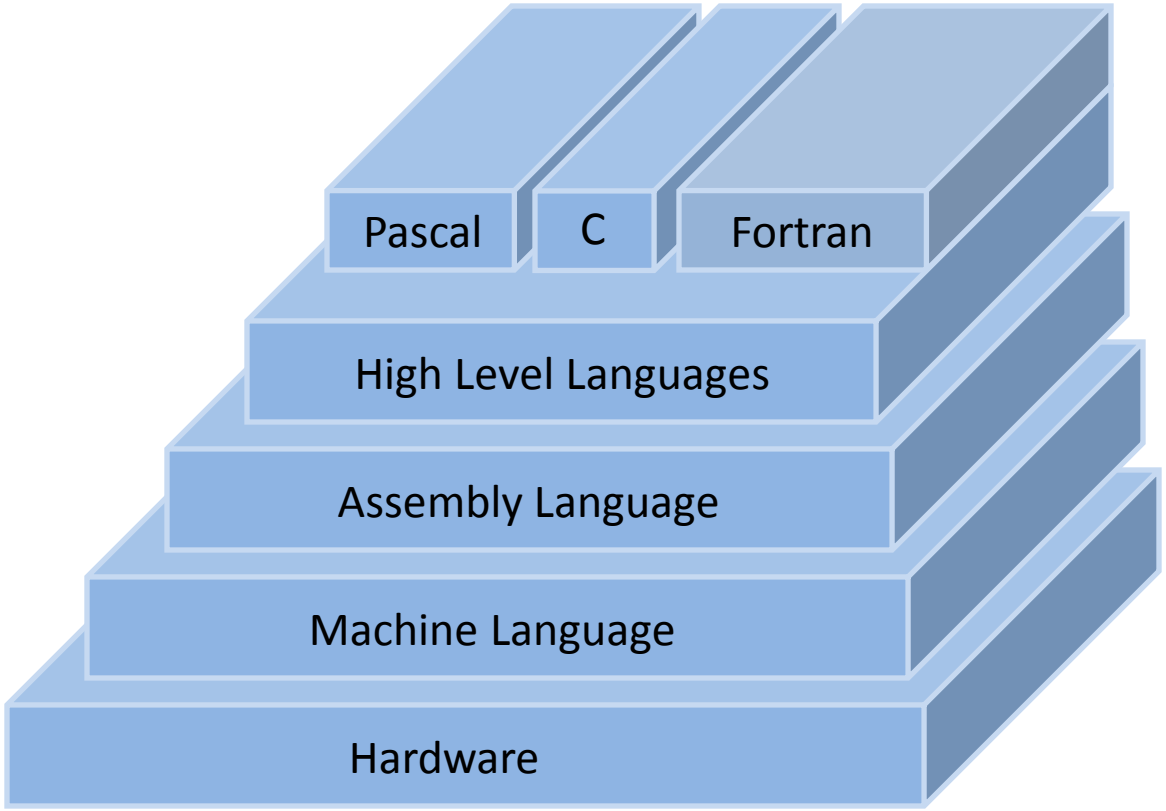
Outline

- Some important questions
- Programmer’s view of a Computer System

Some Questions to Ask

- High and Low Level Computer Languages
- What is Assembly Language?
- What is Machine Language?
- How is Assembly related to High Level Language?
- Is Assembly Language portable?
- etc.

Hierarchy of Computer Languages



High Level Language

- Called High Level because closer to human language and farther from machine language
- Independent of a particular type of processor
- Easier to read, write and understand because uses natural language elements
- Hides implementation details
- Must be translated to machine language

Assembly Language

- Low level programming language
- Used to interact with computer hardware
- Specific to a particular computer architecture
- Focuses on programming microprocessors
- Used to program
  - Embedded system
  - Device driver programming
  - Computer viruses and bootloaders

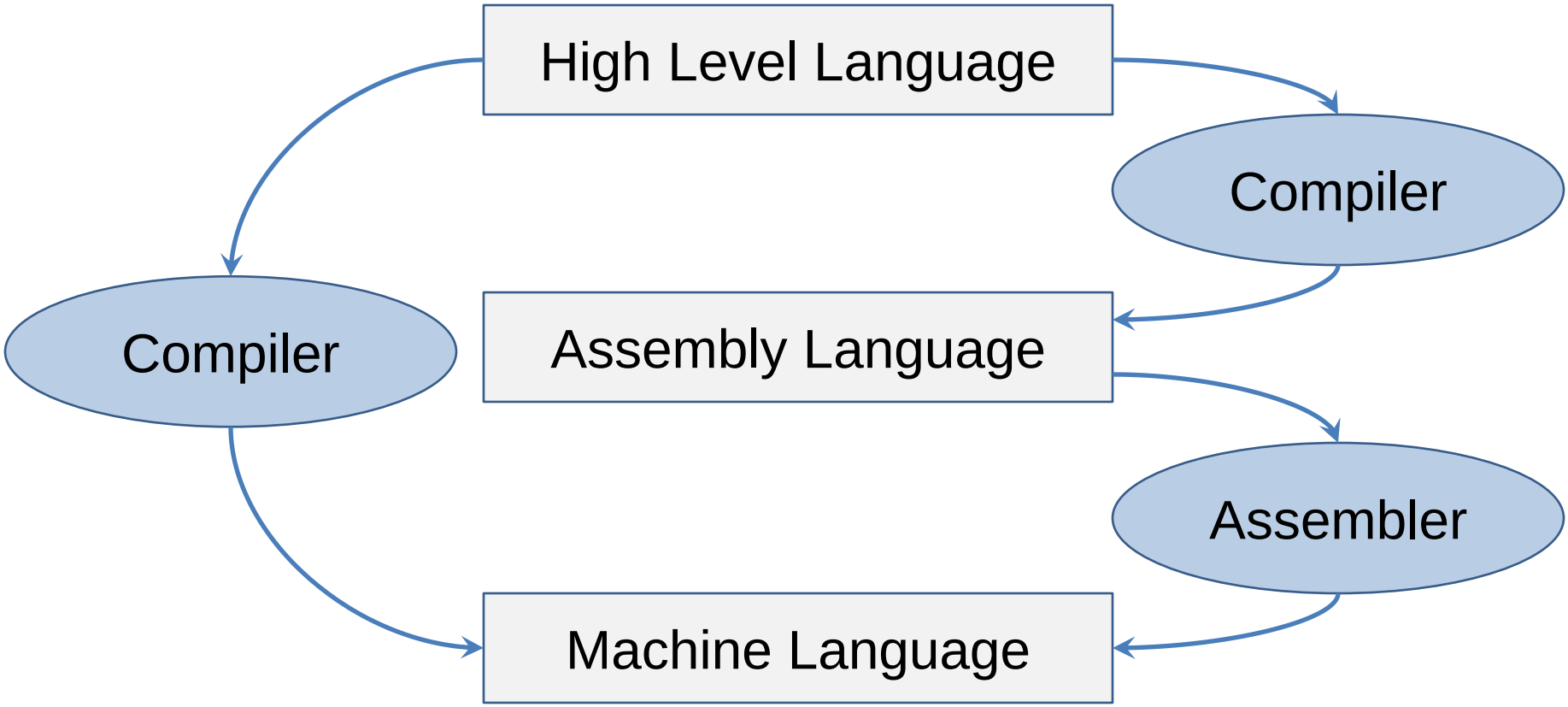
Machine Language

- Lowest level programming language
- Sequence of 1s and 0s
- Easily understood by computers
- Almost impossible for humans to use
- Each CPU has its own unique machine language

Conversion from High Level (HL) to Low Level (LL) Language

- From Assembly to Machine Language
  - Assembler is used
- From High Level to Machine Level Language
  - Compiler converts High Level Language to Object Code
  - Assembler is used to convert Assembly Language code to Machine Code

Compiler and Assembler



Assembly Language Portability

- Can be compiled and run on a wide variety of computers
- Assembly is designed for a specific processor family
- Motorola 68x00, x86, SUN Sparc, Vax, IBM-370 are different processor architectures

Conversion from HL to LL Language

Natural Language: Add 5 into 3 and store the result into X

High Level Language: int X = 5 + 3;

Assembly Language:

mov ax, 5

mov bx, 3

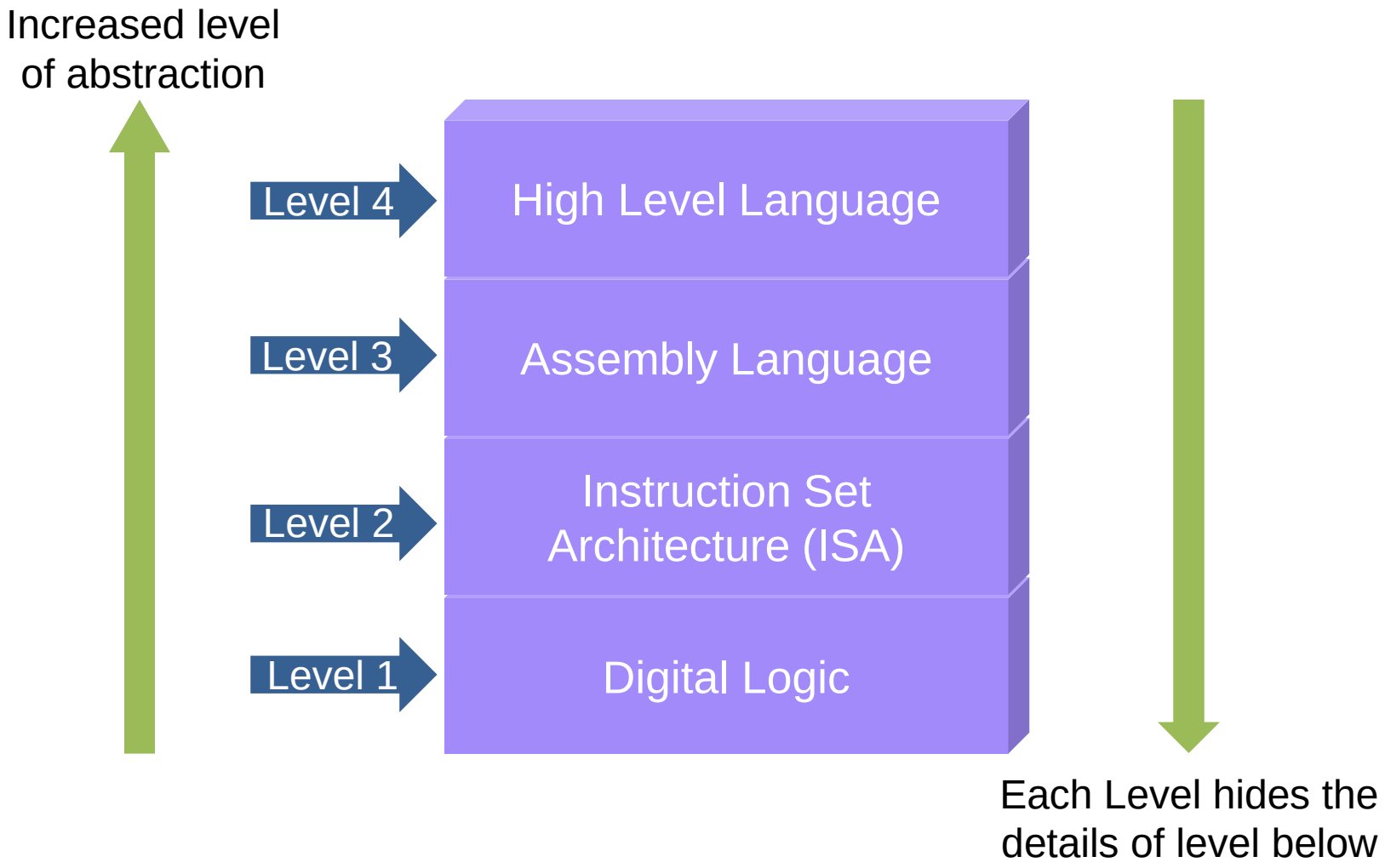
add ax, bx

mov X, ax

Advantages of HL Languages

- Program development is faster
  - High level statements: fewer instructions to code
- Program maintenance is easier
  - For the same above reasons
- Programs are portable
  - Contains less machine dependent details
    - Can be used with little or no modifications on different machines
  - Compiler translates to the target machine language

Programmer's view of a Computer System



Programmer's view (1/2)

- Digital Logic (Level 1)
  - Uses logic gates which are implemented using transistors
  - Machine language is used to program logic gates
- Instruction Set Architecture (Level 2)
  - Specifies how a processor functions
  - Also called Machine Language
  - Machine instructions, registers and memory are exposed

Programmer's view (2/2)

- Assembly Language (Level 3)
  - Have one-to-one correspondence to machine language
  - Translated to machine language for execution
- High Level Language (Level 4)
  - Programs contain powerful statements
  - Compiled programs produce assembly language version

Next Lecture

- Data Representation
  - Binary
  - Hexadecimal
  - Base Conversions
  - Integer storage sizes
  - 2’s complement notation
  - and others…