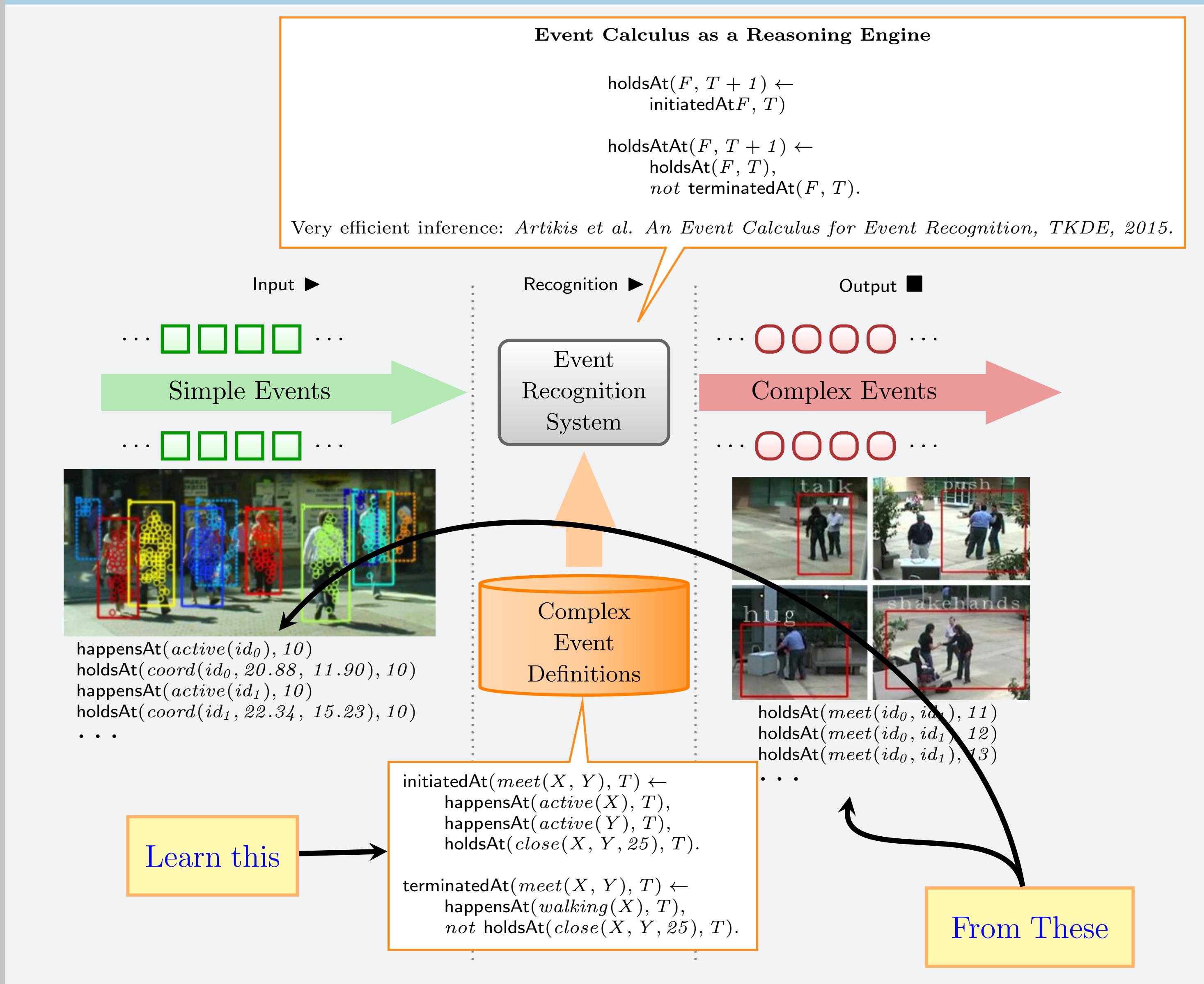


## The Problem Setting: Learning for Complex Event Recognition







## Learning Requirements



- ▶ Event recognition applications deal with noisy data streams.
  - ▷ Resilience to noise → Statistical Relational Learning.
  - ▷ Learning should be online.
    - ▶ Single-pass.
    - ▶ Learn from past mistakes.

## Contribution of This Work

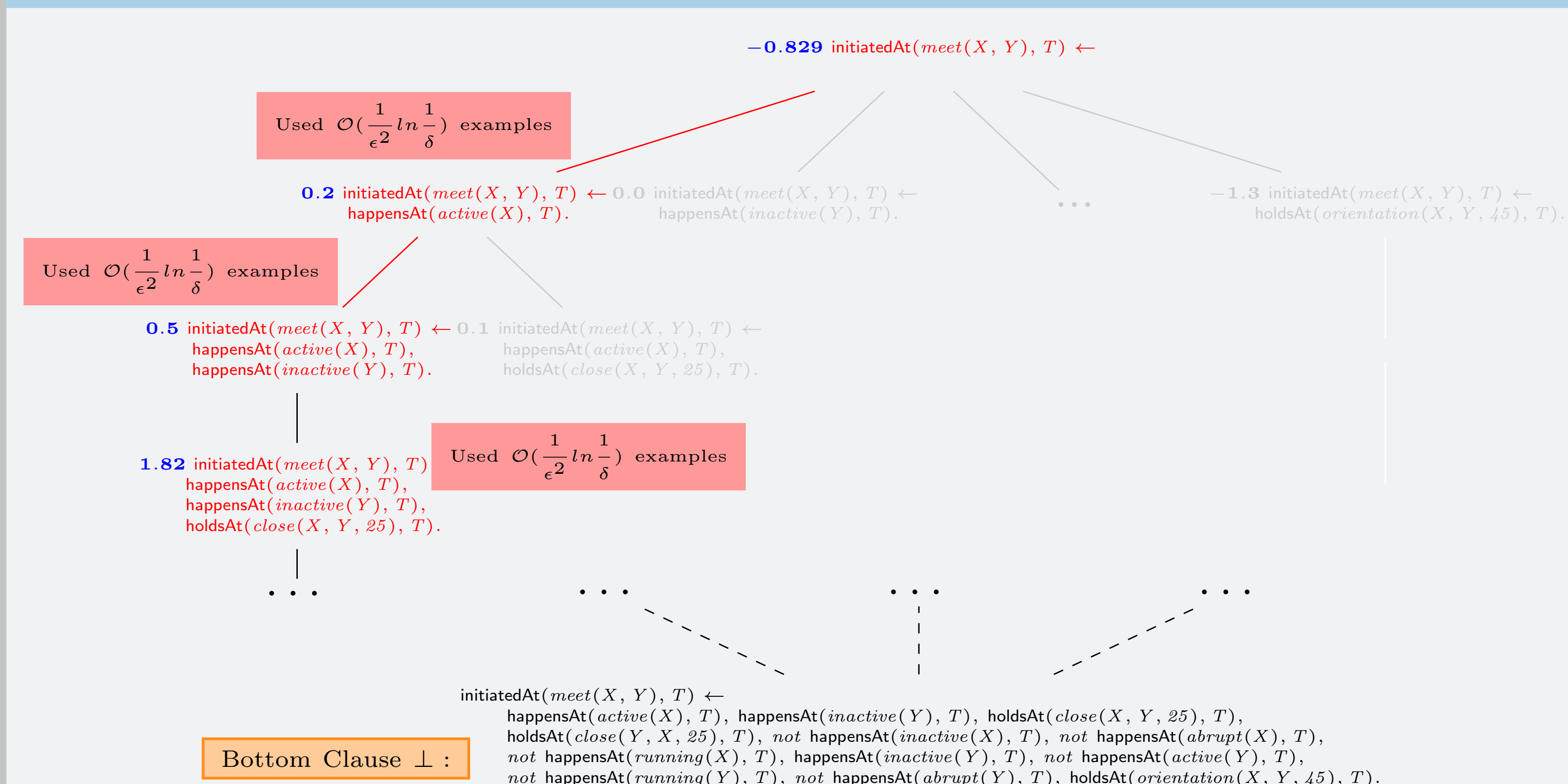
### Two online learners from previous work:

- ▶ **OLED**
  - ▷ Katzouris N. et al. Online Learning of Event Definitions, TPLP, 2016.
  - ▷  Efficient structure learning using Hoeffding bounds.
  - ▷  Crisp learner.
- ▶ **OSLα**
  - ▷ Michelioudakis V., et al. OSLα: Online Structure Learning using Background Knowledge Axiomatization, ECML, 2016.
  - ▷ MLN learner.
  - ▷  Efficient weight learning.
  - ▷  Inefficient structure learning.
    - ▶ Blindly generates too many rules.

### Current work:

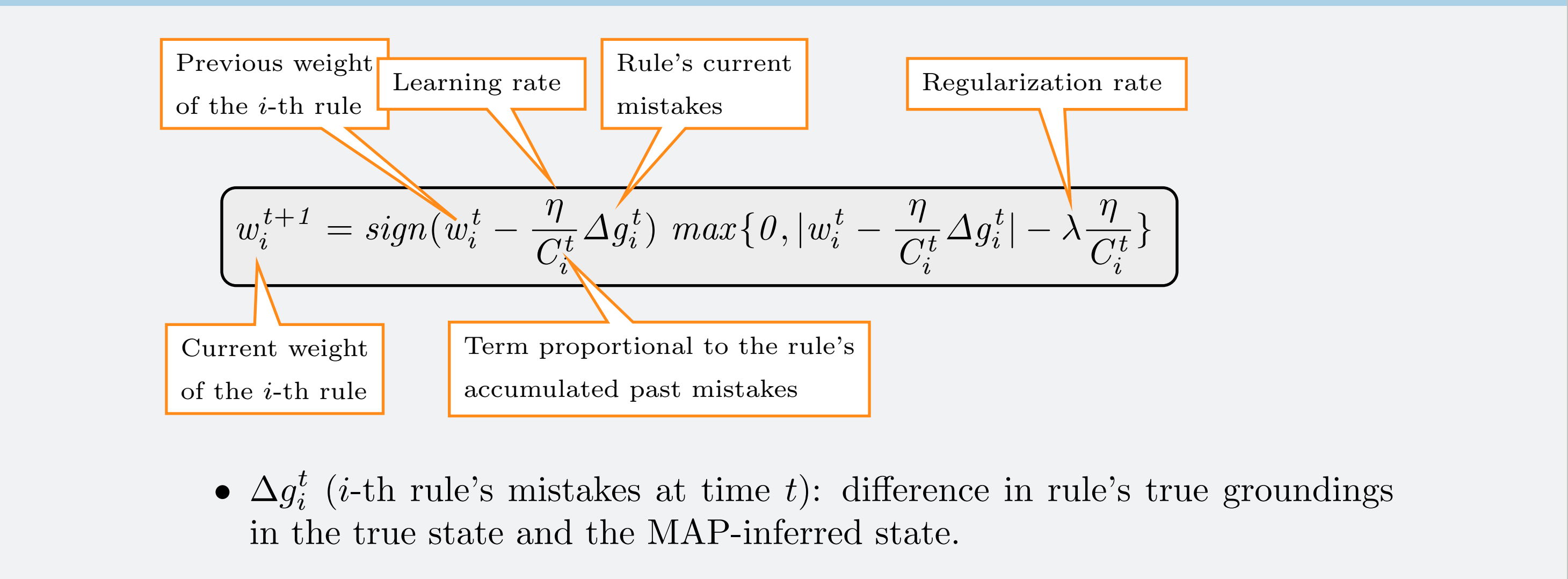
- ▶ **WoLED** (OLED + weight learning)
  - ▷ MLN learner
  - ▷  Efficient structure learning.
  - ▷  Efficient weight learning.

## WoLED: Learning a Rule

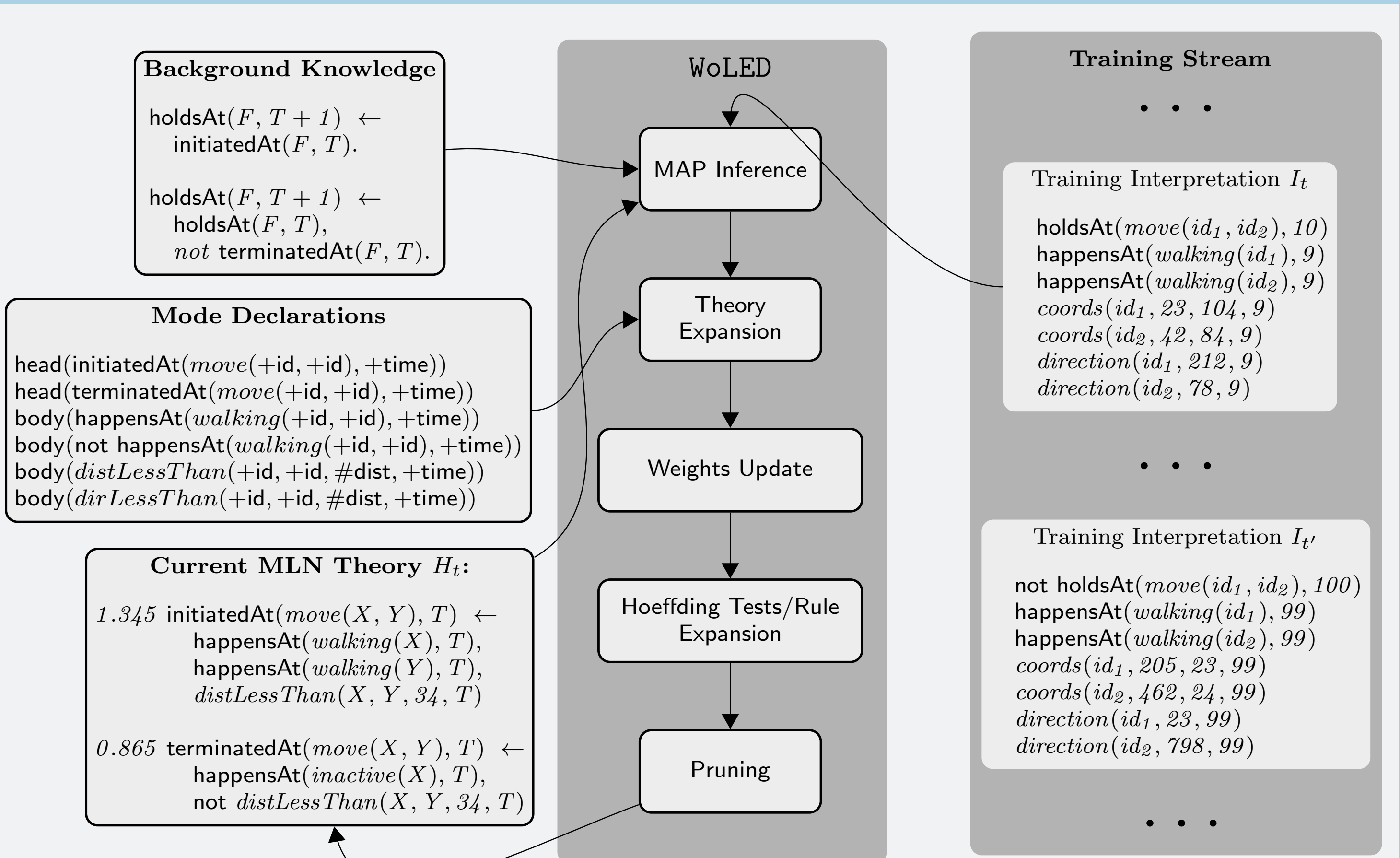


- ▶ Simultaneous structure & weight learning.
- ▶ Online hill-climbing. Uses Hoeffding tests for  $(\epsilon, \delta)$ -optimal decisions.
- ▶ Weight learning with Adagrad.

## The AdaGrad Weight Update Rule



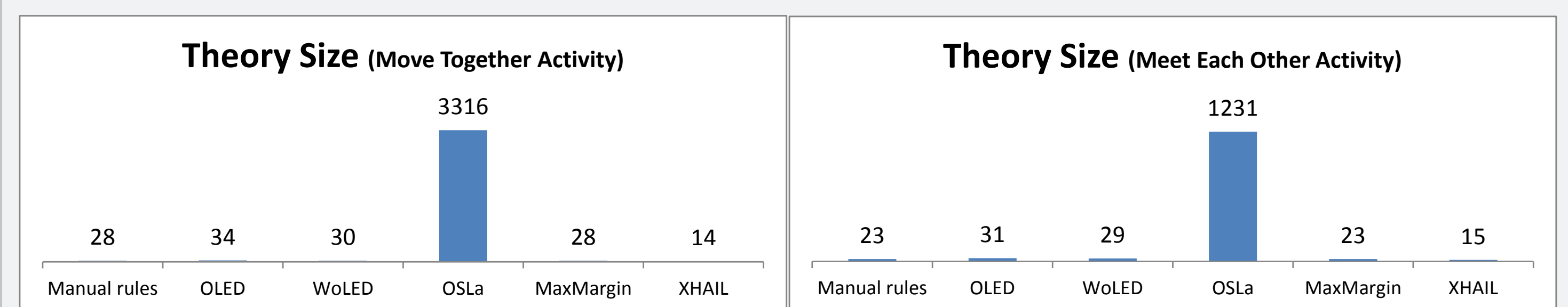
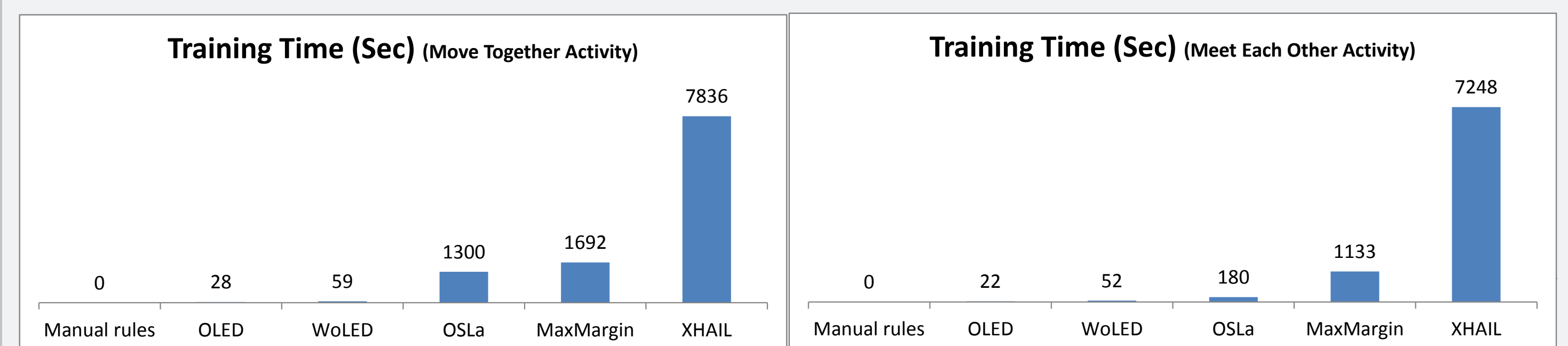
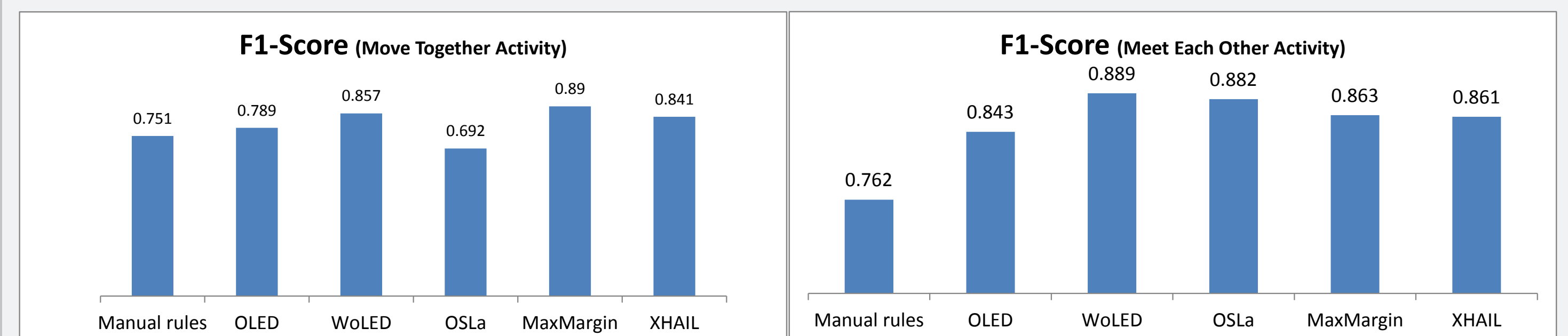
## WoLED Overview



## Experimental Evaluation (tenfold cross-validation)

CAVIAR dataset: Activity Recognition (<http://homepages.inf.ed.ac.uk/rbf/CAVIARDATA1/>)

- ▶ “Manual rules” is a set of hand-crafted rules (no learning involved).
- ▶ OLED: Crisp version of this work (**online**).
- ▶ WoLED: this work (**online**).
- ▶ OSLα/OSL: Online learners, relational pathfinding + AdaGrad-based weight learning (**online**).
- ▶ MaxMargin: Manual Rules + MaxMargin-based weight learning (**batch**).
- ▶ XHAIL: theory-level crisp structure learner (**batch**).



## Experimental Evaluation (Holdout Evaluation)

CAVIAR dataset: Activity Recognition (<http://homepages.inf.ed.ac.uk/rbf/CAVIARDATA1/>)

