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Advancing Behavioral Research Through Digital and Optimally-designed Experiments

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Opportunity

- Behavioral science: how do humans make decisions?
- Experiments performed in physical labs are **expensive** and **slow**
- With the vast computation power and connectivity today, why don't we **digitize** and **optimize** experiments?
- Our goal is to foster the search for scientific knowledge by **reducing time and cost** of experimentation

Approach

Try nodeGame live
nodeshowcase.herokuapp.com

1. nodeGame; an open-source, web platform for designing real-time experiments that are **robust, rapidly deployed, cost-effective, scalable**

2. GPUCB-PE search algorithm pinpoints the **optimal experimental payoffs** through computer model simulations

- We tested this process on the Prisoner's Dilemma game
- The best experiment to run has the highest KL-Divergence between the different model likelihoods divided by the predicted cost of running that experiment

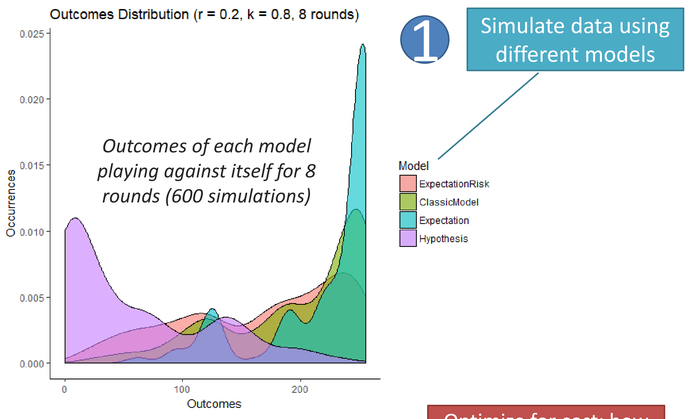
$$I(1;\theta) = \sum_{x \in X} l_1(x;\theta) \log \left(\frac{(1-p_1) l_1(x;\theta)}{\sum_{i=2}^{n} p_i l_i(x;\theta)} \right)$$

Information

$$max(\frac{I(1;\theta)}{cost(\theta)})$$

Information per $ Spent

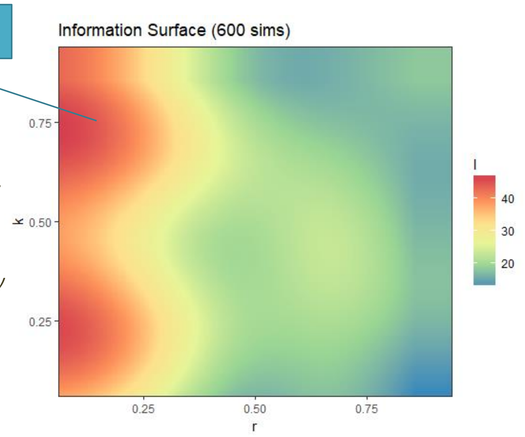
Data, Results



Outcomes of each model playing against itself for 8 rounds (600 simulations)

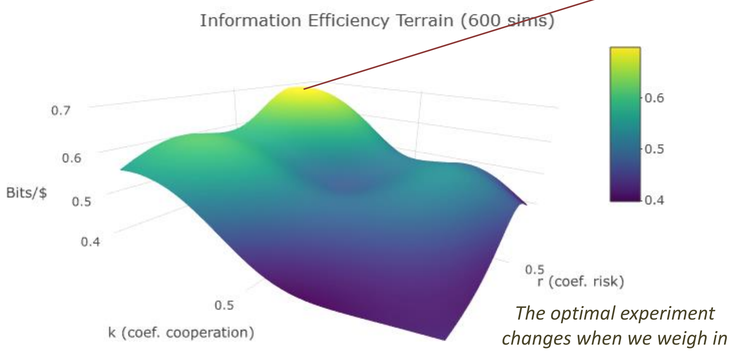
1 Simulate data using different models

2 Locate optimal experimental design



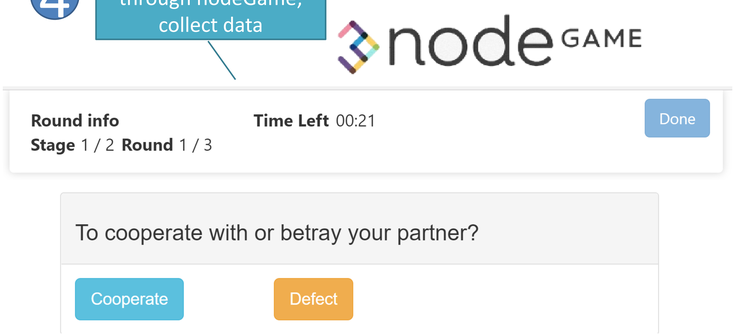
Heat map of KL-Divergence of all combinations of r and k. Our Gaussian Process algorithm predicts values based on known simulations to efficiently determine where to search next

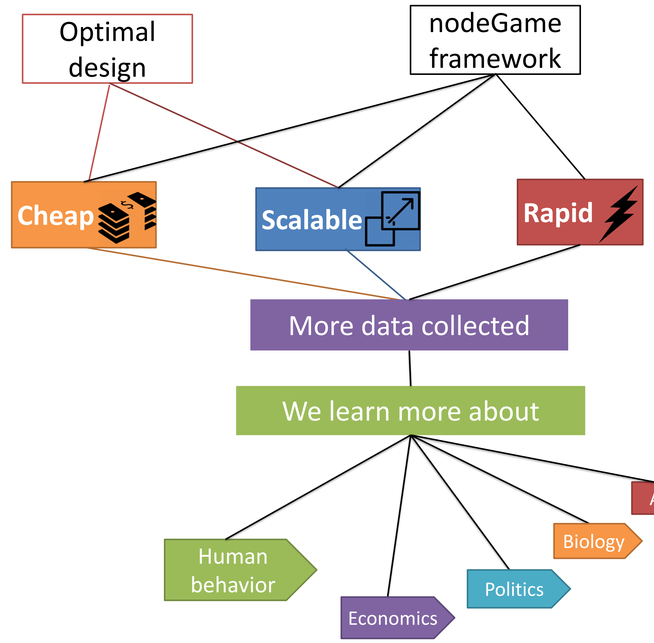
3 Optimize for cost: how much information can I buy for a dollar?



The optimal experiment changes when we weigh in the hypothetical cost of running that experiment

4 Implement and deploy through nodeGame; collect data





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