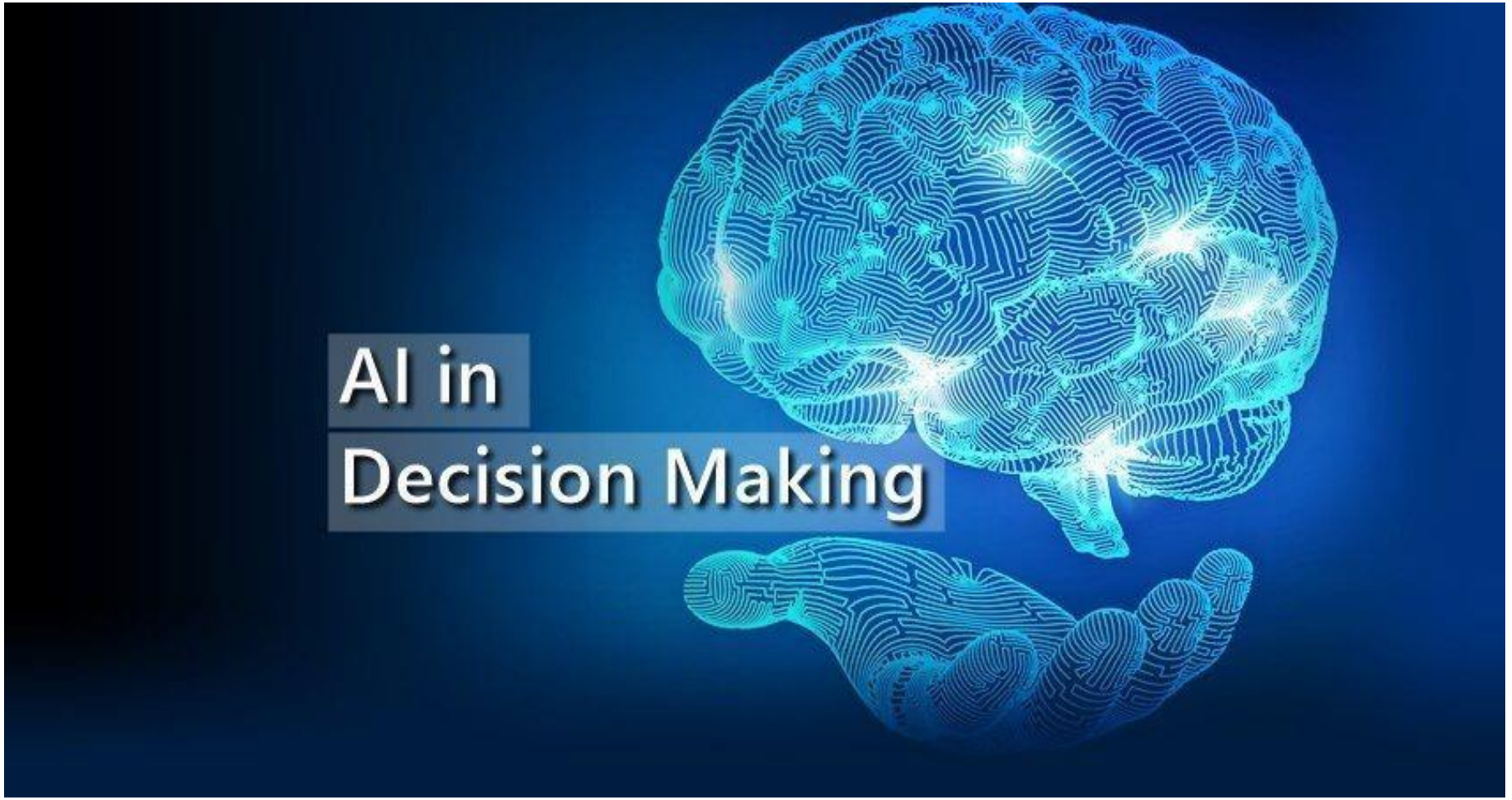

National College of Ireland

Welcome to AI Driven Decision Making

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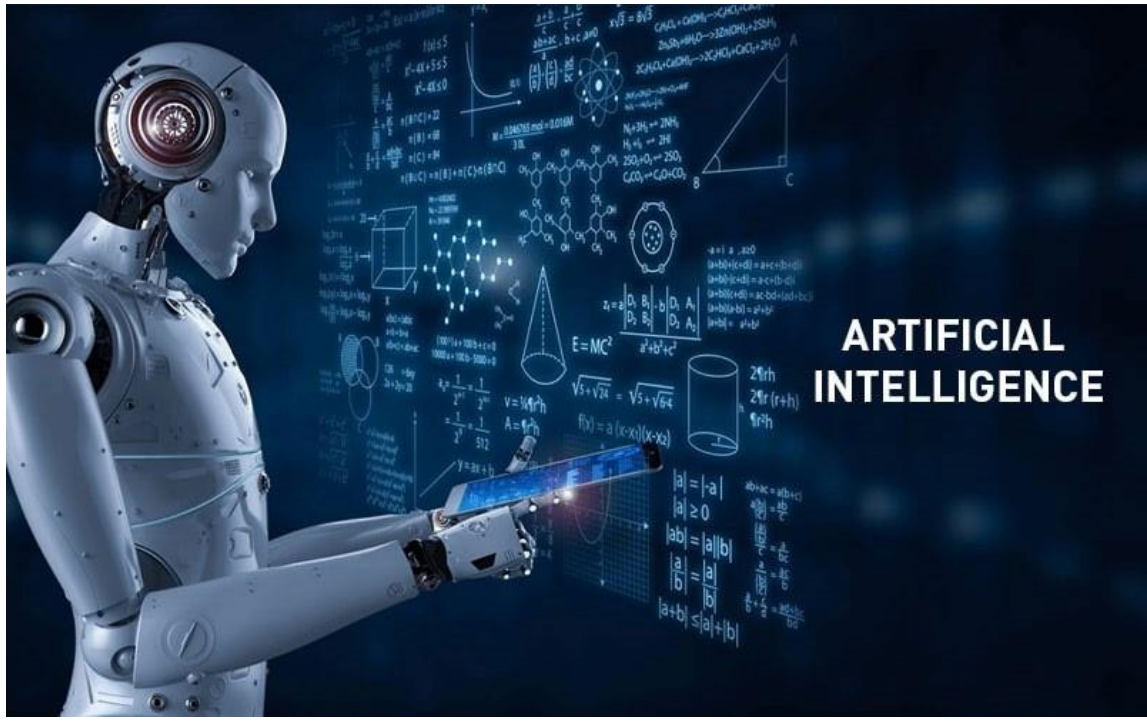
Agenda Today

- Foundations of AI
- Theory & Models of Decision Making
- Historical AI Approaches to Decision Making

What Is Artificial Intelligence?

- “The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.”

  -- Oxford dictionary



- "It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.“

  -- John McCarthy (IBM)

- “Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition and machine vision.”

  -- Ed Burns, Nicole Laskowski, Linda Tucci

Foundations of AI

1. Philosophy
2. Mathematics
3. Economics
4. Neuroscience
5. Psychology
6. Computer engineering
7. Control theory and cybernetics
8. Linguistics

Foundations of AI

Philosophy

- Can formal rules be used to draw valid conclusions?
- How does the mind arise from a physical brain?
- Where does knowledge come from?
- How does knowledge lead to action?

Foundations of AI

Mathematics

- What are the formal rules to draw valid conclusions?
- What can be computed?
- How do we reason with uncertain information?

Foundations of AI

Economics

- How should we make decisions so as to maximize payoff?
- How should we do this when others may not go along?
- How should we do this when the payoff may be far in the future?

Foundations of AI

Neuroscience

- How do brains process information?

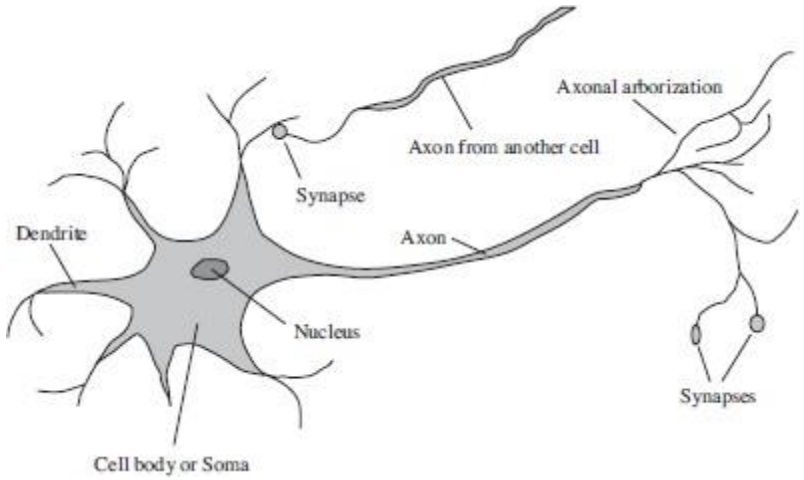


Figure 1.2, page 11, book "Artificial Intelligence: A Modern Approach"
By Stuart Russell and Peter Norvig

Foundations of AI

Psychology

- How do humans and animals think and act?

Foundations of AI

Computer engineering

- How can we build an efficient computer?

Foundations of AI

Control theory and cybernetics

- How can artifacts operate under their own control?

Foundations of AI

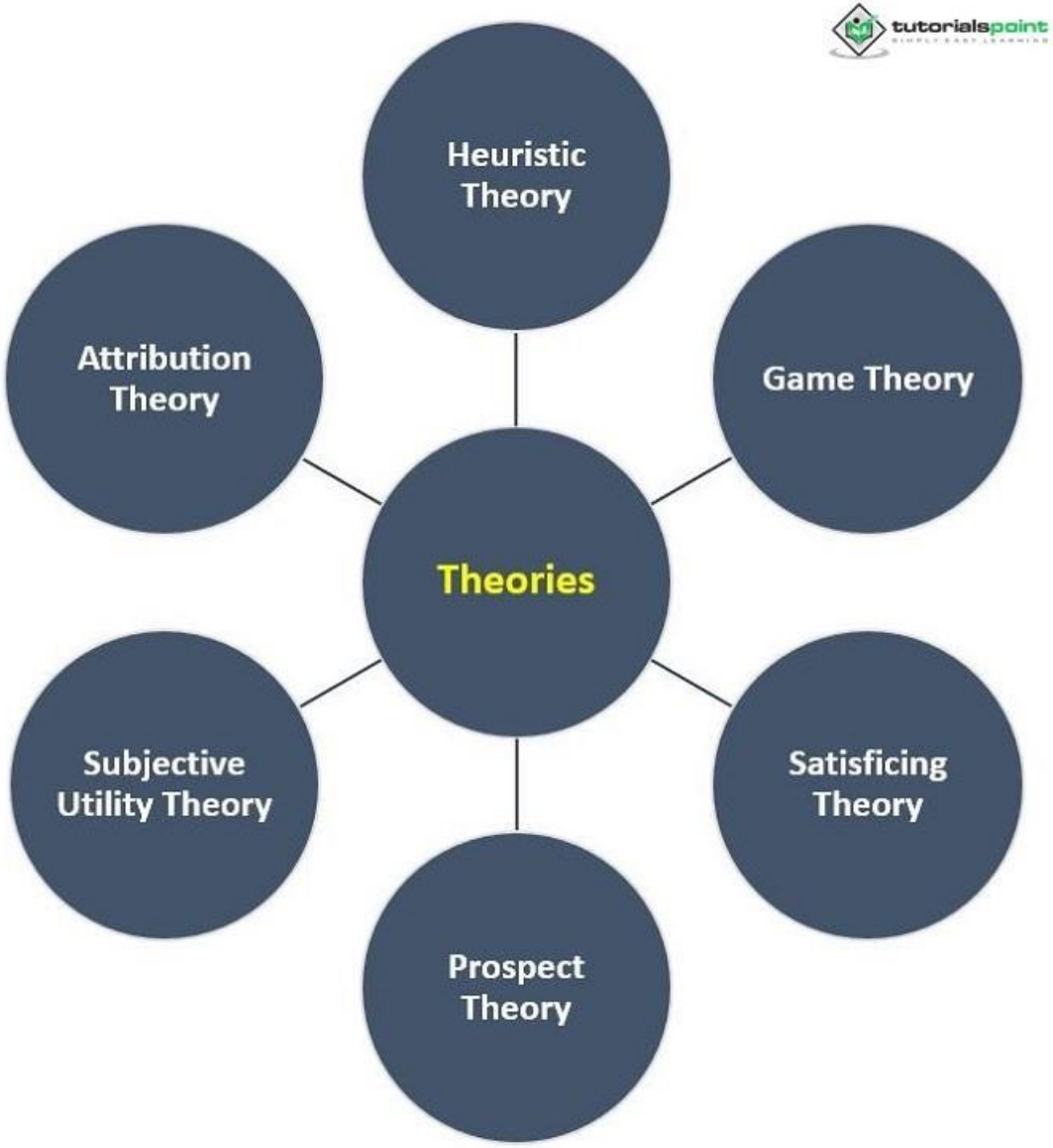
Linguistics

- How does language relate to thought?

Decision Making

- The process of making a choice!!!

Major Theories of Decision-Making



Major Theories of Decision-Making

- Subjected Expected Utility Theory

  This theory is an approach in which decisions are taken under risk, allowing for the subjective evaluation of variables under different options and the associated probabilities

- Prospect Theory

  This theory states that decision-making depends on choosing between various alternatives, but the decision depends on biased judgments

- Satisficing Theory

  In this theory, the decision maker chooses the option that satisfies the problem

- Attribution Theory

  Attribution refers to explaining the reasons behind any action or motive. Heider proposed this thesis, on which other researchers expanded.

- Game Theory

  In game theory, there is an understanding of choice between competing people.

- Heuristic Theory

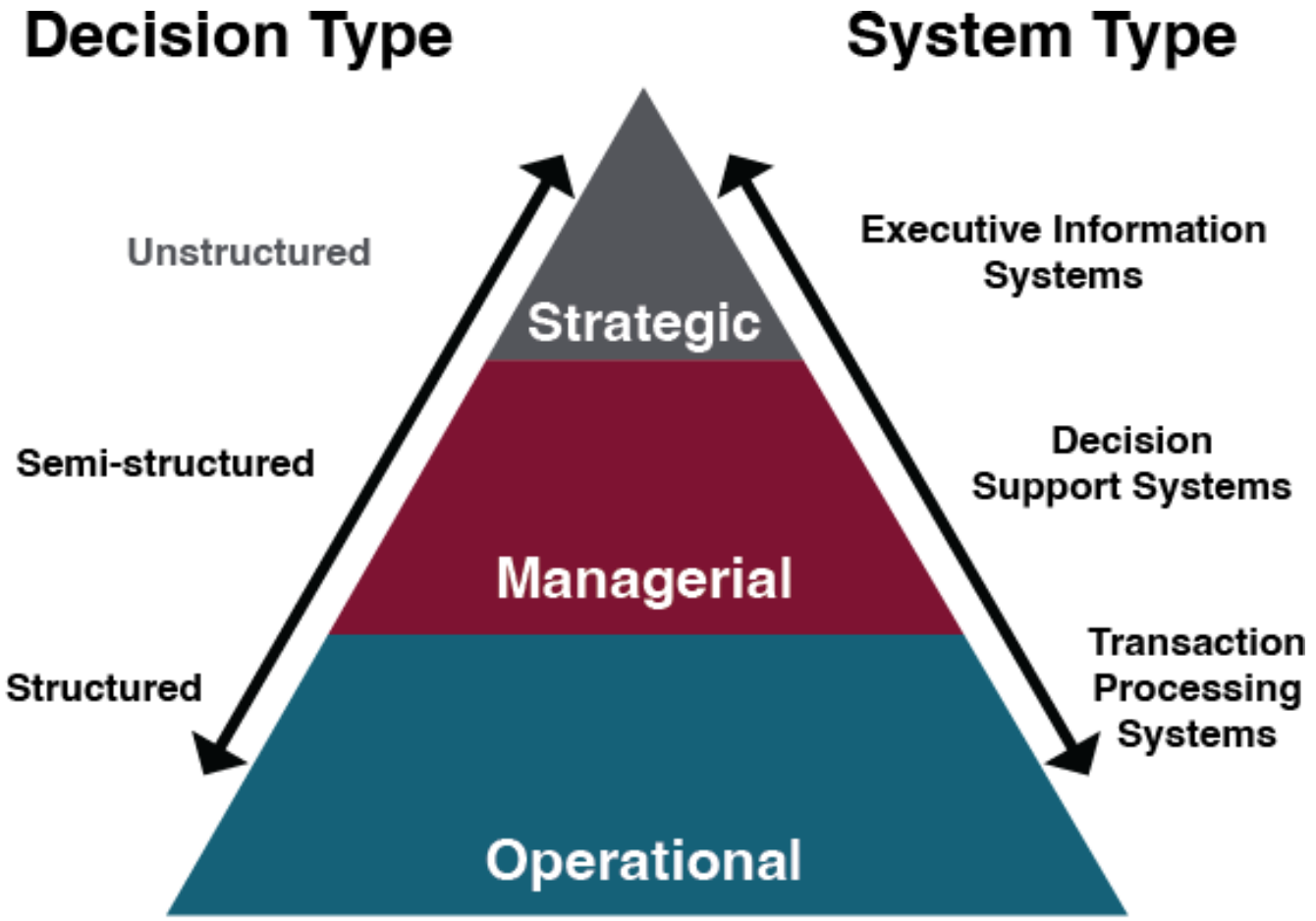
  Heuristics are efficient cognitive processes that ignore part of the information, conscious or unconscious.

Types of Decision Making

- Structured – Semi-Structured – Unstructured
  - A structured decision is one that is made quite often, and one in which the decision is based directly on the inputs
  - A semi-structured decision is one in which most of the factors needed for making the decision are known but human experience and other outside factors may still impact the decision
  - An unstructured decision or non programmed decision involves a lot of unknowns

Decision Type vs. System Type

- Strategic decisions set the course of an organization
- Tactical/Managerial decisions are decisions about how things will get done
- Operational decisions refer to decisions that employees make each day to make the organization run



Decision Type and System Type Pyramid (click to enlarge).

Types of Decision Making

- Individual vs. Collective
  - Single decisions do not take into account what others are doing or thinking
  - Collective decisions – decision makers are taking into account opinion(s) of the others

Group Decision Making

- Decision makers are taking into account opinion(s) of the others
- 2 subfields of DM theory:
  - Social choice theory
  - Game theory

Social Choice Theory

- History:
  - Pioneered in the 18th century by Nicolas de Condorcet and Jean-Charles de Borda
  - Continued in the 19th century by Charles Dodgson (also known as Lewis Carroll)
  - Took off in the 20th century with the works of Kenneth Arrow, Amartya Sen, and Duncan Black
- Principles – This theory establishes principles how decision involving more than one decision maker are made
- How do we aggregate the divergent beliefs and desires of a heterogeneous individuals into a collective decision?

Game Theory

- The outcome of the decision depends on what others do
- If others (opponents) are clever to predict and foresee your action, they can adjust their strategies accordingly!
- Rational decisions will allow you to adjust your strategy, too, based on what you believe will be the next step of your opponent!

Decision Making Models

- Classical

  Classical approach is also known as prescriptive, rational or normative model.

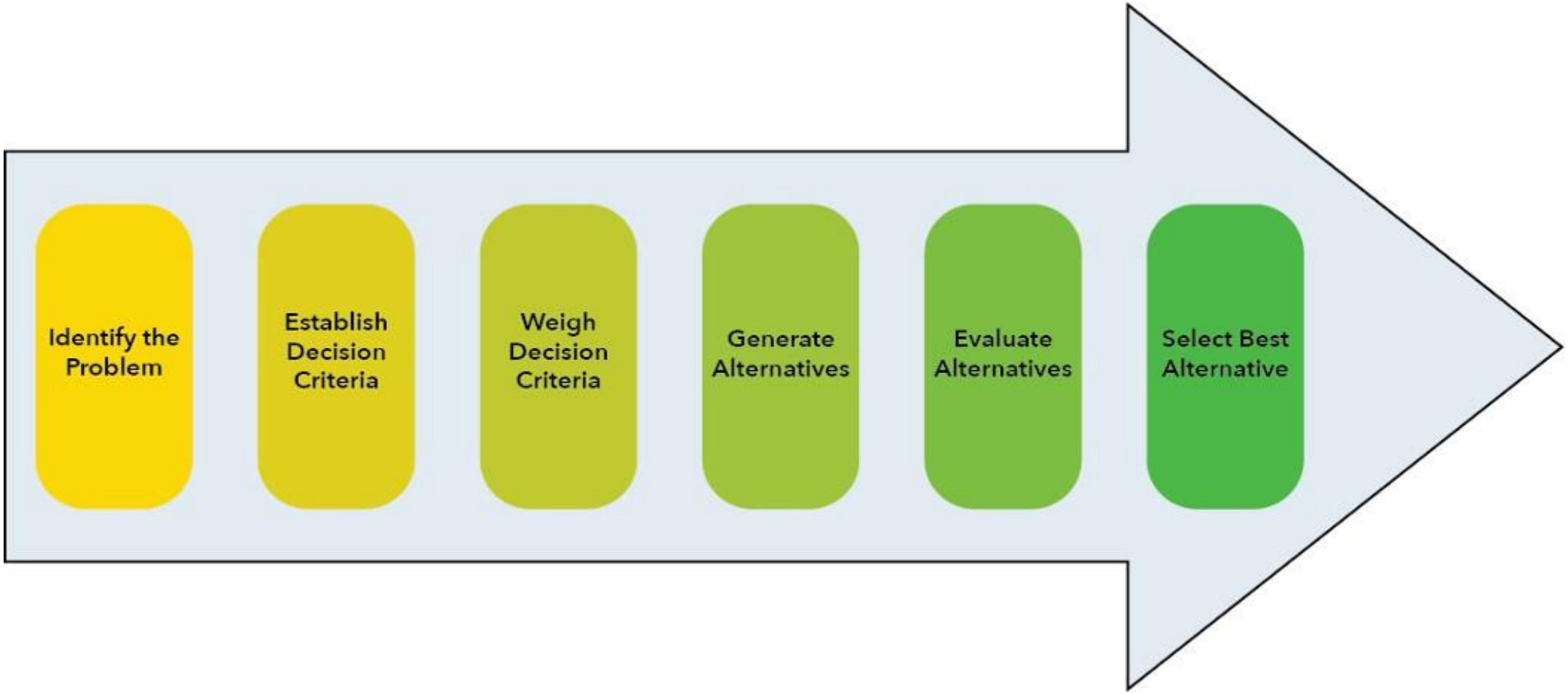
- Administrative

  The administrative model of decision making assumes that decision makers' rationality is bounded and that they're willing to consider only a limited number of criteria and alternatives before making decisions.

- Political

  This is a group decision-making model based on democratic choices.

The Rational Decision-Making Process

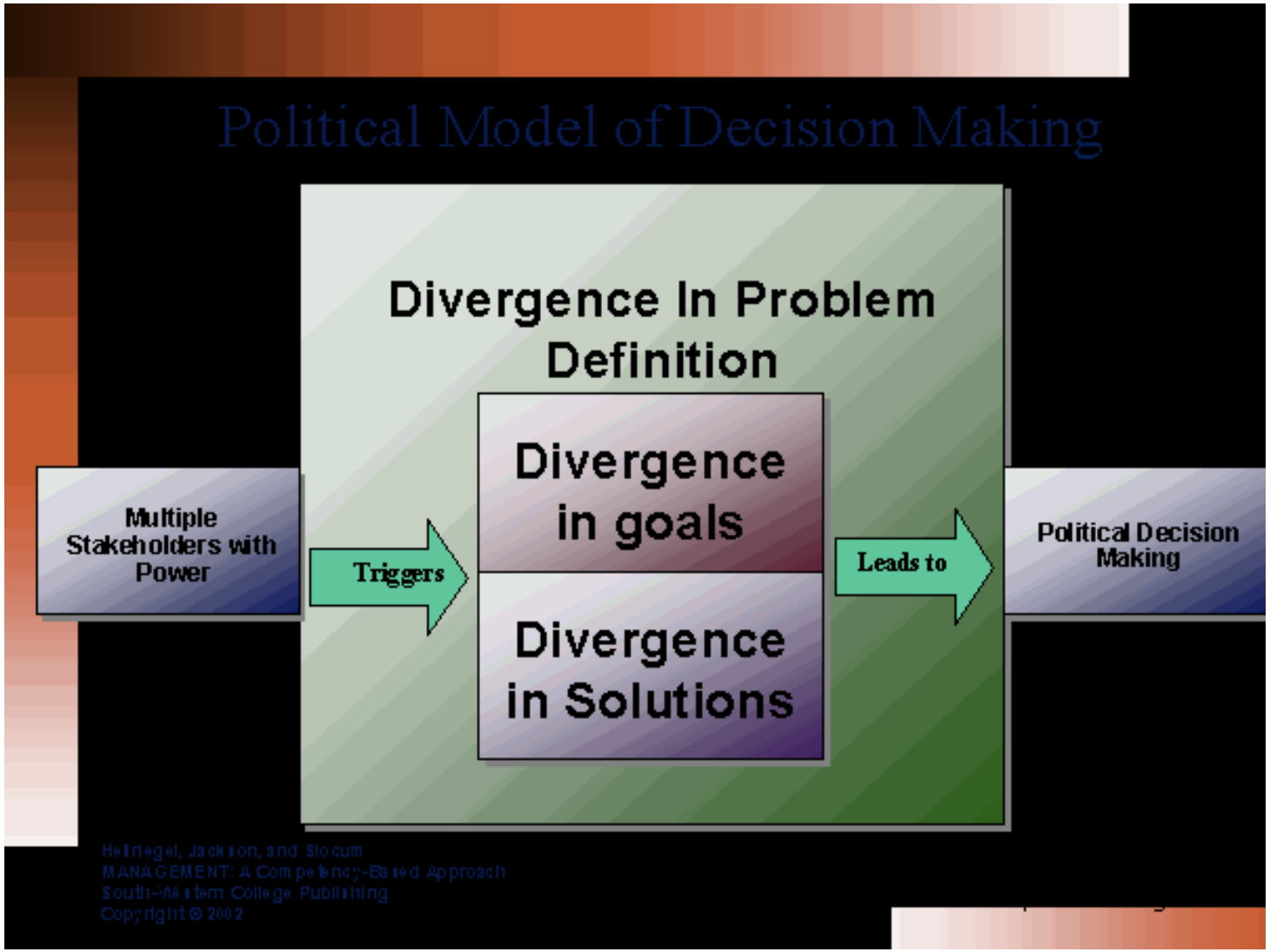


Rational vs. Administrative

Assumptions	Rational Model	Administrative Model
Decision maker's rationality	• Complete	• Bounded
Availability of resources (e.g. time, information, etc.)	• Complete	• Limited
Alternative selection	• Optimisation – selecting an alternative with a maximum utility	• Satisfaction – selecting an alternative that meets a minimum standard of sufficiency

Source: Kutschera I., Ryan M.H.: *Implications of Intuition for Strategic Thinking: Practical Recommendations for Gut Thinkers*, Advanced Management Journal, Summer 2009, p.14.

Political Model



AI Approaches to Decision Making

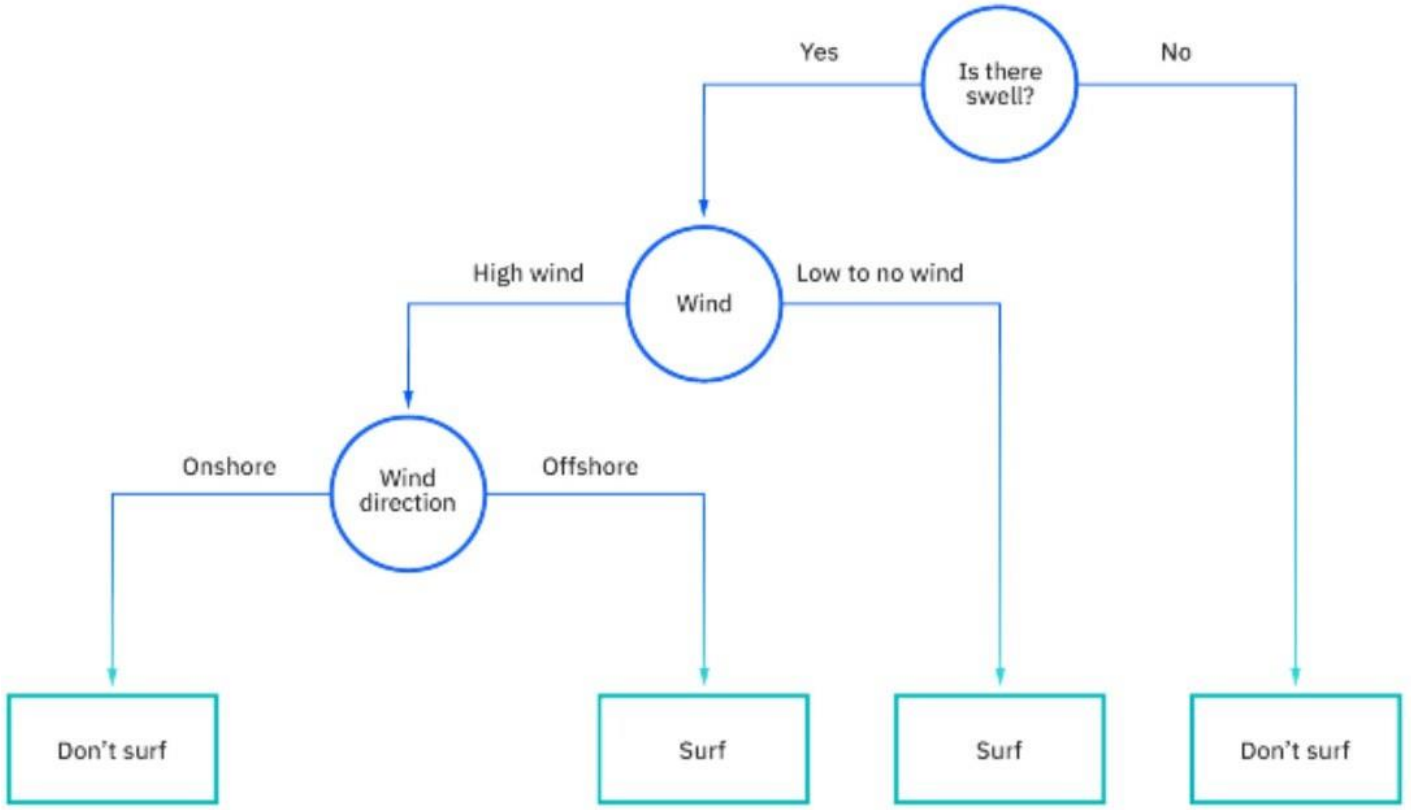
- AI Decision Support Systems
- Contextual AI/Human Decision Making
  - Support
  - Augment
  - Replace
  - Automate
- Explainable AI Expert Systems
- Case-based & Rule-based systems

Contextual Decision Intelligence

- Contextual decision intelligence uses artificial intelligence (AI), machine learning, natural language processing, and automation to reveal patterns and relationships around business metrics and recommends specific actions for improved performance.
- Examples:
  - Store managers of FMCG products can decide on how much and which items to stock using CDI on customer behavior during adverse environmental predictions, like hurricanes.
  - Lenders can understand creditworthiness and process loan applications faster by applying CDI on credit scores, requested amount, purpose of loan, and other influencing factors.
  - Organizations can improve operations, reduce warehouse costs, and streamline supply chains by using CDI to forecast demand.
  - Healthcare providers and hospitals can use CDI to prepare better in terms of availability of beds, medicines, medical staff, and other facilities as seasons change and infections rise.

Rule-Based Systems

- Decision Trees
  - A decision tree is a non-parametric supervised learning algorithm
  - It has a hierarchical, tree structure, which consists of a root node, branches, internal nodes and leaf nodes



Questions?

See you next session.....