

**Programme:** B.Sc.

**Subject:** Computer Science

**Semester:** V

**Paper Code:** CSD101

**Paper Title:** Human Computer Interaction (HCI)

### **Unit I: Foundations Of HCI**

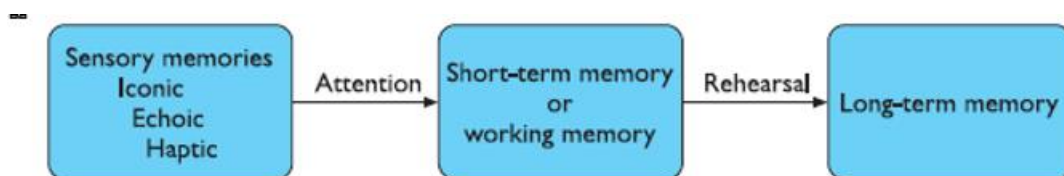
**Module Name:** The Human: Memory, Reasoning and Problem Solving

**Module No:** 02

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### **Memory**

is the second part of our model of the human as an information-processing system. Memory is associated with each level of processing. Bearing this in mind, we will consider the way in which memory is structured and the activities that take place within the system. It is generally agreed that there are three types of memory or memory function: sensory buffers, short-term memory or working memory, and long-term memory. There is some disagreement as to whether these are three separate systems or different functions of the same system. It is sufficient to note three separate types of memory. These memories interact, with information being processed and passed between memory stores.



Figure

e A model of the structure of memory

### **Sensory memory**

The sensory memories act as buffers for stimuli received through the senses. A sensory memory exists for each sensory channel: iconic memory for visual stimuli, echoic memory for aural stimuli and haptic memory for touch. These memories are constantly overwritten by new information coming in on these channels. The existence of echoic memory is evidenced by our ability to ascertain the direction from which a sound originates. This is due to information being received by both ears. Since this information is received at different times, we must store the stimulus in the meantime. Echoic memory allows brief play-back of information. Information is passed from sensory memory into short-term memory by attention, thereby filtering the stimuli to only those which are of interest at a given time. Attention is the concentration of the mind on one out of a number of competing stimuli or thoughts. It is clear that we are able to focus our attention selectively, choosing to attend to one thing rather than another. This is due to the limited capacity of our sensory and mental processes.

## **Short-term memory**

Short-term memory or working memory acts as a ‘scratch-pad’ for temporary recall of information. It is used to store information which is only required fleetingly. Short-term memory can be accessed rapidly, in the order of 70 ms. It also decays rapidly, meaning that information can only be held there temporarily, in the order of 200 ms. Short-term memory also has a limited capacity. There are two basic methods for measuring memory capacity. The first involves determining the length of a sequence which can be remembered in order. The second allows items to be freely recalled in any order.

## **Long-term memory**

If short-term memory is our working memory or ‘scratch-pad’, long-term memory is our main resource. Here we store factual information, experiential knowledge, procedural rules of behaviour – in fact, everything that we ‘know’. It differs from short-term memory in a number of significant ways. First, it has a huge, if not unlimited, capacity. Secondly, it has a relatively slow access time of approximately a tenth of a second. Thirdly, forgetting occurs more slowly in long-term memory, if at all. Long-term memory is intended for the long-term storage of information. Information is placed there from working memory through rehearsal. Unlike working memory there is little decay: long-term recall after minutes is the same as that after hours or days.

## **Reasoning**

Reasoning is the process by which we use the knowledge we have to draw conclusions or infer something new about the domain of interest. There are a number of different Types of reasoning: **deductive, inductive and abductive**. We use each of these types of reasoning in everyday life, but they differ in significant ways.

### **Deductive reasoning**

Deductive reasoning derives the logically necessary conclusion from the given premises. For example,  
If it is Friday then she will go to work  
It is Friday Therefore she will go to work.

### **Inductive reasoning**

Induction is generalizing from cases we have seen to infer information about cases we have not seen. Induction is a useful process, which we use constantly in learning about our environment. We can never see all the elephants that have ever lived or will ever live, but we have certain knowledge about elephants which we are prepared to trust for all practical purposes, which has largely been inferred by induction. Even if we saw an elephant without a trunk, we would be unlikely to move from our position that ‘All elephants have trunks’, since we are better at using positive than negative evidence.

**Abductive reasoning** The third type of reasoning is abduction. Abduction reasons from a fact to the action or state that caused it. This is the method we use to derive explanations for the events we observe.

For example, suppose we know that Sam always drives too fast when she has been drinking.

If we see Sam driving too fast we may infer that she has been drinking. Of course, this too is unreliable since there may be another reason why she is driving fast: she may have been called to an emergency.

**Problem solving** Human problem solving is characterized by the ability to adapt the information we have to deal with new situations often solutions seem to be original and creative. There are a number of different views of how people solve problems.

### **Skill acquisition**

All of the problem solving that we have considered so far has concentrated on handling unfamiliar problems. A commonly studied domain is chess playing. It is particularly suitable since it lends itself easily to representation in terms of problem space theory. The initial state is the opening board position; the goal state is one player checkmating the other; operators to move states are legal moves of chess. It is therefore possible to examine skilled behavior within the context of the problem space theory of problem solving.

### **Errors and mental models**

Human capability for interpreting and manipulating information is quite impressive. Some are trivial, resulting in no more than temporary inconvenience or annoyance. Others may be more serious, requiring substantial effort to correct.

### **Types of errors**

1. slips
  - a. right intention, but failed to do it right
  - b. causes: poor physical skill, inattention etc.
  - c. change to aspect of skilled behaviour can cause slip
2. mistakes
  - d. wrong intention
  - e. cause: incorrect understanding