Deterrence Analysis: AI and Cognitive Science As Necessary Ingredients

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Abstract

The concept of deterrence can be defined as the display of possible threats by one party to convince another party to refrain from initiating certain courses of action. The most common deterrent is that of a threat that convinces the adversary not to carry out intended actions because of costly consequences.

In a nutshell, deterrence analysis comprises these three factors:

- The benefits of a course of action
- The costs of a course of action
- The consequences of restraint (i.e., costs and benefits of not taking the course of action we seek to deter).

Deterrence analysis aims to create scores based on these three elements. Often these exercises are static in nature and are conducted for a special problem, without automation or sensible reuse of previous results. One preferred method was to create typical colored tables (HIGH, MEDIUM, LOW) of scores and risks. These tables were compiled mostly manually. A more elegant approach was game theory. In this talk we discuss briefly behavioral game theory and its suitability to deterrence analysis. Further, we propose a computational framework that that has an Artificial Intelligence foundation and employs cognitive sciences in the design and as means to achieve a permeating validation.

We will close the talk with a list of deterrence open questions and an example of their refinement, as a first step to create a true computational engine.

Biographical Sketch

Michelle Quirk is a project scientist in the Basic and Applied Research Office, InnoVision Directorate, National Geospatial-Intelligence Agency (NGA). She has a career that spans over 25 years in the areas of applied computer science and computational mathematics.

Michelle began her research activities in modeling rock mechanics and continued with numerical methods for solving partial differential equations, where she pioneered the work on infinite elements method for the Maxwell's Equations. As a scientist at Los Alamos National laboratory, Michelle developed extensions to JPEG-2000 Standard with applications to hyper-spectral imagery analysis and processing.

Prior to joining NGA, Michelle was a computational scientist at the Defense Threat Reduction Agency, where she worked on strategic deterrence assessments and decision analysis under uncertainty with non-probabilistic, soft metrics.

Michelle earned a M.S. in computational and applied mathematics (1994) and a Ph.D. in mathematics (2003), from the University of Texas at Austin.