

Potential Functions and Routing Games

Tim Roughgarden*

December 10, 2006

Abstract

We survey one area of the emerging field of algorithmic game theory: the use of approximation measures to quantify the inefficiency of game-theoretic equilibria. Potential functions, which enable the application of optimization theory to the study of equilibria, have been a versatile and powerful tool in this area. In this lecture, we apply the potential function technique to bound the inefficiency of equilibria (the “price of anarchy”) in routing games.

References

- [1] D. Monderer and L. S. Shapley. Potential games. *Games and Economic Behavior*, 14(1):124–143, 1996.
- [2] R. W. Rosenthal. A class of games possessing pure-strategy Nash equilibria. *International Journal of Game Theory*, 2(1):65–67, 1973.
- [3] T. Roughgarden. *Selfish Routing and the Price of Anarchy*. MIT Press, 2005.
- [4] T. Roughgarden. Potential functions and the inefficiency of equilibria. In *Proceedings of the International Congress of Mathematicians (ICM)*, volume III, pages 1071–1094, 2006.
- [5] T. Roughgarden and É. Tardos. How bad is selfish routing? *Journal of the ACM*, 49(2):236–259, 2002.

*Department of Computer Science, Stanford University, 462 Gates Building, 353 Serra Mall, Stanford, CA 94305.
Email: tim@cs.stanford.edu.