Performative Power

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Summary

Digital platforms exhibit power by shifting the consumption patterns, preferences, and behavior of market participants.

Our contribution: A normative and technical proposal for reasoning about the power of digital platforms

✓ We propose the definition of Performative Power.
✓ We illustrate the sensitivity of Performative Power to market factors, using strategic classification as a case study.
✓ We construct Discrete Display Design, an approach to bound performative power by the causal effect of position.
✓ We show that, in the context of optimization, Performative Power bounds the firm's ability to steer the population.

Algorithms can shape the marketplace
where they are deployed.

Content Recommender System

Spotify   YouTube   G

content creators   *consumers*
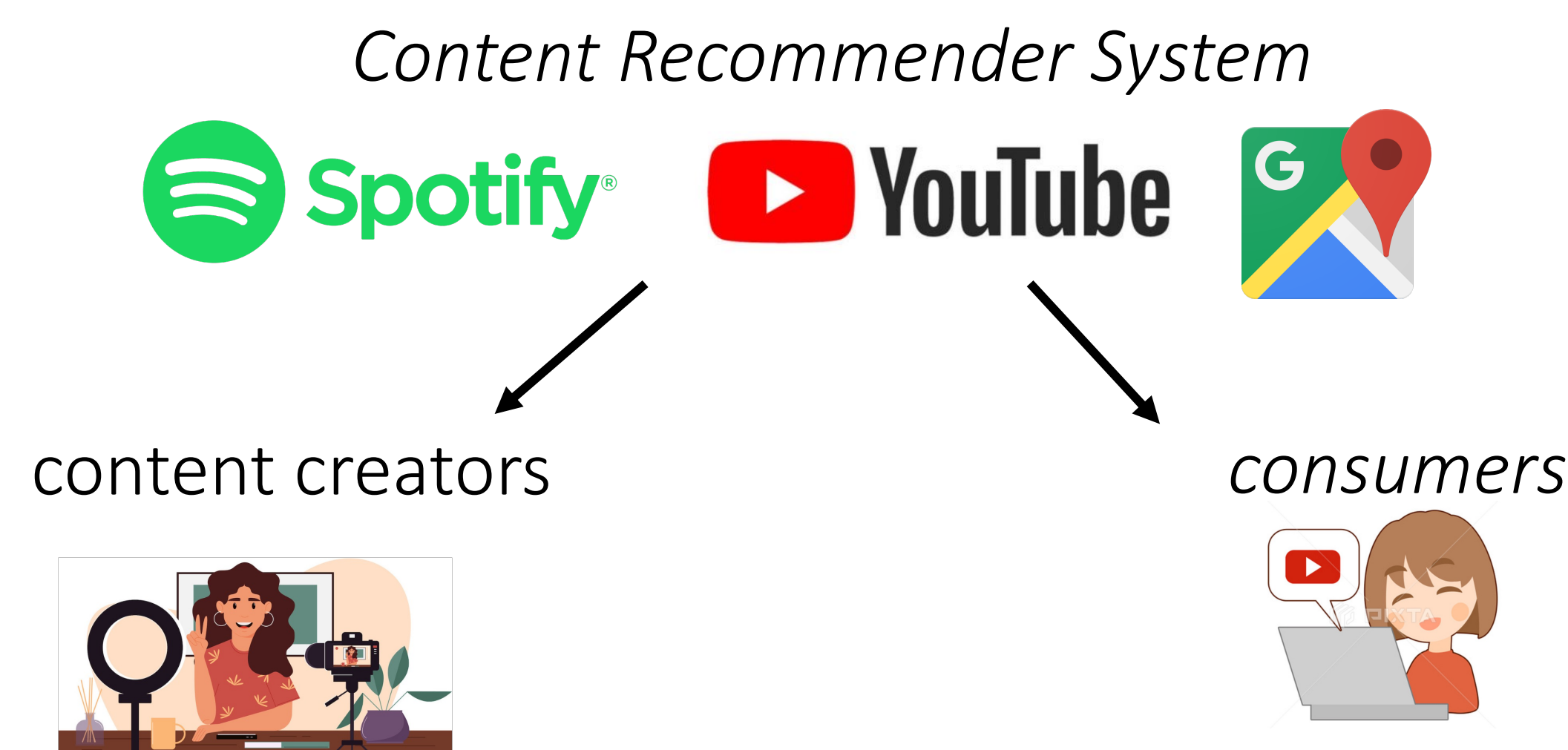
Instantiations of Performative Power:

Consumers

U = viewers
F = arrangement of content into display slots
$z(u)$ = content currently watched by viewer
$z_f(u)$ = content the viewer watch if recommendations changed
dist = changes in consumption levels

PP = ability of the platform to shape the consumption patterns of viewers through display slots

Content creators

PP = ability of the platform to shape the types of videos that content creators stream on their channels

Formalizing the power of a digital platform

Approach: measure the ability to induce change on participants

> Definition (Performative Power): Given a platform with a set of participants U, a set of platform actions F, potential outcome pairs $(z(u), z_f(u))$ for every $u \in U$ and $f \in F$, and a metric **dist** over data, the Performative Power is defined as:
>
> $$PP := \sup_{f \in F} \frac{1}{|U|} \sum_{u \in U} E[\text{dist}(z(u), z_f(u)]$$

✓ Performative Power is a causal, statistical notion: *maximum average treatment effect induced by potential firm actions*.
✓ Performative Power does not require knowledge of the specifics of the mechanism by which f impacts participants

Performative Power in Strategic Classification

classification rule f impacts feature vector of participants

○ x_{orig}
--- classifier f
● x_f
▨ users willing to adapt
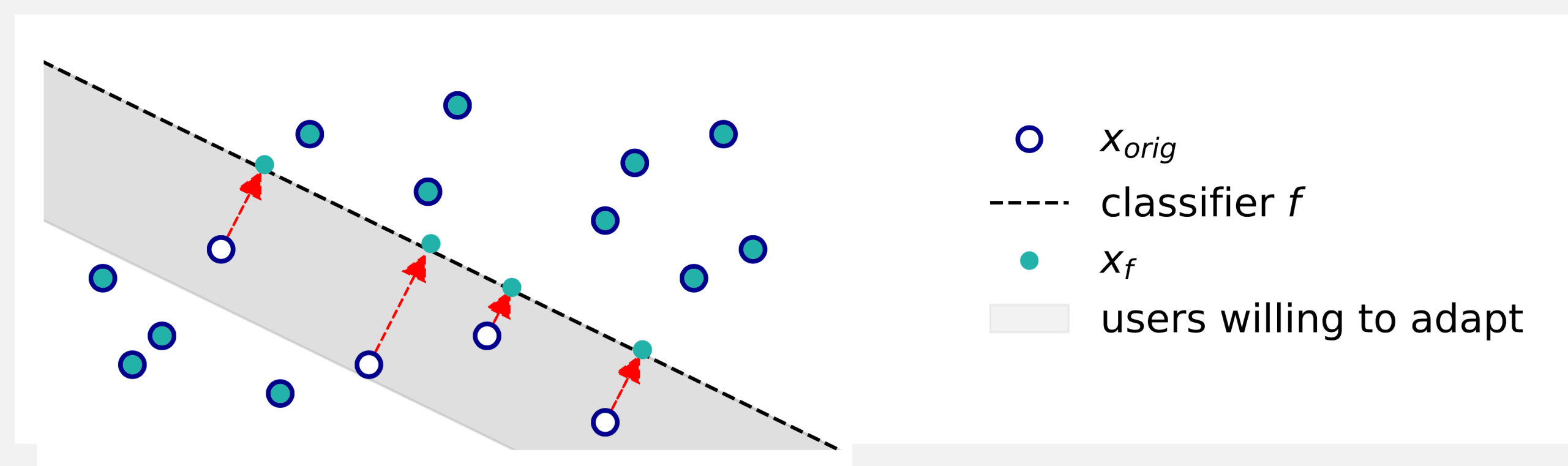
Qualitative Properties of performative power:

• Maximized when firms can fully personalize decisions
• Reduced in presence of outside options and competition
• Reduced to zero under perfect Bertrand competition

→ PP *can serve as a measure for the competitiveness of the market*

Performative Power of Discrete Decisions

Content 1	Content 2	Content 3	Content 4

Causal effect of position := average treatment effect of swapping content displayed in two display slots

> Theorem (Informal): Performative power is *lower bounded* by the *causal effect of position* between any two slots.

We show a concrete lower bound for search engine advertising.

→ *Reported estimates of causal effects can be repurposed to provide a lower bound on performative power in some contexts.*

Is Performative Power useful for market regulation?

"Pinpointing the locus of competition can also be challenging because the markets are multisided and often ones with which economists and lawyers have little experience." – Stigler Committee on Digital Platforms (2019)

A European Union Commission (2019) called for *"less emphasis on analysis of market definition, and more emphasis on theories of harm and identification of anti-competitive strategies."*

Role of Performative Power in Optimization

We build on *Performative Prediction* [Perdomo et al. 2020].

• Define $z(u) = (x, y)$ as the feature, label pair of participant u
• Let $D(\theta)$ denote the distribution over data $z_\theta(u)$ with $u \sim U$.

The performative risk $PR(\theta) = \mathbb{E}_{Z \sim D(\theta)}[\ell(z; \theta)]$, equals

$$(\mathbb{E}_{Z \sim D(\phi)}[\ell(z; \theta)]) + (\mathbb{E}_{Z \sim D(\theta)}[\ell(z; \theta)] - \mathbb{E}_{Z \sim D(\phi)}[\ell(z; \theta)])$$

Optimize via learning on historical data

Optimize via steering towards desirable distribution

→ *Performative power offers an additional lever to a platform for achieving small ex-post risk through steering*

> Theorem (Informal): The gain a platform can achieve through steering is bounded by the platform's performative power.

Discussion

Power plays an important societal role in prediction. With our proposal, we provide a formal framework to reason about power in prediction and hope to inspire future discourse on this important topic.

Future Work

• To what extent does performative power implicitly or explicitly impact a platform's optimization strategy?
• Power and harm are different normative concepts. What are the implications of performative power for user welfare?
• In the context of regulation, how should this qualitative form of power be handled and what is the right way to instantiate performative power in concrete contexts?