ROB 538
Multiagent Systems
Fall 2024
Homework 4: Game Theory
Due Nov 12, 2024

1. Consider the bar problem from Homework 3 with 50 agents, b=4, and k=6.

   (a) Compute the Nash Equilibrium when each agent uses the local reward:

   $$L(z) = x_k(z)e^{\frac{-x_k(z)}{b}} \tag{1}$$

   where z is the system state and $x_k(z)$ is the number of agents that attend on night k.
   Explain why this is the Nash equilibrium for this system.

   (b) Compute the Nash Equilibrium when each agent uses the global reward, given by:

   $$G(z) = \sum_{k=1}^{K} x_k(z)e^{\frac{-x_k(z)}{b}} \tag{2}$$

   Are the Nash Equilibria in a) and b) the same?
   What does the answer imply about the expected performance of the local reward?

   (c) Compute the Nash Equilibrium for the Difference Reward with a zero counterfactual:

   $$D_i(z) = x_i(z)e^{\frac{-x_i(z)}{b}} - (x_i(z) - 1)e^{\frac{-(x_i(z)-1)}{b}} \tag{3}$$

   where z is the system state, and $x_i(z)$ is the attendance of the night agent i selected.
   Explain why this is a Nash equilibrium.
   Is this Nash equilibrium the same as the local or global reward's Nash Equilibria?
   What does the answer imply about the expected performance of the difference reward?

Your report should be in research paper format, and clearly describe your algorithms, results and analysis. You may use IEEE, AAMAS, or other similar conference standards as a template. Please submit your report as a PDF. **Please also submit the code for your assignment in a SEPARATE zip file or a link to a repository**.