chapter 1

the human

INPUT–OUTPUT CHANNELS

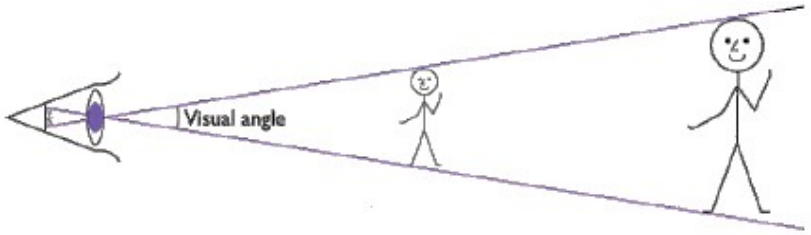
Vision

- Input in the human occurs mainly through the senses
- Five major senses: sight, hearing, touch, taste and smell
- Taste and smell do not currently play a significant role in HCI
- Which sense is the most important of them?
- Vision is undoubtedly the most important sense:
  - It is very difficult to live without vision.
  - It provides most of the data that we receive – megabits of data at each glance.
  - It analyzes and interprets the whole scene effortlessly within a tenth of a second.

INPUT–OUTPUT CHANNELS

Vision

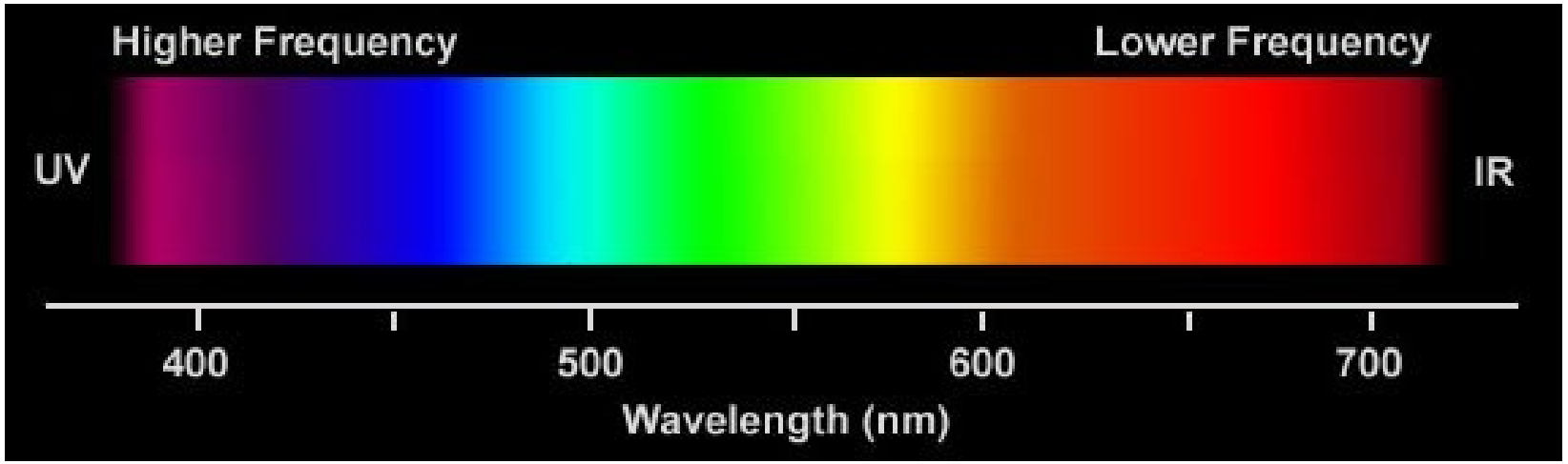
- Visual angle indicates how much of view object occupies (relates to size and distance from eye)
  - Objects of different sizes and different distances may have the same visual angle!



INPUT–OUTPUT CHANNELS

Vision:

1) Color can be a powerful tool to *improve* user interfaces by communicating key information
2) Inappropriate use of color can severely *reduce the performance* of systems we build

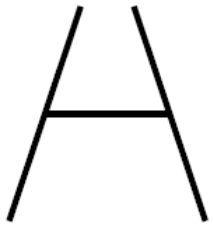


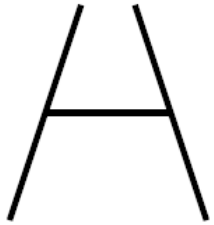
INPUT–OUTPUT CHANNELS

Vision

- Context is used to resolve ambiguity

What's below?





Demo

INPUT–OUTPUT CHANNELS

Vision:

- Negative contrast (dark characters on a light screen) improves reading from computer screen

INPUT–OUTPUT CHANNELS

Hearing

- Provides information about environment:
  distances, directions, objects etc.

INPUT–OUTPUT CHANNELS

Hearing (cont)

- Humans can hear frequencies from 20Hz to 15kHz

- Auditory system filters sounds
  - can attend to sounds over background noise.
  - for example,
    - where we can pick out our name spoken across a crowded noisy room.
  - However, if sounds are too loud, or frequencies too similar, we are unable to differentiate sound
- sound can convey a remarkable amount of information
  - Warning sounds and notifications

INPUT–OUTPUT CHANNELS

Touch or haptic

- Provides important feedback about environment.
- May be key sense for someone who is visually impaired.
- Some areas more sensitive than others e.g. fingers

Memory

There are three types of memory function:

Sensory memories

Attention

Short-term memory or working memory

Rehearsal

Long-term memory

sensory memory

- Buffers for stimuli received through senses
  - iconic memory: visual stimuli
  - echoic memory: aural stimuli
  - haptic memory: tactile stimuli
- Continuously overwritten

Short-term memory (STM)

- limited capacity - 7± 2 chunks

Examples

265397620853

212348278493202

The successful formation of a chunk is known as *closure*

0121 414 2626

HEC ATR ANU PTH ETR EET

Long-term memory (LTM)

- Repository for all our knowledge
  - slow access
  - slow decay
  - huge or unlimited capacity

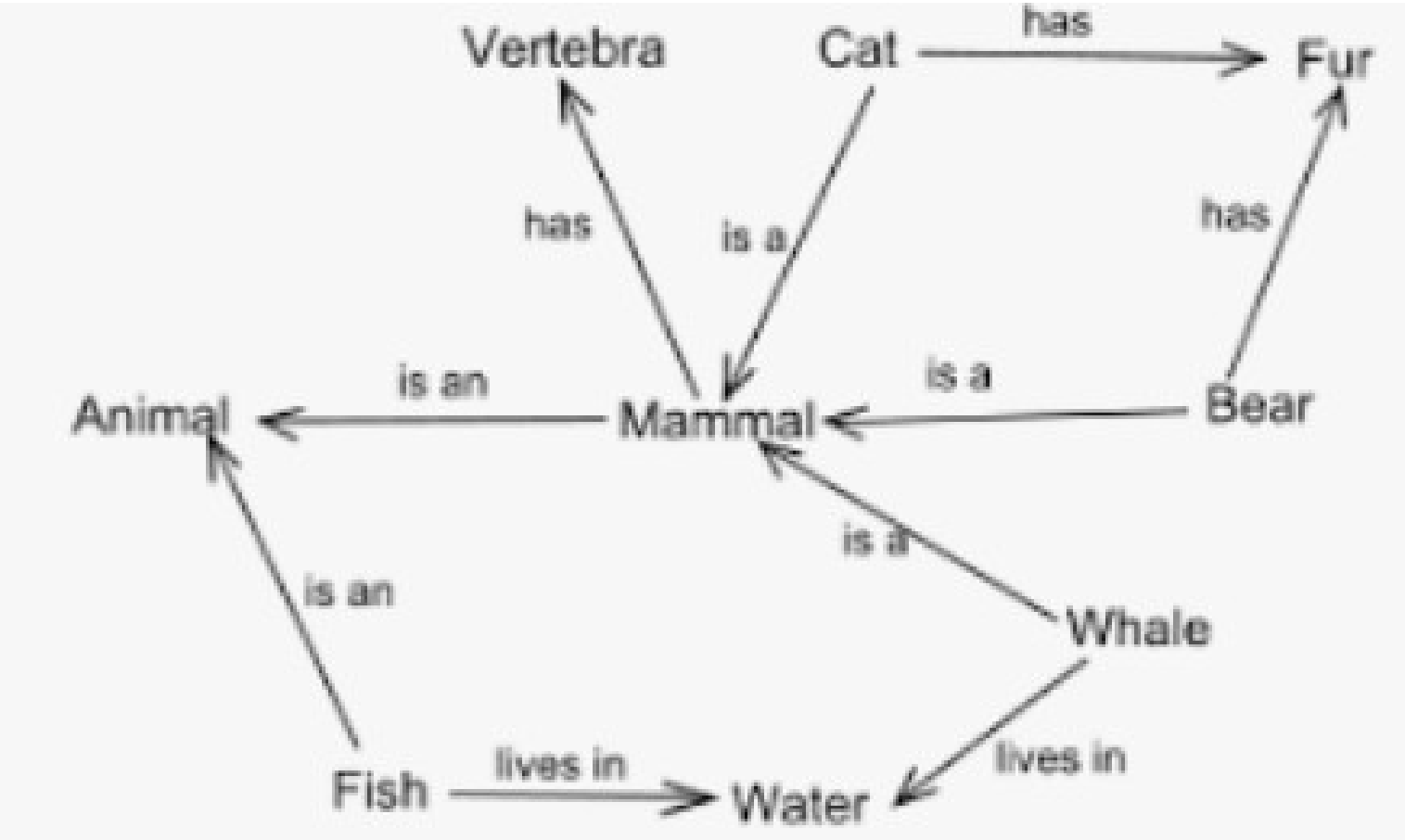
- Two types
  - episodic – serial memory of events
  - semantic – structured memory of facts, concepts, skills

  semantic LTM derived from episodic LTM

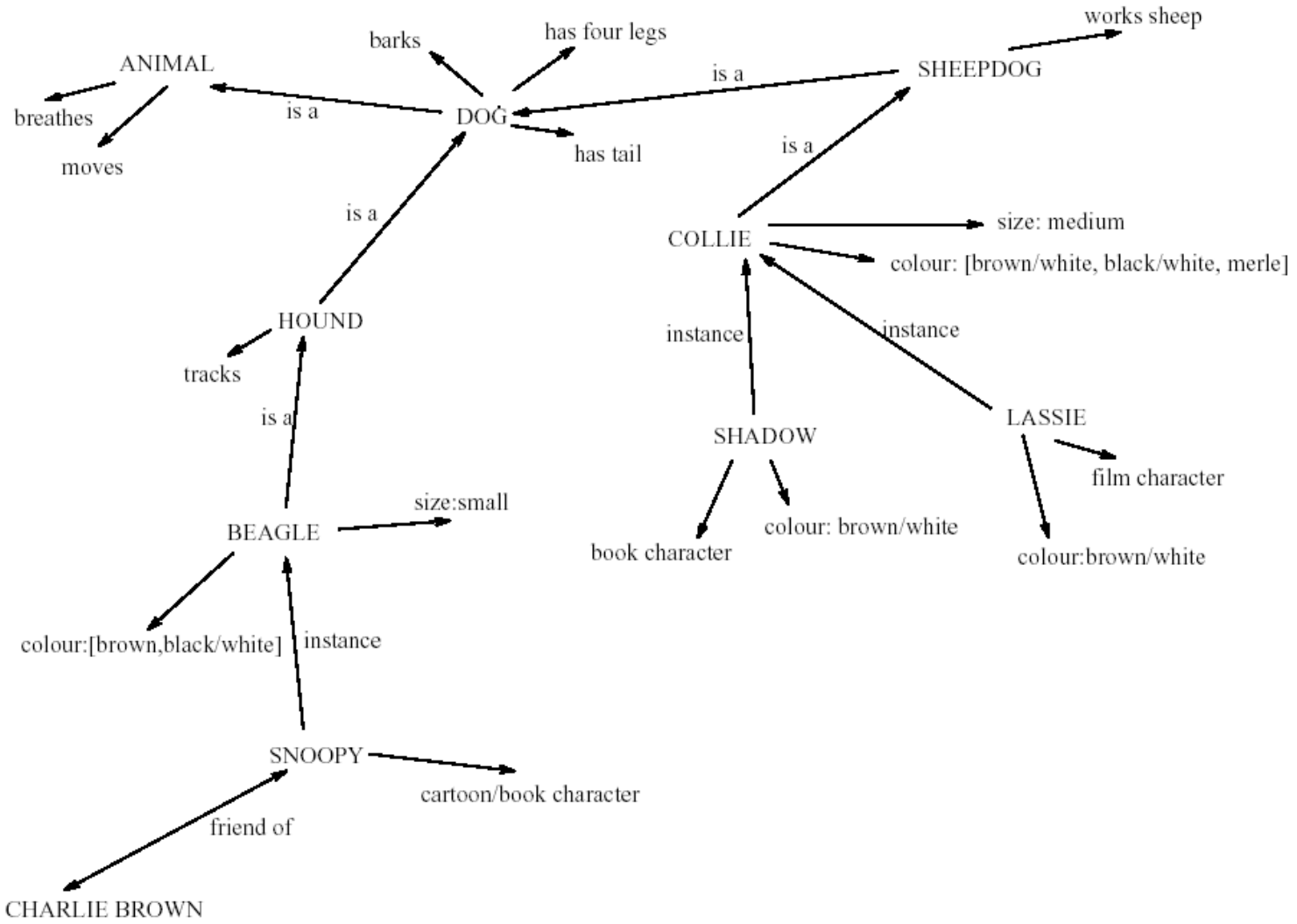
Long-term memory (cont.)

- Semantic memory structure
  - provides access to information
  - represents relationships between bits of information
  - supports inference
- Model: semantic network
  - inheritance – child nodes inherit properties of parent nodes
  - relationships between bits of information explicit
  - supports inference through inheritance

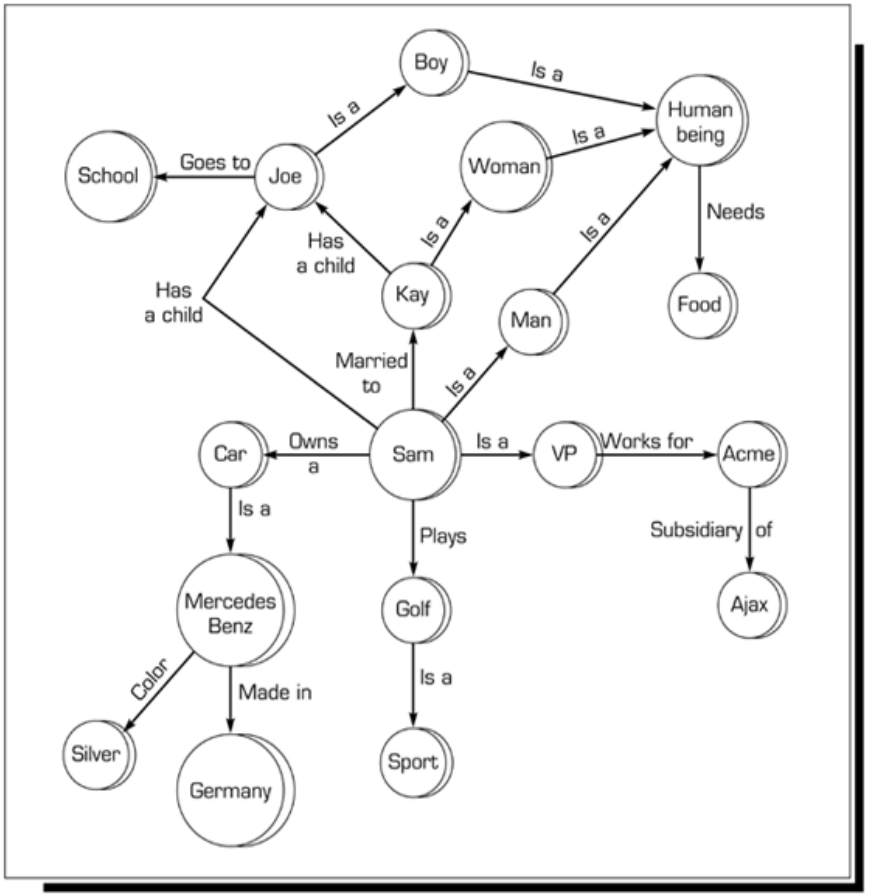
LTM - semantic network



LTM - semantic network



Semantic Networks



Models of LTM - Frames

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

DOG

Fixed
legs: 4

Default
diet: carniverous
sound: bark

Variable
size:
colour

Models of LTM - Production rules

Condition/action rules

if condition is matched

then use rule to determine action.

IF dog is wagging tail
THEN pat dog

IF dog is growling
THEN run away

Thinking

Reasoning

deduction, induction, abduction

Problem solving

Deductive Reasoning

- Deduction:
  - derive logically necessary conclusion from given premises.

    e.g. If it is Friday then she will go to work
    It is Friday
    Therefore she will go to work.

- Logical conclusion not necessarily true:

    e.g. If it is raining then the ground is dry
    It is raining
    Therefore the ground is dry

- Often truth and logical validity clash …

Inductive Reasoning

- Induction:
  - generalize from cases seen to cases unseen

    e.g. all elephants we have seen have trunks
    therefore all elephants have trunks.

Abductive reasoning

- reasoning from event to cause

  e.g. Sam drives fast when drunk.
  If I see Sam driving fast, assume drunk.

- Unreliable:
  - can lead to false explanations

Problem solving

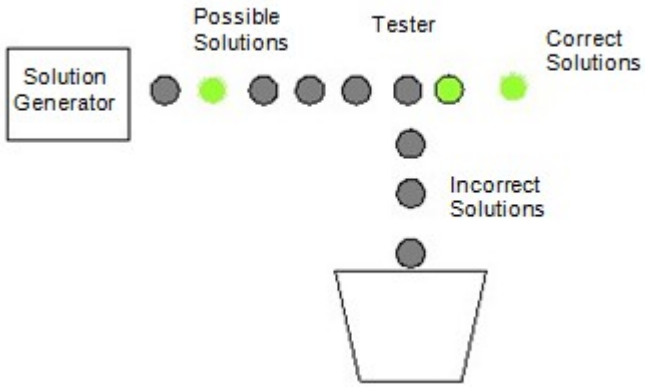
- Process of finding solution to unfamiliar task using knowledge.
- Several theories:

Classical Approach

- The classical approach to solving a problem is pretty simple. Given a problem at hand, use hit and trial method to check for various solutions to that problem. This hit and trial approach usually works well for trivial problems and is referred to as the classical approach to problem solving.

Generate and Test

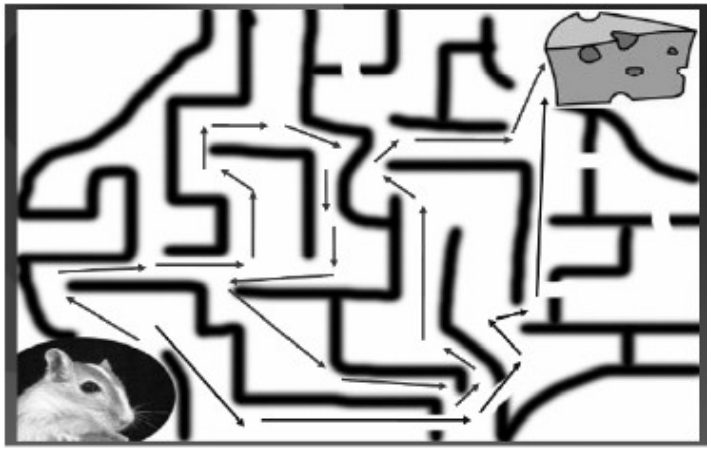
- This is a technical name given to the classical way of solving problems where we generate different combinations to solve our problem, and the one which solves the problem is taken as the correct solution. The rest of the combinations that we try are considered as incorrect solutions and hence are destroyed.



Problem solving (cont.)

Problem space theory

- problem space comprises problem states
- problem solving involves generating states using legal operators
- heuristics may be employed to select operators



Components of Problem Solving

- They are namely:
- Problem Statement,
- Goal State,
- Solution Space
- and Operators.

Problem Statement

- The two major things that we get to know about the problem is the Information about what is to be done and constraints to which our solution should comply.
- For example, taking the same example of the mouse, problem statement will tell us things like, the mouse has to reach the cheese as soon as possible and in case it is unable to find a path within an hour, it might die of hunger.

Goal State

- what should be the output of our procedure in order to solve the problem.
- For example in the case of mouse, the ultimate aim is to reach the cheese. The state of world when mouse will be beside the cheese and probably eating it defines the aim. This state of world is also referred to as the Goal State or the state that represents the solution of the problem.

Solution Space

- We have to go though a certain amount of states of nature to reach the solution.
- For example when the mouse was in the lower left corner of the maze, represents a state i.e. the start state. When it was stuck in some corner of the maze represents a state. When it was stuck somewhere else represents another state When it was traveling on a path represents some other state and finally when it reaches the cheese represents a state called the goal state.
- The set of the start state, the goal state and all the intermediate states constitutes something which is called a solution space.

Operators

- The traveling inside a solution space requires something called as “operators”.
- In case of the mouse example, turn left, turn right, go straight are the operators which help us travel inside the solution space.
- In short the action that takes us from one state to the other is referred to as an operator.
- So while solving a problem we should clearly know that what are the operators that we can use in order to reach the goal state from the starting state.
- The sequence of these operators is actually the solution to our problem.

Problem solving (cont.)

- Analogy
  - analogical mapping:
    - Similarities between the known domain and the new one are noted and
    - operators from the known domain are transferred to the new one.