Who am I?

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Starting in the name of Allah,

the most beneficial,
the most merciful.

اَمۡ لِلۡاِنۡسَانِ مَا تَمَنّٰی ﴿۲۴﴾

کیا انسان کو ہر وہ چیز حاصل ہے جس کی اس نے تمنا کی؟

وَاَنۡ لَّیۡسَ لِلۡاِنۡسَانِ اِلَّا مَا سَعٰی

اور یہ کہ انسان کے لیے نہیں ہے مگر وہی کچھ جس کی اس نے سعی کی ہوگی۔

القرآن - سورۃ نمبر 53 النجم
آیت نمبر 39

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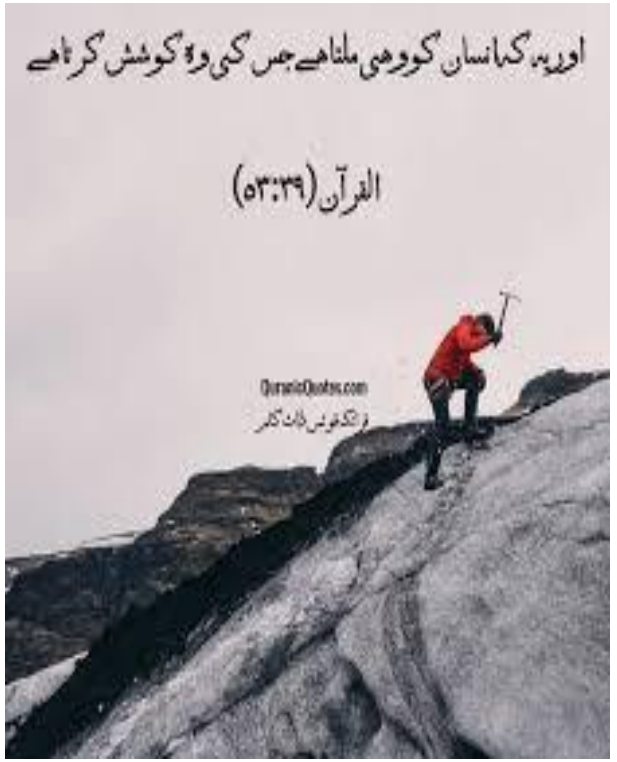
And there is not for man except that [good] for which he strives.

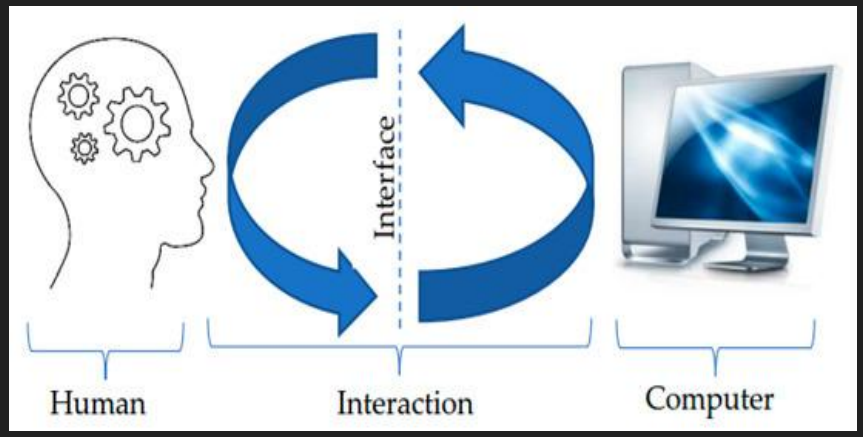


Week 02

Human Computer Interaction & Computer Graphics

Department of Computer Science (DCS/UBIT)
University of Karachi
January 2026

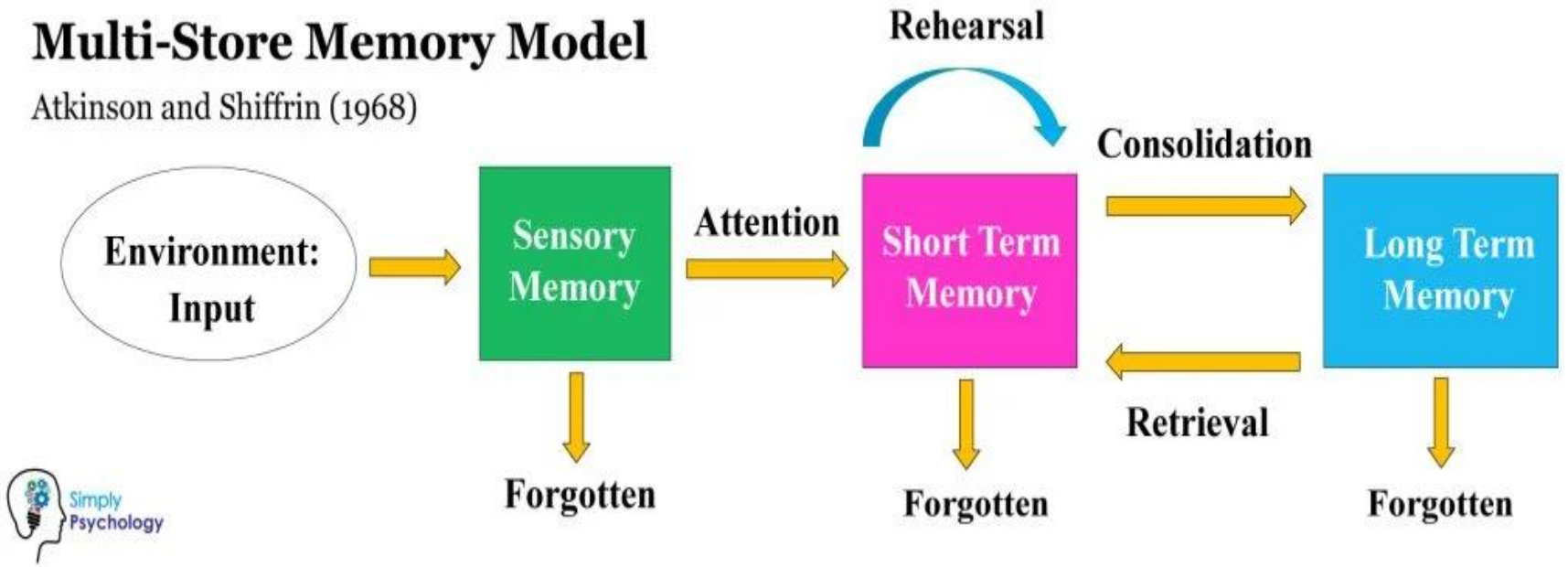
Reflect : Week 1



Foundation of HCI

- *Study, Observe, learn how people use computers and other things*
- *Design UI, technology and the entire user experience (UX)*
- *Analyze, evaluate and assess human computer interaction*

Memory Models (Encoding-storing-retrieval)



Information is passed from sensory memory into short term memory by attention thereby filtering the stimuli to only those which are of interest at given time.

Information received by sensory memories is quickly passed into a more permanent memory store or overwritten or lost.

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Lets' Retrieve Week Thoughts (1)

🧠 STM (Milliseconds → Seconds) 🔁 Rehearsal (Seconds → Minutes) 🧠 LTM (Hours → Years)

Lecture Sense

Short-Term / Working Memory (STM)

⏱️ 200 ms – 30 secs

- Sensory processing (visual/auditory)
- Attention & perception
- Capacity ≈ 7±2 items

Rehearsal + Meaning + Examples

⏱️ 30 seconds – several minutes

- Chunking
- Elaboration (Netflix, Amazon)
- Repetition & discussion
- Semantic association

Encode

Long-Term Memory (LTM)

⏱️ Hours → days → years

- Semantic memory (laws, principles)
- Procedural memory (design thinking habits)
- Organized as semantic networks

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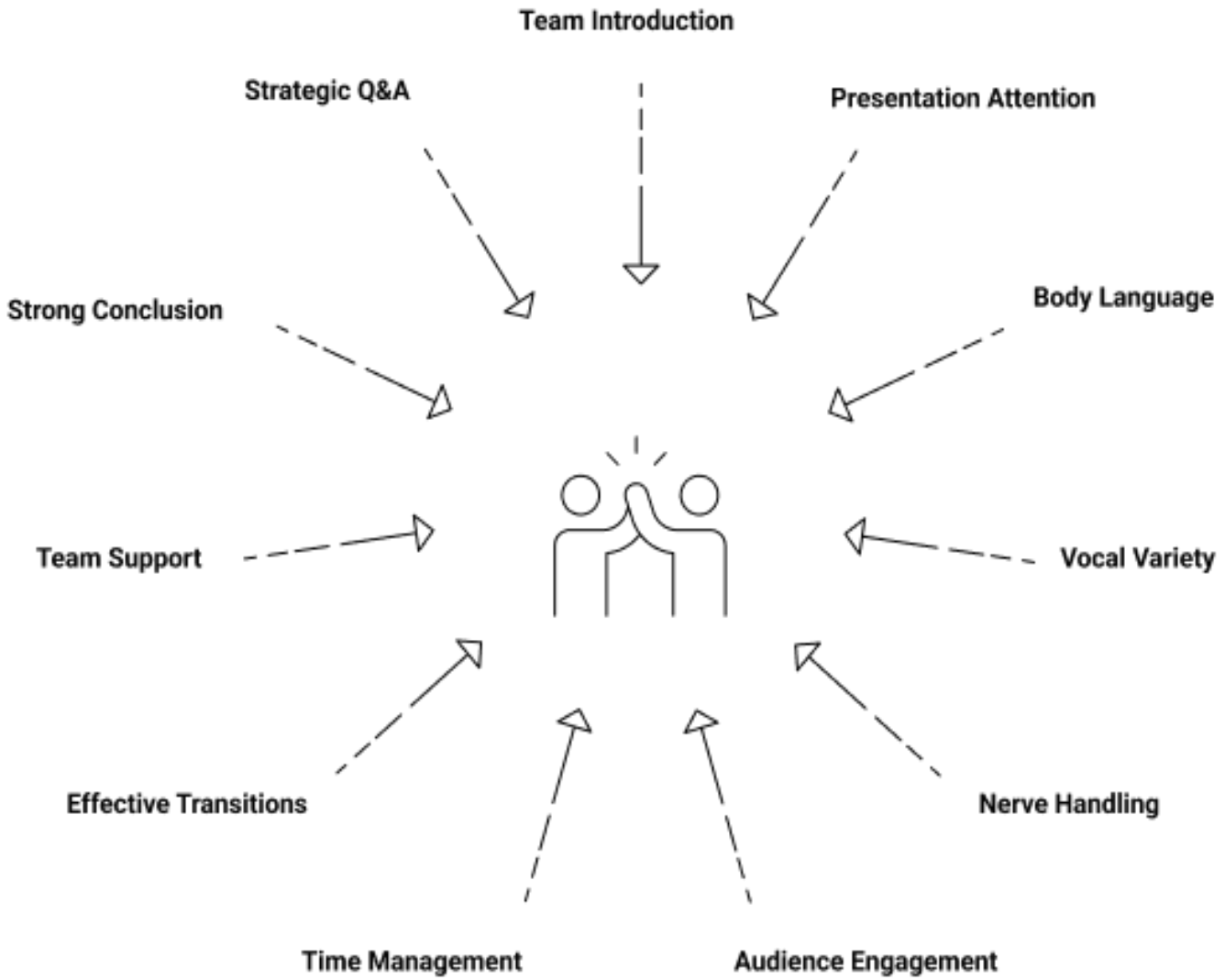
Daily Life User Experiences (UX)

Rs 455,000 = 1,625.73 USD



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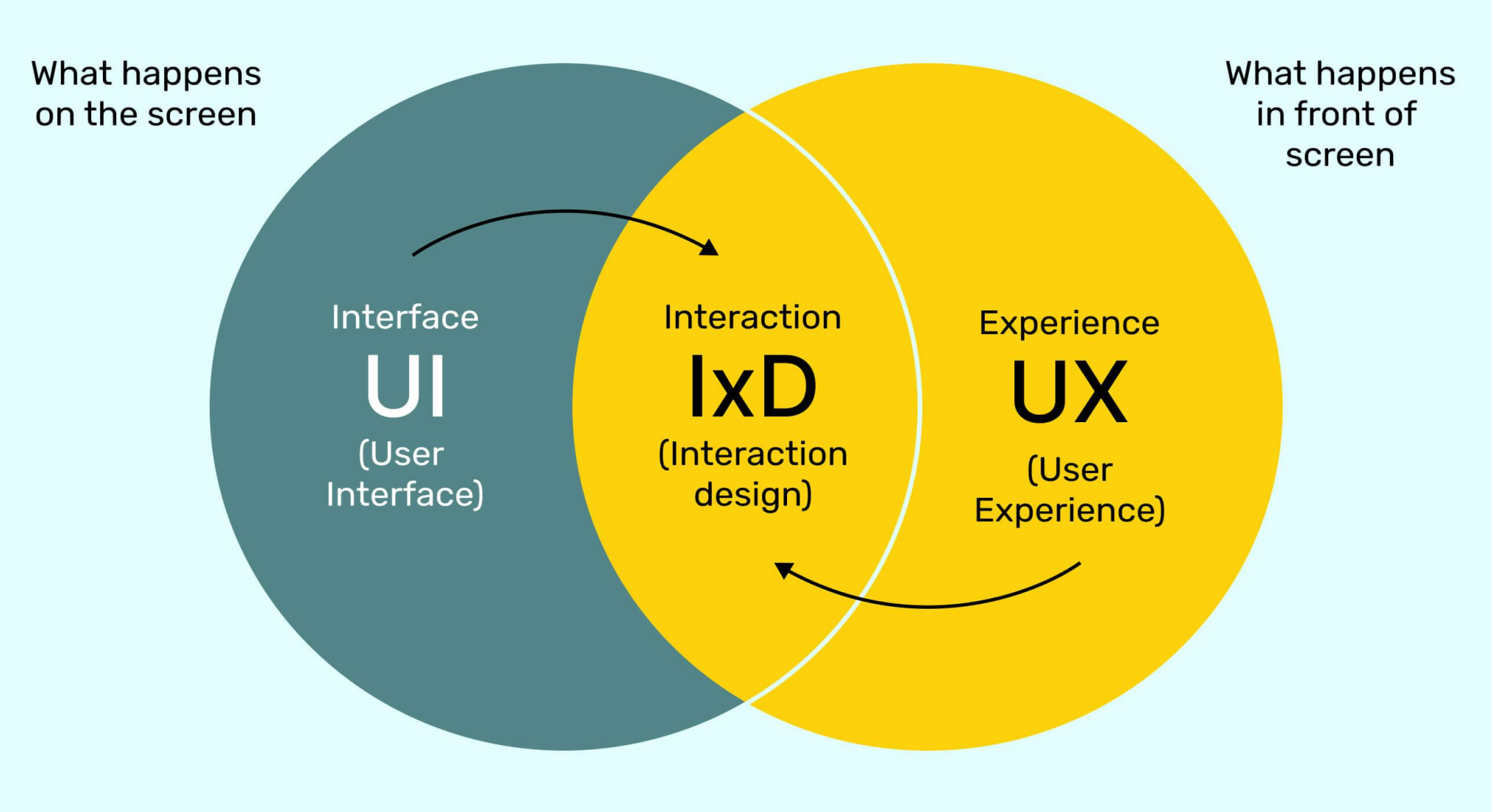
UI vs UX vs IxD



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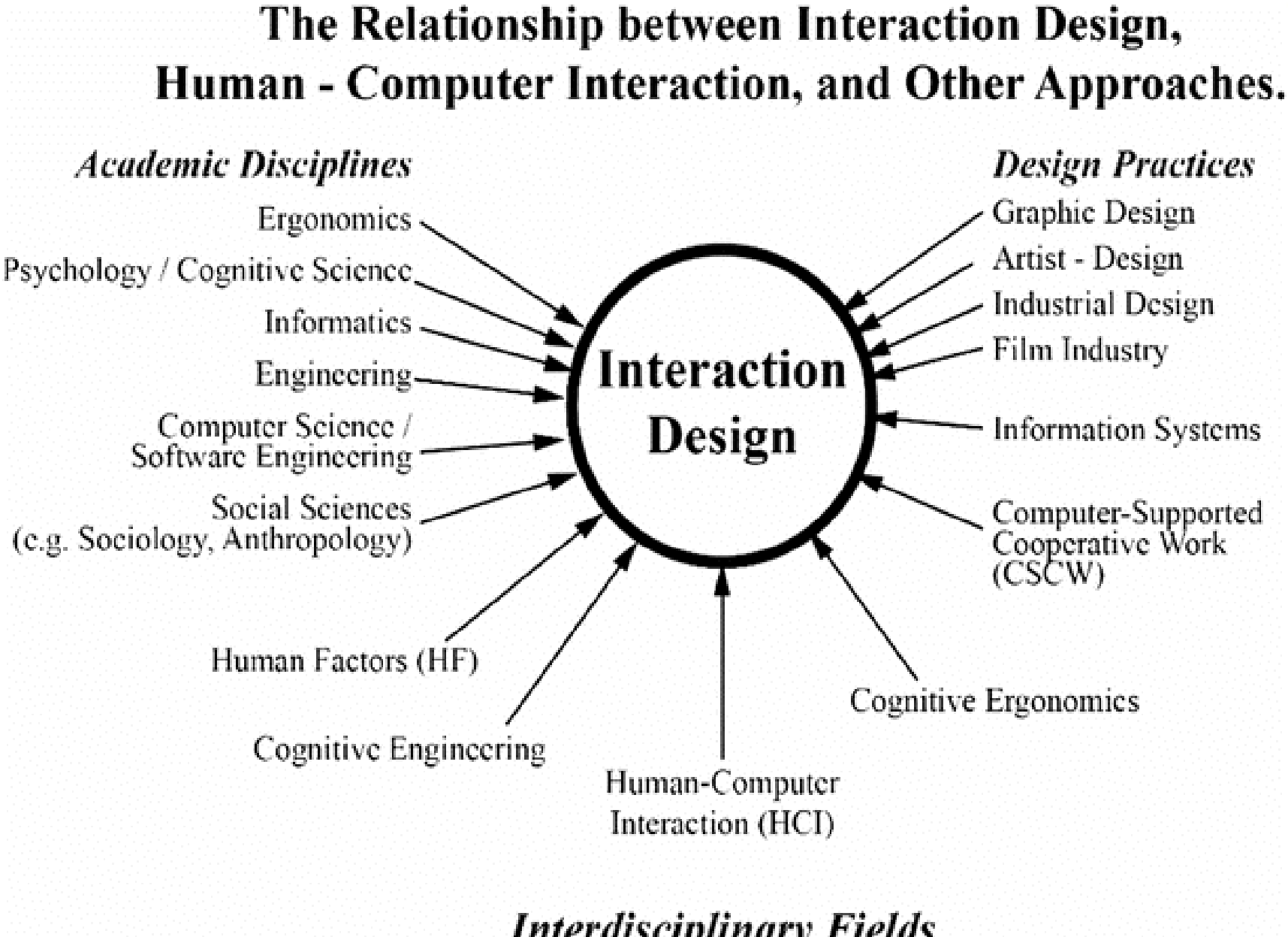
What will we do in Theory & Lab ?



Interaction design (IxD) is the design of interactive products and services in which a designer's focus goes beyond the item in development, including how users interact with it. Thus, closely examining the needs, limitations, contexts, etc. of the users empowers the designers to customize the output to suit the exact demands.

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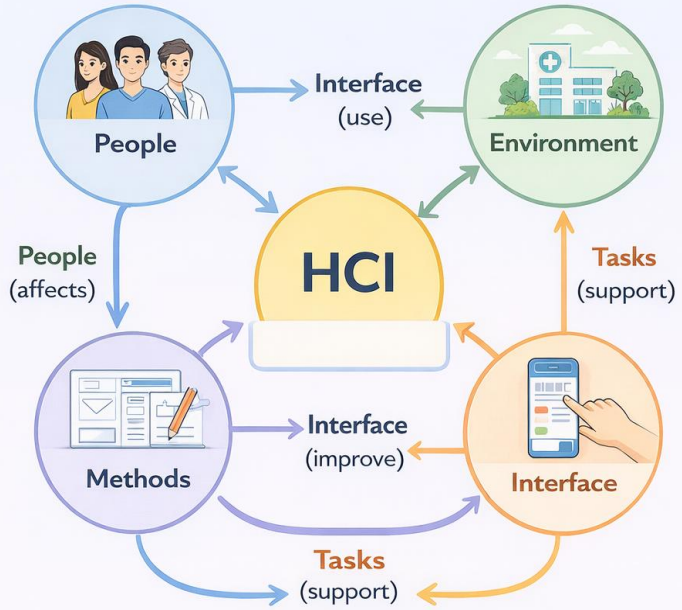
Practice Semantic Networks (Lab: Chunking-STM-LTM)

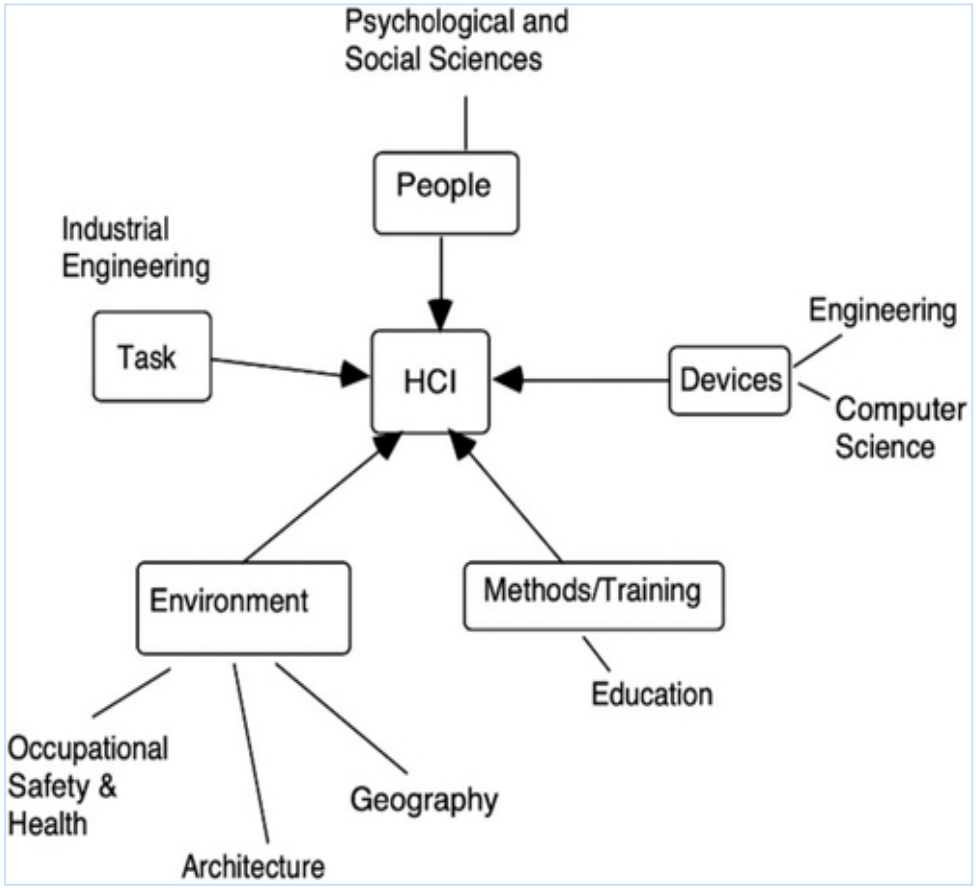
HCI is not about computers — it is about people using technology to achieve goals **safely, effectively, and meaningfully** in real contexts.



Key Learning Idea:
HCI is not just about screens—
It is about people, goals, tools, and context working together.

Semantic network is a structure that represents knowledge as **nodes (concepts)** connected by **links (relationships)** showing how meanings are related.

Issues and disciplines related to human–computer interaction (Reprinted from Figure 1 in Chignell, Hancock and Takeshita, 1999).



Labeled Relationships:

People → *use* → Interface
Interface → *supports* → Tasks
Environment → *affects* → People
Methods → *improve* → Interface
Tasks → *define requirements for* → Interface *(implicit but valid)*

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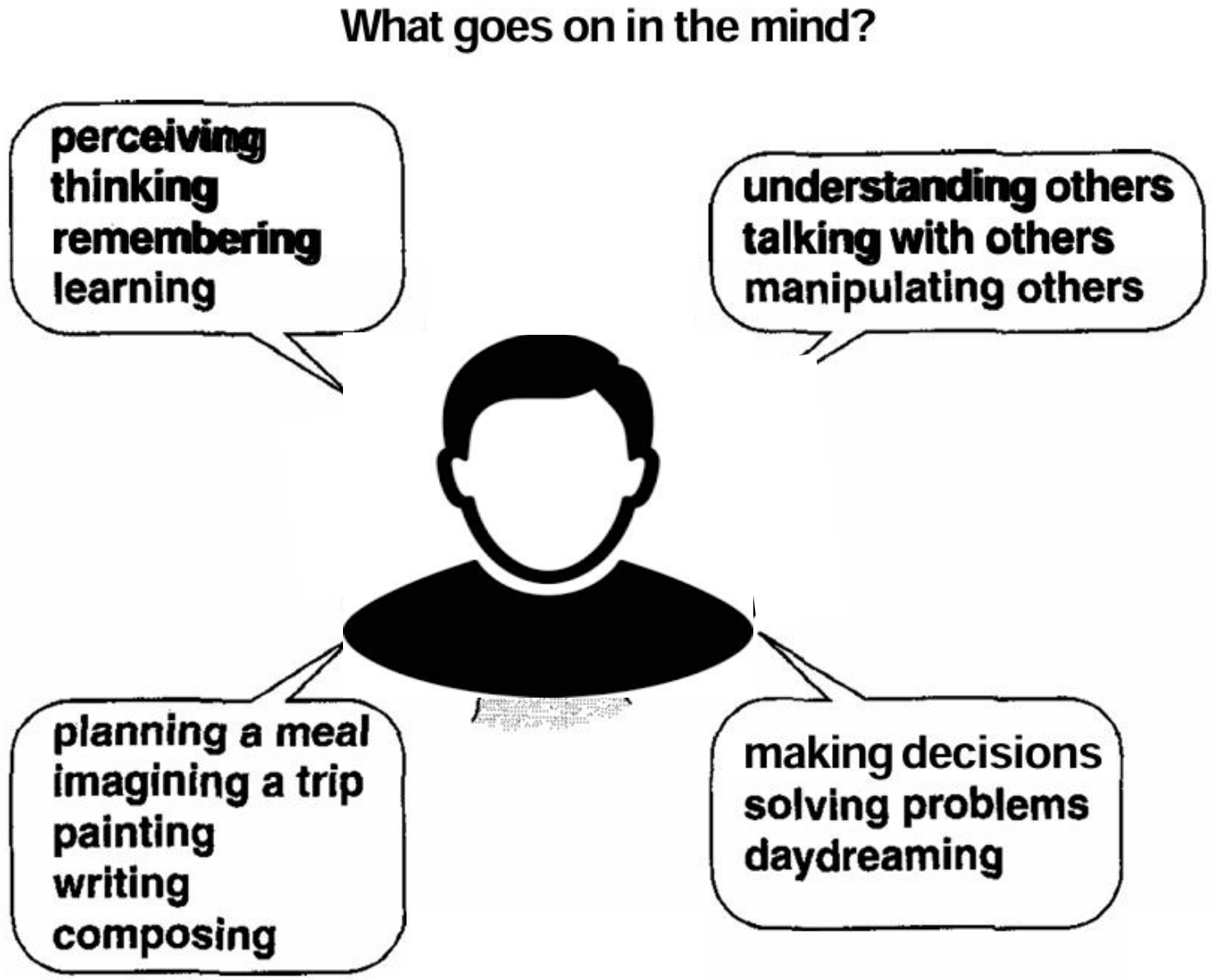
Let's Start : Week 2

What is happening in our minds!



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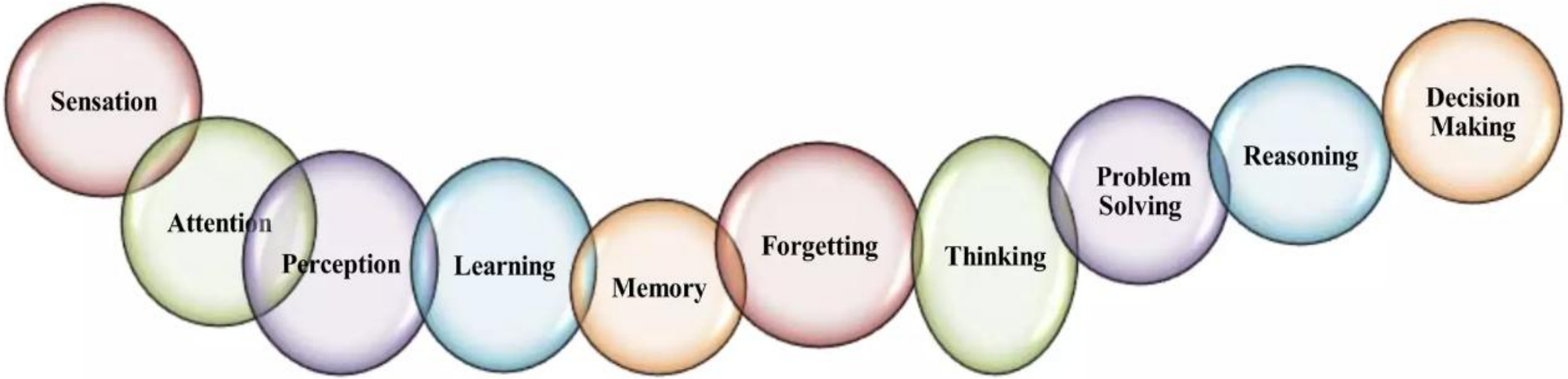
Cognitive Processes (Higher mental state)

- ✓ Attention is the mental process of brining few stimuli into the center of awareness out of many stimuli present.
- ✓ The process of assigning meaning to the information received about the environment based on past experiences.



- ✓ Cognitive processes include all processes underlying mental activities like attention, perception, learning, memory thinking, problem solving, reasoning.

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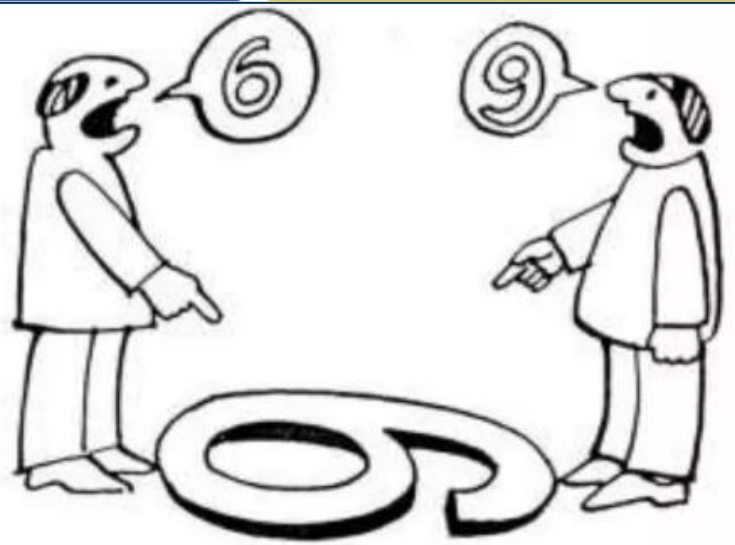
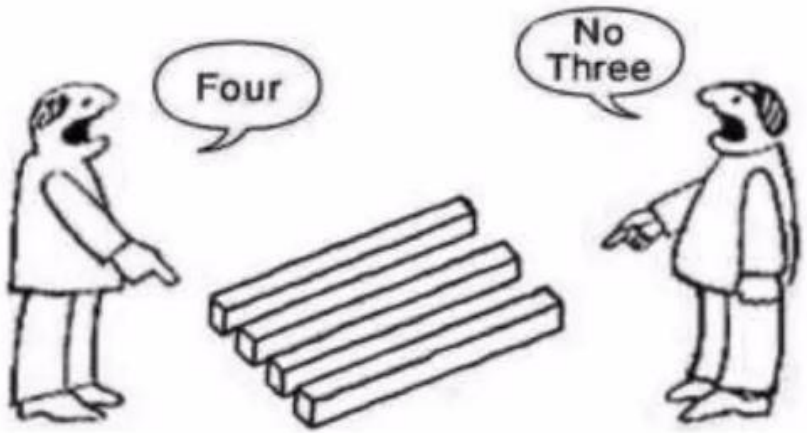
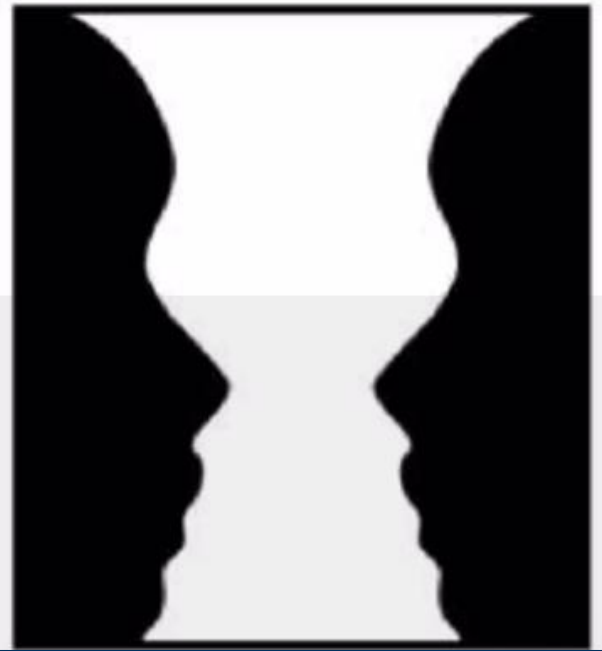
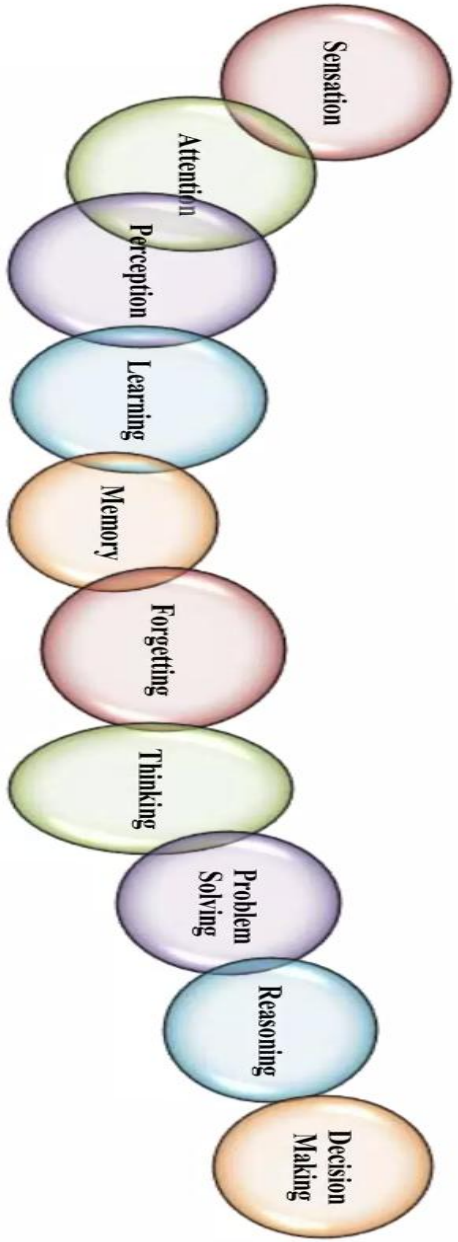
Map picture onto cognitive process









How Do Attention and Perception Affect Information Processing?

Attention acts as a filter that determines which information moves from sensory memory to short-term memory for further processing.

Perception interprets and organizes sensory information, giving it meaning based on prior knowledge and experiences.

Together, attention and perception control what information gets processed and how it is understood by the learner.

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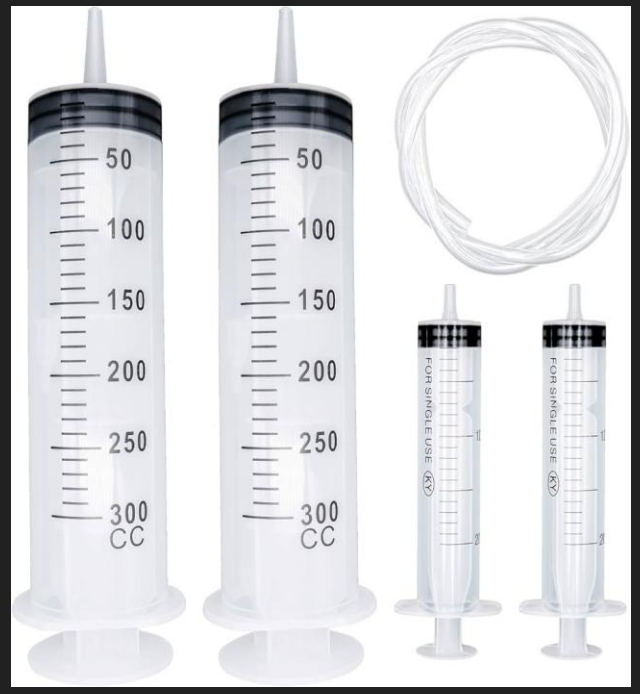
Seven Stages of Action Theory & Ideas



What's Wrong with Automatic Syringe Interface ? Prototype

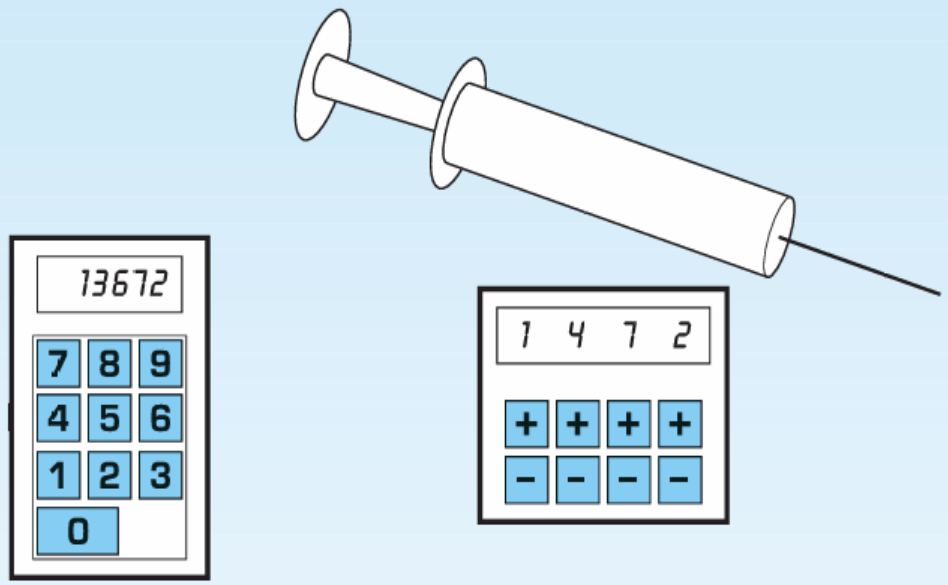


Figure 0.1 Automatic syringe: setting the dose to 1372. The effect of one key slip before and after user involvement

The doses were entered via a numeric keypad: an accidental keypress and the dose could be out by a factor of 10! The production version had individual increment/decrement buttons for each digit (more about participatory design in Chapter 13).

Iterate

People are complicated, so you won't get it right first time. Programming an interface can be a very difficult and time-consuming business. So, the result becomes precious and the builder will want to defend it and minimize changes. Making early prototypes less precious and easier to throw away is crucial. Happily there are now many interface builder tools that aid this process. For example, mock-ups can be quickly constructed using HyperCard on the Apple Macintosh or Visual Basic on the PC. For visual and layout decisions, paper designs and simple models can be used (more about iterative design in Chapter 5).

Visibility of system state _____ ? (Poor/Good)?

More flexibility # better _____(UI/UX)?

UI simplicity = UX simplicity (True/False)

Designing for humans ≠ designing for machines (True/False)

⚠ In a **safety-critical system**, error tolerance must be _____ .

A *single key slip* can cause a **10× overdose**

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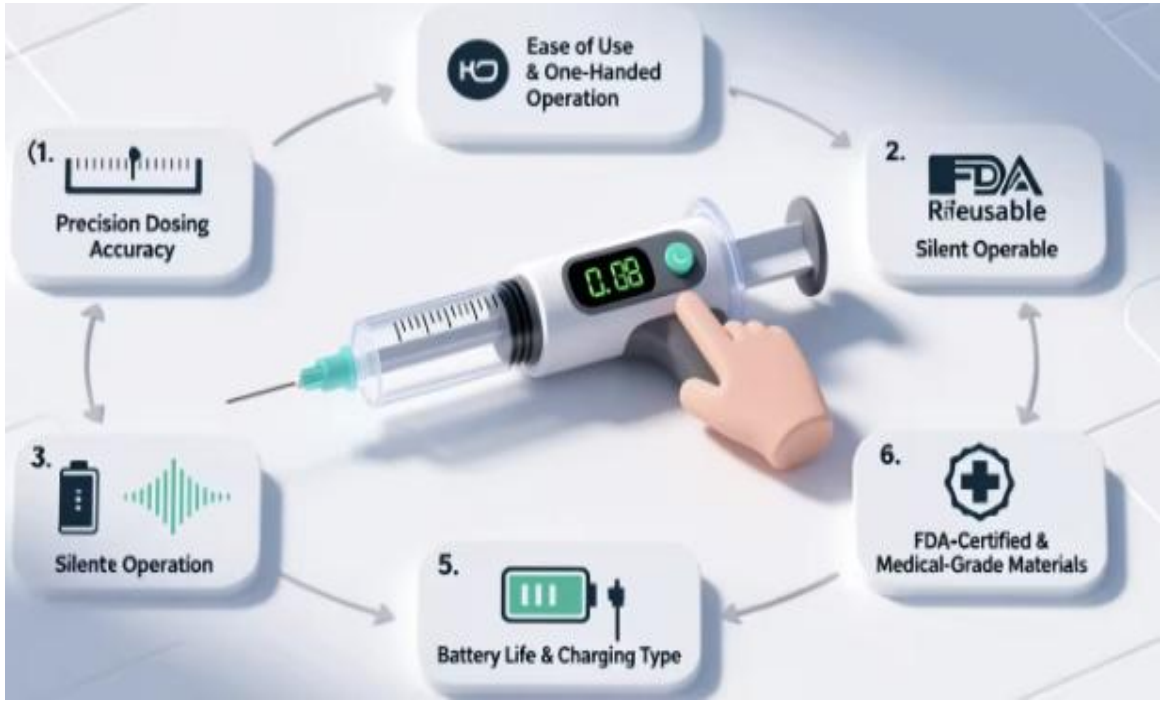

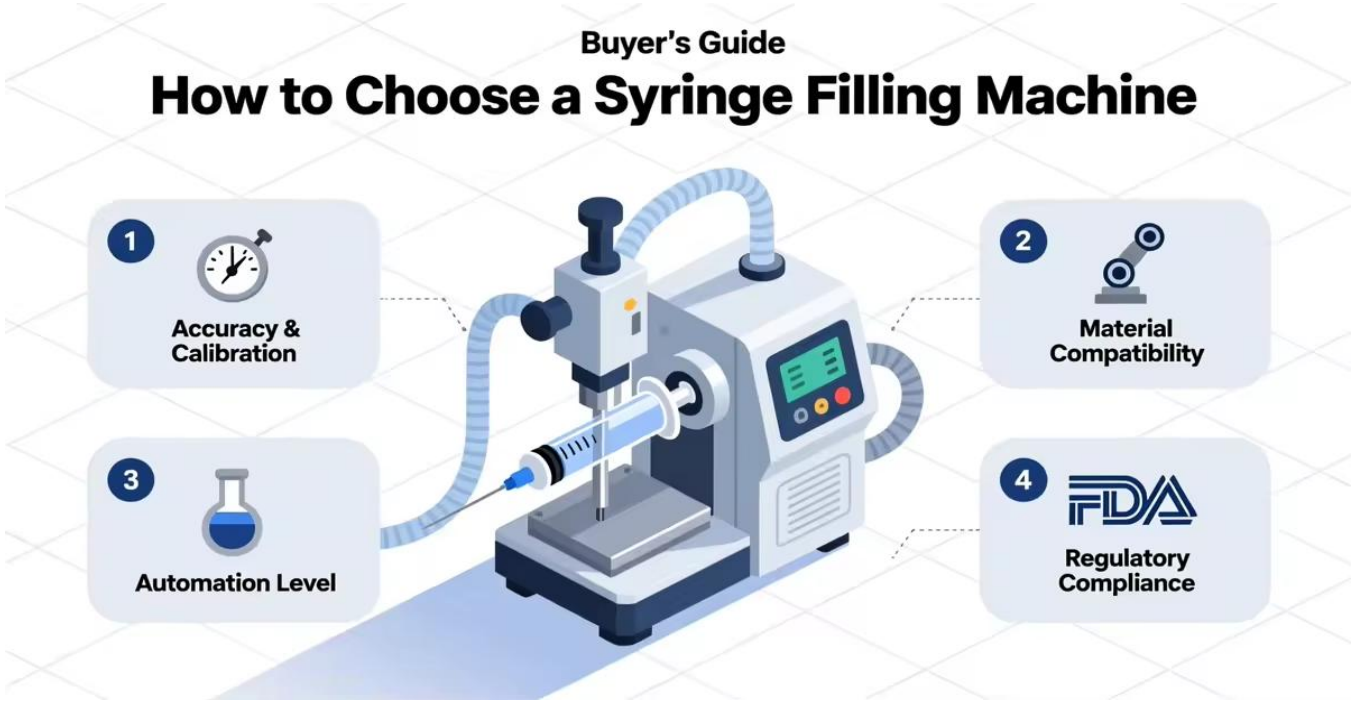

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Infusion pump for chemotherapy/pediatric - ICU

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Recall-heavy interaction (Infusion pump)

The Nurse is translating **intent → number → action** (True/False) ?

A nurse is preparing to administer lactated Ringer's 250 mL IV to infuse over 15 min.

The nurse should set the IV pump to deliver how many m

answer to the nearest whole number.

Use a leading zero if it applies.

Do not use a trailing zero.). mL/hr.

Explanation

Correct Answer: 1000

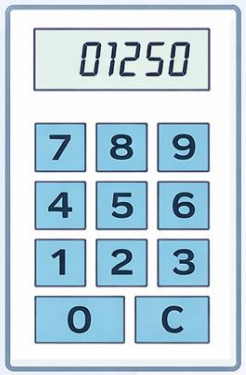
Step 1 is to calculate the total volume to be infused in mL/hr. This is done by dividing the total volume (250 mL) by the time in hours (15 min ÷ 60 min/hr). So, 250 mL ÷ (15 min ÷ 60 min/hr) = 1000 mL/hr.

So, the correct answer is 1000 mL/hr.

What the nurse must do with a numeric keypad

Recall-heavy interaction: the burden is on the nurse to get everything right.

1. **Recall the correct dosage**
   "The patient needs 12.5 ml/hr."
2. **Recall the unit and decimal placement**
   "Is it 12.5 or 0.125?"
3. **Recall the exact digit sequence**
   "That means typing: 0 1 2 . 5. 50"
4. **Execute perfectly with no slips**



- Nothing on the interface helps the nurse think
- The system assumes perfect recall + perfect execution

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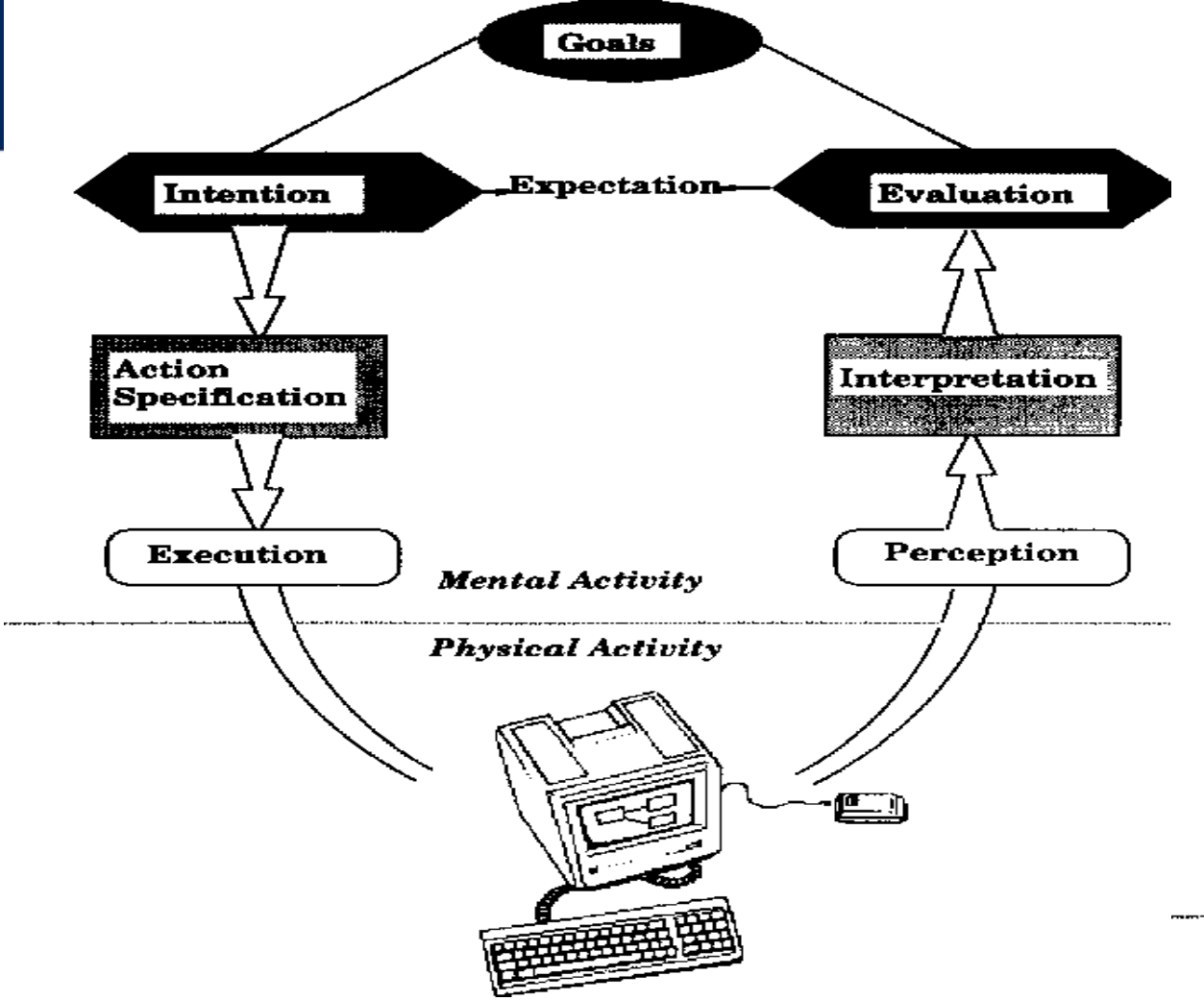

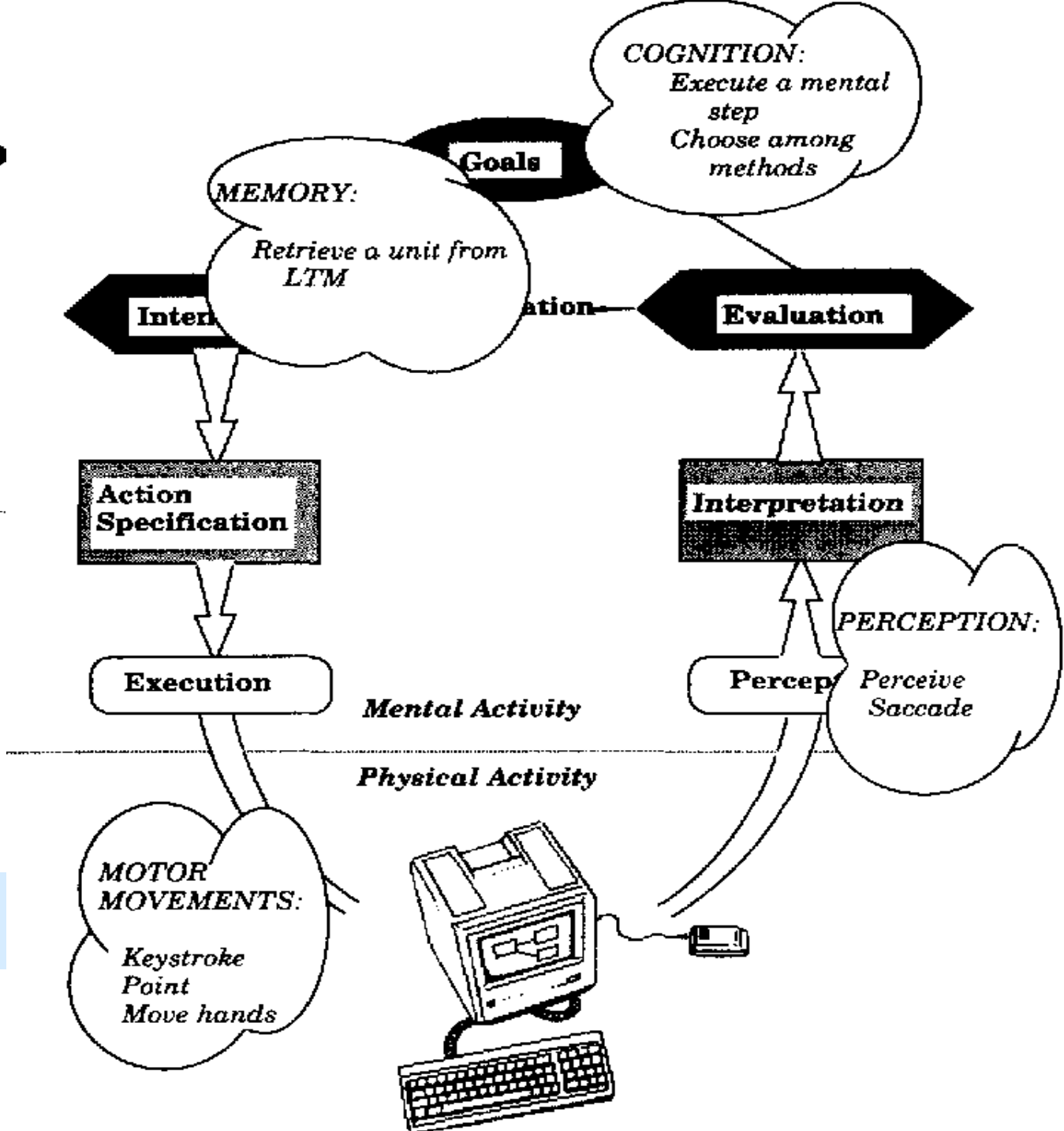

The seven steps of user activities involved in the performance of a computer-based task (based on Norman, 1988).

Published in Hum. Comput. Interact. 1990

The Growth of Cognitive Modeling in Human-Computer Interaction Since GOMS

The Seven Stages (Mapped to Syringe Interface)

🧠 **Donald A. Norman**
📘 *The Design of Everyday Things* (1988, 2013)

Activity Design → 1 = Goal formation
Interaction Design -> 2,3,4 = Intention + Action
Information Design -> 5,6,7 = State of world + outcome + Evaluation

Norman's Stage	Syringe Example
1. Form goal	"Deliver correct medication dose"
2. Form intention	"Set infusion to 12.5 ml/hr"
3. Specify action	"Type 0-1-2-.-5-0"
4. Execute action	Press keys on keypad
5. Perceive system state	Read display
6. Interpret state	"Is this correct?"
7. Evaluate outcome	"Does this match my goal?"

The keypad **forces an extra abstraction layer**:

```
Clinical intent
    ↓
Abstract numeric encoding
    ↓
Motor execution (key presses)
```

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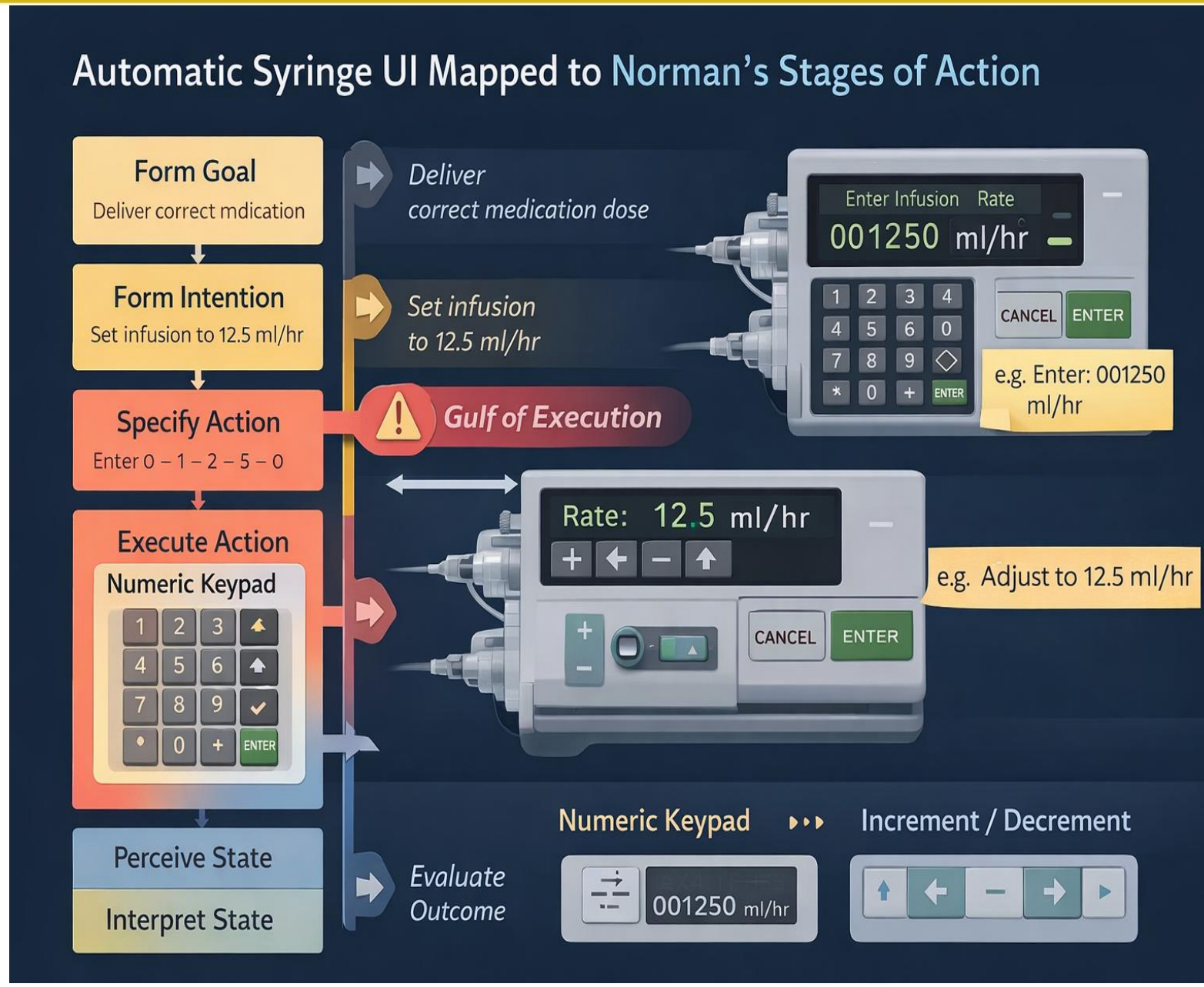
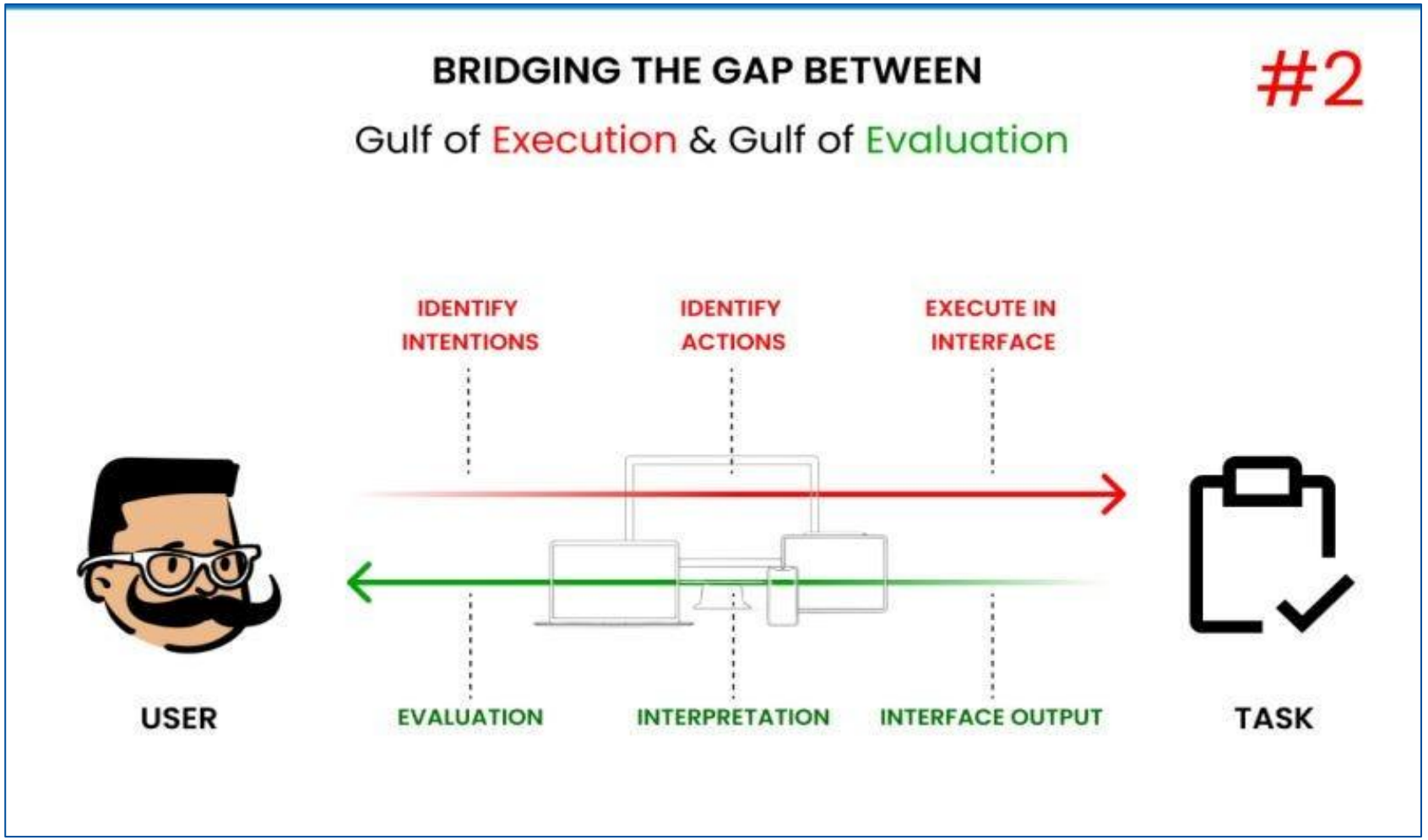
Map interface to 7 Norman stages (Lab 2)

The translation from intent to numeric input to action corresponds to Norman's execution stages in the Seven Stages of Action model, where additional abstraction increases the gulf of execution and the likelihood of slips in safety-critical interfaces.



Gulf of Execution

The gap between **what a user wants to do** and **how the interface lets them do it**.



Gulf of Execution contains — Identifying the Intentions, then Identifying the Actions and Execute in Interface — to reach a certain goal.

Gulf of Evaluation contains — Interface Output, Interpretation and Evaluation.

Wanting to **dim a light**, but instead of a knob you must **type the exact brightness number (e.g., 037)** — the harder that translation is, the wider the gulf of execution.

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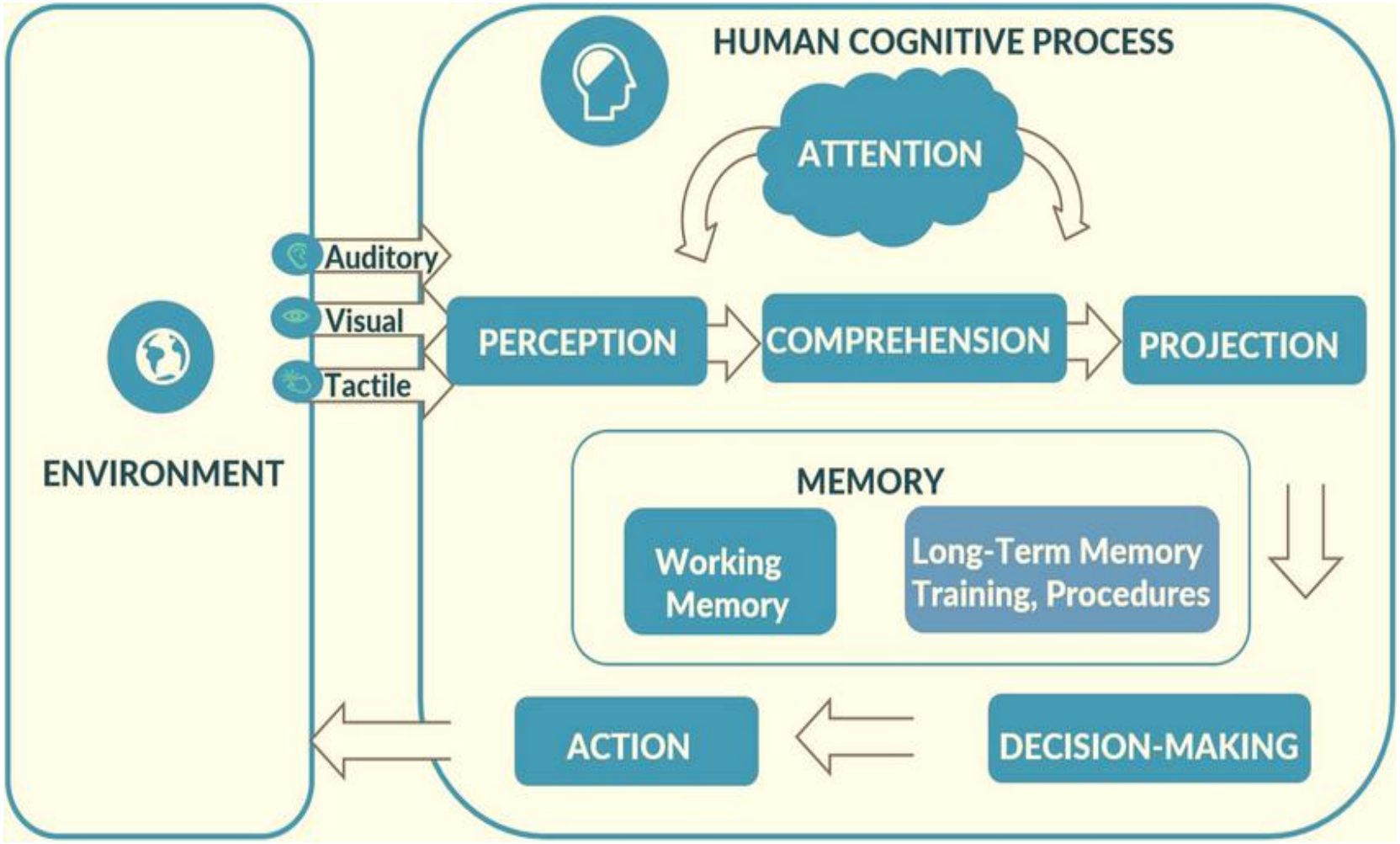
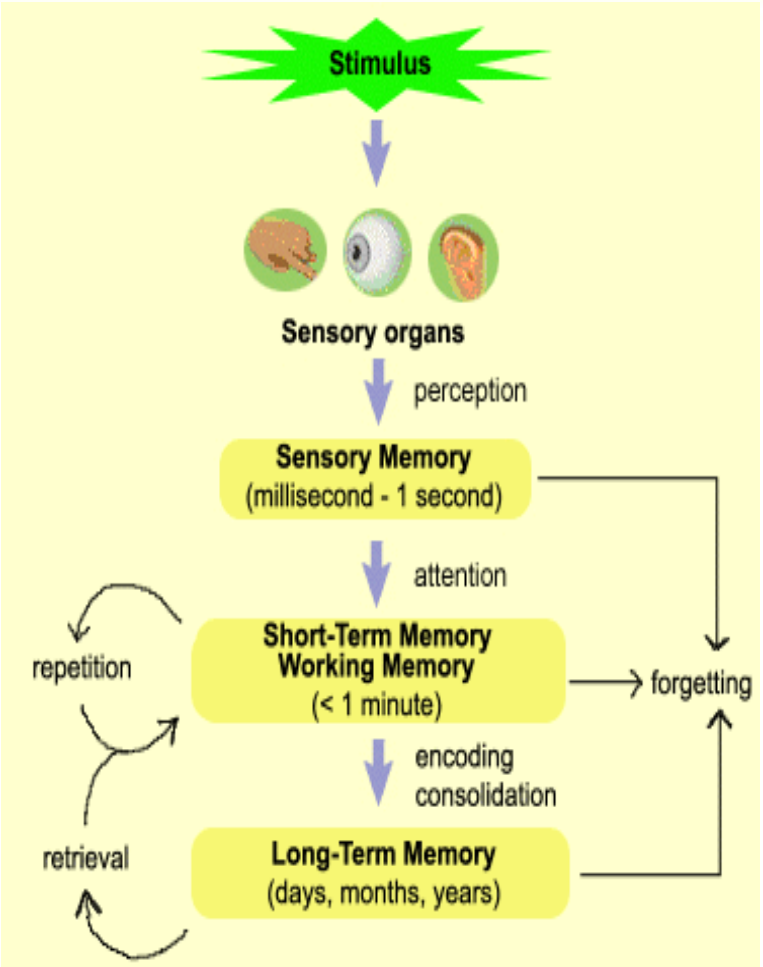
HCI Theories

e.g. the 7 Stages of Action are Donald Norman's analytic model explaining why users succeed or fail when interacting with an interface.

Stage Model of Human Information Processing (Wickens,1992)





Human information processing model showing the information input channels (auditory, visual, tactile) and how the human cognitive process uses these inputs to drive perception, attention, and comprehension with memory into decision-making and actions

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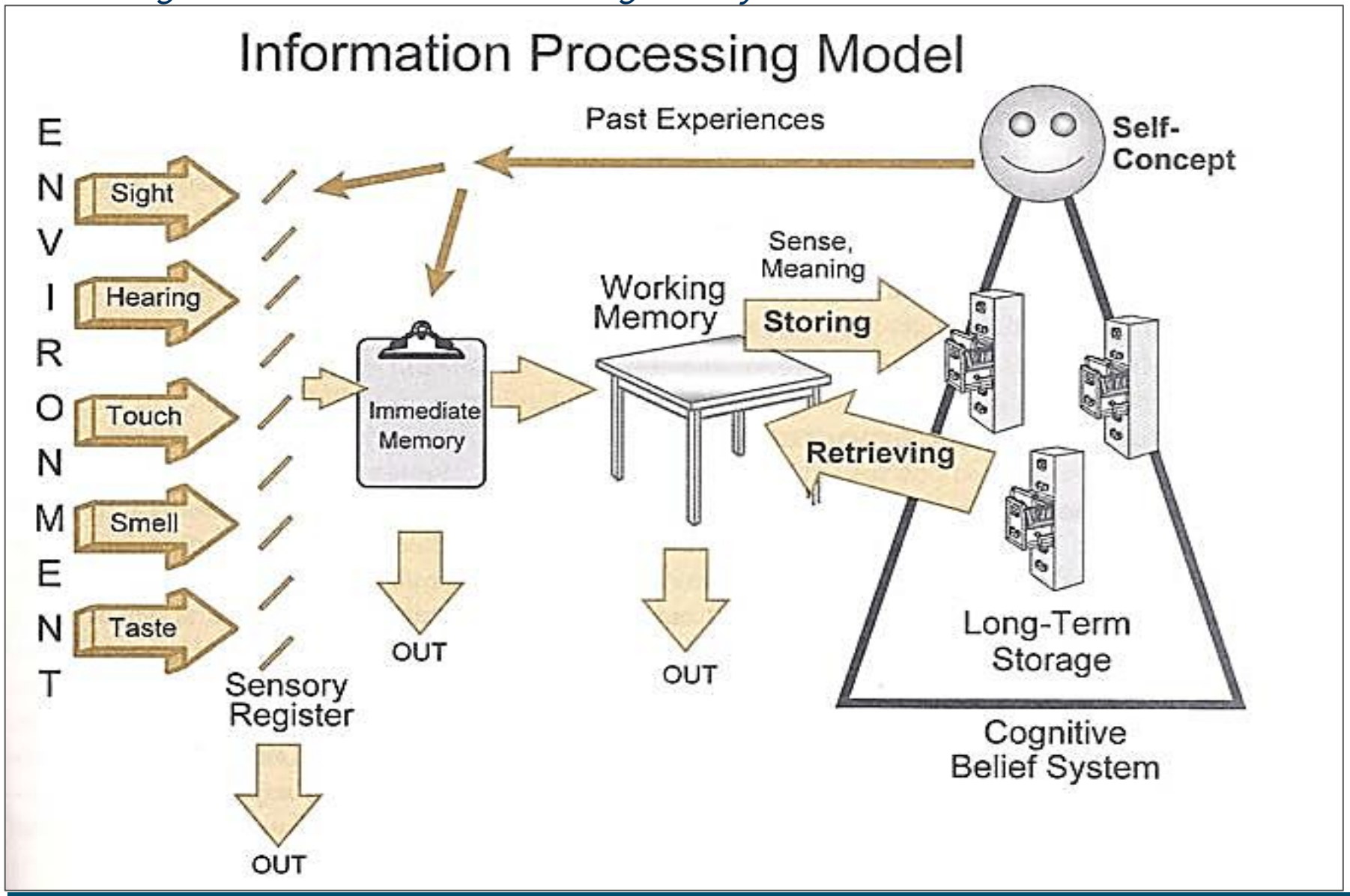
Three Stages of Information Processing Theory

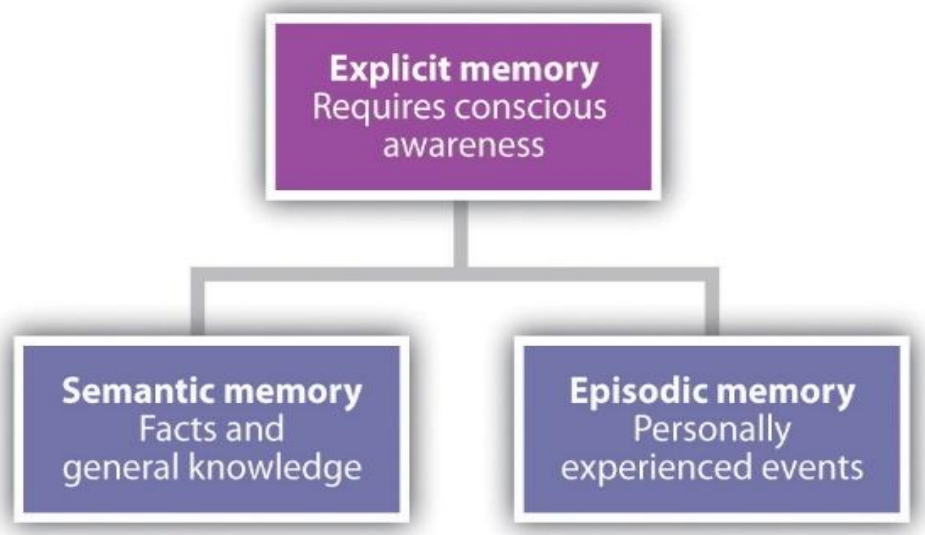


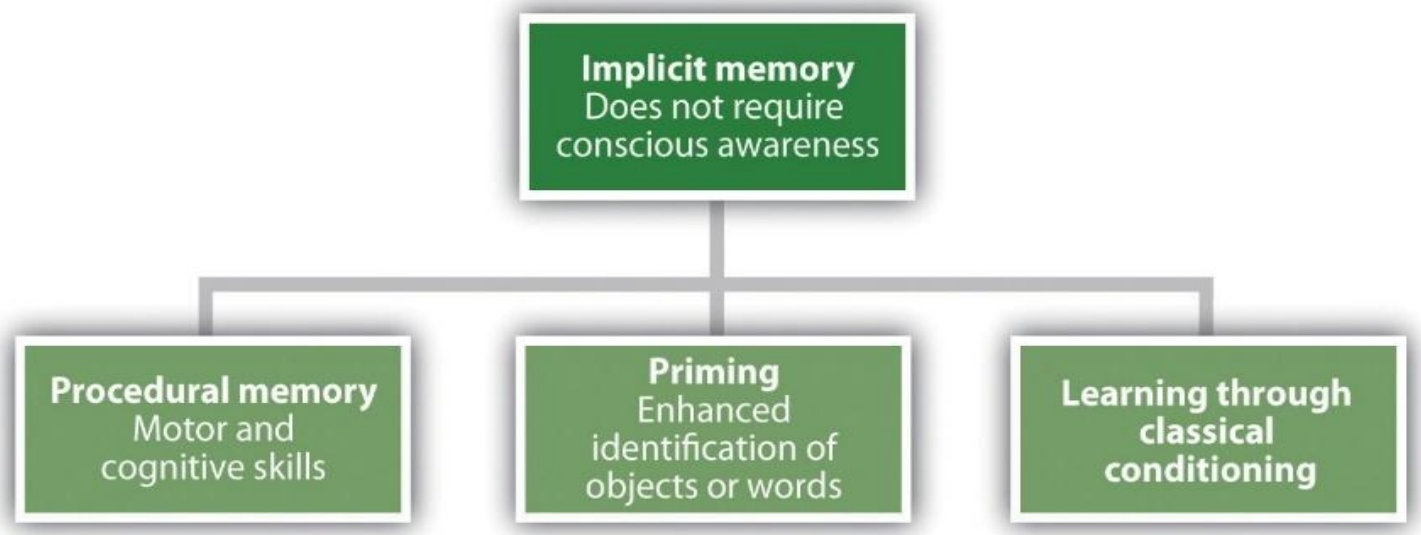
Sensory memory: This initial stage briefly holds and filters external stimuli. With a limited capacity and short duration, sensory memory is *responsible for selective processing*, allowing us to focus on relevant information and disregard irrelevant stimuli.

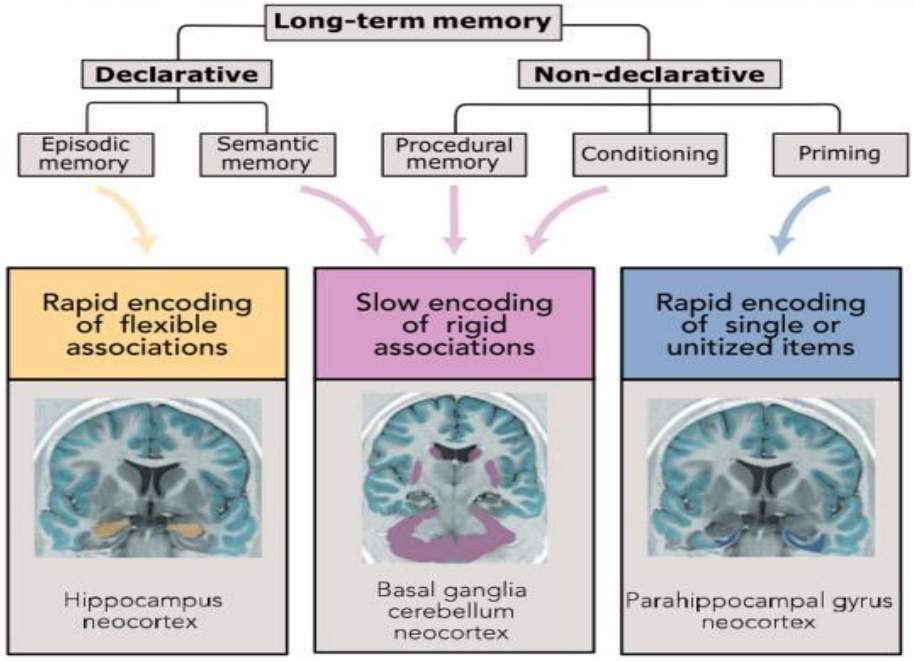
Short-term memory (STM):
Information from sensory memory is transferred to STM, where it is temporarily stored and manipulated. The , a key component in cognitive theory, oversees STM's operations, managing cognitive resources and controlling attention. STM has a limited capacity (7 ± 2 items, as suggested by George Miller) and a short duration (around 20-30 seconds).

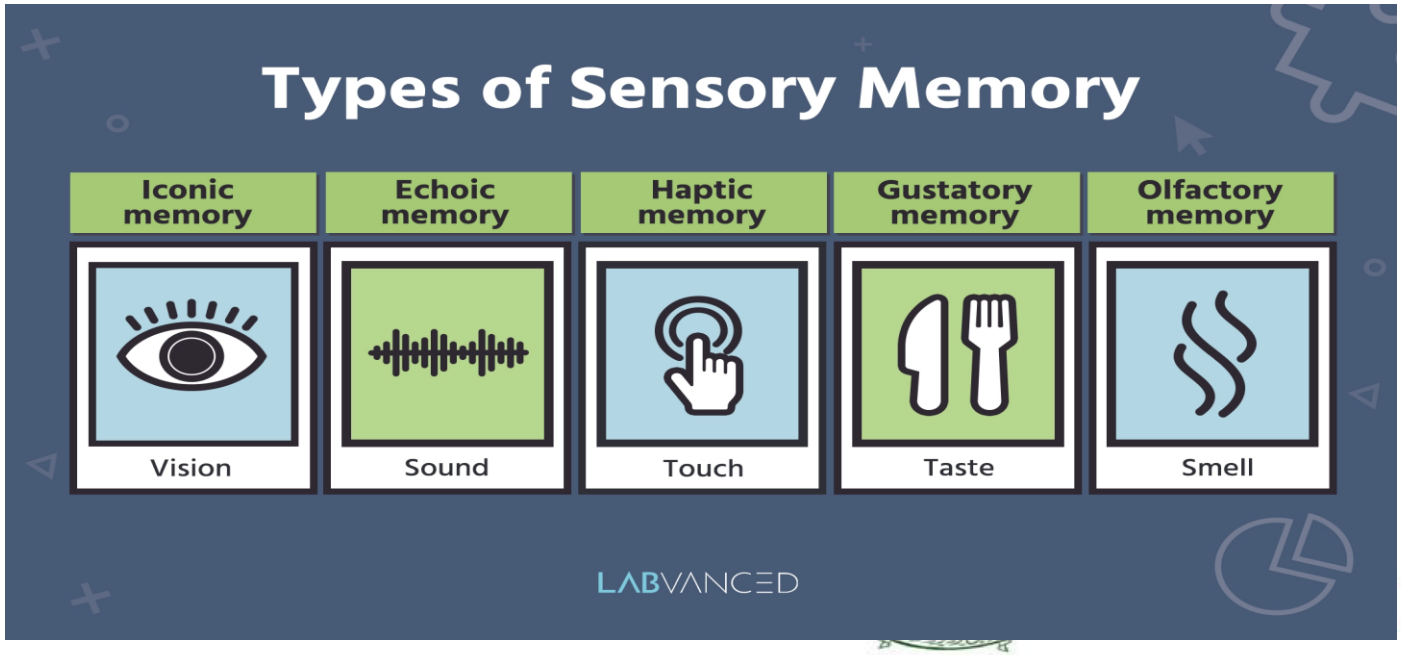
Long-term memory (LTM): Important information from STM is encoded and transferred to LTM, where it can be stored indefinitely. LTM, with its unlimited capacity, serves as long-term storage for information throughout our lifetime.

Types of Cognitive memories









What theory explains the redesign?

Memory Hooks to remember theories

Name	Year	Key Idea	Memory Hook
Card et al.	1983	Humans as processors	"Can the human physically and mentally do this fast enough?"
Norman (7 Stage)	1988	Affordances & errors	"If users make mistakes, the design is wrong."
Schneiderman	1983	Design rules	"Follow rules and usability improves."
Nielsen	1991	Usability heuristics	"Find usability problems cheaply and early."
Suchman	1990	Context matters	"Real use never follows the plan."
Dix et al.	2000	Interaction framework	"HCI is people, tasks, systems, and context."

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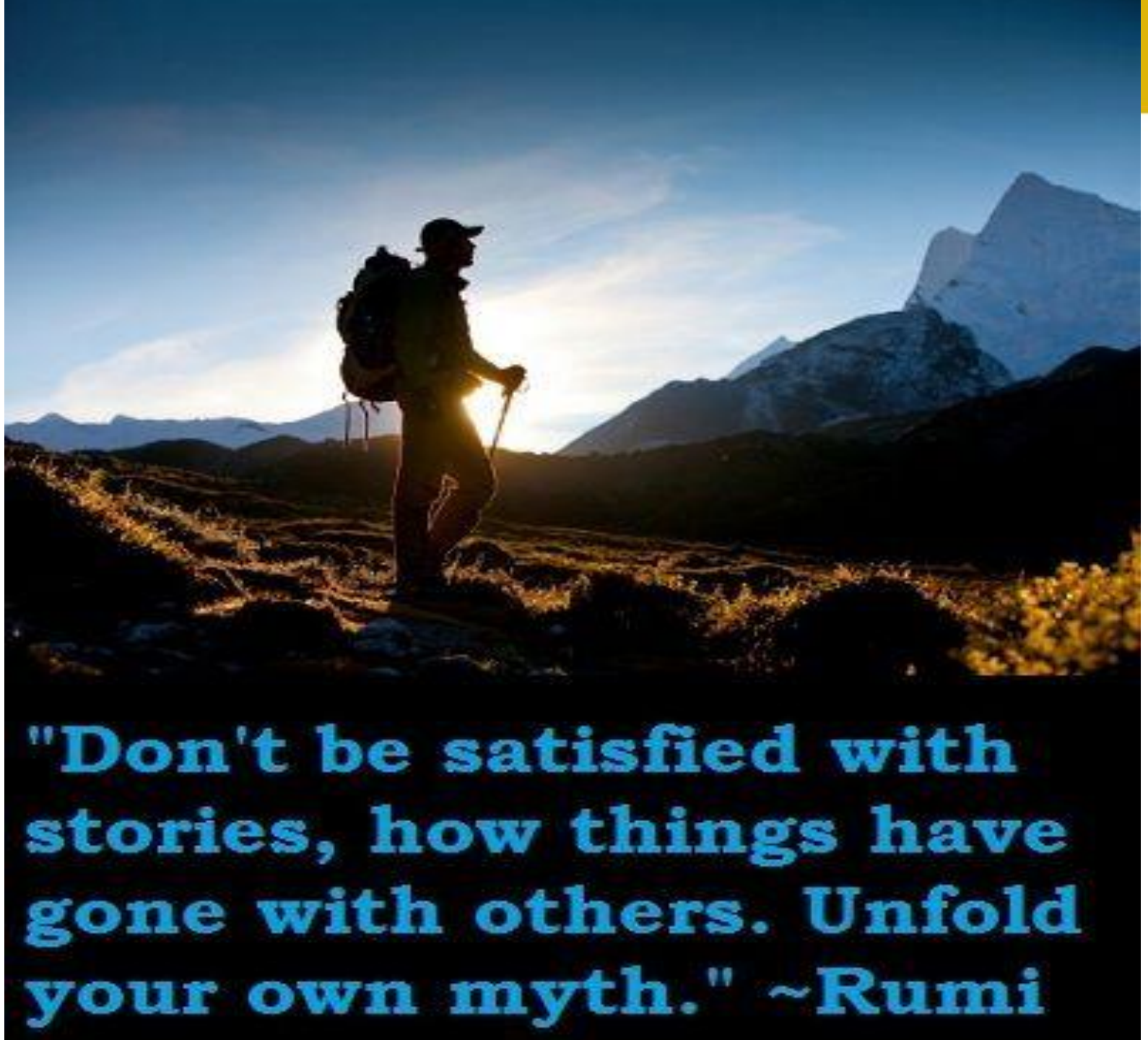

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Department of Compute Science (UBIT Building), Karachi, Pakistan.

1200 Acres (5.2 Km sq.)
53 Departments
19 Institutes
25000 Students

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My Homeland Pakistan