Introduction to Computer & Software Engineering

Applications

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Dersler

1) Yazılım: Python, C++, JavaScript, Matlab, Assemble, C-Sharp.
Programlama dilleri
↳ ploting (2D, 3D), Analyzes.

2) Data Base Management.
Veri yapıları, boyutu (byte)
Dizi, Vektör; Matris -
ekleme, çıkarma
Arama - Search.

3) Veri Madenciliği. (Sayısal, Sayısal Olmayan Sembolik Karakterler.)
Sınıflandırma, Regresyon, Kümeleme.
↓
Katsayı.

4) Data Preparing.
Eksik, hatalı, Manipüle, Gürültü, Anomali datası
loss error manipulate Noise

5) İstatistik - Olasılık
Bayesian, Markov | Ağırlık ortalama, Varyans/Standart Sapma.

6) Veri Analitiği
Görselleştirme.

7) Bilgisayar Organizasyon ve Mimarisi

8) Sinyaller - sistemler

9) Quantum bilgisayar

10) Web teknolojileri.

11) Algoritma - Mathematical Models.

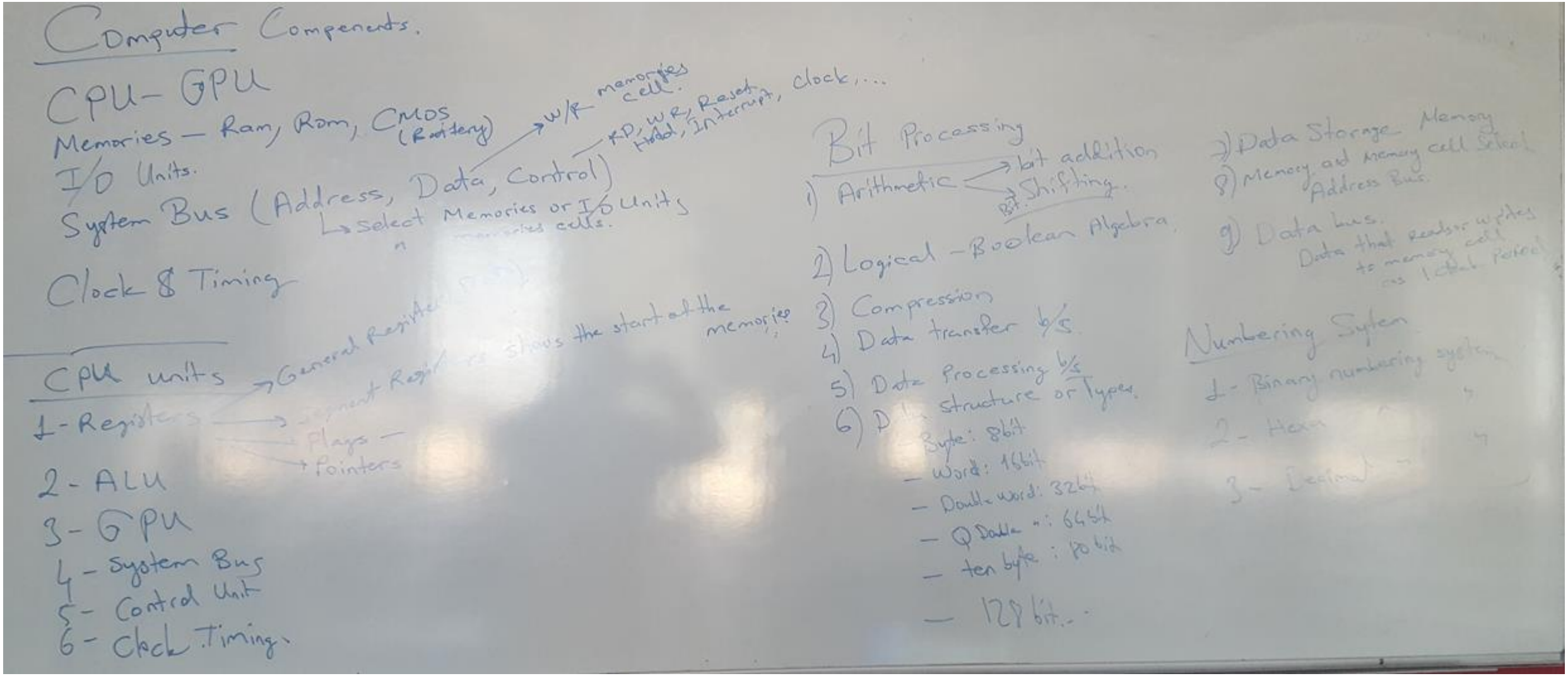
Olasılık.

$A \cdot x = b$

$x = A^{-1} \cdot b$

$A x = b$
giriş, çıkış

Bit Processing



Inside Computer (CPU, memory, ...) numbering system
Only binary (bits 0/1)

Outside_World: Signal is Analog.

$X(t) = A \sin(\omega t + \phi)$

$\omega \rightarrow 2\pi f$

ϕ: phase (radyan)

x radyan : x = 180 degree : 30

$x = \frac{\pi}{6}$ rad.

f: frequency ($\frac{1}{sec} = Hz$)

$T = \text{Peryod} = \frac{1}{f}$ [sec]

A: Volt/Amper.

Voice is acoustic Signal

microphone transform Pressure Signal to Elektrical Signal (Analog Signal)
Voice.

Convert analog Signal to digital Signal: ADC
How can we use the analog Signal inside Computer?

Addition with carry

$0 + 0 = 0$, $0 + 1 = 1$, $1 + 0 = 1$, $1 + 1 = (1)0$, $1 + 1 + 1 = (1)1$

Carry	a	b	Carry+a+b
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	(1)0
1	0	0	1
1	0	1	(1)0
1	1	0	(1)0
1	1	1	(1)1

Example:

$(1010\ 1011)_b$
$+\ (1100\ 1010)_b$
$(1\ 0111\ 0101)_b = (?)_h$

indexing

$2^8 + 2^6 + 2^5 + 2^4 + 2^2 + 2^0$ $(175)_h$

256
64
32
16
4
1
$+\ (373)_d$

decimal	hex	
0	0	0000
1	1	0001
		0010
		0011
		0100
		0101
		0110
		0111
		1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

Right to left 1bit multiply 2
2 " " 4
3 " " 8
4 " " 16

Example:

$(2BE)_h = (?)_b$

$(0010\ 1011\ 1110)_b$

$= 2^9 + 2^7 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 = (\ .\ )_d$

Example:

$(1001\ 0010)_b = (146)_d$

$2^7 + 2^4 + 2^1 = 128$
16
2
$+\ 146$

Left side to Right side 1 bit divide 2
2 " " 4
3 " " 8
4 " " 16

2 bit shift added ...

1001 0010

$(0010\ 0100)_b$

$2^5 + 2^2 = 36$

divided integer

146 | 4
12 | 36
26
24
2

Examples

- What are the basic components of a Computer system? CPU, Memory, I/O, Clock, System Bus
- What are the Basic Operations on the Computer? Data Input, Data Storage, Data Processing, Data Output
- The computer processes data on which units in the Microprocessor according to the commands written. Registration
- What kind of memories are read-only units? ROM (Read Only Memory)
- Can the message be delivered? After which discovery did the question begin to be asked? electric
- Latin translations of his works on Indian numerals introduced the decimal number system to the Western world in the 12th century. Al-Kharazmi
- What are fifth generation computers called? Quantum Computer
- How many states are there in the binary number system? 2
- It is the smallest possible unit of information in a computer. bit
- Which unit is used when calculating memory size or defining data type? Byte

Computer Components

1) CPU (Central Processing Unit)

2) System Bus (Address, Data, Control)

* Communication between CPU and Memories, I/O units
* Address Bus selects memory and cell of memory. or I/O units.

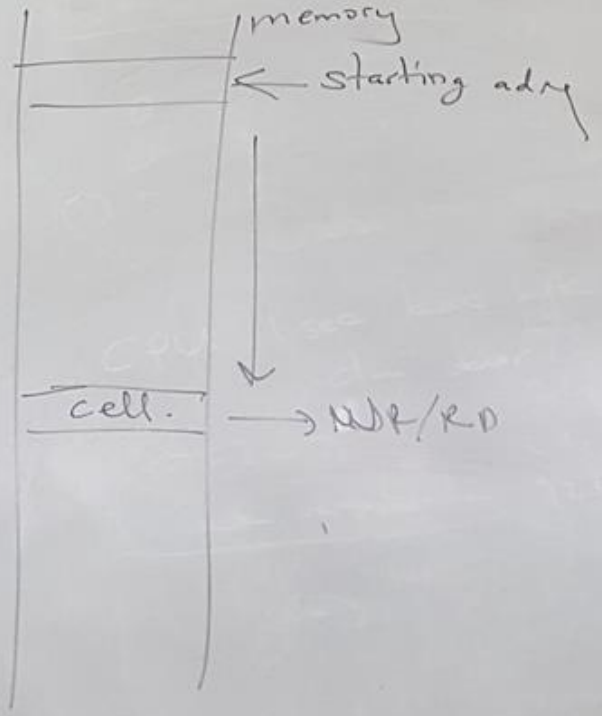
Steps

1- CPU selects Memory or I/O unit. (Address Bus)

2- Activates Data lines

3- Activates WR/RD

* Data lines are activated by CPU.
* WR/RD or Control bus by CPU is activated



Bit: 1/0

Byte: 8 bit

Word: 16 bit

Doubleword: 32 bit
64 bit
128 bit

Veri → bellek kapasitesi

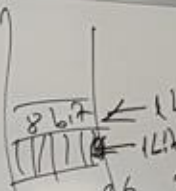
Byte:

Bellek gözünün boyutunu temsil eder.

Soru: 40 Mbyte → kaç byte, kaç bit.

→ 64 Mbyte $= 2^6$ Mbyte
$= 2^6 \times 2^{20}$ byte $= 2^{26}$ byte.

Adres bus hat sayısı



$2^{26} \times 2^3 = 2^{29}$ bit

byte, word, DW, QW
8 bit 16 bit 32 bit 64 bit

Bellek / Saklama

GSM phone

Laptop.

Sunucu

⋮

Cep telefon: 20 Gbyte ⇒ $2^5 \cdot 2^{30} = 2^{35}$ byte.
1 milyar kişi
$1.000.000.000 \times 2^{35}$ byte

Clock

(Veri işler → yükselen kenar)

Her bit 1 Clock periyodunda işlenir.

8 bit " " "
16 " " " "
32 " " " "
64 " " " "

Yazılır/okunur.

$\frac{2}{10^9}$ sec. × 16 bit

1 sec × ×

$x = \frac{16}{\frac{1}{2\sqrt{0}}} = \frac{2 \times 16 \times 10^9}{1} = 32 \times 10^9$ bit/sec

$= 32 \times 10^6$ kbit/sec

$= 32 \times 10^3$ Mbit/sec

$= 32$ Gbit/sec

1 Clock sinyalinin frekansı 2 GHz ise.

Belleğin Data bus hat sayısı 16 bit ise.

Bu belleğe 1 sec'de kaç bit yazılır yada okunur?

frekans, $f = 2$ GHz $= 2 \cdot 10^9$ Hz $(1/\text{sec})$

Periyod, $T = \frac{1}{f} = \frac{1}{2 \times 10^9}$ sec

Bilgisayar Bileşen

1) CPU

2) Bus (Adres, Data, Control)

CPU ile Belleklerin ve I/O birimlerinin haberleşmesini ve Senkronizasyonu (Uyum)

Hangi belleğin hangi gözü (W/R)
I/O " register.

Seçme: Adres Bus. ⟶ Tek yönlü

Yazma/okuma: Data Bus ⟷ iki yönlü (W/R)

Senkronizasyon: Control " ⟷ Tek yönlü
R/W, Reset, hold, ...

Hatlar üzerinde veri, bit: 0/1

3) Bellek

4) I/O

5) Clock & Timing. (Veri okuma yazma)

Adres Bus hat sayısı $= ^{n}$ Bellek Erişim Kapasitesi (byte)

$= 2^n$ byte.

Örnek: 10 adet bellek var.

(5) 4 ⟵ 3 adet 10 kbyte → 16 kbyte $= 2^4 \cdot 2^{10} = 2^{14}$ byte

8 ⟵ 5 adet 222 M byte → 256 Mbyte $= 2^8 \cdot 2^{20} = 2^{28}$ byte

2 ⟵ 2 adet 110 M byte → 128 mbyte $= 2^7 \cdot 2^{20} = 2^{27}$ byte.

Toplam Kapasite nedir?
Hat sayısı nedir?

(14)
$2^{14} \times 2^{2} = 2^{16}$ byte
$2^{28} \times 2^{3} = 2^{31}$ byte
$2^{1} \times 2^{27} = 2^{28}$ "

max $= 2^{31}$

(10) $n = 31$ adet.
Adres Bus hat sayısı

(15) $2^{31} = 2^{1} \times 2^{30} = 2$ Gbyte

Script
Python
sayıgetir() { ⟶ int / undefined
{null}
None

( ) ' | default → 30/undefined

sinx + sinxcosx = 0
cosx

→ 2048.000 byte

Data Bus

The number of data bus lines are (64 bit) w/r during 1 clock peryod.

-Number of data bus lines are 64

frequency is 2 GHz.

What is the data rate, for w/r, in 1 sec. (b/s)

$f = 2\,GHz$

$T = \frac{1}{f} = \frac{1}{2 \cdot 10^9} = \frac{1}{2} 10^{-9}$ sec

during this period $\frac{1}{2} 10^{-9}$ sec — 64 bit w/r

1 — x

$x = \frac{64}{\frac{1}{2} 10^{-9}} = 2 \times 64\, 10^9 = 128\, 10^9$ b/sec.

$= 128$ Gigabit/sec.

How many bytes w/r during 1 sec.

$\frac{128 \cdot 10^9}{8} = 16 \times 10^9$ byte/sec.

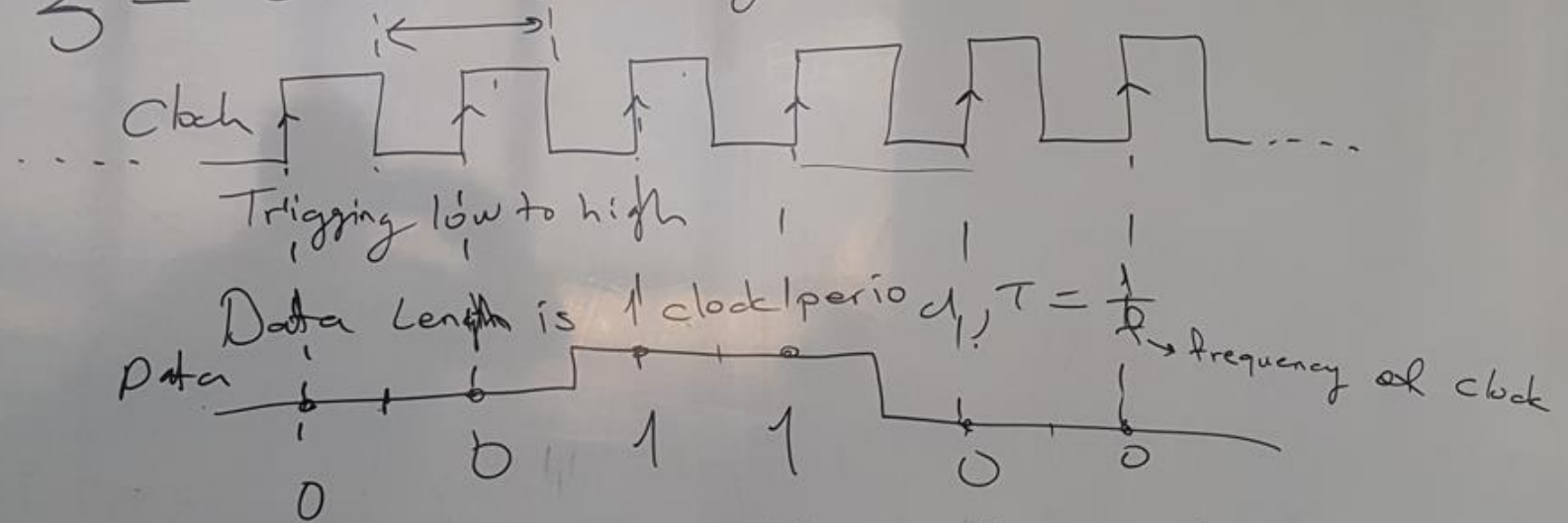
Data bus:

1- Parallel lines, every line has bit (0/1)

2- Carry — data (write to memory cell, two drictional. (R/W)

every memory cell has 8 bit = 1 byte.

3 — Clock & Timing Senkronize the data as bit (0/1)



4- Parallel lines carry th data, write or read to Memory cell. at 1 clock peryod

for example, if number of lines are 64, what is mean; that?

as 1 clock peryod. Write or read 64 bits

64 bits = 8 byte.

Number of Address Bus, N

↓

- Parallel lines
- Everyline has bit: 0/1
- 2^N cases.

↳ Every case select

- Memory - memory cell or I/O units.

a 0/1
b 0/1
c 0/1

a	b	c
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

$2^3 = 8$

- Total memory capacity is 2^N (Numbe of memory cell)

↓

1 cell has 8 bit → byte.

Example, N = 44 how much total capacity of Memory.

Memory Capacity / Number of memory cell $= 2^{44} = 2^4 \cdot 2^{40} = 16$ TByte.

↓ Tera

16

Example, Memory Capacity is 37 Mbyte, What is the Number of adress Bus Lines.

Number Adress Bus Lines = 26

37 Mbyte → 64 Mbyte $= 2^6 \cdot 2^{20} = 2^{26}$

Soru:

Bir CPU

15 adet belleğe yazıp okuyor

5 adet bellek 97 kbyte

3 " " 122 kbyte.

5 adet " 72 kbyte

2 " " 87 kbyte.

a) Her bir belleğin adres hat sayısı nedir?

b) Toplam bellek kapasitesi kaç byte?

" " " bit?

c) " "

97 kbyte → 128 kbyte = 2^7 kbyte.

122 kbyte → 128 kbyte = 2^7 "

72 " → 128 kbyte = 2^7 "

87 " → 128 " = 2^7 "

Herbir belleğin kapasitesi aynıdır. 2^7 kbyte.

Hat sayısı:

2^7 kbyte $= 2^7 \times 2^{10}$ byte $= 2^{17}$ byte.

17 adet → Adres bus hat sayısı.

indis: $A_{16}, A_{15}, \dots A_0$ → Bellek gözü say

17.

= Bellek sayısı × Maksimum adres hat sayısı. (Belleklerden)

b) Toplam bellek kapasitesi.

$= 15 \times 2^{17}$ byte

$= 16 \times 2^{17}$ byte $= 2^4 \times 2^{17} = 2^{21}$ byte

b1) CPU dan çıkan adres hattı sayısı nedir?

21 adet, $A_{20}, A_{19}, \dots, A_0$

b2) Adres Decoding devresine gelen adres hat sayısı n

$2^4 = 16$ adet bellek seçer. $(15+1)$

Bellek Seçer ← $A_{20}, A_{19}, A_{18}, A_{17}$

Toplam bellek sayısı $= 2^n$

$= 2^4$

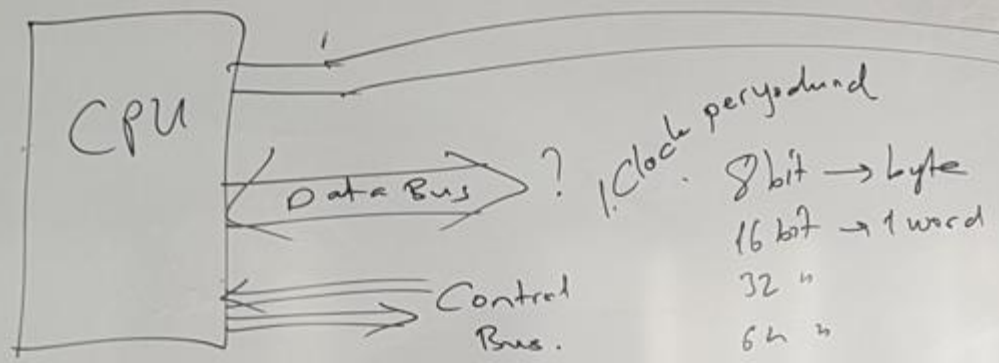
$= 16$

yedek

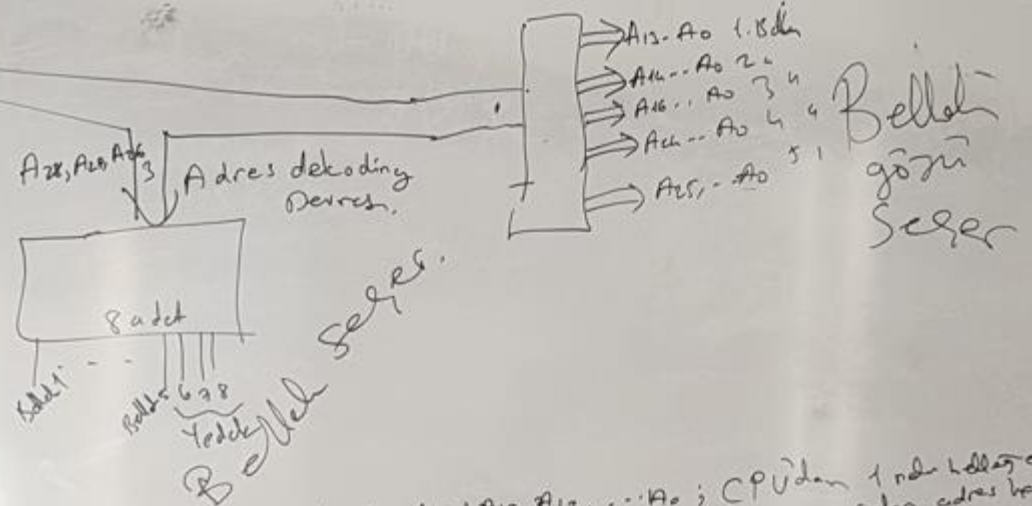
c) Toplam bellek kapasitesi

bit? $2^{21} \times 2^3 = 2^{24}$ bit

byte



? 1 Clock periyodunda 8 bit → 1 byte
16 bit → 1 word
32 " "
64 " "
128 " "



Soru: 5 adet bellek ve CPU var.

1. Bellek 10 kbyte → 16 kbyte $= 2^4 \times 2^{10} = 2^{14}$ byte ; Adres hat sayısı : 14 adet, indis : $A_{13}, A_{12}, \dots A_0$; CPU'dan 1 nolu belleğe gelen adres hat sayısı : 2
2. " 25 kbyte → 32 kbyte $= 2^5 \times 2^{10} = 2^{15}$ byte ; " " " : 15 " , indis : $A_{14}, A_{13} \dots A_0$; " 3 "
3. " 65 " → 128 kbyte $= 2^7 \times 2^{10} = 2^{17}$ " " " " : 17 " , indis : $A_{16}, A_{15} \dots A_0$; " 4 "
4. " 25 Mbyte → 32 Mbyte $= 2^5 \times 2^{20} = 2^{25}$ " ; " " " : 25 , indis : $A_{24}, A_{23} \dots A_0$; " 5 "
5. " 35 " → 64 Mbyte $= 2^6 \times 2^{20} = 2^{26}$ " ; " " " : 26 , indis : $A_{25}, A_{24} \dots A_0$;

↳ CPU dan çıkacak bellekler için maksimum adres indisi A_{25}, hat sayısı : 26

Bellek seçmek için Adres dekoding devresine gelen adres hat sayısı = m ; 2^m = Toplam bellek sayısı

$2^m = 5$; $m = 3$

CPU'dan çıkacak toplam adres hat sayısı = m + maksimum hat sayısı = 3 + 26 = 29

" " " " indisi = $A_{28}, A_{27}, A_{26}, A_{25} \dots A_0$

CPU toplam bellek kapasitesi = 2^{29} byte = 512 Mbyte.

For example

Segment Register

Number of SR tell us how many grup memory (Ram, Rom, CMOS

Ram1 R1

Ram2 R2

Ram3

Number of SR is 6 (Ram1, Ram2, Ram3, Rom1, Rom2, CMOS1)

Whats types of data are used?

" " of memory "?

Rom is programming memory

Ram is data memory.

SR shows starting of the memory address of

SR1 shows as starting cell of the Ram1 memory

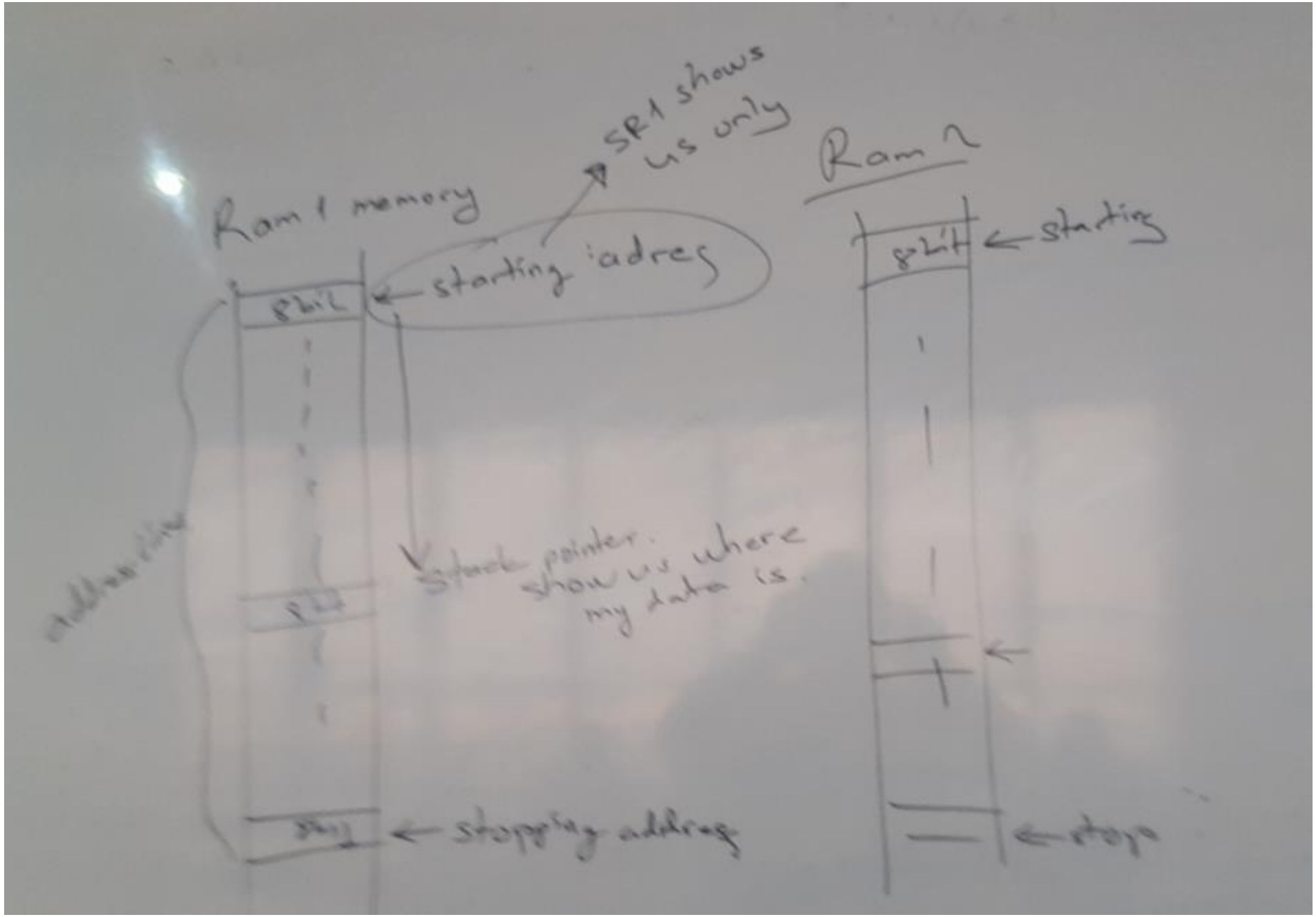
SR2 " " " " " " Ram2 "

SR3 " " " " " " Ram3 "

SR4 " " " " " " Rom1 "

SR5 " " " " " " Rom2 "

SR6 " " " " " " CMOS1 "


Ram 1 memory
SP1 shows us only
starting adress
8bit
address line
stack pointer. show us where my data is.
stopping address
Ram 2
8bit
starting
stop

4 adet
8 adet
2 adet.

Tek bellek
Tek bellek gözü.

$2^{31} \Rightarrow n = 31$

Soru bellekleri nasıl seçerim.

① = 4×2^{14} → Adres hattı sayısı = 14 ⇒ $A_{13} \ldots A_0$

② = 8×2^{28} → " " " = 28 ⇒ $A_{27} \ldots A_0$

③ = 2×2^{27} → " " " = 27 ⇒ $A_{26} \ldots A_0$

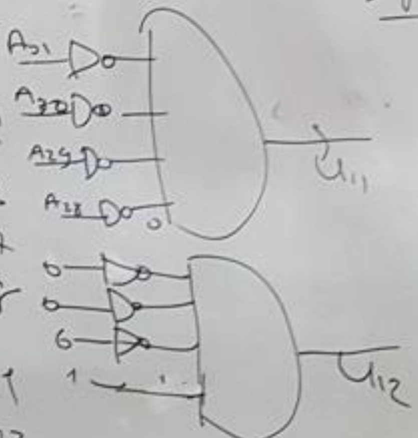
Toplam bellek = 14 ⇒ $16 = 2^4$

Bellek seçmede Adres hattı 4 adet.

Kimler: $A_{31}, A_{30}, A_{29}, A_{28}$

A_{31}	A_{30}	A_{29}	A_{28}	
0	0	0	0	U_{11}
0	0	0	1	U_{12}
0	0	1	0	U_{13}
0	0	1	1	U_{14}
0	1	0	0	U_{21}
0	1	0	1	U_{22}
0	1	1	0	U_{23}
0	1	1	1	U_{24}
1	0	0	0	U_{25}
1	0	0	1	U_{26}
1	0	1	0	U_{27}
1	0	1	1	U_{28}
1	1	0	0	U_{31}
1	1	0	1	U_{32}

i Ycdl.



Script
Python
sayıgetir() { → int / undefined
{null}
None
[3,0]
→ default → 30/undf

Yrosx = 0
?

+P.0001b/n

Adres Bus lines, from CPU to Memories or I/O

On Every line, There is binary, bit: 0/1

There is n line.

every case, show memory cell.

on address Bus lines.

Memory capasity is 2^n byte.

Example: Memory Capasite is 256 Kbyte.
What is the number of addres Bus lines.

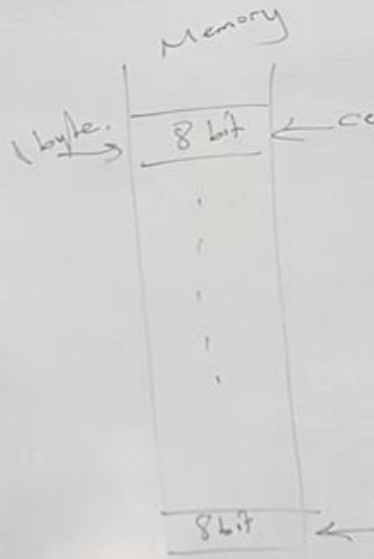
1) 256 Kbyte = (?) byte.

$= 256 \cdot 2^{10}$ byte

$= 2^8 \, 2^{10} = 2^{18}$ byte.

is

the number of address bus line of the memory



2) 2 Gbyte Ram
what is the
number of lines
address bus

2 Gbyte = (?) byte.

2 Gbyte = 2×2^{30} byte

$= 2^{31}$ byte.

the number of the lines is 31
address bus

There are 10 memories.

3 memories has 312 Kbyte
5 memories has 202 kbyte
2 memories has 121 kbyte.

a) What is the Total memory Capacity?
b) what is the number of address bus lines.

312 kbyte → 512 kbyte = $2^9 \times 2^{10} = 2^{19}$ byte. / $A_{18}, A_{17}, \ldots A_0$
202 kbyte → 256 kbyte = $2^8 \times 2^{10} = 2^{18}$ byte. / $A_{17}, A_{16}, \ldots A_0$
121 kbyte → 128 kbyte = $2^7 \times 2^{10} = 2^{17}$ " / $A_{16}, A_{15}, \ldots A_0$

These are memories address bus Lines come from CPU Select the cell of me

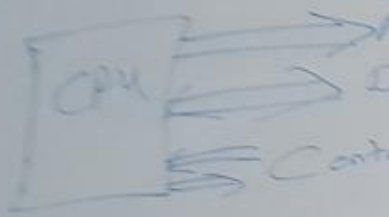
$U_{11}, U_{12}, U_{13}, U_{14}$ 3 → $4 = 2^2$
$U_{21}, U_{22}, U_{23}, U_{24}, U_{25}, U_{26}, U_{27}, U_{28}$ 5 → $8 = 2^3$
U_{31}, U_{32} 2 → $2^1 = 2^1$

How many memory can I take? 4+8+2=14, Addres Dekoding Lines.

$U_{11}, U_{12}, U_{13}, U_{14} = 4 \times 2^{19} = 2^2 \times 2^{19} = 2^{21}$ byte, $A_{20}, A_{19}, \ldots$
$U_{21}, \ldots U_{28} = 8 \times 2^{18} = 2^3 \times 2^{18} = 2^{21}$ ", A_{20}, A_{19}, A_{18}
$U_{31}, U_{32} = 2 \times 2^{17} = 2^1 \times 2^{17} = 2^{18}$ ", $A_{20}, A_{19}, A_{18}, A_{17}$

Select the memory.

Memories and memories cell Selecting.



Address Bus → one direction, Group ⇒ are used
Data Bus → two " , Group ⇒ memories, cell.
, individual. , Group ⇒ 1 clock period data

Example

The number of memory are 121
Maximum capasity of a memory is 192 Mbyte.
What is the number of addres Bus lines for memory cells?

The number of " " " " " is m.

Maximum capacity of memory as byte $= 192\,\text{Mbyte}$
$= 256\,\text{Mbyte}$
$= 2^8 \times 2^{20} = 2^{28}$ byte.

$m = 28$

· Addres line indexing: $A_{27}\ A_{26} \cdots A_1\ A_0$

b) What is address bus lines for memory Select

memory size, $N \times 121$
memory size, $N = 128 = 2^7$

$n = 7$, is required for select memory

indexing $A_{24}\ A_{23}\ A_{22}\ A_{21}\ A_{20}\ A_{19}\ A_{18}$

address

CPU adde bus lines indexing: $A_{34} A_{33} \cdots A_1 A_0$
number of addres lines $= 35$
Total Capacity $= 2^{35}$ byte $= 2^5$ $= 32$ Gbyte

Logical Gates

Inside Computer, it is used logical gates which are electronic circuits.
⇓
transistors are used inside them

Gates

or, and, not, nor, nand, xor, xnor.

Boolean algebra (all values 1/0, also result is 1/0)

- a, b are only 1/0

$a+b+1 = 1$

$a+b+0 = a+b$

$a+1 = 1$

a	a+1
0	1
1	1

a	$\bar{a}$
0	1
1	0

example

Logical gate example

There are 3 inputs in an logical (circuit)

b and c are 1, output is 1

Other case output is 0

the state case $= 2^{\text{number of input}} = 2^3 = 8$

a	b	c	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

$f = a'bc + abc$

$f = (a'+a)bc$

$f = bc$

a or b = ?

a	b	a or b
0	0	0
0	1	1
1	0	1
1	1	1

a	b	a and b
0	0	0
0	1	0
1	0	0
1	1	1

a	a'	a+a'
0	1	1
1	0	1

$a + 1 = ?$ (

$0 + 1 + 1 + 1 + \dots + 1 = 1$ (

elektronik devreler (transistor)

↓

elektrik sinyal: (1/0) bit

Boolean Cebir. → Sonuç: 0/1

$A + 1 = ?$

A = nedir? Mantık devrelerinde Hangi değerleri alır. 1/0

$a + ab = ?$

$a(1 + b) = a$

1

$1 + 1 = 1$

$1 + 0 = 1$

$0 + 1 = 1$

$0 + 0 = 0$

$1 * 1 = 1$

$1 * 0 = 0$

$0 * 1 = 0$

$0 * 0 = 0$

a	$\bar{a}$	$a + \bar{a}$
0	1	1
1	0	1

a	a	$a + a = a$
0	0	0
1	1	1

a	$\bar{a}$	$a \cdot \bar{a}$
0	1	0
1	0	0

Example:

- In any computer system, more than one microprocessor is used when processing very large data or when a single processor is insufficient for very fast data transfer. Multiprocessor
- What is the Fetch - Decode -Execute cycle? Microprocessor function cycle
- According to the rules and laws of Boolean Algebra, A+A+1=? one
- According to the rules and laws of Boolean Algebra, A+B+A'=? one
- It represents the amount of data per second to be transferred or processed on the computer. bps
- It is a continuous, evenly spaced electrical pulse train signal. The bits representing the data gain meaning by being triggered by which pulse train's rising or falling edge. Clock
- Why is data visualization important? It strengthens your message, gives meaning to data, saves time, and enables better decision-making.
- What is done to inform precisely, concisely and specifically about research results? Report preparing
- How many bits does a double word have in data definition? 32
- Write the system bus components in a computer system? Address, Data, Control

Example

- What is the name given to the system path that runs in parallel and as a group in a computer system and exits the processor in one direction? Address Bus Lines
- What are the basic units of a microprocessor (CPU)? Registers, ALU, Control Unit, System Bus, Queue, Clock
- Write the names of the register groups or classes in a microprocessor (CPU)? General or data registers, Segment Register, Flag Register, Pointer and Index registers
- How many Kbytes are obtained when 432Kbyte memory is normalized? (Attention: this is shifted to over 2 expressions, provided that it is larger than the memory.) 512Kbyte
- What is the number of address lines in 512Kbyte memory? (Attention: 2^m is written as bye, the number of lines is m. Be careful when converting Kbyte to Byte.) 512Kbyte=2^9*2^10=2^19 Byte. 19 pieces
- How many KBytes in 2^21B? 2 Mbytes
- The total addressing capacity of the microprocessor is calculated as = 2^n bytes. Here n is the number of address lines. If n=27, how many Mbytes is the addressing capacity of the microprocessor? 128Mbytes
- How many bits/s is 100Gigabit/s? 100*10^9bit/s=10^11bps
- Find the hex equivalent of the binary value (1101 0101 1101 1100)b. (D5DC)h
- Find the binary equivalent of (3D7E)h hex value. (0011 1101 0111 1110)b