

Human Computer Interaction

CSE 4451
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CT → best 3 → 20%
(out of 3 ct and 1 presentation)
Mid → 30%
Final → 40%
Attendance → 10%

Lecture-01

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"Inclusiveness" → गांधीजी की normal व्याख्याते वाले आदर्शों
include व्याकुल system की दृष्टि व्यक्ति (ग्रामन - colour blind people)

Chapter-01 (Human)

Information i/o: → Vision, Reading, Hearing, Touch, Movement

- Visual, auditory, haptic, movement

Information stored in memory

- Sensory, short-term, long-term

Information processed and applied

- reasoning, Problem solving, skill, etc.

Emotion influences human capabilities

Each person is different [কাহুন অবধি আমার ব্যত এর জালা না]

Vision

Two stages in vision:

- ① Physical reception of stimuli (চোখে কীভাবে জোর)
- ② Processing and interpretation of stimuli

The Eye - Physical reception

Eye cells → rods → sensitive to light

Cones → less sensitive to light & more tolerant to light

① Mechanism for receiving light and transforming it into electrical energy.

② light reflects from objects.

③ images are focused upside-down on retina.

④ retina contains rods for low light vision.

and cones for colour vision.

⑤ ganglion cells / brain detect pattern and movement

Processing & interpretation of stimuli / Interpreting the signal:

- size and depth

- Brightness

- Colour

Size and depth:

- Visual angle indicates how much of view object occupies.
(relates to size and distance from eye)
- Visual acuity is ability to perceive detail (limited)
- familiar objects perceived as constant size.
(in spite of changes in visual angle when far away)
- cues like overlapping help perception of size and depth

Brightness:

- subjective reaction to levels of light.
- affected by luminance of object.
- measured by just noticeable difference.
- visual acuity increases with luminance [as does flicker]

Colour:

- made up of hue (पर्याप्ति), intensity (मात्रा), saturation (संरक्षण)
- [saturation & intensity वे ही हैं जो 7 million colour generate हैं]
- cones sensitive to colour wave lengths
- blue acuity is lowest.
- 8% males and 1% females colour blind.

The visual system compensates (for) for:

- movement
- changes in luminance (brightness)

- 1) Context is used to resolve ambiguity (confusion)
- 2) Optical illusions sometimes occur due to over compensation.

Reading

- 1) Several stages:

- visual pattern perceived
- decoded using internal representation of language.
- interpreted using knowledge of syntax, semantics, pragmatics.

- 2) Reading involves saccades and fixations.

- 3) Perception occurs during fixations.

- 4) Word shape is important to recognition.

- 5) Negative contrast improves reading from computer screen.

Hearing

- ① Provides information about environment
- distances
 - directions
 - objects
- ② Physical apparatus
- Outer ear → Protects inner ear and amplifies sound
 - Middle ear → transmits sound waves as vibrations to inner ear
 - Inner ear → chemical transmitters are released and cause impulses in auditory nerve.
- ③ Sound
- Pitch → sound frequency
 - Loudness → amplitude
 - Timbre → type or quality

Humans can hear frequencies from 20Hz to 15kHz

- low/less accurate distinguishing high frequencies than low.

- Auditory system filters sounds
- can attend to sounds over background noise
 - for example, the cocktail party phenomenon.

Touch

- ① Provides important feedback about environment.
- ② May be key sense for someone who is visually impaired.
- ③ Stimulus received via receptors in the skin
- thermoreceptors → heat and cold
 - nociceptors → Pain
 - mechanoreceptors → Pressure
 ↓
 (some instant, some continuous)
- ④ Some areas more sensitive than others (fingers)
- ⑤ Kinesiology → Awareness of body position
- affects comfort and performance.

Movement

- ① Time taken to respond to stimulus = reaction time + movement time.
- ② Movement time dependent on age, fitness etc.
- ③ Reaction time - dependent on stimulus type
- Visual → 200 ms
 - auditory → 150 ms
 - Pain → 700 ms

④ Increasing reaction time decreases accuracy in the unskilled operators but not in the skilled operators.

शक्ति वाही → Skilled operators - यह शक्ति वाही उत्पादन करते हैं

Unskilled operators - अचंक यांत्रिक उपकरणों का उपयोग
-याप्तिशास्त्रीय योगदान

Fitts law describes the time taken to hit a screen-target:

$$M_f = a + b \log_2 \left(\frac{D}{S} + 1 \right)$$

a and b = empirically determined constants

Mt = Movement time

D = Distance

s = Size of target

* target as large as possible
distances as small as possible

* distances as small as possible

Memory

Three types of memory function:

1) Sensory memories. (अपने ज्ञानगृह में अनुभवों का अन्तर्गत सम्पर्क बहुत ज्यादा continuously overwritten होता है)

2) Short-term memory / working Memory

* Sensory तथा प्राइ-अम्ल-वैकिंग ग्रन्ट व्हार्थ

* chunk याहा word/numbers टुक्रिं मात्र बायर brain.

3) Long-term Memory

Sensory Memory

1) Buffers for stimuli received through senses.

- iconic memory \rightarrow visual stimuli

- echoic memory \rightarrow aural stimuli (कुप्रत)

- haptic memory \rightarrow tactile stimuli (स्पर्शक्रिया)

2) Continuously overwritten.

Short-term Memory (STM)

Scratch-pad for temporary recall

- rapid access \rightarrow 7ms

- rapid decay \rightarrow 200ms

- limited capacity 7 ± 2 chunks.

Long-term Memory (LTM)

1) Repository for all our knowledge

- slow access $1/10$ second

- slow decay

- unlimited capacity

Two types:

- 1) Episodic → serial memory of events → Normally आनुभूति याप्ति
- 2) Semantic → Structured memory of facts, concepts, skills. [Ex: $(a+b)^2 = ?$
 $= a^2 + 2ab + b^2$]

* Semantic LTM derived from episodic LTM

Example: Remembering events from the past (episodic memory) and knowing facts. (ज्ञान - विज्ञेय, अवृत्ति)

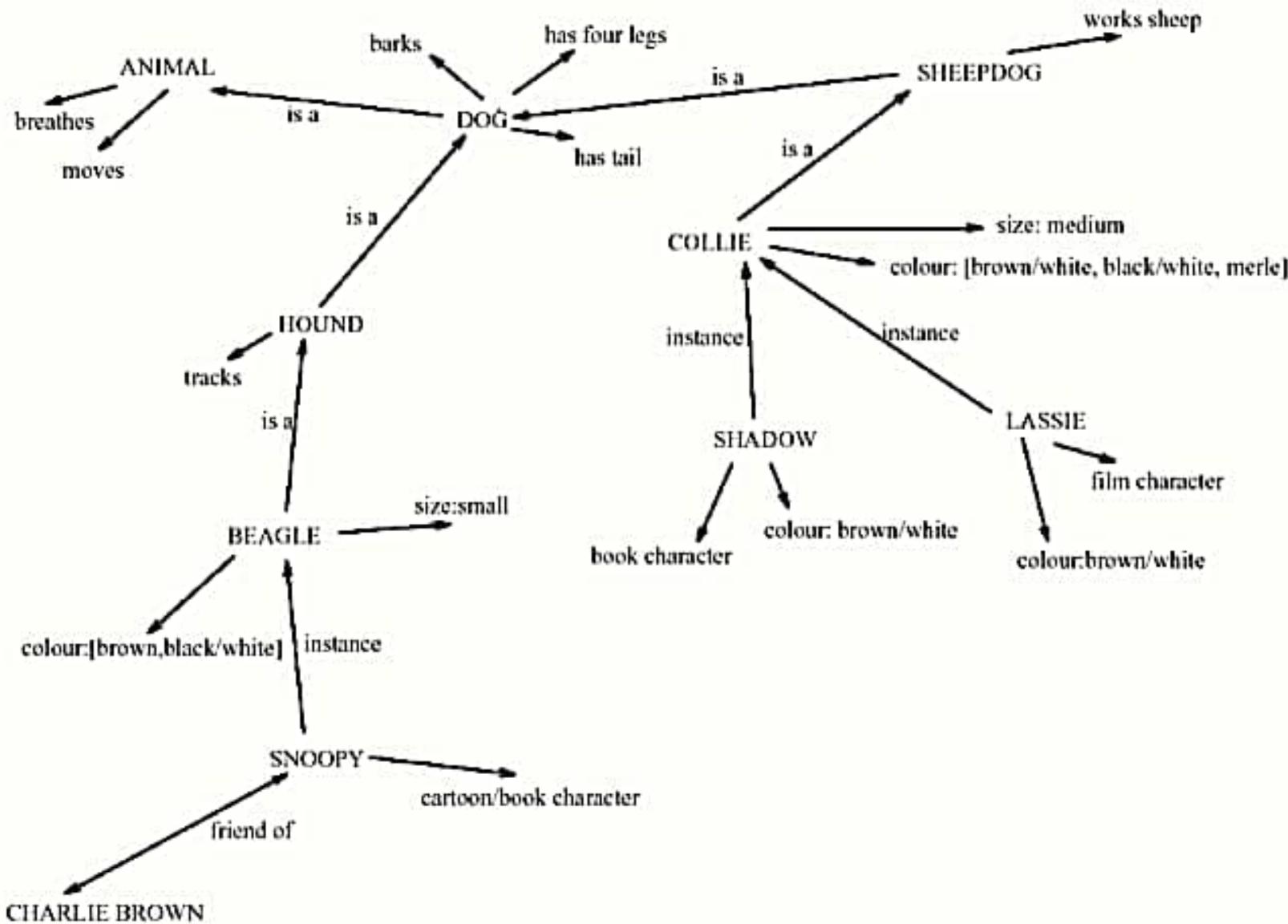
Semantic memory structure:

- Provides access to information
- represents relationships between bits of information
- supports inference.

Semantic Network/Model:

- inheritance → child nodes inherit properties of parent node.
- Relationships between bits of information explicit
- supports inference through inheritance.

LTM - semantic network



Models of LTM - Frames

- Information organized in data structures
- Slots in structure instantiated with values for instance of data
- Type-subtype relationships

DOG

Fixed

legs: 4

Default

diet: carnivorous
sound: bark

Variable

size:
color

COLLIE

Fixed

breed of: DOG
type: sheepdog

Default

size: 65 cm

Variable

color

Models of LTM - Scripts (very important for exam)

Model of stereotypical information required to interpret situation

Script has elements that can be instantiated with values for context

Script for a visit to the vet

Entry conditions:

dog ill
vet open
owner has money

Roles:

vet examines
diagnoses
treats
owner brings dog in
pays
takes dog out

Result:

dog better
owner poorer
vet richer

Props:

examination table
medicine
instruments

Scenes:

arriving at reception
waiting in room
examination
paying

Tracks:

dog needs medicine
dog needs operation

Figure 1.13 A script for visiting the vet

A **script** represents this default or stereotypical information, allowing us to interpret partial descriptions or cues fully. A script comprises a number of elements, which, like slots, can be filled with appropriate information:

Entry conditions Conditions that must be satisfied for the script to be activated.

Result Conditions that will be true after the script is terminated.

Props Objects involved in the events described in the script.

Roles Actions performed by particular participants.

Scenes The sequences of events that occur.

Tracks A variation on the general pattern representing an alternative scenario.

An example script for going to the vet is shown in Figure 1.13.

A final type of knowledge representation which we hold in memory is the representation of procedural knowledge, our knowledge of how to do something. A common model for this is the production system. Condition-action rules are stored in long-term memory. Information coming into short-term memory can match a condition in one of these rules and result in the action being executed. For example, a pair of production rules might be

IF dog is wagging tail
THEN pat dog

IF dog is growling
THEN run away

If we then meet a growling dog, the condition in the second rule is matched, and we respond by turning tail and running. (Not to be recommended by the way!)

LTM - Storage of Information

1) Rehearsal

- information moves from STM to LTM

2) Total time hypothesis

- amount retained \rightarrow rehearsal time

(*जागा तय करने वाले अधिक प्रैक्टिस एसीटी*)

3) Distribution of practice effect

- optimized by spreading learning over time

4) Structure, meaning and familiarity

- information easier to remember

LTM - Forgetting

Decay

- information is lost gradually but very slowly

Interference

- new information replaces old \rightarrow Retroactive interference

- old may interfere with new \rightarrow Proactive inhibition

[*पर्याप्त-विषयीकृत चुनौती देने के लिए ज्ञान संग्रह और विश्लेषण करने की आवश्यकता है।*]
 यहाँ पर्याप्त नियम - negative/कष्टकृति ज्ञान संग्रह और विश्लेषण करने की आवश्यकता है।

LTM - Retrieval

Recall

- information reproduced from memory can be assisted by cues (संकेत) → निजे निजे मनी कहा होता है तो यह आँख

Recognition

- information gives knowledge that it has been seen before → कहे हुए आँख यादी में है
- less complex than recall (information - संकेत से प्राप्त जानकारी)

Thinking

① Reasoning (3 types)

- deduction reasoning / deductive
- induction reasoning / inductive
- abduction reasoning / abductive

② Problem solving

Deductive Reasoning

It is a logical process in which a conclusion is based on a combination of premises that are generally assumed to be true.

Example: आज कनिका, यदि आपका कनिका दूसरे तरफ से काढ़ याएँ गूढ़ तो आज काढ़ याएँ।

Logical conclusion always true हमें यह कहते हैं।

कहा जाये true and logical validity clash कहा है।
Example: Some people are babies. Some babies cry.

Inference - Some people cry

logically incorrect but ~~true~~ true.

Inductive Reasoning

- Generalize from cases seen to cases unseen

Example: all elephants we have seen have trunks (हमने) therefore all elephants have trunks.

- Can only prove false not true but useful.

गलत false prove वाला असू जाना चाहिए -

→ Humans not good at using negative evidence.

Example: If a card has a vowel on one side it has an even number on the other. Is this true? How many cards do you need to turn over to find out? which cards?

7 E 9 K

{2 cards, 7 and E} → Ans

Abductive Reasoning

- Reasoning from event to cause(s) with less info.

Example: Sam drives fast when drunk. (if-then)

If I see Sam driving fast, assume drunk.

- Can lead to false explanations.

Problem Solving

- Process of finding solution to unfamiliar tasks using knowledge.

Gestalt theory

- A problem can be solved by understanding it in all its complexity and context.

- Productive draws on insight and restructuring of problem.

- Gestalt theory behaviourism and information processing theory to find (after B. B. Miller & R. E. Miller).

Problem space theory:

- It uses the approach of defining the problem to find the solution.
- Problem space comprises problem states.
- Problem solving involves generating states using legal operators.
- heuristics may be employed to select operators (means-ends analysis)
- operates within human information processing system (STM limits).
- largely applied to problem solving in well-defined areas. (Puzzles)

Problem Solving Skills

Analogy

- Use knowledge of similar problems from similar domain (called analogical mapping)
- analogical mapping difficult if domains are semantically different.

Skill acquisition:

- skilled activity characterized by chunking
(~~जारी राखा~~ Practice करते होते ही अनुभव में जारी राखा)
- information use ~~करते~~ problem solve (~~जारी~~)
- conceptual rather than superficial grouping
- information is ~~जारी~~ structured more effectively.

Errors and Mental Models

2 types of errors: ① Slips

② Mistakes

Slips:

- right intention, but failed to do it right (exam तर्फ से उत्तीर्ण)
- causes → poor physical skill, inattention
- change to aspect of skilled behaviour can cause slip.

Mistake:

- wrong intention
- cause → incorrect understanding
- humans create mental models to explain behaviour

(प्रयत्न: चाहे भूमि कैसे बिज़े पर्याप्त नहीं)

Emotion

-Theories of emotion:

- ① Oliver James - Lange: emotion is our interpretation of a physiological response to a stimuli.
- ② Cannon: Emotion is a psychological response to a stimuli.
- ③ Schacter - Singer: emotion is the result of our evaluation of our physiological responses, in the light of the whole situation we are in.

- Emotions clearly involves both cognitive and physical responses to stimuli.

* The biological response to physical stimuli is called affect.

Positive affect → creative problem solving

Negative affect → narrow thinking

Negative affect can make it harder to do even easy task; Positive affect can make it easier to do difficult task.

Implications for interface design:

- stress will increase the difficulty of problem solving.
- relaxed users will be more forgiving of shortcomings in design.
- aesthetically pleasing and rewarding interfaces will increase positive affect.

Individual Differences

Long term:

- Gender, physical and intellectual abilities.

Short term:

- effect of stress or fatigue

Changing:

- age

نهاية الفصل ... 