

# Machine Learning with User Intelligence

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# Machine Learning with User Intelligence

## BACKGROUND & MOTIVATION

Automated data analysis tools are unable to bridge the semantic gap between complex data and critical information.



Video, Text, Cyber Data

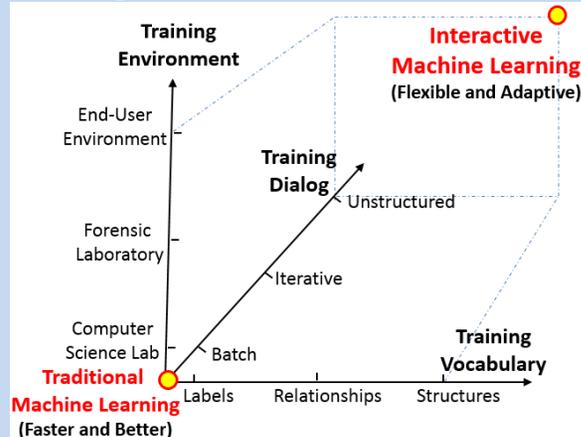


A semantic network captures a chain of entities and relationships

Traditional machine learning happens in the computer science lab.

## INNOVATION

Advancing the *Training Dialog* and the *Training Vocabulary* moves machine learning into end-user environments

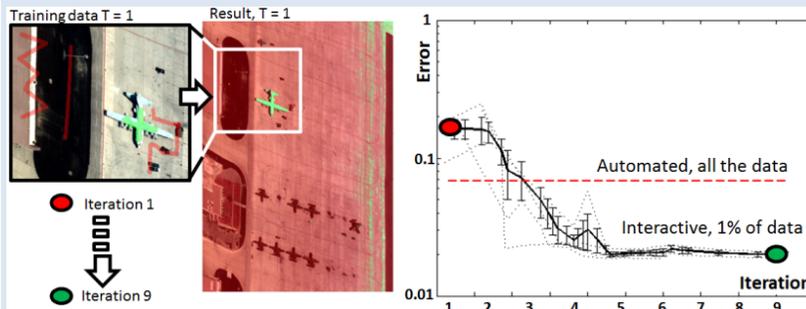


**Interactive Machine Learning** maximizes user input to provide more accurate data analysis with less work from the user.

## DESCRIPTION

Our machine learning advances make better use of end-users in two main ways:

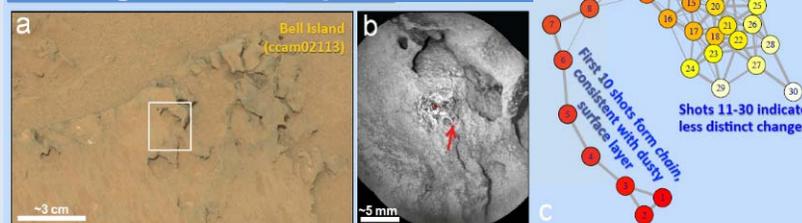
**Dialog:** Interaction is more important than data.



Our framework enables end users to provide training data iteratively which requires less work and outperforms the traditional approach that uses all the data.

**Vocabulary:** Relationships are more expressive than labels.

## Finding relationships on MARS



Bell Island, sol 113. (a) Mastcam image of rock overview, the white box represents the ChemCam sampling region (mcam00694). (b) ChemCam Remote Microimager (RMI) mosaic of Bell Island. The red arrow indicates sampling location 1. (c) Graph of the shot-to-shot partial correlations in location 1 on Bell Island (30 shots). Nodes of graph, representing shots, are colored by shot number.

Our framework enables end users to discover and learn from examples of relationships. These semantic interactions contain more information than labels and are often more intuitive and easier for users to understand.

## Current Technology Readiness Level (TRL) 3

- We have used our framework to develop research prototypes in image analysis and data fusion.

## ANTICIPATED IMPACT

Our advances in machine learning theory and algorithms can benefit a wide range of applications.

- Interactive image analysis tools provide more accurate results with less work in applications from materials microscopy to geo-spatial remote sensing.
- Signature discovery tools help users identify new relationships in multi-sensor, multi-modality data.
- Interactive image search tools match image and video content in specialized multi-media databases.

## PATH FORWARD

### Current Phase – LDRD:

- Develop theory and algorithms for interactive machine learning and demonstrate anticipated impact.

### Phase 2 – Image Quantification:

- Identify new image application domains and work with end-users to tailor and evaluate tools on their specific problems.

### Phase 3 – Signature Discovery:

- Identify multi-sensor, multi-modal applications and end-users that would benefit from interactive data exploration.

**Potential End Users:** Analysts who spend too much time annotating and analyzing unstructured data such as image and video.

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