



# Bias, Variance and Data Products

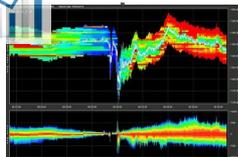
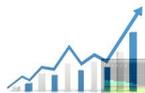
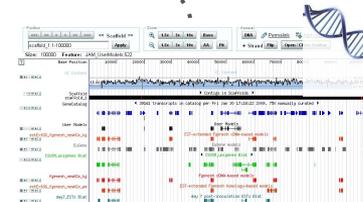
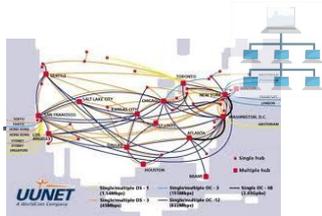
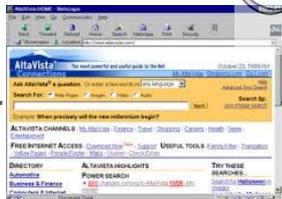
# frame.ai is...

improving business  
conversations

between humans.

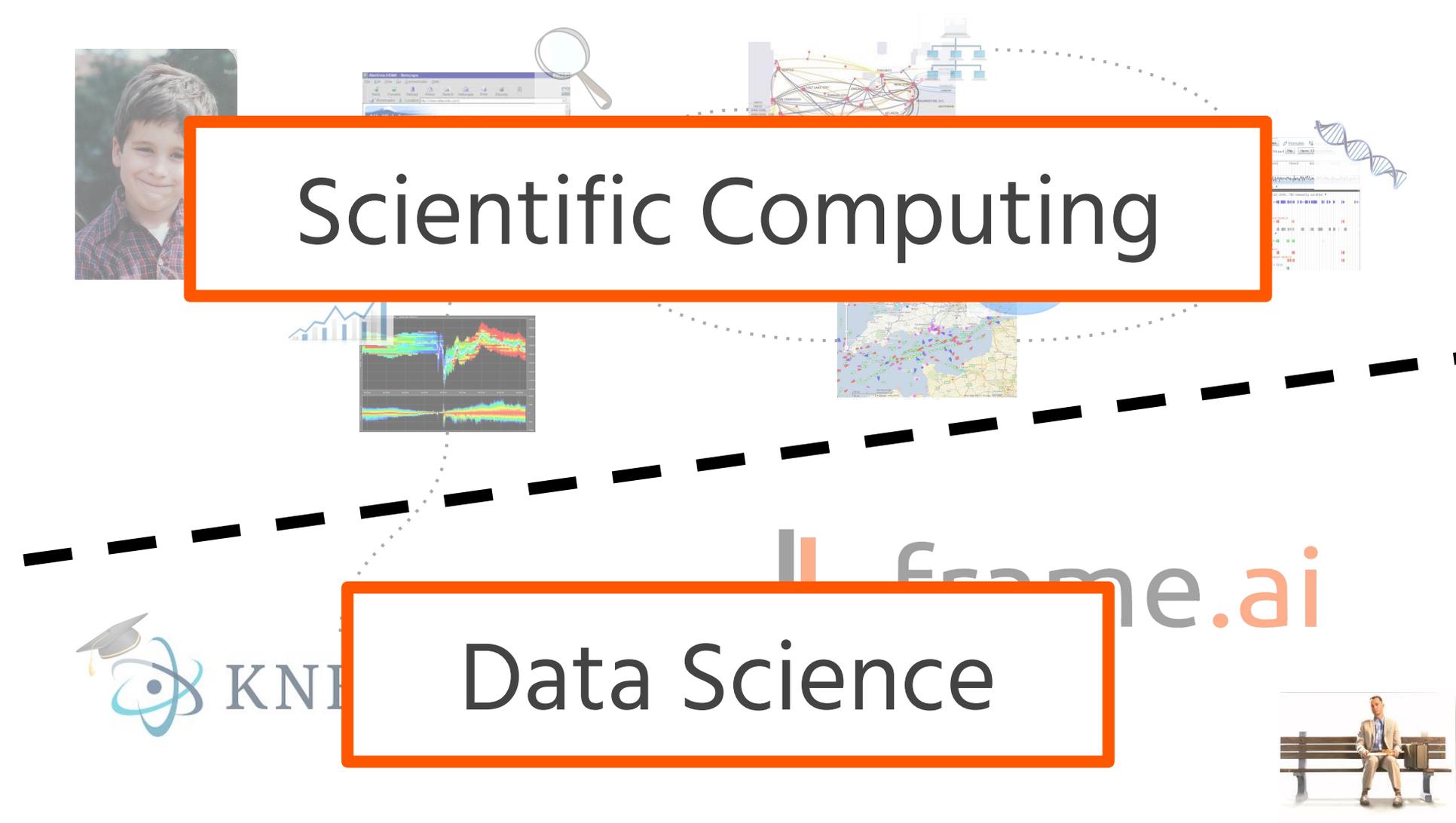
informed by data.

as a nutritious *part* of a  
customer relationship.



KNEWTON

frame.ai



# Scientific Computing



KNIP

# Data Science



## One of Google's self-driving cars is partly to blame for a fender bender in California



# Trending Bad

How Facebook's foray into automated recommendations went from messy to disastrous.

amazon.com

**FAIL**

Recommended for You



[Saw: The Final Chapter](#)  
Our Price: \$3.99

[See all buying options](#)

Rate this item



- I own it
- Not interested

Because you purchased...



[Polar Express](#) (Video On Demand)



- This was a gift
- Don't use for recommendations

[Help](#) | [Close window](#)



**Traditional  
Products**

One User  
Experience  
For Everyone

Convention

Many User  
Experiences

Configuration

**Traditional  
Products**

**Data  
Products**

One User  
Experience  
For Everyone

Convention

Optimization

Many User  
Experiences

Configuration

Adaptivity

P(experience | ...)

**Data  
Scientist**

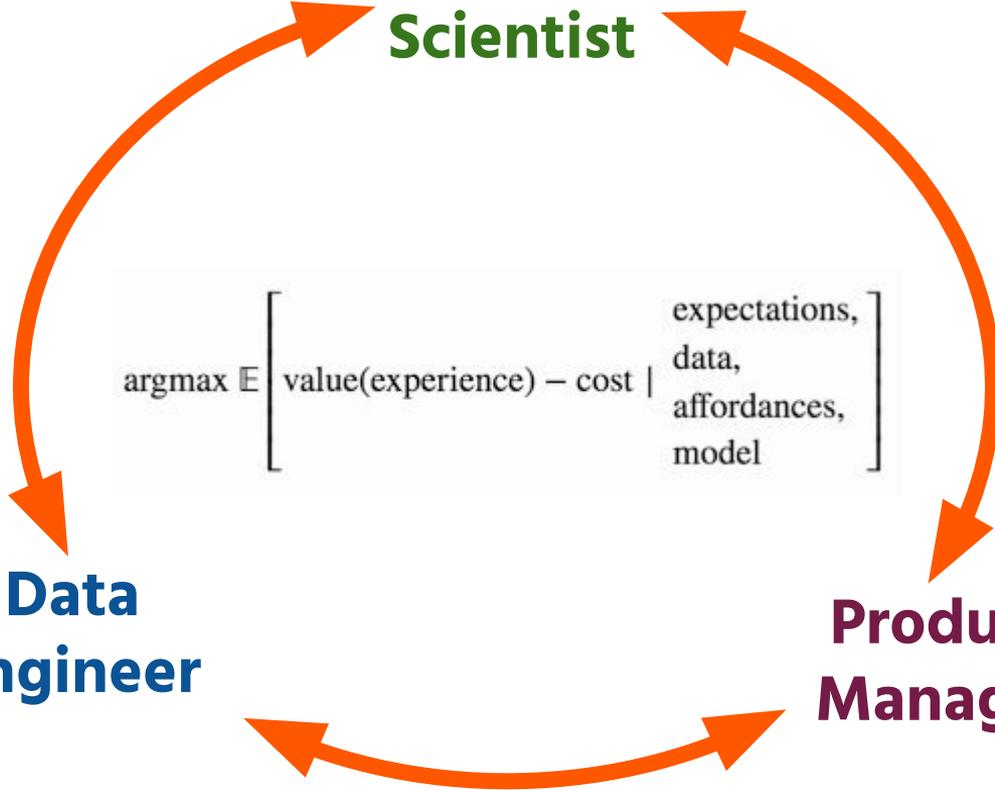
$$\operatorname{argmax} \mathbb{E} \left[ \text{value}(\text{experience}) - \text{cost} \mid \begin{array}{l} \text{expectations,} \\ \text{data,} \\ \text{affordances,} \\ \text{model} \end{array} \right]$$

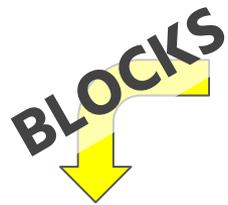
**Data  
Engineer**

cost(...)

**Product  
Manager**

value(...)



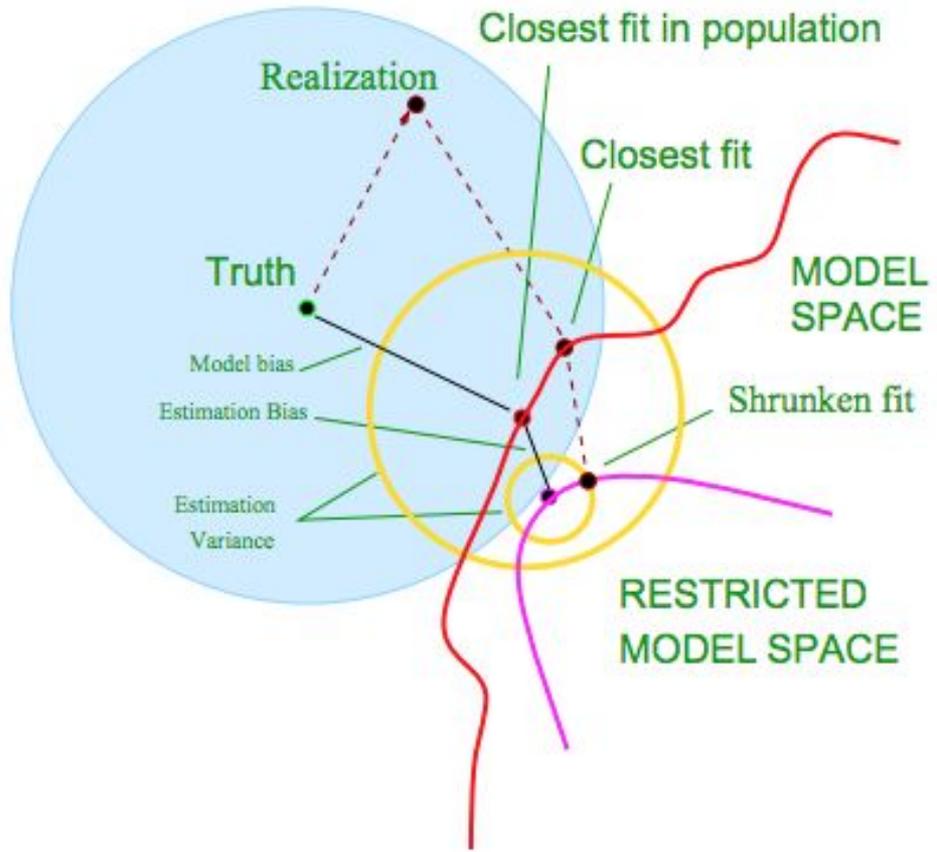


	Data Scientist	Data Engineer	Product Manager
Data Scientist	Awaits perfection; won't step past role.	Data inaccessible or not operationalized	Unclear value prop.
Data Engineer	Intractable model or data requirements.	Awaits perfection; won't step past role.	Unclear product arc.
Product Manager	Unexpected user experiences.	System too expensive or unperformant.	Awaits perfection; won't step past role.

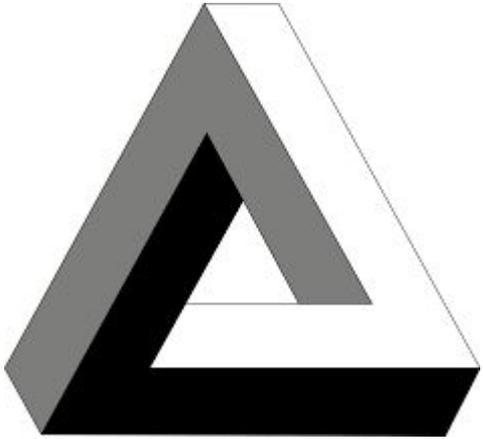
# How do we make this less fragile?

-  ?
- sit together
- **communicate tradeoffs,  
not evaluations**

Bias / Variance



# Assumptions (non-adaptivity)



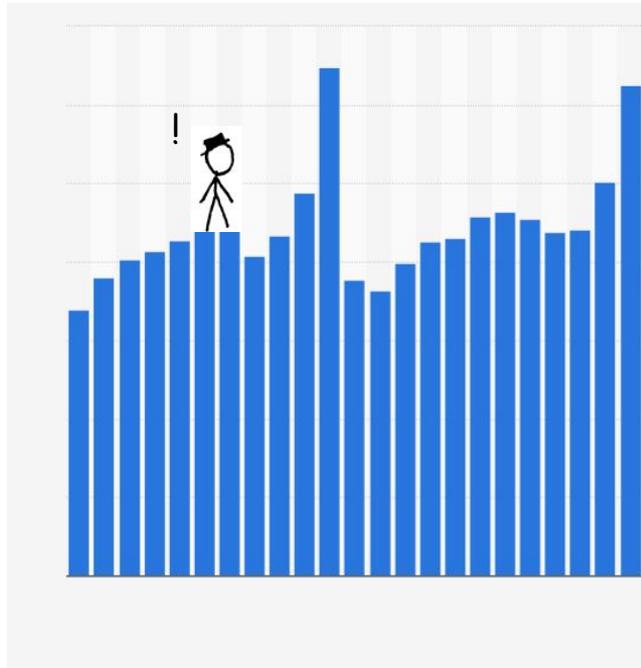
**Tolerance**

**Data**

Model value is the  
*product* of:

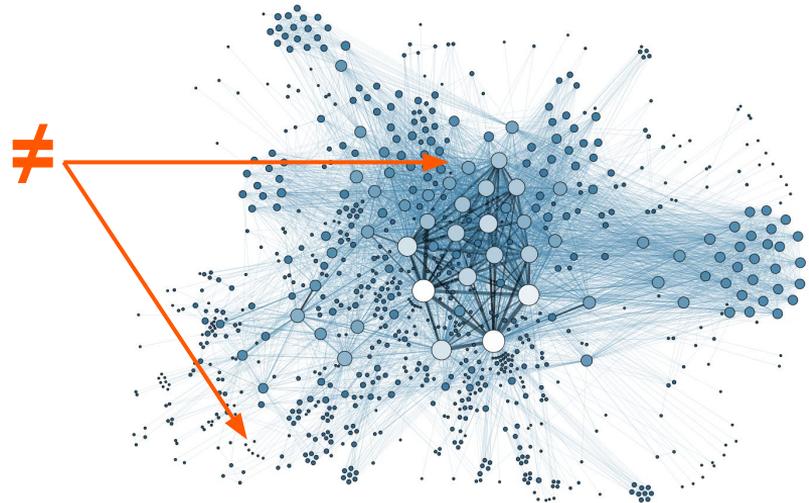
- Plentiful Data
- (Good) Assumptions
- Tolerance for Error

# Sneaky Data Sparsity

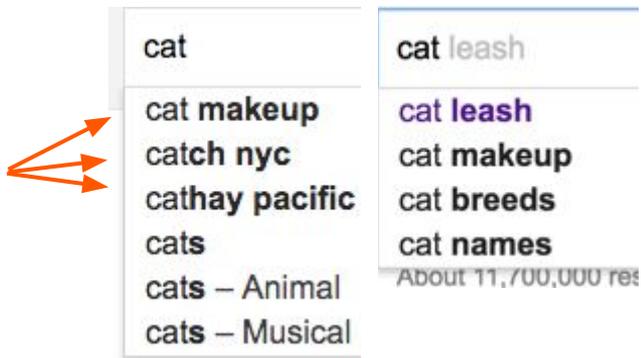


PetSafe Come With Me Kitty Harness and Bungee Leash, ...  
★★★★☆ ▾ 1,984

Yueton® Dog Pet Puppy Cat Kitty Adjustable Nylon Leash...  
★★★★☆ ▾ 32



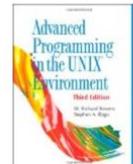
# Failover to high-bias model



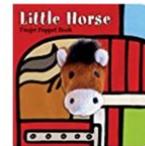
## Recommended for you



Meal Time (Sign About)  
› Anthony Lewis  
Board book  
★★★★☆ (44)  
\$3.27 ✓Prime



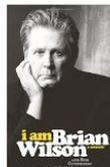
Advanced Programming in the UNIX...  
› Stephen A. Rago, W. Richard Stevens  
Paperback  
★★★★☆ (28)  
Paperback: \$51.90  
Kindle Edition: \$37.79



Little Horse: Finger Puppet Book  
› Klaartje van der Put  
Board book  
★★★★☆ (78)  
\$6.00 ✓Prime

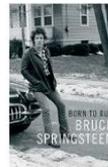
## Related to items you've viewed

### You viewed



I Am Brian Wilson: A Memoir  
› Brian Wilson  
Hardcover  
★★★★☆ (27)  
Hardcover: \$16.27  
Kindle Edition: \$13.99

### Customers who viewed this also viewed



Born to Run  
› Bruce Springsteen  
Hardcover  
★★★★☆ (442)  
Hardcover: \$19.50  
Kindle Edition: \$14.99



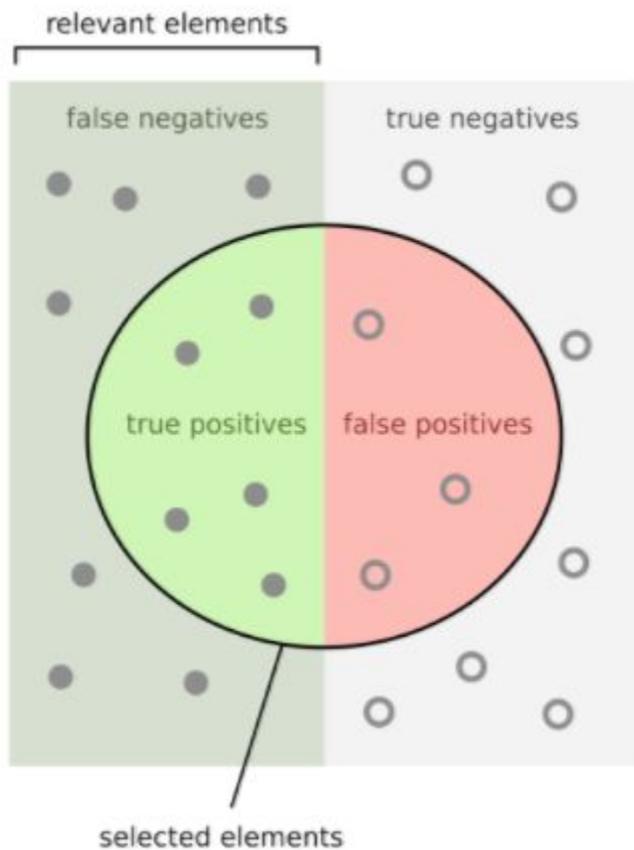
Not Dead Yet: The Memoir  
› Phil Collins  
Hardcover  
★★★★☆ (12)  
Hardcover: \$17.13  
Kindle Edition: \$14.99

# Accept (& Communicate) Variance

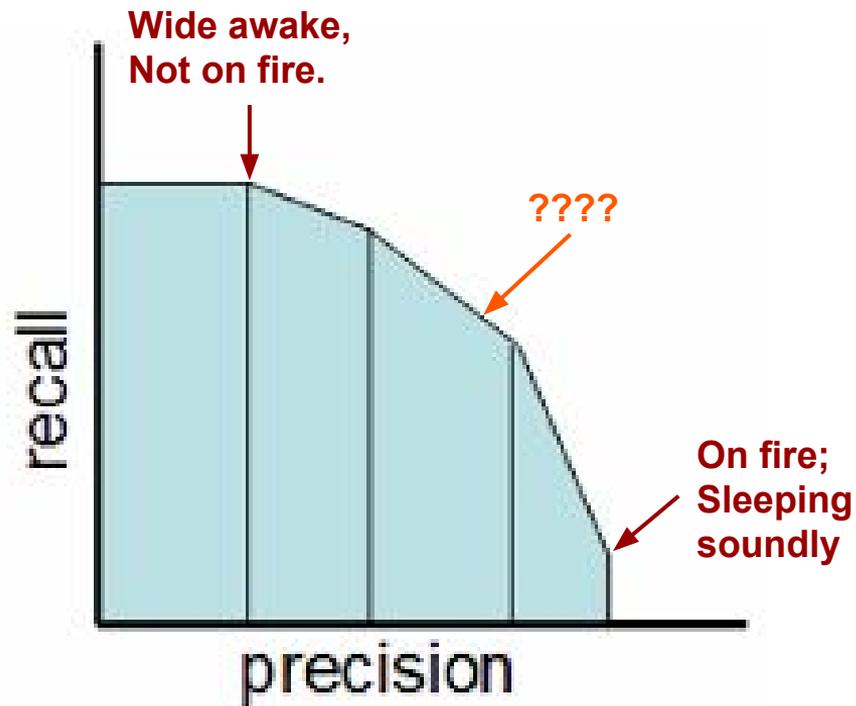


- Delivery by November 9-15. **Happy Dog Place**
  - Ships from NY, United States. ★★★★★ **99% positive** over the past
  - **Shipping rates** and **return policy**. 12 months. (51,094 total ratings)
- 
- Delivery by November 7-10. **Wag.com (Quidsi Retail, an Amazon company)**
  - Get it as soon as **Wednesday, November 2** **Local Expedited Delivery** at checkout. ★★★★★☆ **92% positive** over the past
  - **Shipping rates** and **return policy**. 12 months. (28,279 total ratings)

Precision / Recall



[https://en.wikipedia.org/wiki/Precision\\_and\\_recall](https://en.wikipedia.org/wiki/Precision_and_recall)



<http://aiweb.cs.washington.edu/ai/mln/auc.html>

Extremes are often most relevant.



**Recall!**



**Precision!**

Precision!

About 29,000,000 results (0.47 seconds)

Buy Pittsburgh Steelers Tix - Official NFL Ticket Exchange@

www.ticketexchangebyticketmaster.com/SteelersNFL/Tickets

The Best Tickets Are Always Available at Official NFL Ticket Exchange@

Nov 13 vs Cowboys

Dec 25 vs Ravens

Dec 04 vs Giants

Jan 01 vs Browns

### Pittsburgh Steelers

4-3, 1st in AFC North

#### Scores & Schedule

Sun, Oct 9	vs	Jets	W 13 - 31	Final	
Video Recap					
Sun, Oct 16	@	Dolphins	L 15 - 30	Final	
Video Recap					
Sun, Oct 23	vs	Patriots	L 27 - 16	Final	
Video Recap					

All times are in Eastern Time

Schedule and scores

#### In the news



Pittsburgh Steelers RT Marcus Gilbert to Cam Newton: 'Don't be out there if you're scared'

ESPN - 1 day ago

Pittsburgh Steelers right tackle Marcus Gilbert said he doesn't understand reigning MVP ...

Slew of Pittsburgh Steelers starters return to practice Monday

Behind the Steel Curtain - 14 hours ago

Why the Pittsburgh Steelers defense is hesitant to blitz in 2016

UPI.com - 1 day ago

More news for pittsburgh steelers

The Official Site of the Pittsburgh Steelers

**Pittsburgh Steelers**  
Football team



steelers.com

The Pittsburgh Steelers are a professional American football team based in Pittsburgh, Pennsylvania. The Steelers compete in the National Football League, as a member club of the league's American Football Conference North division. Wikipedia

Head coach: Mike Tomlin

Arena/Stadium: Heinz Field

Mascot: Steely McBeam

Division: AFC North

Owner: Rooney family

NFL championships: 2009, 2006, 1980, 1979, 1976, 1975

#### Roster

Ben Roethlisberger	7
Quarterback	
Antonio Brown	84
Wide receiver	
Le'Veon Bell	26
Running back	

View 45+ more

#### Profiles



Twitter



Facebook



Instagram

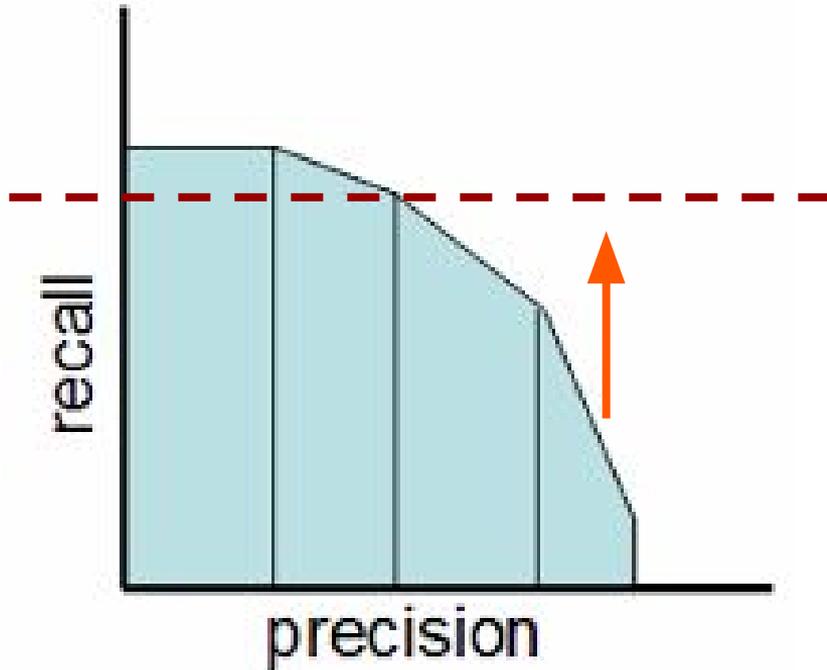


Google+



YouTube

Recall!



*To manage trust: set a threshold, then improve the curve.*

**1/3 of Google queries now hit knowledge base!**

Head coach: Mike Tomlin

Arena/Stadium: Heinz Field

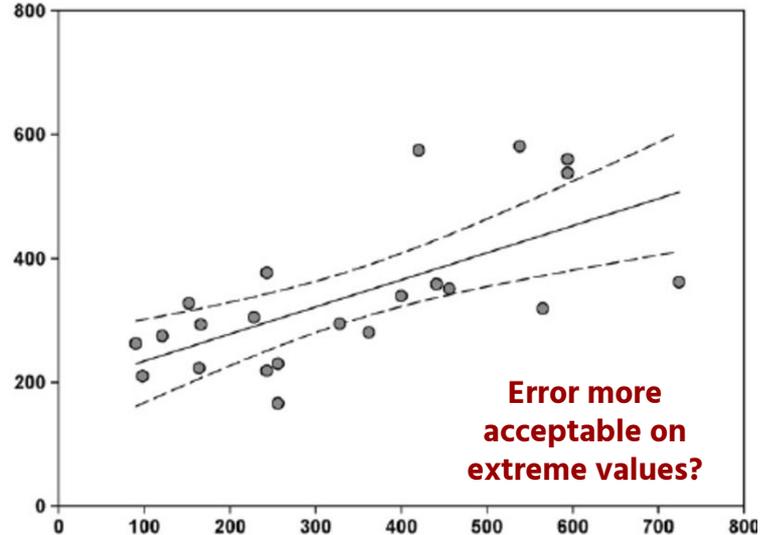
Mascot: Steely McBeam

*More generally:*

Discuss relative costs of errors early and often.

		Predicted		
		Class i	...	Class j
True	Class i	$\lambda_{ii}$	...	$\lambda_{ij}$
	⋮	⋮	⋮	⋮
	Class j	$\lambda_{ji}$	...	$\lambda_{jj}$

**Cost Matrix**



**Cost Function**

# Coevolution

P(experience | ...)

**Data  
Scientist**

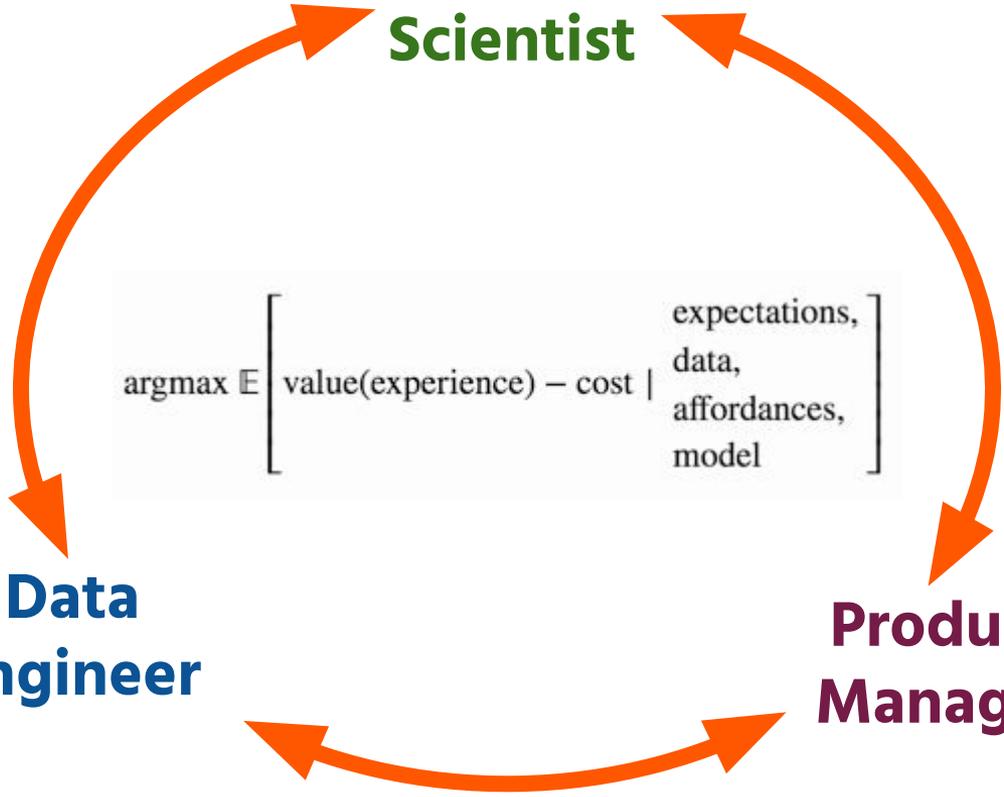
$$\operatorname{argmax} \mathbb{E} \left[ \text{value}(\text{experience}) - \text{cost} \mid \begin{array}{l} \text{expectations,} \\ \text{data,} \\ \text{affordances,} \\ \text{model} \end{array} \right]$$

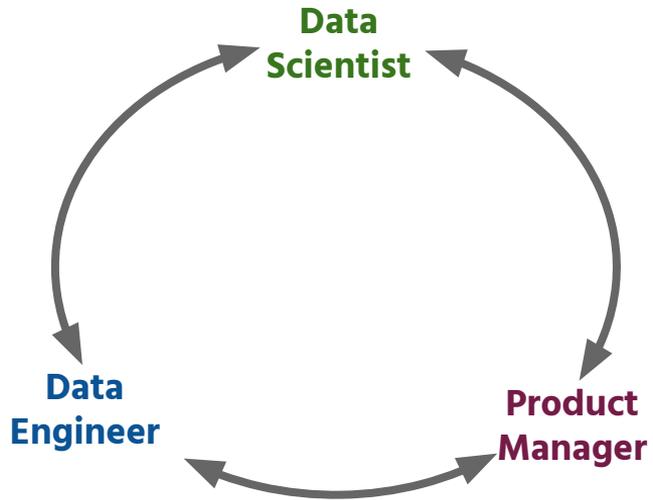
**Data  
Engineer**

cost(...)

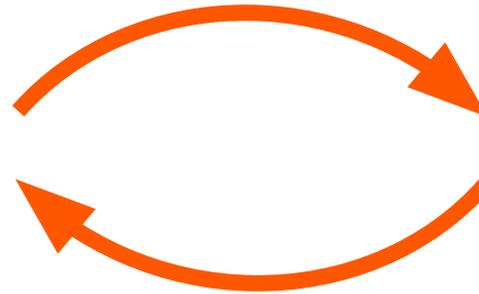
**Product  
Manager**

value(...)





**Value Offered**



**Customer Community**

**Learned Behavior**

# Red Feed, Blue Feed

Jon Keegan

FILTER FEEDS BY TOPIC:

HILLARY CLINTON

DONALD TRUMP

BARACK OBAMA

GUNS

ABORTION

ISIS

PRESIDENTIAL DEBATE

LIBERAL ⓘ

SHOWING POSTS ABOUT:

"GUNS"

CONSERVATIVE ⓘ



Truthout ✓

on Tuesday



The killing of children domestically and by US forces abroad exposes a society willing to sacrifice its own children to the industries that trade and profit in the massive production and distribution of guns, writes Henry A. Giroux.



Unthinkable Politics and the Dead Bodies of Chi...

The civic function of politics is collapsing, and violence has become the ...

TRUTH-OUT.ORG | BY HENRY A. GIROUX



Breitbart ✓

on Monday



Seriously?

"Peace camp"



Baltimore Kids Get 'Prizes' in Exchange for Surr...

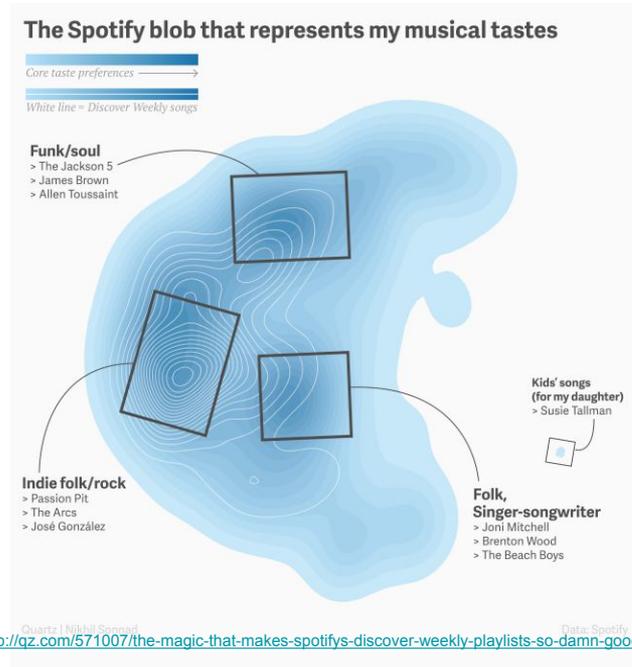
BREITBART.COM

👍 240

💬 340

➡ 130

# Jointly optimize for preferences and novelty



Or open data and people will explore for you!



Treat incentivizing exploration as  
a new prediction problem



Design explicit incentive  
mechanisms for exploration

Bayesian Exploration:  
Incentivizing Exploration in Bayesian Games

Yishay Mansour \*

Aleksandrs Slivkins †

Vasilis Syrgkanis ‡

Zhiwei Steven Wu §

Adding it Up

- Map the *edges* of your data, and how they will evolve.
  - Plan behavior and messaging for low-data situations.
- Compare how different kinds of error impact customers.
  - Target limitations on error to maintain trust, *then* iterate to add value
- Track and plan on users adapting to your product.
  - Shake users out of equilibrium to keep finding new value.

**Communicating about these fundamentals helps the rest of your team think ahead and not get blocked.**

# More Reading

- [DJ Patel's Building Data Science Teams](#)
- [Margit Zwemer's Drivetain Approach](#)
- [Anu Tewari's Product Playground](#)
- [DJ Patel \(again\): What We Wish We'd Known...](#)

# Thanks!

- Let's talk conversational commerce & AI: [george@frame.ai](mailto:george@frame.ai)
- We're hiring! [jobs@frame.ai](mailto:jobs@frame.ai)

