Fun GCAT

FUNCTIONAL GENOMIC AND COMPUTATIONAL ASSESSMENT OF THREATS

INTELLIGENCE VALUE

The Fun GCAT is developing methods to rapidly assess the function of DNA sequences to determine if they pose a threat. Used to automatically process large datasets or to supplement subject matter expert review, Fun GCAT technology will enable improved detection of bio-error or bio-terror.

Current screening methods to flag dangerous DNA sequences are inadequate—they do not consider DNA function, cannot process short or highly engineered sequences, and often require follow-up analysis by an expert. Fun GCAT is developing smart, AI-driven threat screening software to replace current look-up table-based screening. Fun GCAT researchers developed computational pipelines to analyze DNA and answer three questions per sequence: What organism does it come from? What biological functions does it have? How dangerous is it? By using neural networks and other powerful bioinformatic techniques to learn the common patterns of sequences with similar origins and functions, Fun GCAT tools are demonstrating high predictive accuracy against increasingly challenging test sets. Benchmarking has demonstrated significant performance increases beyond top winners in a closely related bioinformatic software development global challenge. It resulted in 500x improvement in computational efficiency over state-of-the-art and stable performance on even short (<50 base pairs) sequences. This enabled a range of Intelligence Community-relevant missions from rapid screening of very large datasets to field-based, targeted analysis.

Fun GCAT is also developing new approaches to meet the demand for rapid, relatively high-throughput experimental assessment of DNA function. The program has developed optical, cell-based tests to identify disruptors of the immune system hardwired within cells. New functions for dozens of virus genes have been discovered and the technologies are being leveraged to develop threat prediction capabilities for faster characterization of new strains and emerging viruses.

The program began in June 2017 and will end in February 2022.

PRIME PERFORMERS

- Battelle Memorial Institute
- Harvard University
- Signature Science
- Virginia Tech
- SRI International

TESTING AND EVALUATION PARTNERS

- Johns Hopkins University Applied Physics Laboratory
- Lawrence Livermore National Laboratory
- Pacific Northwest National Laboratory
- Los Alamos National Laboratory
- Department of Homeland Security
- United States Army Medical Research Institute of Infectious Diseases

KEYWORDS

- DNA screening
- Gene function
- Bioinformatics
- Machine learning
- Threat determination
- Viral
- Toxins
- Innate immunity
- Microscopy
- Taxonomic classification
- Biosecurity
- Synthetic biology
- DNA synthesis
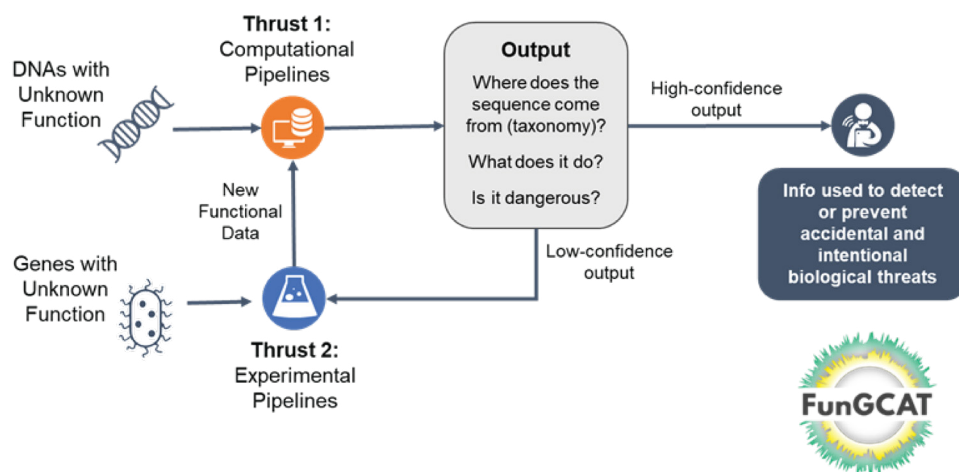
Fun GCAT computational and experimental pipelines work in concert to output high-confidence information on DNA sequences to mitigate biological threats