Principles of Computer Architecture

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Chapter 1: Introduction

Chapter Contents

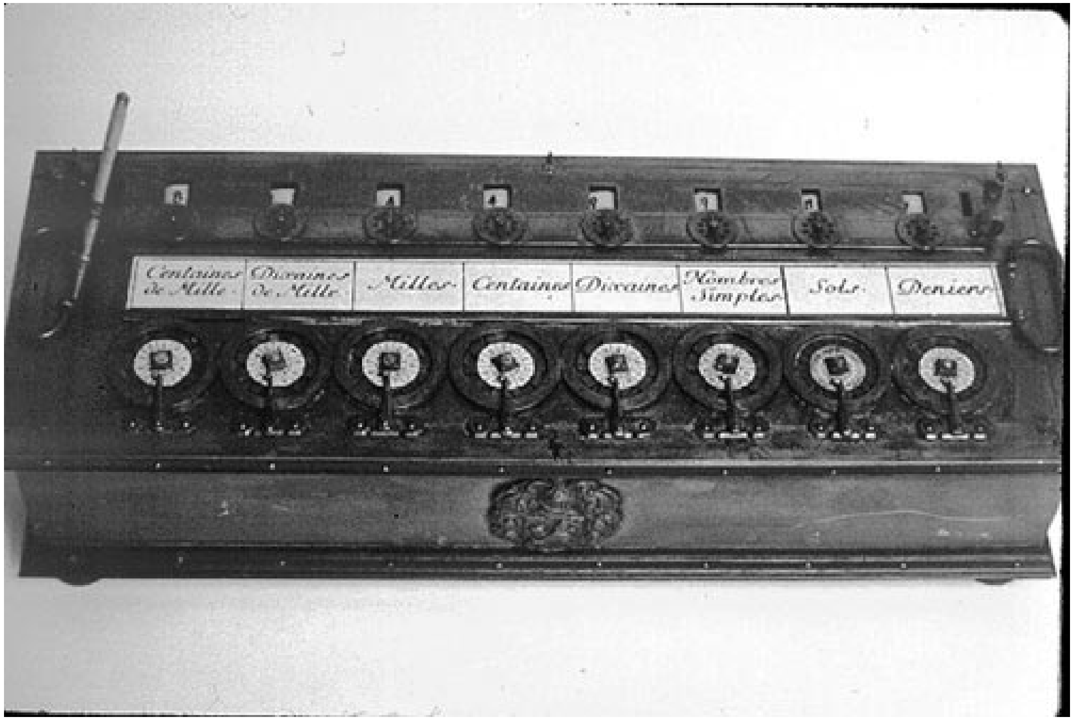
Some Definitions

- ***Computer architecture*** **deals with the functional behavior of a computer system as viewed by a programmer (like the size of a data type – 32 bits to an integer).**
- ***Computer organization*** **deals with structural relationships that are not visible to the programmer (like clock frequency or the size of the physical memory).**
- **There is a concept of** ***levels*** **in computer architecture. The basic idea is that there are many levels at which a computer can be considered, from the highest level, where the user is running programs, to the lowest level, consisting of transistors and wires.**

Pascal's Calculating Machine

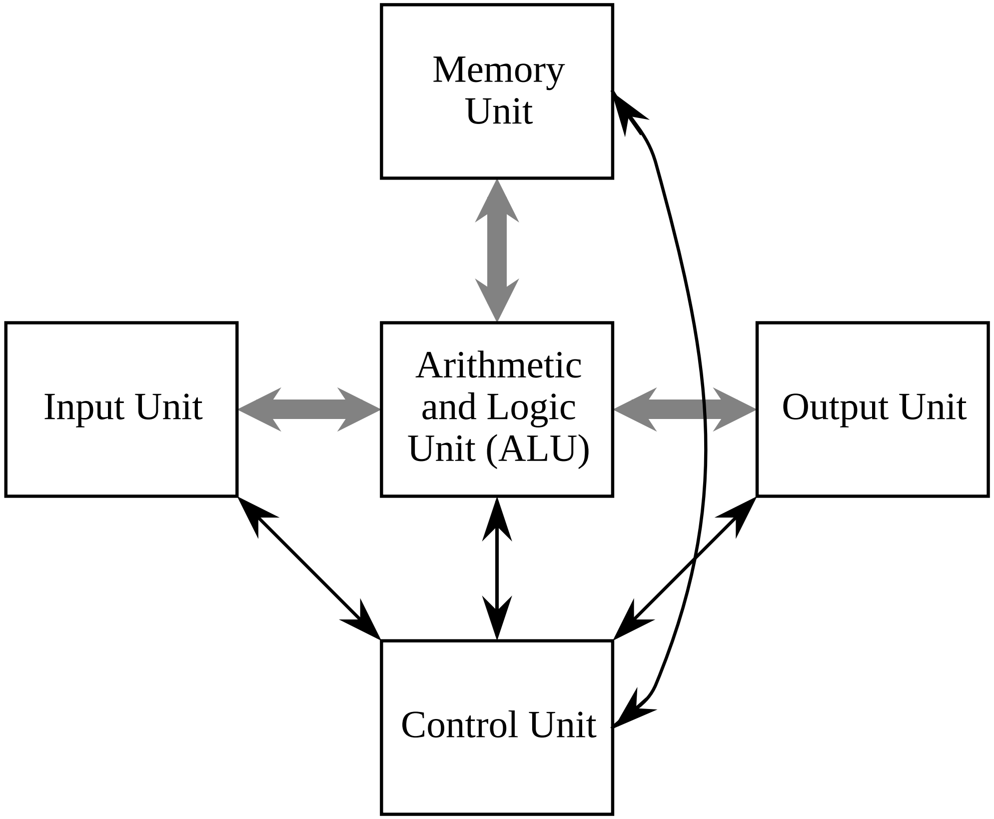
- **Performs basic arithmetic operations (early to mid 1600's). Does not have what may be considered the basic parts of a computer.**
- **It would not be until the 1800's until Babbage put the concepts of mechanical control and mechanical calculation together into a machine that has the basic parts of a digital computer.**

(Source: IBM Archives photograph.)



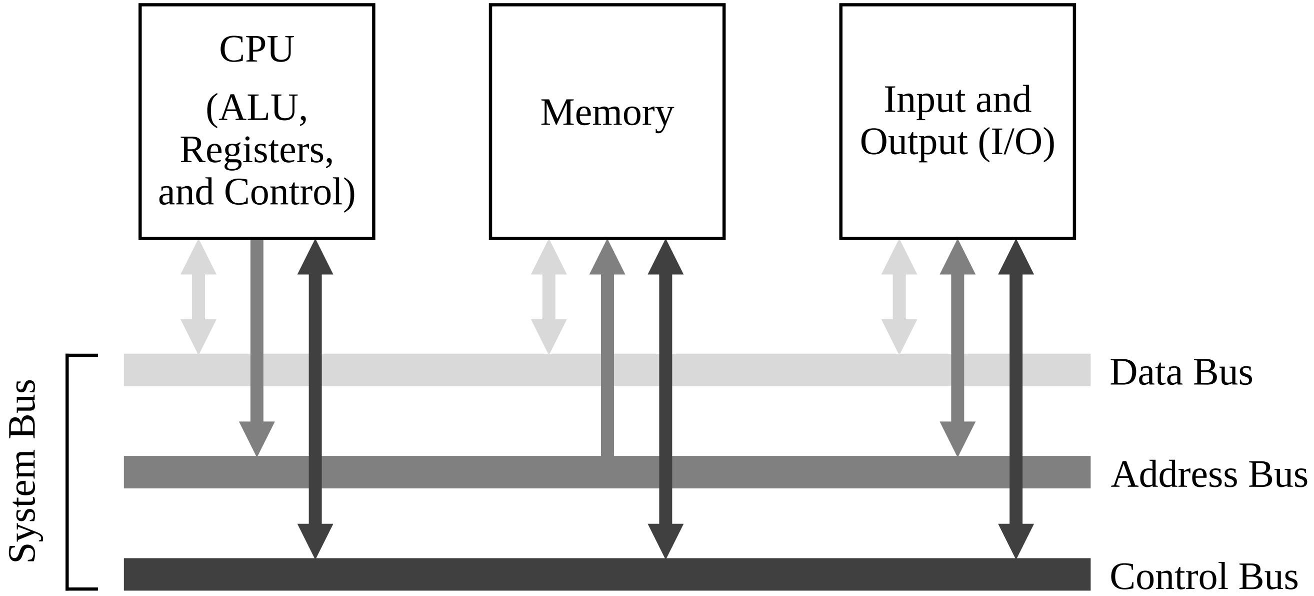
The von Neumann Model

- **The von Neumann model consists of five major components: (1) input unit; (2) output unit; (3) arithmetic logic unit; (4) memory unit; (5) control unit.**



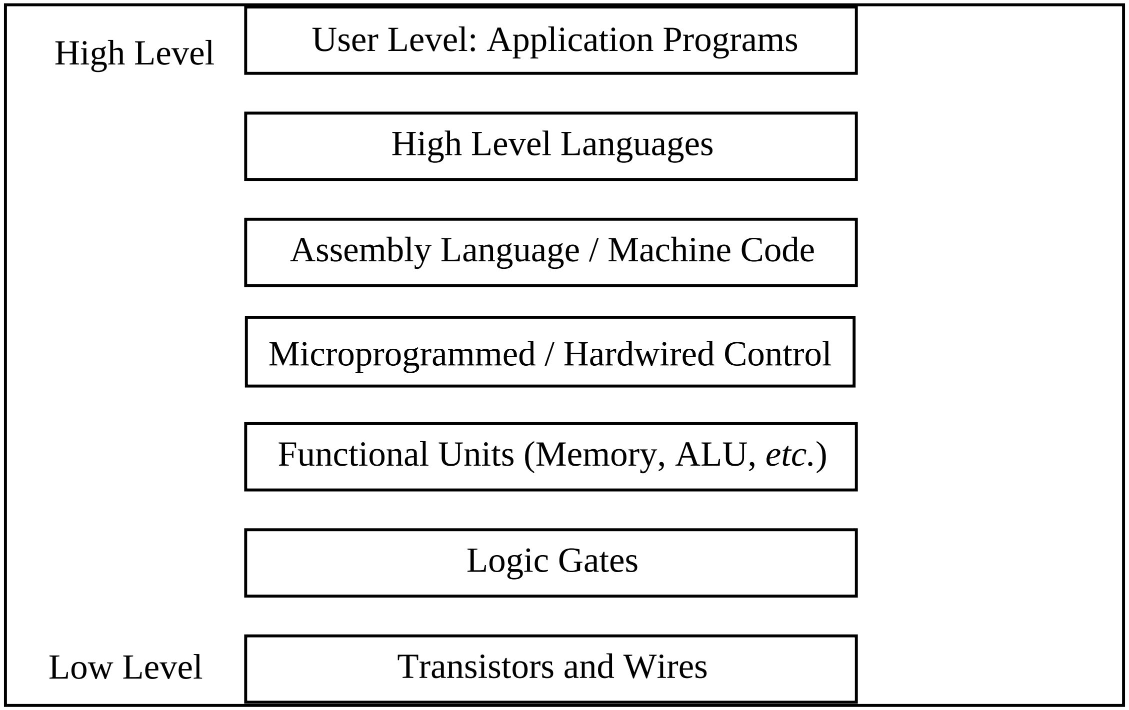
The System Bus Model

- **A refinement of the von Neumann model, the system bus model has a CPU (ALU and control), memory, and an input/output unit.**
- **Communication among components is handled by a shared pathway called the *system bus*, which is made up of the data bus, the address bus, and the control bus. There is also a power bus, and some architectures may also have a separate I/O bus.**

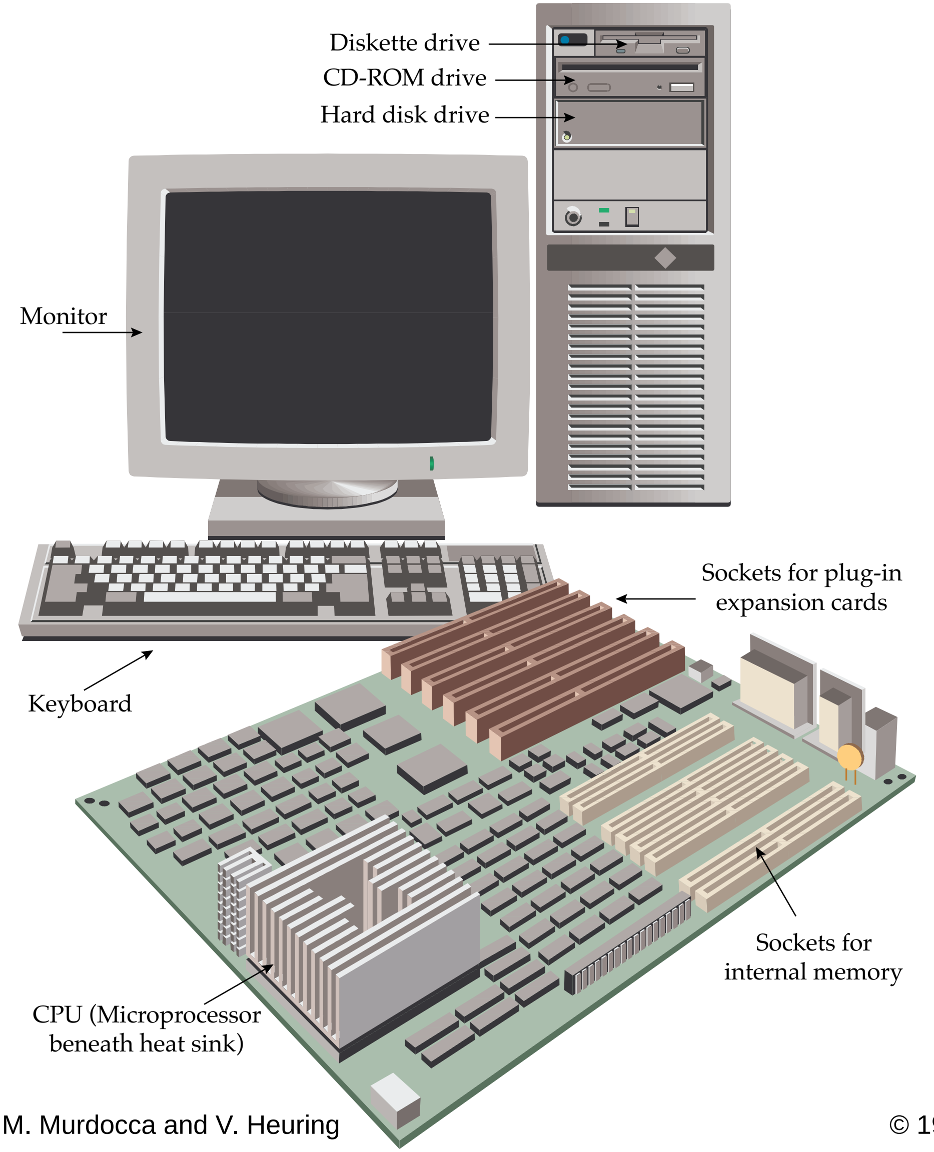


Levels of Machines

- **There are a number of levels in a computer (the exact number is open to debate), from the user level down to the transistor level.**
- **Progressing from the top level downward, the levels become less abstract as more of the internal structure of the computer becomes visible.**



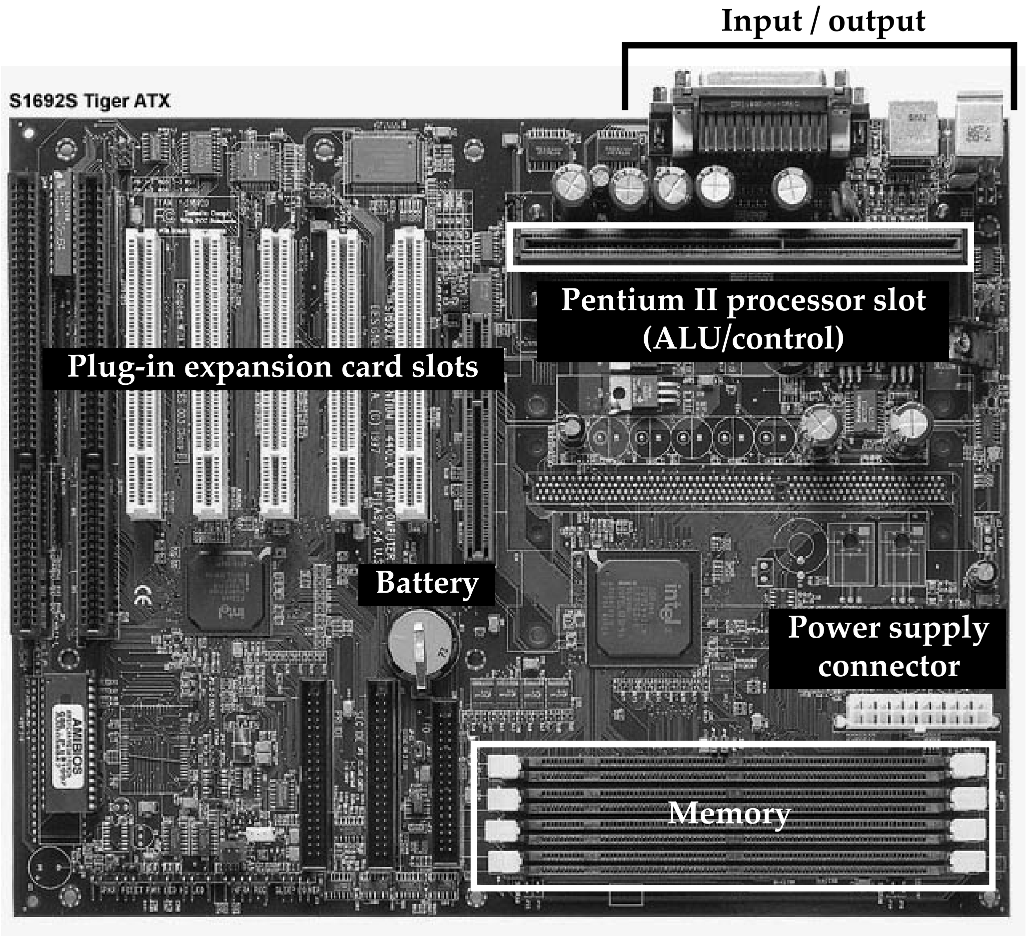
A Typical Computer System



The Motherboard

- **The five von Neumann components are visible in this example motherboard, in the context of the system bus model.**

(Source: TYAN Computer, http://www.tyan.com)



Manchester University Mark I

- Supercomputers, which are produced in low volume and have a high price, have been largely displaced by, high-volume low-priced machines that offer a better price-to-performance ratio.

(Source: http://www.paralogos.com/DeadSuper)

Moore's Law

- Computing power doubles every 18 months for the same price.
- Project planning needs to take this observation seriously: an architectural innovation that is being developed for a projected benefit that quadruples performance in three years may no longer be relevant: the architectures that exist by then may already offer quadrupled performance and may look entirely different from what the innovation needs to be effective.

