LEARNING-AUGMENTED MECHANISM DESIGN

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MECHANISM DESIGN WITH PREDICTIONS

Algorithm with worst-case guarantees

+ Offers **robust** worst-case guarantees
– Defined by a single worst case, sometimes can be **overly pessimistic**

ML-based heuristics

+ Very **efficient** in practice
– Most of them do not admit any **non-trivial worst-case guarantees**

Learning augmented algorithms
(algorithms with predictions)

We propose:
Learning augmented mechanism design

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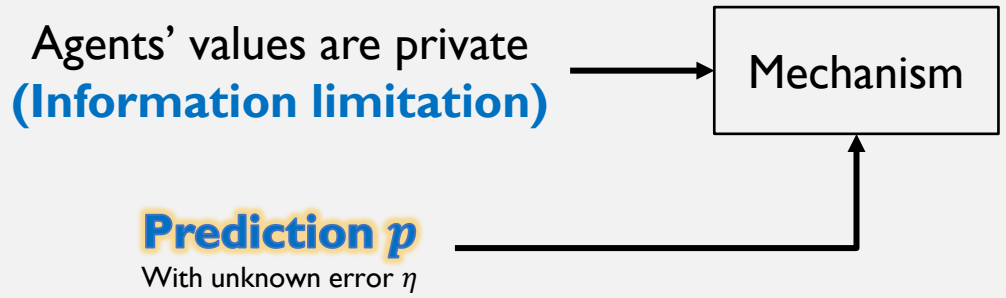
MECHANISM DESIGN WITH PREDICTIONS



Main obstacle:
agents may choose to strategically misreport; mechanism needs to elicit the true value

Performance metrics:

- **Robustness**: worst-case approximation ratio overall
- **Consistency**: worst-case approximation ratio given a correct prediction
- **Performance as a function of error** η

*Question: Can learning-augmented mechanisms achieve good **robustness** and **consistency** trade-offs?*

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PRIOR WORKS AND OPEN QUESTIONS

- Learning-Augmented Mechanism Design: Leveraging Predictions for Facility Location* [ABGOT EC'22]
  - Single facility location in $\mathbb{R}^2$ with predictions
- Improved Price of Anarchy via Predictions* [GKST EC'22]
  - Scheduling games & Network formation games
- Strategyproof Scheduling with Predictions* [BKT ITCS'23]
  - Machine scheduling with incentiveS

- Open questions:
  - *Learning augmented framework with your favorite mechanism design problem.*
  - *Characterizing the reasonable and useful predictions for different settings.*
    - What's easy to learn vs what's useful for analysis
    - Notions of error

* Supported by "Mechanisms with Predictions" Balkanski and Gkatzelis 2022-25