Individually Fair Learning with One-Sided Feedback

Yahav Bechavod, Aaron Roth

yahav.bechavod@cs.huji.ac.il, aaroth@cis.upenn.edu

Full version:

Scan Me

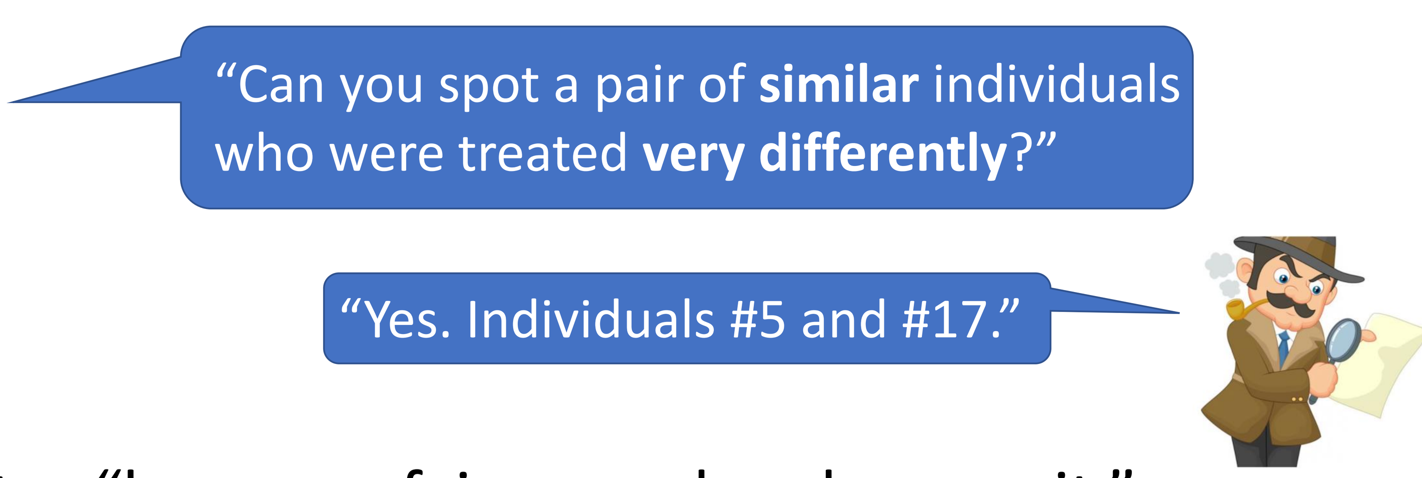
Individual Fairness

"Similar individuals should be treated similarly."

Meaningful guarantee at the individual level.

Problem: Metric often **unavailable.**

Auditor-based Approach



Auditor "knows unfairness when he sees it."

Issue #1: single auditors are prone to **biases.**

- Decision-makers less likely to entrust a single auditor with fairness-related judgements in high-stakes scenarios.
- How to reconcile cases disagreed upon by different auditors?

Auditing by Panels

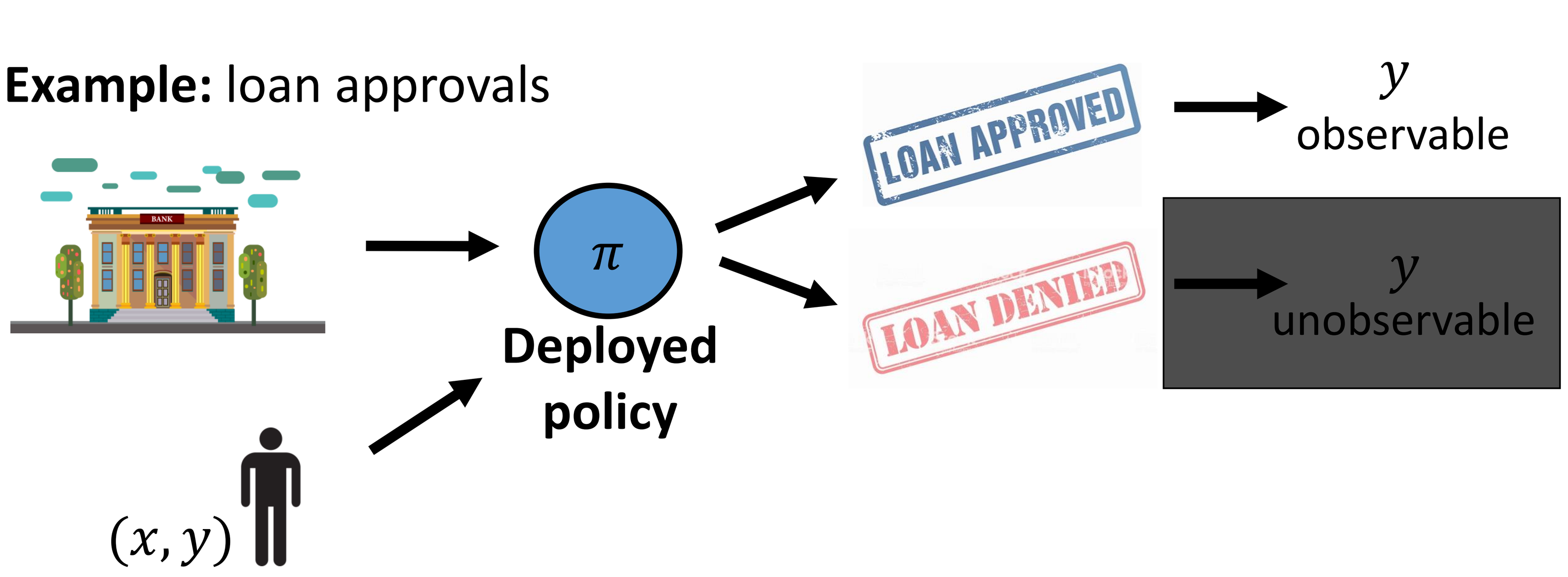
- Fairness violation – only when a consensus is reached within a panel.
- Possible to alter the required fraction to **algorithmically** explore the fairness-accuracy frontier.

One-Sided Feedback

Issue #2: real-life feedback is often **one-sided.**

- "Hidden outcomes" of rejected individuals.
- Uncareful treatment may result in feedback loops.

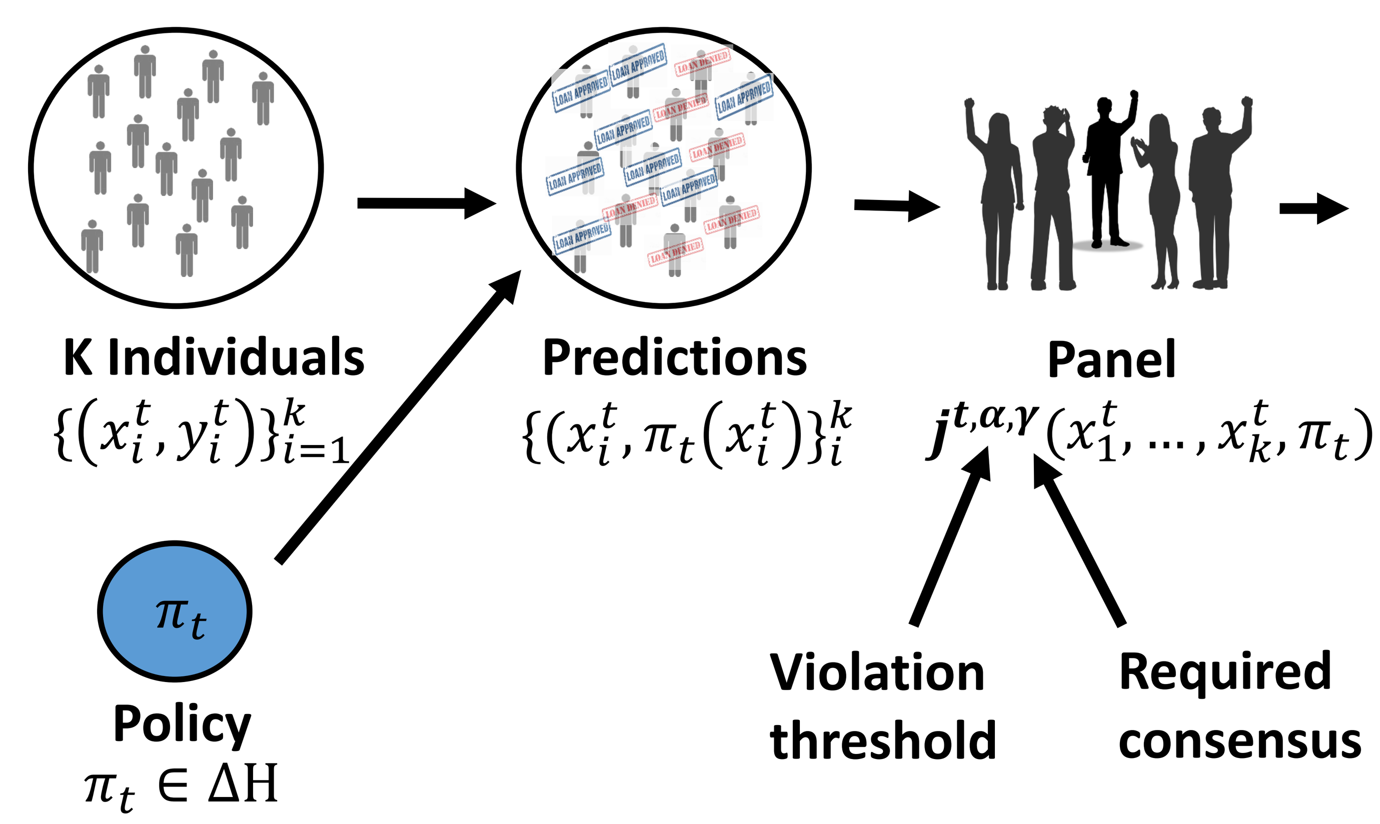
Example: loan approvals



Our Setting

Online Learning with One-Sided Feedback + Feedback from Dynamically-Chosen Panels

Time [1,...,T]



Learner updates upon seeing:

1. Labels – iff predicted **positively**.
2. Fairness feedback from panel.

Results

Result #1: Reduction from online learning **with one-sided feedback** and feedback from **dynamically-chosen panels** to Contextual Combinatorial Semi-Bandit.

Result #2: Multi-Criteria No-Regret Guarantees
Using regret bound of any algorithm for Contextual Combinatorial Semi-Bandit, upper bounding, simultaneously:

1. **Accuracy:** sub-linear regret vs. best fair policy.
2. **Fairness:** sub-linear number of rounds on which fairness violations exist.

Accuracy + Fairness Guarantees

Thm. 1 (simplified.): Using Exp2 algorithm,

Accuracy: $Regret(Exp2, T, Q_{\alpha-\epsilon}) \leq O(k^{\frac{3}{2}} T^{\frac{4}{5}} log|H|^{\frac{1}{2}})$

Fairness: $\sum_{t=1}^{T} Unfair^{\alpha,\gamma}(\pi_t, \bar{x}^t, \bar{j}^t) \leq O(\frac{1}{\epsilon} k^{\frac{3}{2}} T^{\frac{4}{5}} log|H|^{\frac{1}{2}})$

Thm. 2 (simplified.): Using (adapted) Context-Semi-Bandit-FTPL,

Accuracy: $Regret(CSB - FTPL - WR, T, Q_{\alpha-\epsilon}) \leq \tilde{O}(k^{\frac{11}{4}} s^{\frac{3}{4}} T^{\frac{41}{45}} log|H|^{\frac{1}{2}})$

Fairness: $\sum_{t=1}^{T} Unfair^{\alpha,\gamma}(\pi_t, \bar{x}^t, \bar{j}^t) \leq \tilde{O}(\frac{1}{\epsilon} k^{\frac{11}{4}} s^{\frac{3}{4}} T^{\frac{41}{45}} log|H|^{\frac{1}{2}})$