Practice Problems: Algorithmic Game Theory

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October 21, 2020

1. Prove revelation principle for BIC mechanisms.
2. (Taken from an exercise in [Nar14]) Let $N = \{1, 2\}, \Theta_1 = \{a_1, b_1\}, \Theta_2 = \{a_2, b_2\}, \mathcal{X} = \{x, y, z\}$ and

$$u_1(x, a_1) = 100, u_1(y, a_1) = 50, u_1(z, a_1) = 0$$
$$u_1(x, b_1) = 50, u_1(y, b_1) = 100, u_1(z, b_1) = 40$$
$$u_2(x, a_2) = 0, u_2(y, a_2) = 50, u_2(z, a_2) = 100$$
$$u_2(x, b_2) = 50, u_2(y, b_2) = 30, u_2(z, b_2) = 100$$

   For the above environment, give an example for a social choice function for each of the following cases (EPE: Ex-Post Efficient, DSIC: Dominant Strategy Incentive Compatible, BIC: Bayesian Incentive Compatible, D: Dictatorship, ND: Non-dictatorship).

   (i) EPE, DSIC, and D
   (ii) EPE, DSIC, and ND
   (iii) Not EPE but DSIC and ND
   (iv) EPE, BIC (under suitable prior), but not DSIC
   (v) EPE but not BIC (under suitable prior)

3. Can a social choice function has more than one dictator if every player has a strict rational preference relation?

References

[Nar14] Y. Narahari. *Game Theory and Mechanism Design*. World Scientific Publishing Company Pte. Limited, 2014.