SOS POLITICAL SCIENCE AND PUBLIC ADMINISTRATION MBA HRD 205 SUBJECT NAME: MANAGEMENT INFORMATION SYSTEM

TOPIC NAME: SOME CONCEPTS RELATED TO DECISION MAKING (2)

DECISION ANALYSIS:

- Decision analysis is a formalized approach to making optimal choices under conditions of uncertainty. It allows the user to enter costs, probabilities, and health-related quality of life values among other inputs of interest, and then calculates probabilistically weighted means of these outcome measures.
- Decision analysis (DA) is a systematic, quantitative, and visual approach to addressing and evaluating the important choices that businesses sometimes face. Ronald A. Howard, a professor of Management Science and Engineering at Stanford University, is credited with originating the term in 1964. The idea is used by large and small corporations alike when making various types of decisions, including management, operations, marketing, capital investments, or strategic choices.

- Decision analysis is a systematic, quantitative, and visual approach to making strategic business decisions.
- Decision analysis uses a variety of tools and also incorporates aspects of psychology, management techniques, and economics.
- Risk, capital investments, and strategic business decisions are areas where decision analysis can be applied.
- Decision trees and influence diagrams are visual representations that help in the analysis process.
- Critics argue that decision analysis can easily lead to analysis paralysis and, due to information overload, the inability to make any decisions at all.

ELEMENTS OF DECISION ANALYSIS MODELS:

- The mathematical models and techniques considered in decision analysis are concerned with prescriptive theories of choice (action). This answers the question of exactly how a decision maker should behave when faced with a choice between those actions which have outcomes governed by chance, or the actions of competitors.
- Decision analysis is a process that allows the decision maker to select at least and at most one option from a set of possible decision alternatives. There must be uncertainty regarding the future along with the objective of optimizing the resulting payoff (return) in terms of some numerical decision criterion.
- The elements of decision analysis problems are as follow:
- A sole individual is designated as the decision-maker. For example, the CEO of a company, who is accountable to the shareholders.
- A finite number of possible (future) events called the 'States of Nature' (a set of possible scenarios). They are the circumstances under which a decision is made. The states of nature are identified and grouped in set "S"; its members are denoted by "s(j)". Set S is a collection of mutually exclusive events meaning that only one state of nature will occur.

- A finite number of possible decision alternatives (i.e., actions) is available to the decision-maker. Only one action may be taken. What can I do? A good decision requires seeking a better set of alternatives than those that are initially presented or traditionally accepted. Be brief on the logic and reason portion of your decision. While there are probably a thousand facts about an automobile, you do not need them all to make a decision. About a half dozen will do.
- Payoff is the return of a decision. Different combinations of decisions and states of nature (uncertainty) generate different payoffs. Payoffs are usually shown in tables. In decision analysis payoff is represented by positive (+) value for net revenue, income, or profit and negative (-) value for expense, cost or net loss. Payoff table analysis determines the decision alternatives using different criteria. Rows and columns are assigned possible decision alternatives and possible states of nature, respectively. Constructing such a matrix is usually not an easy task; therefore, it may take some practice.
- **Source of Errors in Decision Making:** The main sources of errors in risky decision-making problems are: false assumptions, not having an accurate estimation of the probabilities, relying on expectations, difficulties in measuring the utility function, and forecast errors

DECISION TREE:

- Decision tree is the most powerful and popular tool for classification and prediction. A Decision tree is a flowchart like tree structure, where each internal node denotes a test on an attribute, each branch represents an outcome of the test, and each leaf node (terminal node) holds a class label.
- **Construction of Decision Tree :**
  A tree can be “learned” by splitting the source set into subsets based on an attribute value test. This process is repeated on each derived subset in a recursive manner called recursive partitioning. The recursion is completed when the subset at a node all has the same value of the target variable, or when splitting no longer adds value to the predictions. The construction of decision tree classifier does not require any domain knowledge or parameter setting, and therefore is appropriate for exploratory knowledge discovery. Decision trees can handle high dimensional data. In general decision tree classifier has good accuracy. Decision tree induction is a typical inductive approach to learn knowledge on classification.

- **Decision Tree Representation :**
  Decision trees classify instances by sorting them down the tree from the root to some leaf node, which provides the classification of the instance. An instance is classified by starting at the root node of the tree, testing the attribute specified by this node, then moving down the tree branch corresponding to the value of the attribute as shown in the above figure. This process is then repeated for the sub tree rooted at the new node.
- The decision tree in above figure classifies a particular morning according to whether it is suitable for playing tennis and returning the classification associated with the particular leaf.(in this case Yes or No).
  For example, the instance
- (Outlook = Rain, Temperature = Hot, Humidity = High, Wind = Strong)
- would be sorted down the leftmost branch of this decision tree and would therefore be classified as a negative instance.
- In other words we can say that decision tree represent a disjunction of conjunctions of constraints on the attribute values of instances.
- (Outlook = Sunny ^ Humidity = Normal) v (Outlook = Overcast) v (Outlook = Rain ^ Wind = Weak)

The strengths of decision tree methods are:

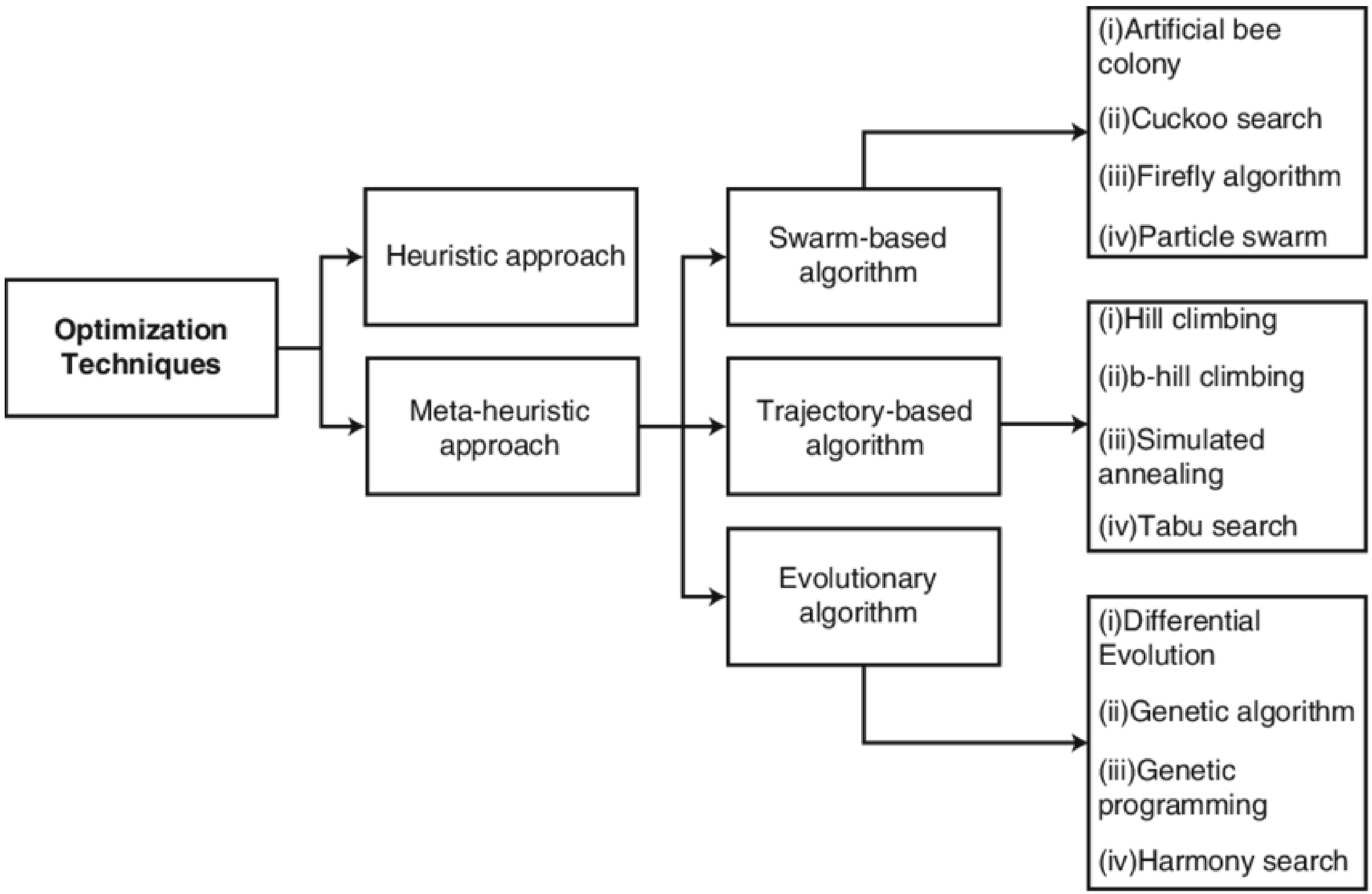
- Decision trees are able to generate understandable rules.
- Decision trees perform classification without requiring much computation.
- Decision trees are able to handle both continuous and categorical variables.
- Decision trees provide a clear indication of which fields are most important for prediction or classification.

The weaknesses of decision tree methods :

- Decision trees are less appropriate for estimation tasks where the goal is to predict the value of a continuous attribute.
- Decision trees are prone to errors in classification problems with many class and relatively small number of training examples.
- Decision tree can be computationally expensive to train. The process of growing a decision tree is computationally expensive. At each node, each candidate splitting field must be sorted before its best split can be found. In some algorithms, combinations of fields are used and a search must be made for optimal combining weights. Pruning algorithms can also be expensive since many candidate sub-trees must be formed and compared.

OPTIMIZATION TECHNIQUES:

- The field of data mining increasingly adapts methods and algorithms from advanced matrix computations, graph theory and optimization. In these methods, the data is described using matrix representations (graphs are represented by their adjacency matrices) and the data mining problem is formulated as an optimization problem with matrix variables. With these, the data mining task becomes a process of minimizing or maximizing a desired objective function of matrix variables.
- Prominent examples include spectral clustering, matrix factorization, tensor analysis, and regularizations. These matrix-formulated optimization-centric methodologies are rapidly evolving into a popular research area for solving challenging data mining problems. These methods are amenable to vigorous analysis and benefit from the well-established knowledge in linear algebra, graph theory, and optimization accumulated through centuries. They are also simple to implement and easy to understand, in comparison with probabilistic, information-theoretic, and other methods. In addition, they are well-suited to parallel and distributed processing for solving large scale problems. Last but not the least, these methodologies are quite flexible and they can be used to formulate a large number of data mining tasks.


Optimization Techniques
Heuristic approach
Meta-heuristic approach
Swarm-based algorithm
Trajectory-based algorithm
Evolutionary algorithm
(i)Artificial bee colony
(ii)Cuckoo search
(iii)Firefly algorithm
(iv)Particle swarm
(i)Hill climbing
(ii)b-hill climbing
(iii)Simulated annealing
(iv)Tabu search
(i)Differential Evolution
(ii)Genetic algorithm
(iii)Genetic programming
(iv)Harmony search