


Combinatorial Decision Making & Optimization

2024/2025

**Second cycle degree/two year
Master's in Artificial Intelligence
Dept of Computer Science and
Engineering (DISI)
University of Bologna**



Artificial Intelligence

- Statistical / Sub-symbolic
 - ML, DL
 - Data-driven
 - Uses probabilistic learning and forecasting
 - Impressive and convincing
 - Lacks general intelligence
 - Recognizes patterns but doesn't understand context
 - No correctness guarantee
 - not fact-based
 - no access to knowledge base
- Classical / Symbolic
 - Represents knowledge using (human readable) symbols and manipulates them using pre-defined rules
 - Uses logic-based inference and search
 - Deterministic methods that provide guaranteed correct results

Need for Symbolic AI

- From a cognitive perspective
 - Deeper real world reasoning (causality), abstraction, common sense reasoning
- From a technological perspective
 - Robustness, verifiability, explainability
- From a social perspective
 - Fairness, ethics

Neurosymbolic AI

- A new class of AI combining Neural Networks with symbolic AI for artificial general intelligence
- Some applications
 - Chatbots
 - NN for text/speech processing & symbolic AI for understanding the context and generating fact-based answers (and to justify answers)
 - Autonomous vehicles
 - NNs for object detection & symbolic AI to reason about traffic rules and safety (and to justify decisions)
 - Medical diagnosis
 - NN for analyzing medical images and patient data & symbolic AI for applying medical knowledge for diagnosis (and to justify decisions)
 - Legal systems
 - NN for text recognition & symbolic AI for legal reasoning (and to justify decisions)

Neurosymbolic AI

- A Paradigm Shift in Computer Science?

This workshop focuses on the challenges for computer science and the sciences in general, the move from logic and algorithmic certainty to probability and LLMs.