

# A Unified Approach to Abductive Inference

## Objective:

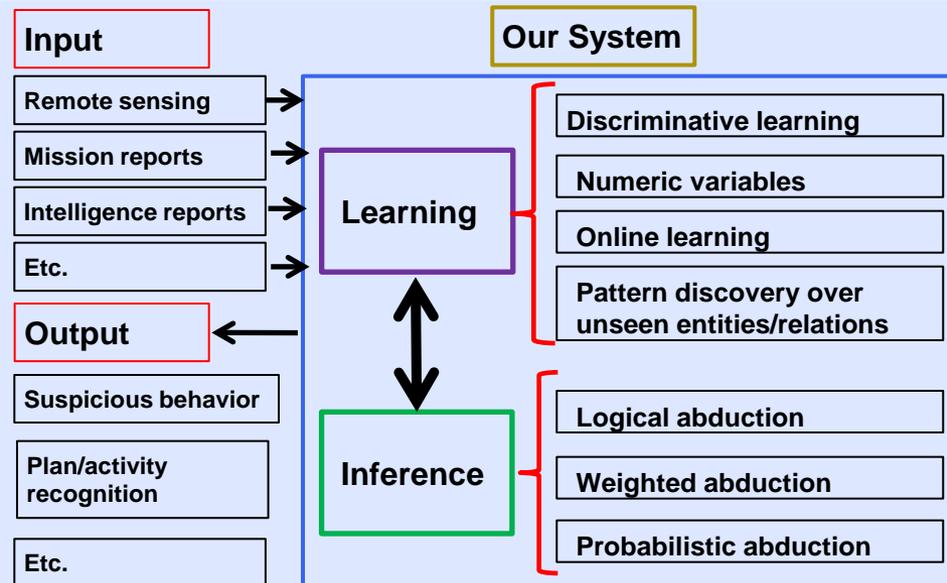
- **Develop a unified approach to abductive inference to aid military commanders in analyzing the bewildering array of information available to them**
- **Approach based on Markov logic:** Well-founded, unified, multi-modal, adaptive, discriminative, continuously operating, adversarial, distributed, psychologically grounded

## Approach:

- **Foundations:** Basic building blocks of abductive inference
- **Real-world issues:** Extend basic functionality to handle multi-faceted problems
- **Scaling up:** Methods to scale our approach to realistic-sized problems
- **Cognitive modeling:** Models of human abduction to inform our approach
- **Applications:** Activity/plan recognition from real-time strategy games & sensor data

## Technical Success:

- **Incorporated features of traditional logical & weighted abduction into Markov logic**
- **Pattern discovery over unseen entities, relations and events**
- **Markov logic to handle numeric data**
- **Approximate lifted probabilistic inference**
- **Parallel belief propagation**
- **Cognitive models of abductive inference and learning for action understanding**



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## Application / Outcome:

- Presented papers at ICML, ECML, SRL, AISTATS, UAI, IJCAI, Cog. Science
- Joint work on scalable and parallel inference between UW & CMU
- Initiated collaboration between MIT and UW on transfer learning
- Initiated collaboration between USC, UT and UW on first-order, probabilistic abduction

## Payoff:

- Public implementations of Markov logic (> 5k downloads) & parallel belief propagation
- Developed first, theoretically grounded work on first-order, probabilistic abduction
- Cognitive models to predict how people ascribe goals to other agents based on those agents' behaviors
- New test beds for activity/plan recognition & managing information overload

## Follow on successes:

- New research directions:
  - Learning & inference algorithms for modal Markov logic
  - Parallel sampling based inferences techniques
  - Approximate compilation for probabilistic inference
  - Discriminative learning for abductive inference

## Remaining technology gaps:

- Query-specific inference and learning
- Approximate lifting with guarantees
- Lifted inference over streaming data
- Discriminative training for abductive inference
- Probability distributions over degrees of belief
- Structure learning with numeric variables
- Approach to fuse audio, video, text, GPS, RFID, etc
- Predicate invention for social networks
- Develop models of social goal inference to classifying agents' social types