

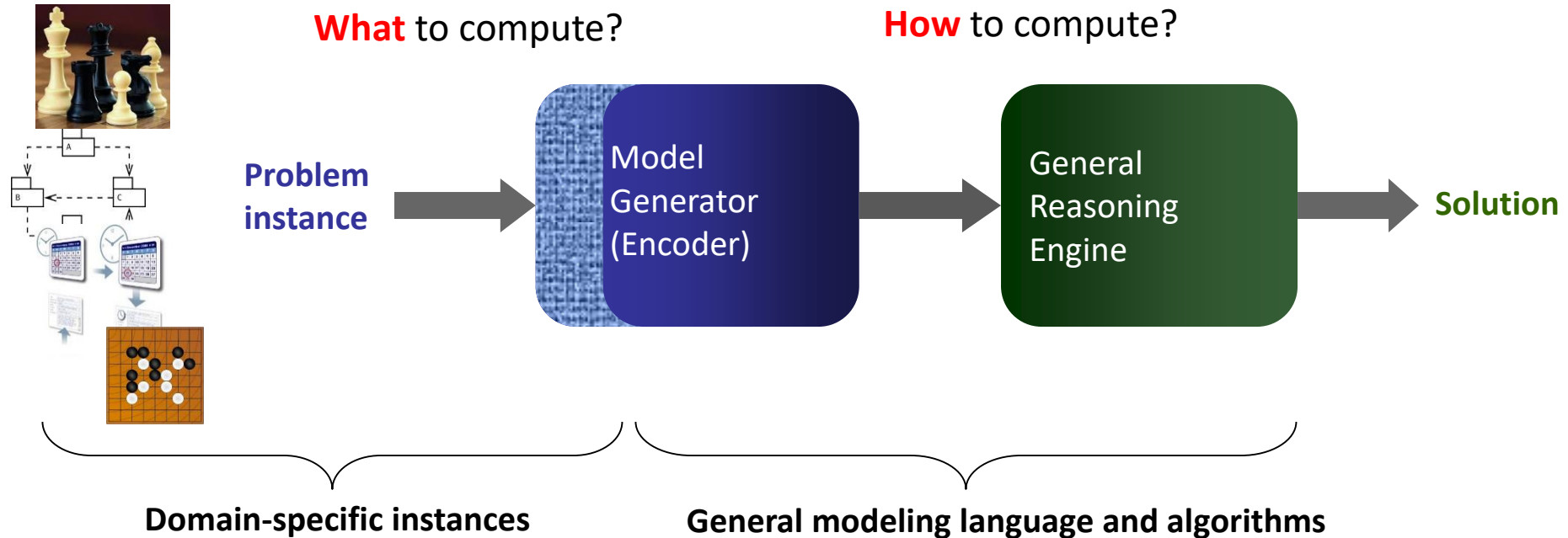


Robust probabilistic inference engines for autonomous agents

Stefano Ermon

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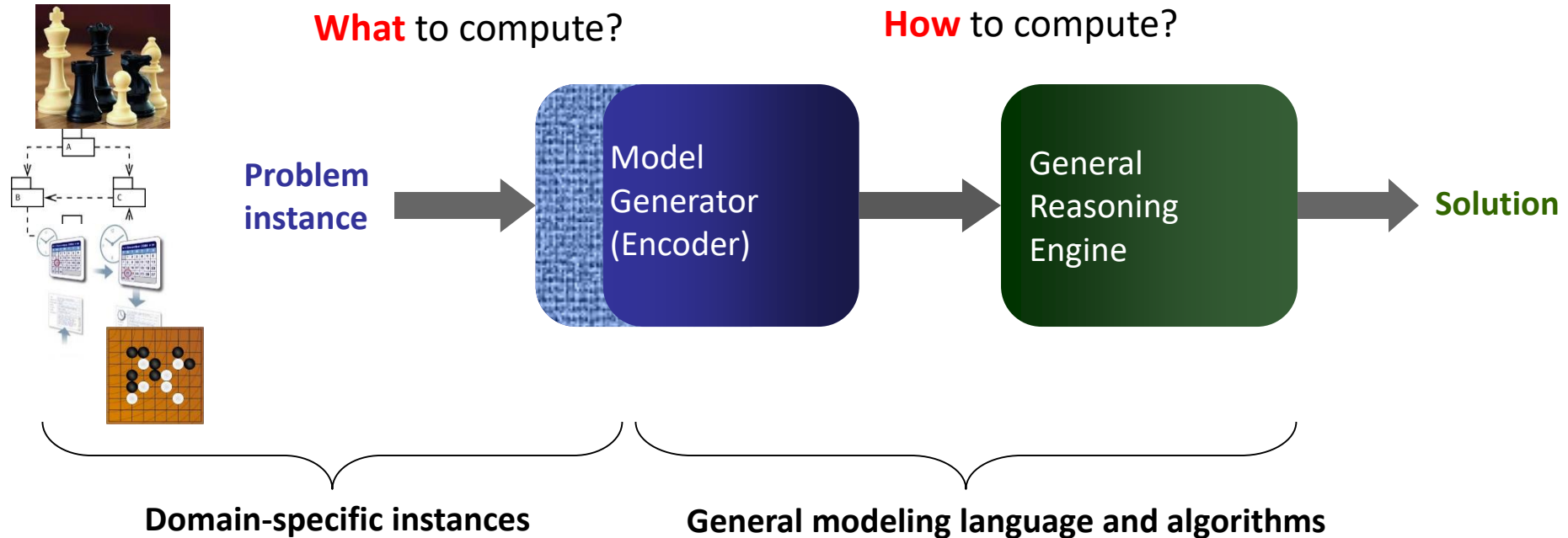
Problem Solving in AI



Problem solving in AI:

Separate modeling from algorithms

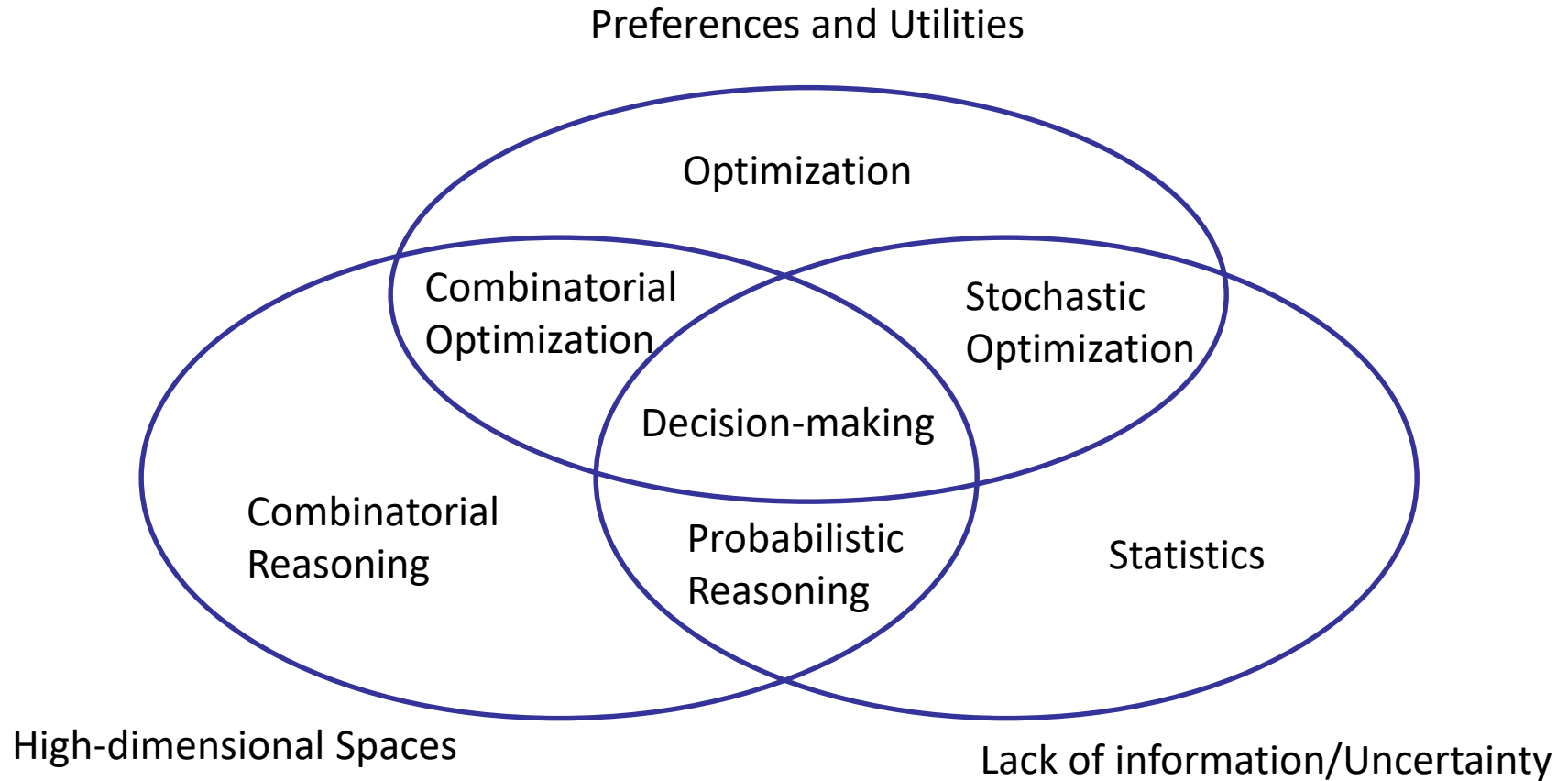
Problem Solving in AI



Safety and **reliability** require:

1. precise models
2. accurate reasoning techniques

Challenges in reasoning about complex systems



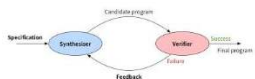
Challenges in reasoning about complex systems



Theorem provers, logical reasoning, SAT solvers, soundness, certificates of optimality, ...

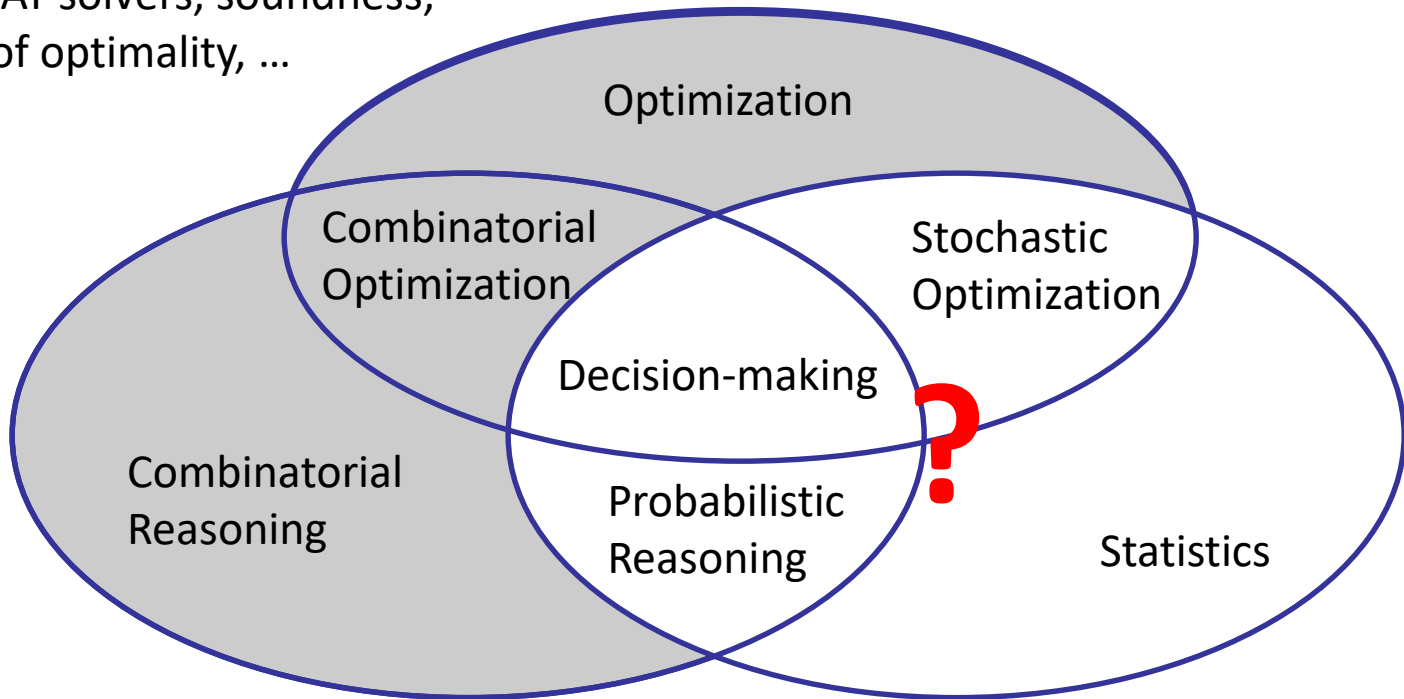


hardware verification



Program synthesis

Preferences and Utilities



High-dimensional Spaces

Lack of information/Uncertainty

Proposal and recent results

Proposal: use *combinatorial reasoning/optimization* techniques (logic, verification, synthesis) for *probabilistic reasoning* tasks (machine learning)

- Algorithms that can provide **certificates/proofs of accuracy**
 - Handle **extreme (unsafe) events**
 - Can support deterministic + probabilistic dependencies
- Some recent results:
 - Satisfiability Modulo Theory solvers for statistical hypothesis testing (Zhao et al., AAI-2016)
 - Integer Linear Programming for sampling (Kim et al., AAI-2016)
 - Integer Linear Programming and SAT for decision making under uncertainty (Xue et al., NIPS-2016)
 - Variational methods with guarantees (Achim et al., AISTATS-2016)

Thanks!