CS 182: Ethics, Public Policy, and Technological Change

Rob Reich
Mehran Sahami
Jeremy Weinstein
Alena Smith (Co-Head TA)
Ece Korkmaz (Co-Head TA)
Pop Quiz Time!

bit.ly/cs182quiz
Political Economy: Optimization and History

1. Quiz
2. The Silicon Valley Story: VC + entrepreneurship = disruptive innovation
3. The Public Origins of the Internet
4. The Privatization of the Internet
5. The Commercialization of the Internet
6. Value Trade-offs
The water we swim in?
The Conventional Story of Silicon Valley?

- Cold War: space race + military defense (geopolitics)
- Stanford University (talent)
- Venture Capital (funding)
- Heroic entrepreneurs (founders)
- Network effects
- Disruptive innovation
- The Digital Revolution
- "Largest legal wealth creation in all of human history."
Study shows Stanford alumni create nearly $3 trillion in economic impact each year

A study by two Stanford professors determines that companies founded by the university’s alumni generate trillions in annual revenue and have created 5.4 million jobs.

BY JAMIE BECKETT

Stanford University has long been known as one of the world’s leading centers for innovation and a breeding ground for the entrepreneurs who created – and continue to shape – Silicon Valley. Now, for the first time, a study puts into perspective the sheer scale of the university’s economic impact, not just in Silicon Valley and California but across the globe.

The study, released today, estimates that companies formed by Stanford entrepreneurs generate world revenues of $2.7 trillion annually and have created 5.4 million jobs since the 1930s.

Students take part in an interactive innovation exercise during Stanford
Venture Capital Firms

The Power Law
Venture Capital and the Making of the New Future
Sebastian Mallaby

An American History
TOM NICHOLAS
Clayton Christensen
Harvard Business School Professor

Theory of Disruptive Innovation

Disruptive Innovation

Disruptive innovation, a term of art coined by Clayton Christensen, product or service takes root initially in simple applications at the bottom end of the market, eventually displacing established competitors.
Reagan and Distrust of the Government

“The nine most terrifying words in the English language are:

I’m from the government, and I’m here to help.”

1986
Milton Friedman (1912-2006)

Nobel Prize Winning Economist

The Social Responsibility of Business is to Increase Its Profits

VC-backed technology companies have created “the greatest legal creation of wealth this planet has ever seen.”

John Doerr
Political Economy: Optimization and History

1. Quiz
2. The Silicon Valley Story: VC + entrepreneurship = disruptive innovation
3. The Public Origins of the Internet
4. The Privatization of the Internet
5. The Commercialization of the Internet
6. Value Trade-offs
Margaret O’Mara’s history

THE CODE
SILICON VALLEY AND THE REMAKING OF AMERICA

MARGARET O’MARA

“...a fresh, provocative tale that upends the self-serving mythologizing of the valley’s own.”—San Francisco Chronicle

How the Department of Defense Bankrolled Silicon Valley

The New York Times
1. The internet has origins outside the market
Silicon Valley was initially funded by the government. The political economy has shifted. The internet has been privatized.

2. The current problems of the internet are due to its commercialization
“The Internet has broken because the Internet is a business. While the issues are various and complex, they are inextricable from the fact that the Internet is owned by private firms and is run for profit. Regulating markets or making them more competitive won’t touch the deeper problem, which is the market itself.” (NY Times op-ed)
“Most of the innovation on which Silicon Valley depends comes from government-funded research, for the simple reason that the public sector can afford to take risks that the private sector can’t. It’s precisely the insulation from market forces that enables the government to finance the long-term scientific labor that ends up producing many of the most profitable inventions. This is particularly true of the internet” (pp.6-7).
“The Entrepreneurial State” by Mariana Mazzucato

“While the products owe their beautiful design and slick integration to the genius of Jobs and his large team, nearly every state-of-the-art technology found in iPod, iPhone, and iPad, is an often overlooked and ignored achievement of the research efforts and funding support of the government and military.” (pp. 94-95)
Internet History Milestones

1969
ARPANET R&D Project

1974
Vinton Cerf and Robert Kahn Initiated TCP/IP

1983
DOD Mandated Adoption of TCP/IP

1983
ARPANET Split into ARPANET and MILNET

1985
NSFNET founded by The National Science Foundation

1991
World Wide Web Released by Tim-Berners Lee

1993
Web Browser “Mosaic” invented by Mark Andreessen

ARPANET

INTERNET
Traditional Three-Part Political Economy

1. For-profit corporations (funded by private investment)
2. Not-for-profit organizations (funded by ??)
3. Public agencies (funded by tax dollars)
A Short Digression on Stanford University

Sources of funding?
2022/23 CONSOLIDATED REVENUES: $8,153.5M

- Student Income: 14%
- University Sponsored Research: 16%
- SLAC Sponsored Research: 7%
- Health Care Services: 23%
- Gifts & Net Assets Released from Restrictions: 7%
- Endowment Income: 21%
- Other Investment Income: 5%
- Other Income: 7%

1 Net Revenues after Transfers: $7,958.8 Million

Source: Stanford University Budget Plan 2022/23
Storytime...

---

Thrun starts web-based university

By Matt Bottenville  
Feb. 9, 2012, 2:07 a.m.

Computer science professor Sebastian Thrun announced the launch last month of his new online university, Udacity, inspired by the massive response to his Stanford course, Introduction to Artificial Intelligence, which was open to the public online this past fall. Contrary to widespread reports otherwise, Thrun will maintain his position as a research professor in the Stanford Computer Science Department.

Thrun decided to offer “Intro to A.I.” online last quarter as an experiment, expecting a turnout of around 500. When more than 160,000 people enrolled in the course, Thrun adapted the course content to the web format using an interactive platform called Know Labs. In a speech last month at the Digital Life Design (DLD) Conference in Munich, Thrun described the experience as life changing, saying that after teaching on such a large and far-reaching scale, he couldn’t return to Stanford classes.
Our mission is to provide a free, world-class education for anyone, anywhere.

A personalized learning resource for all ages

Khan Academy offers practice exercises, instructional videos, and a personalized learning dashboard that empower learners to study at their own pace in and outside of the classroom. We tackle math, science, computing, history, art history, economics, and more, including K-14 and test preparation (SAT, Praxis, LSAT) content. We focus on skill mastery to help learners establish strong foundations, so there's no limit to what they can learn next!
About

We share a commitment to free knowledge and work together with our community.

The Wikimedia Foundation is the nonprofit that hosts Wikipedia and our other free knowledge projects. We want to make it easier for everyone to share what they know. To do this, we keep Wikipedia and Wikimedia sites fast, reliable, and available to all. We protect the values and policies that allow free knowledge to thrive. We build new features and tools to make it easy to read, edit, and share from the Wikimedia sites. Above all, we support the communities of volunteers around the world who edit, improve, and add knowledge across Wikimedia projects.
Developing open source privacy technology that protects free expression and enables secure global communication.
Who we are

The Mozilla Foundation works to ensure the internet remains a public resource that is open and accessible to us all.

In the early 2000s, the Mozilla community built Firefox. We toppled the browser monopoly, gave users choice and control online, and helped create a healthier internet.

Twenty years later, Mozilla continues to fight for a healthy internet — one where Big Tech is held accountable and individual users have real agency online.

Mozilla’s work is guided by the Mozilla Manifesto. Founded as a community open source project in 1998, Mozilla currently consists of two organizations: the 501(c)3 Mozilla Foundation, which leads our movement building work; and its wholly owned subsidiary, the Mozilla Corporation, which leads our market-based work. The two organizations work
1. The internet has origins outside the market
Silicon Valley was initially funded by the government. The political economy has shifted. The internet has been privatized.

2. The current problems of the internet are due to its commercialization
“The Internet has broken because the Internet is a business. While the issues are various and complex, they are inextricable from the fact that the Internet is owned by private firms and is run for profit. Regulating markets or making them more competitive won’t touch the deeper problem, which is the market itself.” (NY Times op-ed)
Political Economy: Optimization and History

1. Quiz
2. The Silicon Valley Story: VC + entrepreneurship = disruptive innovation
3. The Public Origins of the Internet
4. **The Privatization of the Internet**
5. The Commercialization of the Internet
6. Value Trade-offs
True or False: Al Gore invented the internet?
December 21, 1993: A Soothsayer?

“We will transmit more and more information over the same lines of communication.”

“Each person will turn from being just a consumer to being a consumer and a provider.”

“It will mean holding a business meeting without leaving your living room.”

“It will mean using the television not simply as passive entertainment but as an active tool.”

Al Gore, Speech to National Press Club


Image: Wikimedia, CC BY 2.0
The Father of the Internet (Vint Cerf) Says…

Al Gore was “the first elected official to grasp the potential of computer communication to have a broader impact than just improving the conduct of science and scholarship.”

His leadership began with the High-Performance Computing and Communications Act of 1991, which helped to expand NSFNET.

Image: Wikimedia Commons
Al Gore had more than vision:

“A system built by scientists was renovated for the purpose of profit maximization. This took hardware, software, legislation, and entrepreneurship. It took decades. And it touched all of the internet’s many pieces.” (p. xiii)
The Transformation in Two Steps

1. The internet began to allow for commercial traffic and its core assets were privatized
2. The government intentionally crafted a “regulatory oasis” around information services
1980’s NSF does not allow for commercial activity

NSFNET BACKBONE ACCEPTABLE USE POLICY

UNACCEPTABLE USES:

(10) Use for for-profit activities (consulting for pay, sales or administration of campus stores, sale of tickets to sports events, and so on), or use by for-profit institutions unless covered by the General Principle or as a specifically acceptable use.

(11) Extensive use for private or personal business.

This statement applies to use of the NSFNET Backbone only. NSF expects that connecting networks will formulate their own use policies. The NSF Division of networking and Communications Research and Infrastructure will resolve any questions about this Policy or its interpretation.
NSFNET Packet Traffic History

June, 1994–60.6 billion packets

July ‘88 - NSFNET begins operation under Merit’s Management
NSF Director, Stephen Wolff began to pursue privatization.

- Selling commercial access
- Allow commercial providers to run the backbone
- Shut down NSFNET
“The debate has been framed so far by a handful of communications giants who have been working overtime to convince the American people that the data highway will be little more than a virtual electronic shopping mall.”

- Jeffrey Chester, The New York Times, 1993

“Akin to giving a federal park to Kmart”

- William Schrader, U.S. Congressional Hearings, 1992
The Transformation in Two Steps

1. The internet began to allow for commercial traffic and its core assets were privatized
2. The government intentionally crafted a “regulatory oasis” around information services
December 21, 1993:

“We can eliminate many of the regulatory barriers now in the path of the information superhighway and perform the most major surgery on the Communications Act since it was enacted in 1934.”

Al Gore, Speech to National Press Club


Image: Wikimedia, CC BY 2.0
Five Principles

1. Encourage private investment
2. Promote and protect competition
3. Provide open access to the network
4. Avoid creating a society of information “haves” and “have nots.”
5. Encourage flexibility
December 21, 1993:

Democratic National Committee receives $90,000 in contributions from four telecoms companies.

Image: Flickr, CC BY 2.0
Telecommunications Act of 1996

Created a distinction between providers of “telecommunications services” and “information services.” The latter were not subject to common carrier regulations.

Effectively deregulated the internet.
The idea of “common carrier”

“If a business is open to the general public, then it must serve everyone the same way. It must remain neutral, in other words, and not discriminate against certain users or uses of its services.” (Tarnoff, p. 26)
Two Different Policy Regimes

Information services

private data networks linking computers, faxes; dial-up networks (then cable/broadband)

no common carrier

companies could deploy investments as they saw fit

no requirements to share their networks

Telecommunications services

the “telephone” system

common carrier requirements

state-supervised rates, terms and conditions

forced local phone companies to make their networks accessible to competitors
A Public Lane on the Information Highway?

Senator Daniel K. Inouye, 1994

Proposed legislation that would have made telecom companies reserve up to 20 percent of their capacity for “public uses” - free access for non-profits, libraries, civic institutions.

Precedent: US Postal Service, NSF

Did not pass

Image: Flickr, CC BY-NC-ND 2.0

Clinton administration formally commits the federal government to a market-dominated internet

No public lane in the information highway!

Image: Wikimedia Commons, CC BY SA 2.0
“I want to create an oasis from regulation in the broadband world, so that any company, using any technology, will have incentives to deploy broadband in an unregulated or significantly deregulated environment.”

-- William Kennard, FCC Chairman, 1999
How much of the Internet Consists of Porn?
Percentage of websites and web searches containing adult content*

- Websites: 4% Porn, 96% Other
- Web Searches: 13% Porn, 87% Other
- Mobile Searches: 20% Porn, 80% Other

Percentage of U.S. adults 18–35 who watch porn at least weekly**

- Men: 87.0%
- Women: 28.5%

* Data from 2005–2010, latest available
** Data from 2014
Sources: A Billion Wicked Thoughts study, Columbia University, Cosmopolitan study
Communications Decency Act of 1996

Criminalized the transmission of “obscene or indecent” content to people under the age of 18.

It’s been challenged repeatedly in the courts and the constraints narrowed by subsequent legislation.
But somewhere hidden in that legislation was this…

No provider or user of an interactive computer service shall be treated as the publisher or speaker of any information provided by another information content provider.
Political Economy: Optimization and History

1. Quiz
2. The Silicon Valley Story: VC + entrepreneurship = disruptive innovation
3. The Public Origins of the Internet
4. The Privatization of the Internet
5. The Commercialization of the Internet
6. Value Trade-offs
True or False:

Without advertising, the internet wouldn’t be free.
Meanwhile, Back in the 1980s

Image source: Mehran Sahami, personal photograph
Wars Over Access to Content and Applications

- **1980's is the era of online "walled gardens"**
  - America Online (later AOL), CompuServe, and Prodigy provided dial-up service
  - Subscription-based model with access to proprietary games and services
  - Eventually, in 1990s, they provide their offerings on the World Wide Web

- **Desktop (Operating System) Wars**
  - Microsoft Windows and Apple MacOS (and IBM OS/2, but not really) battle for dominance of desktop market
  - System Development Kits (SDKs): set of libraries to develop on each platform
  - Operating System dominance = eco-system dominance
    - Developers want to create applications on most used OS
    - Consumers want to use OS with most applications
And the Winner is…

Global market share of personal computing platforms by operating system shipments

Image: "Why Steve Ballmer Failed" By Derek Thompson, The Atlantic, August 23, 2013 (Edited to only show data through 2005 and caption added for Apple)
Then There Was the Early 1990's

Now, Vice President of Machine Learning at Amazon

Still had not realized the tragedy of the mullet

Image source: CS198 archives, via Mehran Sahami
Invention of the Web Browser

- Tim Berners-Lee invents the World Wide Web in 1990 at CERN
  - Originally intended as way to easily share scientific data
- Released to public in 1991
  - In 1993, CERN makes web protocols and code available royalty free
- Also in 1993, MOSAIC browser released
  - Marc Andreesen is one of the main authors
Sir Tim Berners-Lee Receives 2016 ACM Turing Award

- Turing Award considered the "Nobel Prize" of computer science
  - "For inventing the World Wide Web, the first web browser, and the fundamental protocols and algorithms allowing the Web to scale."
Radia Perlman
"Mother of the Internet"
Inventor of the spanning tree protocol

Elizabeth “Jake” Feinler
Major contributor to creation of ARPANET
Her group created the “.com” domain
Then in the Late 1990's
Story time: Google
(...before it was Google)
STANFORD COMPUTER FORUM

TWENTY-NINTH ANNUAL MEETING

MARCH 19-20, 1997

Department of Computer Science
Professor Jean-Claude Latombe, Chairman
Thursday, March 20, 1997

1:30-3:00  Parallel Session III-A: Information Retrieval
Professor Rajeev Motwani, Chair
H-P Auditorium

1:30  Information Retrieval and the Web
Larry Page
Professor Terry Winograd, Advisor

2:00  Creating Personalized Yahoo!'s: Automated Hierarchical Clustering and Classification of Documents
Mehran Sahami
Professor Daphne Koller, Advisor

2:30  SenseMaker: An Information-Exploration Interface
Michelle Baldonado
Professor Terry Winograd, Advisor

3:00-3:15  Break
Thursday, March 20, 1997

10:30-12:00  Parallel Session II-A: Data Mining
            Professor Nils Nilsson, Chair
            NEC Auditorium

10:40       Adaptive Web Page Recommendation
            Marko Balabanovic  Professor Yoav Shoham, Advisor

11:05       Problems in Data Mining
            Sergey Brin  Professor Hector Garcia-Molina, Advisor

11:30       Association Rules
            Craig Silverstein  Professor Rajeev Motwani, Advisor

12:00-1:30  Lunch
            Gates Building, Room 104
Wednesday, March 19, 1997

8:30-9:00  Registration and Continental Breakfast
           Gates Building, Basement Lobby

9:00-10:30 Opening Session
           Gates Building, H-P Auditorium

Welcoming Remarks
Carolyn Tajnai, Director, Computer Forum
Professor Yoav Shoham, Annual Meeting Program Chair

Department Greetings
Professor Jean-Claude Latombe, Chairman, Computer Science Department
William F. Miller, Computer Forum Faculty Chair

9:30  Keynote Address
      Dr. Eric Schmidt, CTO, CEO, Sun Microsystems
      Evolution or Revolution? The Future of Network Computing

10:30-11:00  Break
http://google.stanford.edu

Image courtesy of Google
google.stanford.edu (circa 1997)

Now on display in the Huang Center basement

Image courtesy of Google
March 2000: Dot-com Bubble Bursts

On 10 March 2000, the NASDAQ Composite peaked at 4132.52. The burst of the dot-com bubble was imminent and the NASDAQ would crash so spectacularly that it would never fully recover from the burst. Even today, it still sits at about 54 percent below that level.

Here we take a look at some of the biggest financial losses of the burst.

- Go.com: $790m
- Kozmo.com: $280m
- Pets.com: $300m
- E-toys.com: $247m
- Inovis: $60m
- GnuWorks: $50m
- Pet's.com: $365m
- Wervan: $800m
- Flooz: $50m

$1.65 trillion
The combined value of the 6 biggest tech-companies in 1999, that was 20% of the US's GDP.

50%
Estimated percentage of dot-coms that survived the burst.

$5 trillion
In market value of technology companies was wiped out between 2000 and 2002.


Image: Flickr, CC BY 2.0
Meanwhile, Back at the Ranch, Who Said This?

"We expect that advertising funded search engines will be inherently biased towards the advertisers and away from the needs of the consumers.

…..we believe the issue of advertising causes enough mixed incentives that it is crucial to have a competitive search engine that is transparent and in the academic realm."

The Anatomy of a Large-Scale Hypertextual Web Search Engine

Sergey Brin and Lawrence Page

Computer Science Department, Stanford University, Stanford, CA 94305, USA
sergey@cs.stanford.edu and page@cs.stanford.edu
The Internet's Original Sin

It's not too late to ditch the ad-based business model and build a better web.

By Ethan Zuckerman

Rise of Online Advertising

- Display (banner) ads existed online since early 1990s (walled gardens)

- Google's original business model was selling search (not ads)
  - Wanted to sell "search appliances" to corporations to search their intranets
  - Google search engine was showcase for search efficacy
  - Starting in 2000, Google had a deal to power search for Yahoo!

- Search ads were pioneered by GoTo.com (later, renamed Overture)
  - Created first advertising keywork auction in 1998
  - Yahoo acquires Overture in 2003
  - Yahoo/Overture sues Google for running ad keyword auctions
  - In 2004, Google licenses tech from Yahoo for 2.7M shares of stock (~$300M at IPO)
    - Yahoo was a big winner from the Google IPO. So was Stanford.
Google will generate more than $40M in revenue during the course of today’s lecture.
What Happened?

- Advertisers saw affordances in online advertising
- Compare to online to TV/radio/print advertising

Online, you can:
- Know the number of impressions
- Only pay for particular interactions: pay-per-click or pay-per-view
- Use second-price auction model to get preferential price for ad placement
- Can target to customer interests!
  - The fact that someone is searching, often means they have immediate interest
  - E.g., "data recovery", "mesothelioma lawsuit", etc.

What's good for search engines and advertisers, may not be good for you
‘Privacy concerns harming online advertising’

An overwhelming majority of consumers are less likely to click on online ads because of privacy concerns, according to a report.

You’re Still Being Tracked on the Internet, Just in a Different Way

Apple and Google are pushing privacy changes, but a shift in digital tracking is giving some platforms a bigger advertising advantage.
Everything Old is New Again

- But, it's not just advertising powering the online world
- The platform wars have returned
- But, please rest assured that the mullet will not return
The Rise of the Internet Platforms

- Facebook (now Meta) as a platform for apps
  - Facebook founded in 2004
  - Platform launched in 2007 for third-party app developers
  - Apps can get access to data in Facebook
    - Anyone remember Farmville? Or, Cambridge Analytica lately?

- Amazon as a platform for sales
  - Founded in 1994 as a marketplace for books
  - Now called "The Everything Store"
  - Also, created marketplace for third-parties to sell on platform
  - Amazon becoming a bigger player in advertising

- Does any of this sound familiar?
The Battle for Advertising Revenue

The Rundown: Google, Meta and Amazon are on track to absorb more than 50% of all ad money in 2022

Image from article "The Rundown: Google, Meta and Amazon are on track to absorb more than 50% of all ad money in 2022" By Seb Joseph and Ronan Shields, Digiday, February 4, 2022, https://digiday.com/marketing/the-rundown-google-meta-and-amazon-are-on-track-to-absorb-more-than-50-of-all-ad-money-in-2022/
Mozilla and Google have extended their current search deal for another three years, multiple sources have told ZDNet.

The new search deal will ensure Google remains the default search engine provider inside the Firefox browser until 2023 at an estimated price tag of around $400 million to $450 million per year.
Let's Not Forget the Rise of Mobile

- **Apple iPhone launches in 2007**
  - In 2008, iOS SDK to develop apps for platform
  - Apple App Store opens in 2008 with ~500 apps. Now, roughly 2M apps
  - Apple gets 30% of sales through App Store

- **Google Android launches in 2008**
  - Google buys Android in 2005 for $50M
  - Created Android Market (now called Google Play) to sell apps on platform
  - Currently, more than 3M apps
  - Google gets 15% or 30% of sales through Google Play (depending on volume)

- **Platforms control interaction of customer, provider, and advertisers**
  - On a related note: anyone wonder why Google built Chrome web browser?
Let's Revisit the Platform Wars

Global market share of personal computing platforms by operating system shipments

Image: "Why Steve Ballmer Failed" By Derek Thompson, The Atlantic, August 23, 2013
Let's Revisit the Platform Wars

Global market share of personal computing platforms by operating system shipments

Image: "Why Steve Ballmer Failed" By Derek Thompson, The Atlantic, August 23, 2013
"Apple’s privacy features are starting to take effect and unsurprisingly, Facebook has been significantly impacted. A few months back, analysts predicted that Apple’s App Tracking Transparency feature—which limits iPhone user tracking—would cost Facebook $12 billion."

The irony is not lost.
Political Economy: Optimization and History

1. Quiz
2. The Silicon Valley Story: VC + entrepreneurship = disruptive innovation
3. The Public Origins of the Internet
4. The Privatization of the Internet
5. The Commercialization of the Internet
6. Value Trade-offs
Let’s return to our three quiz questions.

1. Without the profit motive in the marketplace, there would be no iPhone.
2. Al Gore invented the internet.
3. Without ads, the internet wouldn’t be free.