$\frac{1}{2}$-Approximate MSNE Computation for bimatrix games

Lecture 6.1

We assume $\underbrace{\text{w.l.o.g}}$ that all the utility values lie in $[0,1]$.

because any strategic form game remains invariant under affine transformation of utility matrices.

Algorithm

- Pick any strategy i for player 1.
- Let j be a best-response strategy of player 2 against i.
- Let k be a best-response strategy of player 1 against j.
- Output $\left(\{i:\frac{1}{2}, k:\frac{1}{2}\}, j\right)$

Claim: $(\underbrace{\{i:\frac{1}{2}, k:\frac{1}{2}\}}_{\sigma}, j)$ is a $\frac{1}{2}$-MSNE.

Proof: Let the utility matrices of players 1 and 2 be A and B respectively.

$$\sigma A e_j = \frac{1}{2} \underbrace{e_i A e_j}_{\geq 0} + \frac{1}{2} e_k A e_j$$

$$\geq \frac{1}{2} e_k A e_j$$

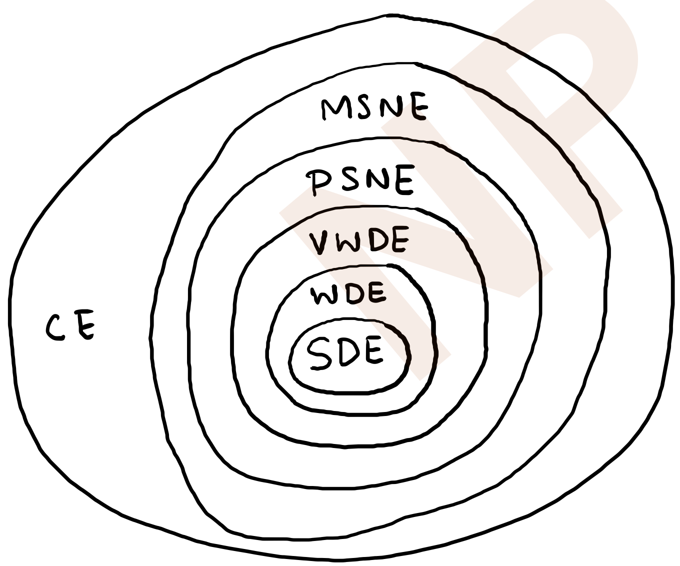
$$\sigma B e_j = \frac{1}{2} e_i B e_j + \underbrace{\frac{1}{2} e_k B e_j}_{\geq 0}$$

$$\geq \frac{1}{2} \underbrace{e_i B e_j}$$

$$\geq \frac{1}{2}$$

Hence $\left(\left\{i:\frac{1}{2}, k:\frac{1}{2}\right\}, j\right)$ is a $\frac{1}{2}$-MSNE. $\blacksquare$

Since finding an MSNE seems to be computationally intractable, how can we expect real-world players to compute an MSNE? This casts doubt on the predictive power of the concept of mixed strategy equilibrium.



1. There exist games with more than one PSNEs / MSNEs.

2. Computing a PSNE and MSNE seems to be computationally intractable.

CE : Correlated equilibrium.

Theorem: Finding a correlated equilibrium is an efficiently solvable computational problem. ∎