

To Community

Simple summary

Model and optimize the search for product-market fit as a form of cooperative communication between a company and a community, focusing on quantifying the value of community input in product development and isolating effective interventions.

Executive summary

The relationship between a company and a user community is a form of cooperative communication: companies build products and services for users, while users provide feedback on those offerings through buy/don't buy signals as well as comments and survey responses.

This iterative, student-teacher dynamic between companies and users (where the users are the teachers) is not well-captured in straightforward machine learning applications, e.g. of consumer data to product design; in current game-theoretic analyses of innovation, which tend to focus on firm-to-firm settings like [R&D competitions](#) or the [startup-investor relationship](#); or in methodologies like [Lean Startup](#), which have formalized aspects of the dynamic but not rigorously or quantitatively. But as [product cycles grow ever shorter](#), [communities become more proactive in shaping products](#), and [technology facilitates new forms of peer production](#), this cooperative dynamic has become increasingly important. It is especially important to tech startups in Web2 and Web3.

In this research project, we apply and extend [Shafto et al.](#)'s mathematical theory of cooperative communication to model the relationship between companies and user communities. The core of our theory is based on optimal transport, which provides us a powerful, general set of mathematical tools for formalizing least-cost coupling of probability distributions. In the context of cooperative communication, we can minimize the cost of communicating ideas, represented as distributions or beliefs over a hypothesis space, via the available data, which varies in cost, by selecting a coupling of hypotheses and data that maximize the probability of successful communication. More than a framework for product development, cooperative communication synthesizes elements of game theory and machine learning in order to present a new, broader perspective on the traditional problem of "alignment".

As a proof of concept, we will begin by showing how our theory can explain, optimize, and accelerate existing frameworks for product development such as Lean. To do this, we first need to extend [Shafto et al.](#) to situations where the company has an evolving distribution over its possible users, likely using some form of Markov chain formalism. In later stages of the project, we hope to explore how the theory can be used to understand and predict various innovative startup structures, including options for collective financing, progressive decentralization, and exit to community.

Funding

\$500k to fund a math postdoc at Rutgers University - Newark, an industry researcher at Metagov, 25% PI time, conference travel, registration, and overhead.

Team description

Dr. Patrick Shafto is Member of the School of Mathematics at the Institute for Advanced Study and Professor of Mathematics and Computer Science at Rutgers University - Newark. Research in his lab focuses on mathematical foundations of learning in humans and machines. He has received honors and awards including an NSF CAREER award, HRT term chair in Data Science, and outstanding paper and reviewer awards at NeurIPS and ICML. His research has been supported by NSF (EHR, CISE, SBE), DARPA, DoD, NIH, and the intelligence community. His research has formed the basis for successful machine learning start-up companies eventually acquired by Salesforce and Tableau, and the current start up, Redpoll, for which he is CSO.

Joshua Tan is a mathematician and computer scientist at Stanford, Oxford, and Metagov whose research focuses on applications of higher mathematics to the design of intelligent systems. He is founder and executive director of Metagov, a nonprofit research collective that builds standards and infrastructure for digital self-governance. He is also an executive editor of *Compositionality*, a peer-reviewed journal, and editor of *Applied Category Theory*, a book series published by Cambridge University Press. He was formerly an entrepreneurial fellow in the MIT math department and a consultant at NIST.