SASTRA

ENGINEERING · MANAGEMENT · LAW · SCIENCES · HUMANITIES · EDUCATION

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THINK MERIT | THINK TRANSPARENCY | THINK SASTRA

Chapter 3
Understanding Users

B.Tech CSBS
VII Semester

Handled by
Smt.T.M.Latha

Outline

1. Cognition
2. Knowledge from Physical to Digital World
3. Conceptual Frameworks for Cognition
4. Informing Design

Cognition

- What goes on in our heads when we carry out our everyday activities
- Involves cognitive processes
  - Thinking
  - Remembering
  - Learning
  - Daydreaming
  - Decision making
  - Seeing
  - Reading
  - Writing and talking

- Norman distinguishes between two general modes
  - Experiential cognition
  - Reflective cognition

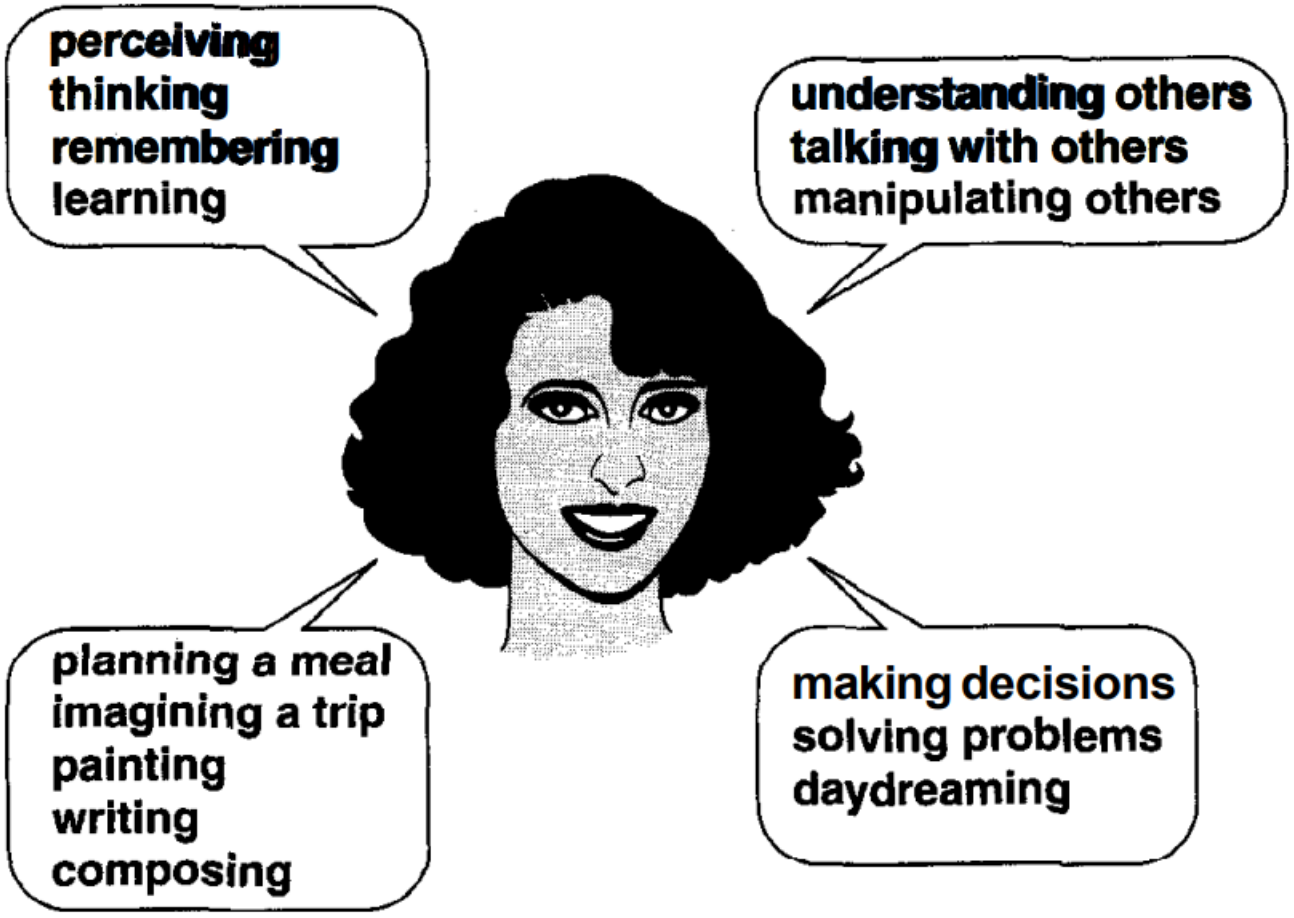
- Experiential cognition
  - State of mind in which user
    - Perceive
    - Act
    - React to events around us effectively and effortlessly
  - Requires certain level of expertise and engagement

- Eg.
  - Driving a car
  - Reading a book
  - Having a conversation
  - Playing a video game

- Reflective cognition
  - Involves
    - Thinking
    - Comparing
    - Decision-making
  - Leads to new ideas and creativity

- Eg.
  - Designing
  - Learning
  - Writing a book

What goes on in the mind?



- Cognition has also been described in terms of specific kinds of processes
  - Attention
  - Perception and recognition
  - Memory
  - Learning
  - Reading, speaking and listening
  - Problem solving, planning, reasoning decision making

- Cognitive processes are independent
  - Eg. Learning material for an exam
    - Attend the material
    - Perceive
    - Recognize
    - Read
    - Think
    - remember
- The cognitive processes most relevant to interaction design
  - memory

- attention
  - Involves our auditory and/or visual senses
  - Eg.
    - Auditory attention
      - Waiting in the dentist's waiting room for our name to be called
    - Visual attention
      - Scanning the football results in the flash news

- attention
  - Allows us to focus on information relevant to what we are doing
  - is easy/difficult depends on
    - Whether we have clear goals
    - Whether the information we need is salient in the environment

- Whether we have clear goals
  - Try to match the goal with available information
  - Finding out who had won the World Cup
    - Scan the headlines
    - Check the web
    - Call a friend
    - Ask someone in the street

- Whether information we need is salient in the environment
  - General goal of eating a meal
    - Vague idea of what want to eat
      - Peruse the menu to find things
      - Letting the attention be drawn to the imaginative descriptions of various dishes
        - Cost
        - Who we are with
        - What the specials are
        - What the waiter recommends
      - Make a decision

- Information presentation
  - The way information is displayed greatly influence how easy or difficult it is to attend

South Carolina

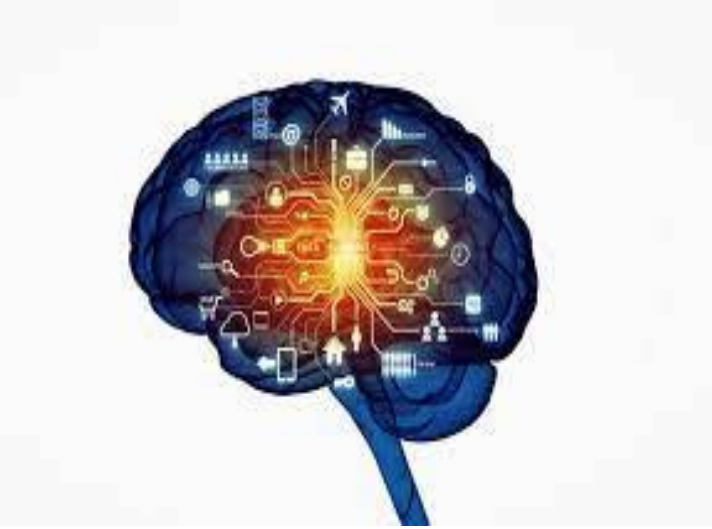
City	Motel/Hotel	Area code	Phone	Rates Single	Rates Double
Charleston	Best Western	803	747-0961	$26	$30
Charleston	Days Inn	803	881-1000	$18	$24
Charleston	Holiday Inn N	803	744-1621	$36	$46
Charleston	Holiday Inn SW	803	556-7100	$33	$47
Charleston	Howard Johnsons	803	524-4148	$31	$36
Charleston	Ramada Inn	803	774-8281	$33	$40
Charleston	Sheraton Inn	803	744-2401	$34	$42
Columbia	Best Western	803	796-9400	$29	$34
Columbia	Carolina Inn	803	799-8200	$42	$48
Columbia	Days Inn	803	736-0000	$23	$27
Columbia	Holiday Inn NW	803	794-9440	$32	$39
Columbia	Howard Johnsons	803	772-7200	$25	$27
Columbia	Quality Inn	803	772-0270	$34	$41
Columbia	Ramada Inn	803	796-2700	$36	$44
Columbia	Vagabond Inn	803	796-6240	$27	$30

Pennsylvania
Bedford Motel/Hotel: Crinaline Courts
(814) 623-9511 S: $18 D: $20
Bedford Motel/Hotel: Holiday Inn
(814) 623-9006 S: $29 D: $36
Bedford Motel/Hotel: Midway
(814) 623-8107 S: $21 D: $26
Bedford Motel/Hotel: Penn Manor
(814) 623-8177 S: $19 D: $25
Bedford Motel/Hotel: Quality Inn
(814) 623-5189 S: $23 D: $28
Bedford Motel/Hotel: Terrace
(814) 623-5111 S: $22 D: $24
Bradley Motel/Hotel: De Soto
(814) 362-3567 S: $20 D: $24
Bradley Motel/Hotel: Holiday House
(814) 362-4511 S: $22 D: $25
Bradley Motel/Hotel: Holiday Inn
(814) 362-4501 S: $32 D: $40
Breezewood Motel/Hotel: Best Western Plaza
(814) 735-4352 S: $20 D: $27
Breezewood Motel/Hotel: Motel 70
(814) 735-4385 S: $16 D: $18

- Perception and recognition
  - How info acquired from different sense of organs are transformed into experiences of
    - Objects
    - Events
    - Sounds
  - Complex process involves cognitive processes
    - Memory
    - Attention
    - language

- Vision is the most dominant sense followed by
  - Hearing
  - Touching
- Info should be presented in such a way it can be readily perceived in the intended manner
  - Eg. The design of lip-synch
    - Animation of an Avatar's face to make it appear to be talking
    - Slight delay make it difficult and disturbing to perceive what is happening
- Info needs to be presented effectively to facilitate perception and recognition of its underlying meaning

- Memory
  - Involves recalling of various kinds of knowledge and allows to act appropriately
  - Allows to
    - Recognize someone’s face
    - Remember someone’s name
    - Recall when we last met them
    - Know what we said to them last



- It is impossible to remember everything that we
  - See
  - Hear
  - Taste
  - Smell
  - touch

- A filtering process is used to decide what information gets further processed
- Filtering process
  - Encoding takes place
  - Determining which information is attended in the environment
    - Extent to ‘which’ affects our ability to recall that information later
  - How it is interpreted
  - More attention that is paid to something more likely it is to be remembered

- Eg.
  - Learning about a topic reflects in
    - Carry out exercises
    - Have discussions
    - Write notes

- Another factor that affects the extent information retrieval is the context in which it is encoded

You are on a train and someone comes up to you and says hello. You don't recognize him for a few moments but then realize it is one of your neighbors. You are only used to seeing your neighbor in the hallway of your apartment block and seeing him out of context makes him ***difficult*** *to recognize initially.*

- Well-known phenomenon
  - People are much better at recognizing things than recalling things

To illustrate the difference between these two processes, consider the following scenario: a user is trying to access a couple of **websites** visited the day before that compared the selling price of cars offered by different dealers. The user is able to recall the name of one **website**: "alwaysthecheapest.com". She types this in and the **website** appears. This is an example of successful recall-directed memory. However, the user is unable to remember the name of the second one. She vaguely remembers it was something like '**autobargains.com**'; but typing this in proves unsuccessful. Instead, she switches to scanning her **bookmarks/favorites**, going to the list of most recent ones saved. She notices two or three **URLs** that could be the one desired, and on the second attempt she finds the **website** she is looking for. In this situation, the user initially tries recall-directed memory and when this fails, adopts the second strategy of recognition-basedscanning—which takes longer but eventually results in success.

- Learning
  - can be considered in terms of
    - How to use a computer-based application
    - Using a computer-based application to understand a given topic
  - of computer-based applications is preferred as “learn through doing”
- GUI and direct manipulation interfaces
    - are good environments to learning
    - Support exploratory interaction
    - Allows users ‘undo’ actions

- “training-wheels
  - Another way of helping learners
  - Restrict functions carried out by a novice and extend as they become experienced
  - Make initial learning tractable
  - Help learner focus on simple operations before moving on to complex ones

- Reading, speaking and listening
  - Three forms of language processing
  - Meaning of sentences or phrases is same regardless of the mode
  - People find listening much easier than reading

- Difference between three modes
  - Written language is permanent while listening is transient
  - Reading can be quicker than speaking or listening
  - Listening requires less cognitive effort than reading or speaking
  - Written language tends to be grammatical while spoken language is ungrammatical
  - Dyslexics have difficulties understanding and recognizing written words, making it hard for them to write grammatical sentences and spell correctly
  - People who are hard of hearing or hard of seeing are also restricted in the way they can process language

- Many applications capitalize on people's reading, writing and listening skills

  - interactive books and web-based material that help people to read or learn foreign languages
  - speech-recognition systems that allow users to provide instructions via spoken commands (e.g., word-processing dictation, home control devices that respond to vocalized requests)
  - speech-output systems that use artificially generated speech (e.g., written-text-to-speech systems for the blind)
  - natural-language systems that enable users to type in questions and give text-based responses (e.g., Ask Jeeves search engine)
  - cognitive aids that help people who find it difficult to read, write, and speak. A number of special interfaces have been developed for people who have problems with reading, writing, and speaking (e.g., see Edwards, 1992).
  - various input and output devices that allow people with various disabilities to have access to the web and use word processors and other software packages

- Problem-solving, planning, reasoning and decision making
  - Cognitive processes
  - Involves reflective cognition
  - Include thinking about
    - What to do
    - What the options are
    - What the consequences might be carrying out a given action

- Eg.
  - Planning the best route to get somewhere
    - Asking others
    - Use a map
    - Get instructions from the web
    - Analyzing the advantages and disadvantages of each route to decide on best one

- Reflective cognition depends on
  - Experience with a domain
  - Application
  - Skill
- Novices
  - tend to have limited knowledge
  - Often make assumptions
  - Act by trial and error
  - Exploring and experimenting with ways of doing things

Conceptual Frameworks for Cognition

- Mental models
- Information processing
- External cognition

Mental models

- When people are learning and using a system, they
  - Develop knowledge of
    - how to use the system
    - How system works (to a lesser extent)
  - These two kinds of knowledge is called user's mental model

- People make inferences to carryout tasks using mental model
- Mental model helps
  - What to do
    - when something unexpected happens
    - When encountering unfamiliar systems
- The more user learns about a system and its functions, the more their mental model develops

- Eg.
  - TV engineers have a ‘deep’ mental model on
    - how TVs work
    - How to fix errors
  - Average citizen have
    - a reasonably good mental model of how to operate TV
    - Shallow mental model of how it works

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You arrive home from being out all night, starving hungry. You look in the fridge and find all that is left is an uncooked pizza. The instructions on the packet say heat the oven to 375°F and then place the pizza in the oven for 20 minutes. Your oven is electric. How do you heat it up? Do you turn it to the specified **temperature** or **higher?**

When asked the second question, most people say they would turn the oven to the specified temperature and put the pizza in when they think it is at the desired temperature. Some people answer that they would turn the oven to a higher temperature in order to warm it up more quickly. Electric ovens work on the same principle as central heating and so turning the heat up higher will not warm it up any quicker. There is also the problem of the pizza burning if the oven is too hot!

- Why do people use erroneous mental models?
  - ‘More is more’ principle
    - The more you turn them, the more heat or volume is given
  - Using incorrect mental models to guide behaviour is common
  - Eg.
    - TV starts acting up
      - hit the top of the box repeatedly with bare hand or a rolled-up newspaper
    - Pressing elevator button twice

- People’s mental models of interactive product
  - is poor
  - Incomplete
  - Easily confusable
  - Inappropriate analogies
  - superstition

- If People develop better mental models of interactive systems,
  - they would know
    - How to carry out tasks efficiently
    - What to do if the system started acting up
  - Develop mental model that matches conceptual model developed by designer

- People are resistant to spending time to learn how things work
  - Specially if it involves
    - reading manuals
    - Other documentations
  - Alternate proposal is to design transparent system

    - useful feedback in response to user input
    - easy-to-understand and intuitive ways of interacting with the system

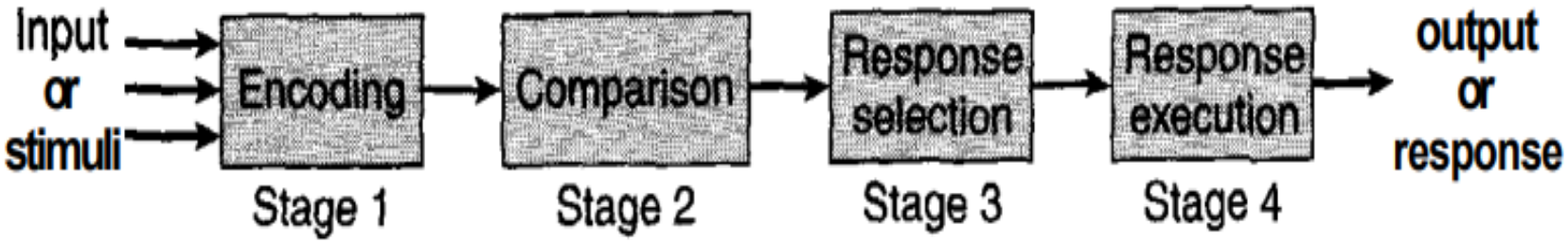
    In addition, it requires providing the right kind and level of information, in the form of:

    - clear and easy-to-follow instructions
    - appropriate online help and tutorials
    - context-sensitive guidance for users, set at their level of experience, explaining how to proceed when they are not sure what to do at a given stage of a task.

Information processing

- Conceptualizes how mind works using
  - Metaphors and analogies
    - Conceptualizing a mind as
      - Reservoir
      - Telephone network
      - Digital computer

- A prevalent metaphor from cognitive psychology
  - Information processor
    - Information is thought to
      - Enter and exit the mind through a series of ordered processing stages



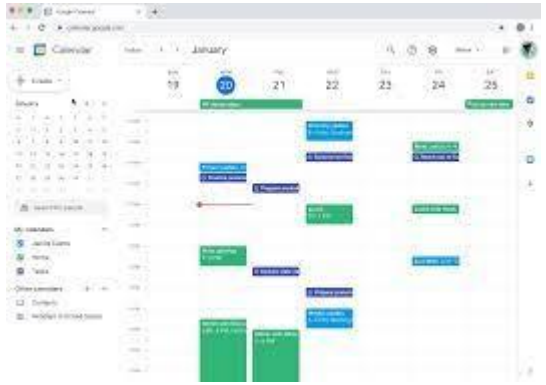
- Information processor model predicts
  - Which cognitive processes are involved when user interacts with a computer
  - How long a user will take to carry out various tasks by comparing different interfaces

External Cognition

- Supports people's ability to carry out cognitive activities
    - Externalizing to reduce memory load
    - Computational offloading
    - Annotating and cognitive tracing

Externalizing to reduce memory load

- Transforming knowledge into external representations
- Acting as external reminders of what we need to do at a given time
  - Externalizing things difficult to remember
    - Birthdays
    - Appointments
    - Addresses
      - We have
        - Diaries, personal reminders and calendars



- Externalizing help reduce people's memory burden by
  - Reminding them to do something
  - Reminding them what to do
  - Reminding them when to do

Computational Offloading

- Occurs when we use a tool or device in conjunction with an external representation

Multiply 2 by 3 in your head. Easy. Now try multiplying 234 by 456 in your head. Not as easy. Try doing the sum using a pen and paper. Then try again with a calculator. Why is it easier to do the calculation with pen and paper and even easier with a calculator?

Carrying out the sum using pen and the paper is easier than doing it in your head because you "offload" some of the computation by writing down partial results and using them to continue with the calculation. Doing the same sum with a calculator is even easier, because it requires only eight simple key presses. Even more of the computation has been offloaded onto the tool. You need only follow a simple internalized procedure (key in first number, then the multiplier sign, then next number and finally the equals sign) and then read of the result from the external display.

Annotating and Cognitive Tracing

- Modifying representations to reflect changes
- Cross-things off in a to-do list to show that they have been completed
  - Annotating
    - Modifies representations by
      - Crossing off
      - Underlining items
  - Cognitive tracing
    - Externally manipulating items into different orders or structures

- Cognitive tracing
  - Externally manipulating items into different orders or structures
  - Eg.
    - Card game
      - Continued rearrangements of cards
      - As game progresses tactics changes

- Eg.
  - Online Learning Package
    - Highlighting all the topics visited
    - Exercises completed
    - Units still to study

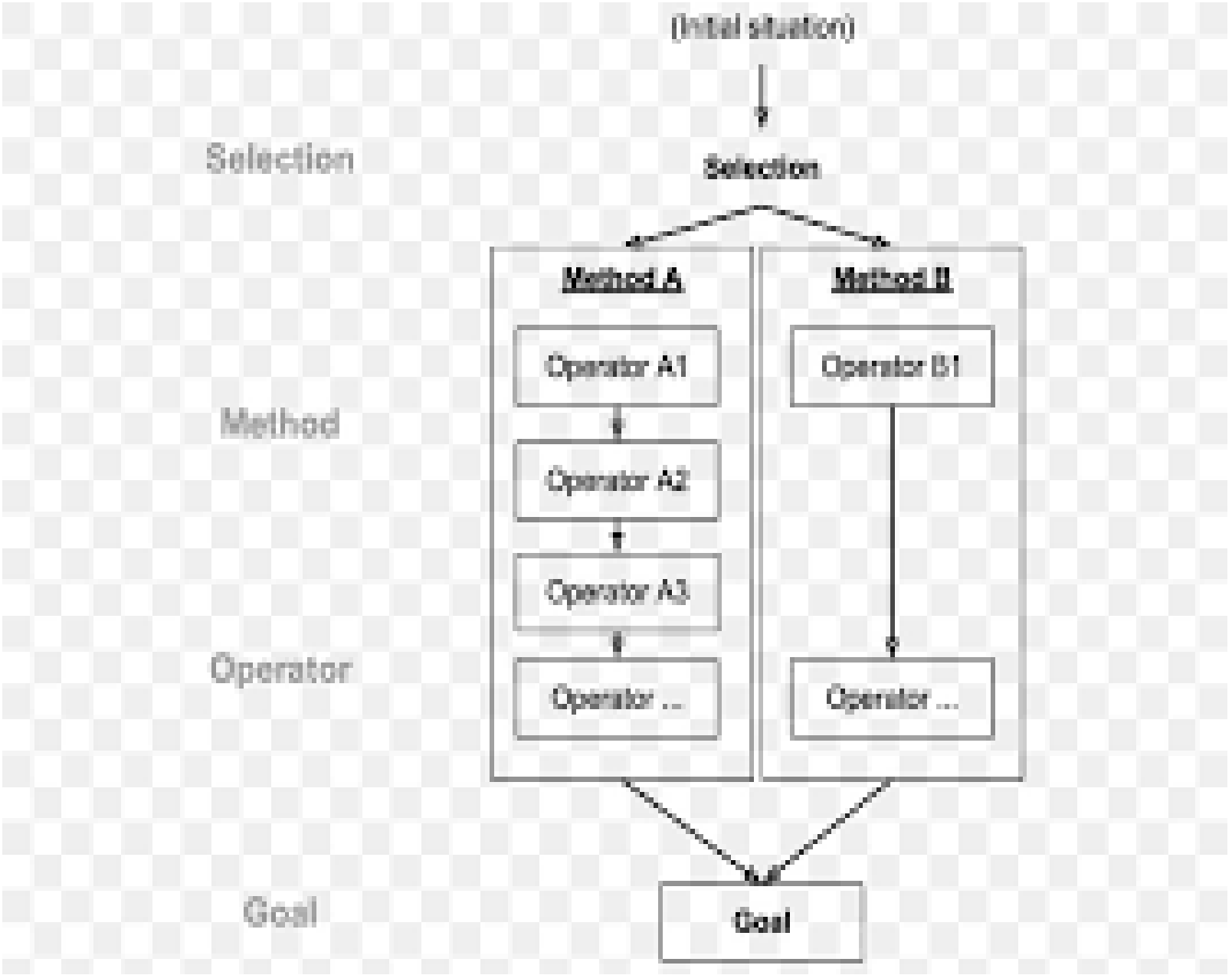
- General cognitive principle for interaction design
  - External cognition

Informing Design: from theory to practice

- Theory
  - difficult to digest
  - Terminology and jargon quite off-putting to those not familiar with it
  - Requires much time to become familiar with it
    - Designers and engineers can’t afford when working to meet deadlines

- Researchers help out by making theory more accessible and practical
- Translation includes
  - Design principles and concepts
  - Design rules
  - Analytic methods
  - Design and evaluation methods

- There is an emphasis on
  - Transforming theoretical knowledge into tools that can be used by designers
  - The psychological model of the human processor simplified into GOMS
    - Goals – what the user trying to accomplish
    - Operators
      - atomic elements in the GOMS
      - requires perceptual, motor and cognitive actions
    - Methods – sequence of operators necessary to accomplish a goal
    - Selection
      - rules specify which method should be used to satisfy a given goal
      - There may be several different ways of achieving same goal


(Initial situation)
Selection
Selection
Method
Operator
Goal
Method A
Operator A1
Operator A2
Operator A3
Operator ...
Method B
Operator B1
Operator ...
Goal

The model has also been transformed into keystroke level method (KLM)

- Keystroke-Level Model (KLM) is a simplified version of GOMS
- Proposed by Card and Moran
- Used to predict user performance
- Using KLM, execution time is estimated by
  - listing sequence of operators
  - Summing the times of individual operators
- Aggregates all perceptual and cognitive function into a single value for an entire task

- Original KLM had six classes of Operators
  - K for pressing a key
  - P for pointing to a location on screen with the mosue
  - H for moving hands to home position on the keyboard
  - M for Mentally preparing to perform an action
  - R for the response where the user waits for the system
- For each operator, there is an estimate of execution time

KLM

Consider the text editing task of searching a Microsoft Word document for all occurrences of a four-letter word, and replacing it with another four-letter word. Here we use the notation of Card et. al (1983, p264-265). **K** represents pressing a key or a button. **P** represents pointing with the mouse to a target on the display. **H** represents moving hands to the home position on the keyboard or mouse. **M** is a heuristic to incorporate mentally preparing for a task. The time intervals are taken from the same source, for an average typist (55 wpm). In the table below, operations are sometimes concantenated and repeated. For example, M4K means "**M**ental preparation, then **4** **K**ey presses."

- The model has also been transformed into keystroke level method (KLM)

Description	Operation	Time (sec)
Reach for mouse	H[mouse]	0.40
Move pointer to "Replace" button	P[menu item]	1.10
Click on "Replace" command	K[mouse]	0.20
Home on keyboard	H[keyboard]	0.40
Specify word to be replaced	M4K[word]	2.15
Reach for mouse	H[mouse]	0.40
Point to correct field	P[field]	1.10
Click on field	K[mouse]	0.20
Home on keyboard	H[keyboard]	0.40
Type new word	M4K[word]	2.15
Reach for mouse	H[mouse]	0.40
Move pointer on Replace-all	P[replace-all]	1.10
Click on field	K[mouse]	0.20
Total		**10.2**

THANK YOU