

Principles of Computer Engineering

Bachelor of Science, Electrical Engineering (Communication Engineering)

Course Description

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Outline

- Introduction
- Historical View
- Computers' Classifications
- Basics
 - Architecture and Organization
 - Structure and Functions
 - Definitions

Introduction

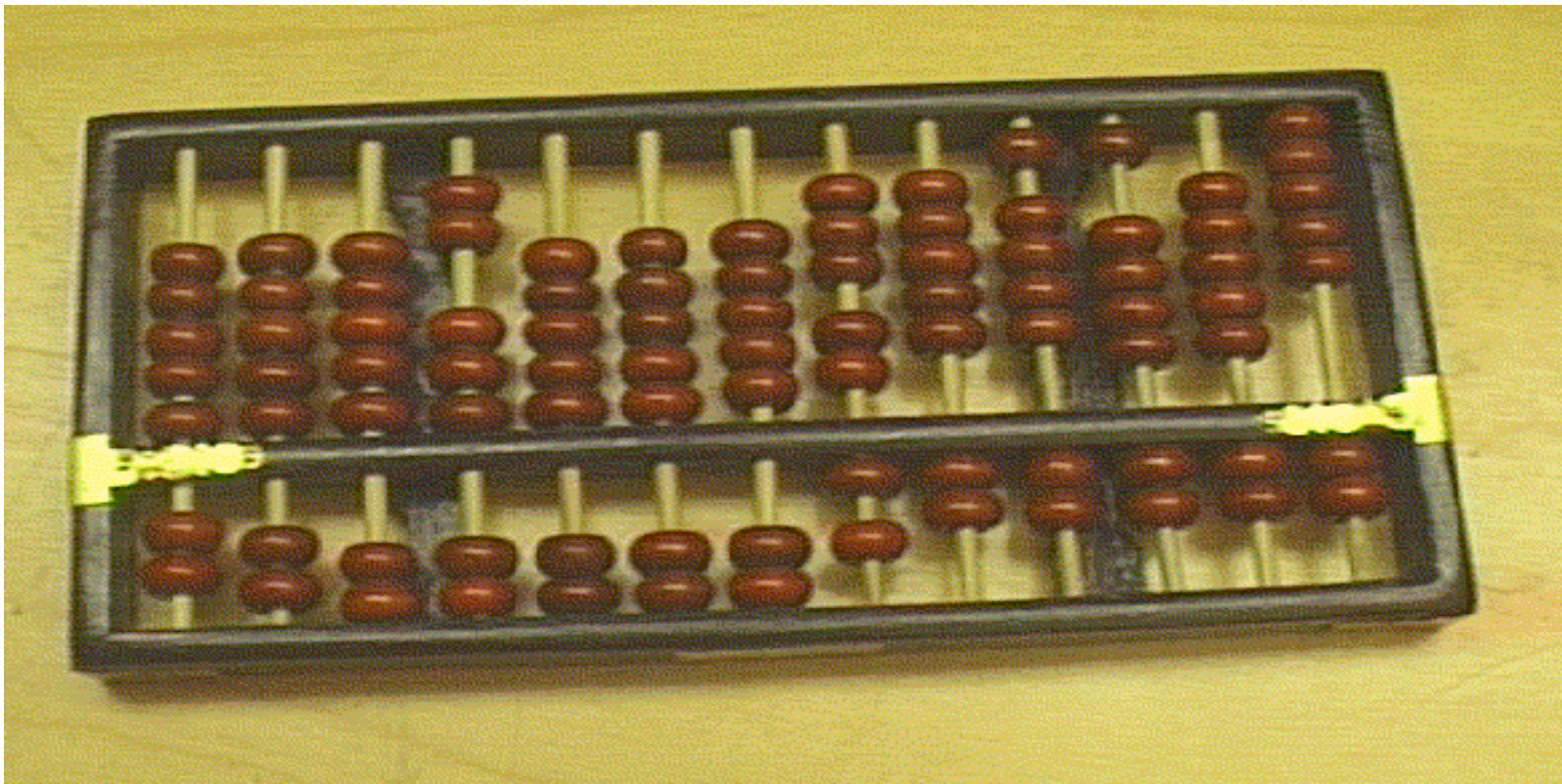
Introduction

- Computer Engineering is crucial for today's economy
- Huge usage of computers and processors
 - Faster processing
 - Size reducing
 - Increase in memory capacity
 - ...
- Development's aim
 - More operations per time unit and less size
 - Threading
 - Parallel processing
 - Distributed processing
 - Computer grids
 - ...

Historical View

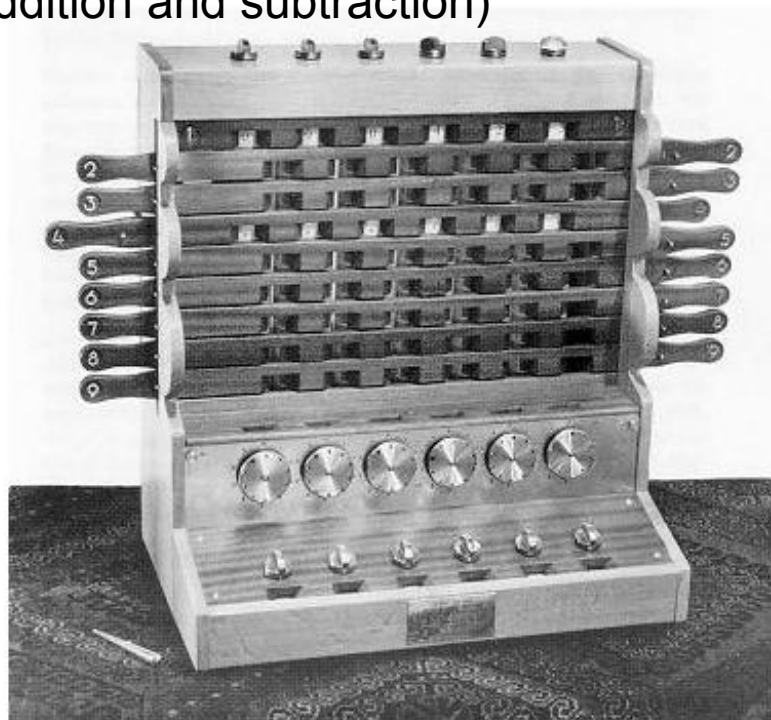
Abacus

- 3000 BCE, early form of beads on wires, used in China



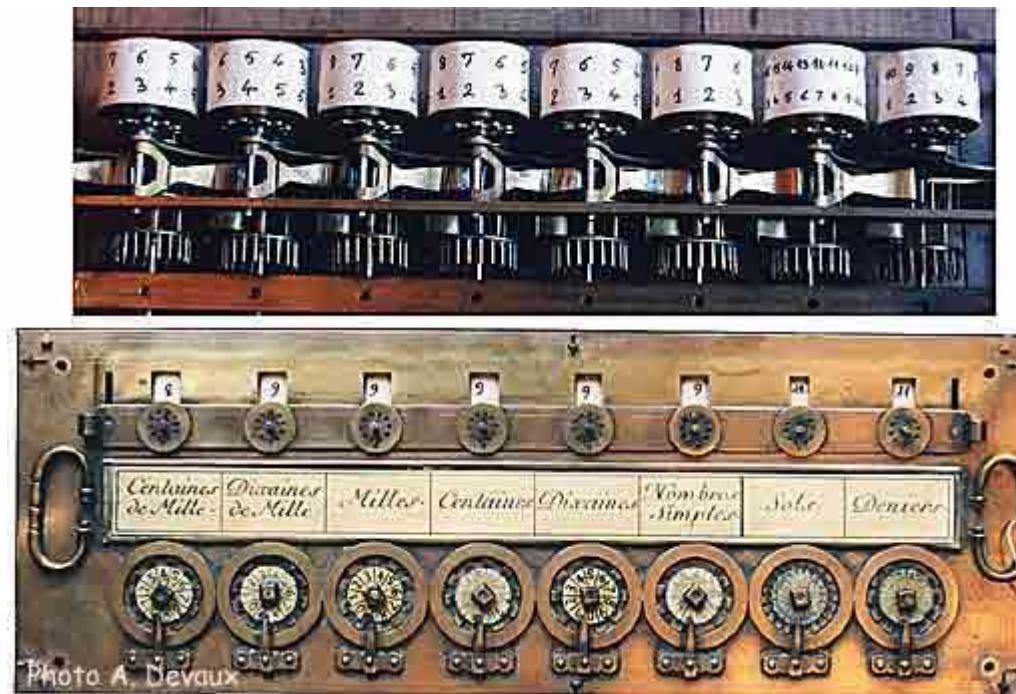
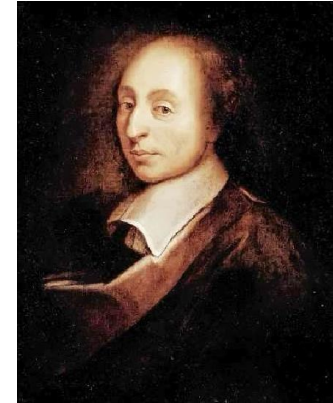
Schickard's Calculator

- Invented by **Wilhelm Schickard** in 1623
- The first calculator for the known four operations (addition, subtraction, multiplication and division)
- Two parts
 - Upper part (multiplication and division)
 - Lower part (addition and subtraction)



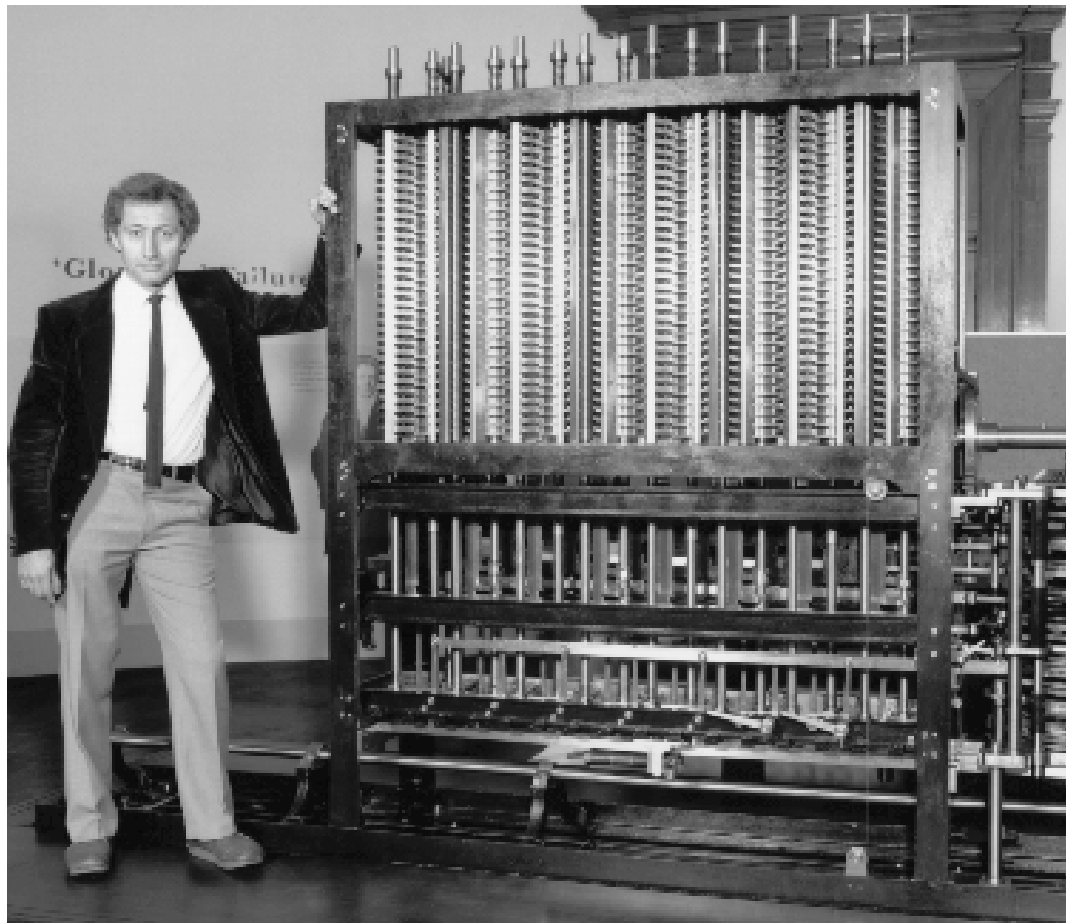
Pascal's Calculator (The Pascaline)

- The **Pascaline** is invented by Blaise Pascal in France in 1642
- Mechanical calculator
 - To simplify the calculation of taxes
 - Could add and subtract directly. However, it could not multiply and divide

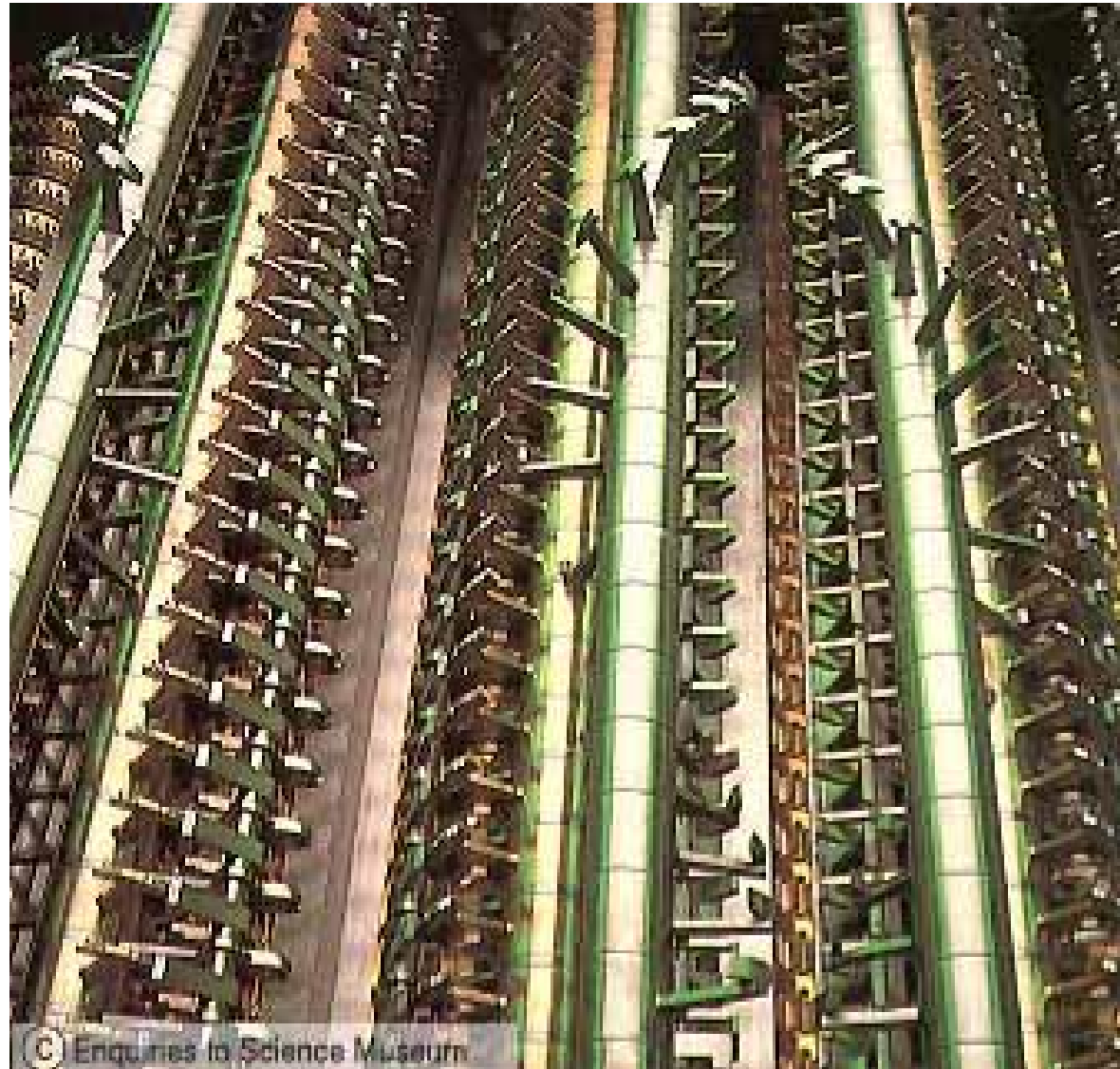


The Difference Engine

- Mechanical machine invented by **Charles Babbage**
- Used for the calculation of arithmetical functions



The Difference Engine



The Difference Engine

- **Babbage** set out plans for an "analytical engine" whose operation would have included logarithmic and trigonometric functions as well

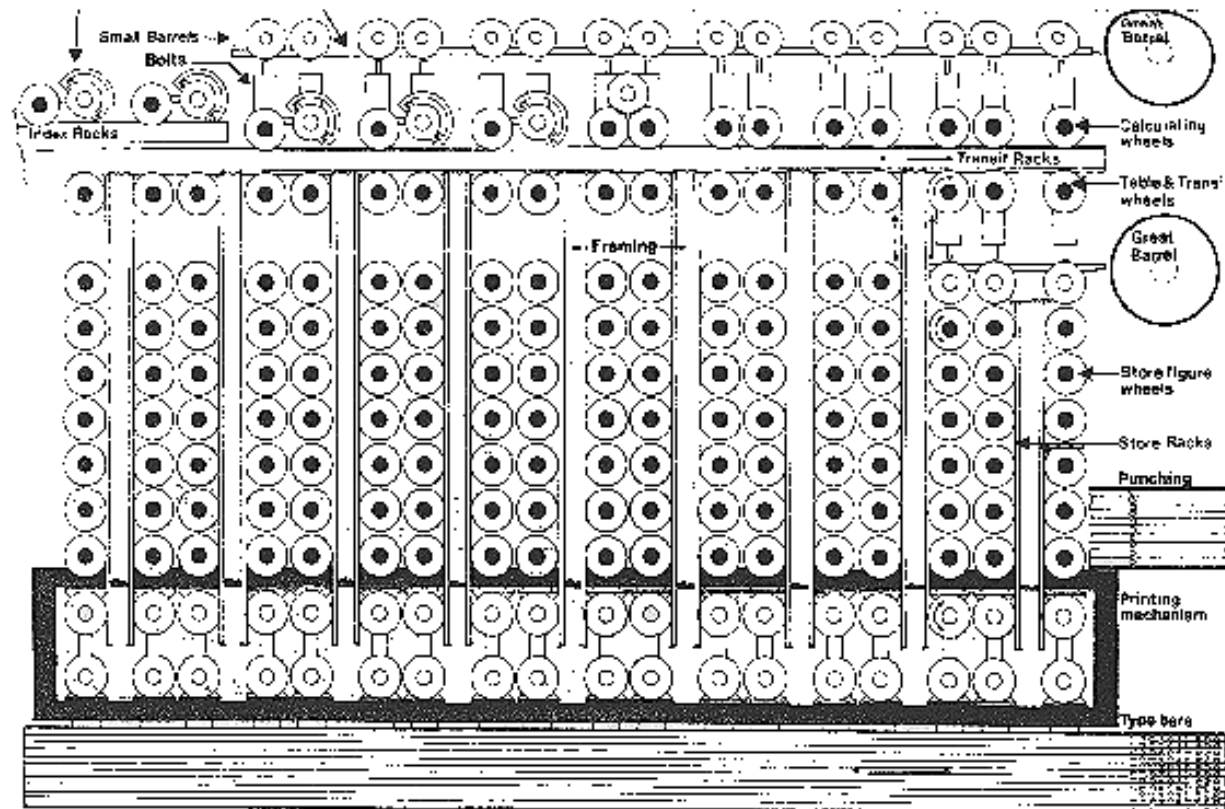


Fig. 2. Plan of Analytical Engine with grid layout, 1858 Redrawn.

Harvard Mark I

- The first large scale, automatic, general purpose, electromechanical calculator (invented in 1930)
 - Weighed 5 tons
 - Had 500 miles of wiring
 - Used only for numeric calculations
 - Took three seconds to carry out one multiplication



Konrad Zuse - The first relay computer

- Civil engineer graduated from the Technical College of Berlin Charlottenburg
- Motivation
 - Solving the equations required for construction of buildings and roads
 - This type of constructions requires solving of huge systems of linear equations, which was very hard to be done by means of a logarithmic rule or even mechanical calculator of this time



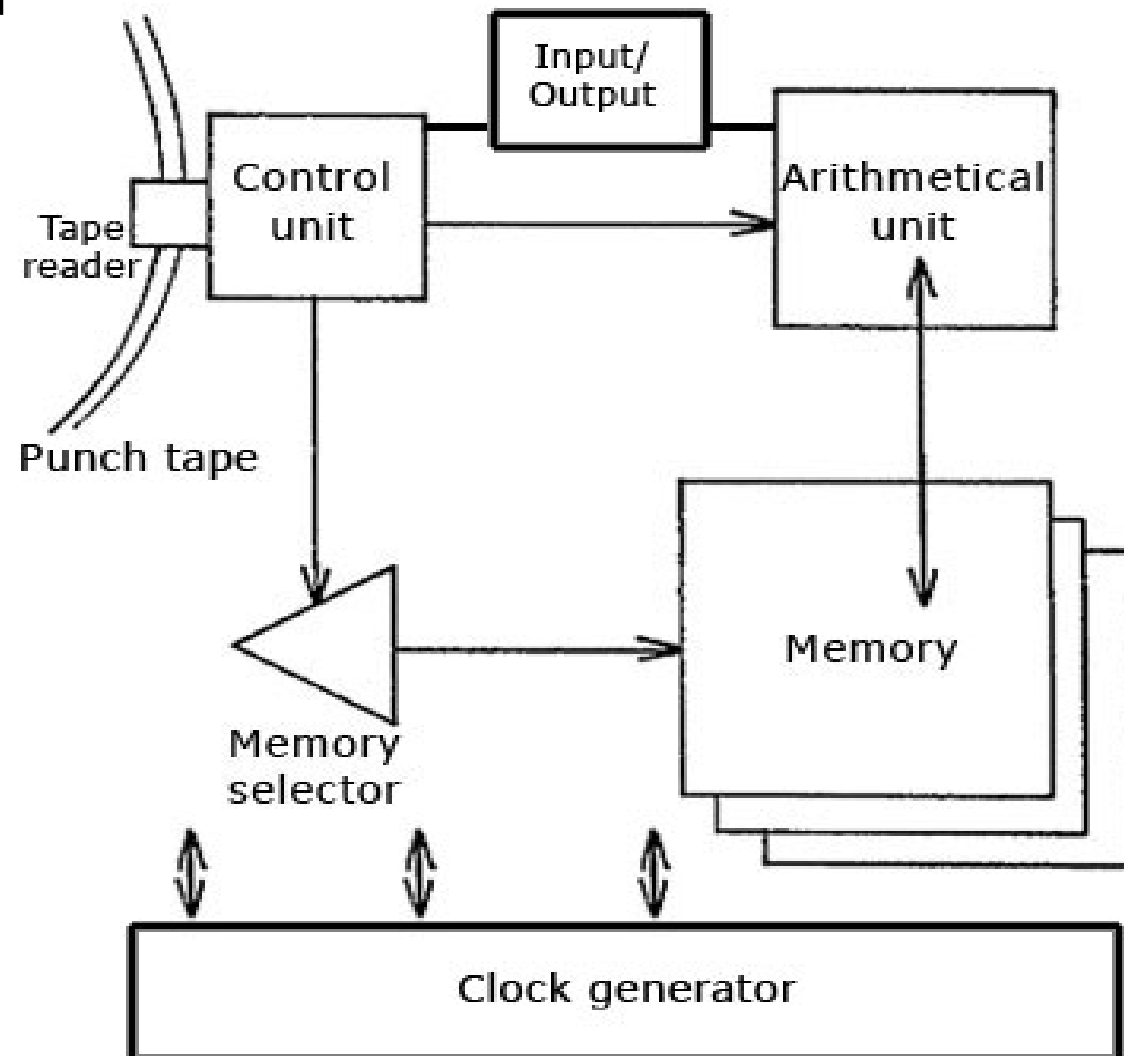
Konrad Zuse - Z1 Computer

- Finished in 1936
- **Z1** was a machine of
 - About 1000 kg weight,
 - About 20000 parts
 - Programmable computer based on binary floating point numbers and a binary switching system



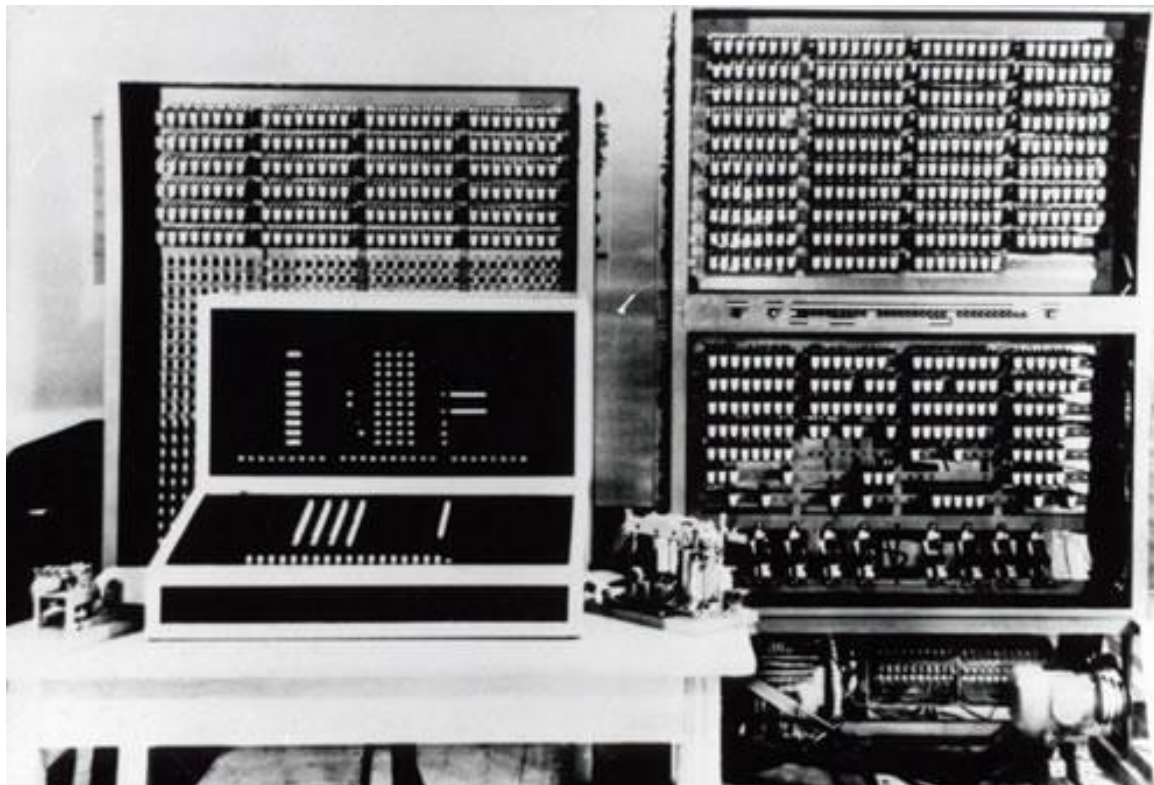
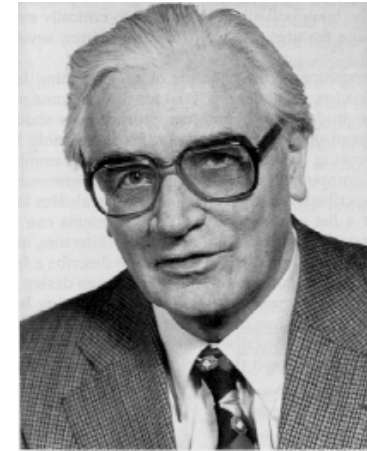
Konrad Zuse - Z1 Computer

- Architecture of **Z1**



Konrad Zuse - Z3 Computer

- First workable programmable computer (1941)
- Could operate logical operations (or, not, etc.)
- Could write floating points



Konrad Zuse – Z4 Computer

- Goal of the Z4
 - Build a prototype for a machine, that was intended to be produced in the thousands



Computers Generations

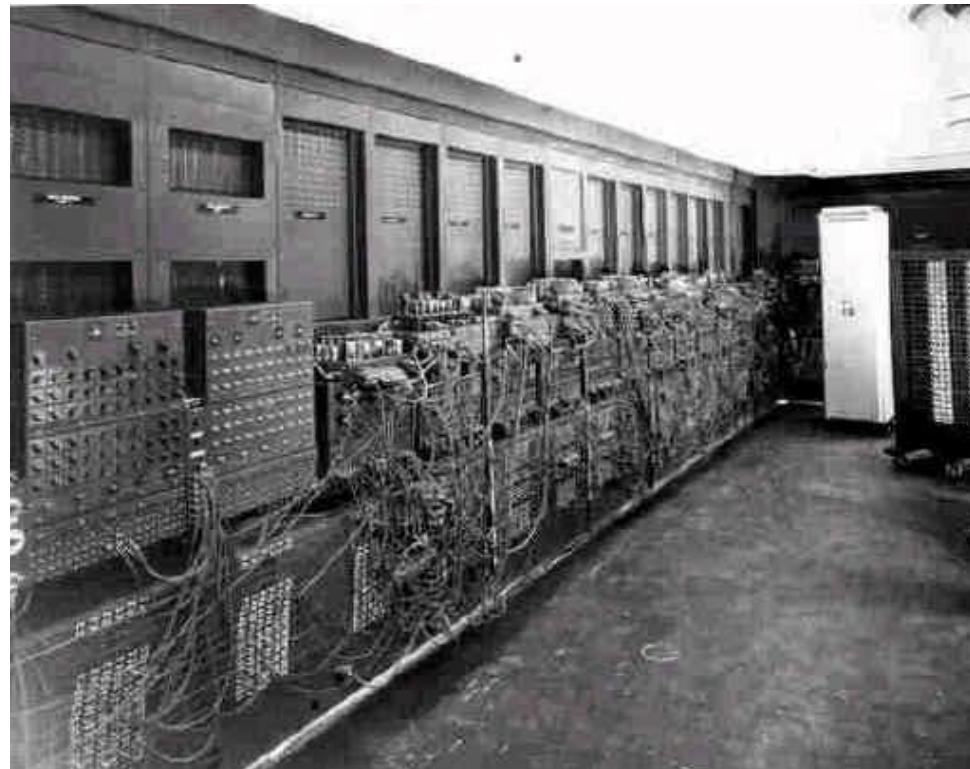
- **First generation** (1947 - 1957): vacuum tubes generation
- **Second generation** (1958 - 1964): Transistors generation
- **Third Generation** (1965 - 1971): Integrated circuits generation
 - Small and Middle Scale Integration (SSI & MSI)
 - Up to 1.000.000 pieces on the circuite
- **Fourth generation** (1972 - 1977): Integrated circuits generation
 - Large and Very Large Scale Integration (LSI & VLSI)
 - Up to 10.000.000 pieces on the circuite
- **Fifth generation** (1978 - now): Integrated circuits generation
 - Ultra Large Scale Integration (ULSI)
 - Up to 100.000.000 pieces on the circuite

1st Generation of Computers

- Vacuum tubes technology



- First Computer was the **ENIAC** (Electronic Numerical Integrator And Computer)
 - Invented in 1945 by
 - John Mauchly
 - Presper Eckert



ENIAC

- Specifications
 - 1,000 times faster than the Mark 1
 - Weighed 30 tons
 - Filled an entire room
 - Used some 18,000 vacuum tubes, 70,000 resistors, and 10,000 capacitors
 - stored a maximum of twenty 10-digit decimal numbers
- **ENIAC** solved its first problem (calculations for the hydrogen bomb) in 1945



IAS

- Difficulties in the usage of **ENIAC**
 - Input and output of data
 - Replace programmes
 - Programming
- Developement of IAS computer by John Von Neuumann in 1952
- IAS
 - Saves programmes
 - Programmable in simpler manner than by ENIAC

Computers' Classifications

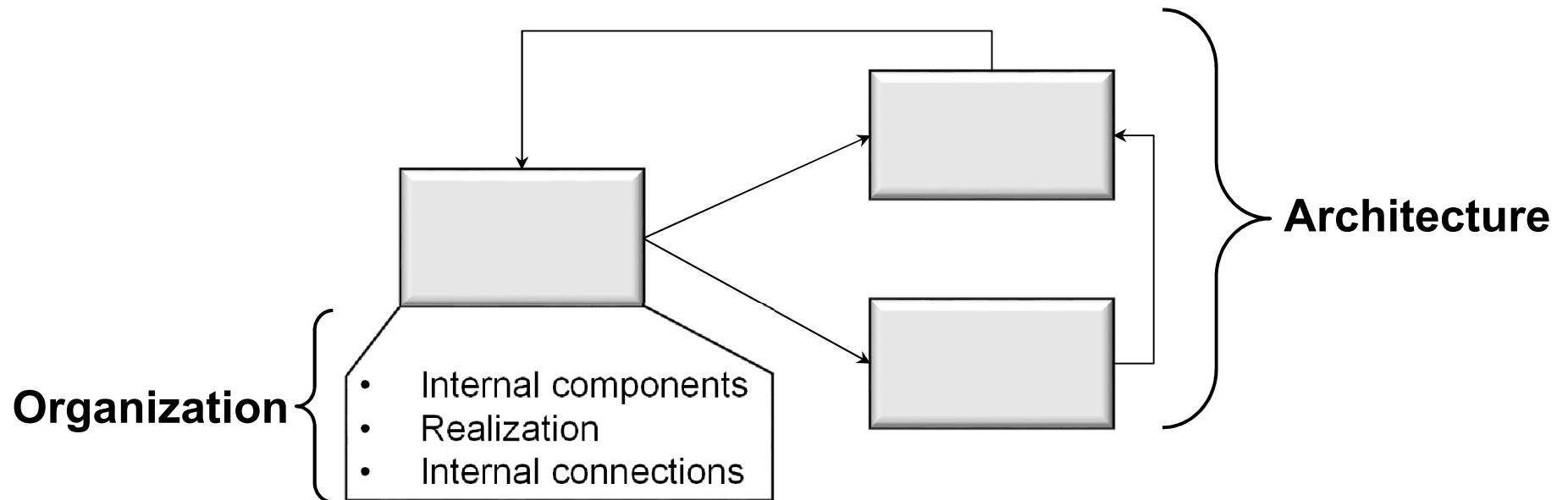
Classification

- **Super computer**
 - Very fast
 - Billions of operations per time unite
 - High cost
 - Used for sensible/critical operations (military, space industry, etc.)
 - Example: Crayt3e-900 (1.8 Tera operations per time unit)
- **Mainframe computer**
 - Fast processing
 - Server for many terminals
 - Used mainly in companies, universities
- **Minicomputer**
 - Scaled down mainframe computer
- **Personal computer**
 - Stand-alone computer (used by one person)

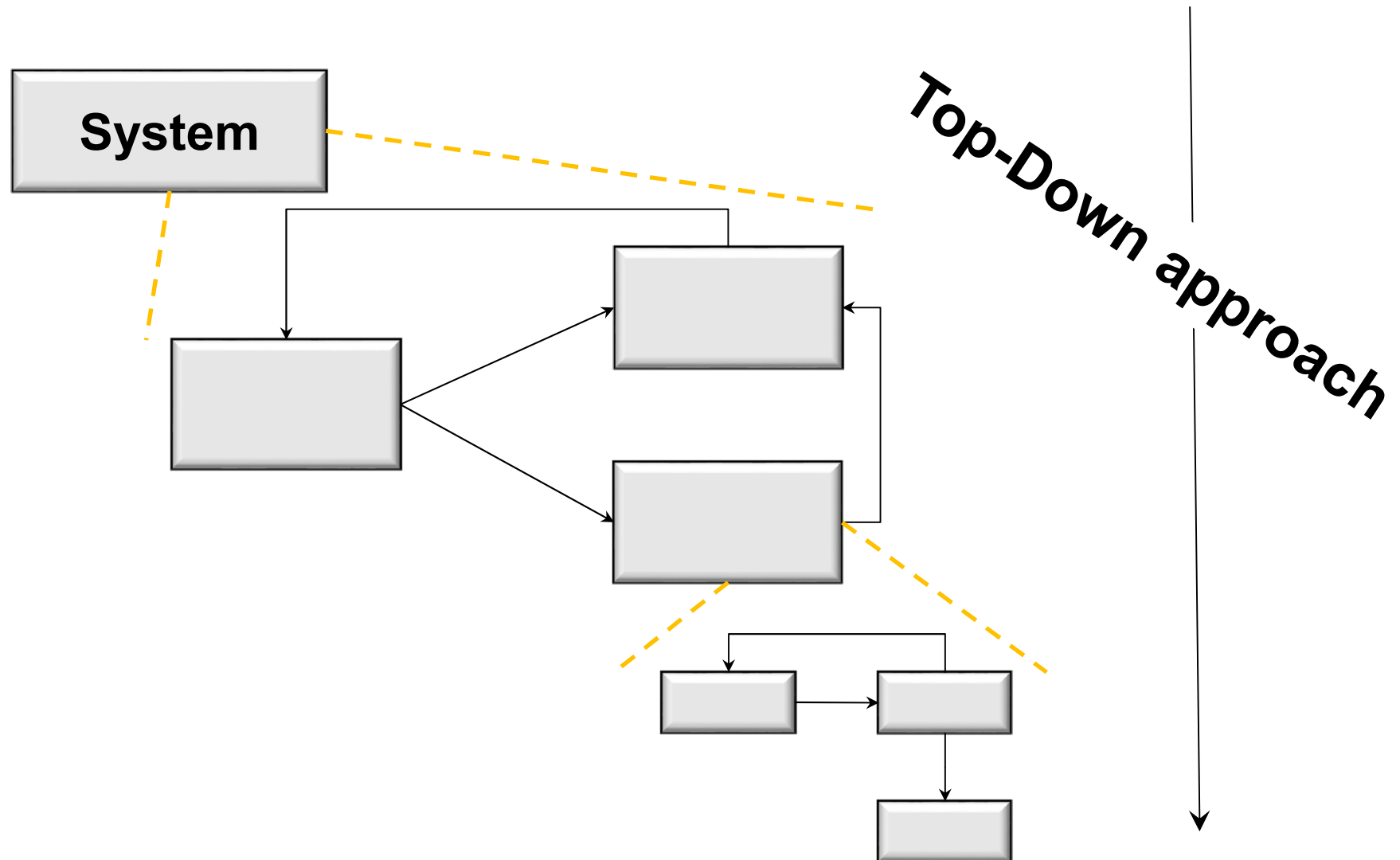
Basics

Architecture and Organization

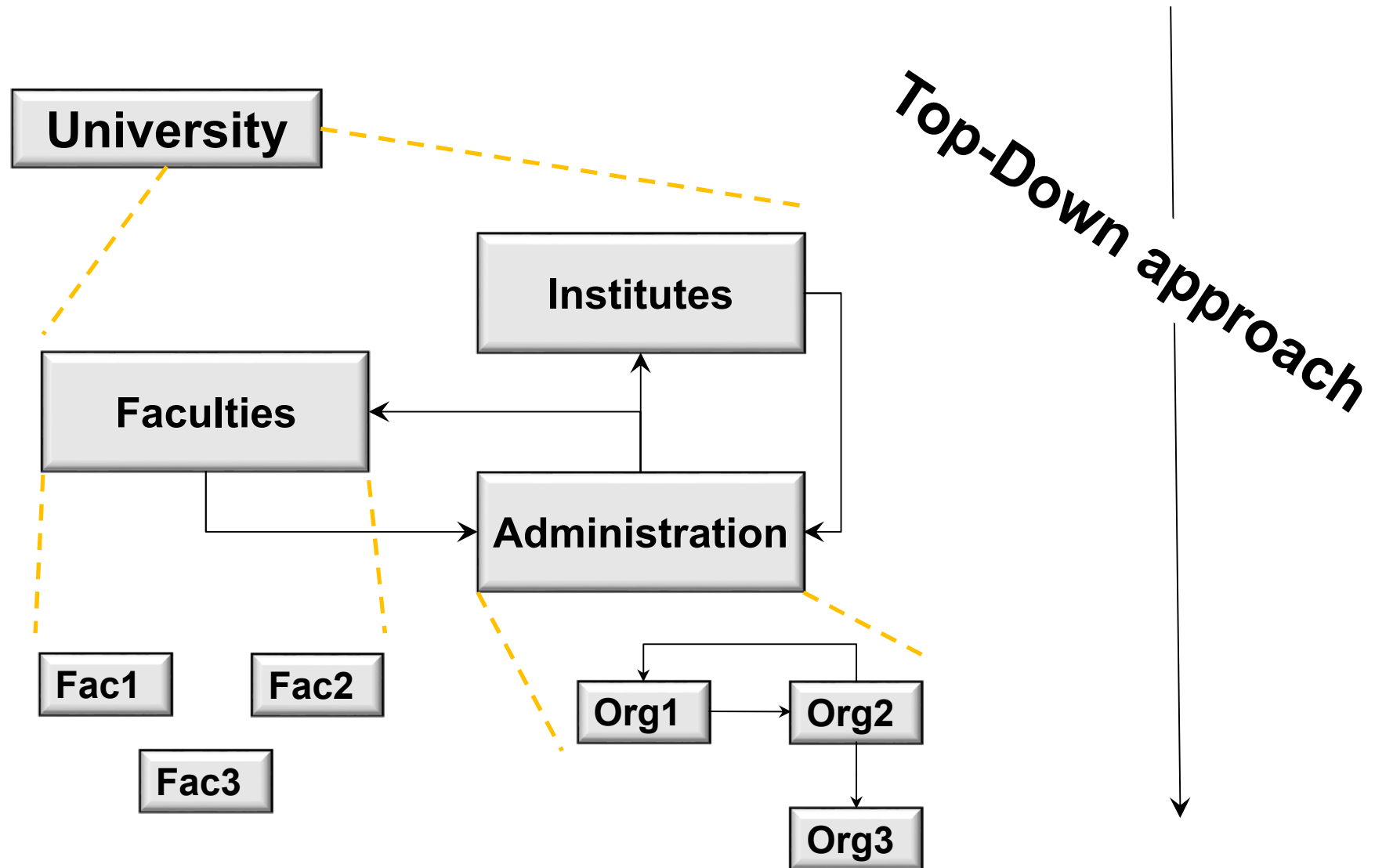
- **Architecture**
 - System description from the programmer/designer point of view
 - Components of the system, signals between them, etc.
- **Organization**
 - Details for architecture realization
 - Internal components, how are they connected, which commands, etc.



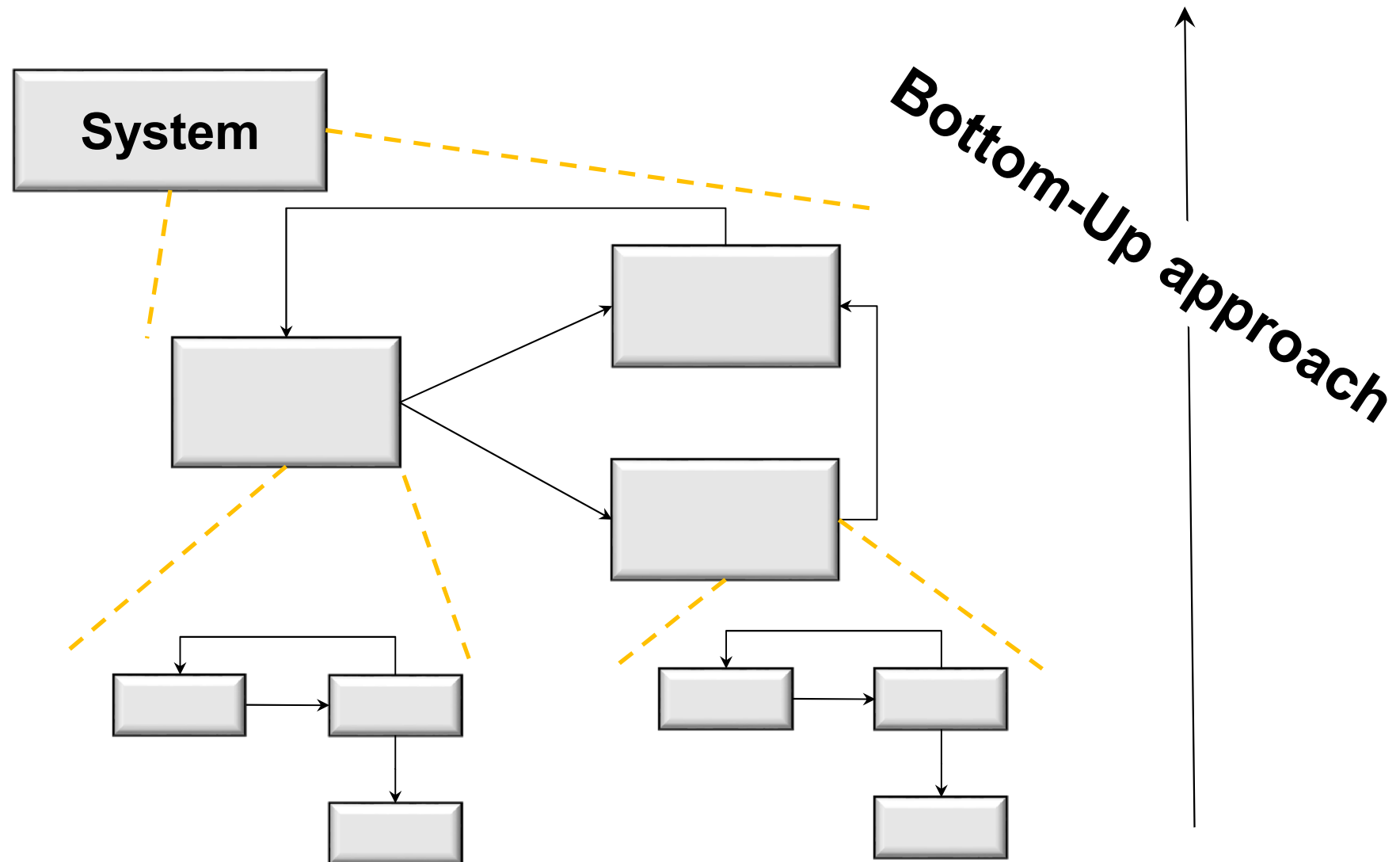
How can Systems be described?



How can Systems be described?



How can Systems be described?



Functions and Structure

- Computers consists of many components
- The task of each component is called **function**
 - Main functions of a computer are
 - **Data processing**
 - **Data storage**
 - **Data movement**
 - **Control**
- The **structure** describes how system components are interconnected

Main Functions of Computers

- **Data processing**
 - Processing of various types of data (addition, logical operations, etc.)
- **Data storage**
 - Temporal and permanent storage of data
 - Use the stored data when needed
- **Data movement**
 - Transfer of data among
 - computer components themselves and
 - Computer components and peripheral devices (Input and output (I/O))
 - Data communication (transfer of data via a network)
- **Control**
 - Control of all components and functions

Structure of Computers` System



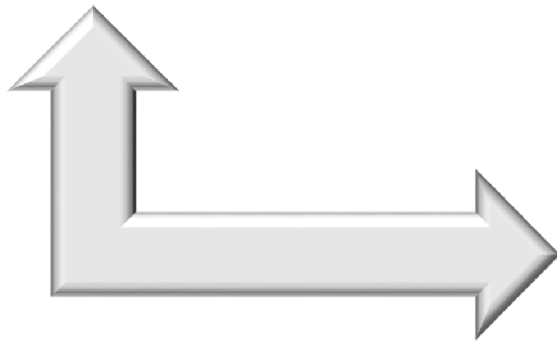
Peripheral devices



Communication cables

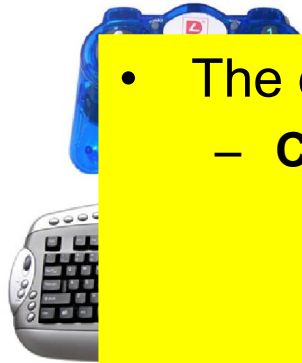


Computer



Structure of Computers` System

- The computer consists of
 - **Central Processing Unit (CPU)**
 - Main unit of the computer
 - Contains Arithmetic and Logic Unit (ALU), control unit and registers
 - **Main memory**
 - For data storage
 - **I/O unit**
 - For transferring data between the computer and peripheral devices



Pe

les



Computer