Chapter 01: Introduction

Lesson 04
Evolution of Computers Part 4– Third generation computers

Objective

- Understand how electronic computers evolved during the Third generation of computers
- Third Generation
- IBM 360
- Greatly reduced power dissipation, space and computation time compared to 2nd generation

Third generation Electronic Systems

- 1964-74
- Transistor Integrated circuits (ICs) evolved for electronic circuits
- IC circuit based computers— *third generation computers*

LSI ICs

- ICs with 100–1000 electronic logic gates
- Each IC had a large scale integrated (LSI) circuit

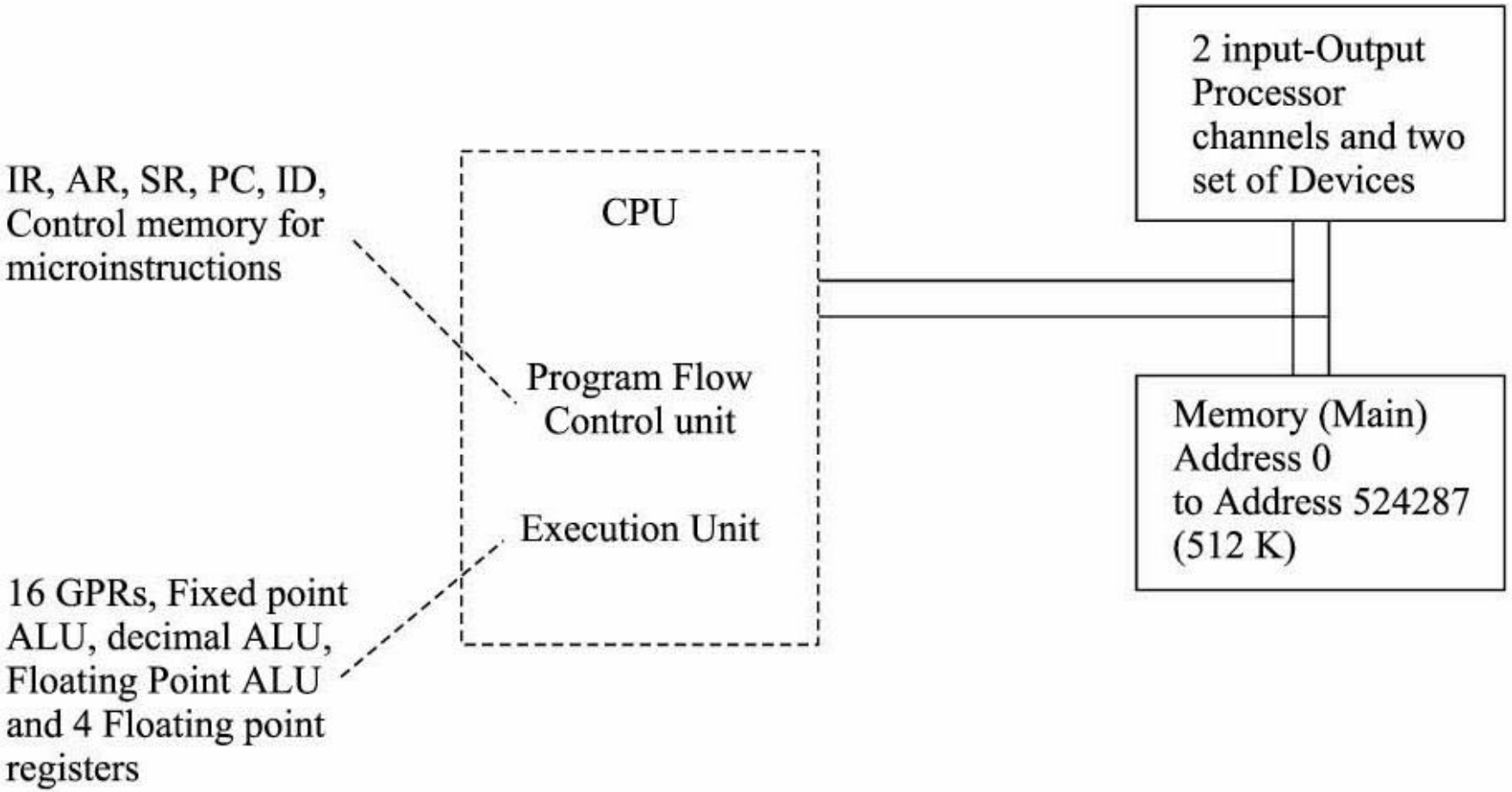
Examples of 3rd Generation of Computers during 1964–1975

- IBM 360
- PDP 11
- VAX
- CDC Cyber

3rd Generation Computer IBM 360

- A large number (16) of general purpose registers (GPRs) of 32-bit each and four floating point registers of 64-bit each
- Semiconductor ICs as main memory
- A large-sized main memory became feasible in the computer

Third generation IBM 360



3rd Generation Computer
IBM 360

- 32-bit instruction formats
- ~200 opcodes (distinct instructions) executable at the execution unit
- Use of Concept of Instruction decoder circuits

3rd Generation of Computer IBM 360

- Addition, subtraction, multiplication, and division on fixed point and floating point numbers and on multiple data types with multiple word sizes (8-bit byte and 32-bit word)

3rd Generation of Computer IBM 360

- Enhanced number of addressing modes for fetching operands

3rd Generation of Computer IBM 360

- Concept of two modes of CPU operations: supervisory mode and user mode

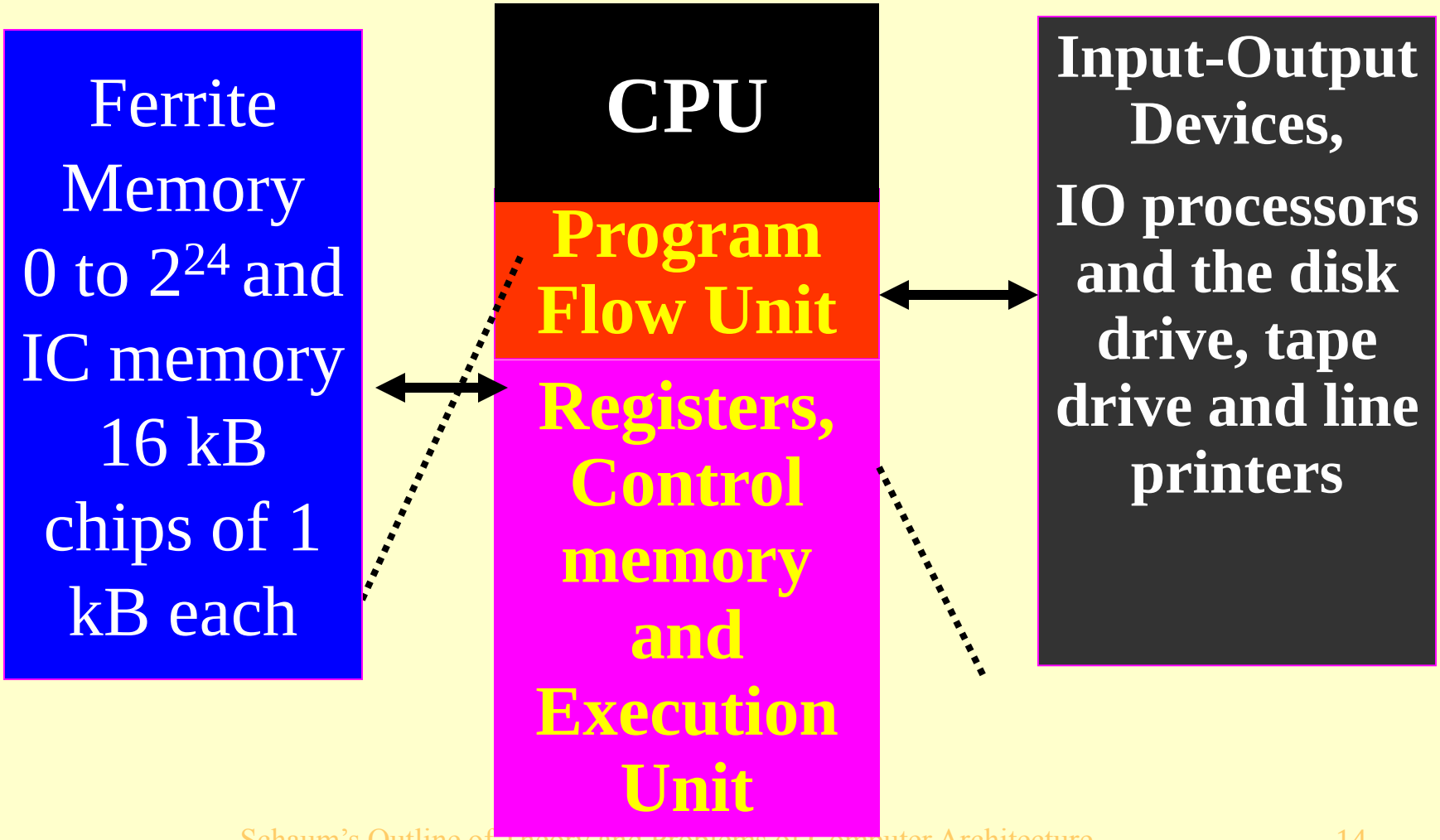
3rd Generation of Computer IBM 360

- Concept of overflow, carry, and zero and interrupt (s)– in a status register (SR) holding the flags for exceptional conditions that result from operations or events

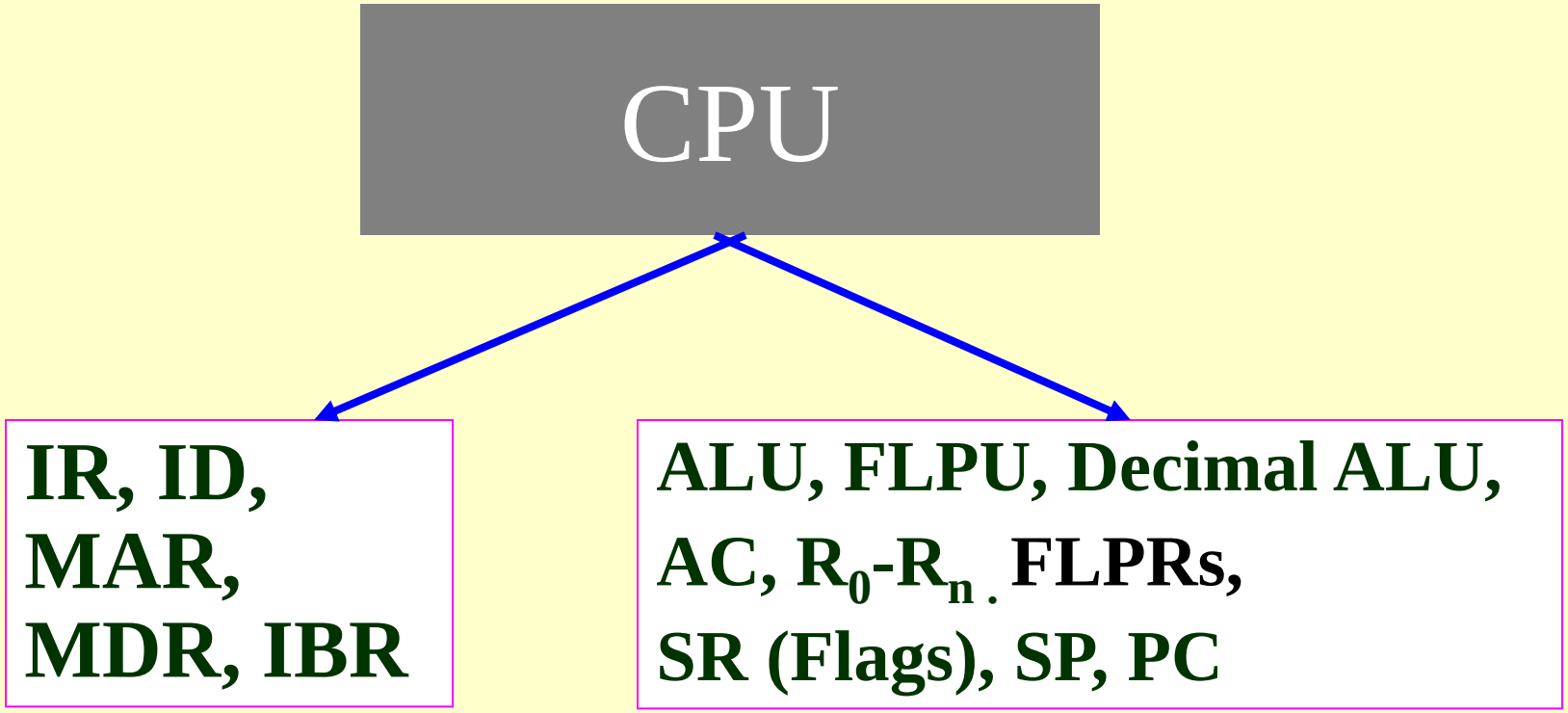
3rd Generation of Computer IBM 360

- Concept of micro-programmed implementation of instructions
- An instruction executed by a number of microinstructions at the execution unit, which reduces the hardware complexity of the execution unit

3rd Generation Computer — Architecture



CPU Registers



Greatly Reduced Power Dissipation

- Assume─ a transistor operated at 5 V and 1 mA and an IC operated at 5V and 4 μA
- Reduction in power dissipation by factor of 5 mW/20 μW = 250 times

Greatly Reduced Memory Size

- Assume — a main memory unit needs 4 transistors per bit
- The *number of transistors* for 4 K words, each word being of 32 bits, = 512K = 16 kB
- An LSI IC stored 1024 bits using 4096 transistors
- The number of ICs needed for 16 kB main memory unit equals $16 \times 1024 \times 8 \div 1024 = 128$

Greatly Reduced Space

- Assume– a transistor needs 0.4×0.3 cm^2 space
- Assume– an LSI IC has 1000 transistors and uses the same $0.\ 4 \times 0.3$ cm^2 silicon area
- Reduction in circuit space requirements by a factor of 1000

Greatly Reduced Computational Time

- Assume– a transistor device switched current from state 0 to 1 in 1 μs
- Assume– an IC circuit transistor in 0.1 μs
- Enhancement in speed of processing by a factor of 1 μs /0.1 μs = 10 times

Summary

We learnt

- Used Ferrite core large memories
- Used Multiple Registers
- Used Stack Pointer
- Used Subroutines (functions) and nested calls
- Used Assembly and High level languages FORTRAN and COBOL
- IBM 3rd Generation computer Architecture
- ALU, FLPU, AC, R0-Rn (as ARs, DRs) , SP, PC, IR, MAR, MDR, IBR

We learnt

- Instruction decoder Reduced power dissipation 1250 plus times
- 32-bit instruction format
- Over 200 opcodes
- Microprogrammed control
- Reduced space 200 times
- Reduced computational time 10 plus times

End of Lesson 03

Evolution of Computers Part 4– Third generation computers