MICROPROCESOARE (I)

Ph. D. EUGEN LUPU

- **Obiectivele cursului**

- Familiarizarea cu arhitectura software Intel 8086 …
- Asimilarea setului de instructiuni de baza (8086) + x86
- Dezvoltarea de aplicatii in Limbaj Asamblare (LA)

- **Evaluare:**

NOTA:
- 65% examen scris (teorie+probleme)
- 35% teste laborator

OBS: Intrare la examen: **maxim 2 absente Nemotivate laborator!!**

BONUS:
- Prezenta la curs, > 50% = rotunjirea notei finale in favoarea studentului (la nota de trecere > 4.5)

BIBLIOGRAFIE RECOMANDATA

1. Musca, Gh. *Programare în limbaj de asamblare,* TEORA 2004
2. Lupu, E. si col. Initiere in *Limbajul de Asamblare x86. Lucrari practice, teste si probleme. Galaxia Gutenberg 2012*
3. Lungu, V. *Procesoare Intel. Programare în L.A.* TEORA, 2004
4. Burileanu, C. şi col. *Microprocesorul x86 - o abordare software* Ed. Albastră, 1999
5. Hyde, R. The *Art of Assembly Language,* 2000
6. Buchanan, W. *PC interfacing, Communications and Windows Programing* Addison Wesley, 1999
7. Carter, Paul A., PC assembly language, 2003, www.computer-books.us
8. Rollins, D. *Program Tech help V 6.0. The electronic technical reference manual,* 1995
9. [***] www.intel.com
10. [***] www.x86.org
11. [***] www.softwareforeducation.com
12. [***] www.programmersheaven.com
13. etc.

Slide-uri cursuri MP1: http://users.utcluj.ro/~elupu/Curs/index.php

Curs 1

1. INTRODUCERE
2. SCURT ISTORIC – Evolutia calculatoarelor si μP
3. ARHITECTURI DE PRELUCRARE
4. LIMBAJ de ASAMBLARE . COD MASINA.
- Tema

1. INTRODUCERE

Sistem numeric **-** O structura de dispozitive asamblate in vederea prelucrarii, stocarii sau transmiterii informatiei numerice

- *Avantajele prelucrarii numerice:*

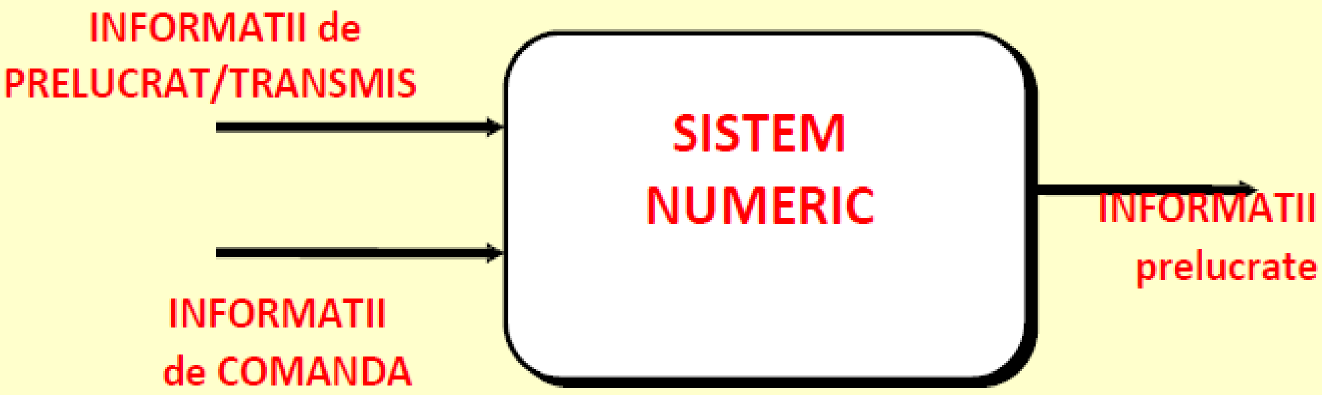
> stabilitate si imunitate la perturbatii, temperatura

> siguranta in functionare, chiar la variatii ale parametrilor in timp

> precizie (nu e nevoie de reglaje/compensari ca la circuitele analogice)

> afisare digitala

- *Problemele practice sunt de diverse complexitati si vitezele proceselor urmarite au o gama larga de desfasurare*
- ***Logica cablata / Logica programata***



Flexibility

	You choose
Full Custom	polygons (Intel)
ASIC	circuit (Sony)
Gate Array	wires
FPGA	logic network
PLD	logic function
GP Processor	program (e.g., Pentium)
SP Processor	program (e.g., DSP)
Multifunction	settings (e.g., Ethernet)
Fixed-function	part number (e.g., 74LS00)

2. SCURT ISTORIC AL CALCULATOARELOR

- abacul (antichitate)

<u>calculatoare mecanice – (??-1940)</u>

- sec. 17 – Pascal –masina de calcul mecanica (+, -)
- sec. 17-18 – Leibnitz – (+,-,*,/)
- sec 19 - Ch. Babbage (Cambridge) – masina diferentiala si masina analitica (memorie, unitate de calcul, cititor de cartele si perforator de cartele)

<u>sec. XX</u>

- Howard Aiken (Harvard 1937) – Mark I, II – calculatoare cu secventa de comanda automata (Babbage+IBM) (relee + comutatoare) >> inceputul noii ere a calculatoarelor

Prima generatie ~ 1943-55

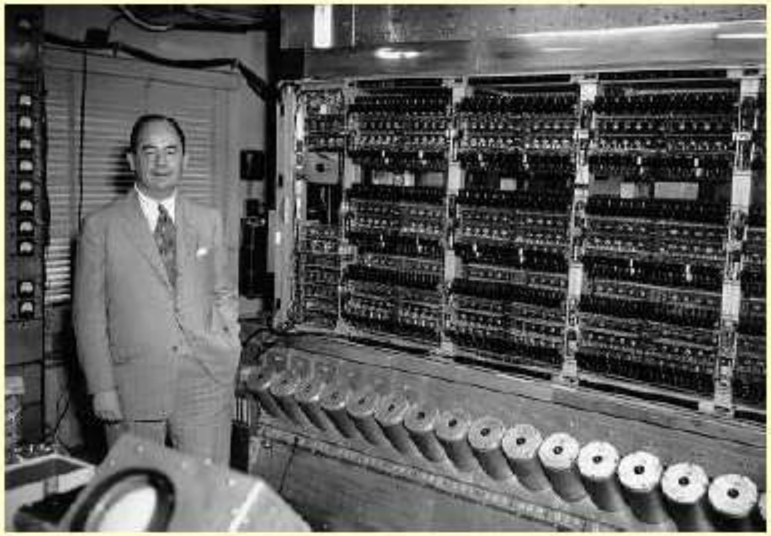
tehnologie: tuburi electronice

1943-46 – P. Eckert & J. Mauchley (Univ. Pensilvania- Aberdeen)
 – ENIAC – primul calculator electronic (versiunea MARK I)
18000 tuburi, 1500 relee, 30 tone
- conceptele si ideile - John von Neumann – calculatorul cu program memorat

- alte variante: EDVAC, ILLIAC, MANIAC, Wirlwind, UNIVAC IBM 701,704,709 – primele calculatoare comerciale

DACICC, CIFA, MECIPT – variante romanesti

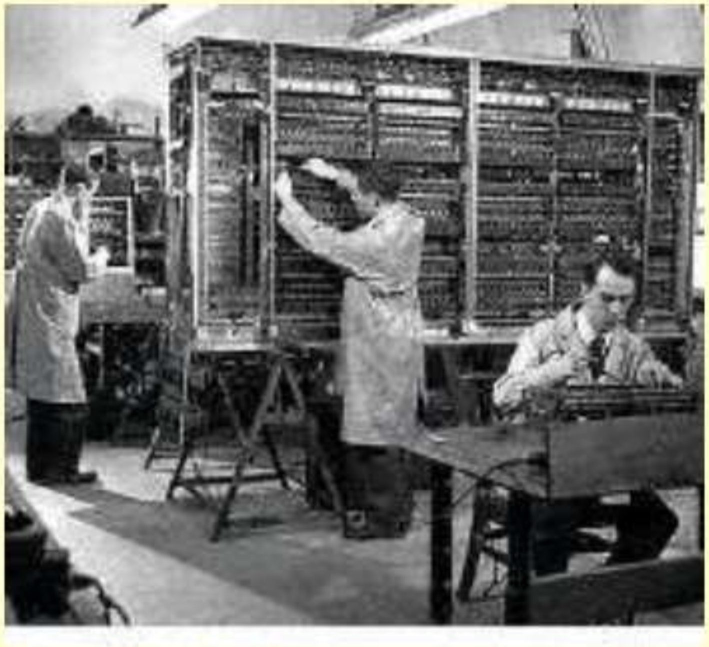
Eckart si Mauchley



John von Neumann

UNIVAC

ENIAC



ADVAC

IBM 701

Generatia a II-a ~ 1955-65

tehnologia: tranzistorul

Shockley, Brattain si Bradley – (Bell labs) - 1 Iulie 1947

- primul calculator tranzistorizat: TX-0
- BM 7090 – varianta tranzistorizata, IBM 1401
- Wirlwind – MIT
- PDP-1, PDP-8, firma DEC
- CDC 6600 – primul calculator paralel
- CETA – calc. romanesc

TX-0

PDP-1

Generatia a III-a ~ 1965-75

tehnologia: circuite integrate
Primul CI digital 12 sept. 1958 ? (Fairchild ?? Texas Instr.)

familii de calculatoare:
- mainframe: IBM 360, IBM 370
- mini: PDP 11

calculatoare romanesti:
- Felix C-256, C-512, C-32
- Independent, Coral – copiaza PDP-11

imbunatatiri:
- Viteza,fiabilitate, dimensiuni,capacitatea memoriei (256k-512k)
- Noi periferice: consola-display (PDP11)

Calculator HP

HP (1972)

Apollo

Generatia a IV-a 1975 -

tehnologia: VLSI >> µP

-aparitia primului microprocesor - Intel 4004 (1971)

- avantaje: viteza, grad ridicat de integrare, fiabilitate mare, cost redus, dimensiuni mici

- CI ROM, RAM, DRAM de capacitate mare (1-16ko)

- aparitia µcalculatoarelor – pe baza de microprocesor

- apar calculatoarele personale:

- **home-computer: ZX81, Spectrum**
- **PC: IBM-PC, XT, AT, Apple, Machintosh**
- **calculatoare romanesti: seria M18, PRAE, aMIC, Felix PC, Telerom-PC**

Apple I 1976

IBM PC 1981

Sinclair ZX80 1980

Atari 400 1979

Apple Mac 1984

Bill Gates

Steve Jobs si Steve Wozniak

Generatia a V-a ??? (1982-

-proiect japonez ambitios - esec

obiective: -viteze f.mari de calcul (mil.inferente/s)
- interfete om-calculator naturale (voce, imagine)
- aplicatii de inteligenta artificiala
- arhitecturi paralele de calcul

ce nu s-a prevazut:
- dezvoltarea sistemelor bazate pe microprocesoare
- dezvoltarea retelelor de calculatoare
-dezvoltarea sistemelor / aplicatiilor distribuite (Internet)

-http://en.wikipedia.org/wiki/Fifth_generation_computer

INFERÉNȚĂ= Operație logică de trecere de la un enunț la altul și în care ultimul enunț este dedus din primul

Width	Processor	Application
4 bit	4004	Pocket calculators
8 bit	8080	Small CP/M based home computers
16 bit	8086, 8088, 80286	IBM-compatible PC's running MS-DOS
32 bit	80386 - Pentium 4	32 bit versions of Windows (Windows 95/98/2000/ XP)
64 bit	Athlon 64 Pentium 4 Itanium	Server software 64 bits versions of Windows, Linux etc.

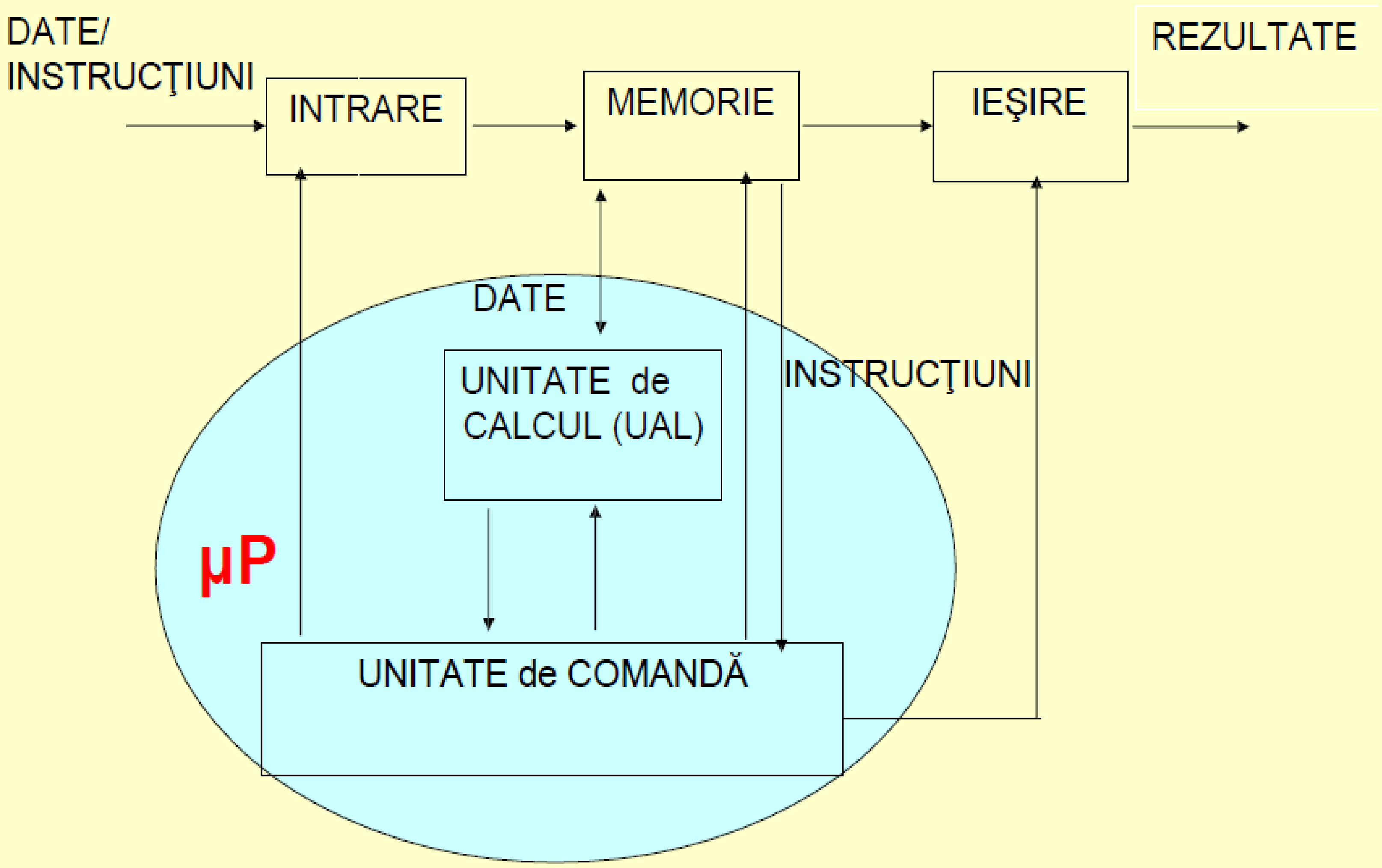
GENERATII DE PC-uri

PC	CPUs	Year	Number of transistors
1st. Generation	8086 and 8088	1978-81	29,000
2nd. Generation	80286	1984	134,000
3rd. Generation	80386DX and 80386SX	1987-88	275,000
4th. Generation	80486SX, 80486DX, 80486DX2 and 80486DX4	1990-92	1,200,000
5th. Generation	Pentium Cyrix 6X86 AMD K5 IDT WinChip C6	1993-95 1996 1996 1997	3,100,000 -- -- 3,500,000
Improved 5th. Generation	Pentium MMX IBM/Cyrix 6x86MX IDT WinChip2 3D	1997 1997 1998	4,500,000 6,000,000 6,000,000
6th. Generation	Pentium Pro AMD K6 Pentium II AMD K6-2	1995 1997 1997 1998	5,500,000 8,800,000 7,500,000 9,300,000
Improved 6th. Generation	Mobile Pentium II Mobile Celeron Pentium III AMD K6-3 Pentium III CuMine	1999	27,400,000 18,900,000 9,300,000 ? 28,000,000
7th. Generation	AMD original Athlon AMD Athlon Thunderbird Pentium 4	1999 2000	22,000,000 37,000,000 42,000,000

Alte familii de microprocesoare:

- **Motorola: 6800 (8 biti), 68000 (16 biti), 68020, 68030 (32 biti), 68040**
- **Zilog: Z80, Z8000**
- **Texas Instruments: -DSP: TMS320c10/20/30/5x/6x; DSC**
- **Microchip: microcontrolere: PICxxx**
- **Atmel AT89Sxxx, AT90SXXX (AVR)**
- **MIPS, ARM etc.**

3. ARHITECTURI DE PRELUCRARE



Schema bloc a calculatorului cu program memorat

Un calculator cu program memorat trebuie să posede :

1. Intrare pentru un număr nelimitat de date şi instrucţiuni

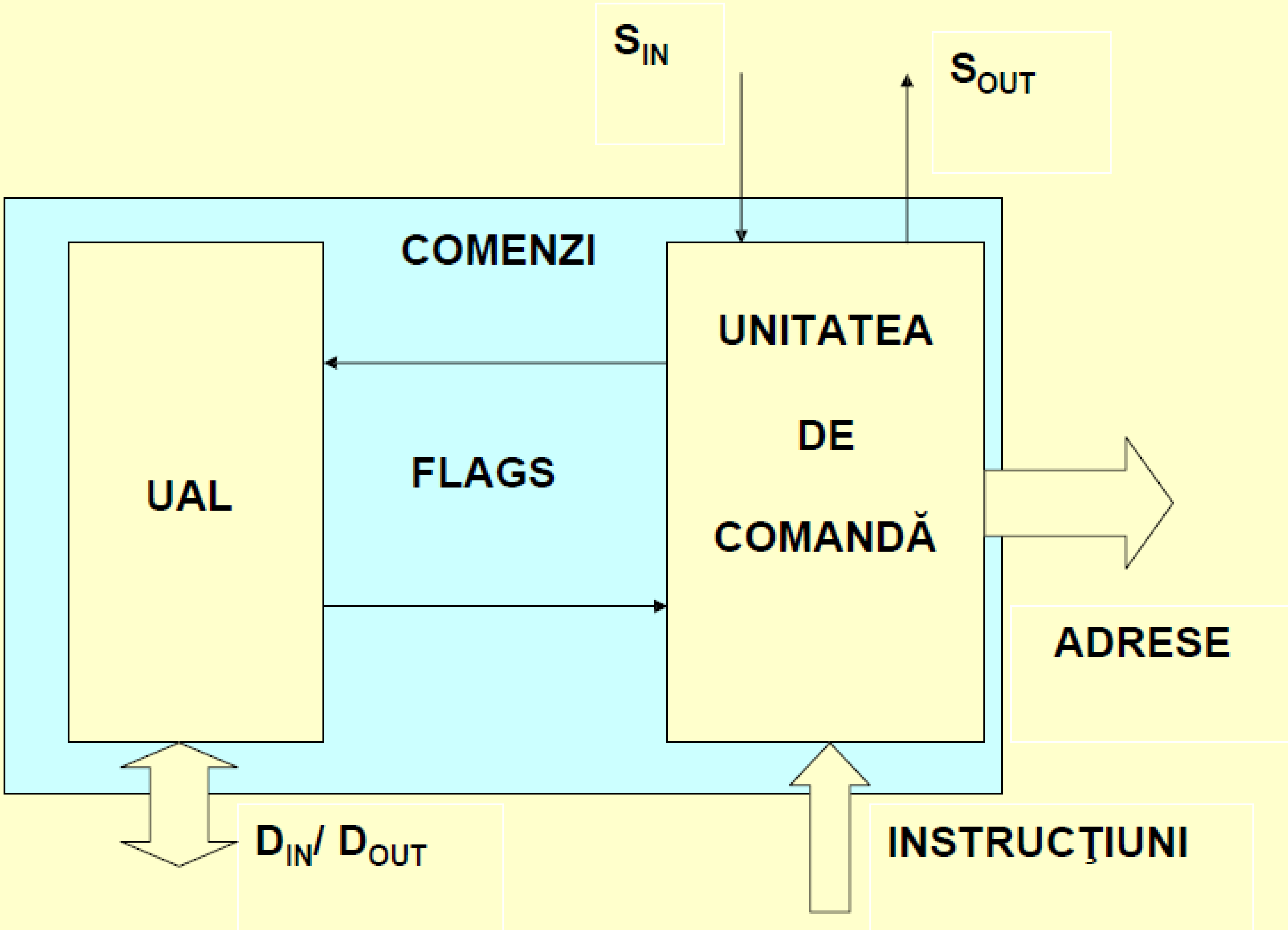
2. Memorie din care se pot citi instrucţiuni şi operanzi şi se depun rezultate

3. Ieşire prin care să pună rezultatele la dispoziţia utilizatorului

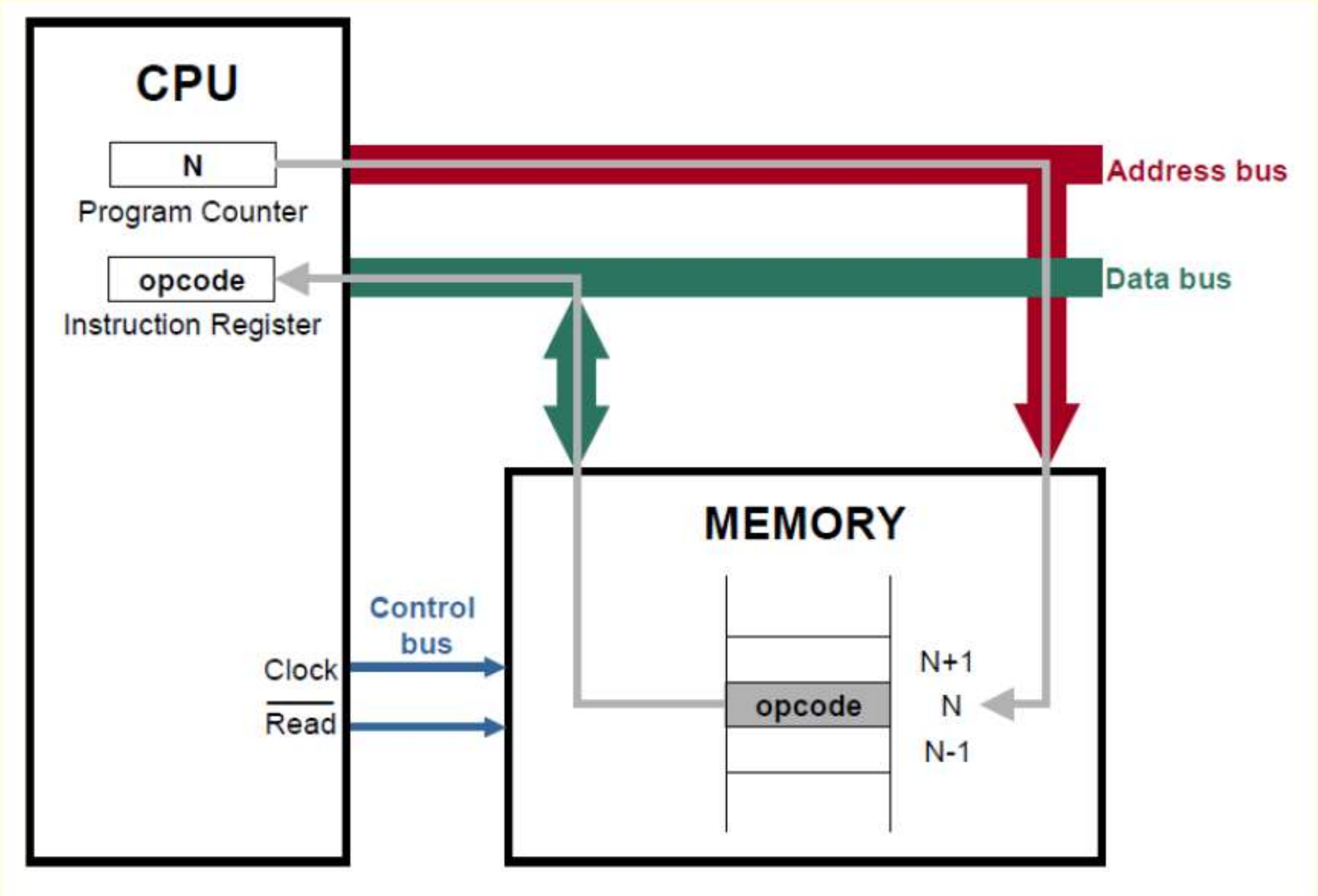
4. Unitate de calcul (UAL –unitate aritmetică şi logică sau de execuţie) care să execute operaţii aritmetice şi logice asupra datelor din memorie

5. Unitate de comandă (control) care să interpreteze instrucţiunile extrase din memorie şi să aleagă diferite acţiuni pe baza rezultatelor calculelor

MICROPROCESOR = Unitate de calcul + Unitate de comandă (4+5)
MICROCALCULATOR (single-chip) = 1 +…+ 5 (microcontroler)

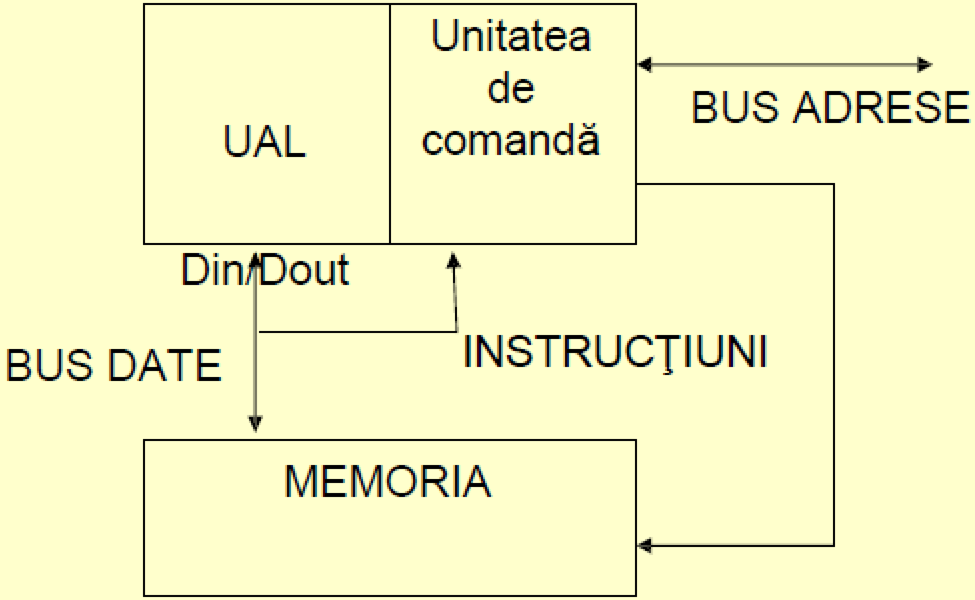


SCHEMA BLOC A MICROPROCESORULUI



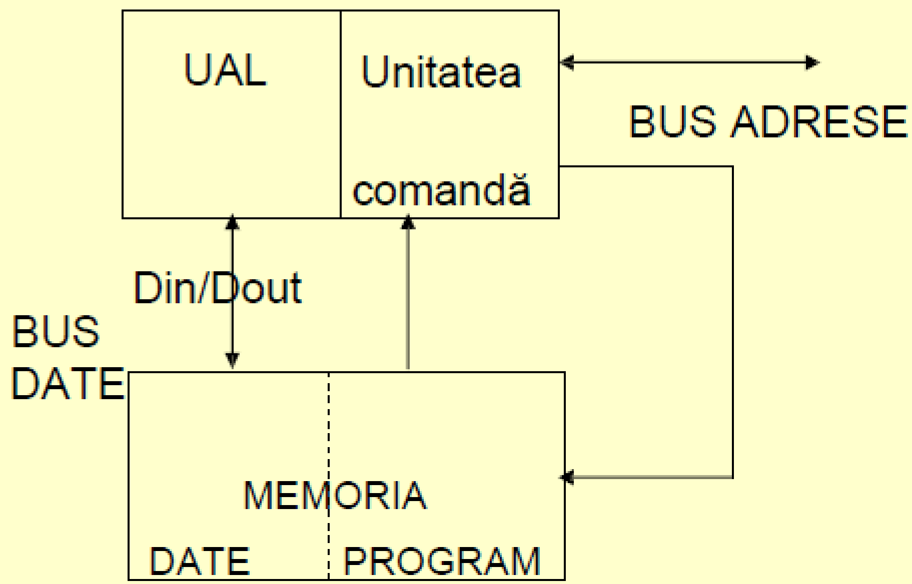
CPU
N
Program Counter
opcode
Instruction Register
Address bus
Data bus
MEMORY
Control
bus
Clock
$\overline{\text{Read}}$
N+1
opcode
N
N-1

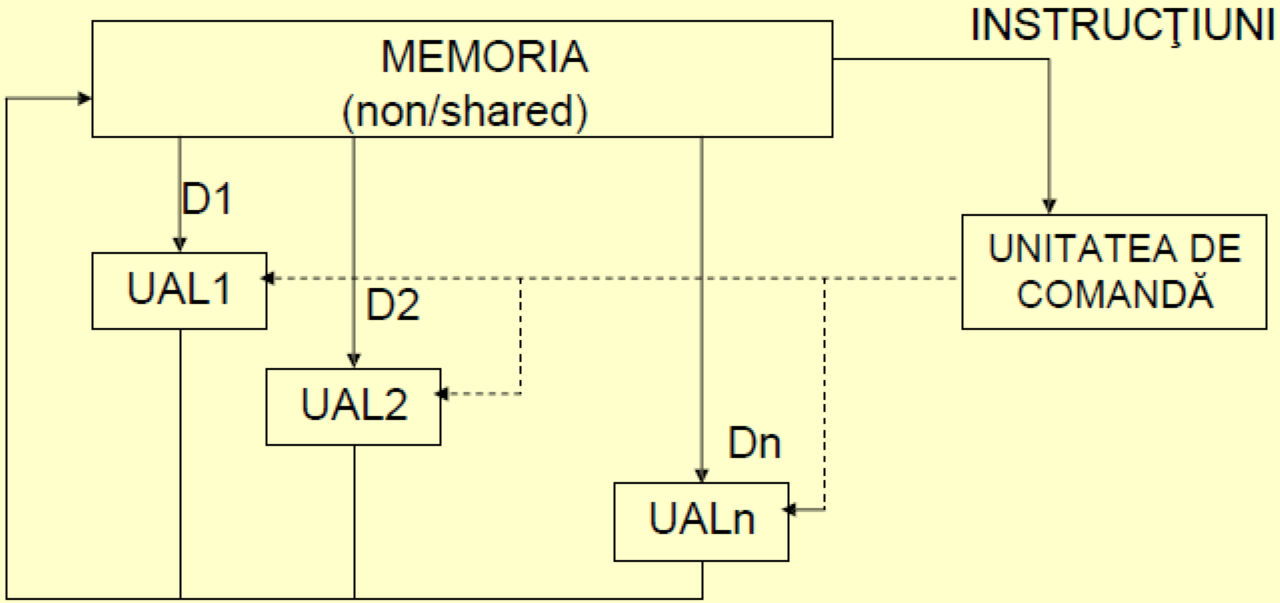
Clasificarea arhitecturilor de prelucrare - dupa Flynn



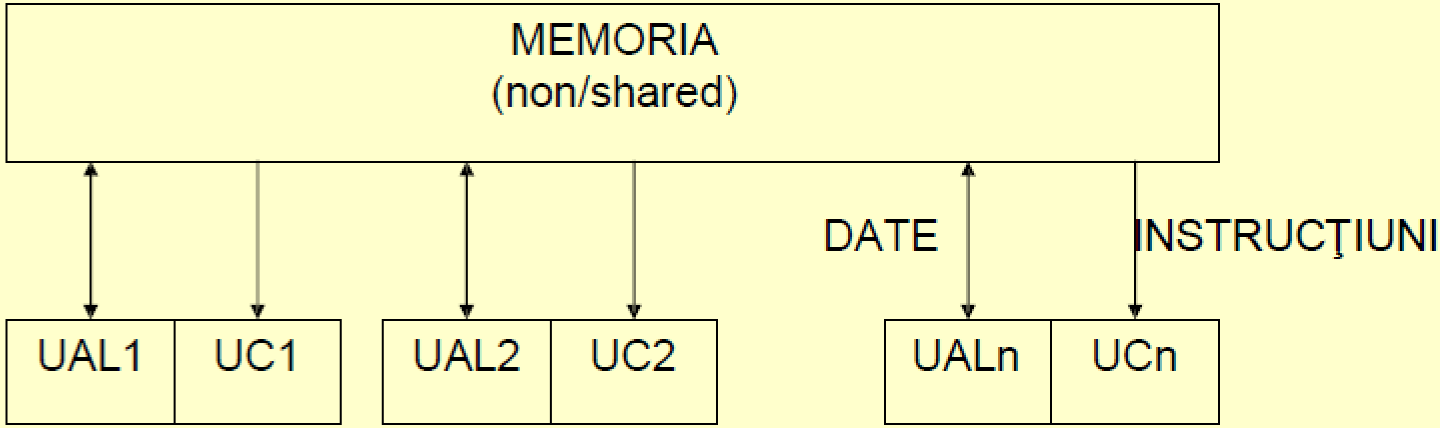
Arhitectura SISD (von Neumann)

Arhitectura HARVARD





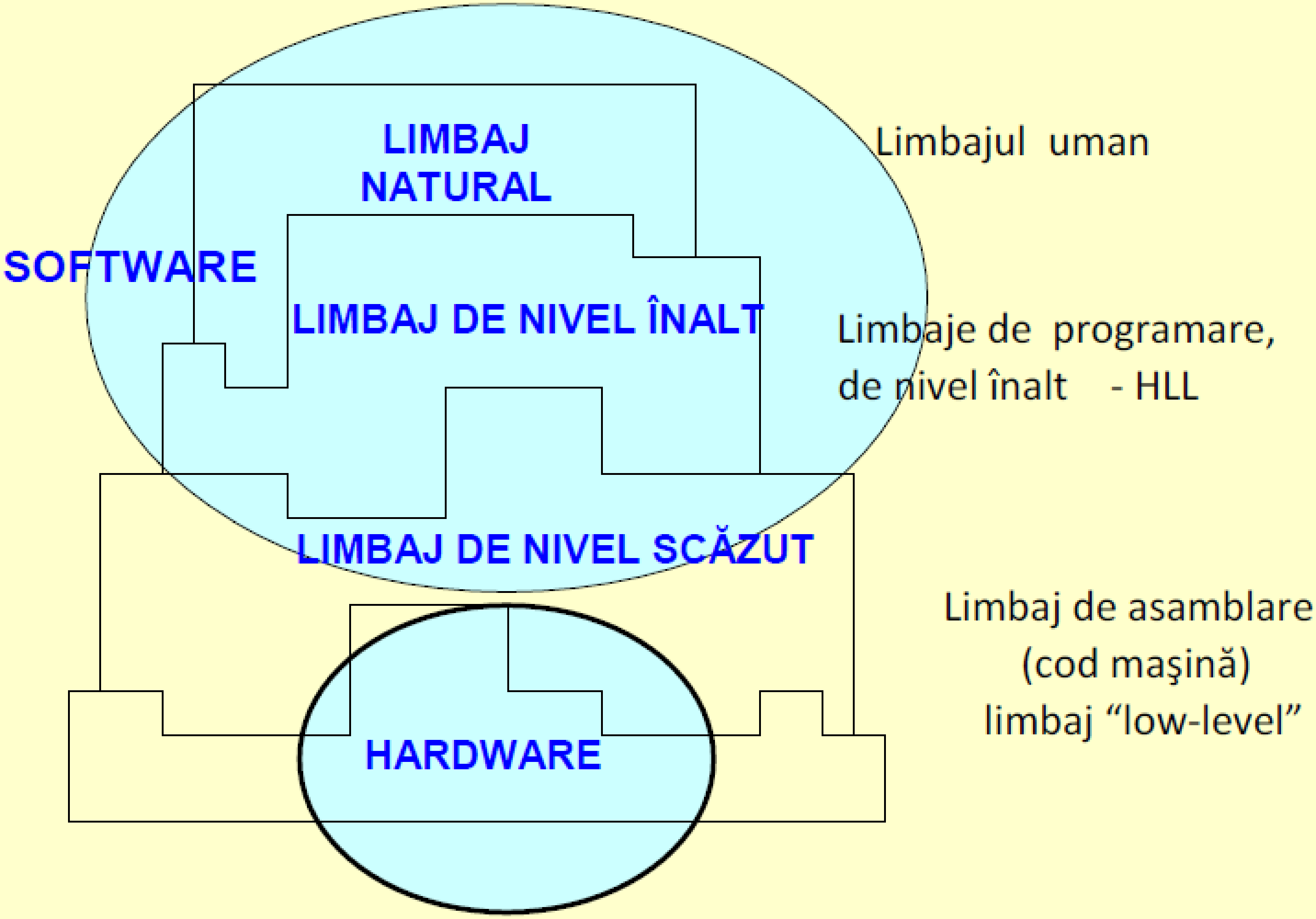
Arhitectura
SIMD



Arhitectura MIMD

Arhitectura MIS

4. LIMBAJUL DE ASAMBLARE



Ierarhizarea limbajelor

Afiseaza suma dintre A * B si C.

C++: cout << (A * B + C);

Intel - Limbaj Asamblare

```
MOV     eax,A
MUL     B
ADD     eax,C
CALL    WriteInt
```

Intel - Limbaj Masina

```
A1 00000000
F7 25 00000004
03 05 00000008
E8 00500000
```

The Top Programming Languages 2015

Courtesy of IEEE Spectrum

Language Types (click to hide)

Web | Mobile | Enterprise | Embedded

Language Rank	Types	Spectrum Ranking
1. Java	Web, Mobile, Enterprise	100.0
2. C	Mobile, Enterprise, Embedded	99.9
3. C++	Mobile, Enterprise, Embedded	99.4
4. Python	Web, Enterprise	95.9
5. C#	Web, Mobile, Enterprise	91.6
6. R	Enterprise	84.8
7. PHP	Web	84.6
8. JavaScript	Web, Mobile	83.2
9. Ruby	Web, Enterprise	75.5
10. Matlab	Enterprise	72.9
11. SQL	Enterprise	71.7
12. Shell	Enterprise	71.0
13. Assembly	Embedded	68.2
14. Go	Web, Enterprise	67.6
15. Perl	Web, Enterprise	66.6
16. Swift	Mobile, Enterprise	65.7

Language Types (click to hide)

Web | Mobile | Enterprise | Embedded

Language Rank	Types	Spectrum Ranking
1. C	Mobile, Enterprise, Embedded	99.9
2. C++	Mobile, Enterprise, Embedded	99.4
3. Assembly	Embedded	68.2
4. Arduino	Embedded	63.6
5. D	Web, Embedded	45.1
6. Haskell	Enterprise, Embedded	41.1
7. VHDL	Embedded	36.3
8. Ada	Enterprise, Embedded	33.4
9. LabView	Enterprise, Embedded	31.8
10. Erlang	Enterprise, Embedded	30.5
11. Verilog	Embedded	26.1
12. Ladder Logic	Embedded	22.9
13. TCL	Enterprise, Embedded	13.1
14. Forth	Embedded	5.1

LIMBAJUL DE ASAMBLARE

DEZAVANTAJE	AVANTAJE
• Assembly is hard to learn •Assembly is hard to read and understand • Assembly is hard to debug • Assembly is hard to maintain • Assembly is hard to write •Assembly language programming is time consuming •Improved compiler technology has eliminated the need for assembly language •Today, machines are so fast that we no longer need to use assembly •If you need more speed, you should use a better algorithm rather than switch to assembly language. •Machines have so much memory today, saving space using assembly is not important. •Assembly language is not portable.	•Speed. Assembly language programs are generally the fastest programs around. • Space. Assembly language programs are often the smallest. •Capability. You can do things in assembly which are difficult or impossible in HLLs. •Knowledge. Your knowledge of assembly language will help you write better programs, even when using HLLs.

Site-uri utile:

Intel Home: www.intel.com
Intel Processor page: http://developer.intel.com/design/processor/
Intel Developer Home: http://developer.intel.com/
Intel Pentium II: http://developer.intel.com/design/PentiumII/
Intel Pentium III: http://developer.intel.com/design/PentiumIII/
Intel Pentium 4: http://developer.intel.com/design/pentium4/
Intel Desktop Boards
(Motherboards):http://developer.intel.com/design/motherbd/
PC Design Guide (Microsoft and Intel): http://www.pcdesguide.org/
AMD Home: www.amd.com
AMD Athlon: http://www.amd.com/products/cpg/athlon/index.html
PC Guide: http://www.pcguide.com/index.htm

5. TEME:

http://en.wikipedia.org/wiki/History_of_computing_hardware
http://www.karbosguide.com/
http://en.wikipedia.org/wiki/List_of_Intel_microprocessors

CPU technologies

Architecture		ISA : CISC · EDGE · EPIC · MISC · OISC · RISC · VLIW · ZISC · Harvard architecture · von Neumann architecture · 4-bit · 8-bit · 12-bit · 16-bit · 18-bit · 24-bit · 31-bit · 32-bit · 36-bit · 48-bit · 64-bit · 128-bit
Parallelism	**Pipeline**	Instruction pipelining · In-order & out-of-order execution · Register renaming · Speculative execution · Hazards
	Level	Bit · Instruction · Superscalar · Data · Task
	Threads	Multithreading · Simultaneous multithreading · Hyperthreading · Superthreading
	Flynn's taxonomy	SISD · SIMD · MISD · MIMD
Types		Digital signal processor · Microcontroller · System-on-a-chip · Vector processor
Components		Arithmetic logic unit (ALU) · Barrel shifter · Floating-point unit (FPU) · Back-side bus · Multiplexer · Demultiplexer · Registers · Memory management unit (MMU) · Translation lookaside buffer (TLB) · Cache · register file · microcode · control unit · clock rate
Power management		APM · ACPI (states) · Dynamic frequency scaling · Dynamic voltage scaling · Clock gating