

# INTEGRATED METHODOLOGIES FOR OPTIMIZATION, CONSTRAINT REASONING AND MACHINE LEARNING

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## BACKGROUND

Artificial Intelligence techniques can be based on **symbolic** or **sub-symbolic** manipulation

symbolic

sub-symbolic

- Based on **Logic** and **Numerical Optimization**
- Require **domain expertise**
- Do not **learn** nor **generalize**

- Based on **Machine Learning**
- Cannot handle **constraints**
- Difficult to **interpret**

## MOTIVATION

Research focused on **hybrid techniques** so to overcome the limitations of both worlds

state of the art

limitations

- **Learning for Optimization**
  - *neural heuristics*
  - *predict+optimize*
- **Optimization for Learning**
  - *constrained ML*
  - *informed ML*

- Most works are only focused on **computational efficiency**
- Little interest in **robustness** and **trustworthiness**

## CONTRIBUTION

Develop new methodologies aimed at dealing with external **constraints and requirements**

fairness

accountability

- Iterative method to inject **fairness constraints** into machine learning
- Able to deal with **continuous protected features** as well

- Iterative method to **verify a reinforcement learning policy**
- Retrain the agent behavior every time it performs an **illegal action**