

Economics of tracking and control

(Computer mediated transactions)

Kelvin Dong, Silas Hsu

Hal Varian. Computer Mediated Transactions. In American Economic Review: Papers & Proceedings 100 (May 2010): 1–10.

Author

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Prelude: why we should care

At first glance: “look at all the things computers will enable!”

What does this have to do with the class?

Prelude: why we should care

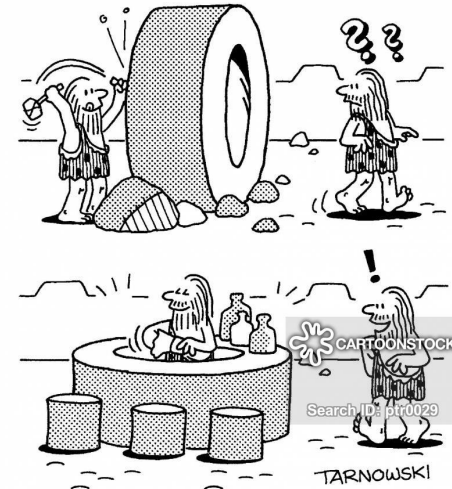
At first glance: “look at all the things computers will enable!”

What does this have to do with the class?

- What mechanisms do computers enable?
- How can computers shape the dissemination of knowledge?
- How can we leverage computing to shape social behavior for the better?

Combinatorial innovation

- Not about reinventing the wheel
- Leveraging existing or emerging technologies in an innovative way to create new devices and applications



What invention does this combination led to?



+



+



= ?



The Internet and the Web

- Described as a “lab experiment that got loose”
- Arose from the research community rather than the private sector, thus has no obvious business model
- Offer a **flexible set of component technologies** that encouraged combinatorial innovation



Why was innovation so rapid on the Internet?

- Components all made of bits
 - Protocols: TCP/IP, HTTP, ...
 - Languages: HTML, Java, Javascript, ...
 - Software libraries: TensorFlow, OpenCV, ...
- Can be combined to create web pages, search engines, apps
- Innovators can work from anywhere, in parallel
- No real limit on supply, zero/low cost to create, no shipping delay
- Question: how does combinatorial innovation relate to diffusion in networks?¹

Question that the author asks: **What are the implications of such combinatorial innovation for commerce?**

¹Y. Xiao, A. Krishnan and H. Sundaram, Discovering Strategic Behavior for Collaborative Content-Production in Social Networks. to appear in WWW 2020.

Computer mediated transactions

Definition: Economic transactions that involve a computer

Examples:

- Cash registers
- Buying goods online

Original purpose to include a computer:

- To keep a record of the transactions

Implications/New purposes

- New forms of contract
- Data extraction and analysis
- Controlled experimentation
- Personalization and customization

New forms of contract

“I will do X if you do Y” → “I will give you \$1 if you give me a cup of coffee”

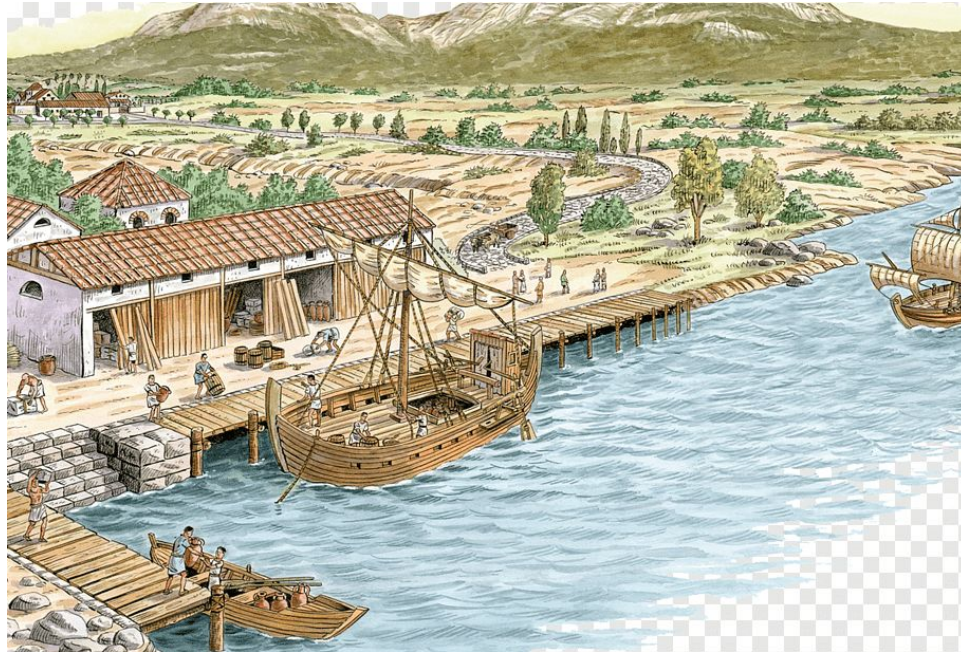
- Contracts require actions to be verifiable



Before computers ...

Mediterranean shipping 3300 BC

Problem: How to ensure that your cargo is fully delivered when there is **no written language** and the **people cannot read or write**?



Mediterranean shipping 3300 BC (accounting)

Solution: Use small clay tokens known as “bullae” which were shaped to represent the items to be shipped.



So how can computers enable new forms of contract?

Ritty's Incorruptible Cashier (1883)



Ritty's Incorruptible Cashier (1883)

Solution: Build a device that can **record each transaction on a paper tape** and make a sound whenever a transaction is completed

Impact: Deter stealing, retailers more willing to hire people from outside their immediate family



Rental cars



Rental cars



Rental cars

Solution: Putting a **computer transmitter** that can monitor the speed of the car in its trunk

Therefore, the new contract is now **enforceable** and also offers a **Pareto improvement** on the original contract.

See related work: Game theory/mechanism design (to improve social welfare)¹

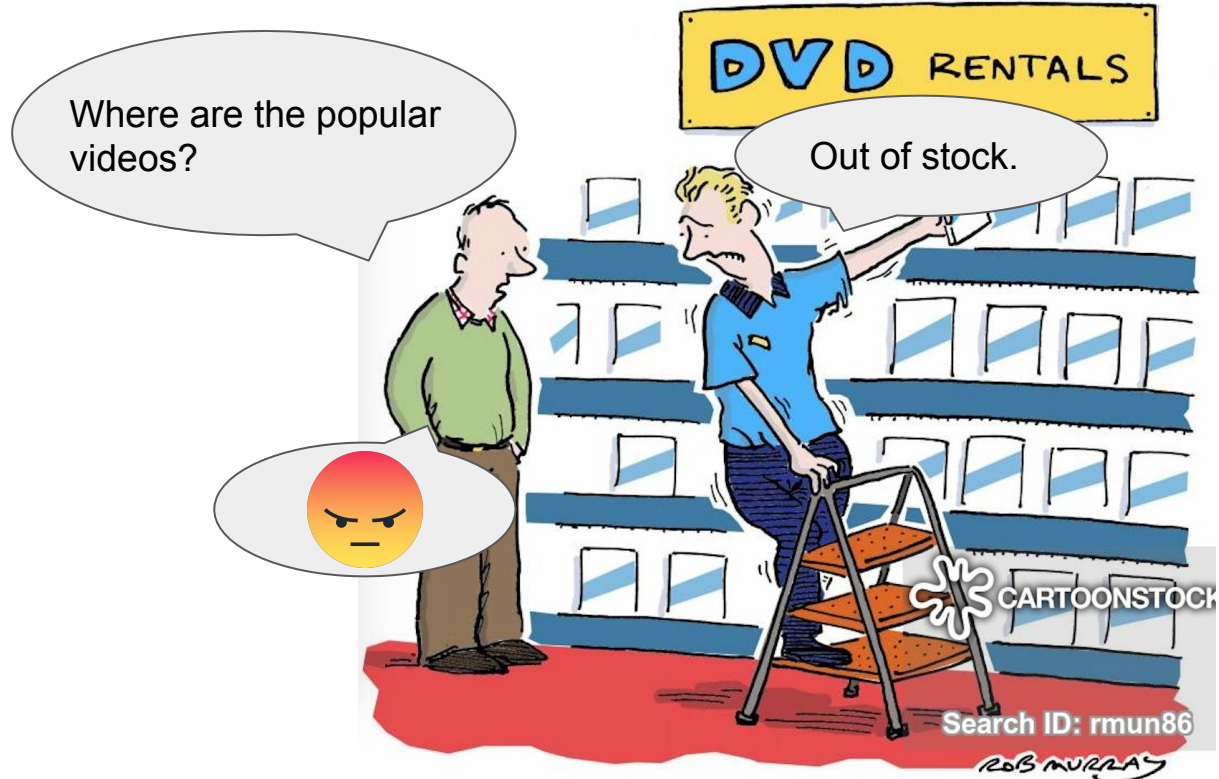
¹Roughgarden, T. (2016). Twenty lectures on algorithmic game theory. Cambridge University Press.

Videotape rental

Where are the popular videos?



Videotape rental



Videotape rental

Solution: Revenue sharing model (1998)

- Rental stores can buy the videos from the distributor at a **low cost**
- BUT give a **% of the profit earned from those videos** to the distributor

To enforce the contract, the cashiers will scan the barcodes (1970) on the videos and the cash registers would record the transactions.

Online advertising

Publishers (Website owners): Sell ad impressions (i.e. views)

Advertisers: Buy ad clicks

Problem: Their incentives do not align

#impressions \neq #clicks

Online advertising

Solution: Click-through rate

Price per impression = Price per click X Click per impression

- Advertisers submit bids for price per click
- Website owner calculates click per impression (view) for each ad
- Auction winner determined by price per impression

Related Work: second-price auction¹

Is this mechanism a good solution?

¹Roughgarden, T. (2016). Twenty lectures on algorithmic game theory. Cambridge University Press.

Online advertising (What about user's experience?)

The screenshot shows a web browser window displaying a forum thread on the Neopets website. The browser's address bar shows the URL `www.neopets.com/neoboards/topic.phtml?topic=159527119&next=1#bottom`. The forum page has a yellow navigation bar with links for 'my account', 'customise', 'games', 'explore', 'news', 'community', 'shops', 'nc mall', and 'premium'. The thread title is 'Neopets' and the current topic is 'Ads on bottom of window'. The thread contains two messages:

- Message 1:** From 'polarpause' (13 Jul 2018 - 10:20 am). The message says: "These are a little annoying when I'm playing Neopets. They pop up over the things I'm trying to click. It's like playing Advert Attack on the actual Neopets site. Could you make it so that they don't interfere with the game (like the top and side ads)?"
- Message 2:** From 'cinders_lair' (13 Jul 2018 - 10:21 am). The message says: "if your not premium or using ad blockers.. you need to." and includes a link: "Avatar Game Help <http://www.neopets.com/~tropator>".

The forum page is heavily cluttered with advertisements. At the top, there are banners for 'SEPHORA' and 'BEACH, PLEASE! COLLECTION'. On the right side, there is a large vertical ad for 'SEPHORA Perfecting' foundation. On the left side, there are ads for 'instacart' and 'Neopets' characters. The bottom of the browser window shows a taskbar with various application icons.

Ad quality/relevance is important!

Example of a relevant ad

The image shows a screenshot of the PCWorld website. At the top, there is a navigation bar with the PCWorld logo and links for News, Reviews, How-To's, Downloads, Shop & Compare, Apps, and Business Center. A search bar contains the text "netbook laptop". Below the navigation bar, there are several promotional banners, including one for PCWorld Magazine, one for Intel Xeon processors, and one for a 70% energy efficiency improvement. A sign-in section is also visible.

The main content area shows search results for "netbook laptop". On the left, there is a "Filter Results" sidebar with options for All Results, News, Reviews, Video, How-To and Tips, Products, Downloads, Shop & Compare, Android Apps, and iOS Apps. Below this is a "More About..." section with links for Business Laptops and Laptops.

The search results are displayed in a grid. The first row contains sponsored links:

- The HP Mini Laptop at VzW**: Explore the internet at lightning fast 3G speeds. Ultra-portable. Verizon/Wireless.VZW.com
- XFIBITY® is the Fastest**: Internet Provider in the Nation According to PC Mag! Sign Up Today. www.Comcast.com
- Microsoft PC Promo**: Buy a PC over \$699 and get a \$200 Gift Card at the Microsoft Store! www.MicrosoftStore.com/teleatv

The second row contains a "News" section with 462 results, sorted by Relevance | Date:

- Lenovo Stops Selling Netbooks Online** (Feb 24) - Agam Shah - Laptops: Lenovo has stopped selling netbooks through its website and hasn't decided if it will start selling them again there in the future, the company said.
- Are Netbooks Dead? The Prognosis Is Grim** (Feb 20)
- Ready for Another Linux Tablet? Meet the Rugged Trimble Yuma** (Feb 7)
- Kinect Inside: Asus Bakes Motion Control Tech into Laptops** (Jan 30)
- Lenovo ThinkPad X120e Ultraportable, \$299** (Jan 25)

At the bottom of the news section, there is a link to "See all 462 News results".

The third row contains a "Downloads" section with 7 results:

- ArcSoft Photostudio Paint** (Draw & Paint Software)
- Dropbox Basic** (Backup)
- Dropbox Pro** (Backup)
- SRS Labs, Inc. SRS HD Audio LAB** (Audio Tools)
- Lance at pendrive.linux.com Universal USB Installer** (Utilities)

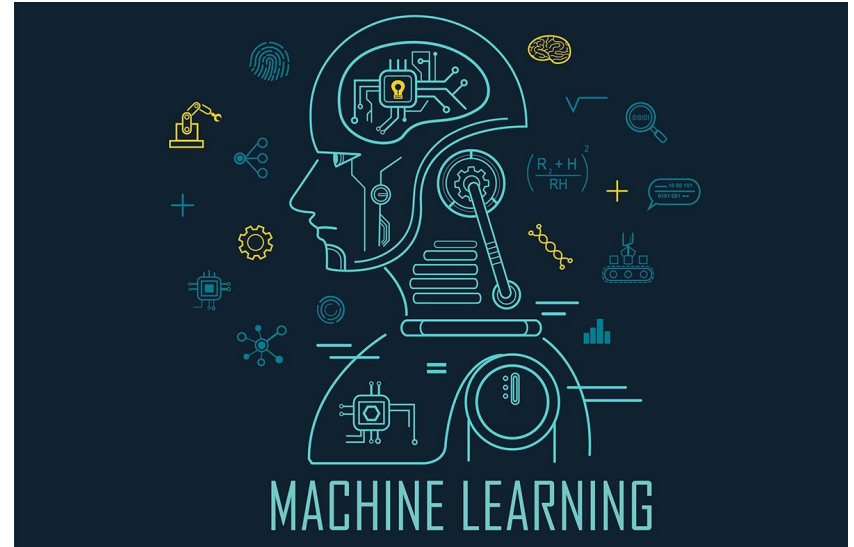
At the bottom of the downloads section, there is a link to "See all 7 Downloads results".

On the right side of the page, there is a large advertisement for Toshiba Satellite Series laptops. The ad features a red background and a laptop. The text reads: "The always-has-your-back Satellite® Series." Below this, it says "Learn more" and "TOSHIBA Leading Innovation 100". At the bottom, it says "Toshiba recommends Windows 7" and "Your PC, simplified. Windows 7".

Data extraction and analysis

- Data from computer mediated transactions can be analyzed and used to improve the performance of future transactions

Collect data and observe patterns using computers



Sabre air passenger reservation system

Initial idea: To automate the creation of an airline reservation

New, additional usage:

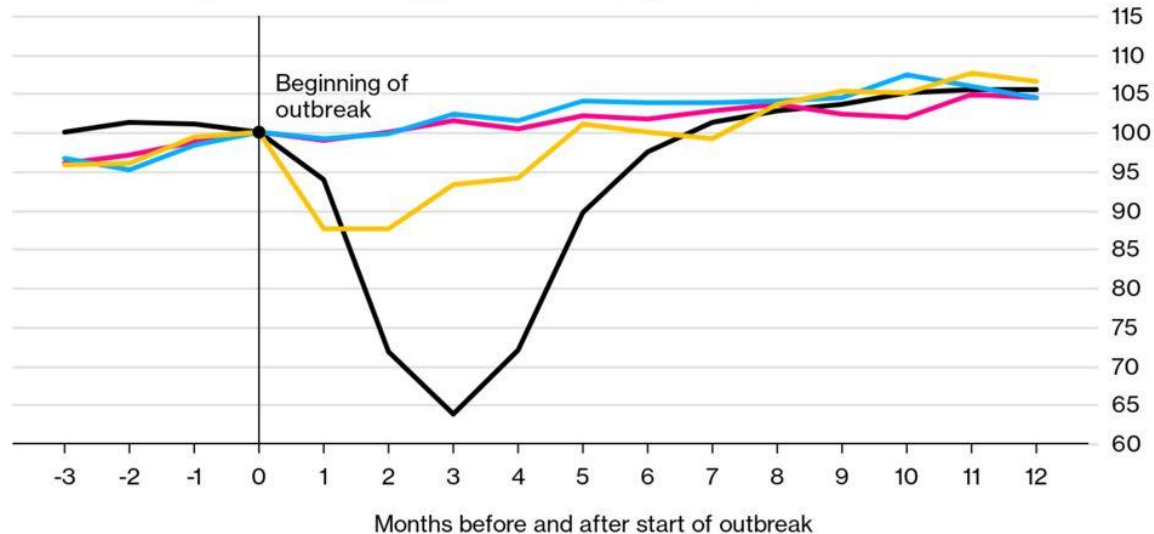
- Study patterns in airline reservation process
- Enabled “yield management” in the transportation business

Patterns of various virus outbreaks on air travel

Recovery Path

International airline passenger traffic has been resilient during past outbreaks

▀ SARS (2003) ▀ Avian Flu (2005) ▀ Avian Flu (2013) ▀ MERS (2015)



Source: International Air Transport Association
Note: Index values for crisis start month = 100

Bloomberg

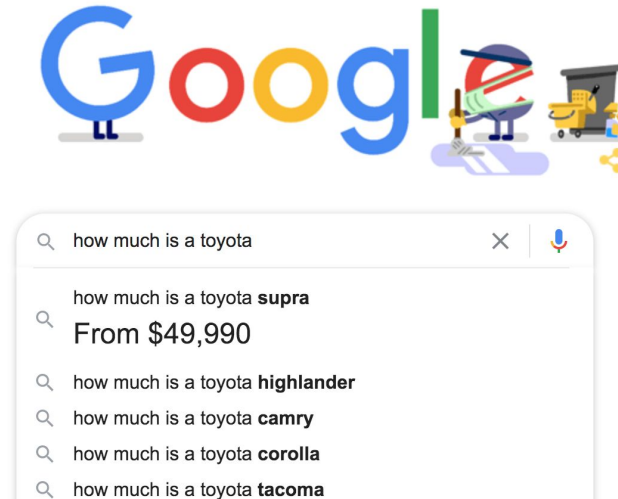
How air ticket price changes



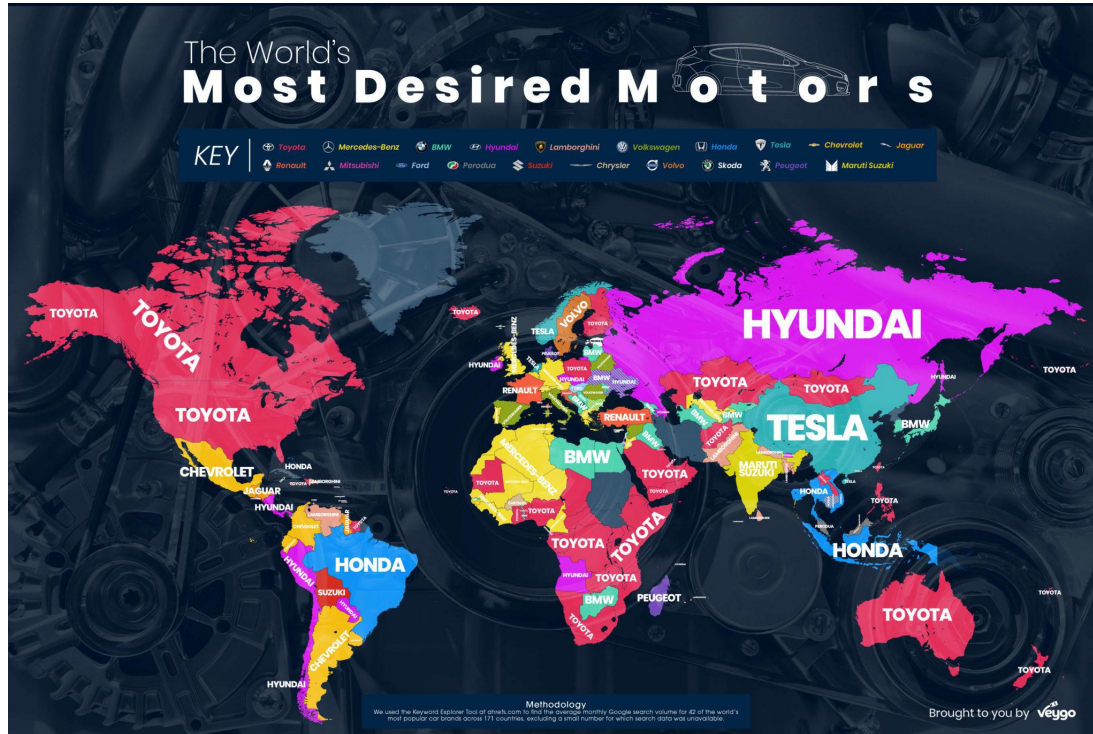
<https://www.cheapair.com/blog/airfare-fluctuations-can-a-flight-price-really-change-135-times/>

Search engine data

- Example: most popular search terms for a category
- Used to predict the current level of economic activity for automobile, real estate, retail trade, travel, and unemployment indicators

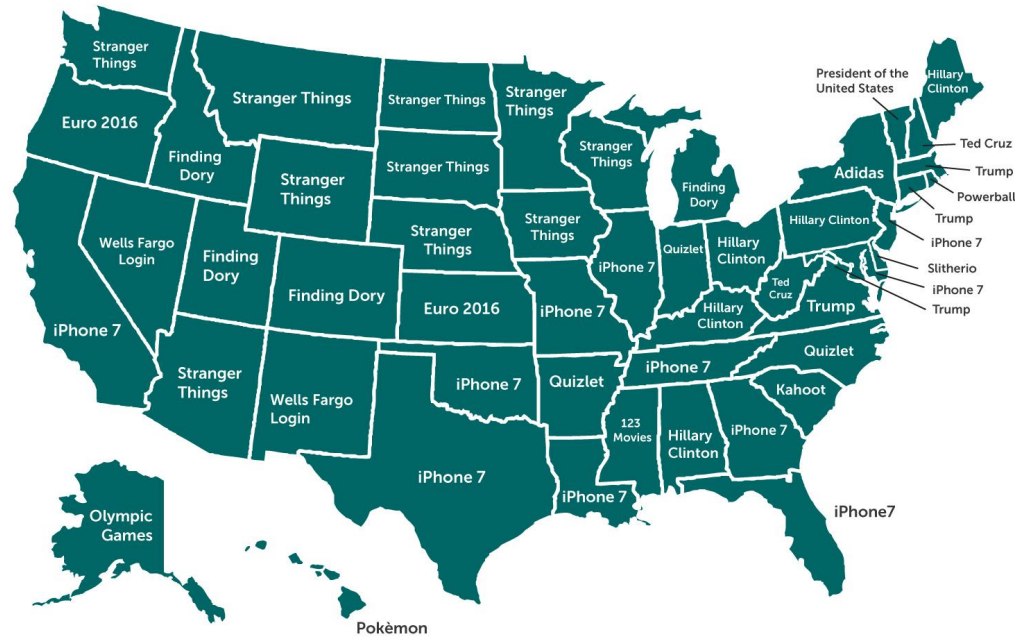


Most Googled car brand worldwide in 2018



<https://www.gtplanet.net/toyota-tops-the-list-of-2018s-most-googled-automotive-brands/>

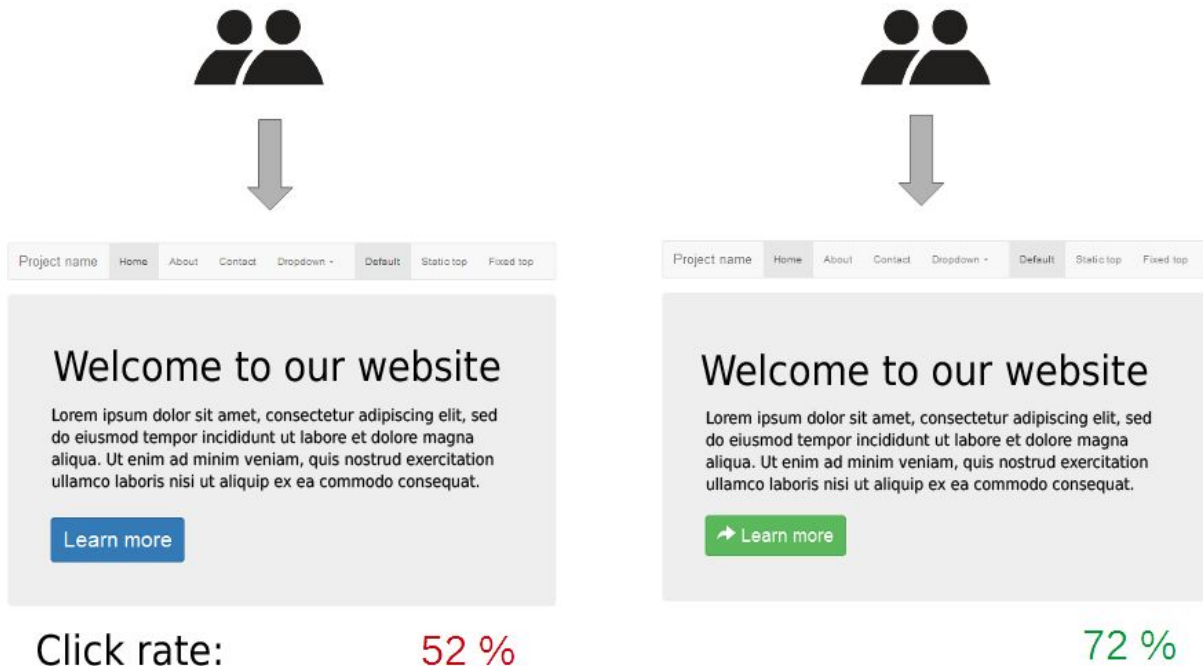
Most Googled terms of 2016 by State



<https://www.highspeedinternet.com/resources/most-googled-terms-2016>

Enable [Cheap] Experimentation

Either through direct testing (figure below) or user simulations



Enable [Cheap] Experimentation

- Implications:
 - (From paper) Decisions made by data instead of opinions of people w/ authority
 - (From us) Relates to optimization of choice architecture and policies¹
- Question: what are some issues or concerns with doing experiments on people?



¹R. H. Thaler, C. R. Sunstein, and J. P. Balz. Choice architecture. In E. Shafir, editor, The Behavioral Foundations of Public Policy, chapter 25. Princeton University Press, 2014.

Enable [Cheap] Experimentation

- Implications:
 - (From paper) Decisions made by data instead of opinions of people w/ authority
 - (From us) Relates to optimization of choice architecture and policies¹
- Question: what are some issues or concerns with doing experiments on people?
- Our critique:
 - Idea in general is good, but have to be careful
 - Informed consent issues
 - Possible to do experiments badly



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Customization and Personalization

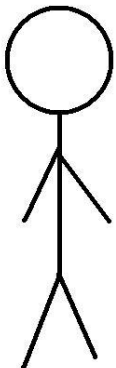
Trends for you 

Politics · Trending 

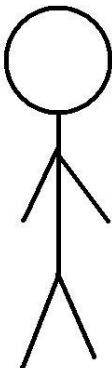
Biden's VP
7,347 Tweets

#WWTBAMillionaire
Who Wants To Be A Millionaire Premieres
Tonight 10|9c on ABC
 Promoted by Millionaire TV

Your price:
\$20









Your price:
\$15



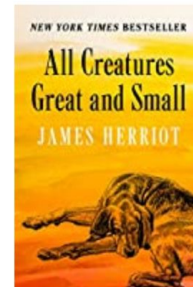
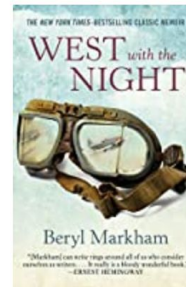
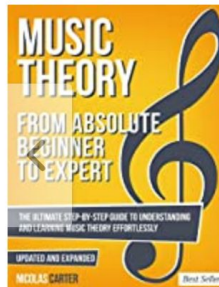
Why You're Seeing This Ad

 Only you can see this 

You're seeing this ad because your information matches **DoorDash's** advertising requests. There could also be more factors not listed here. [Learn More](#)

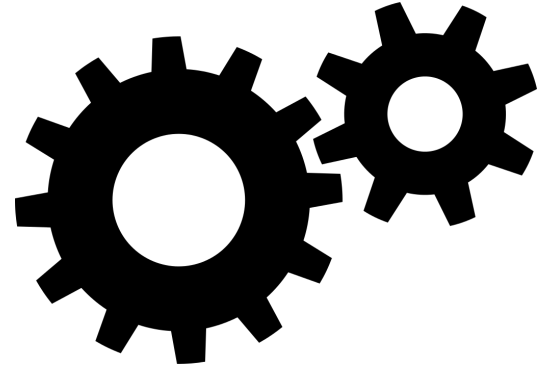
-  DoorDash indicated you may have visited www.doordash.com. 
-  DoorDash is trying to reach people, ages 18 and older. 
-  DoorDash is trying to reach people whose primary location is the United States. 

Recommended for you in Prime Reading



Critique of Customization and Personalization

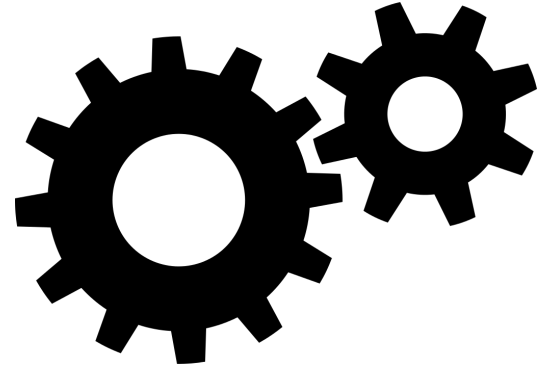
- Connection: choice architecture -- structure large number of options¹
- Question: **what are the pitfalls?**



¹R. H. Thaler, C. R. Sunstein, and J. P. Balz. Choice architecture. In E. Shafir, editor, *The Behavioral Foundations of Public Policy*, chapter 25. Princeton University Press, 2014.

Critique of Customization and Personalization

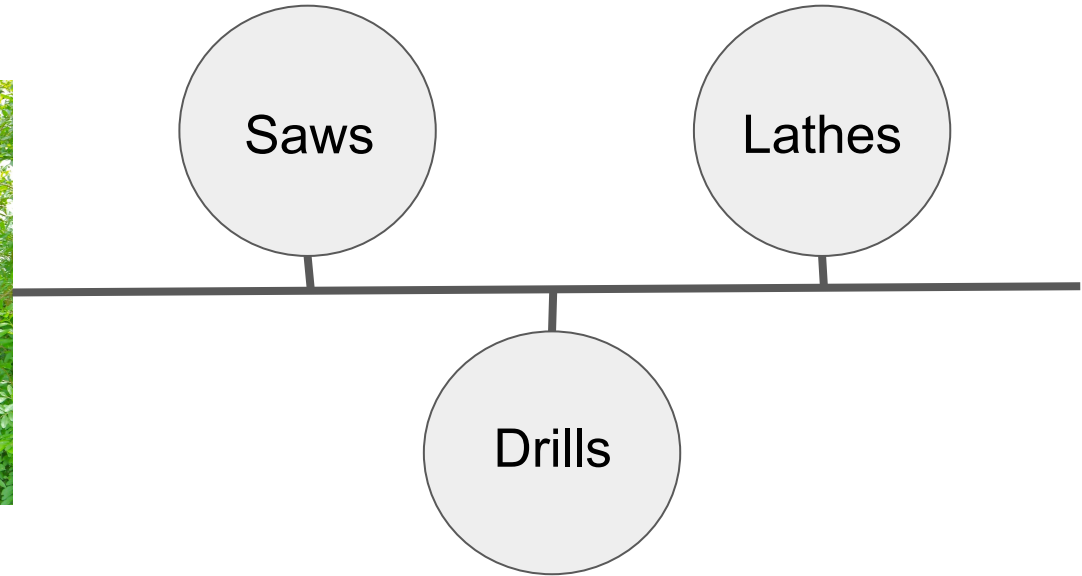
- Connection: choice architecture -- structure large number of options¹
- Question: **what are the pitfalls?**
 - Privacy issues
 - Echo chambers
 - People don't always know how to customize



¹R. H. Thaler, C. R. Sunstein, and J. P. Balz. Choice architecture. In E. Shafir, editor, *The Behavioral Foundations of Public Policy*, chapter 25. Princeton University Press, 2014.

Transactions Among Workers (i.e. Collaboration)

The early factory:



Transactions Among Workers

Analogy for documents:



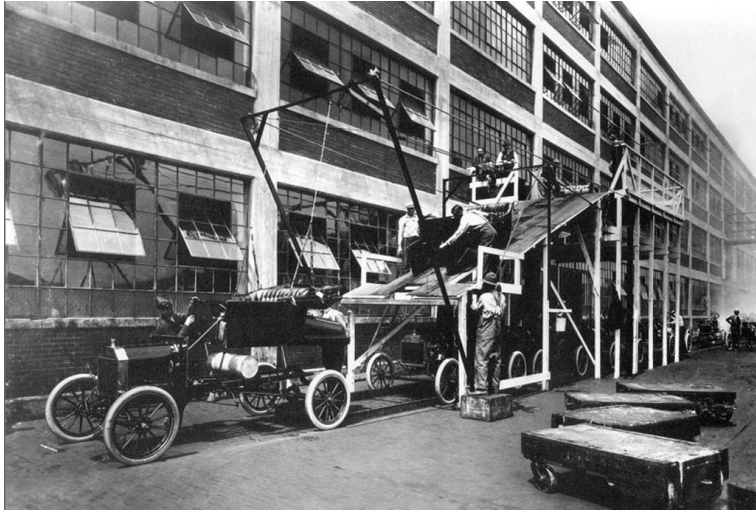
Main
author

Comment
givers

Typists

Transactions Among Workers

Innovation: bring current assembly to the workers!



Innovation: bring the data/document to the worker!



(and multiauthoring
and version control)

Micro-Multinomials (i.e. Collaboration Part 2)

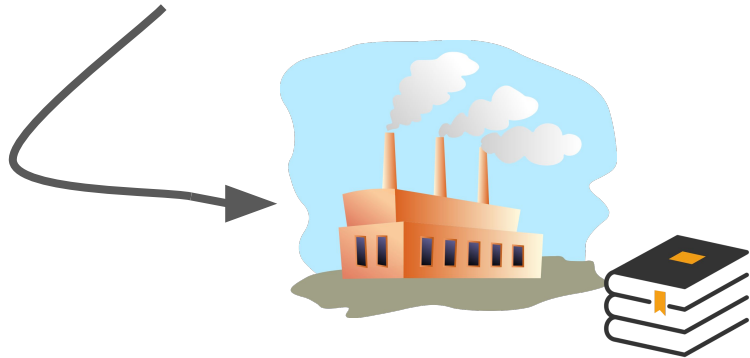
- “Nowadays, a ten- or 12-person company can have communications capabilities that only the largest multinationals could afford 15 years ago.”
- Enables:
 - Crowdsourcing
 - 24-hour work cycle
 - This class!



Deployment of Applications

New businesses very easy to deploy: outsourcing, standardized services and economies of scale

Penguin
Random
House



My New
Company



Conclusion

- Computers have enabled a revolution of innovation
 - New mechanisms from contract verification
 - Optimize choice architecture from experimentation and personalization
 - Communication → knowledge work productivity++
- General critiques:
 - Ideas are supported, true predictions
 - Skill at using analogies
 - Does not discuss drawbacks enough