

# **COGNITIVE ERGONOMICS**

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# **SUMMARY OF PREVIOUS LECTURES**

- 1. Response selection and execution**
- 2. Factors affecting it**



# SRK MODEL

SKILL-RULE-KNOWLEDGE MODEL

# SKILL-RULE-KNOWLEDGE (SRK) MODEL

Identifies three types of behavior in cognitive processing while performing various kinds of tasks:

1. Skill-based
2. Rule-based
3. Knowledge-based

# SKILL-BASED BEHAVIOR

Characteristic behavior when a person has gained a high degree of familiarity and proficiency in a task

- The task can be performed automatically and subconsciously
- The task usually has a high manual content
- Attention resources required are minimal
- Examples:
  - Walking, riding a bicycle
  - Unloading a production machine that produces the same part every cycle

# RULE-BASED BEHAVIOR

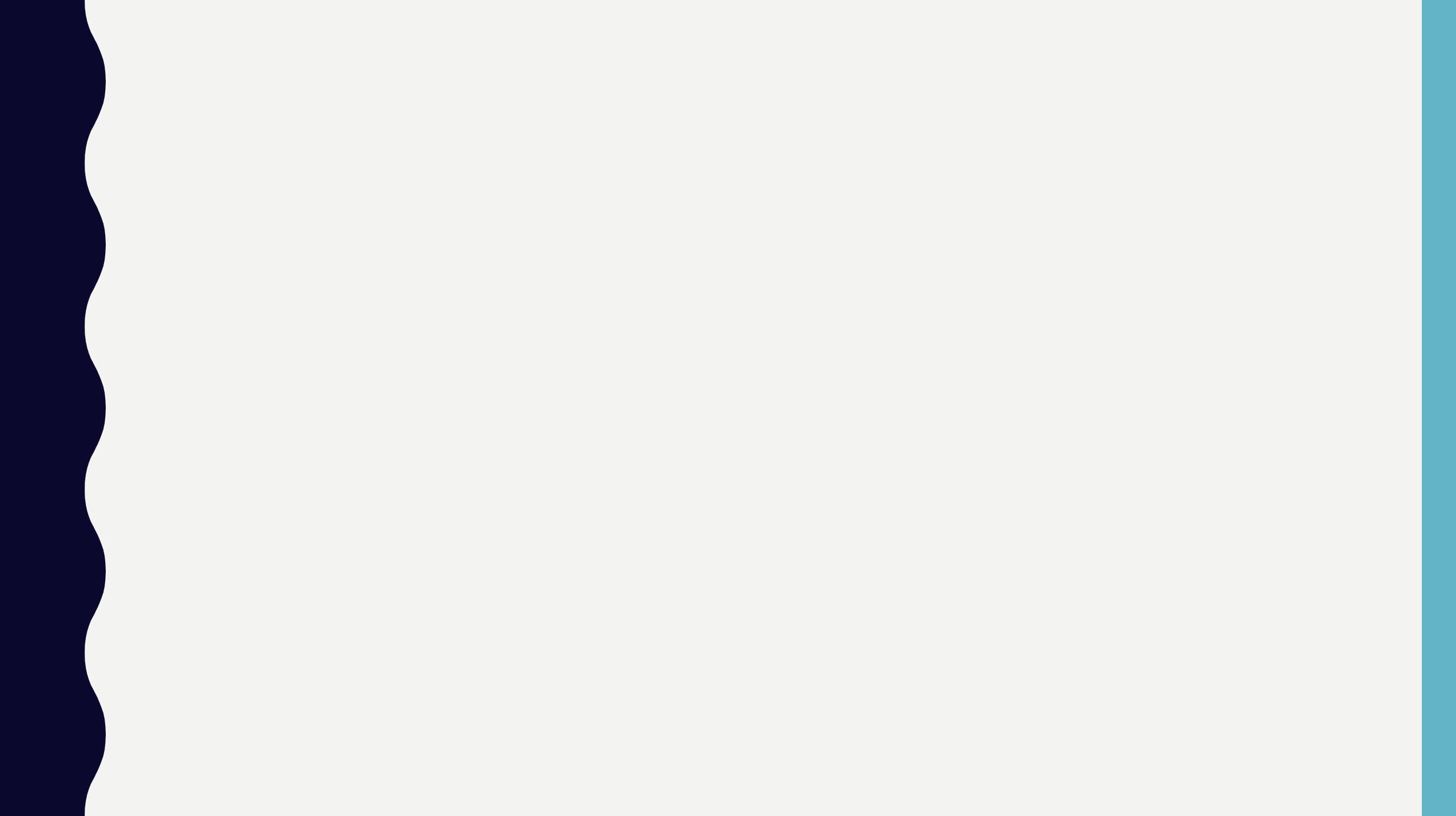
Characteristic behavior when a person performs a task according to a set of rules or instructions

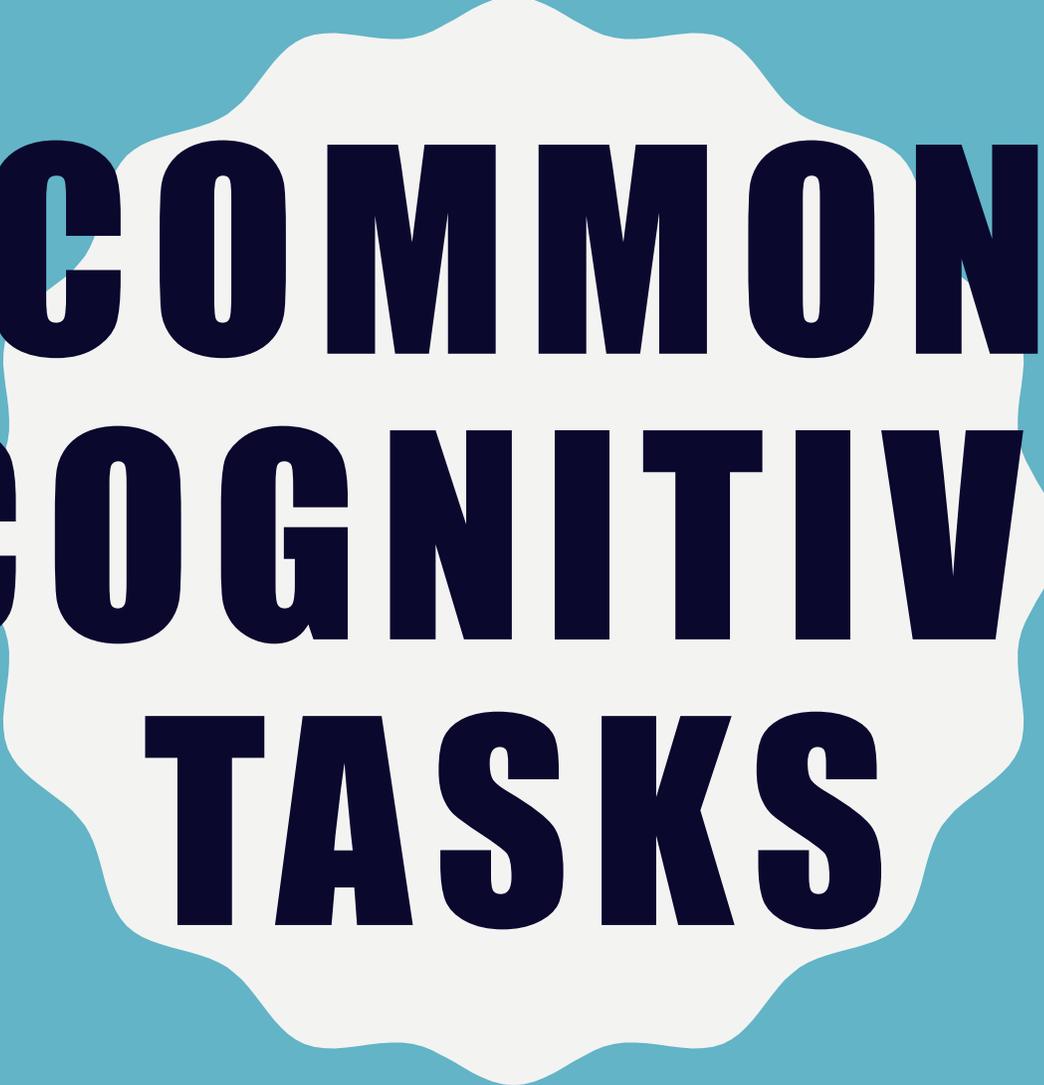
- Greater demands on attention resources than in skill-based behavior because rules or instructions have to be consciously followed
- Examples:
  - Following a recipe in preparing a dessert
  - Following a checklist when starting up a chemical process
  - Setting up a fixture on a milling machine

# KNOWLEDGE-BASED BEHAVIOR

Characteristic behavior when a person performs a task that requires a high degree of cognitive processing because the situation is unfamiliar and rules or past experience cannot be applied

- Person must define objectives, evaluate alternatives, and mentally or physically test consequences of the alternatives
- Examples:
  - Engineer designing a part
  - Doctor making a medical diagnosis





**COMMON  
COGNITIVE  
TASKS**

# COMMON COGNITIVE TASKS

- Decision making
- Planning
- Problem solving



# **DECISION MAKING**

# DECISION MAKING

Mental process in which a person makes a judgment to select one alternative over other possible alternatives in order to achieve some objective or satisfy some criteria

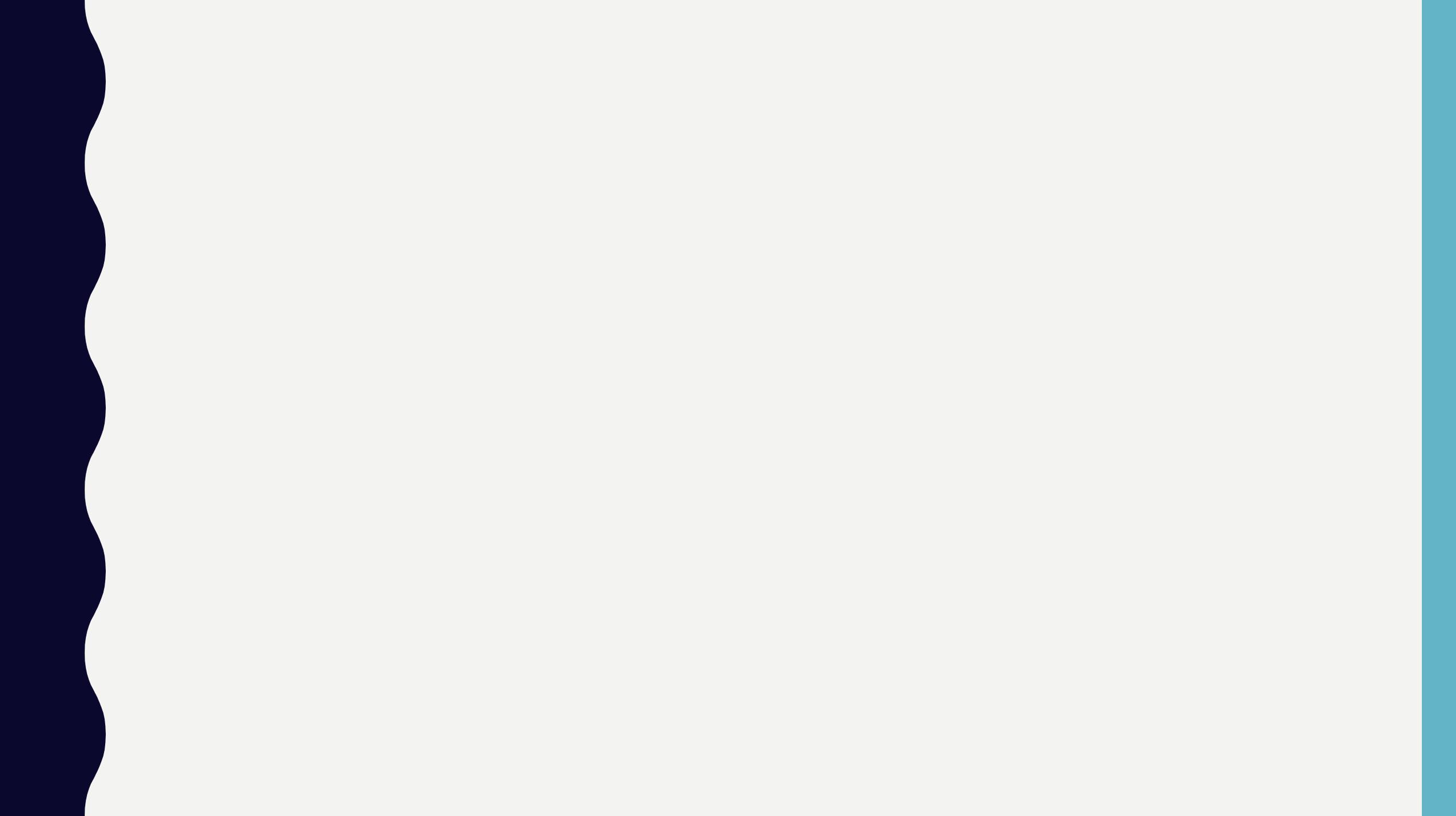
- Elements of typical decision-making situations:
  1. One alternative must be selected from among multiple options
  2. Some information is available about options
  3. Time frame is relatively long
  4. There is uncertainty about operations and outcomes

# MODELS OF DECISION MAKING

1. Rational decision models
  - Emphasis on logical or quantitative selection among options
2. Descriptive decision models
  - Emphasis on the cognitive and behavioral aspects of human decision making

# RATIONAL DECISION MODELS

- The way people should make decisions
- Overall score is determined for each option to judge which should be selected
- Example:
  - State lottery worth \$20 million. Ticket costs \$1.00. Chances of winning per ticket = 1/700 million. Should a person buy 5 tickets?
  - Solution: Expected value of investment
  - $E(V) = 5(1/700,000,000)(\$20,000,000) - \$5$   $E(V) = -\$4.86$ 
    - Person should not buy 5 lottery tickets



# DESCRIPTIVE DECISION MODELS

- Use of heuristics - approaches guided by rules of thumb and simplifications to make decisions
- Some common heuristics:
  - Satisficing - person considers a sequence of options, picks the first one that is satisfactory
  - Anchoring - more weight given to information obtained early in the decision-making process
  - Availability - people are likely to retrieve from long-term memory an alternative that has been used recently or frequently
    - It is the first thing that comes to mind



**PLANNING**



# PLANNING

Mental process of devising a detailed method for doing or making something

- So many human endeavors must be planned:
  - Vacations, careers, weddings, meetings, projects
- Related cognitive activities:
  - Scheduling, designing, scheming, plotting

# COGNITIVE PROCESSES USED IN PLANNING

1. Scripts - planning based on previous plans and experience for similar activities, making adjustments to account for differences in the present situation
  - Example: professional wedding planners
2. Mental simulation - mental development of the steps and imagining what would happen if those steps were followed
  - Used when planning situation cannot be reduced to a script
  - Example: Planning next move in chess



# **PROBLEM SOLVING**

# PROBLEM SOLVING

Mental process in which a question or issue is considered and analyzed to determine an appropriate answer or solution

- Arriving at a solution may require:
  - Mathematical calculations
  - Brainstorming
  - Analysis and diagnosis
  - Evaluation of alternatives
  - Creative design work
  - Combinations of these cognitive activities

# MORE ABOUT PROBLEM SOLVING

- Problems have a technical context - a field of expertise needed to solve the problem
  - Chemical engineering problems are different from accounting problems
- Problems possess a degree of difficulty:
  - Uniqueness of the problem
  - Number of steps required to solve the problem
  - Technical complexity, e.g., a product with 1000 parts is more complex than a product with 100 parts

# APPROACHES IN PROBLEM SOLVING

- Skill-based problem solving - recalling from long-term memory a solution for an identical or similar problem
- Rule-based problem solving - following a step-by-step procedure (e.g., a mathematical algorithm) that leads to the solution
- Knowledge-based problem solving - the problem is unfamiliar, and the person must rely on his or her expertise and understanding of the technical context, combined with a general problem-solving approach

# PROBLEMS IN PROBLEM SOLVING

- Cognitive tunneling - when a problem solver seeks out evidence to confirm a chosen hypothesis but overlooks or ignore clues that might disprove it
- One solution fixation - when a problem solver sticks to a chosen solution even though it is not succeeding
- Stuck in a loop - when a problem solver repeats a sequence of actions that do nothing but lead back to the starting point
- Inability to think ahead more than a few steps



**LECTURE  
CLOSING**

# DID YOU KNOW.....?????

- before sleeping, 90% of your mind begins to imagine the stuff you would like to happen



# A BRIEF HISTORY OF COGNITIVE PSYCHOLOGY & ERGONOMICS

## REEMERGENCE OF COGNITIVE PSYCHOLOGY

- According to Anderson (1995), cognitive psychology first emerged in the two decades between 1950 and 1970. The modern development of cognitive psychology was due to the WWII focus on research on human performance and attention, developments in computer science, especially those in artificial intelligence, and the renewal of interest in the field of linguistics.

### Noam Chomsky (1928-)

- Noam Chomsky's review of Skinner's book on language (Verbal Behavior) in the 1959 journal Language is considered the famous turning point for Cognitive psychology. Chomsky, a linguist at the Massachusetts Institute of Technology, argued that language cannot be explained through a stimulus response process as Skinner explained, because this does not account for some of the common facts about language. The creative use of language can be better explained as a central process than a peripheral process. Language is a way to express ideas, and the way that these ideas are turned into language is a cognitive process. Chomsky's critique stimulated much more interest in the cognitive processes of all types of human activity (Benjafield, p.41). He showed that language was much more complex than anyone previously believed and that behavioral explanations could not reasonably explain the complexities of language.

### David Rumelhart & James McClelland

- Rumelhart and McClelland are prime examples of modern cognitive psychologists. Their names are associated with Parallel Distributed Processing (PDP). This model stresses that information processing happens simultaneously (parallel) as opposed to serially (one at a time). Their theory suggests that many simple processing units are responsible for sending excitatory and inhibitory signals to other units. By understanding these basic features, they believe that the complex system can be explained. The idea that processing involves interconnected elements and the reference to neural models, makes up their Connectionist Theory.

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**THANK YOU ...**



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UNDERSTANDING OF NEXT LECTURE**