DHS SCIENCE AND TECHNOLOGY

Modeling and Simulation Technology Center (MSTC)
Predictive Threat Modeling (PTM) Core Research Activity
National Information Exchange Model (NIEM) Collaboration

Homeland Security
Science and Technology

Syed Mohammad, Ph.D.
Director, M&S Technology Center

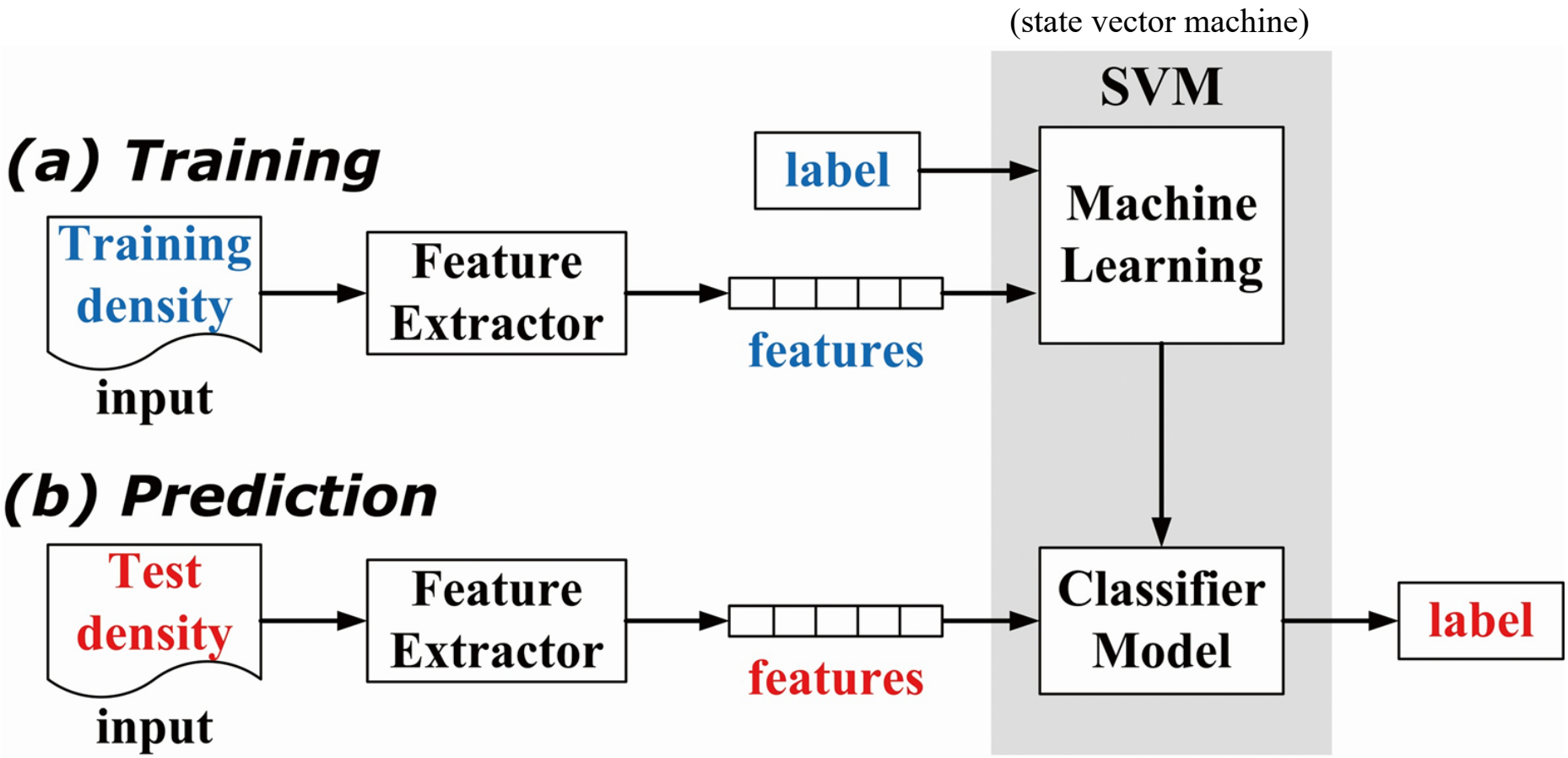
Science and Technology Directorate

Modeling and Simulation Technology Center Predictive Threat Modeling Overview

- An applied research area for modeling “pattern of life” using machine learning, Bayesian Analysis, and other methods for “needle-in-a-haystack” problem sets
- **Current** application in the area of Air Domain
- Collaborative partners from Department of Homeland Security Component partners
- DHS S&T project collaboration
  - Develop algorithm prototypes
  - Deploy PTM within a test enclave
  - Work with prime contractors to deploy matured PTM capabilities
- **Future** applications in Maritime and other domains
- Discuss potential **NIEM application** opportunities & collaboration on current and future activities

MSTC Core Research Activity: Predictive Threat Modeling

Training and Prediction Core Foundation



Citation: D. Si, S. Ji, K. Al Nasr, J. He, "A Machine Learning Approach for the Identification of Protein Secondary Structure Elements from Electron Cryo-Microscopy Density Maps", Biopolymers, Volume 97, Issue 9, pages 698-708, 2012.

MSTC Core Research Activity: Predictive Threat Modeling

Conceptual PTM Overview

Predictive Threat Modeling Engine

Server

Historic Data

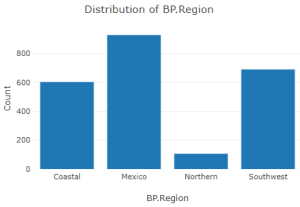
- ↓ **Re-Train** Regularly
- ↓ **Validate** Rigorously
- ↓ **Save** for Live Stream Performance

Validated Model: Save Best Models For Operational Platform

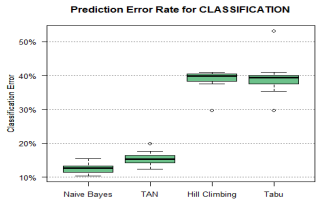


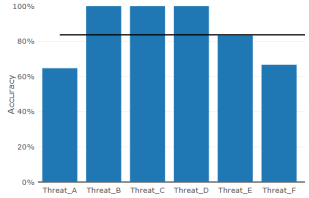
Process Data: Adjust Discretization and Preparation

CMAR_ORIGIN	SHIFT	BP Region
AIR	2-Day	Mexico
LAND	3-Swing	South west
AIR	1-Mid	Coastal



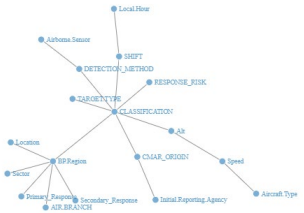
Testing: Rigorous Validation and Review

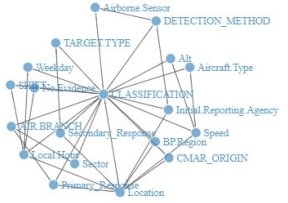




Machine Learning: Core Training. Algorithm Optimization

Graphical Models: Retrieve Optimal Networks



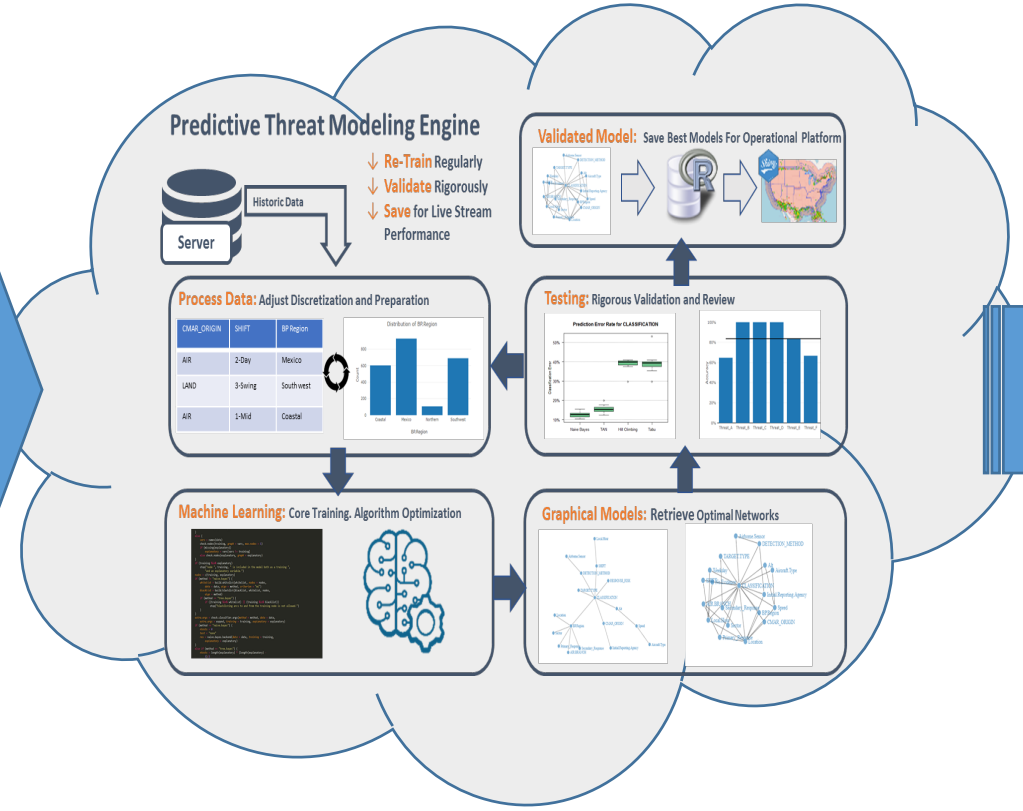


Current PTM Dataflow Overview

MS-TC PTM

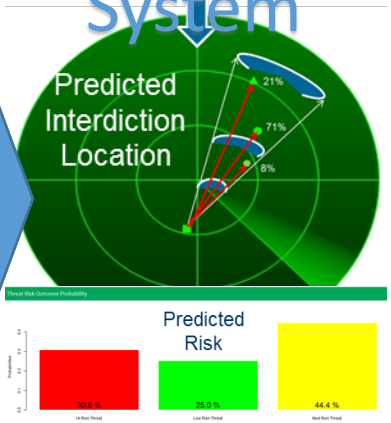
Operational User System

JSON, **XML**, *potentially unstructured* data needs cleaning



Cloud Infrastructure

Operational User System



XML Curser-on-Target (**CoT**), *structured* schema

Potential NIEM / MS-TC Collaboration

- Several areas where NIEM can have immediate impact to enable future applications of MS-TC's PTM capabilities
- Definition of MS-TC's "enclave" re: PTM data exchanges allowing easy adaptability, in alignment with NIEM strategic objectives:
  - **Increase efficiency and agility**
  - **Facilitate common understanding**
  - **Achieve information exchange needs of today and tomorrow**
  - **Connect with NIEM community**
  - **Real-world results through standardization**

Homeland Security

Science and Technology