Homework 03

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**Q1** Please explain why the proof of them 2 in paper reading 2-2 is incorrect.

from lemma

$$g(S_n) \geq \left(1 - \prod_{i=1}^{n}\left(1 - \frac{c(S_i)^2}{B^2}\right)\right) g(S^*)$$

According to termination rule

$$c(S_n) = \sum_{i=1}^{n} S_i \geq B$$

$\therefore$

$$1 - \prod_{i=1}^{n}\left(1 - \frac{c(S_i)^2}{B^2}\right) \text{ achieves its}$$

minimum value of $1 - \prod_{i=1}^{n}\left(1 - \left(\frac{1}{n}\right)^2\right)$ when

$c(S_1) = c(S_2) \ldots c(S_n) = c(S_n)/n$

we have

$\therefore$

$$\prod_{i=1}^{n}\left(1 - \frac{c(S_i)^2}{B^2}\right) \leq \prod_{i=1}^{n}\left(1 - \left(\frac{1}{n}\right)^2\right)$$

$$= \left(1 - \left(\frac{1}{n}\right)^2\right)^n$$

$$= \left( \left(1+\frac{1}{n}\right)\left(1-\frac{1}{n}\right) \right)^n$$

$$\geq \left(1-\frac{1}{n}\right)^{2n}$$

Thus $1-\left(1-\frac{1}{n}\right)^{2n}$ is not the minimum value, we cannot get guaranteed ratio of $\frac{1}{2}\left(1-\frac{1}{e^2}\right)$ for $BM^2A$ problem.

2) In paper, '2-r', the theoretical analysis is incorrect, why experimental results are still good i.e. outperform previously known algorithms? Give your review on theoretical analysis and computer experiments.

- According to total performace images, performance of PCME is better than random, MaxDegree & greedy algorithm. As random & maxdegree are heuristic based, there performace is unstable. approximation ratio of greedy algorithm is $\frac{1}{2}(1-1/e)$ also

$$1-\left(1-\left(\frac{1}{n}\right)^2\right)^n \leq 1-\left(1-\frac{1}{n}\right)^n \leq 1-1/e$$

experimental result show the results of ~~PEAE~~ PMCE are very close, even better than that of greedy algorithm.

Q3. Why profit function is not monotone?

→ $B(x) = \hat{x}.J(S) - \hat{y}.|S|$. here $\hat{x}$ & $\hat{y}$ are arbitary constant number. when $\hat{y} \neq 0$, $\hat{x}.J(S)$ is monotone nondecreasing function & $\hat{y}.|S|$ is monotone ~~no~~ increasing func.

∴ $B(x)$ is not a monotone func being a difference of non-decreasing & ~~decr~~ increasing. The monotone property is required, if the function is monotone non-decreasing submodular function under the cardinality constraint, greedy heuristic method is guaranteed to bound of $(1 - \frac{1}{e})$. $|S| = p$. it is a approximate solution for $k = p$ the approximate solution for $k = p+1$ is determined by adding to S. a $j^*$ such that $Z(S \cup \{j^*\})$ $= \max_{j \notin S} Z(S \cup \{j\})$ & $Z(S \cup \{j^*\}) \geq Z(S)$

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Q4: Mover strategy can be applied to more than two players.

Q5

In noncooperative algorithms, we calculate Nash equilibria, however, it is NP hard. ∴ we need to relax the condition of Nash equilibria, get an approximate Nash equilibria, in order to reduce the computational cost to low level.