The DecisionMakers' DIRECT
new insights,new tools,new solutions

Crafting intelligent solutions
www.decisioncraft.com

Issue No:06/03/1

Solutions Inspired by Biology

"I have called this principle, by which each slight variation, if useful, is preserved, by the term Natural Selection."

- Charles Robert Darwin, The Origin of Species, 1859, ch. 3

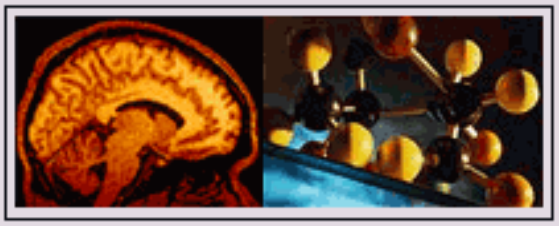
In an increasingly complex and inter-connected world, decision-making is complex. The nature and timing of outcomes of decisions taken today are getting increasingly difficult to predict. This makes it imperative for businesses to adapt and respond effectively and rapidly to the evolving environment **(See** Managing Complexity). Management scientists have looked to tools and methodologies from life sciences for tackling the tough problems faced today.

Some of the popular tools / concepts, inspired by biology are:

1. Artificial Neural Networks (ANN): An interconnected group of artificial nerve cells affect each other in such a way as to arrive at a result based upon their inputs. This is adjusted in time until it best matches the required answer. This programming approach is patterned after the developmental processes of the nervous systems of the animal kingdom.

2. Genetic Algorithms: It is a computing approach based on processes that attack problem solving in the manner that natural selection in biological evolution attacks the problem of survival of the fittest. Just as in natural selection, the program is set up to generate all sorts of programming solutions to a particular problem, and the ones that succeed and solve the problem survive, and the ones that don't are discarded.

3. Ant Colony Optimization: This is based on observation of foraging (food gathering) behavior of ants. As the ants begin their trail, they secrete a substance known as pheromone. Each ant is guided on a particular path based on its concentration of this



More Resources

- Artificial Neural Networks

- Ant Colony IT

- Metaphorically Speaking
(computer deemed to have human intelligence)

- Neural networks and financial prediction

About DecisionCraft Analytics

We provide decision-making solutions to improve operational efficiency and business responsiveness. Our consulting services employ our strengths in industry knowledge, conceptual rigor, and information technologies. Developed using concepts from decision theory; our solutions use robust optimization, simulation, and statistical engines adapted to our client's focus areas.

---

pheromone. As the number of ants following a particular path increase, the concentration of pheromone on the path increases as well, further making the path more attractive for more ants to follow. This way the ants can effectively move around obstacles in its path and quickly adapt their movements to reach the food source. In this way, each agent working towards its individual goal actually drives the organization closer towards its larger goals.

4. Wasp Colonies: These have been studied for the automatic task allocation that takes place among a set of wasps in a colony. The task allocation is based on a dominance hierarchy, which is set up among the wasps. These have been applied to solve complex factory routing and scheduling problems.

5. Cellular Automata: It is a computing approach centered on simple programming sub-routines (called agents), which are given certain operational limitations. These limitations are often constraints / business rules for the business problem to be solved. These agents then solve their own individual problems, and coordinate together, which then contributes to the accomplishment of the overall structure's task or goal. This is patterned after the way cells operate as parts of an organ in the body, and support the functioning of that organ.

Some of the areas, which have been impacted by these solutions, are mentioned below.

	Business Situations	Techniques
1	Forecasting of financial indicators, Assessing individual credit risk, Understanding patterns in customer behavior	Artificial Neural Networks (ANN)
2	Production Scheduling - Batch process	Genetic Algorithms
3	Production scheduling, factory routing, complex task allocation	Wasp Colony
4	Sales force routing, optimal vehicle routing, production scheduling	Ant Colony Optimization

DecisionCraft Products

Travel Route Optimizer
Optimizes travel routes and automates travel planning process

View TRO Flash

qcCharts™
Enhances process capability of critical processes through interactive data visualization

dataOrganizer™
Integrates data from diverse sources on to one destination database

Supply Chain Simulator
Determines optimum inventory policy such as re-order point and maximum stock based on fill rates

Logistics Planner
Synchronizes supply with demand to minimize distribution costs

5	Predicting behavior such as growth of cities, crime rates, spread of disease and diffusion of a new product in market of large complex systems	Cellular Automata

Some of the important characteristics of these solutions are:

Robustness: As they are modeled on natural systems, solutions provided by these techniques are persistent, even under changing circumstances and exhibit the property of graceful degradation. For instance of in case of ANN's, this means that a forecasting model does not have to be tuned, every time fresh data is available. The model would be reliable under moderately changed conditions.

Contingency planning: In real life, disruptive change happens all the time. Many of these solutions have a population of alternate solutions, which are close to the best solution for the given conditions. In case conditions change, (for instance, in a scheduling scenario, if a machine breaks down or in a routing scenario, a path is no longer available), these solutions are able to very quickly find cost effective and feasible alternatives.

De-centralized problem solving: These solutions thrive on complexity brought about by the large number of variables, which may interact in a non-linear fashion. For instance, consider prediction of inflation, using ANN. The determinants of inflation, namely, money supply and demand, interest rates, etc. have complex relationships among each other and with inflation. However, when each of these factors is modeled separately, along with their interactions, this facilitates a bottom-up way to internalize complex relationships.

Next Issue: Sales Force Modeling
Previous Issue: Scheduling Simplified