An Analytical Study of Puzzle Selection Strategies for the ESP Game

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How the ESP Game Works?

PLAYER 1

GUESSING: CAR

GUESSING: HAT

GUESSING: KID

SUCCESS!
YOU AGREE ON CAR

PLAYER 2

GUESSING: BOY

GUESSING: CAR

SUCCESS!
YOU AGREE ON CAR

Why is it Important?

- Some statistics (July 2008)
  - 200,000+ players have contributed 50+ million labels.
  - Each player plays for a total of 91 minutes.
  - The throughput is about 233 labels/player/hour (i.e., one label every 15 seconds)

The Ideas behind the ESP Game

- "Human Computation" represents a new paradigm of applications.
  - solve some problems which are difficult to be solved by computers

- "*Games With A Purpose" (GWAP)* – by Dr. Luis von Ahn (CMU)
  - take advantage of people's desire to be entertained
  - produce useful metadata as a by-product

Our Contributions

- We propose an evaluation metric for human computation systems.
- We study the inner properties of the ESP game using analysis.
- We propose an "*Optimal Puzzle Selection Algorithm" (OPSA).*
- We present a comprehensive set of simulation results.
- Our model is easy and applicable to other ESP-like systems.

The Main Ideas

- There are two goals :
  - the system prefers to maximize the number of puzzles which have been played
  - the system prefers to take as many labels as possible for each puzzle
- Unfortunately, there is a trade-off between the two goals.

The Proposed Metric

$$System \quad Gain \quad (G) = ln(N) \times ln(S/N)$$

the number of the puzzles that have been played

the average score of played puzzle

$$r = \frac{T}{N} \Rightarrow N = \frac{T}{r}$$

T : total played rounds
r : each puzzle should be played how many times in average

$$\frac{S}{N} = E[S] \times r$$

r : each puzzle should be played how many times in average
E[S] : the expected score value of each label

The Proposed Metric

$$System \quad Gain \quad (G)$$

$$= ln(N) \times ln(S/N)$$

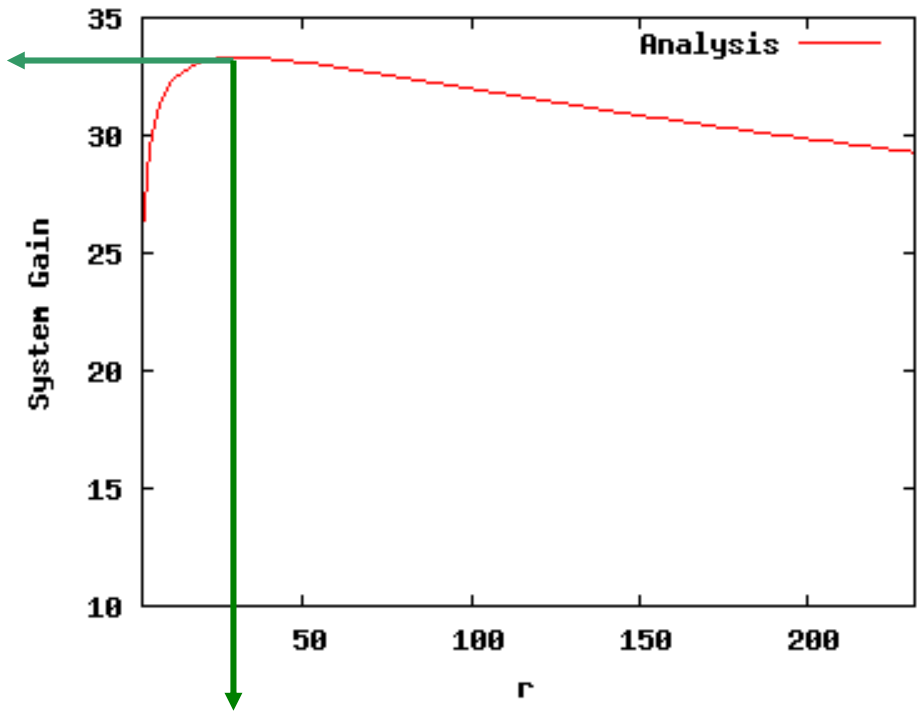
$$= ln(T/r) \times ln(E[S] \times r)$$

$$= -\left(ln(r) - \frac{ln(T) - ln(E[S])}{2} \right)^2 + C$$

$$Maximum\ G = C,\ when\ r = e^{\frac{ln(T) - ln(E[S])}{2}}$$

The Proposed Metric

Maximum G



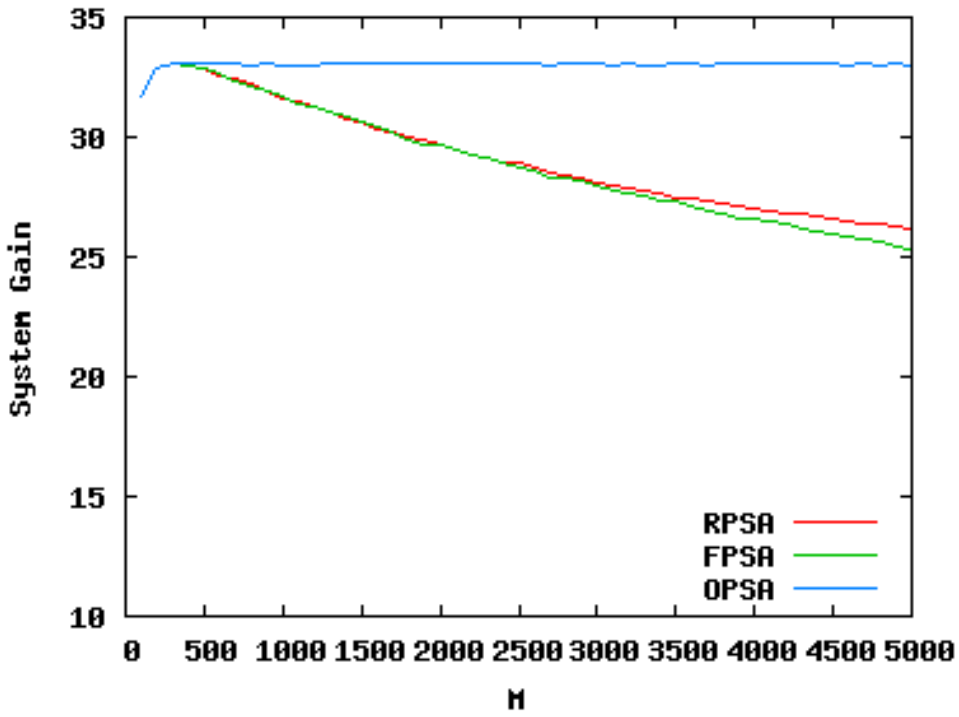
$$r = e^{\frac{ln(T) - ln(E[S])}{2}}$$

Puzzle Selection Algorithms

- Optimal Puzzle Selection Algorithm (OPSA)
  - select a puzzle based on our analysis
- Random Puzzle Selection Algorithm (RPSA)
  - select a puzzle by random
- Fresh-first Puzzle Selection Algorithm (FPSA)
  - select a puzzle that has been played least frequently

Evaluation

- Using Monte Carlo Simulations
- # of rounds: T = 10,000
- # of puzzles: 100 <= M <= 5,000



Conclusion

- We have proposed a metric to evaluate the performance of GWAP.
- We argue that GWAP needs to be "*played with a strategy*".
- We propose the Optimal Puzzle Selection Algorithm (OPSA) for ESP-like games.

Thank You!

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