Game-theoretic models identify useful principles for peer collaboration in online learning platforms

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Problem: Incentivising students to collaborate online is difficult

- Anonymity due to large classes
- Concerns about reciprocation
- *Free-rider* tendency

Idea: Game Theory has helped design incentives for users of online systems

- Internet auctions
- Question-answer forums
- P2P sharing systems, like BitTorrent

Case: Peer feedback system

- Students provide subjective feedback on submissions of other students
- Simple model using cost of providing feedback and value of receiving one

Can we use Game Theory to incentivise more students to provide feedback in a peer feedback system?

Intuition: If Bob provides feedback to Alice and Alice to Charlie

- $\text{Payoff}_{\text{Alice}} = \text{Value}_{\text{Bob}} - \text{Cost}_{\text{Alice}}$
- If $\text{Cost}_{\text{Alice}}$ is low, Alice has better payoff. Alice has the incentive to **not** provide feedback!
- How do we fix this?
  By adding constraints!

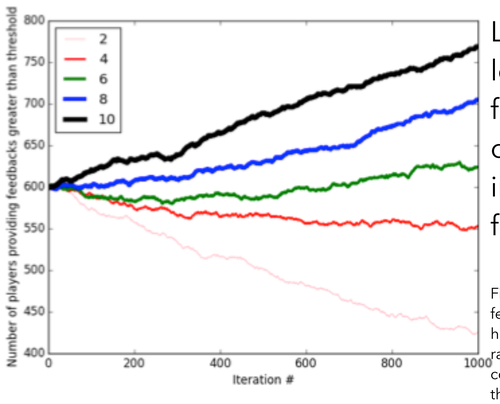
Darwin: Game-theoretic model for peer feedback system for 1000 students

1. ***Game parameter***: *Benefit ratio*
   Value of receiving a feedback/cost of providing feedback
2. ***Constraint***: *Threshold*
   A number which represents how many feedbacks should be provided by a player to see her own feedbacks
3. ***Player strategies***: Students' *frequency* of providing feedback.1000 players whose frequency of providing feedback varies between 0.0 and 0.9 (at 0.1 increments, with 100 students in each group)

Experiments: Simulations at scale

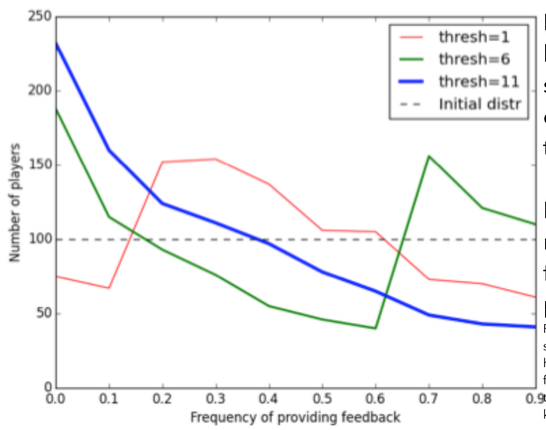
1. Vary game parameter and constraint
2. Observe how player strategies evolve and become stable by playing the game repeatedly. Do more students provide feedback now?
3. Tweak constraint to improve outcome

But how will students respond to constraints? Run simulations to test!



Low benefit ratios lead to less feedback; students don't see the value in providing feedback.

Figure 1: More players provide feedback when the benefit ratio is higher (the lines show different benefit ratio values). The threshold was kept constant at 3 across all the runs, but this trend is consistent for any fixed value of threshold.



Low thresholds (0-2) lead to lesser feedback; students only do enough to cross the threshold.

High thresholds (7-10) result in lesser feedback; students stop putting effort

Figure 2: The final distribution of player strategies (frequency of providing feedback) highly depends on the threshold value for a fixed benefit ratio. For all the three runs with threshold=1, 6, and 11, the benefit ratio was kept constant at 8.

Early results and discussion

1. To encourage more students to provide feedback, the feedback system should provide large benefit from a feedback received and it should ask students to provide feedback for realistic number of other students (3-5).
2. Game theory suggests design principles to incentivise submitting feedback, **before** building the system.