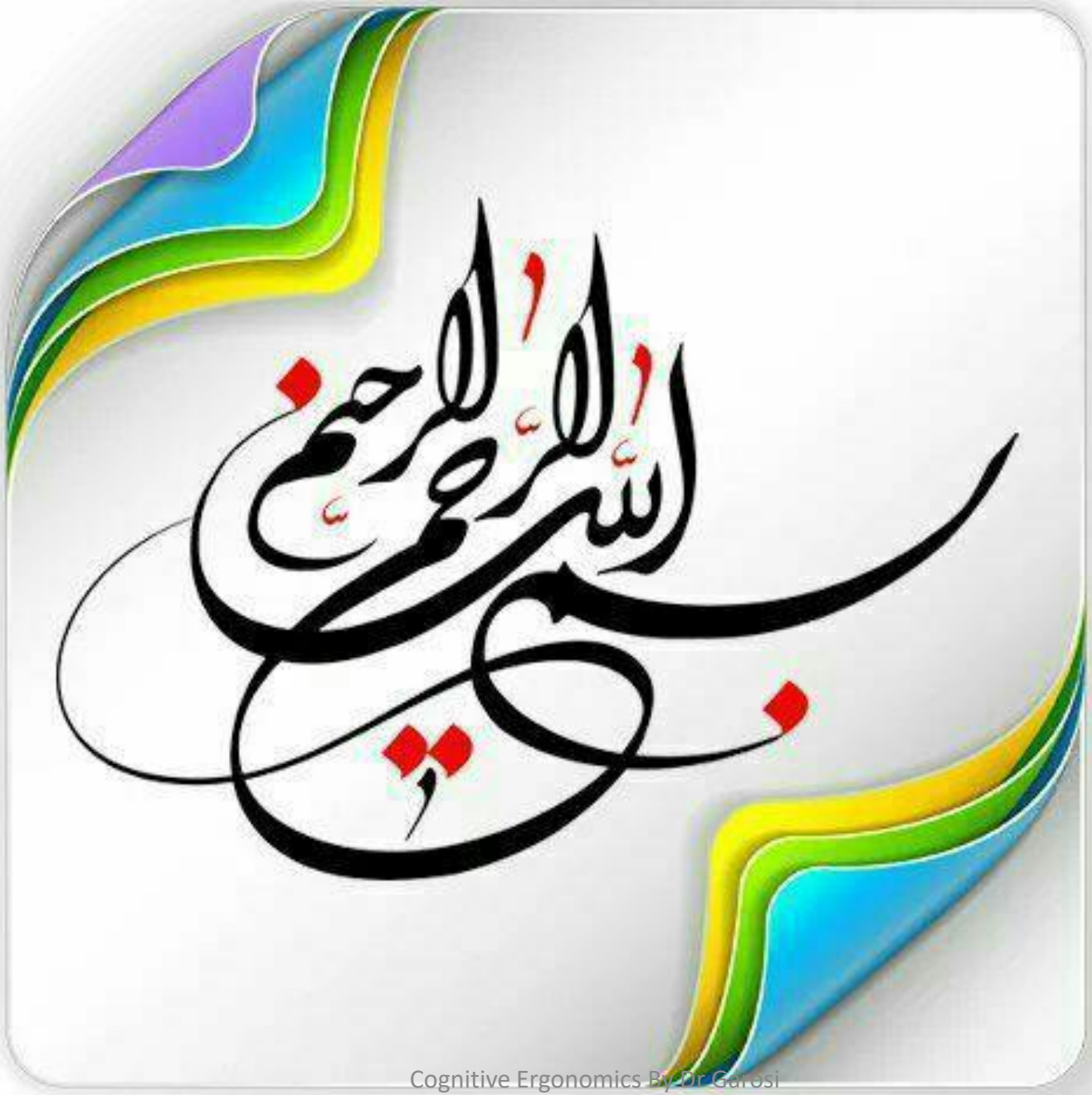

بسم الله الرحمن الرحیم

Ergonomics (1)

ارگونومی-۱

مدرس: احسان گروسی

دکتری تخصصی(PhD) ارگونومی

اهداف این جلسه

- **آشنایی به حوزه های ارگونومی شامل:**
  - ❑شناختی
  - ❑ فیزیکی
  - ❑ سازمانی
- **آشنایی با جنبه های آناتومیک فیزیولوژیک سایکولوژیک انسان در رابطه با ارگونومی**

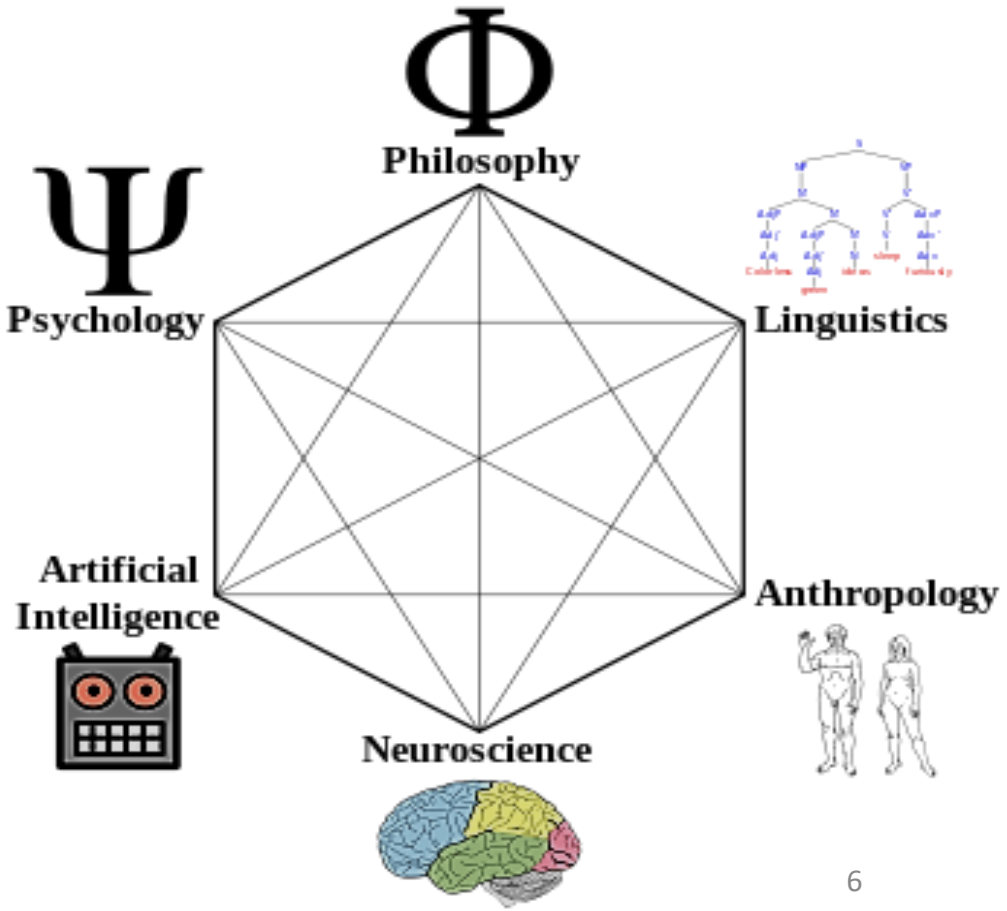
ارگونومی شناختی

علوم شناختی چیست؟

- یک علم میان رشته است و شاخه های روانشناسی، علوم عصبی، علوم رایانه، انسان شناسی زبان شناسی، فلسفه و ارگونومی و..... را در بر می گیرد.
- علوم شناختی به معنی مطالعه ی علمی ذهن نیز می باشد.
- گاهی علوم شناختی را بصورت مطالعه ی علمی شناخت نیز تعریف شده است.

Cognitive science

- Cognitive science is the interdisciplinary, scientific study of the mind and its processes.



شناخت

- شناخت مجموع **حالت ها** و **فرآیند های ذهنی** مانند تفکر استدلال ، درک ، تولید زبان، دریافت حواس پنجگانه، آموزش، آگاهی ، احساسات و.... در نظر گرفته می شود.
- منظور از ذهن مجموع هر آنچه که نمود های هوشمندی و آگاهی هستند مانند تفکر ، ادراک، حافظه، احساس، استدلال و نیز تمام روندهای نا اگاهانه شناختی است.

What is the difference between mind and cognition?

- As nouns the difference between cognition and mind:

✓ **Cognition is the process of knowing while mind is the ability for rational thought.**

علوم شناختی

- مهمترین اصل در این علم آن است که ذهن را میتوان به طور علمی فهمید. همین امر باعث میشود که علوم شناختی یک رویکرد مادی گرایانه (مانند فیزیک ، شیمی ، و...) به ذهن باشد.
- هدف تعیین اتفاقاتی است که در ذهن رخ می دهد.

ارگونومی شناختی

- ارگونومی شناختی بعبارت دیگر مهندسی شناختی است. شاخه ای از علم ارگونومی که تاکید ویژه ای بر تجزیه و تحلیل شناختی فرآیند های ذهنی و نحوه اثر این فرآیند های ذهنی در تعامل انسان با سایر اجزای سیستم می پردازد .

ارگونومی شناختی

- In August 2000, the Council of the International Ergonomics Association (IEA) adopted an official definition of ergonomics as shown below:
- **Cognitive ergonomics** is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system.
- Relevant topics include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design.

ارگونومی شناختی

- ارگونومی شناختی در ارتباط با به فرآیند های (ذهنی) مانند ادراک، حافظه ، استدلال،پاسخ های حرکتی و به اثرات این فرآیند ها در تعامل انسانها و سایر عناصر یک سیستم می باشد.

شامل مباحث با موضوعات:

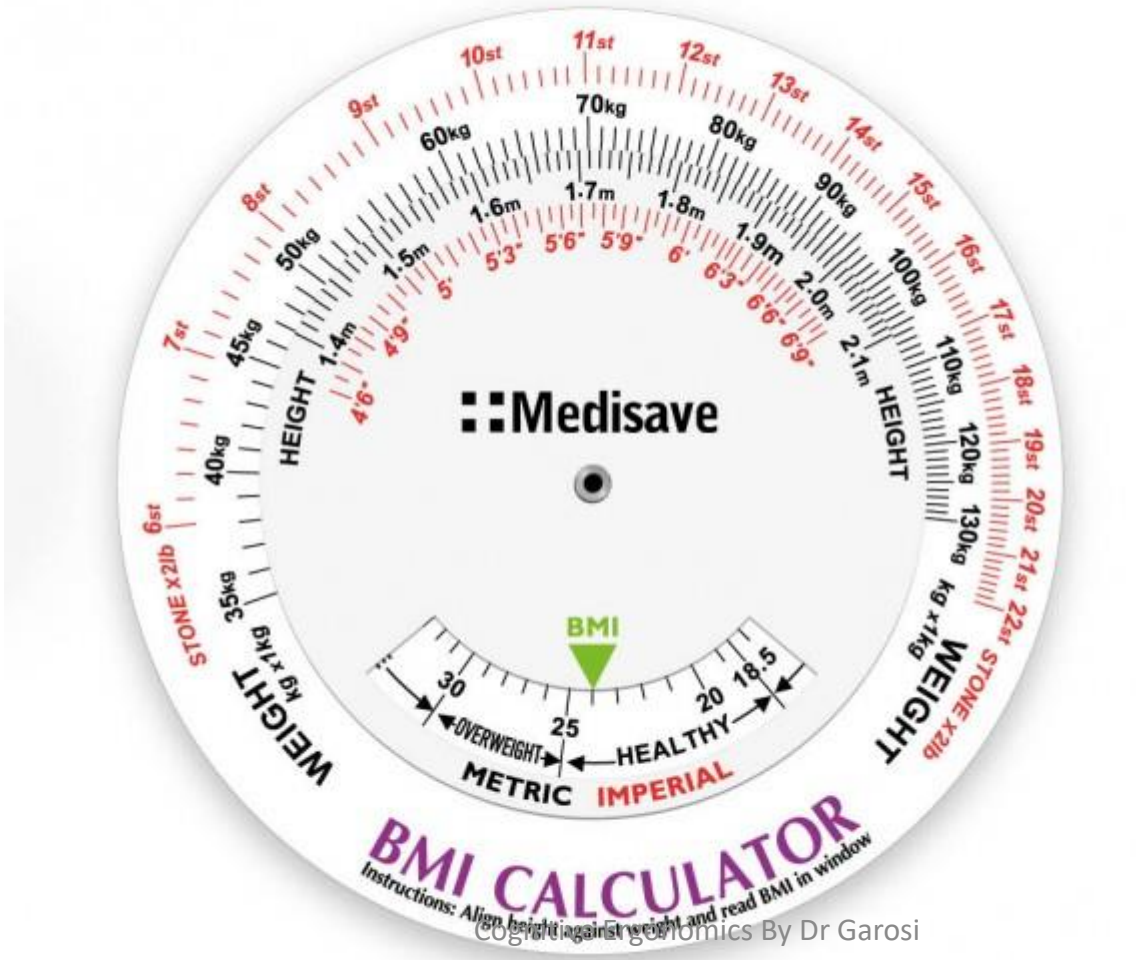
- بار کار ذهنی
- تصمصم گیری
- سبک عملکرد
- تعامل انسان با کامپیوتر
- قابلیت اطمینان انسان
- استرس کار
- آموزش
- عناوین مرتبط با طراحی انسان- سیستم

هدف ارگونومی شناختی

- **هدف ارگونومی شناختی ارتقائ عملکرد کارکردهای شناختی با استفاده از مداخلات مختلف از جمله :**

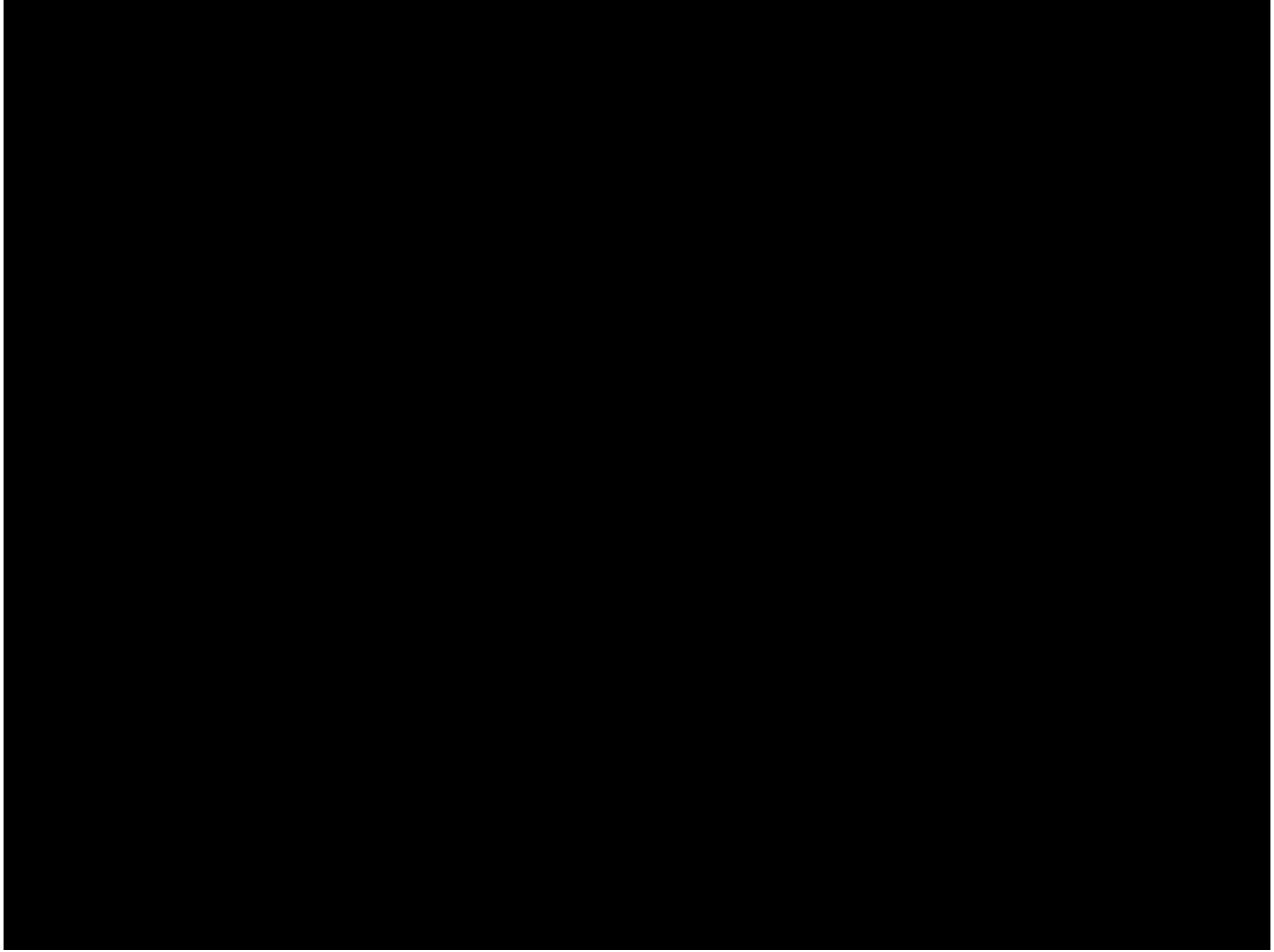
- User-centered design of human-machine interaction and human-computer interaction (HCI).
- Design of information technology systems that support cognitive tasks
- Design of alternative performance tools
- Work redesign to manage cognitive workload and increase human reliability.

An alternative performance tools



Physical ergonomics

- Physical ergonomics is about **the human body's responses to physical and physiological work demands**
- Physical ergonomics is concerned with the impact of anatomy, anthropometry, biomechanics, physiology, and the physical environment on physical activity.



Macro-Ergonomics

System

1-A set of things working together as parts of a mechanism or an interconnecting network; a complex whole.

Work System

سیستم کاری:

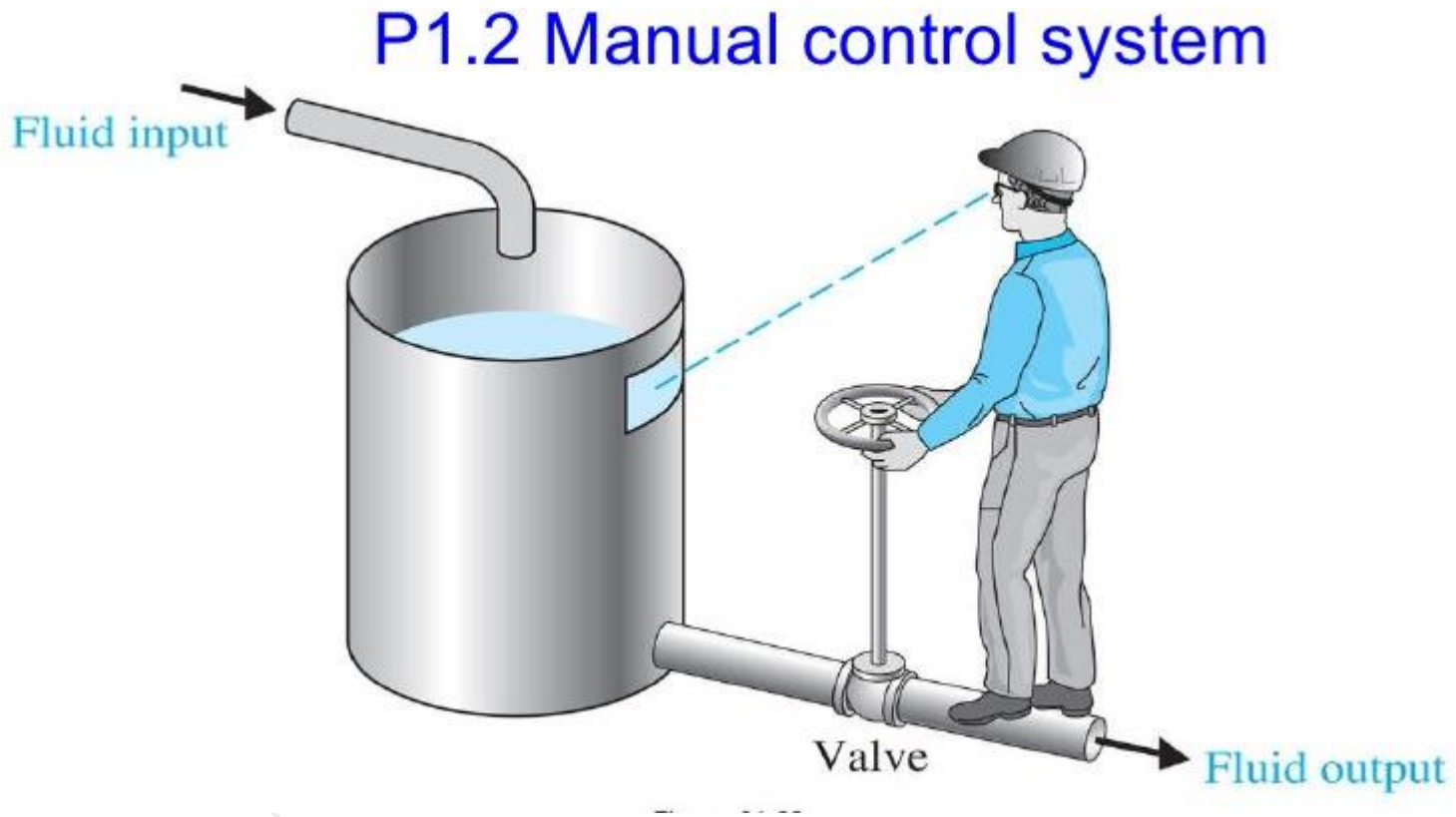
سیستم (انسان – ماشین)، چیدمان ماشین و انسان که در یک محیط باهم برای رسیدن به یک هدف خاص کار می‌کنند و در تعامل هستند گفته می شود.

ویژگی های یک سیستم کاری....

- هدفمند می باشد.
- دارای ورودی و خروجی می باشد. (Input/output)
- دارای ساختار یا سلسله مراتبی می باشد. (hierarchical)
- اجزا با یکدیگر در تعامل هستند و معمولا هماهنگ کار می کنند. (Interaction)

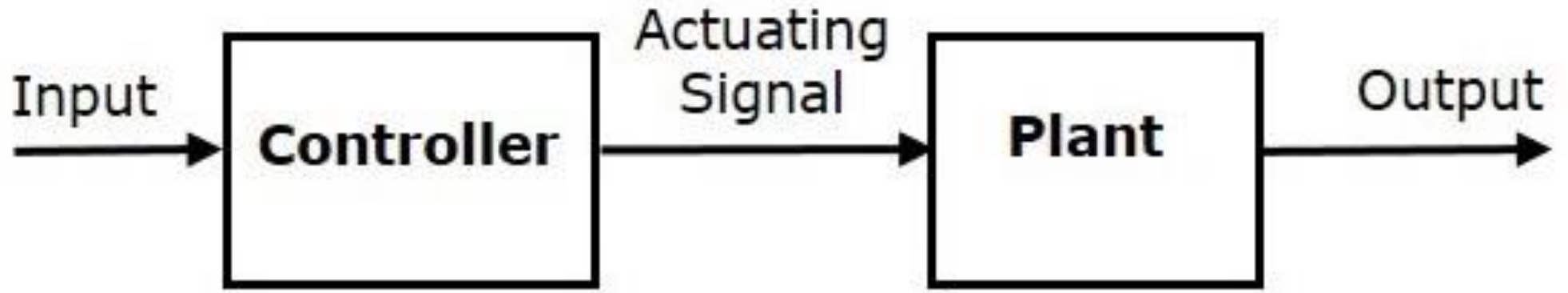
انواع سیستم بر اساس کنترل

1. Manual
2. Mechanical
3. Automatic
4. Intellectual

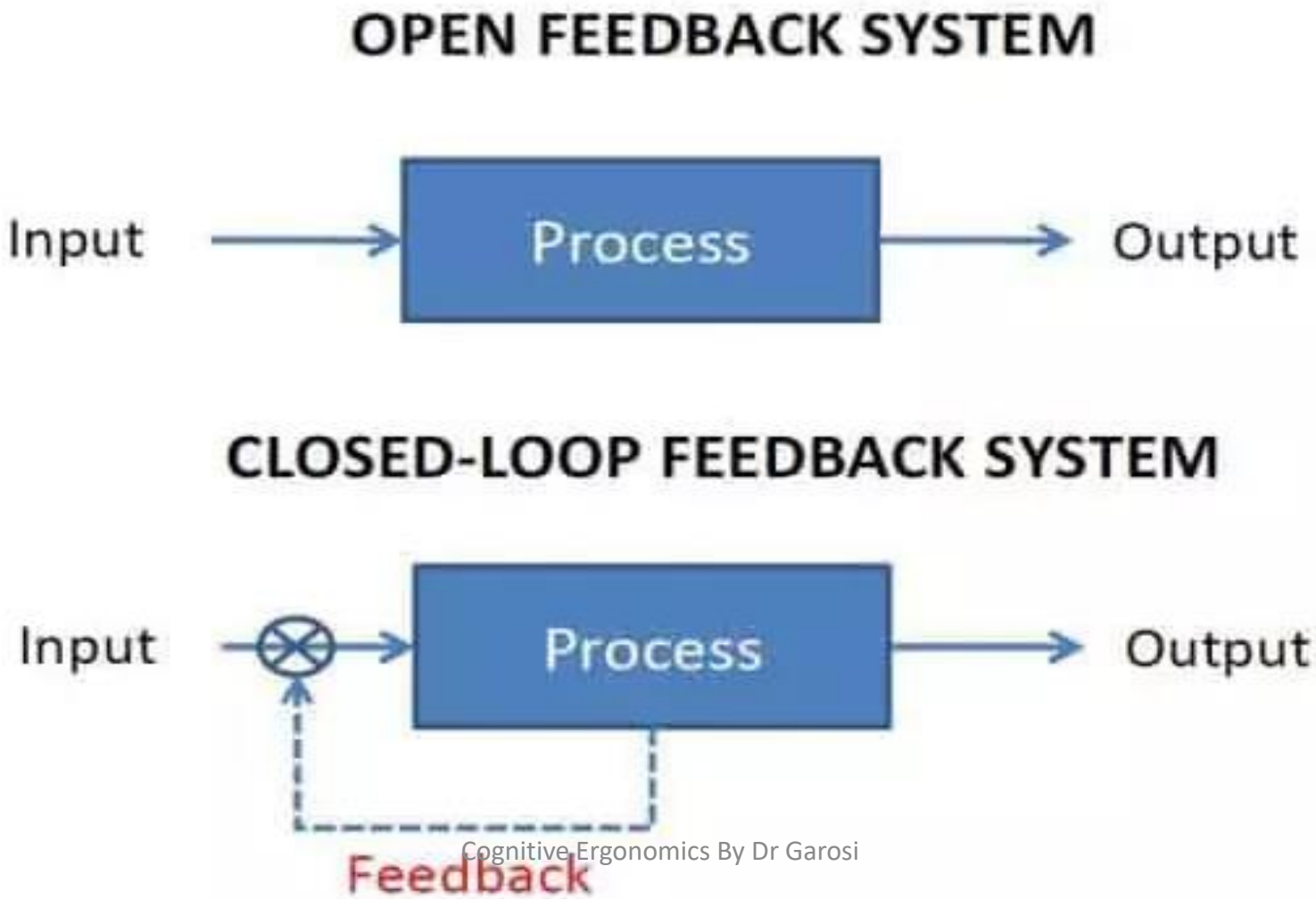


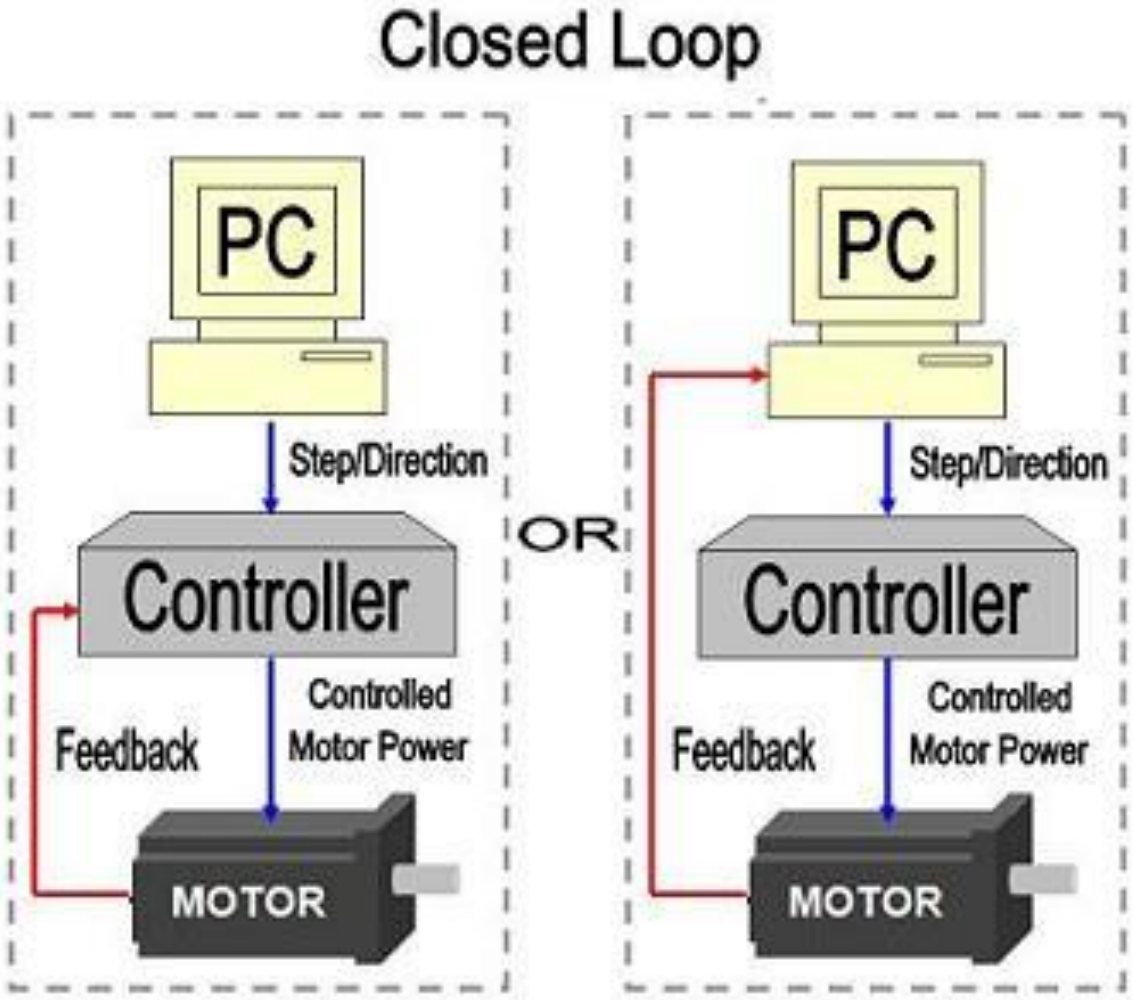
Control

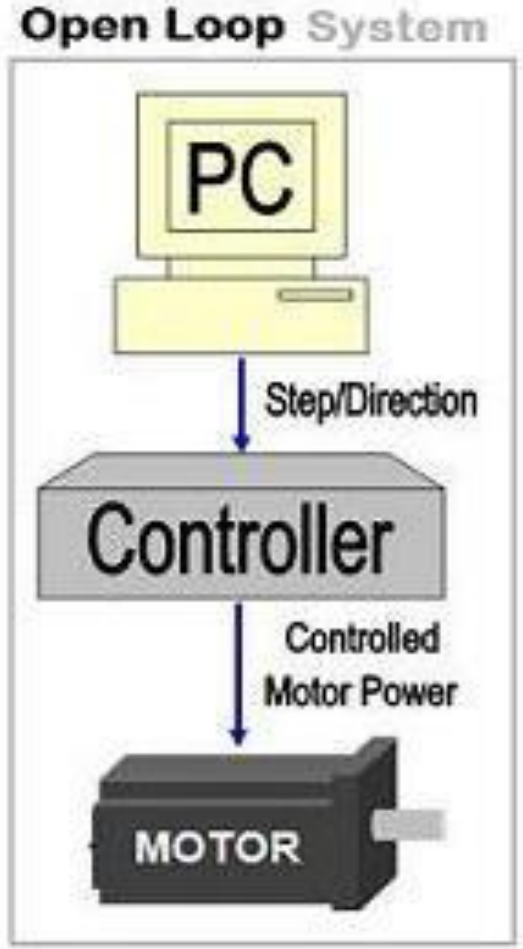
- Regulate
- Direct
- Command



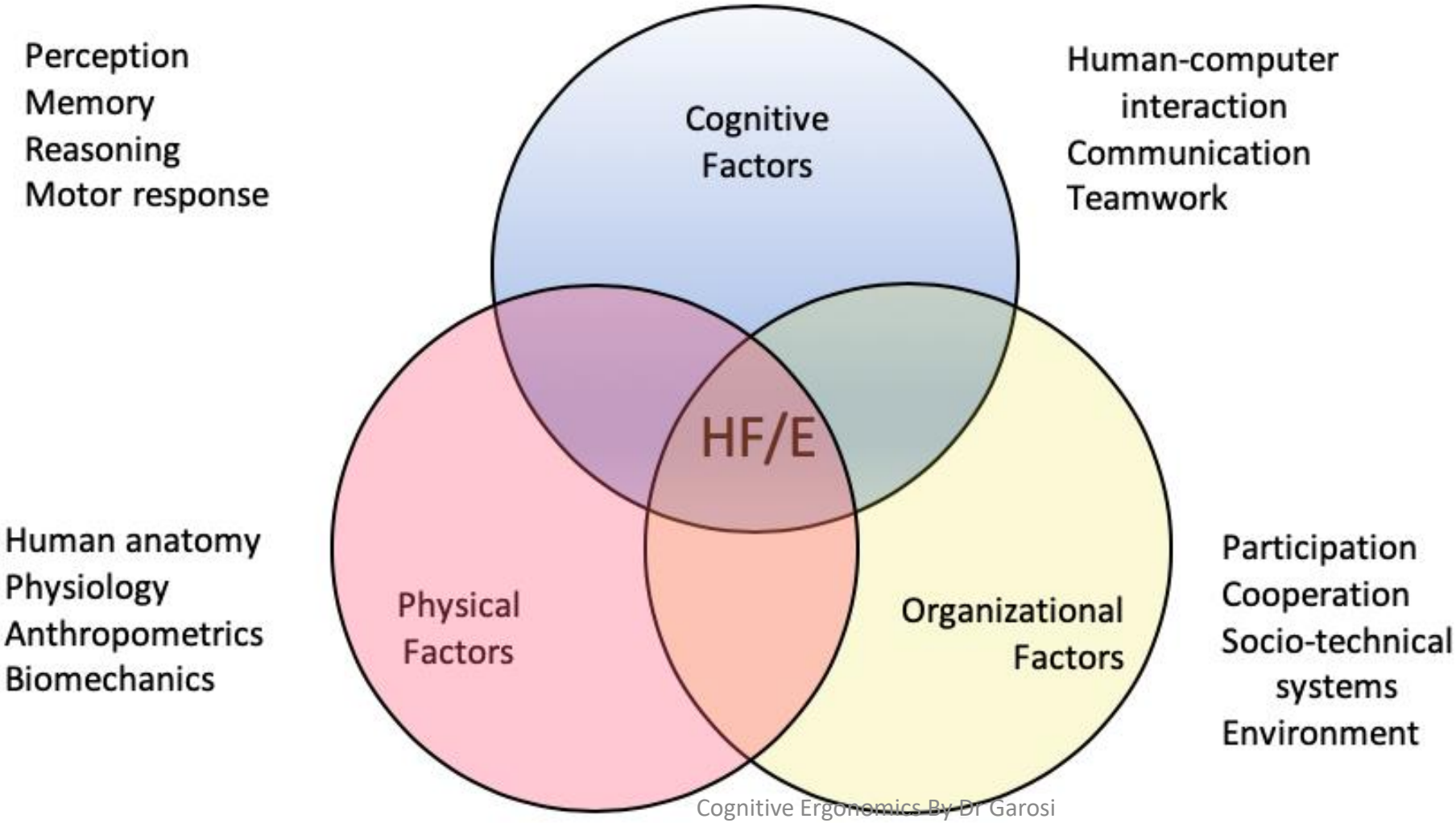
انواع سیستم بر اساس عملکرد

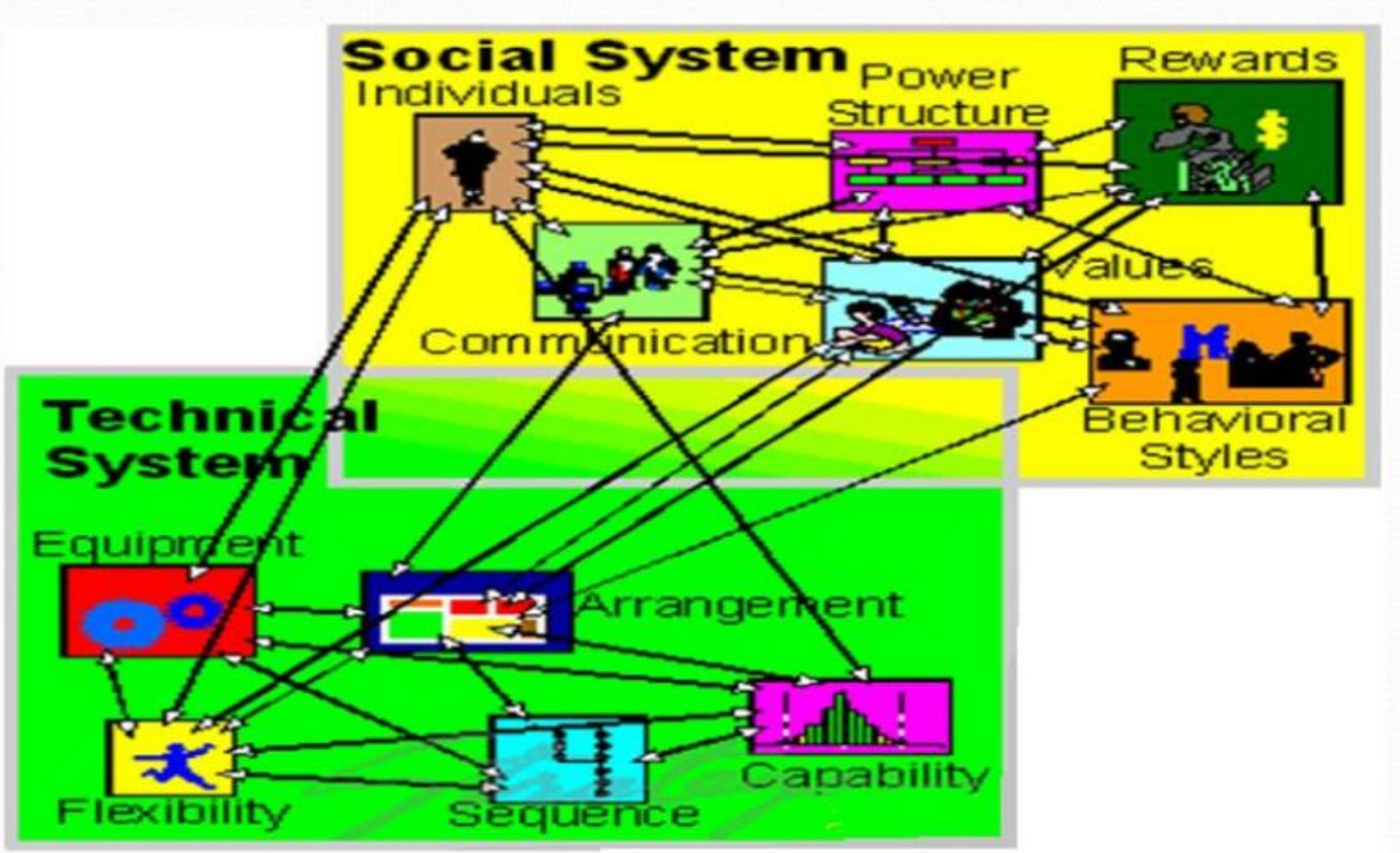



Closed Loop
PC
Step/Direction
Controller
Feedback
Controlled
Motor Power
MOTOR
OR
PC
Step/Direction
Controller
Feedback
Controlled
Motor Power
MOTOR


Open Loop System
PC
Step/Direction
Controller
Controlled
Motor Power
MOTOR

Domains of the HF/E or E/HF





Sociotechnical system diagram (Consultants-Engineers-Strategists, 2008).

Macro-Ergonomics

- Macroergonomics is one of ergonomics domain that concerned with optimization of organization and work system design through consideration of relevant personal, technological and environment variables and their interaction.
- Macroergonomics is concerned with the analysis, design and evaluation of **work systems**.

Macro-Ergonomics

- The term **work** is used herein to refer to any form of human effort or **activity**, including recreation and leisure pursuits.

- **System** refers to sociotechnical systems. These systems may be as **simple** as a single individual using a hand tool or as **complex** as a multinational organization.
- Sociotechnical refers to interaction between people and technology in workplaces. The term also refers to the interaction between society's complex infrastructures and human behavior.

Work system

- **A work system consists of two or more persons interacting with some form of …..**

(1) job design

(2) hardware and/or software

(3) internal environment

(4) external environment

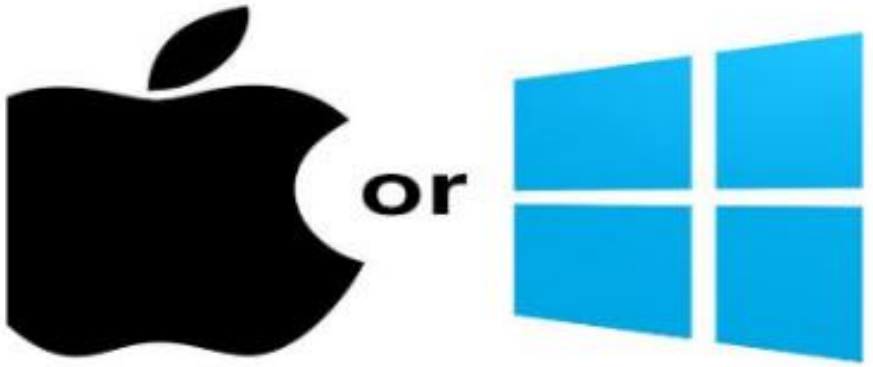
(5)organizational design

Job design

- Job design includes work modules, tasks, knowledge and skill requirements, and such factors as the degree of autonomy, identity, variety, meaningfulness, feedback, and opportunity for social interaction.

Hardware and/or software

- The hardware typically consists of machines or tools.



Internal environment

- The internal environment consists of various physical parameters, such as temperature, humidity, illumination, noise, temperature, humidity, air quality, and vibration.

External environment

- The external environment consists of those elements that permeate the organization to which the organization must be responsive to be successful. Included are political, cultural, and economic factors (e.g., materials and parts resources, customers, available labor pool, and educational resources).

Organizational design

- The organizational design of a work system consists of its organizational structure and the processes by which the work system accomplishes its functions.

اهداف ماکروارگونومی

Fully harmonized work system at the both macro and micro ergonomic level which result in improve:

- ❖productivity and performance
- ❖job satisfaction
- ❖Health
- ❖Safety
- ❖Employee commitment.

پروژه

- با تکیه بر مباحث که در درس ارگونومی فرا میگیرید می توانید طراحی های ارگونومیک خود را به صورت های:
- یک ابزار دستی
- یک تعامل دوطرفه بین انسان و ماشین
- یک ایستگاه کاری
- ابزار کمک عملکردی
- ابزارهای آموزشی
- ....

جلسه چهارم

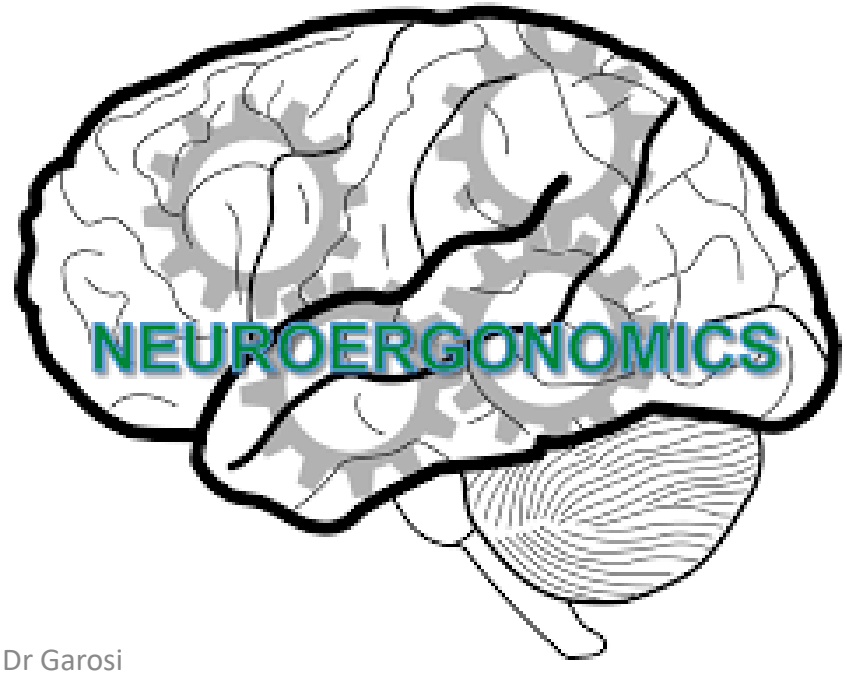
Memory

اهداف؟

- تعریف حافظه؟
- آشنایی با انواع حافظه و دسته بندی آنها؟
- آشنایی با ویژگی های دو نوع حافظه کوتاه و بلند مدت؟
- آشنایی با مدل پردازش اطلاعات؟
- لزوم در نظر گرفتن حافظه در تعامل انسان با اجزای سیستم و یا محیط؟

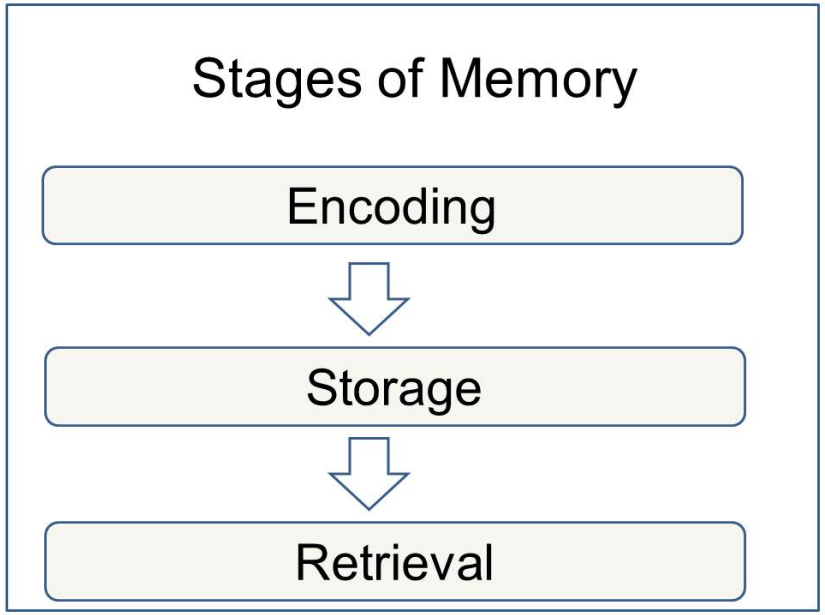
Neuroergonomics

- Neuroergonomics is an emerging science that aims to understand neural and physiological factors as they contribute to human performance in everyday settings and activities.



Memory

Memory is the intrinsic ability of the brain by which data or information is encoded, stored, and retrieved when needed.



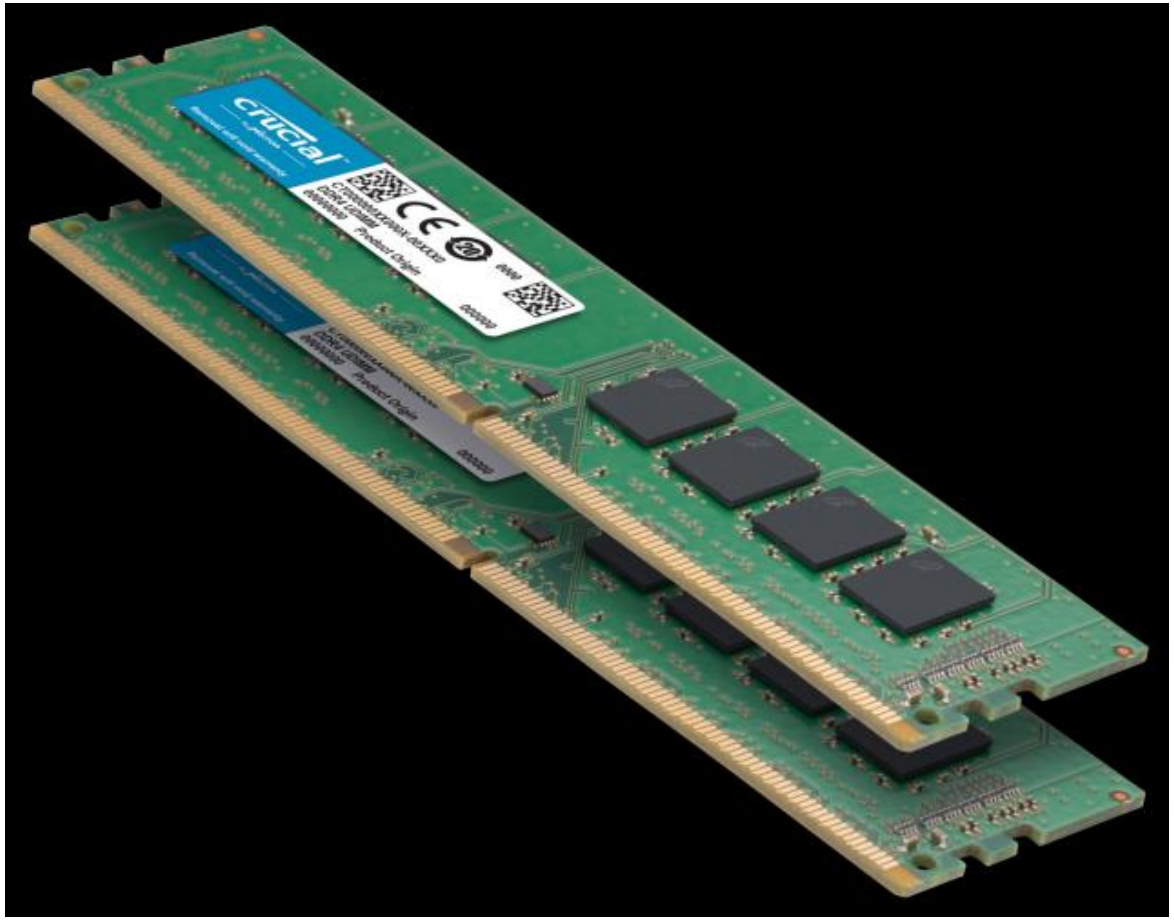
Type of memory

- Sensory memory (SM): 200-500 (250) ms,
- Short term memory (STM): working memory, 7±2 (Miller (1956)), 5-20 s ,phonetic
- Long term memory (LTM) : life time, semantic

Humans have five traditional senses

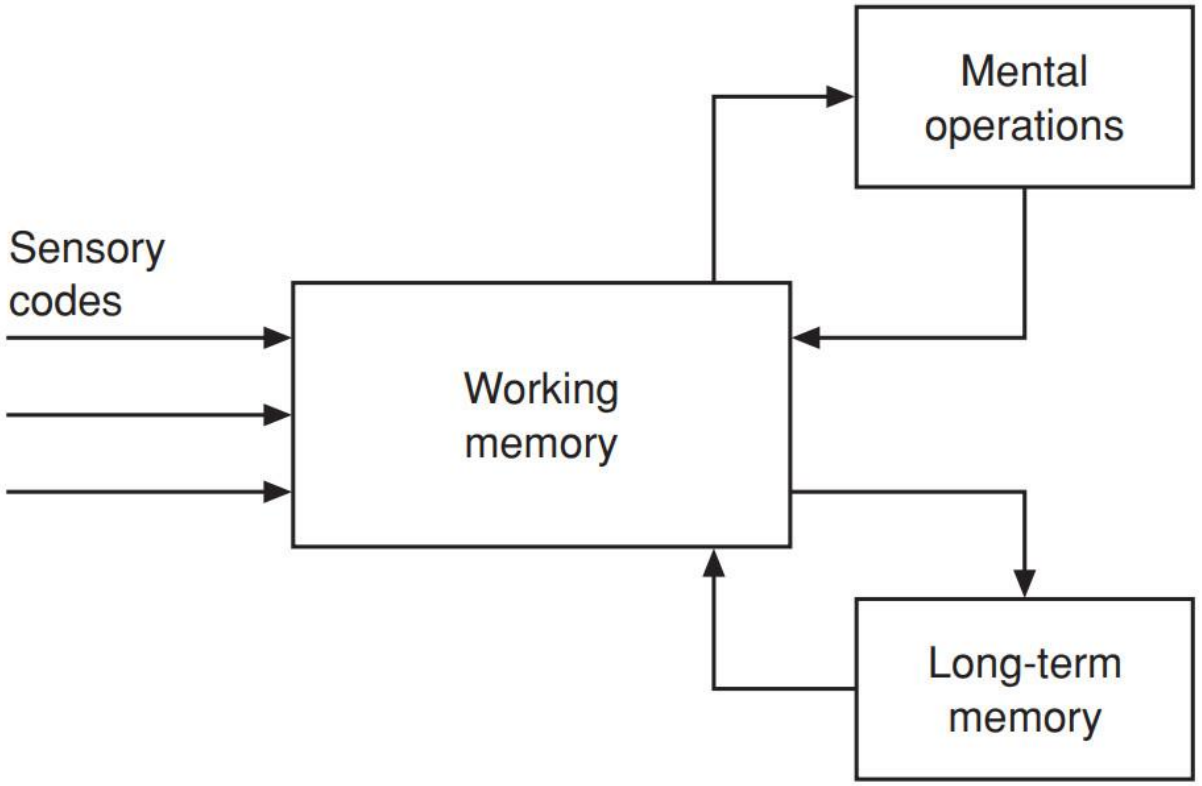
- **Sight**
- **Hearing**
- **Taste**
- **Smell**
- **Touch**

STM



LTM

Memory


Mental operations
Sensory codes
Working memory
Long-term memory

Information processing model (HIP)

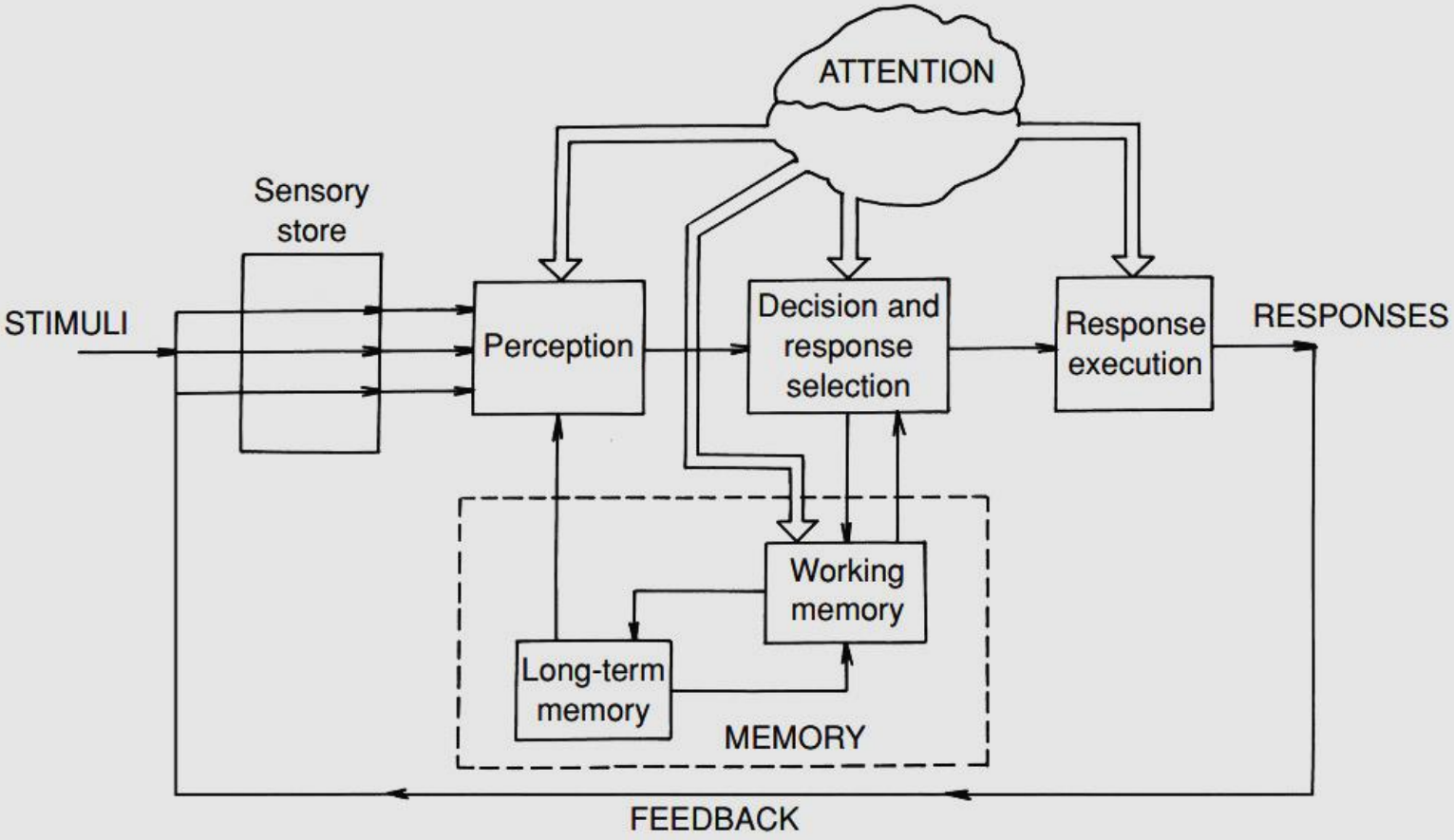
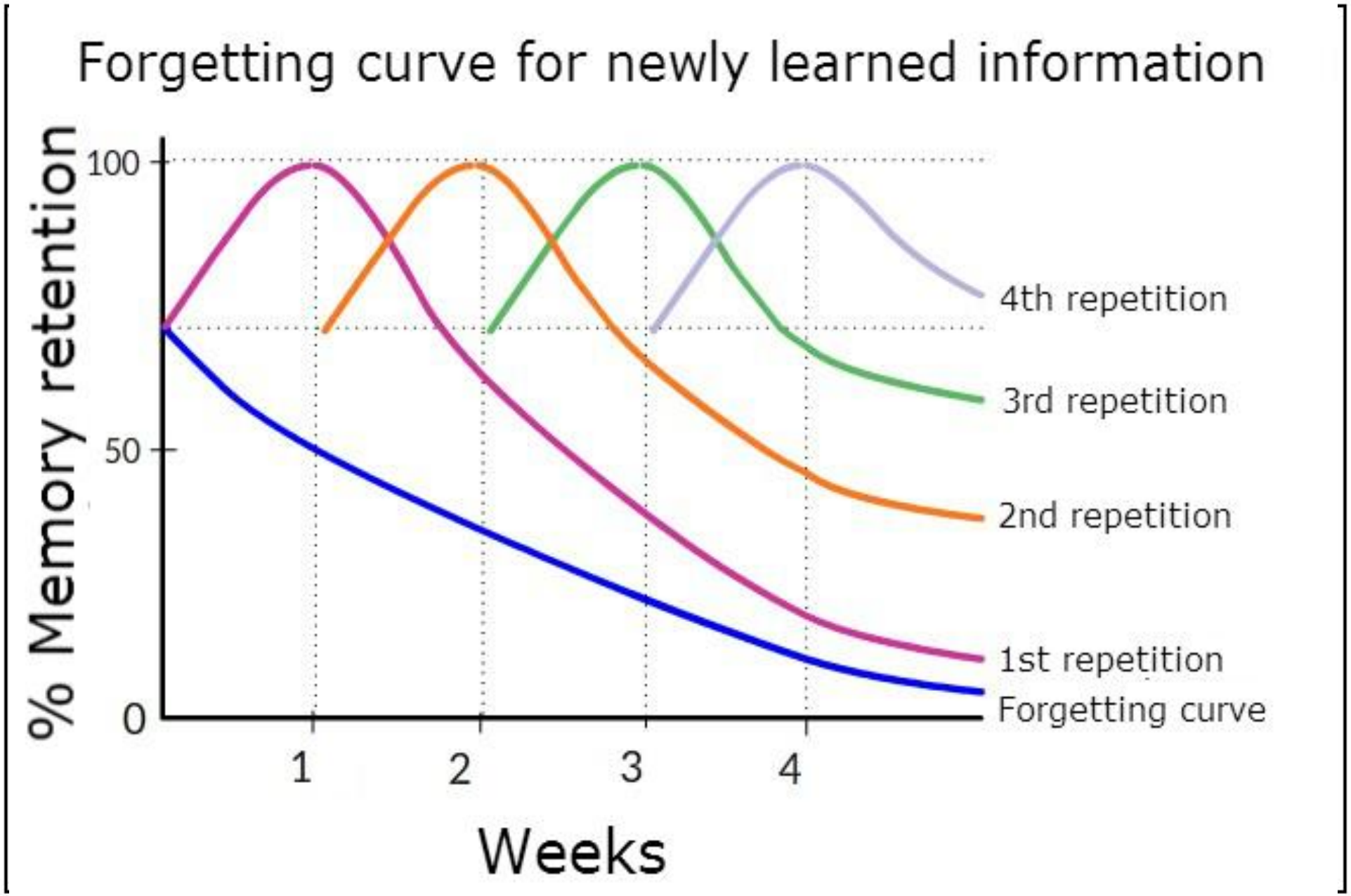
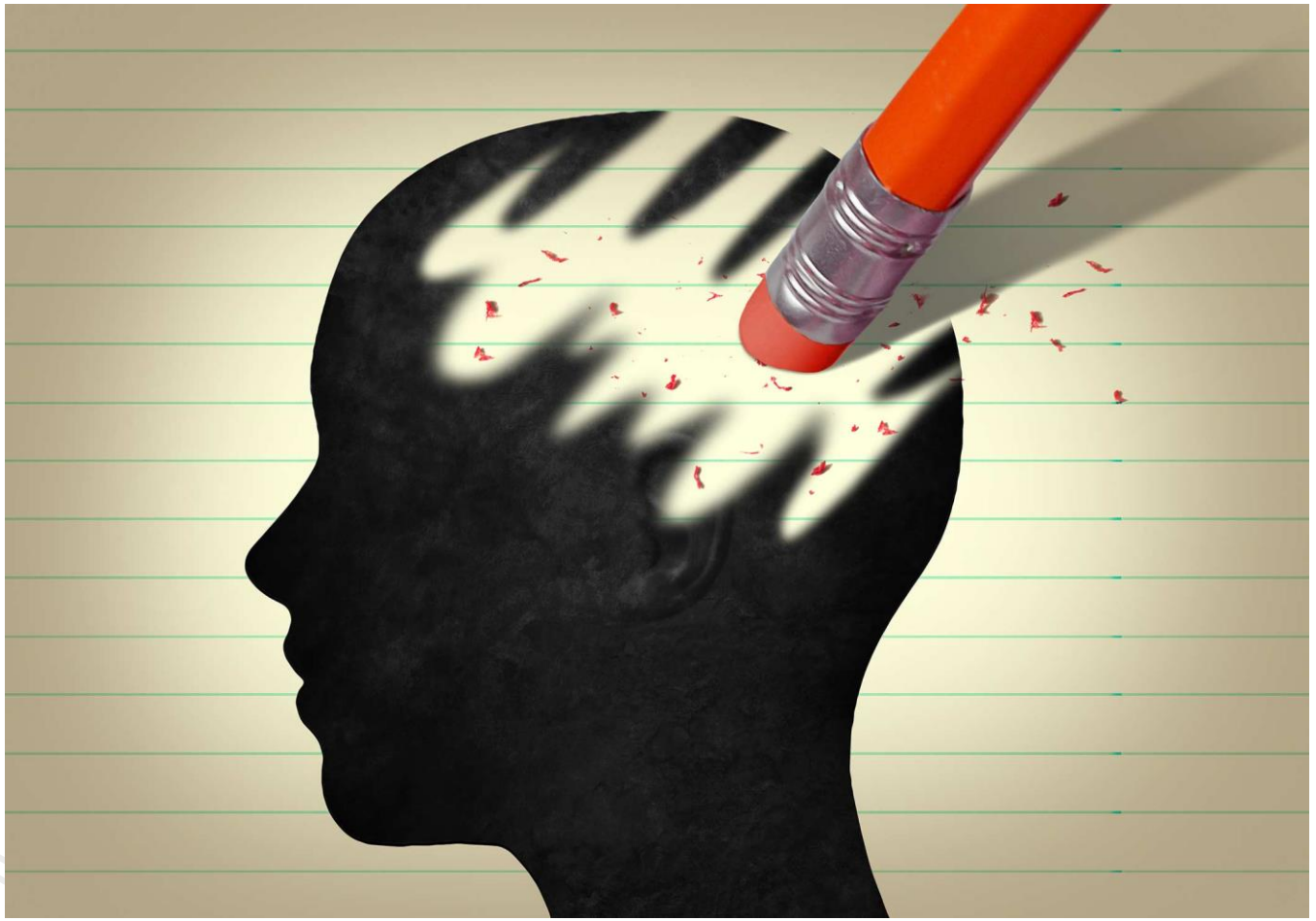


Figure 12.1 Wickens' general model of human information processing. (From Wickens, 1992. © Reprinted by permission of Pearson Education, Inc., Upper Saddle River, NJ.)


Forgetting curve for newly learned information
% Memory retention
100
50
0
1
2
3
4
Weeks
4th repetition
3rd repetition
2nd repetition
1st repetition
Forgetting curve

Memory loss is usually described as:

- **Forgetfulness**
- **Amnesia**



جلسه پنجم

- ادامه درس حافظه

STM

Murdock (1962) drew up lists of unrelated words from 10 to 40 words in length. The lists were presented to subjects who then had to recall the words in any order. Murdock found that the items at the end of the list were recalled first and with the highest recall probability. He called this the recency effect. The items at the beginning of the list were next best recalled. This was called the primacy effect. The items in the middle of the list were recalled worst.

STM

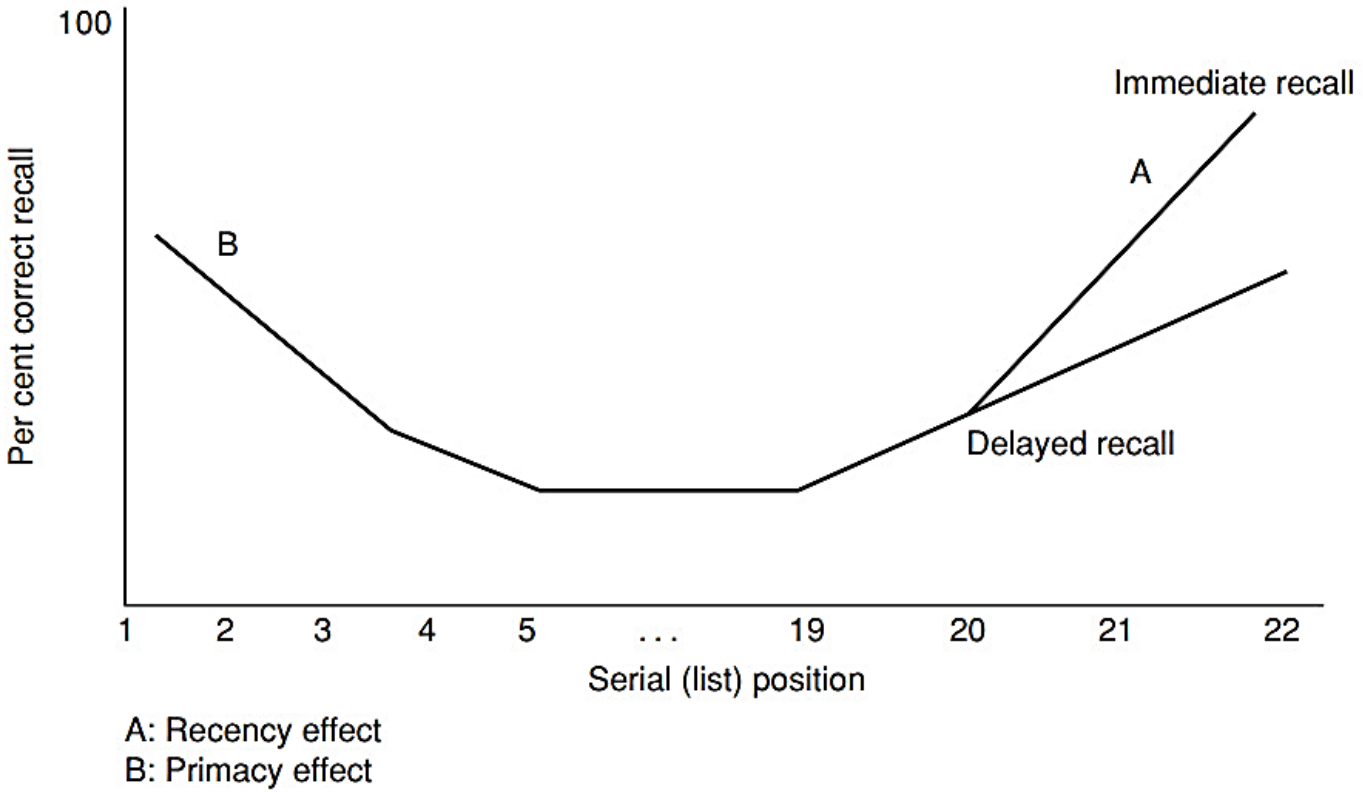


Figure 12.4 The serial position effect in short-term storage.

SM

Iconic memory

Iconic memory is described as a very brief (<1 second), pre-categorical, high capacity memory store. It contributes to VSTM by providing a coherent representation of our entire visual perception for a very brief period of time.

- **Change blindness**

Refers to an inability to detect differences in two successive scenes separated by a very brief blank interval.

SM

- **Echoic memory**

Echoic memory is the sensory memory register specific to auditory information (sounds).

The sensory memory for sounds that people have just perceived is the form of echoic memory.

The echoic sensory store holds information for 2–3 seconds to allow for proper processing.

- **Unlike** visual memory, in which our eyes can scan the stimuli over and over, the auditory stimuli cannot be scanned over and over

Haptic memory

- Haptic memory represents SM for the tactile sense of touch. Sensory receptors all over the body detect sensations such as:
- Pressure
- Itching
- Pain

Differences between long-term and short-term memory

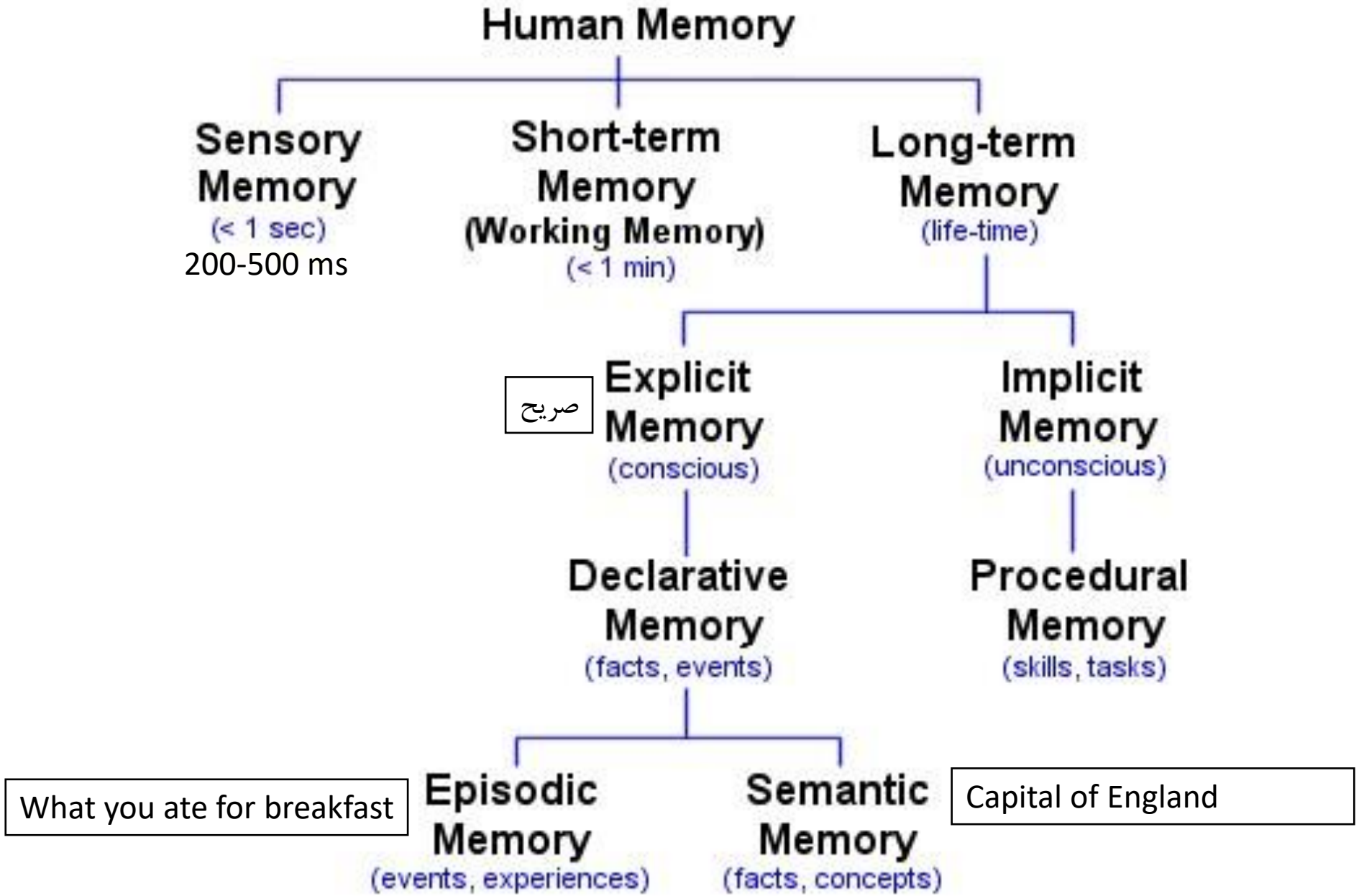
	STS	*LTS*
Storage capacity	7 items ±2	Extremely large
Retention interval	5–30 seconds	Many years
Mechanism of information loss	Trace decay Displacement by new items	Inability to retrieve item
Way information is coded	Phonetic/articulatory	Semantic

Highlight

- Tasks that require STM storage from multiple sources can be said to be of high mental workload.
- **For example:**

Operators, Pilot, And so on….

- **This requires that the task requirements be analyzed early in the design stage and that the skills and knowledge of the operator be taken into account.**


Human Memory
Sensory Memory
(< 1 sec)
200-500 ms
Short-term Memory
(Working Memory)
(< 1 min)
Long-term Memory
(life-time)
صريح
Explicit Memory
(conscious)
Implicit Memory
(unconscious)
Declarative Memory
(facts, events)
Procedural Memory
(skills, tasks)
What you ate for breakfast
Episodic Memory
(events, experiences)
Semantic Memory
(facts, concepts)
Capital of England

Decrease memory workload

- **Best practices of cognitive ergonomics:**

❑Reasonable number of objects/information to be kept in mind,

❑Decreasing unnecessary visual information, background speech, and interruptions,

❑Use of external memory aids and visualizations,

❑Non-overlapping modalities, codes, stages, and responses required in a task,

❑Reducing costs of task switching and the need to perform simultaneous tasks.