

Inductive Logic Programming

Lecture 2.2

Meta-Interpretive Learning from noisy images

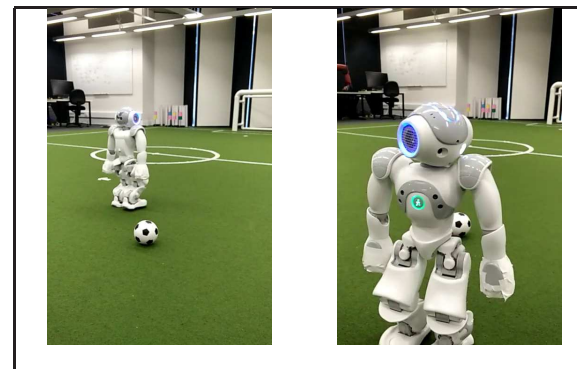
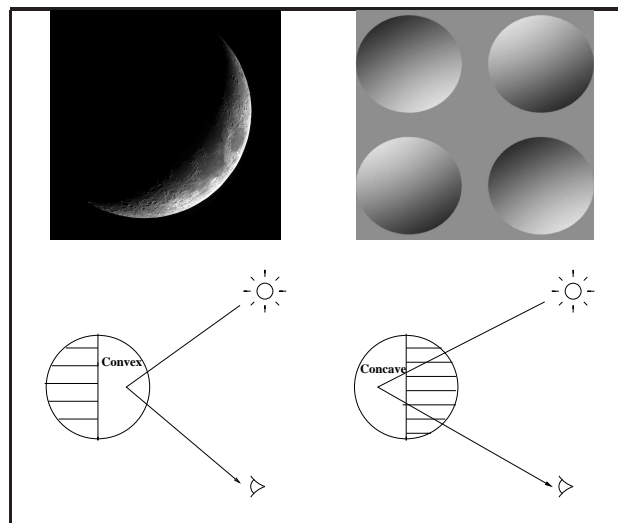
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5th July, 2018

Paper for this lecture

Paper06: S.H. Muggleton, W-Z. Dai, C. Sammut, A. Tamaddoni-Nezhad, J. Wen, and Z-H. Zhou. Meta-interpretive learning from noisy images. Machine Learning, 107:1097-1118, 2018.

Motivation - Logical Vision on Real Images



Generalised Meta-Interpreter

prove([], *BK*, *BK*).

prove([*Atom*|*As*], *BK*, *BK_H*) : –

metarule(*Name*, *MetaSub*, (*Atom* :- *Body*), *Order*),
Order,

save_subst(*metasub*(*Name*, *MetaSub*), *BK*, *BK_C*),

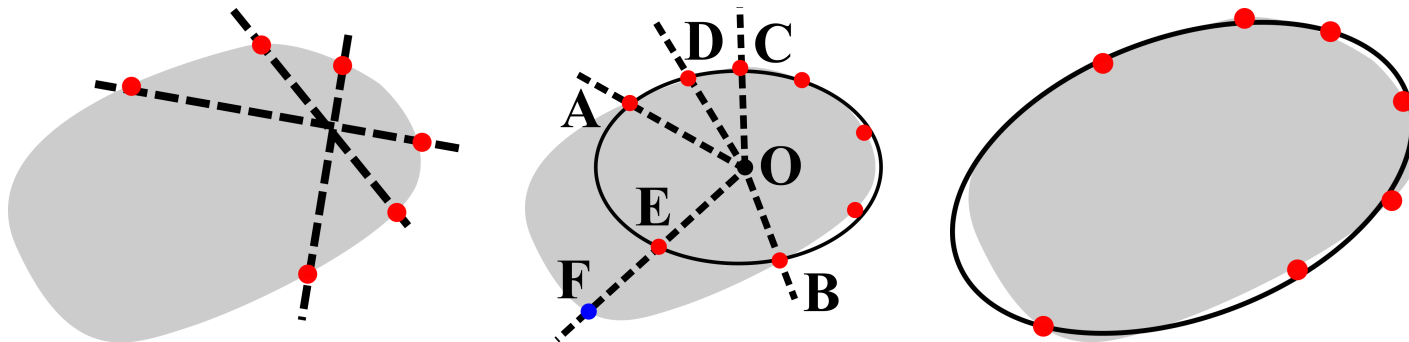
prove(*Body*, *BK_C*, *BK_Cs*),

prove(*As*, *BK_Cs*, *BK_H*).

Noise-Tolerant Learning, $Metagol_{NT}$

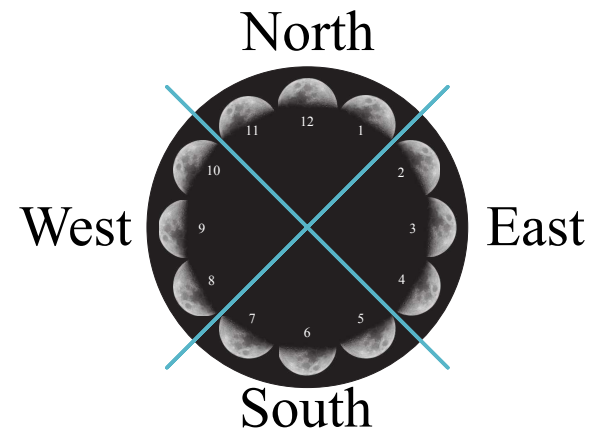
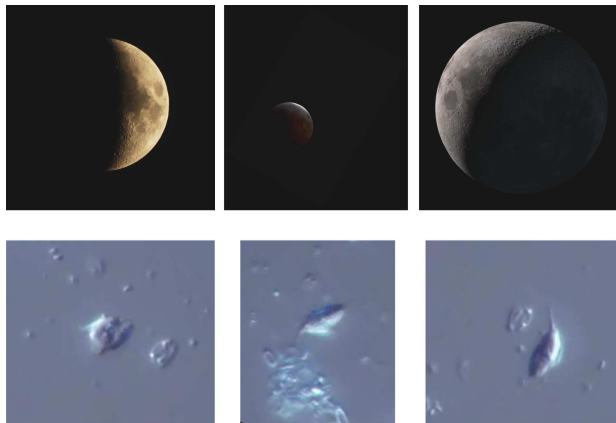
- Given training examples E and background knowledge B .
- Repeatedly sample training examples $Tr_i \subset E$.
- Optimize predictions of $H_i = \text{Metagol}(Tr_i, B)$ on $E \setminus Tr_i$.
- Return optimal hypothesis H .

Low-level object detection - ellipse model

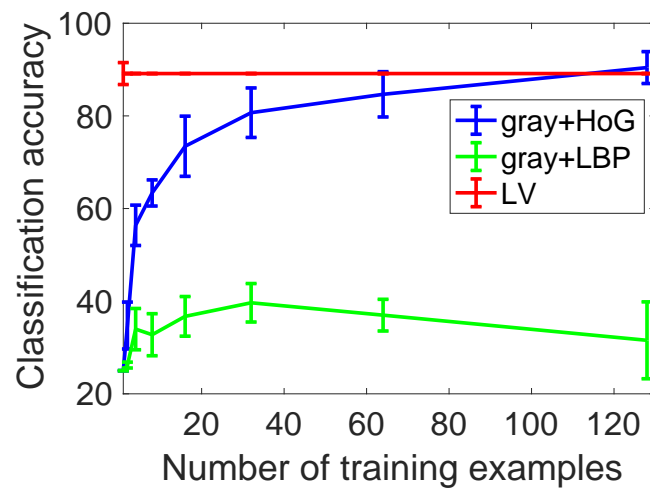


Experiment 1 - Predict direction of light source

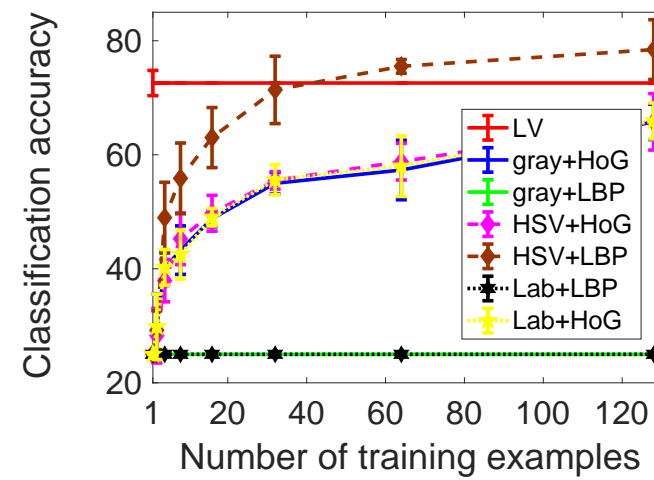
Moons and Protists



Experiment 1 - Classification accuracy

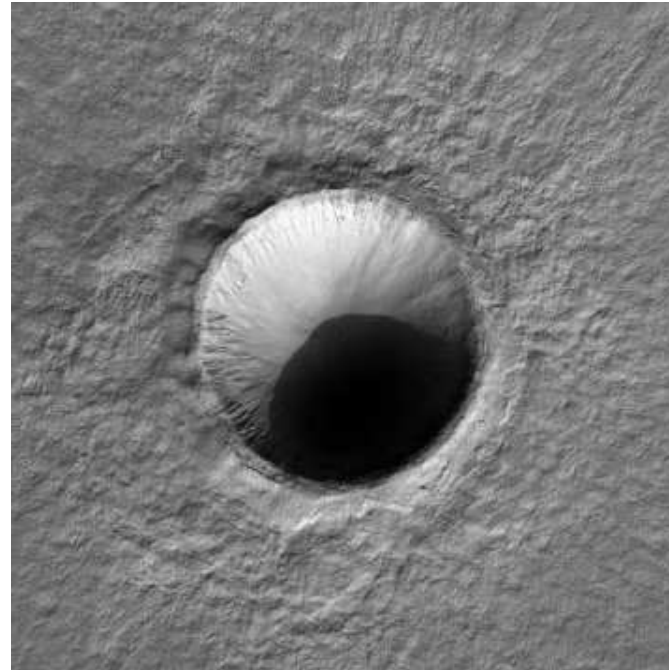
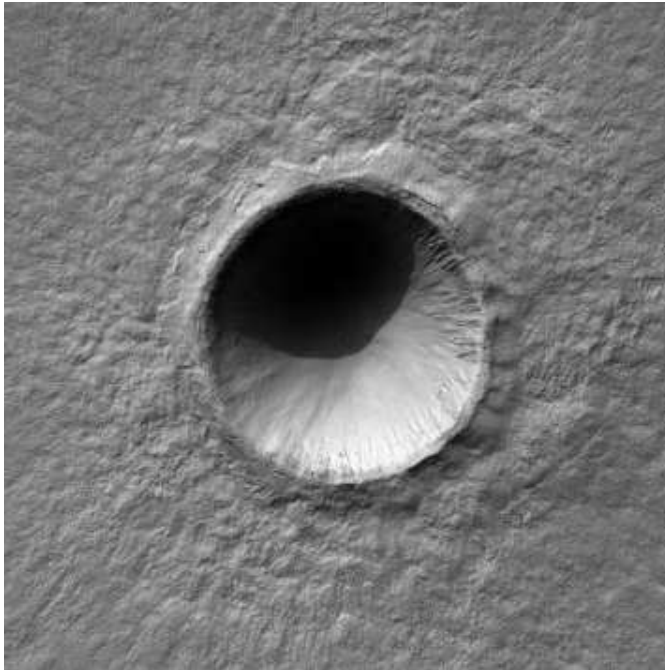


a) *Moons*

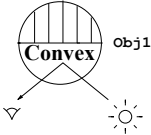
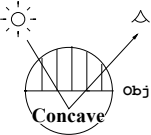


b) *Protists*

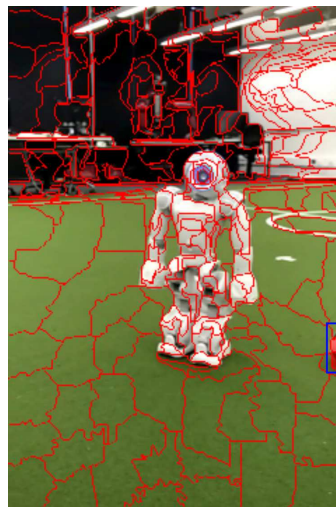
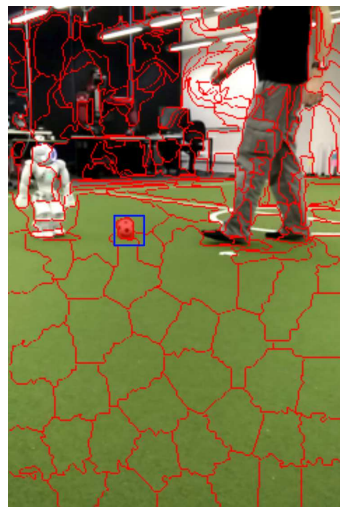
Experiment 2 - Mars Crater/Mountain



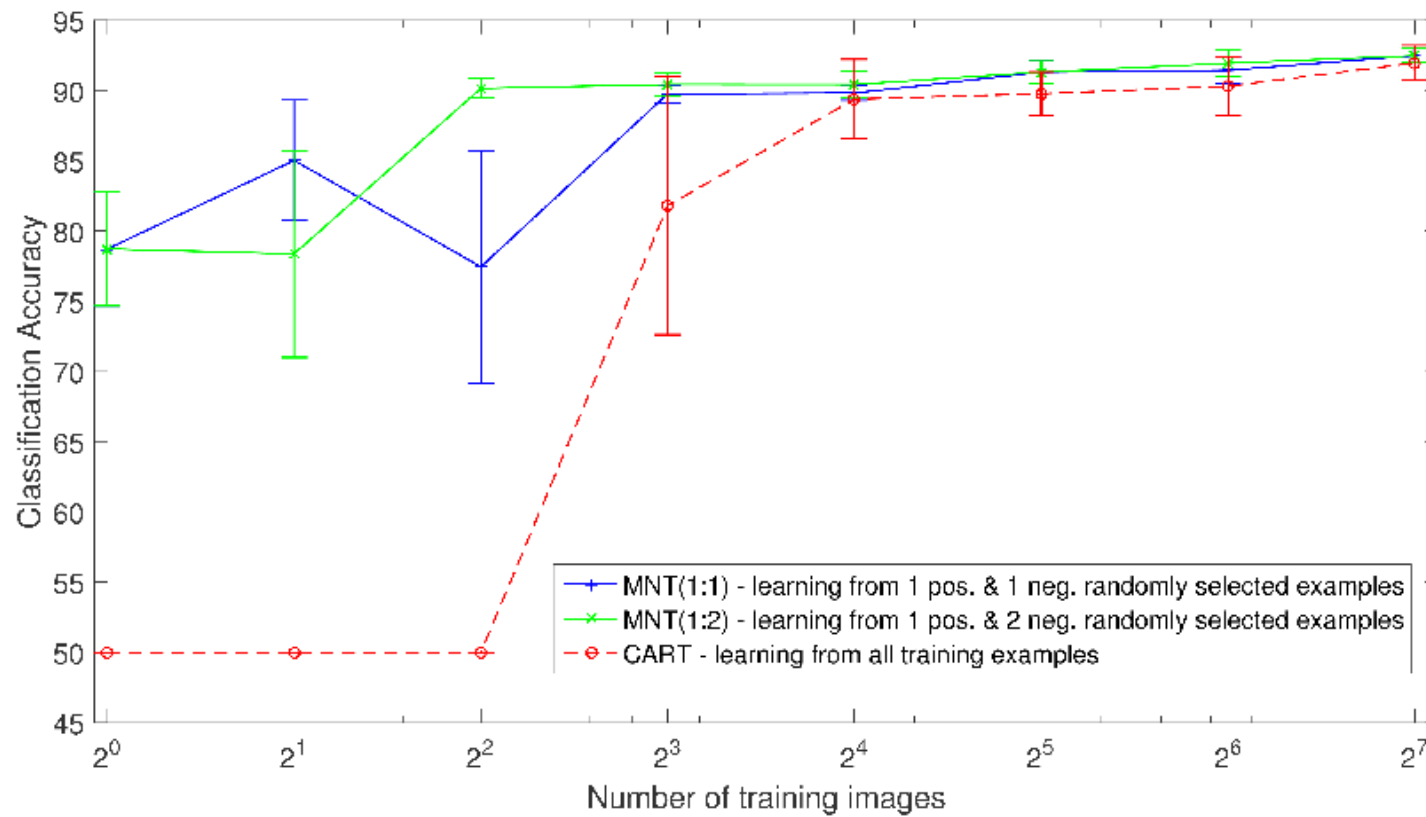
Experiment 2 - Learned theories

Depiction	Hypothesis
<p>a)</p> 	<p>light_source(light).</p> <p>light_source_angle(obj1,light,south).</p> <p>convex(obj1).</p>
<p>b)</p> 	<p>light_source(light).</p> <p>light_source_angle(obj1,light,north).</p> <p>concave(obj1).</p>

Experiment 3 - Robots with super-pixels



Experiment 3 - Classification accuracy



Summary and further work

- Logic-based learning from images
- Deals with classification noise
- Active learning
- Efficient problem decomposition