

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



مباحث ویژه پیرامون فضای سایبر

مبحث ۵

دکترین محاسبات

Doctrine of Computation

کاظم فولادی
دانشکده مهندسی برق و کامپیوتر
دانشگاه تهران

<http://courses.fouladi.ir/cyber>

دکترین محاسبات

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مقدمه

فلسفه‌ی محاسبه
و
نظریه‌ی محاسبه

سیستم محاسبه

پردازش اطلاعات



سیستم محاسبه

ورودی و خروجی



مثالهایی از محاسبه

محاسبه‌ی الکترونیکی

Electronic Computation

دیجیتال

Digital

آنالوگ

Analog

چرتکه

Abacus

حساب قلم و کاغذ

Pen & Paper Calculation

حساب خطکش و پرگار

Ruler and Compass Calculation

مغز انسان

Human Brain

سلول‌ها و DNA

Cells and DNAs

محاسبه‌ی شیمیایی

Chemical Computation

چاره‌ی «محاسبات»

محاسبات		
دکترین	پردازش اطلاعات (بر اساس تعدادی متناهی قاعده)	چیست؟
	برای تولید اطلاعات جدید از روی اطلاعات موجود (حل مسئله)	چرا؟
	از طریق دریافت ورودی، دستکاری آن و ارائه‌ی خروجی (با الگوریتم)	چگونه؟
	در هنگام لزوم	چه‌گاه؟
	در پرداننده، محاسبه‌گر (کامپیوتر)	چه‌جا؟
	توسط کامپیوتر برای کاربر، بهره‌بردار، استفاده کننده	چه‌کس؟

نظریه‌ی محاسبه

نظریه‌ی محاسبه
*Theory of Computation***حد محاسبه****قابلیت‌های پایه و محدودیت‌های پایه‌ی محاسبه چیست؟****پرسش پایه :**

حوزه‌های نظریه‌ی محاسبه

نظریه‌ی محاسبه
*Theory of Computation***نظریه‌ی پیچیدگی**
*Complexity Theory***نظریه‌ی محاسبه‌پذیری**
*Computability Theory***نظریه‌ی اتوماتا**
Automata Theory

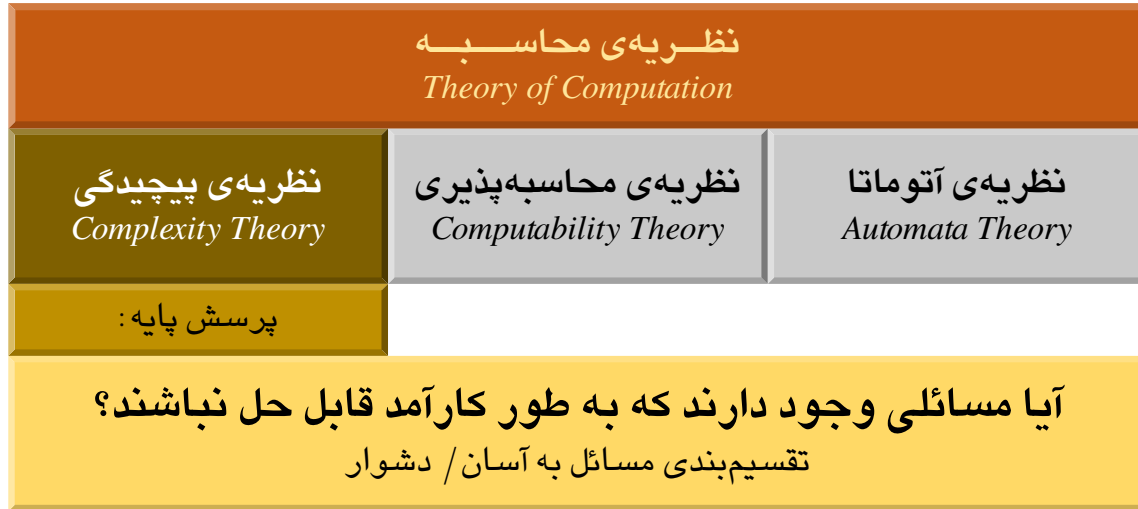
نظریه‌ی اتوماتا در نظریه‌ی محاسبه



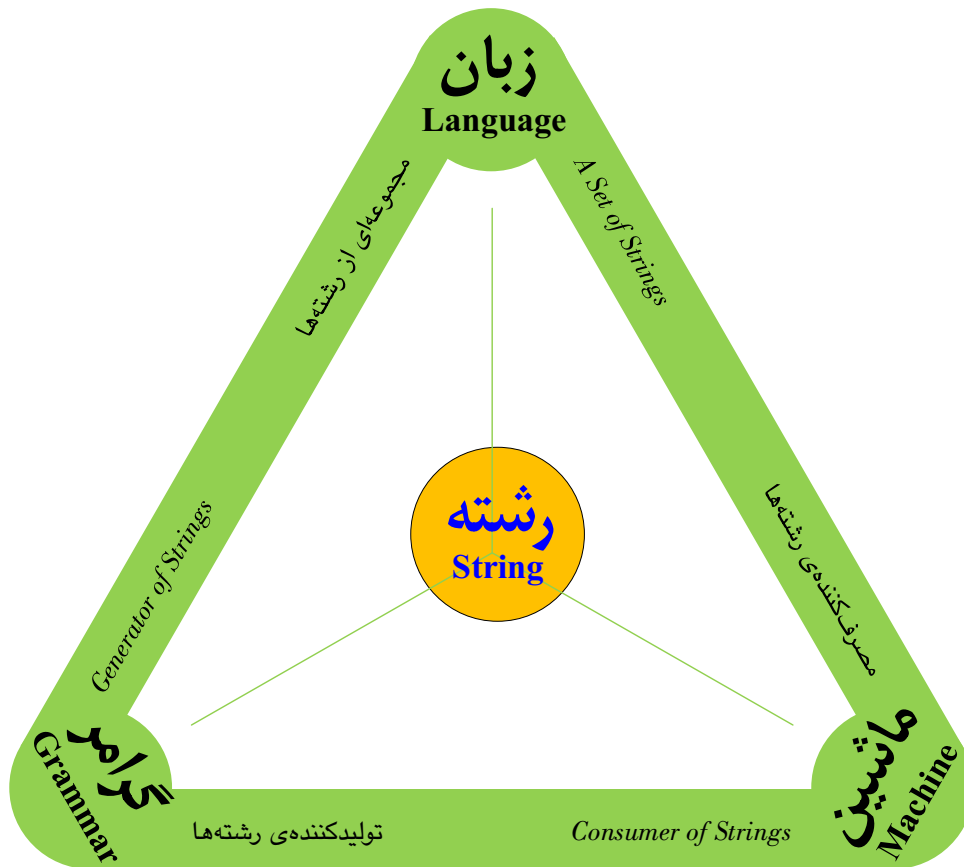
نظریه‌ی محاسبه‌پذیری در نظریه‌ی محاسبه



نظریه‌ی پیچیدگی در نظریه‌ی محاسبه

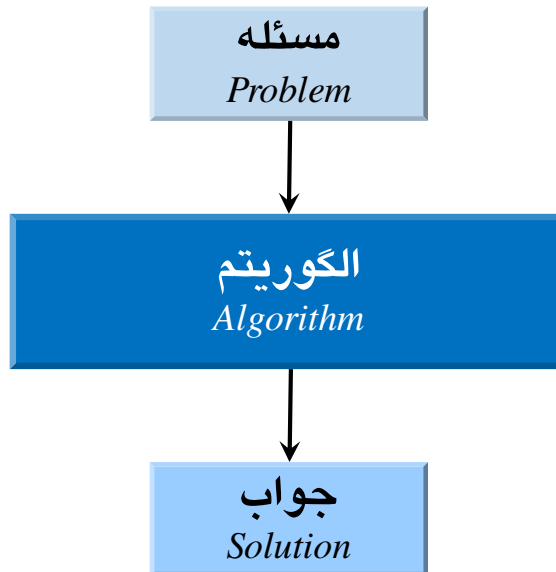


نظریه‌ی اتوماتا: نظریه‌ی زبان‌ها و ماشین‌ها



نظریه‌ی اتوماتا: نظریه‌ی زبان‌ها و ماشین‌ها

مسئله، الگوریتم و جواب

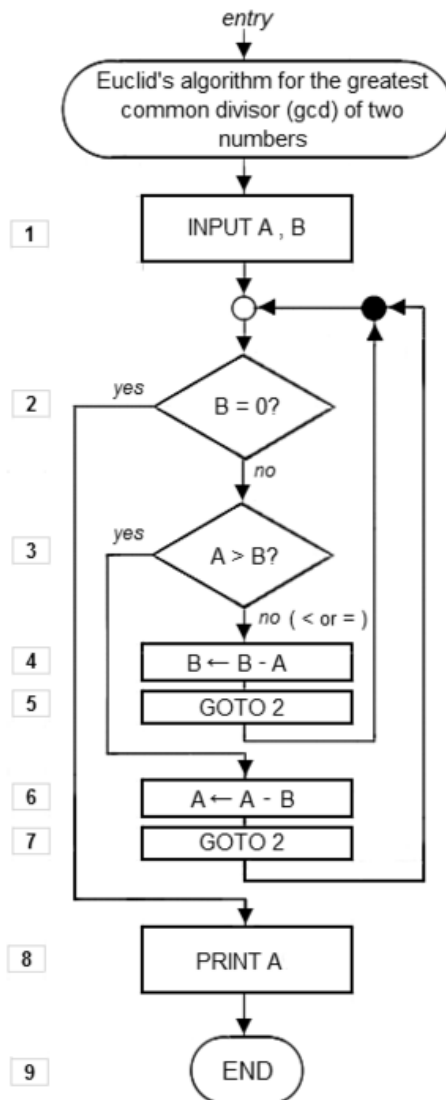



```

def add5(x):
    return x+5

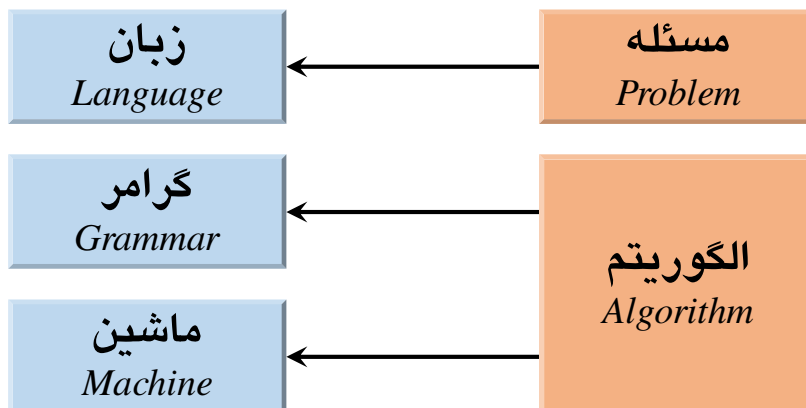
def dotwrite(ast):
    nodename = getNodeName()
    label=symbol.sym_name.get(int(ast[0]),ast[0])
    print '    %s [label="%s' % (nodename, label),
    if isinstance(ast[1], str):
        if ast[1].strip():
            print '= %s";' % ast[1]
        else:
            print '"]'
    else:
        print '["; '
        children = []
        for n, childenumerate(ast[1:]):
            children.append(dotwrite(child))
        print ', ' %s -> {' % nodename
        for n, namechildren:
            print '%s' % name,

```

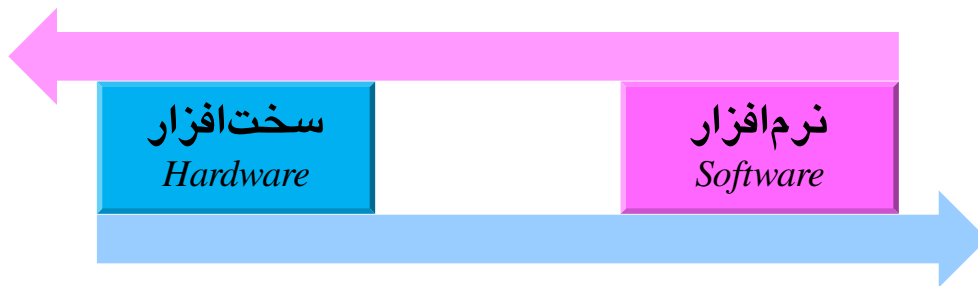


نظریه‌ی اتوماتا: نظریه‌ی زبان‌ها و ماشین‌ها

نسبت مسئله و زبان / الگوریتم و گرامر - ماشین



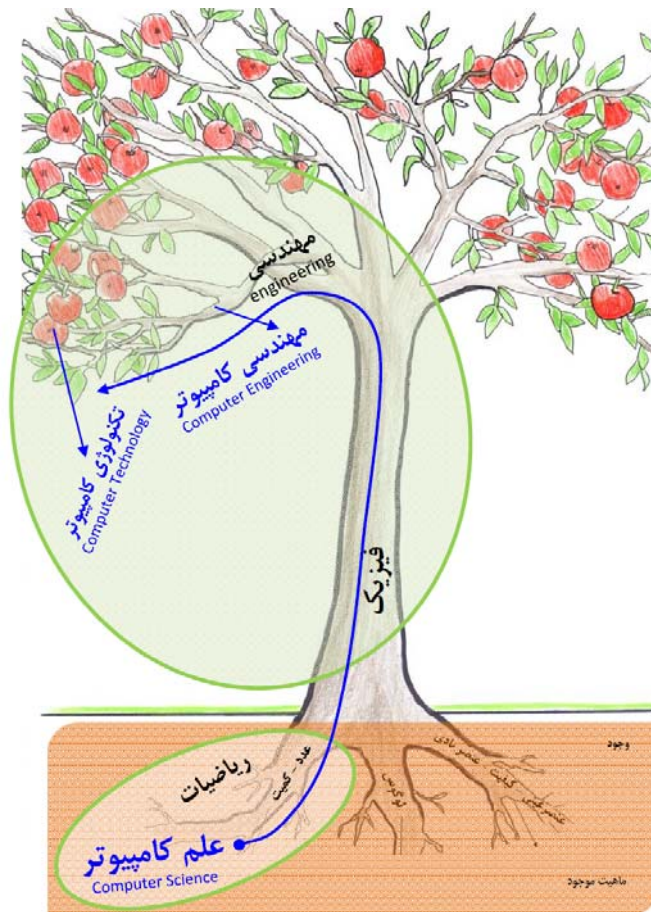
سخت افزار - نرم افزار



دکترین محاسبات

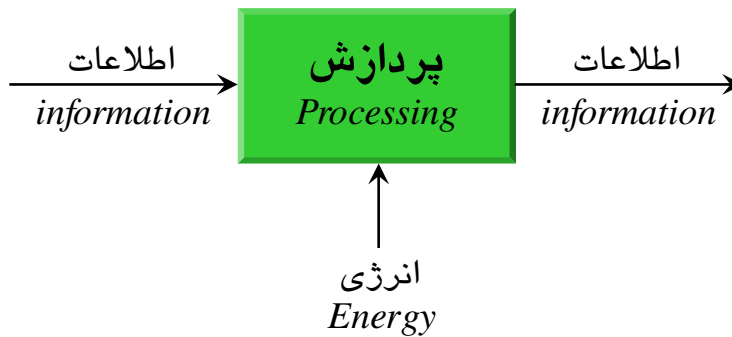
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دانش،
مهندسی و
تکنولوژی
کامپیوتر

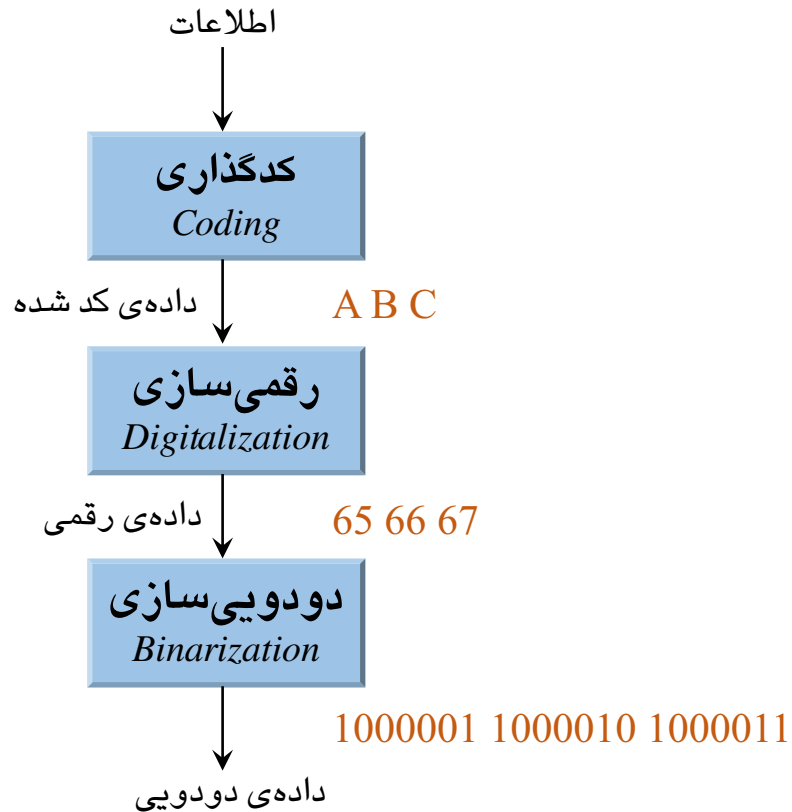


نقش انرژی در سیستم محاسبه

انرژی: توانایی انجام کار



فرآیند تبدیل اطلاعات به داده‌های دودویی

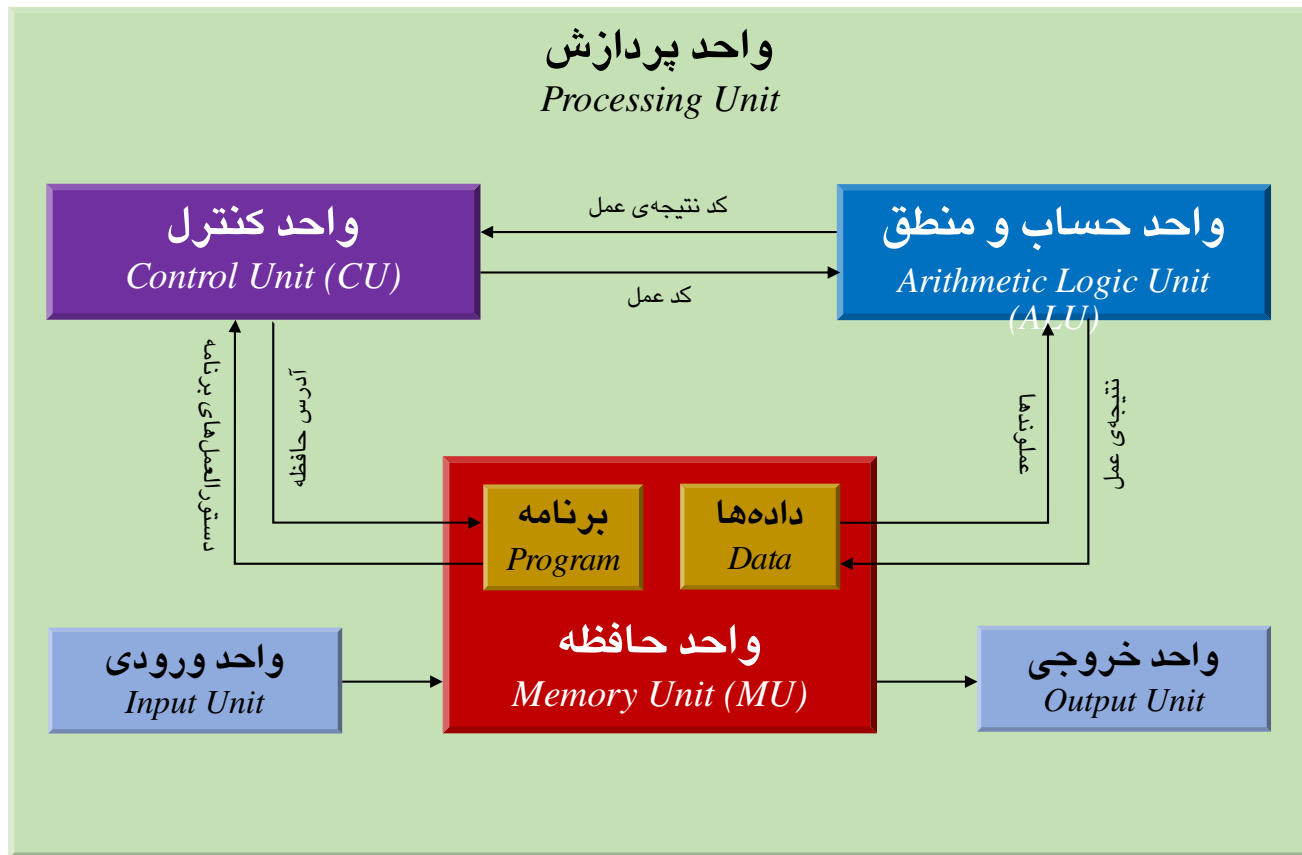


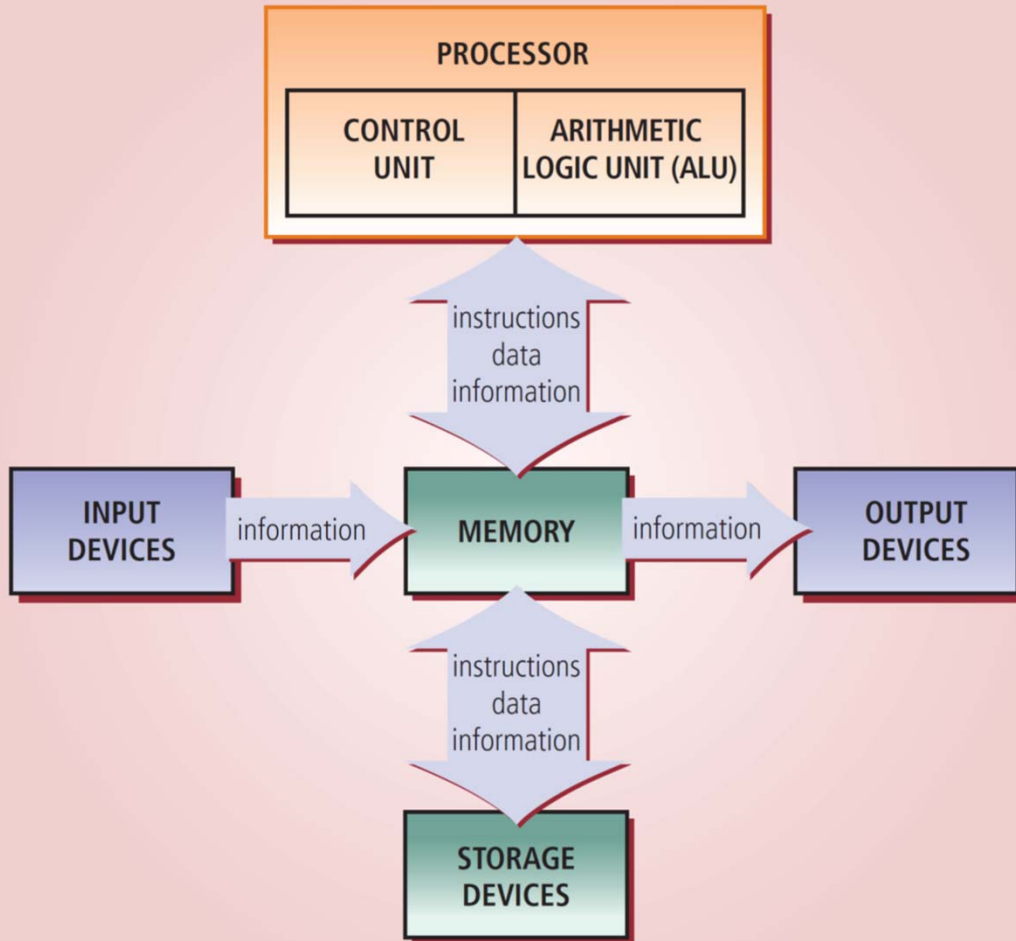
```

ASSUME CS:CODE,DS:DATA
DATA SEGMENT
LIST DW 2579H,0A500H,0C009H,0159H,0B900H
COUNT EQU 05H
DATA ENDS
CODE SEGMENT
START:      XOR BX,BX
            XOR DX,DX
            MOV AX,DATA
            MOV DS,AX
            MOV CL,COUNT
            MOV SI,OFFSET LIST
AGAIN:      MOV AX,[SI]
            SHL AX,01
            JC NEG
            INC BX
            JMP NEXT
NEG:        INC DX
NEXT:      ADD SI,02
            DEC CL
            JNZ AGAIN
            MOV AH,4CH
            INT 21H
            CODE ENDS
            END START

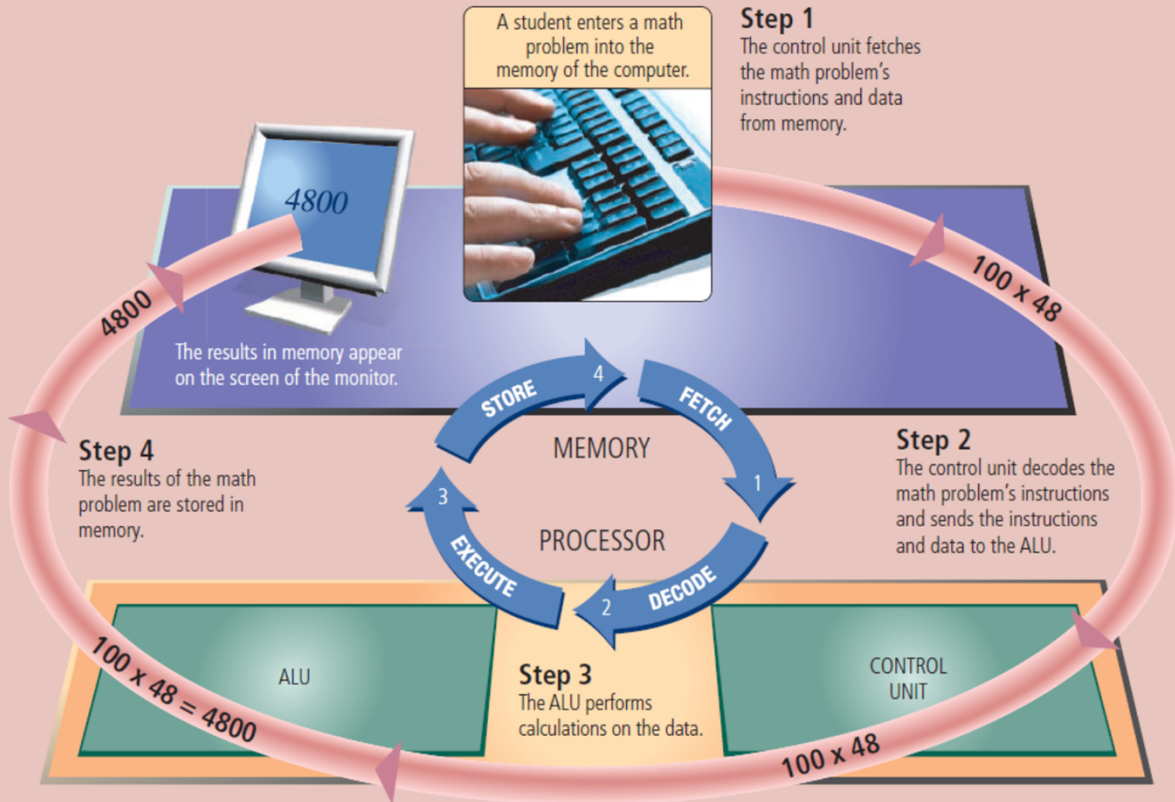
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سیستم پردازشگر دیجیتال





The Steps in a Machine Cycle



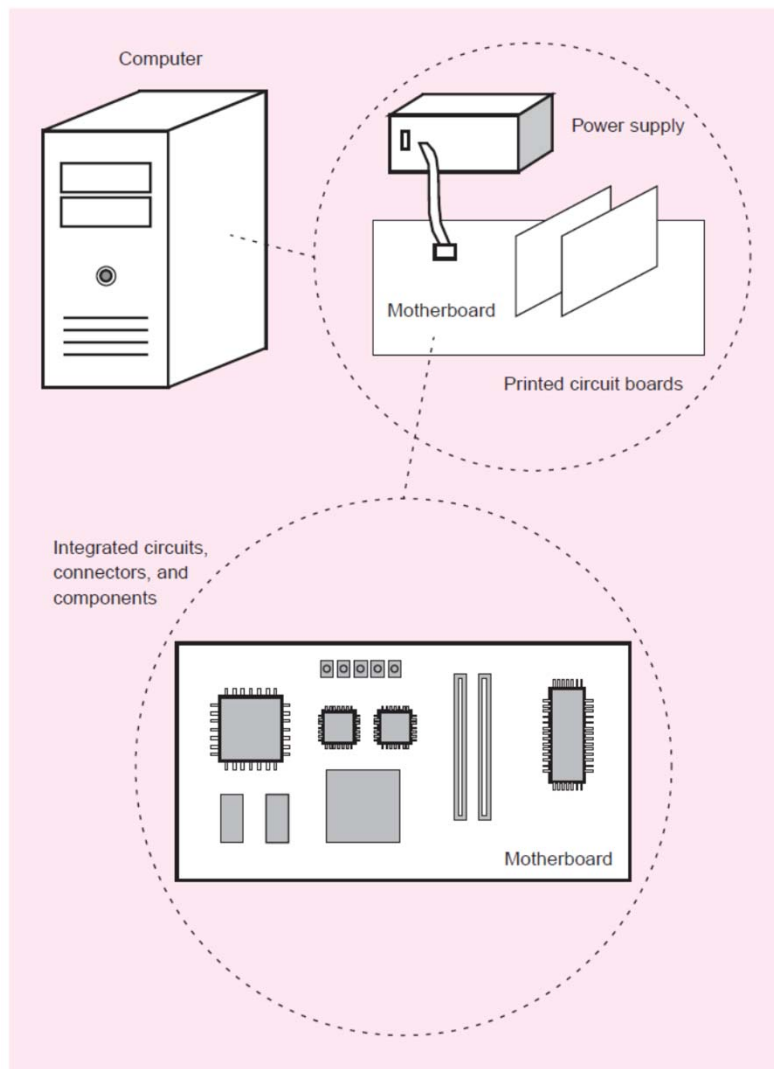
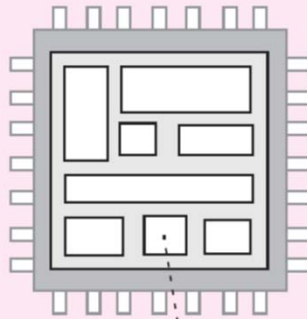
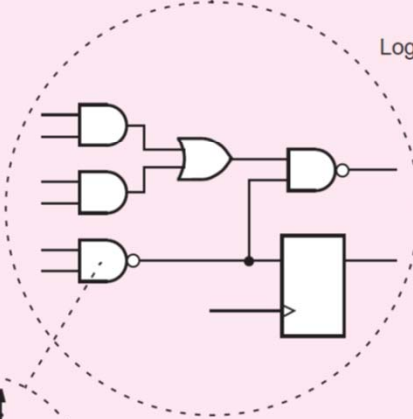


Figure 1.5 A digital hardware system (Part a).

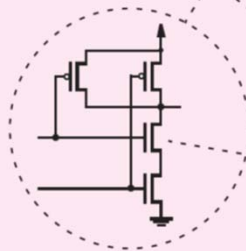
Subcircuits
in a chip



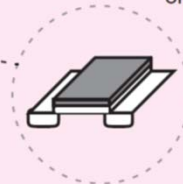
Logic gates

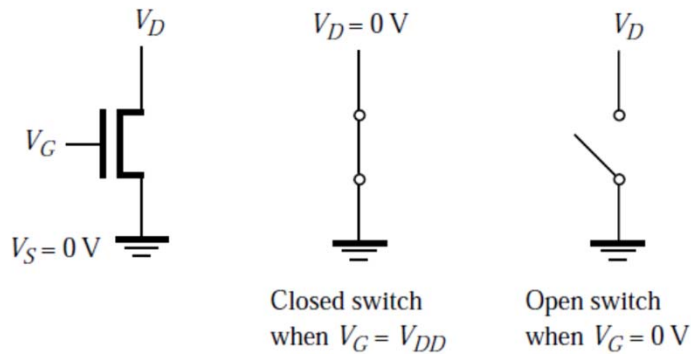


Transistor circuit

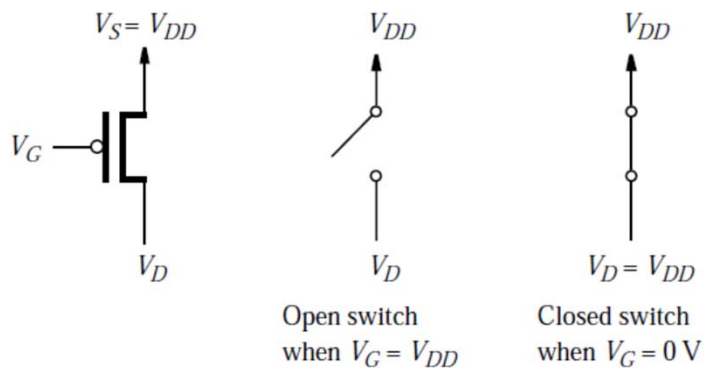


Transistor
on a chip



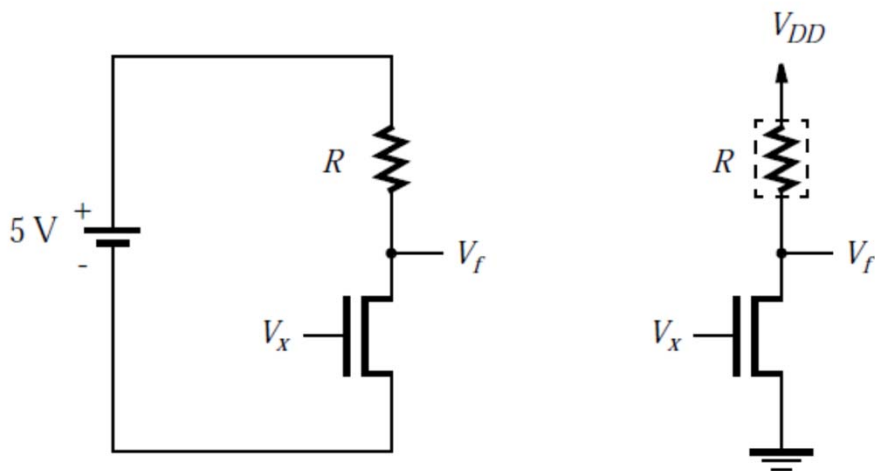


(a) NMOS transistor



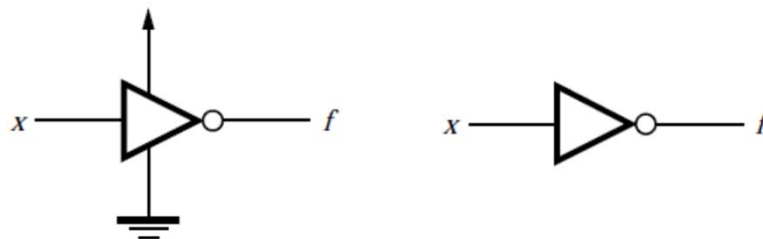
(b) PMOS transistor

Figure 3.4 NMOS and PMOS transistors in logic circuits.



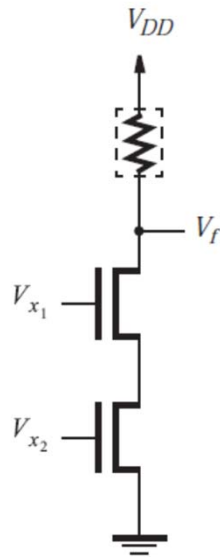
(a) Circuit diagram

(b) Simplified circuit diagram



(c) Graphical symbols

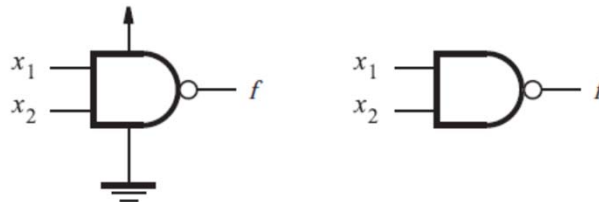
Figure 3.5 A NOT gate built using NMOS technology.



(a) Circuit

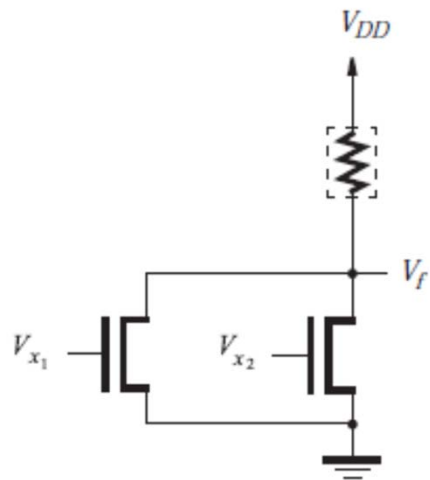
x_1	x_2	f
0	0	1
0	1	1
1	0	1
1	1	0

(b) Truth table



(c) Graphical symbols

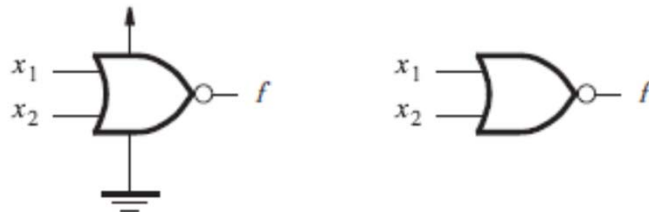
Figure 3.6 NMOS realization of a NAND gate.



(a) Circuit

x_1	x_2	f
0	0	1
0	1	0
1	0	0
1	1	0

(b) Truth table



(c) Graphical symbols

Figure 3.7 NMOS realization of a NOR gate.

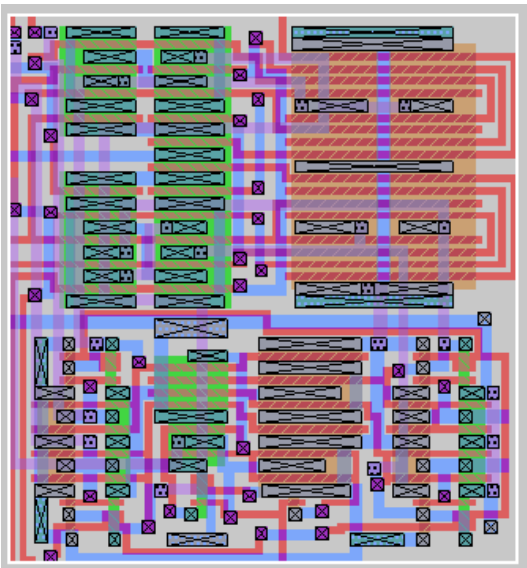
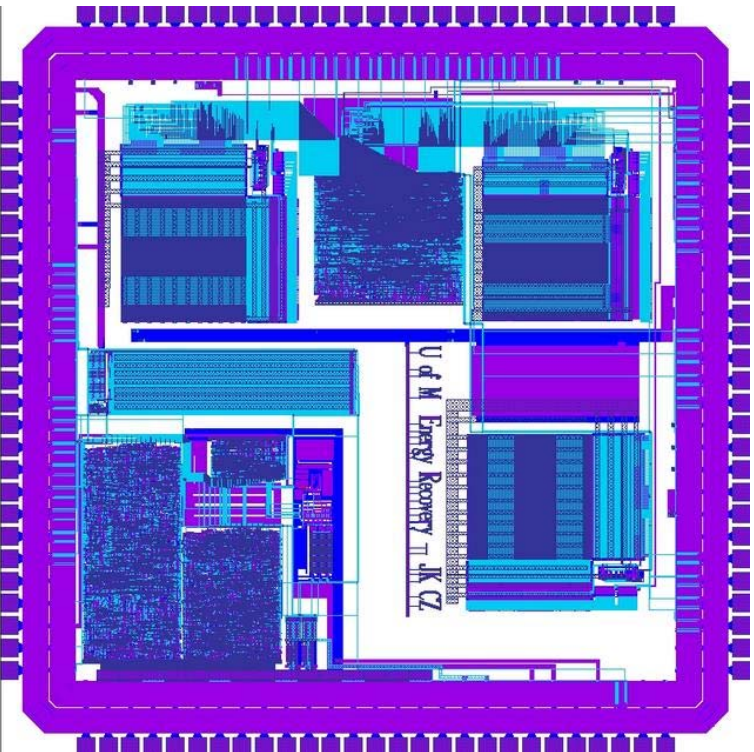


Table 1.1 A sample of the International Technology Roadmap for Semiconductors.

	Year					
	2006	2007	2008	2009	2010	2012
Technology feature size	78 nm	68 nm	59 nm	52 nm	45 nm	36 nm
Transistors per cm ²	283 M	357 M	449 M	566 M	714 M	1,133 M
Transistors per chip	2,430 M	3,061 M	3,857 M	4,859 M	6,122 M	9,718 M

Categories of Computers

Category	Physical Size	Number of Simultaneously Connected Users	General Price Range
Personal computers (desktop)	Fits on a desk	Usually one (can be more if networked)	Several hundred to several thousand dollars
Mobile computers and mobile devices	Fits on your lap or in your hand	Usually one	Less than a hundred dollars to several thousand dollars
Game consoles	Small box or handheld device	One to several	Several hundred dollars or less
Servers	Small cabinet	Two to thousands	Several hundred to a million dollars
Mainframes	Partial room to a full room of equipment	Hundreds to thousands	\$300,000 to several million dollars
Supercomputers	Full room of equipment	Hundreds to thousands	\$500,000 to several billion dollars
Embedded computers	Miniature	Usually one	Embedded in the price of the product

printer
(output device)



optical disc drive
(storage device)

hard disk drive
(storage device)

system unit
(processor, memory,
and storage devices)



USB flash drive
(storage device)



card reader/writer
(storage device)



memory cards
(storage device)



monitor
(output device)

screen

Web cam
(input device)

speakers
(output device)



keyboard
(input device)



mouse
(input device)

microphone
(input device)



external hard disk
(storage device)



modem
(communications device)





client



client

printer



server







الگوهای متنوع محاسبه

محاسبات تعبیه شده
Embedded Computing

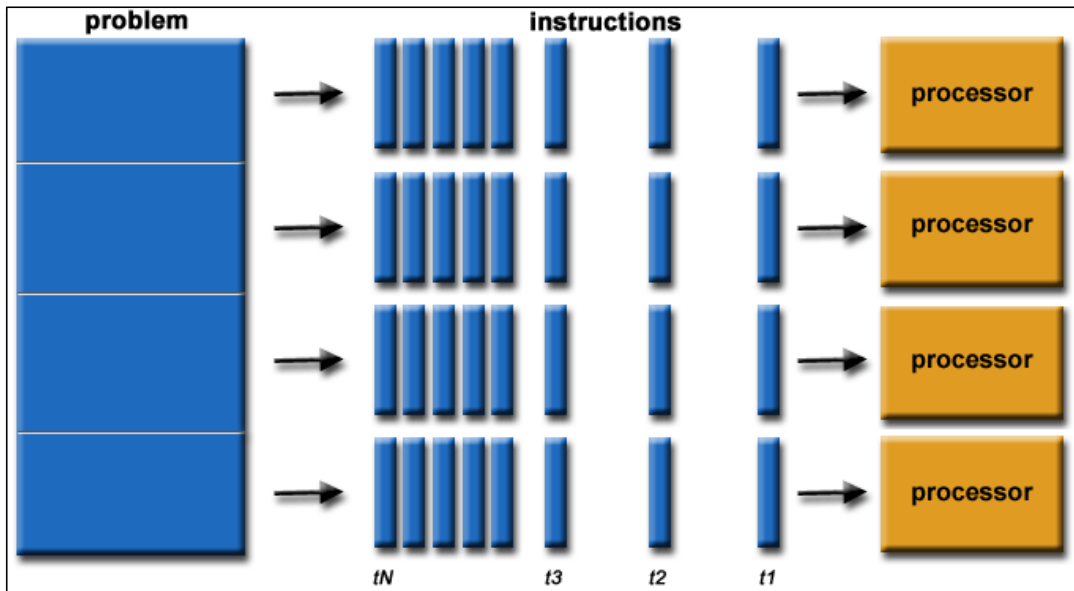
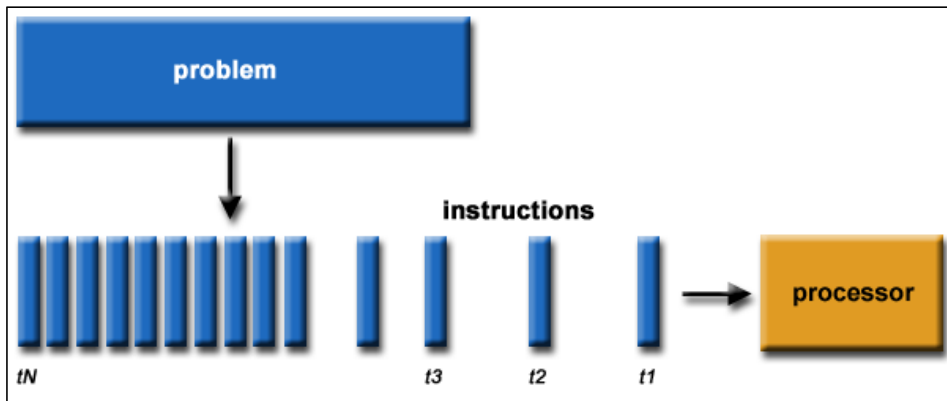
محاسبات توزیع شده
Distributed Computing

محاسبات موازی
Parallel Computing

محاسبات ابری
Cloud Computing

محاسبات توری
Grid Computing

محاسبات خوشه‌ای
Cluster Computing



زبان‌های برنامه‌نویسی

PROGRAMMING LANGUAGES

دکترین محاسبات

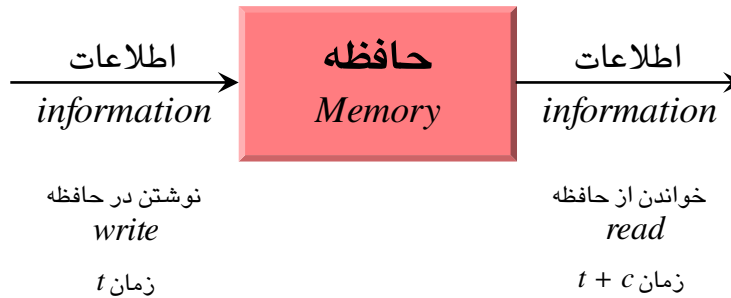
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حافظه

ذخیره و
بازتابی
اطلاعات

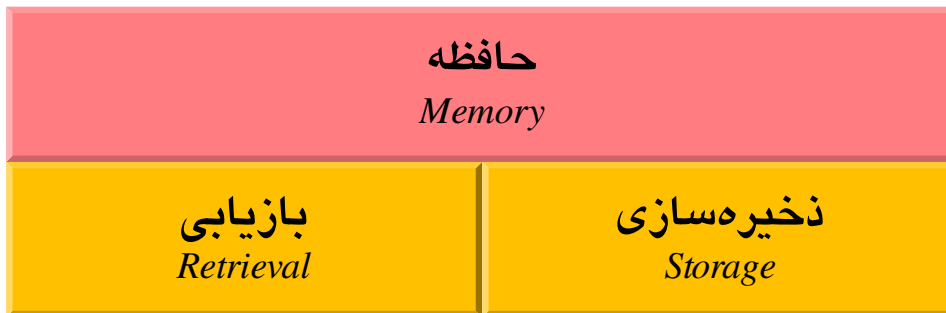
سیستم حافظه

حافظه به عنوان پردازش اطلاعات



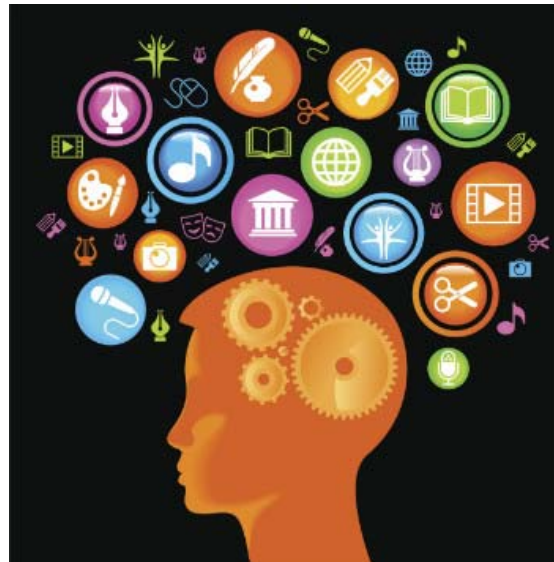
سیستم حافظه

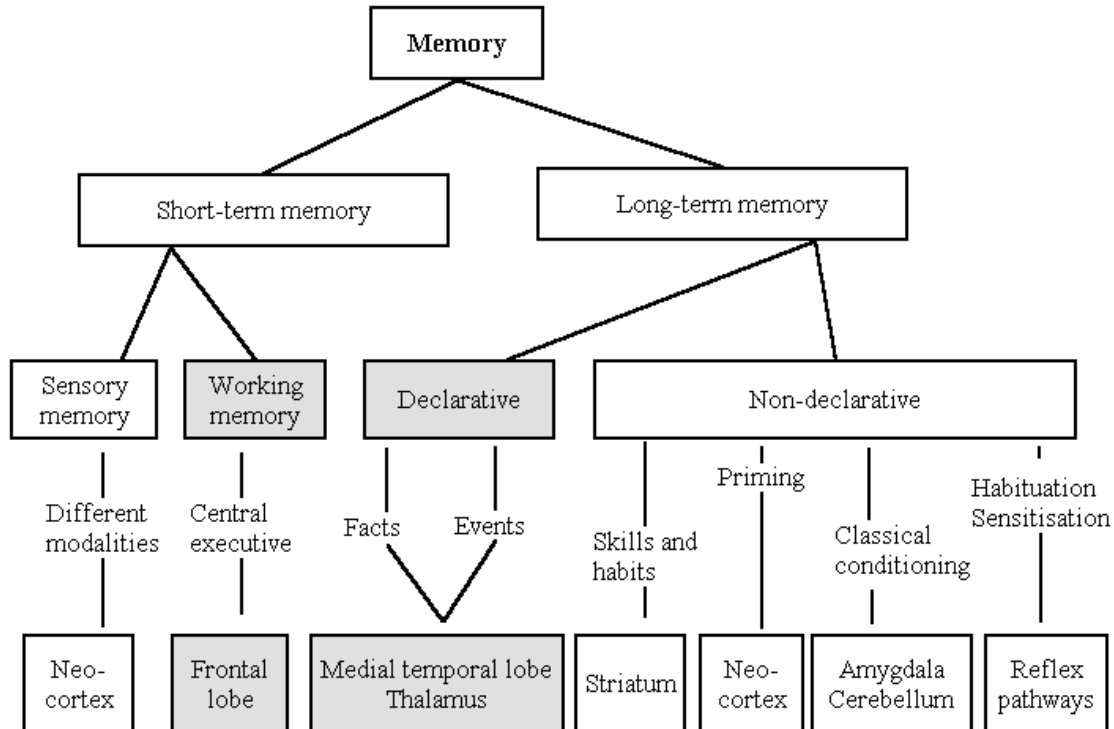
ذخیره و بازیابی اطلاعات



حافظه در انسان

HUMAN MEMORY





Memory Systems

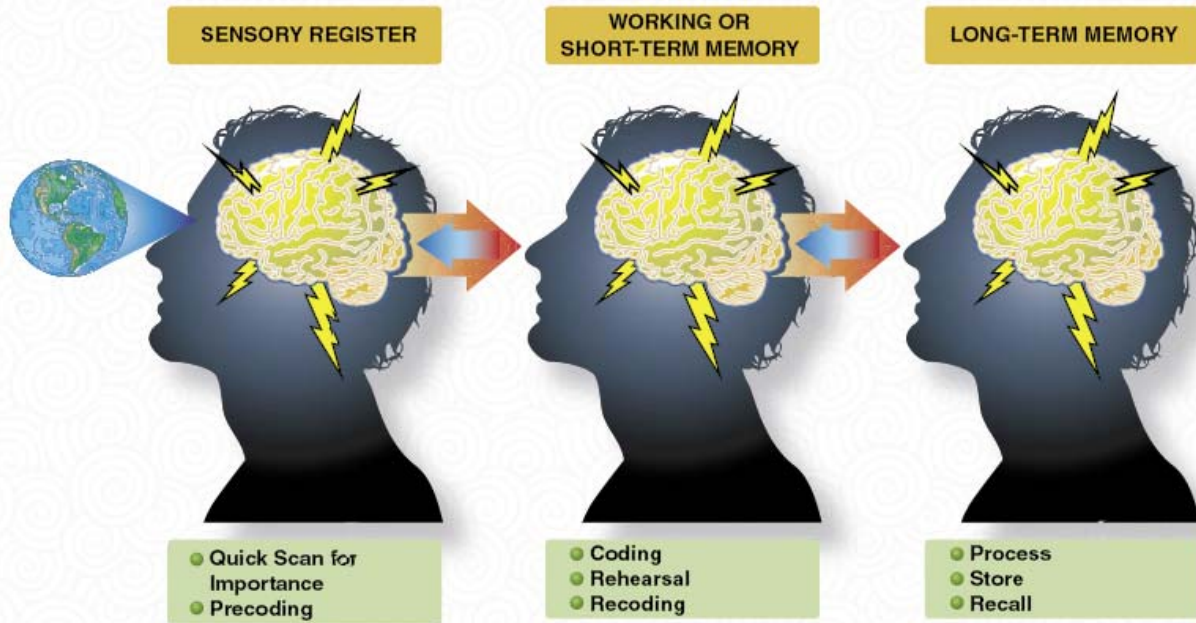
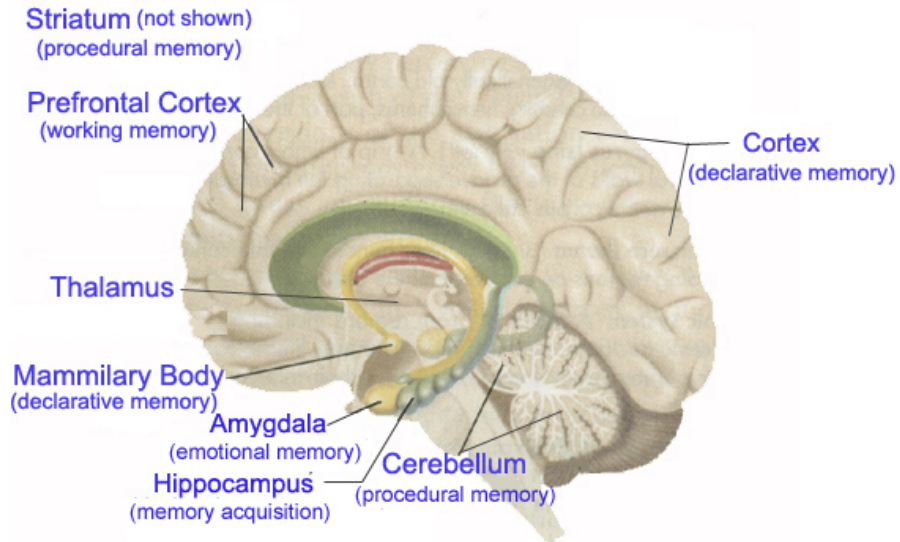


Figure 2-24. Information processing within the sensory register, working on short-term memory, and long-term memory includes complex coding, sorting, storing, and recall functions.

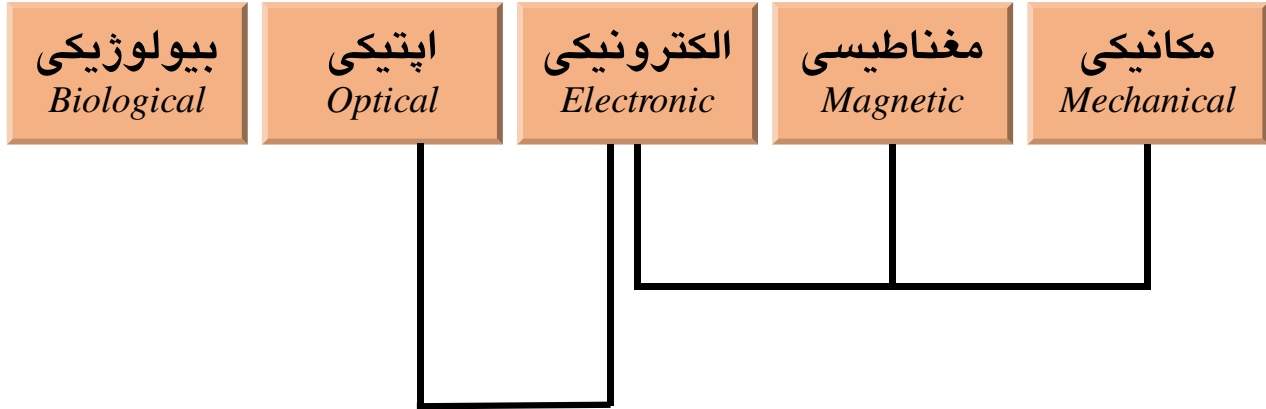




The Brain and Memory



انواع حافظه‌های فیزیکی



مشخصه‌های حافظه

ماندگاری

Persistence

ظرفیت

Capacity

آدرس‌پذیری

Addressability

خواندن / نوشتن

Read/Write

پهنای باند

Bandwidth

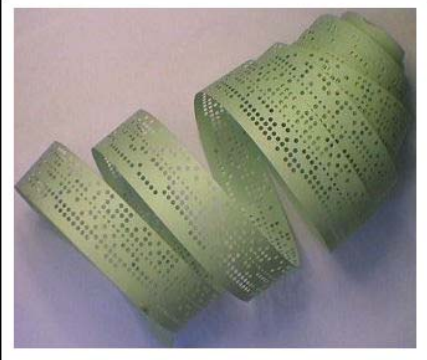
زمان دسترسی

Access Time

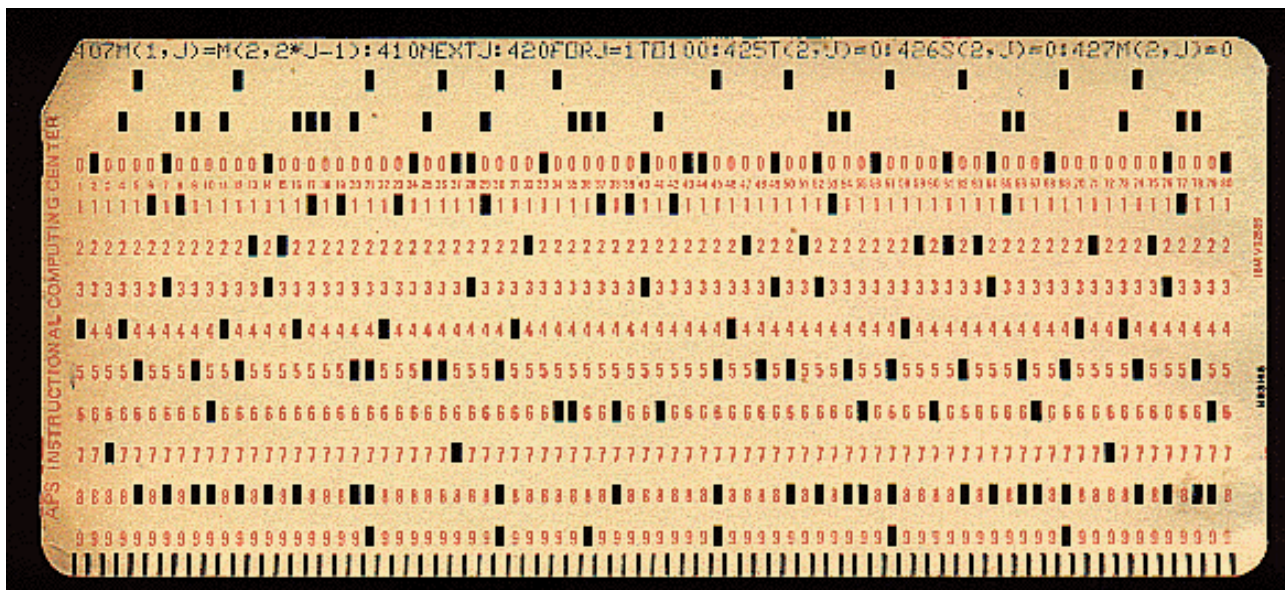


Write words
with red ink
on yellow paper
to help you
remember them!





Paper Tape





internal hard disk



external hard disks



network attached storage device



miniature hard disk



solid state drive



memory cards



microfilm

magnetic stripe card



smart card



optical disc



cloud storage



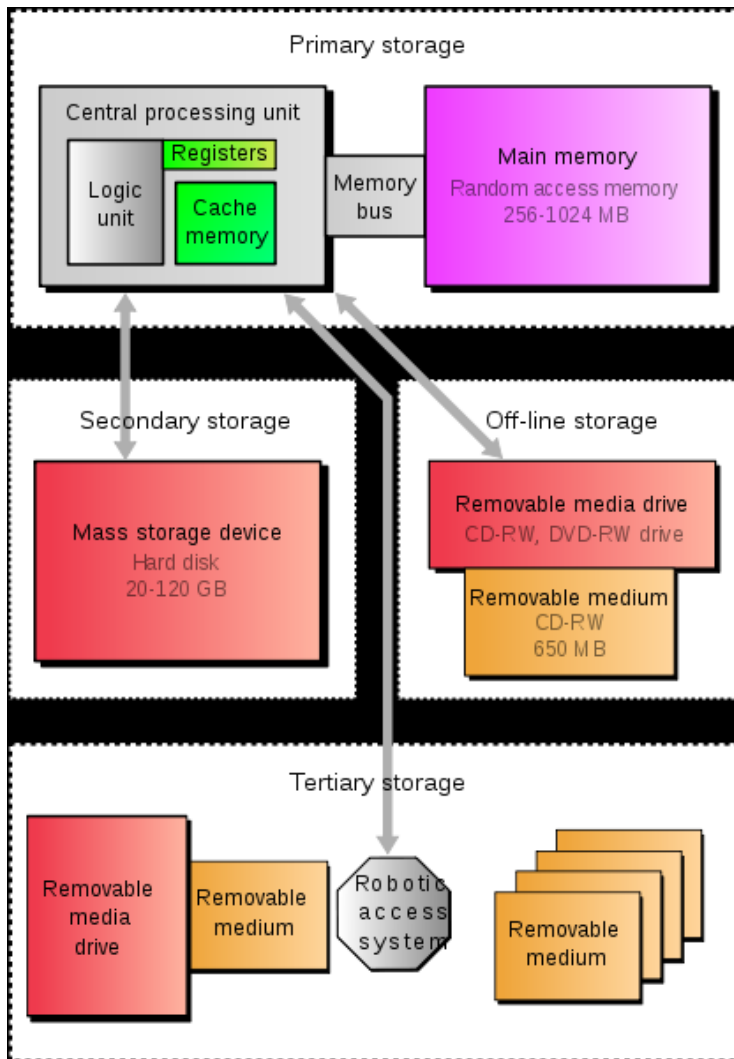
USB flash drive

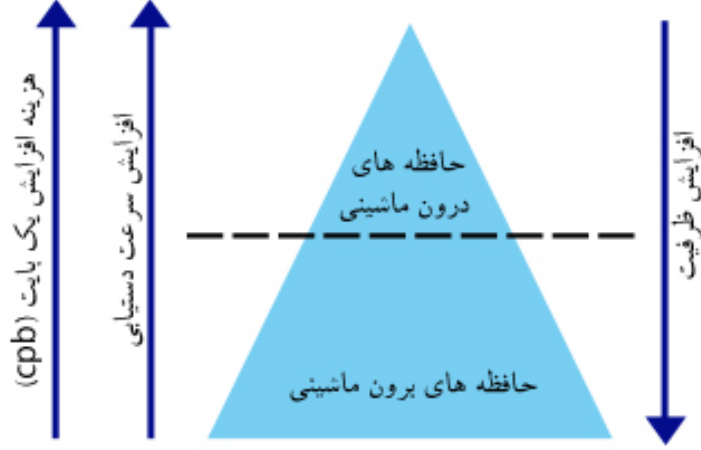


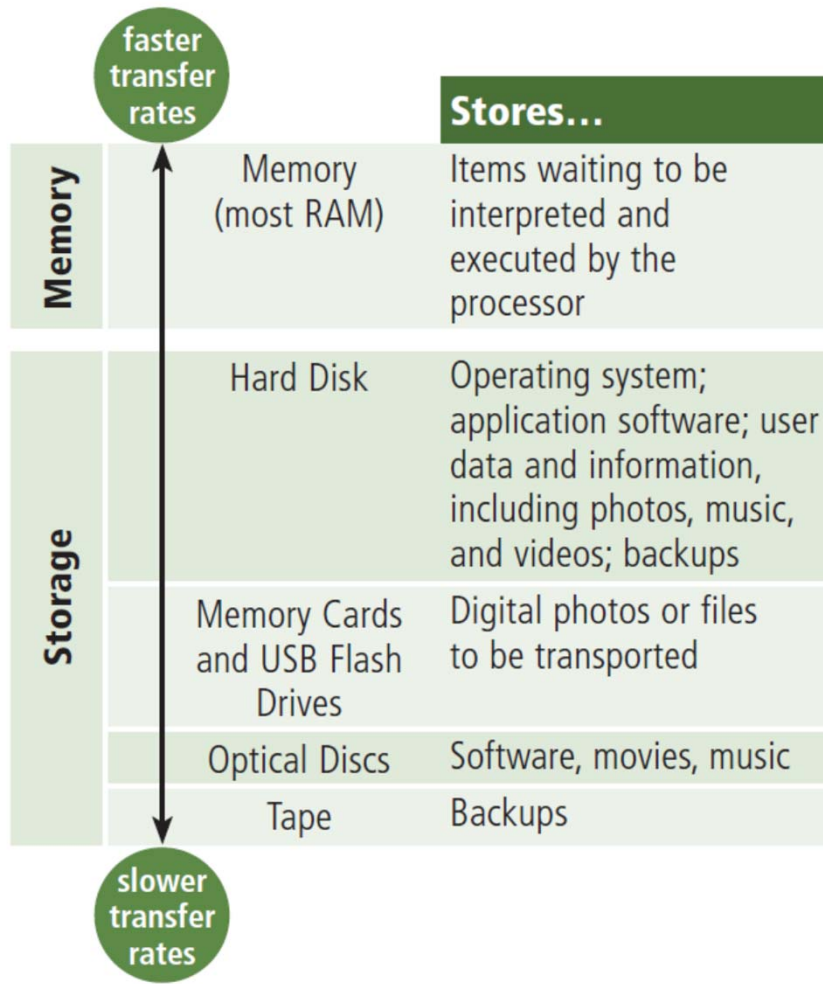
ExpressCard module

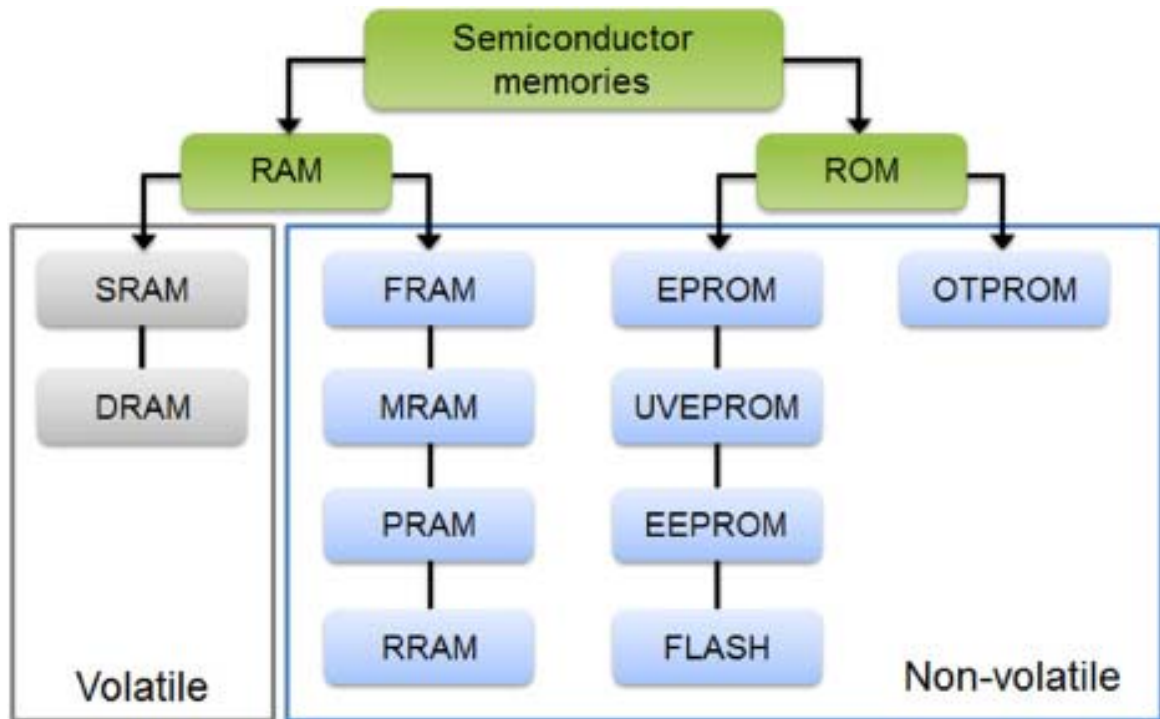
Storage Terms

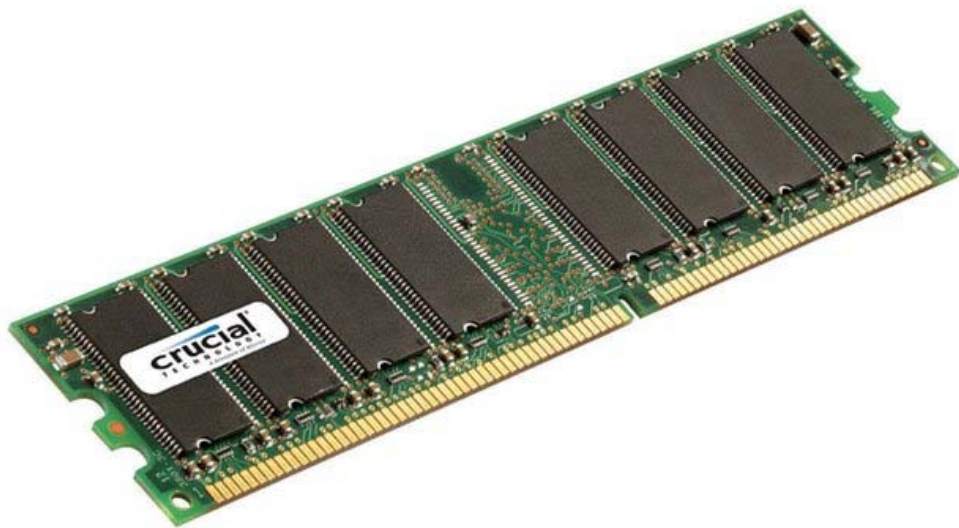
Storage Term	Approximate Number of Bytes	Exact Number of Bytes
Kilobyte (KB)	1 thousand	2^{10} or 1,024
Megabyte (MB)	1 million	2^{20} or 1,048,576
Gigabyte (GB)	1 billion	2^{30} or 1,073,741,824
Terabyte (TB)	1 trillion	2^{40} or 1,099,511,627,776
Petabyte (PB)	1 quadrillion	2^{50} or 1,125,899,906,842,624
Exabyte (EB)	1 quintillion	2^{60} or 1,152,921,504,606,846,976
Zettabyte (ZB)	1 sextillion	2^{70} or 1,180,591,620,717,411,303,424
Yottabyte (YB)	1 septillion	2^{80} or 1,208,925,819,614,629,174,706,176









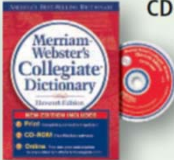




Various Memory Cards

Media Type		Storage Capacity	Use
CompactFlash (CF)		512 MB to 100 GB	Digital cameras, smart phones, PDAs, photo printers, portable media players, notebook computers, desktop computers
Secure Digital (SD)		512 MB to 8 GB	Digital cameras, digital video cameras, smart phones, PDAs, photo printers, portable media players
SDHC		4 to 32 GB	Digital cameras
microSD		1 to 2 GB	Smart phones, portable media players, handheld game consoles, handheld navigation devices
microSDHC		4 to 16 GB	Smart phones, portable media players, handheld game consoles, handheld navigation devices
xD Picture Card		256 MB to 2 GB	Digital cameras, photo printers
Memory Stick PRO Duo		1 to 16 GB	Digital cameras, smart phones, handheld game consoles
Memory Stick Micro (M2)		1 to 16 GB	Smart phones

Optical Disc Formats

Optical Disc	Read	Write	Erase
 CD-ROM	Y	N	N
 CD-R	Y	Y	N
 CD-RW	Y	Y	Y
 DVD-ROM BD-ROM	Y	N	N
 DVD-R DVD+R BD-R	Y	Y	N
 DVD-RW DVD+RW DVD-RAM BD-RE	Y	Y	Y

Media Life Expectancies* (when using high-quality media)

Media Type	Guaranteed Life Expectancy	Potential Life Expectancy
Magnetic disks	3 to 5 years	20 to 30 years
Optical discs	5 to 10 years	50 to 100 years
Solid state drives	50 years	140 years
Microfilm	100 years	500 years

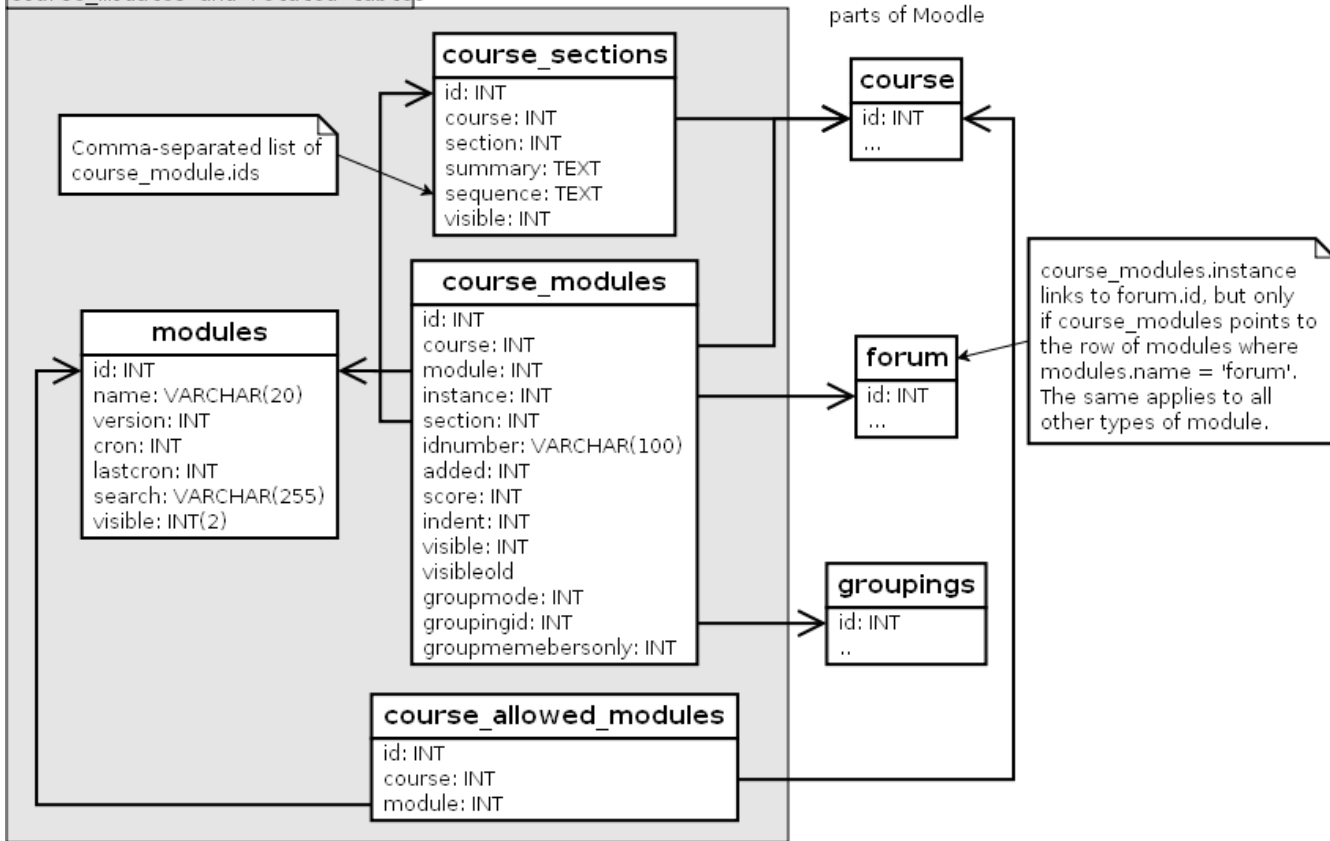
* according to manufacturers of the media

پایگاه داده‌ها

DATABASE

نخیره و بازیابی داده‌های ساخت‌یافته

course_modules and related tables



Flat File Model

	Route No.	Miles	Activity
Record 1	I-95	12	Overlay
Record 2	I-495	05	
Record 3	SR-301	33	

Relational Model

Activity Code	Activity Name
23	Patching
24	Overlay
25	Crack Sealing

Key = 24

Activity Code	Date	Route No.
24	01/12/01	I-95
24	02/08/01	I-66

Object-Oriented Model

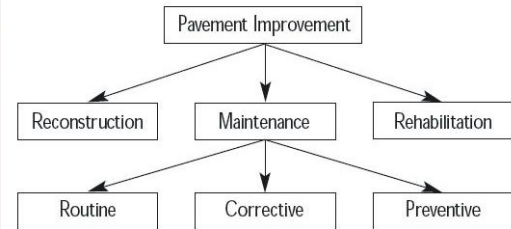
Object 1: Maintenance Report Object 1 Instance

Date	01-12-01
Activity Code	24
Route No.	I-95
Daily Production	2.5
Equipment Hours	6.0
Labor Hours	6.0

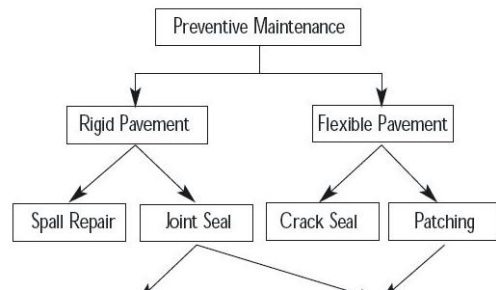
Object 2: Maintenance Activity

Activity Code	
Activity Name	
Production Unit	
Average Daily Production Rate	

Hierarchical Model



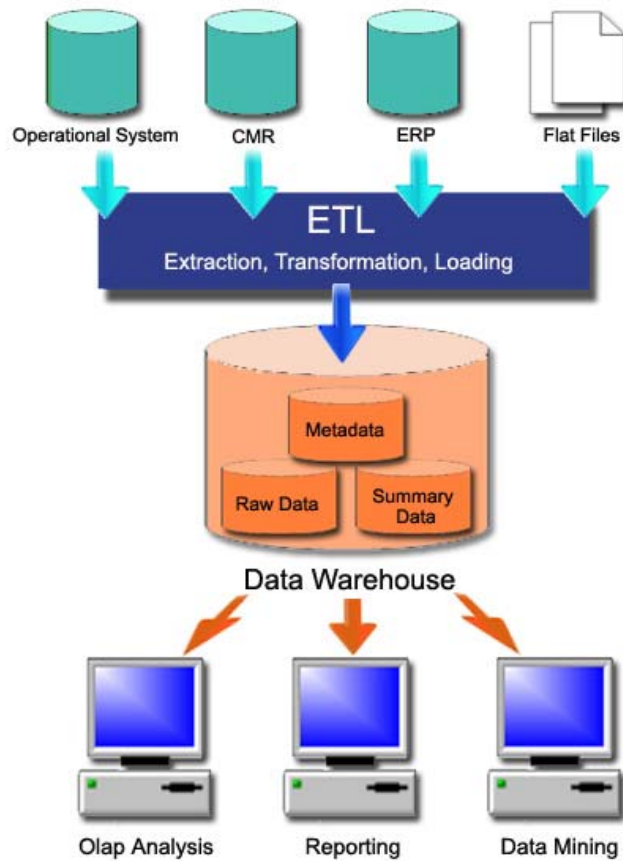
Network Model

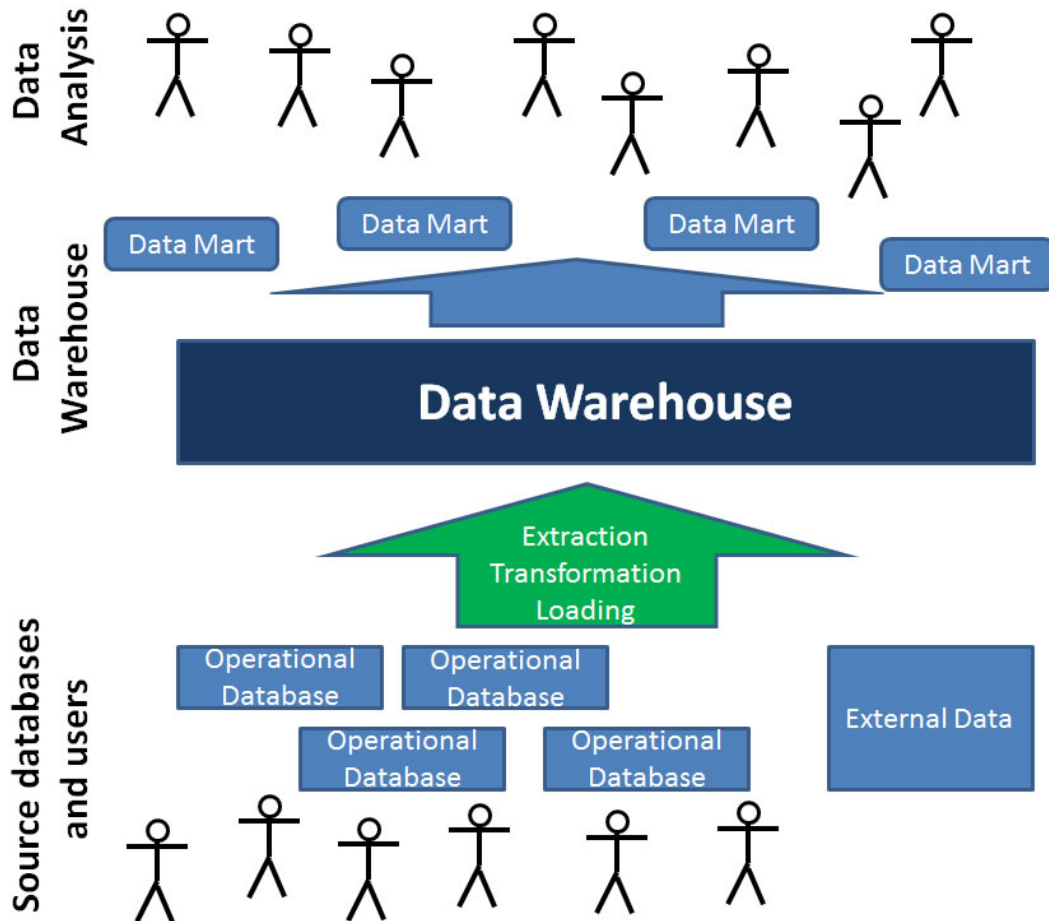


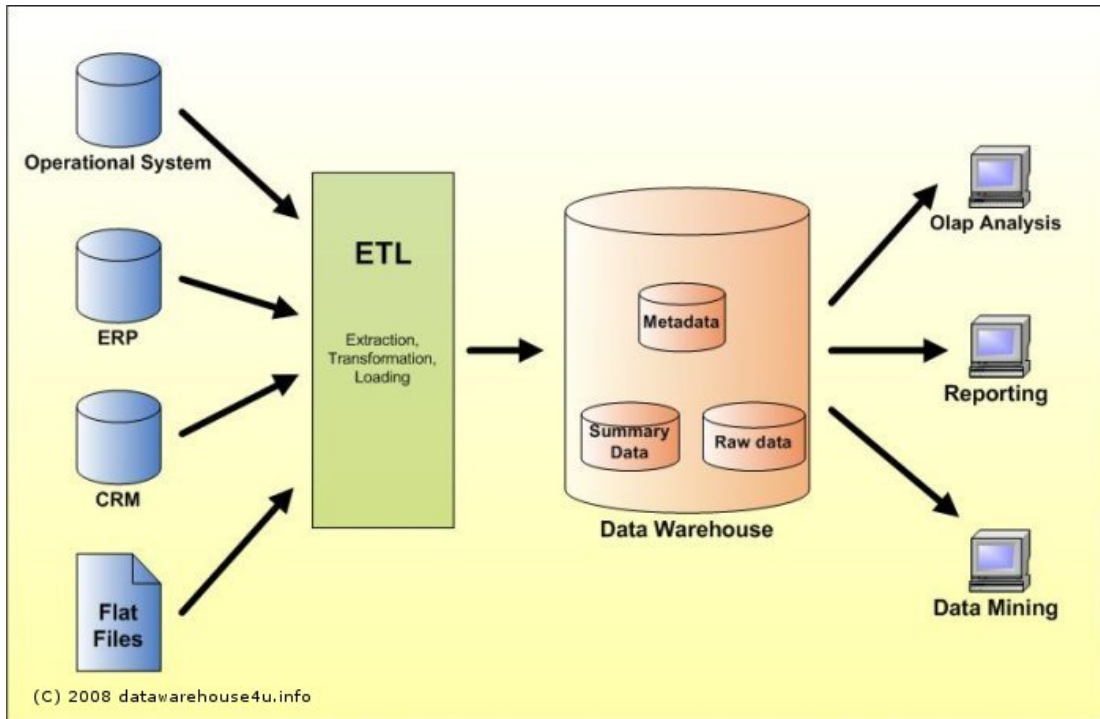
انبار داده‌ها

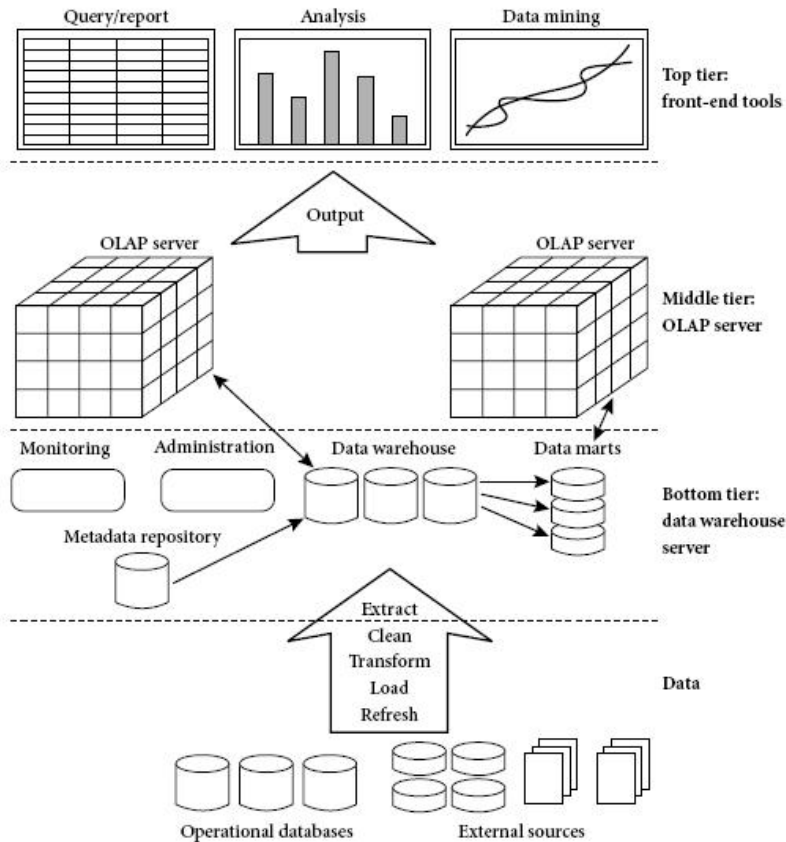
DATA WAREHOUSE

محل نگهداری حجم بالای داده‌ها









3.12 A three-tier data warehousing architecture.



Figure 7-39 An enterprise uses high-capacity storage devices.

ذخیره و بازیابی اطلاعات

دکترین جامع فضای سایبر

INFORMATION STORAGE AND RETRIEVAL

به‌خاطر سپاری و به‌یادآوری اطلاعات

Inverted index

Document 1

The bright blue
butterfly hangs
on the breeze.

Document 2

It's best to
forget the great
sky and to
retire from
every wind.

Document 3

Under blue
sky, in bright
sunlight, one
need not
search around.

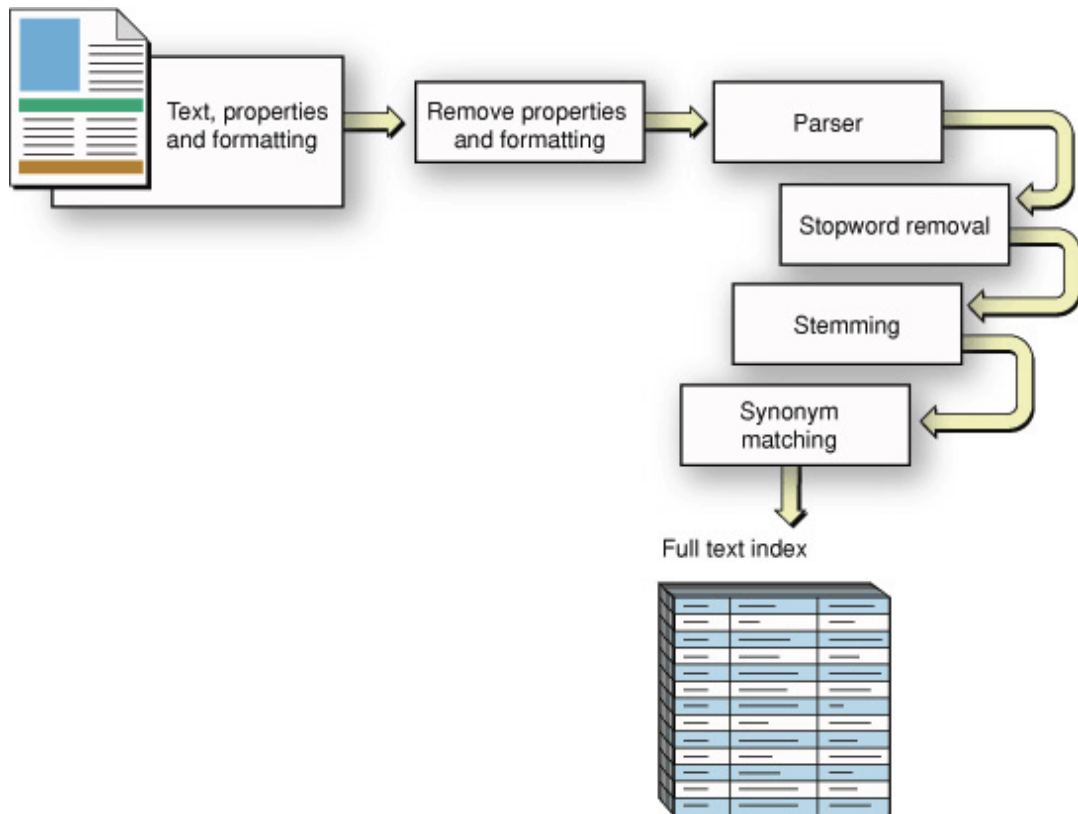
Stopword list

a
and
around
every
for
from
in
is
it
not
on
one
the
to
under

Inverted index

ID	Term	Document
1	best	2
2	blue	1, 3
3	bright	1, 3
4	butterfly	1
5	breeze	1
6	forget	2
7	great	2
8	hangs	1
9	need	3
10	retire	2
11	search	3
12	sky	2, 3
13	wind	2

Text Extraction



Document 1

The bright blue butterfly hangs on the breeze.

Document 2

It's best to forget the great sky and to retire from every wind.

Document 3

Under blue sky, in bright sunlight, one need not search around.

Query

Q- "blue sky" X

Inverted index

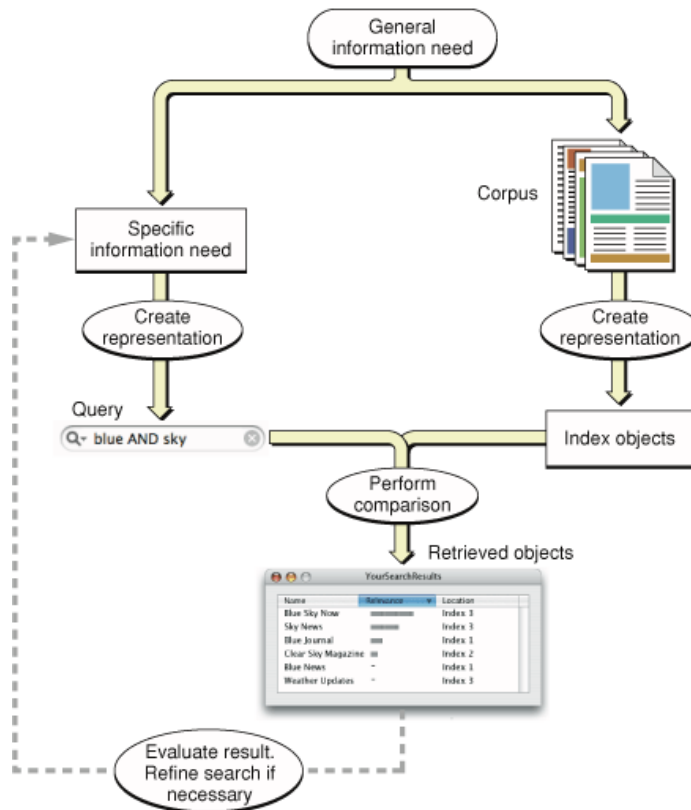
ID	Term	Document : position
1	best	2 : 3
2	blue	1 : 3, 3 : 2
3	bright	1 : 2, 3 : 5
4	butterfly	1 : 4
5	breeze	1 : 8
6	forget	2 : 5
7	great	2 : 7
8	hangs	1 : 5
9	needs	3 : 8
10	retire	2 : 11
11	search	3 : 10
12	sky	2 : 8, 3 : 3
13	wind	2 : 14

Match on sequential terms

blue - 3 : 2
sky - 3 : 3

Search object

Document reference	Relevance
3	100%



Properties of the Model Mathematical Basis	without term-interdependencies	with term-interdependencies	
		immanent term-dependencies	transcendent term-interdependencies
set-theoretic	Standard Boolean Extended Boolean		Fuzzy Set
algebraic	Vector Space Extended Boolean	Generalised Vector Space Latent Semantic Spread. Activation Neuronal Network	Topic-based Vector Space Balanced Topic-based Vector Space Backpropagation Neuronal Network
probabilistic	Binary Interdependence Language Inference Network Belief Network		Retrieval by Logical Imaging

موتور جستجو

SEARCH ENGINE

گردآوری، طبقه‌بندی و به‌یادآوردن اطلاعات از یک مجموعه (مانند وب)



WebCrawler®



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• • • find it all • • •

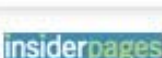
LookSmart™
Where To Look For What You Need.™

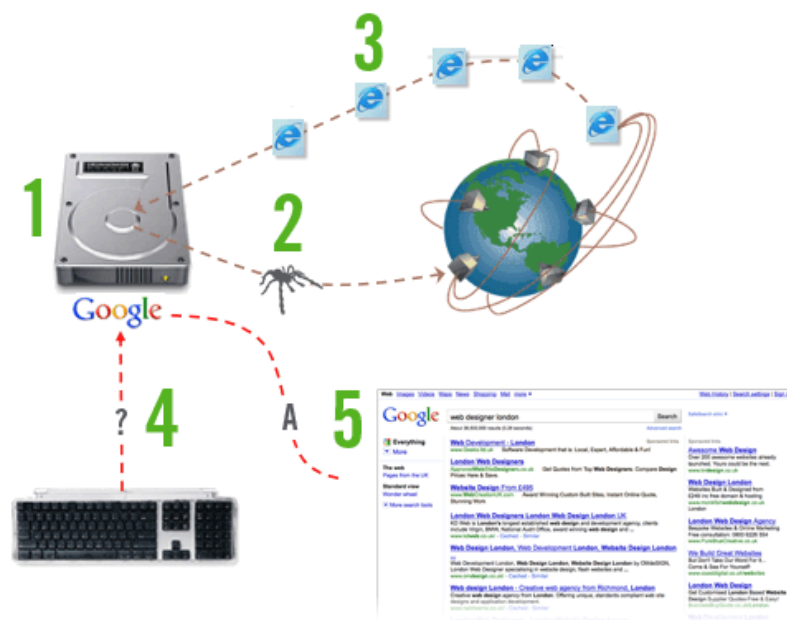
altavista™

Google™
UK



dmoz open directory project

Images					
Music					
Videos					
Health					
Shopping					
Local					
Cooking					
Finance					
Jobs					



SPIDER

An automated browser that views your web pages and strips out the html text content



DATABASE

Stores records of all pages viewed by the spider, when you click "search", it is this database that is being searched



RELEVANCY ALGORITHM

Used to sort through the database of spidered web pages to find those that are most relevant