



서강대학교 ICT법경제연구소 세미나

Machine Learning and Market Competition: Some Preliminary Thoughts

Haksoo Ko

Seoul National University

August 31, 2017

SNU School of Law

CONTENTS

- I. New Era: Advent of Machine Learning!**
- II. Competition Issues related to Machine Learning**

New Era: Advent of Machine Learning!

Machine Learning

- Machine learning, in general
 - X =features, classifiers, characteristics, covariates
 - Y =label, category, outcome
- Deep learning
 - (X, Y) : supervised learning
 - X alone: unsupervised learning, clustering problem
- Reinforcement learning
 - Not maximizing predictive accuracy, but maximizing value
 - Periodically updating “policy” and “value” in order to maximize the probability of winning
 - Generating additional data through self-play

Machine Learning: Pre-requisites



**Computational
resources**



CPU



GPU



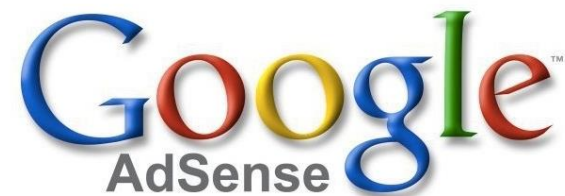
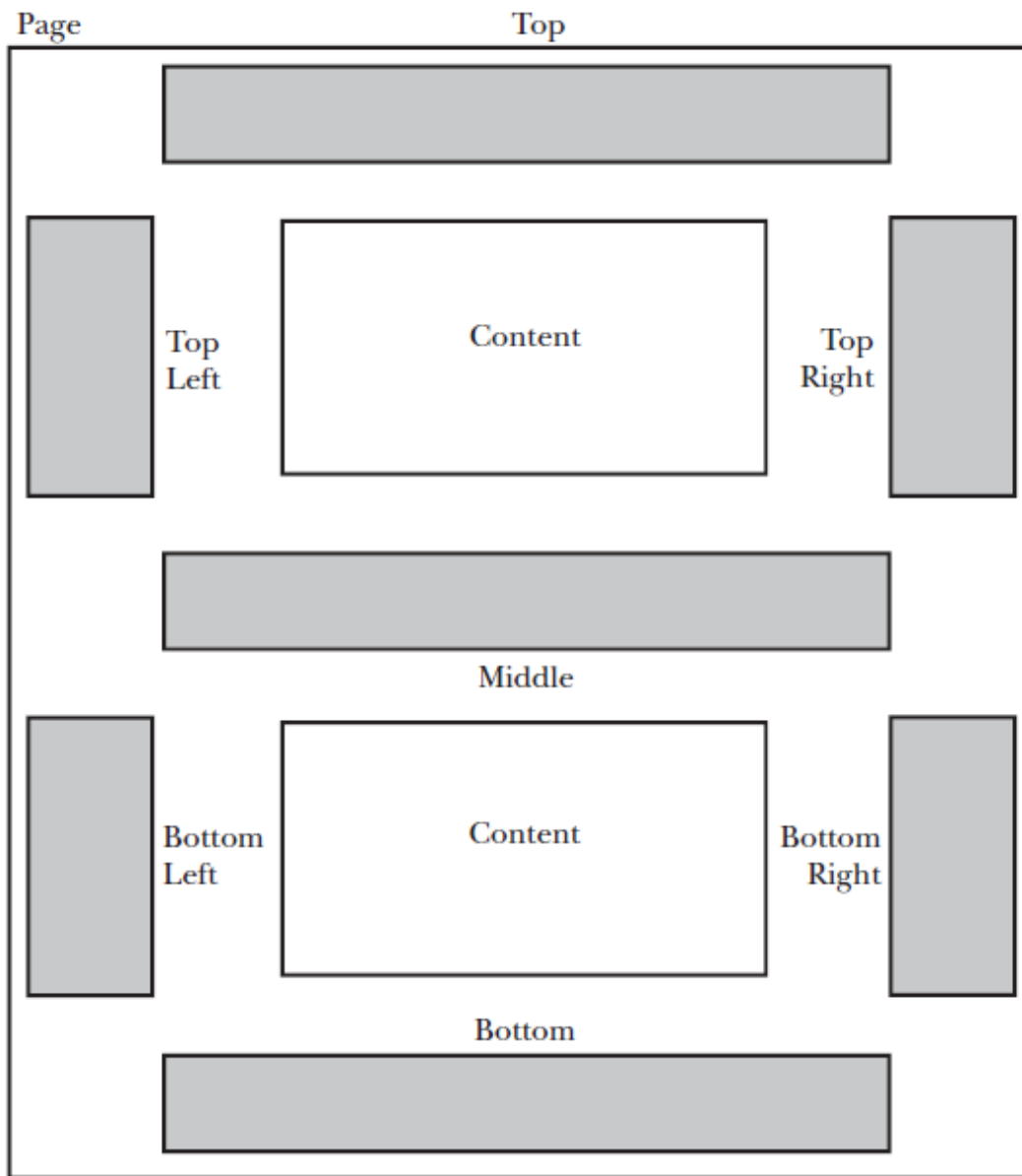
Training Data
(examples
to learn from)

Data-driven economy and users' personal information

- Some characteristics of data-driven economy
 - Massive and continuous collection, analysis, and utilization of (personal) data
 - Collection is important
 - However, collection itself is not the goal
 - Data analytics and its business utilization are what matters.
 - Competition often happens at a platform level
 - Network externalities; multi-sided market
 - Platform competition often entails competition for user data, at the same time
 - Platform-level competition may, or may not, foster competition
 - Impact of data on competition?

Role of data in platform competition?

- Significance of data: analytics
 - (1) pattern recognition, (2) marketing, (3) demand estimation...
- Platform business
 - Often serviced for free
 - In return, collection of user data
 - Ability to collect data and conduct analytics became an important dimension of competition
 - In particular, in a multi-sided market (e.g., 'match-making' type), having individualized information on each user is crucial
 - (1) important for 'good' match with another user who belongs to another side of the market;
 - (2) important for purposes of targeted advertisement



D. Evans, "The Online Advertising Industry: Economics, Evolution, and Privacy" JEP (2009)

모바일 뉴스피드

데스크톱 뉴스피드

오른쪽 칼럼

**Jasper's Market**

Sponsored ·

페이지 좋아요

It's fig season! Not sure what to do with figs? Here's a great dessert recipe to share.



Fig Tart with Almonds

The simplicity of this tart perfectly accents ripe figs. If you don't have enough time t...

WWW.JASPERS-MARKET.COM

[더 알아보기](#)

공감 120개 댓글 5개 공유 19회

[좋아요](#)
[댓글 달기](#)
[공유하기](#)

☑ 캠페인

↳ 목표 ✓

☰ 광고 세트

- 트래픽
- 쿠폰
- **타겟**
- 노출 위치
- 예산 및 일정

☰ 광고

- 페이지
- 형식
- 전체 화면 환경
- 링크

위치 ⓘ 이 위치의 모든 사람 ▼

대한민국

📍 서울, Seoul + 40km ▼

📍 포함 ▼ | 위치를 더 추가하려면 입력하세요

| [찾아보기](#)

지도

일괄 위치 추가...

연령 ⓘ 18 ▼ - 65+ ▼

성별 ⓘ **전체** 남성 여성

언어 ⓘ 언어 입력

상세 타게팅 ⓘ 다음 중 하나 이상과 일치하는 사람 포함 ⓘ

인구 통계학적 특성, 관심사 또는 행동 추가

| 추천 | [찾아보기](#)

타겟 제외

타겟 규모



타겟이 정의되었습니다.

최대 도달 범위: 9,800,000명

일일 추산 결과

도달

7,100~26,000(총 6,000,000) ⓘ

링크 클릭

130~590(총 86,000) ⓘ

예측의 정확도는 이전 캠페인 데이터, 입력한 예산, 시장 데이터 등의 요인에 따라 달라집니다. 수치는 예산의 성과를 예측하기 위한 목적으로만 참고하시기 바라며, 정확한 결과를 나타내지 않을 수도 있습니다.

[이 추산치가 도움이 되었나요?](#)

Competition Issues related to Machine Learning

Competition Issues related to Machine Learning

- Competition when ML is involved
 - Market competition may involve (1) platform competition, and may show (2) network externalities
 - From a competitor's perspective, it could be crucial to preempt the market, to provide *de facto* standards, and to secure many users at an early stage
 - ML product may or may not form a separate market
 - ML may only play a role of improving existing products
 - Even when there's no separate market for an ML product, there may well be fierce competition underneath among existing competitors
 - Thus, many technology companies provide API (application programming interface) for free
 - To try to secure a large 'installed user base', and to induce 'tipping'
 - Through this, at the same time, competition takes place to collect users' data

Competition Issues related to Machine Learning

- Competition when ML is involved
 - Competition sometimes involves widespread use of robots (bots) in order to monitor competitors' behavior, in particular pricing behavior
 - Automated price adjustment mechanism, reflecting the result of monitoring ← very low “menu cost”
 - Constant monitoring of pricing behavior of competitors
 - This may paradoxically lead to price rigidity
 - Although competitors may be exposed to tremendous competitive pressure, “conscious parallelism” may be a market outcome

Competition Issues related to Machine Learning

- Case of ‘price matching/guaranteeing lowest price’
 - Conceptually a form of MFN (most-favored-nation clause)
 - Would the resulting prices resemble the prices that would be formed under perfect competition?
 - Or, on the contrary, to induce tacit collusion or something analogous to collusion?
 - Possibility of overall upward shift of prices, and of price rigidity
 - Plausibility of MFN (and of lessening of competition)
 - Widespread use of robots and the possibility of monitoring competitors’ prices easily
 - “lowest price guarantee” could lead to overall price rigidity
 - This could even function as *de facto* “entry barrier”

Competition Issues related to Machine Learning

- Algorithmic tacit collusion might be facilitated, if
 1. Concentrated markets with homogeneous products
 - In such markets monitoring competitors' behavior would be less burdensome
 2. Credible deterrence or punishment possible for deviation
 - Speedy and effective retaliation would be a key
 3. Markets with diffused consumers
 - Consumers are unable to exert *de facto* bargaining power as a group
 4. Markets where algorithms with similar functionality and where market data are available among competitors
 - Industry-wide use of a single algorithm
 - Industry-wide sharing of relevant data

See Ezrahi and Stucke, "Two Artificial Neural Networks Meet in an Online Hub and Change the Future (of Competition, Market Dynamics and Society)" (2017)

Competition Issues related to Machine Learning

- ML, Big Data analytics and price discrimination
 - Businesses would try to engage in extensive monitoring of consumers' behavior, conduct analysis regarding individuals' preference structure, and, try to offer tailored and targeted services
 - At the same time, prices could also be tailored, targeted prices, which reflect consumers' individual level "willingness to pay"
 - In the extreme, this could be a perfect (first degree) price discrimination
 - Economic impact of price discrimination
 - Dead-weight loss could be reduced → beneficial to social welfare
 - Consumer surplus could be reduced, while producer surplus could be enlarged → detrimental impact on wealth distribution possible

Competition Issues related to Machine Learning

- Enforcement challenges
 - Liability
 - Imputing liability could be difficult for a company's unilateral competitive behavior, using algorithms and available data
 - Detection
 - Even if above-competition level prices are prevalent, it could be difficult to detect
 - It could be difficult to assess competition-level prices
 - Also, auditing or verifying algorithms may not be practicable due to (1) concerns on gaming/abusing and (2) lack of explainability

Concluding observations

1. ML may, or may not, facilitate collusive behavior and/or lead to price rigidity
 - Conjectures explained above are mostly theoretical or anecdotal
 - More detailed analyses in individual markets are needed
 2. Enforcement is a separate issue
 - Further discussions are warranted as to whether liability can be imputed
 - Even when there might be anti-competitive behavior, detection and verification could be troublesome
- New challenges for regulators and researchers!