The Center for Brains, Minds and Machines
a National Science Foundation funded Science and Technology Center on the interdisciplinary study of intelligence.
Vision for CBMM
• The problem of intelligence is one of the great problems in science.

• Work so far has led to many systems with impressive but narrow intelligence

• Now it is time to develop a basic science understanding of human intelligence so that we can take intelligent applications to another level.
Rationale for a Center

Convergence of progress: a key opportunity

Science + Technology of Intelligence
Rationale for a Center

Convergence of progress: a key opportunity

Machine Learning & Computer Science

Science + Technology of Intelligence
Rationale for a Center

*Convergence of progress: a key opportunity*

- Machine Learning & Computer Science
- Neuroscience & Computational Neuroscience

Science + Technology of Intelligence
Rationale for a Center

Convergence of progress: a key opportunity

Cognitive Science

Machine Learning & Computer Science

Science + Technology of Intelligence

Neuroscience & Computational Neuroscience
Rationale for a Center

Convergence of progress: a key opportunity

Machine Learning & Computer Science

Neuroscience & Computational Neuroscience

Cognitive Science

Science + Technology of Intelligence

“Change comes most of all from the unvisited no-man’s-land between the disciplines” Norbert Wiener
Good Time to Study Intelligence

(Machine) Learning systems trained on data rather than programmed
From Current AI Systems ...

From Current AI Systems ...

expansive computations

human supervision

From Current AI Systems ... expansive computations

...To Learning like Humans do

“One of the most obvious differences, however, is the ability of people and animals to learn from very few examples”

Looking inside the Box

data + computations

Secret Ingredient + supervised learning = ?

Thursday, December 5, 13
Data representation (DR) is a (the?) key to reduce the need of human supervision.

“We believe that a set of techniques based on a new area of science and engineering becoming known as “supervised learning” will become a key technology to extract information from the ocean of bits around us and to make sense of it.”

Workshop on
Learning Data Representation: 
Hierarchies and Invariance
November 22-24, 2013 | McGovern Institute for Brain Research, MIT

Program at a Glance

- Session 1: Early Features in Vision
- Session 2: Learning Features and Representations
- Session 3: Learning Invariances and Hierarchies
- Session 4: Beyond Feedforward Architectures
• Session 1: **Early Features in Vision**
• Session 2: **Learning Features and Representations**
• Session 3: **Learning Invariances and Hierarchies**
• Session 4: **Beyond Feedforward Architectures**

**Friday November 22, 2013**

**Session: Early Features in Vision | Chair: C. Tomasi**

14:50 *Filters and other potions for early vision and recognition* (P. Perona)
15:30 *Transformations in early vision from a symmetry argument* (C. Stevens)
16:10 Break
16:40 *Feedforward hierarchical models of visual processing in visual cortex* (T. Serre)
17:20 Panel discussion: C. Tomasi (moderator), W. Freeman, G. Sandini + Speakers
Session 1: Early Features in Vision
Session 2: Learning Features and Representations
Session 3: Learning Invariances and Hierarchies
Session 4: Beyond Feedforward Architectures

Saturday November 23, 2013
8:30 am Breakfast

Session: Learning Features and Representations | Chair: A. Verri

9:30 Data representation, compressed sensing and matrix factorization (B. Recht)
10:10 Dictionary learning and all that (G. Sapiro)
10:50 Break
11:20 Panel discussion: A. Verri (moderator), L. Rosasco, M. Belkin, J. Buhmann + Speakers
12:20 Lunch
- Session 1: *Early Features in Vision*
- Session 2: *Learning Features and Representations*
- Session 3: *Learning Invariances and Hierarchies*
- Session 4: *Beyond Feedforward Architectures*

**Saturday November 23, 2013**

**Session: Learning Invariances and Hierarchies | Chair: J. DiCarlo**

14:00 *Learning invariant feature hierarchies* (Y. LeCun)
14:50 *Scattering bricks to build invariants for perception* (S. Mallat)
15:40 Break
16:10 *M-theory* (T. Poggio)
17:00 Panel discussion: J. DiCarlo (moderator), P. Baldi, M. Riesenhuber + Speakers
• Session 1: **Early Features in Vision**
• Session 2: **Learning Features and Representations**
• Session 3: **Learning Invariances and Hierarchies**
• Session 4: **Beyond Feedforward Architectures**

**Sunday November 24, 2013**

8:30 am Breakfast

**Session: Beyond Feedforward Architectures | Chair: J. Tenenbaum**

9:00 *The role of mobility and control in the inference of representations* (S. Soatto)
9:40 *Atoms of recognition* (S. Ullman)
10:20 Break
10:50 *Compositional Models: complexity of representation and inference* (A. Yuille)
11:30 Panel discussion: J. Tenenbaum (moderator), R. Salakhutdinov + Speakers
12:30 Final remarks