DTRA Algorithm Prize

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ABOUT US

The Defense Threat Reduction Agency (DTRA) is a combat support agency of the U.S. Department of Defense, founded in 1998, headquartered at Fort Belvoir, Virginia. DTRA includes 2,000 military and civilian personnel located around the world.

DTRA MISSION

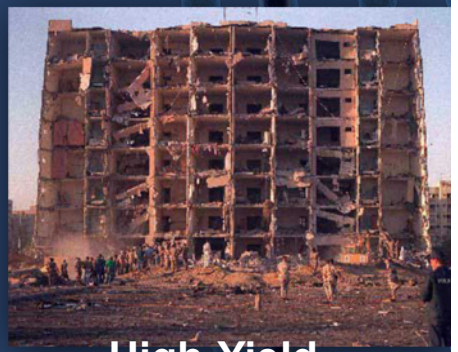
"To safeguard the US and its Allies from Weapons of Mass Destruction (Chemical, Biological, Radiological, and Nuclear) and High-Yield Explosives by providing capabilities to reduce, eliminate and counter the threat, and mitigate its consequences"

Chemical

Biological

Radiological

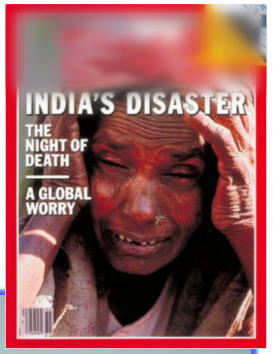
Nuclear

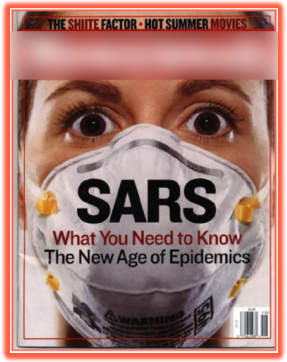


High-Yield Explosives

CHEMICAL AND BIOLOGICAL THREATS

- **Chemical**
  - **Traditional chemical warfare agents**
    - (e.g., nerve agents, vesicants)
  - **Toxic industrial materials and toxic industrial chemicals**
  - **Emerging and non-traditional agents**
- **Biological**
  - **Traditional biological threat agents**
    - (e.g., anthrax and ebola)
  - **Emerging diseases**
    - (e.g., pandemic flu, SARS)
  - **Enhanced threats**
    - (genetically engineered or especially virulent)

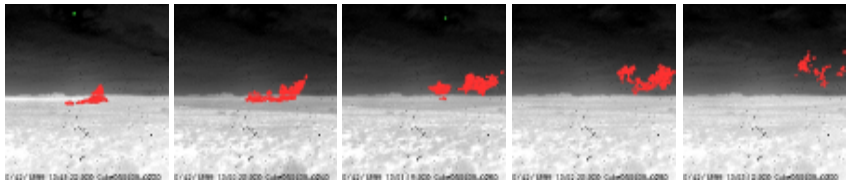


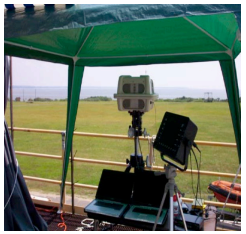


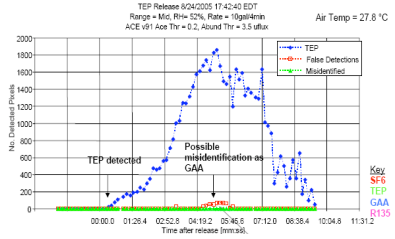
FRAMING RESEARCH AS A FUNCTION OF TOUGH PROBLEMS

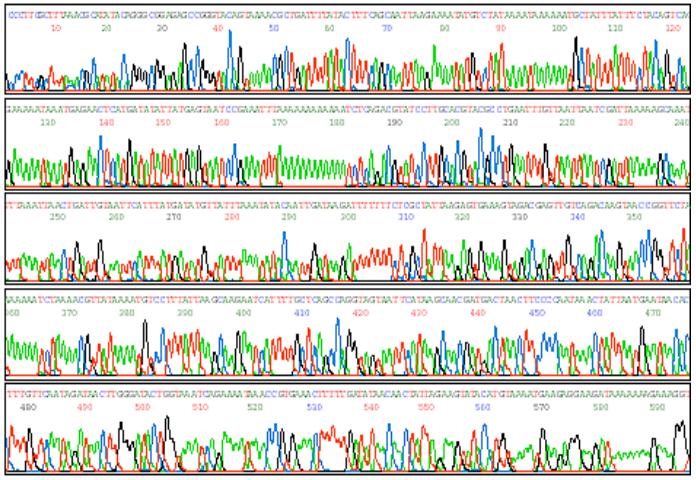
- **Biological/chemical sciences**
  - Exploitable characteristics shared among threat agents
  - Differentiating harmful from non-harmful environmental factors
  - Biological signatures that can be interrogated at a distance and retain their diagnostic value
- **Mathematics/Physics/Computing**
  - Signal to noise enhancing algorithms
  - Exploitation and/or cancellation of stochastic factors
  - Electromagnetic interrogation and readout
- **Environmental**
  - Environmental anomaly detection
- **Nano- and Material Sciences**
  - Interaction of biological agents with materials at various size scales
  - Materials that have intrinsic detection and mitigation capability

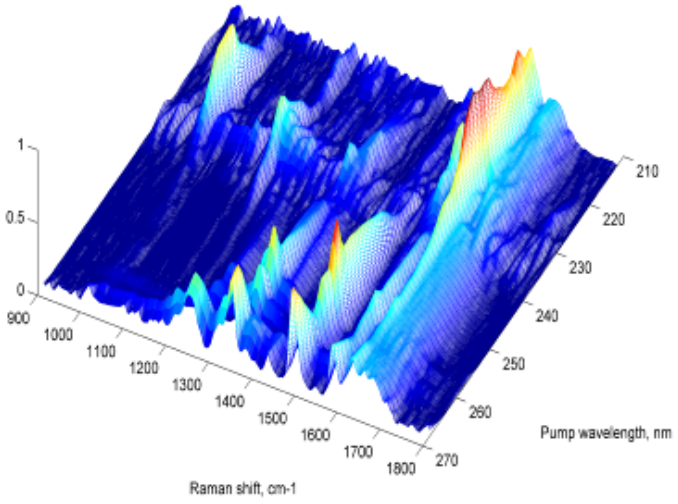
DETECTION DATA DELUGE

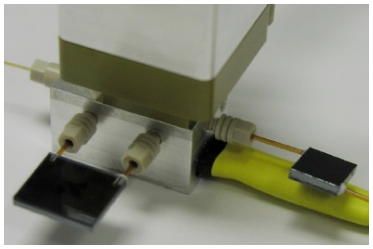




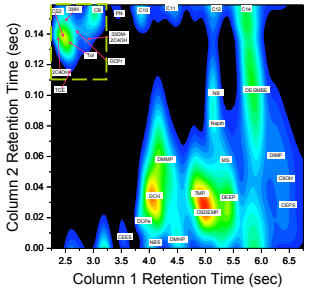








GCxGC Test Module



4 sec, 30 Compound GCxGC Separation

ALGORITHM DEVELOPMENT PRIZE

THE PROBLEM

The biological "threat space" is getting bigger.

- Old threats evolving new capabilities, i.e. resistance
- Emergent threats from nature
- Engineered threats from unlawful places (speculation)

The world is getting smaller.

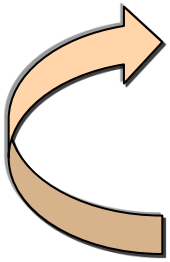
- Transportation is faster
- Borders are more porous

A POSSIBLE SOLUTION

DNA sequencers are getting smaller and faster

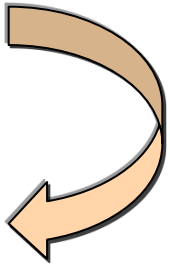
What if we could sequence everything?.....

FOLLOW-ON PROBLEMS



How much data do we need?

What do we do with all the data?



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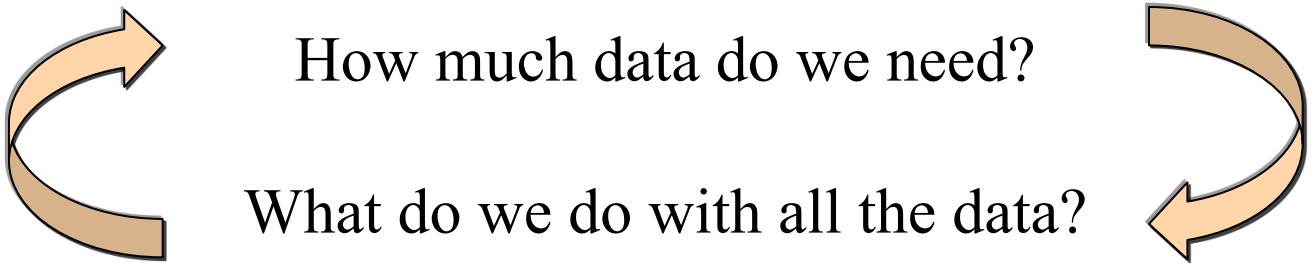

Assumptions:

- Not everyone has access to the cloud.
- Bandwidth and processing power are not free.
- There are not enough expert bioinformaticians to go around.

THE GAP

We need an algorithm that…

- Assesses the data, however complete or limited
- Provides the best possible characterization of the sample
  - Identify and quantify all components when possible
  - Speculate (with probability and justification) when positive ID is not possible
  - Make recommendations for further analysis
- Does not rely on an expert user
- Requires little overhead
- Is fast

THE DTRA CHALLENGE

The Challenge:
Given raw sequence read data from a complex diagnostic sample, which algorithm can most rapidly and accurately characterize the sample?

The Stakes:
$1,000,000

FOR MORE INFORMATION….

Monitor http://www.dtra.mil/business.aspx for updates.

Prize details and training datasets will be made available in the Fall of 2012.