Contradiction Based Logic Approach to Hypothesis Generation (ANTI-FUSE)

Project Overview

ANTI-FUSE is a proposed Knowledge Discovery program requested by the National Security Program's Knowledge Discovery and Databases program. The program leverages our experience in knowledge discovery and hypothesis generation in biological systems and is being executed in collaboration with Stanford University's Computational Learning Laboratory. The ANTI-FUSE program has four main goals:

- Automatically fuse large quantities of disparate data.
- Develop a system for graphically interacting with user to allow her to explore various explanations for available data.
- Provide a mechanism for automatically generating hypotheses about a data set that does not suffer from the problems of exponential explosion common to such systems.
- Execute an experiment on a database provided by the sponsor to demonstrate the power of the system developed at ORNL.

To achieve these goals, we apply a novel logical formulation of the scientific method called Contradiction Based Logic and a new method of hypothesis generation that uses techniques from mathematical programming

to automatically create sets of data-consistent hypotheses.

$$\min_{\epsilon} \sum_i \alpha_i \epsilon_i$$

$$\text{s.t.} \quad Ax = b$$
$$A_R x = b_R$$
$$Dx + C\epsilon = b_D$$
$$x \in \{0, 1\}$$
$$0 \le \epsilon \le 1$$

Key ANTI-FUSE products and publications include:

- A novel software system (HyBrow) used by researchers at the Huck Institute of Life Sciences for gene microarray analysis and used to proof read the entirety of hypotheses made about the human genome in the reactome database.
- C. Griffin and S. Racunas. Logical data fusion for biological hypothesis evaluation. In Proceedings of FUSION 2005, Philadelphia, PA, USA, July 24-28 2005.
- S. Racunas, C. Griffin, and N. Shah. A finite model theory for biological hypotheses. In Computational Systems Bioinformatics Conference, Stanford, CA, August 16-19 2004.

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