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## Two-Sided Matching with Indifferences\*

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**Abstract**

Most of the two-sided matching literature maintains the assumption that agents are never indifferent between any two members of the opposite side. In practice, however, ties in preferences arise naturally and are widespread. Market design needs to handle ties carefully, because in the presence of indifferences, stability no longer implies Pareto efficiency, and the deferred acceptance algorithm cannot be applied to produce a Pareto efficient or a worker-optimal stable matching.

We allow ties in preference rankings and show that the Pareto dominance relation on stable matchings can be captured by two simple operations which involve rematching of workers and firms via *cycles* or *chains*. Likewise, the Pareto relation defined via workers' welfare can also be broken down to two similar procedures which preserve stability. Using these structural results we design *fast* algorithms to compute a Pareto efficient and stable matching, and a worker-optimal stable matching.

*Keywords:* Two-sided matching; matching with ties; matching with indifferences; efficient and stable matching.

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