

All You Need to Know to Build a Product Knowledge Graph

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Outline

Overview and Introduction

20 min



Knowledge Extraction

40 min



Knowledge Cleaning

25 min



Break

20 min

Ontology Mining

25 min



Applications

20 min



Conclusion and Future Directions

10 min



Overview and Introduction

Overview and Introduction

20 min



Knowledge Extraction

Knowledge Cleaning

Q&A

Break

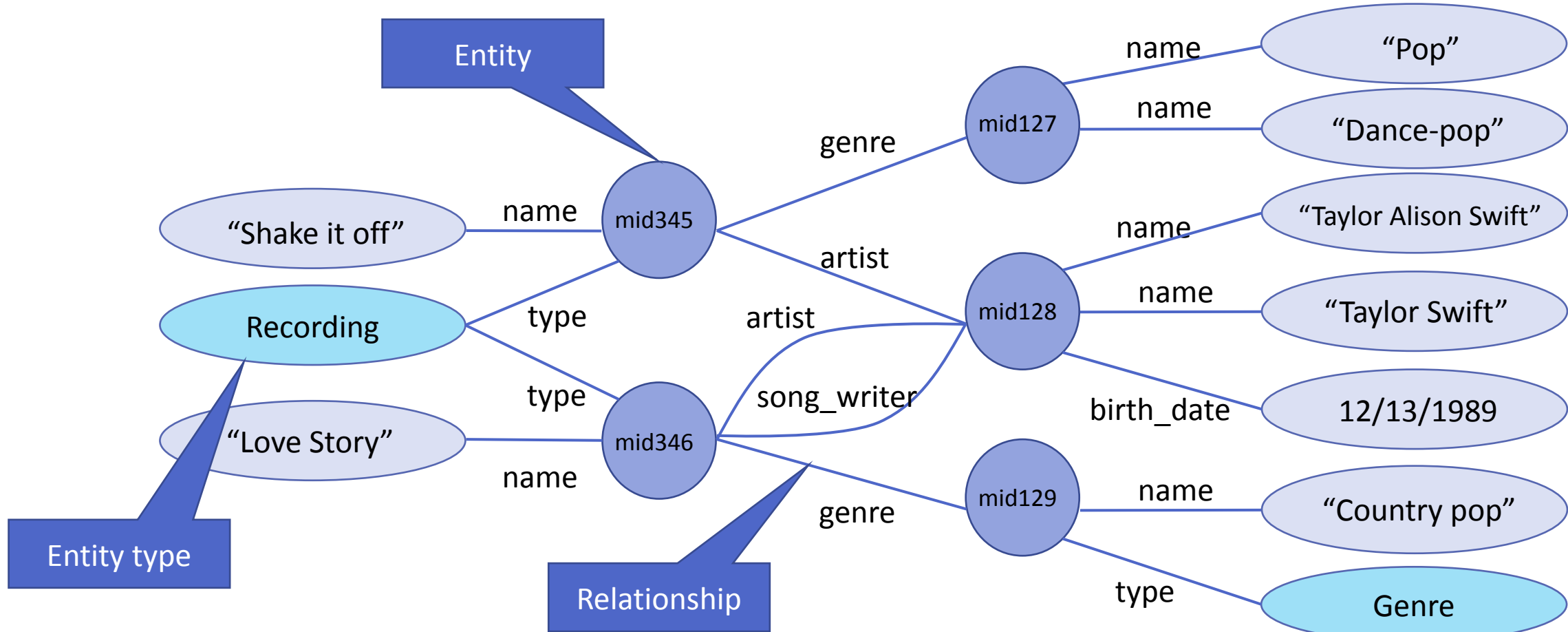
Ontology Mining

Applications

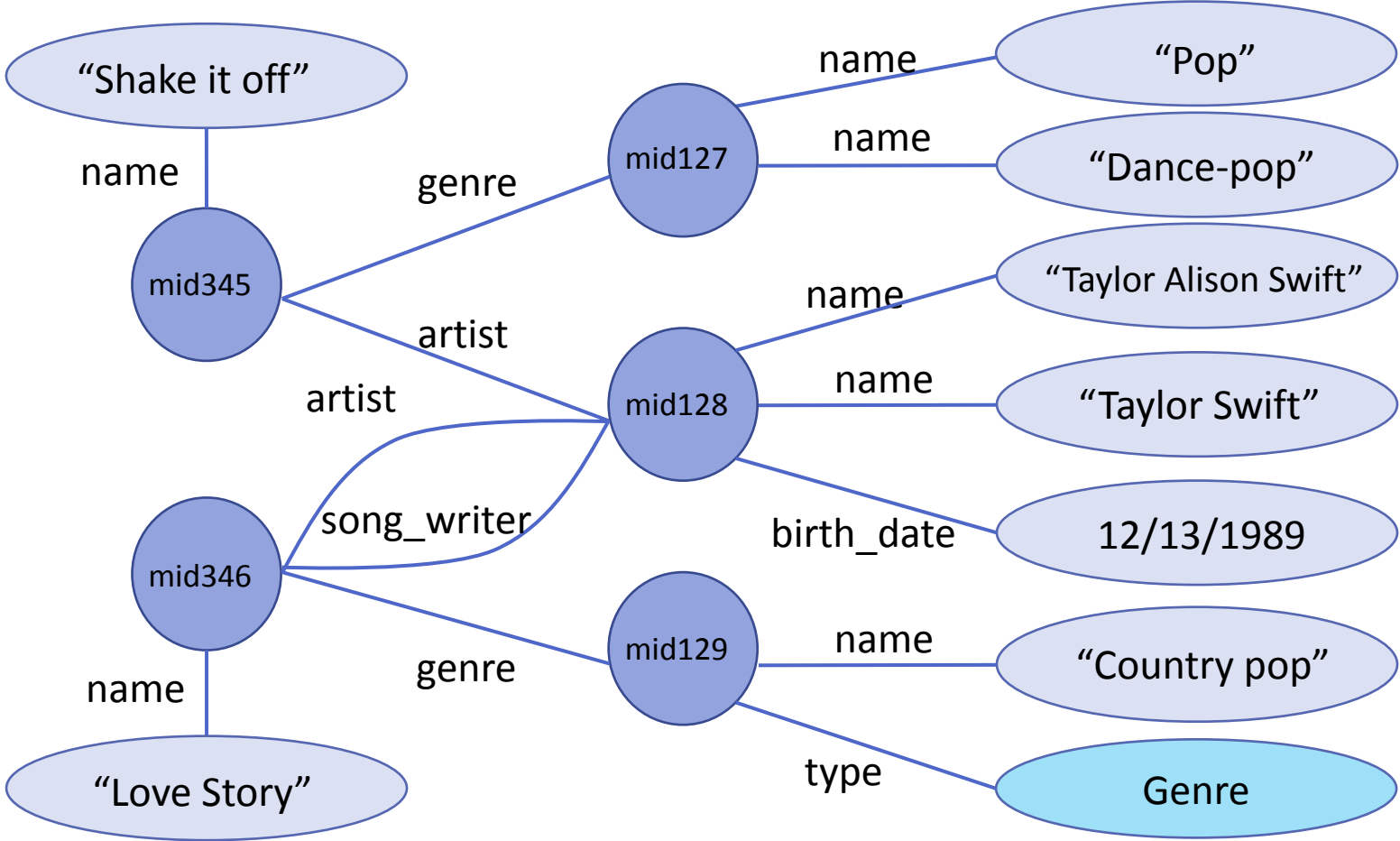
Conclusion and Future Directions

Q&A

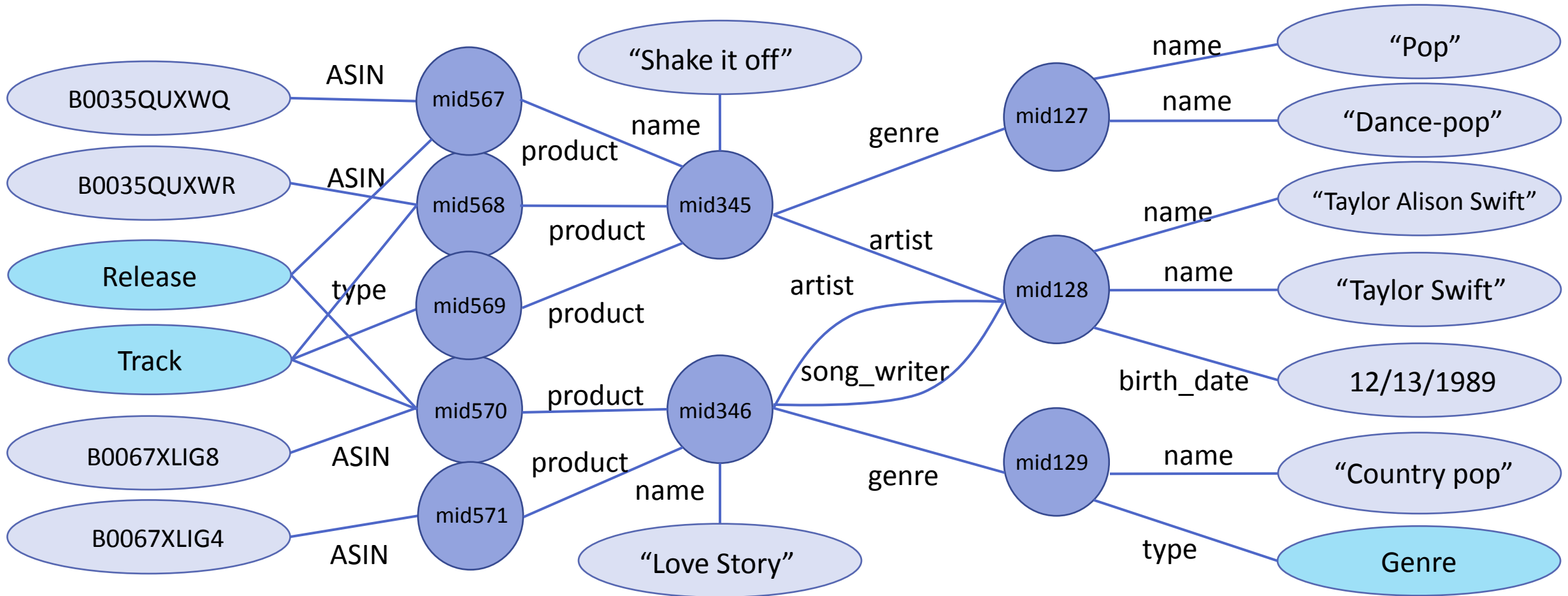
Knowledge Graph Example for 2 Songs



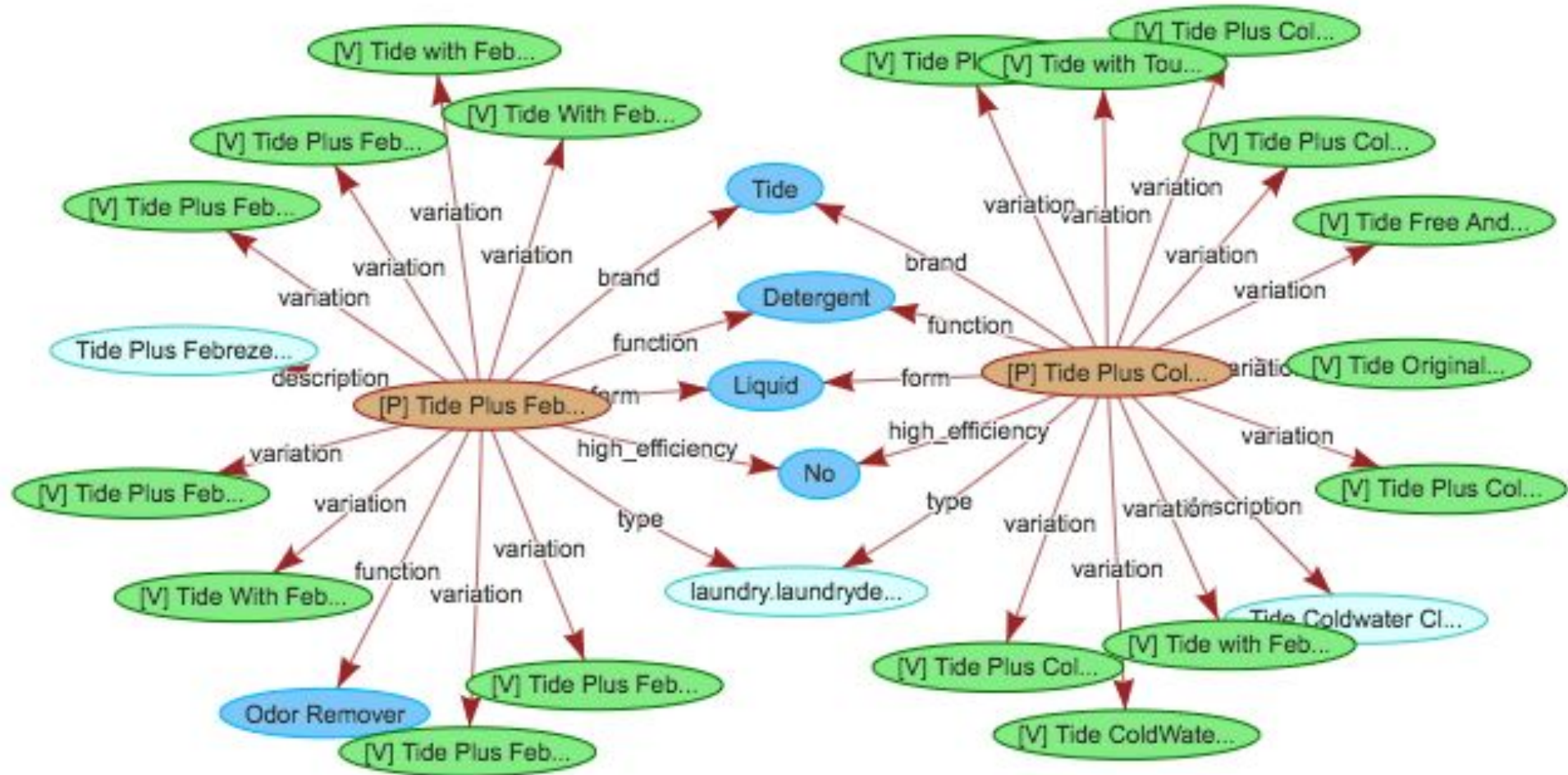
Product Graph Example for 2 Songs



Product Graph Example for 2 Songs



Product Graph Example for 2 Products



Use Case I: Providing Information



Roll over image to zoom in

Brand	Cetaphil
Ingredients	Water, Cetyl Alcohol, Propylene Glycol, Iodopropynyl Butylcarbamate, 2-Bromo-2-Nitropropane-1, 3-Diol, Sodium Lauryl Sulfate, Stearyl Alcohol, Methylparaben, Propylparaben, Sodium Citrate, Butylparaben, Allantoin, Zinc Gluconate.
Scent	Fragrance free
Additional Information	Non-Comedogenic, Fragrance-free, Natural
Skin Type	Sensitive


About this item

- Gentle for everyday use; Cetaphil gentle skin cleansing cloths will leave your skin feeling clean, refreshed and balanced after every use
- Removes makeup & dirt: Thoroughly remove makeup and dirt, leaving skin clean
- Mild & non irritating: Soap free formulation won't strip skin of its natural protective oils and emollients

Use Case II: Providing Choices

Visit the Bigmuscles Nutrition Store ★★★★☆ 6,270
Bigmuscles Nutrition Crude Whey 1kg, Whey Protein Concentrate 80%, 24g Protein, 5.5g BCAA, 4 g Glutamine

40% off



● ○ ○ ○ ○ ○ ▶

Style name:
Crude Whey [Unflavored] ▼


Flavor:
Unflavored ▼

Size:
1Kg[2.2lbs] ▼

₹ 779 (₹ 82.50 / 100 g) **Lightning Deal**
MRP: ₹-1,299.00 **Save ₹520**
prime

Visit the Bigmuscles Nutrition Store ★★★★☆ 6,270
Bigmuscles Nutrition Crude Whey 1kg, Whey Protein Concentrate 80%, 24g Protein, 5.5g BCAA, 4 g Glutamine

40% off



● ○ ○ ○ ○ ○ ▶

Style name:
Crude Whey [Unflavored] ▼


Flavor: **Unflavored** ▲

Unflavored ₹ 779.00 prime (₹ 77.90 / 100 g) Deal is 34% Claimed	Caffe Latte See available options	Isola See a optio
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Size: ▼

Use Case III: Improving Search

All ▾ k-cups dunkin donuts dark 🔍



Dunkin' Donuts Original Blend
Medium Roast Coffee, 88 K Cups for Keurig Coffee Makers
★★★★☆ ~ 3,395
\$38⁵⁰ (\$0.44/Count)
Save 5% more with Subscribe & Save
✓prime FREE Delivery Sun, May 10
88 Count

Dunkin Donuts K-cups Dark Roast - 48 K-cups
★★★★☆ ~ 112
\$38⁶⁹ (\$38.69/Count)
✓prime FREE Delivery Fri, May 8
More Buying Choices
\$28.00 (7 new offers)






Dunkin' Donuts Dark K Cup Pods, Dark Roast Coffee, for Keurig Brewers, 60Count
★★★★☆ ~ 55
\$35⁹⁹ (\$0.60/Count)
Save 5% more with Subscribe & Save
✓prime FREE Delivery Sun, May 10
60 Count (Pack of 1)

Dunkin Donuts Dunkin Dark Coffee K-Cups For Keurig K Cup Brewers (96 Count) - Packaging May Vary
★★★★☆ ~ 79
\$70⁵⁷ (\$0.74/Count)
✓prime FREE Delivery Sat, May 9
More Buying Choices
\$66.95 (8 new offers)

The Original Donut Shop Keurig Single-Serve K-Cup Pods, Regular Medium Roast Coffee, 72 Count
★★★★☆ ~ 9,914
\$29⁹⁹ (\$0.42/Count)
Save 5% more with Subscribe & Save
✓prime FREE One-Day Get it Tomorrow, May 5
72 Count


Use Case III: Improving Search

All ▾ k-cups dunkin donuts dark 🔍

 Dunkin' Donuts Original Blend Medium Roast Coffee, 28 K Cups for Keurig Coffee Makers ★★★★★ 3,395 \$38 ⁵⁰ (\$1.44/Count) Save 5% more with Subscribe & Save ✓prime FREE Delivery Sun, May 10 88 Count	 Dunkin Donuts K-cups Dark Roast - 48 K-cups ★★★★★ 112 \$38 ⁶⁹ (\$38.69/Count) ✓prime FREE Delivery Fri, May 8 More Buying Choices \$28.00 (7 new offers)	 Dunkin' Donuts Dark K Cup Pods, Dark Roast Coffee, for Keurig Brewers, 60Count ★★★★★ 55 \$35 ⁹⁹ (\$0.60/Count) Save 5% more with Subscribe & Save ✓prime FREE Delivery Sun, May 10 60 Count (Pack of 1)	 Dunkin Donuts Dunkin Dark Coffee K-Cups For Keurig K Cup Brewers (96 Count) - Packaging May Vary ★★★★★ 79 \$70 ⁵⁷ (\$0.74/Count) ✓prime FREE Delivery Sat, May 9 More Buying Choices \$66.95 (8 new offers)	 The Original Donut Shop Keurig Single-Serve K-Cup Pods, Regular Medium Roast Coffee, 72 Count ★★★★★ 9,914 \$29 ⁹⁹ (\$0.42/Count) Save 5% more with Subscribe & Save ✓prime FREE One-Day Get it Tomorrow, May 5 72 Count
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Use Case III: Improving Search

All ▾ k-cups dunkin donuts dark 🔍



Dunkin Donuts Dunkin Dark, Dark Roast Coffee K-Cups For Keurig K Cup Brewers (96 Count)
★★★★★ ▾ 18
\$73⁹² (\$73.92/Count)
✓prime FREE Delivery Tue, May 12
More Buying Choices
\$69.98 (7 new offers)
96 Count


Dunkin Donuts K-cups Dark Roast - 48 K-cups
★★★★★ ▾ 112
\$38⁶⁹ (\$38.69/Count)
✓prime FREE Delivery Fri, May 8
More Buying Choices
\$28.00 (7 new offers)

Dunkin' Donuts Dark K Cup Pods, Dark Roast Coffee, for Keurig Brewers, 60Count
★★★★★ ▾ 55
\$35⁹⁹ (\$0.60/Count)
Save 5% more with Subscribe & Save
✓prime FREE Delivery Sun, May 10
60 Count (Pack of 1)

Dunkin Donuts Dunkin Dark Coffee K-Cups For Keurig K Cup Brewers (96 Count) - Packaging May Vary
★★★★★ ▾ 79
\$70⁵⁷ (\$0.74/Count)
✓prime FREE Delivery Sat, May 9
More Buying Choices
\$66.95 (8 new offers)

Dunkin Donuts K-cups Dark Roast - 24 Kcups for Use in Keurig Coffee Brewers
★★★★★ ▾ 140
\$20¹⁵ (\$0.84/Count)
✓prime FREE One-Day Get it Tomorrow, May 5
More Buying Choices
\$13.20 (8 new offers)

Use Case IV: Improving Recommendation



KitchenAid KSM150PSER Artisan Tilt-Head Stand Mixer with Pouring Shield, 5-Quart, Empire Red
by KitchenAid
★★★★★ 6,331 customer reviews | 972 answered questions


List Price: \$429.99
Price: **\$249.99 & FREE Shipping**
You Save: **\$180.00 (42%)**




i Item is eligible for **6 Month Special Financing** with your Amazon.com Store Card. [Learn more](#)

Note: Not eligible for Amazon Prime. Available with free Prime shipping from [other sellers on Amazon](#).

Only 14 left in stock.
Estimated Delivery Date: July 28 - Aug. 2 when you choose Standard at checkout.
Ships from and sold by [GE Premier](#) in [easy-to-open packaging](#).

Color: **Empire Red**




Share   

Qty:

\$249.99 + Frt
Only 14 left in sto
Prem


Include **2-Year I**
\$14.99

 **Add**


[Turn on 1-Click order!](#)

Ship to:
KEVIN DAVENPOF




Other Sellers

\$264.99

Sold by: Amazon.com

\$264.99
+ Free Shipping
Sold by: Marcus AV

\$289.00

Sold by: goldentech

Similar But Different

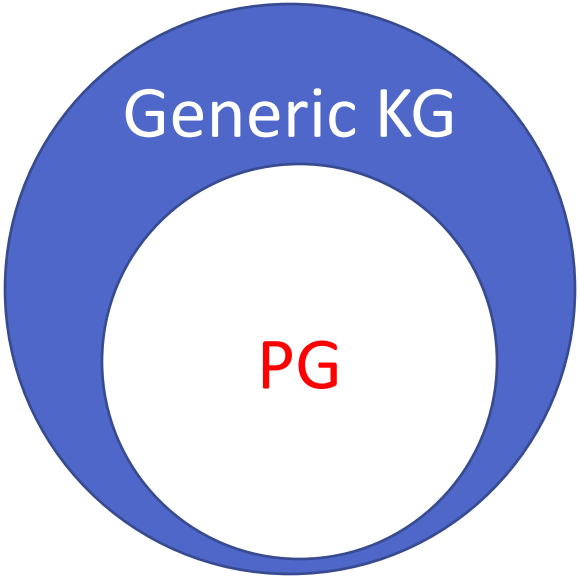
More Capacity	More Attachments	Different Brand
		
<input type="button" value="See more choices"/>	<input type="button" value="See Color Options"/>	<input type="button" value="See Color Options"/>
KitchenAid® MSE Certified®	KitchenAid KP26M1XER 6	Hamilton Beach 63232 Electric

Product Graph vs. Knowledge Graph

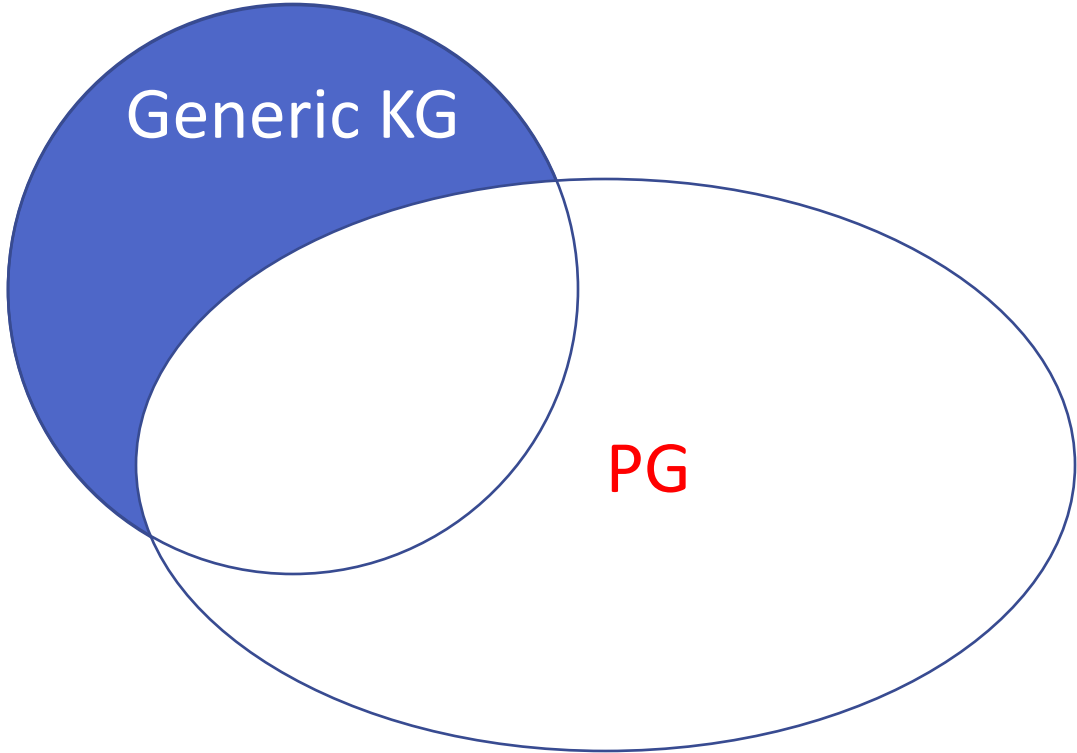
(A)



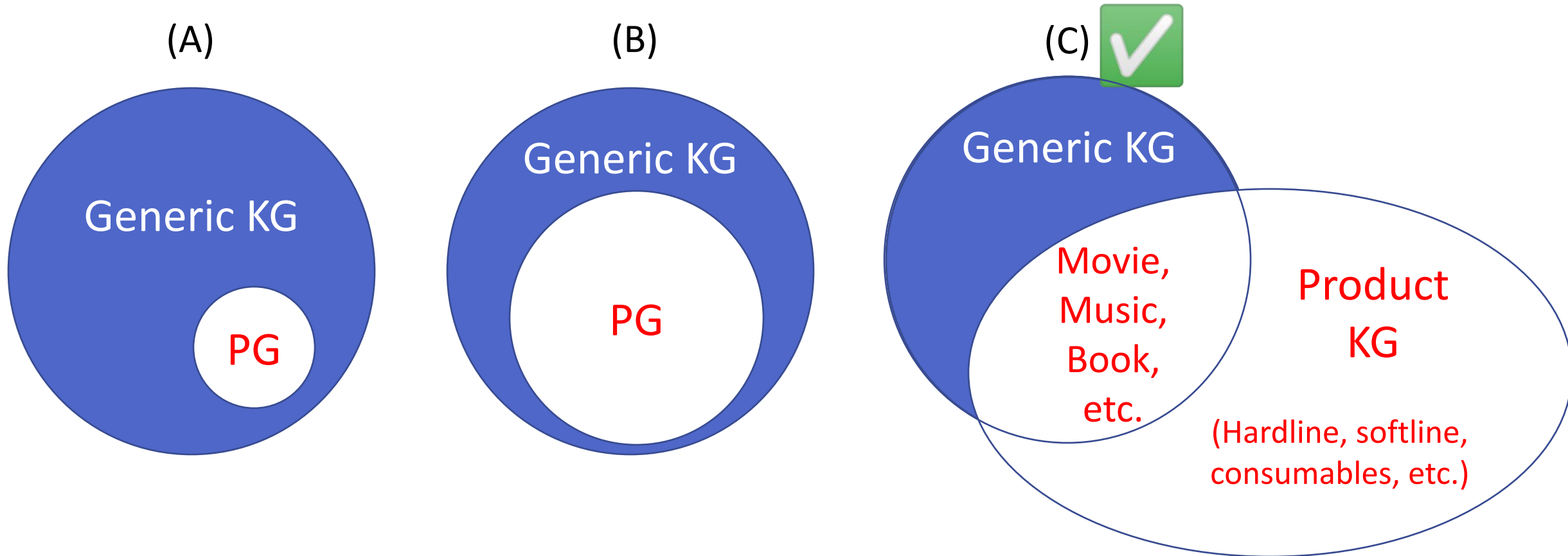
(B)

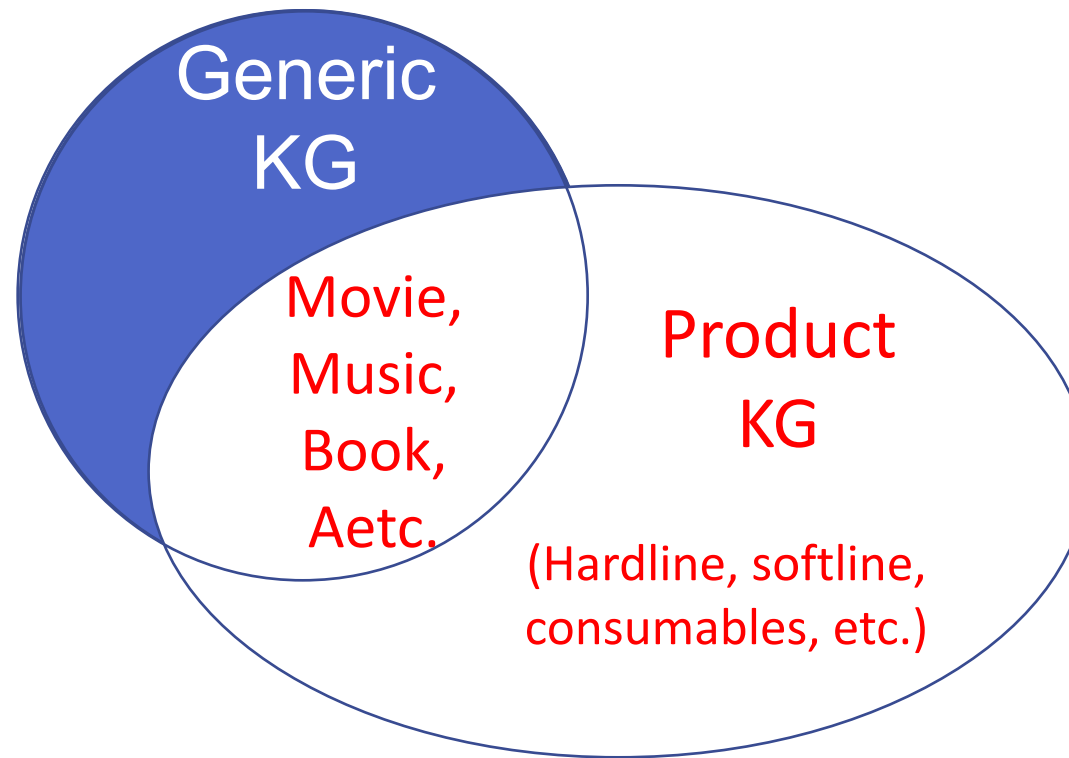


(C)



Product Graph vs. Knowledge Graph





**We focus on
retail products in
this tutorial**

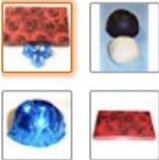
But, Is The Problem Harder?

Challenges in Building Product Graph I

❑ Sparse and noisy structured data

Scott's Cakes Dark Chocolate Toffee Cream Filling Candies with Dark Blue Foils in a 1 Pound Red Roses Box
by [Scott's Cakes](#)

[Be the first to review this item](#)



Price: **\$19.95** + \$14.95 shipping
You can get 5% back on all Amazon.com purchases with the Amazon Prime Store Card. No annual fee.

Note: Not eligible for Amazon Prime.

In Stock. Ships from and sold by [Scott's Cakes](#).

38 Flavors: 1 lb. Red Rose Box

1 lb. Christmas... \$19.95	1 lb. Daisy Box \$19.95	1 lb. Red Rose Box \$19.95	▼
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19 Sizes: Dark Blue Foils

Aqua Foils \$19.95	Burgandy Foils \$19.95	Dark Blue Foils \$19.95	▼
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Get it Thu, Aug 22 - Tue, Aug 27

Get it Tue, Aug 20 - Fri, Aug 23 if you choose paid shipping at checkout.

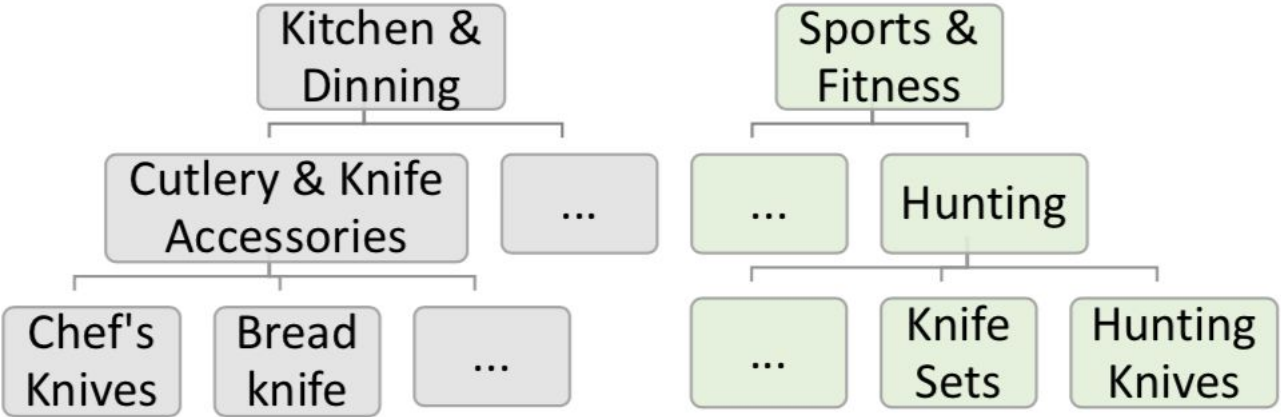
📍 Deliver to Yaqing - Seattle 98109

Qty: 1 ▼

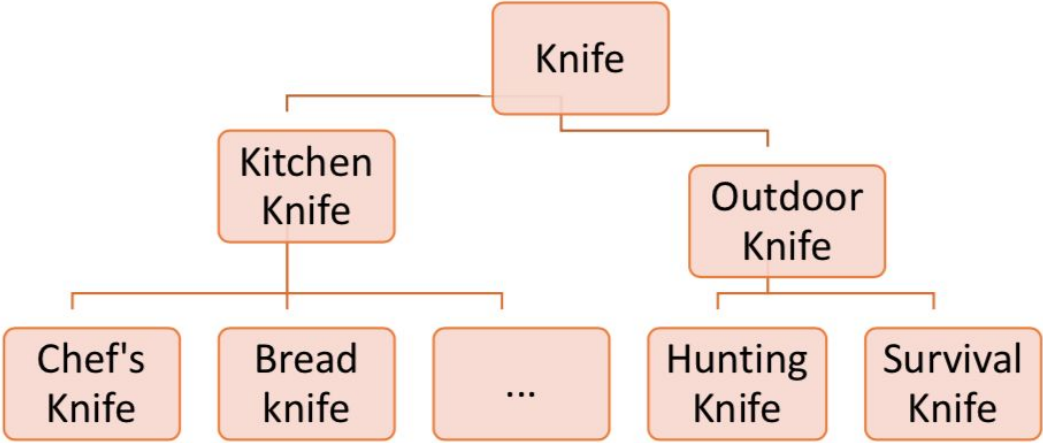
[Turn on 1-click ordering](#)

Challenges in Building Product Graph II

- ❑ Extremely complex domains
- ❑ How to identify the millions of product types?
- ❑ How to organize types into a taxonomy tree?



Sellers' view



Buyers' view

Challenges in Building Product Graph III

- ❑ Big variety across product types
- ❑ Different attributes apply to different product types
- ❑ Different value vocabularies and different patterns



Cute Rascals

Cute Rascals Blue Red Cranberry Taped Neck Girl Ruffle Cotton Long
Sleeve Sunflower Dress

[Be the first to review this item](#)

Price: **\$30.99**

Color: Soft Pink



Flavor

Ingredient

Challenges in Building Product Graph III

- ❑ Big variety across product types
- ❑ Different attributes apply to different product types
- ❑ Different value vocabularies and different patterns



Samsung UN58RU7100FXZA Flat **58-Inch**
4K UHD 7 Series Ultra HD Smart TV with
HDR and Alexa Compatibility (2019 Model)

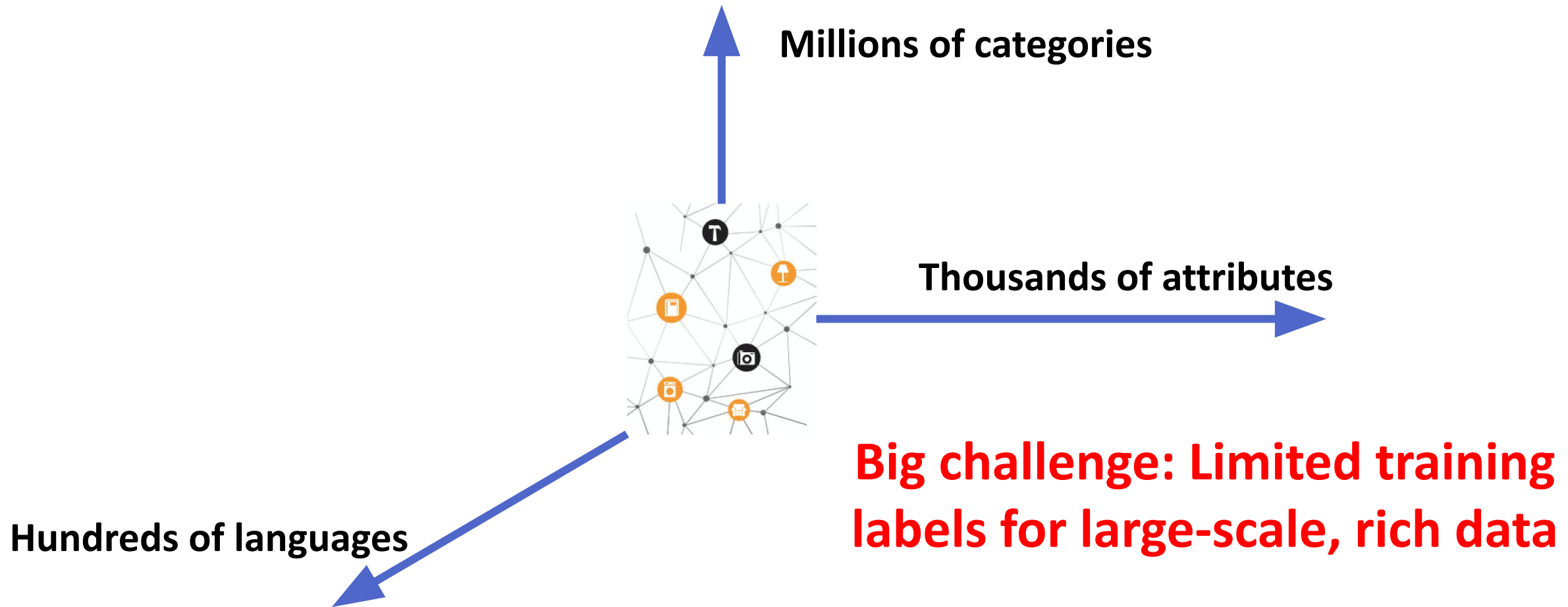


Taylors of Harrogate Classic Tea Variety Box,
48 Count (Pack of 1)



Caribou Coffee Caribou Blend, Medium
Roast Ground Coffee, **20 Ounce** Bag,
Rainforest Alliance Certified

Scale Up in 3 Dimensions

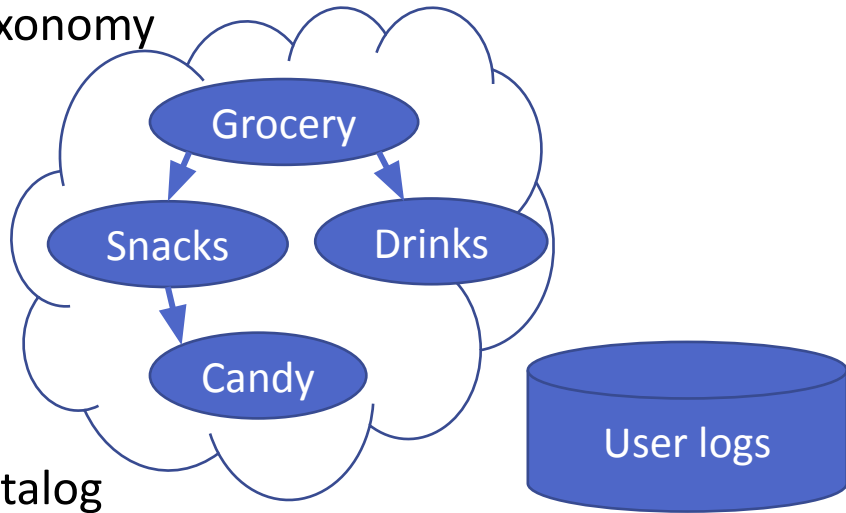




Can We Build A **Self-Driving**
Product Understanding System?

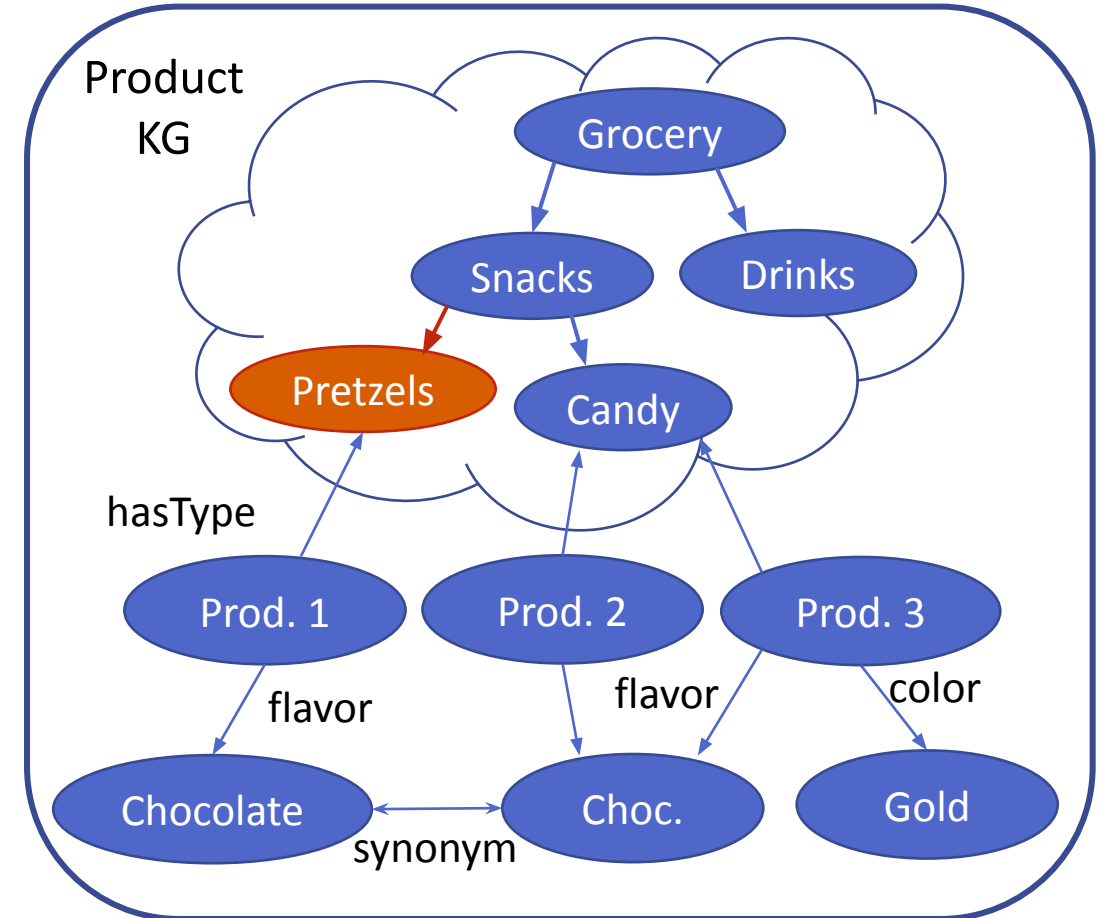
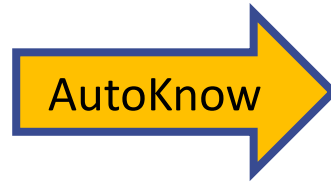
Our Goal: Self-Driving Product Knowledge Collection

Taxonomy

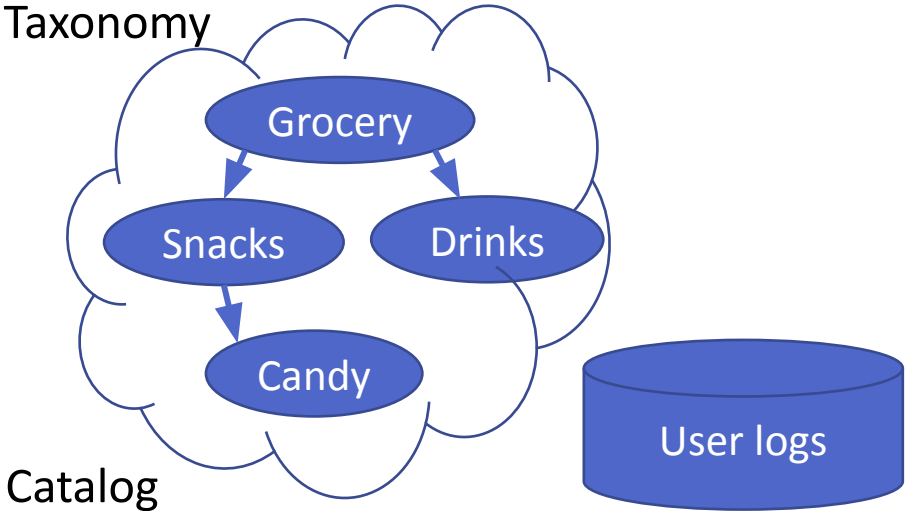


Catalog

Product	Type	Flavor	Color
Product 1	Snacks	Cherry	
Product 2	Candy	?	?
Product 3	Candy	Choc.	Gold

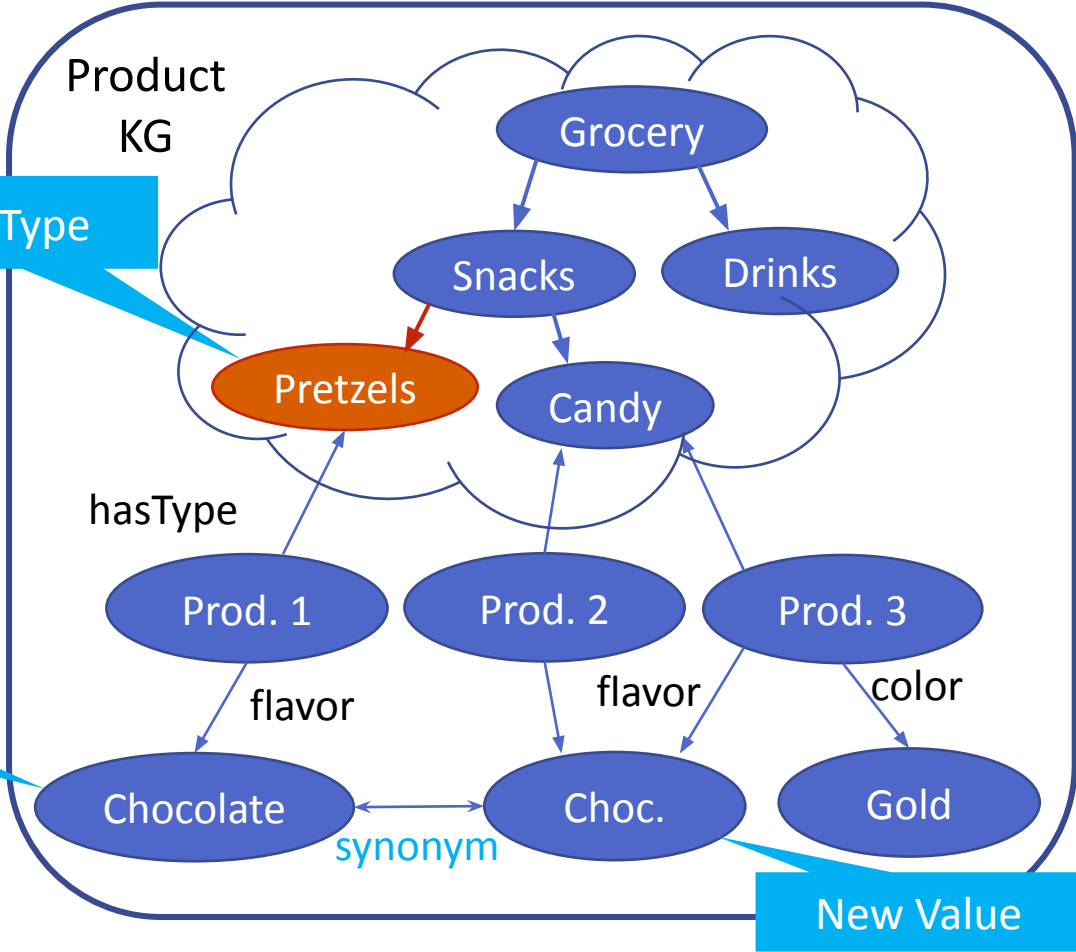


Our Goal: Self-Driving Product Knowledge Collection



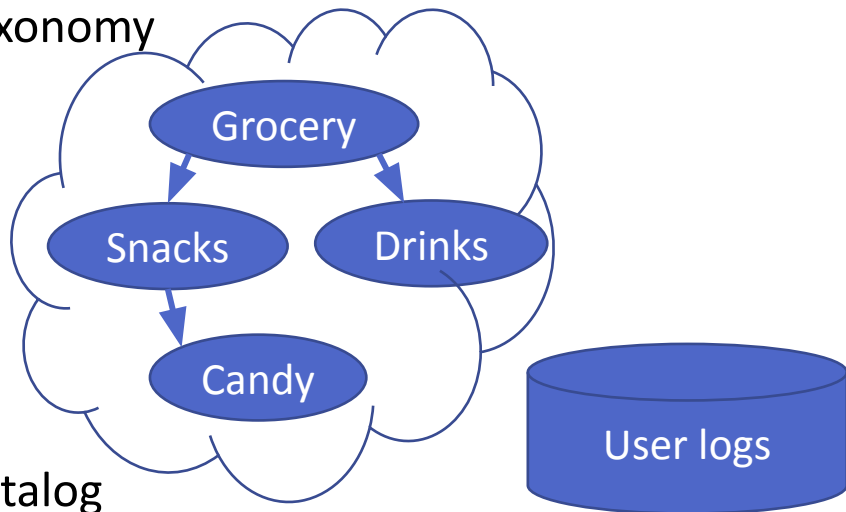
Catalog

Product	Type	Flavor	Color
Product 1	Snacks	Cherry	
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Product 3	Candy	Choc.	Gold



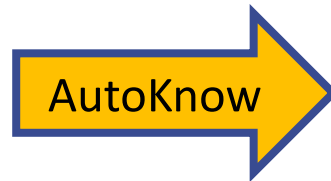
Amazon AutoKnow: Self-Driving Product Knowledge Collection

Taxonomy

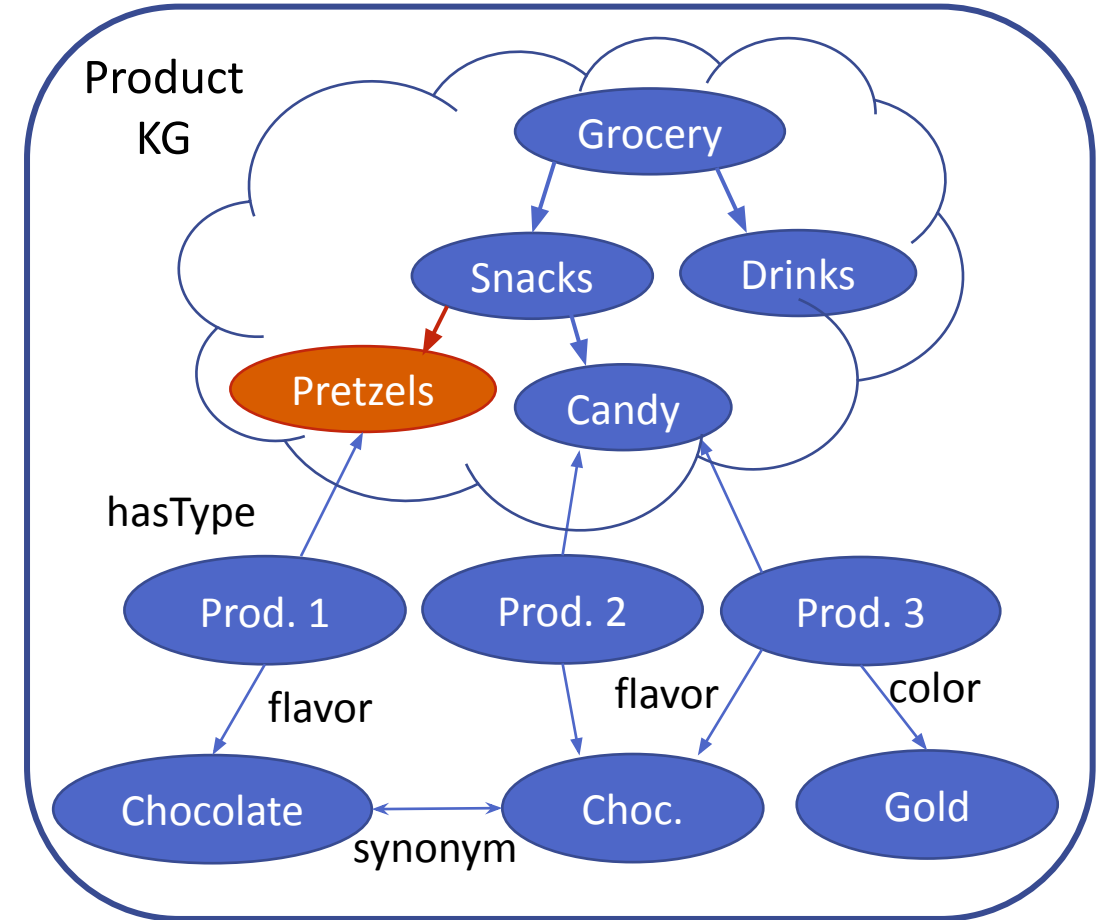


Catalog

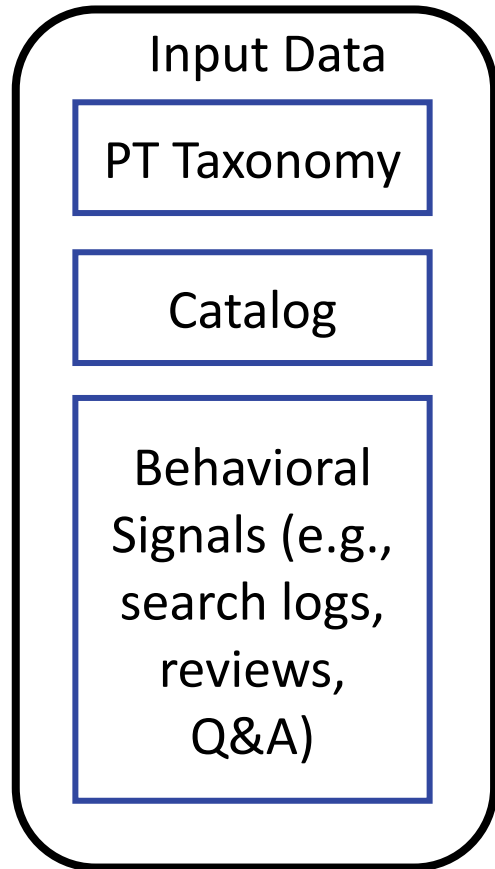
Product	Type	Flavor	Color
Product 1	Snacks	<i>Cherry</i>	
Product 2	Candy	?	?
Product 3	Candy	<i>Choc.</i>	<i>Gold</i>



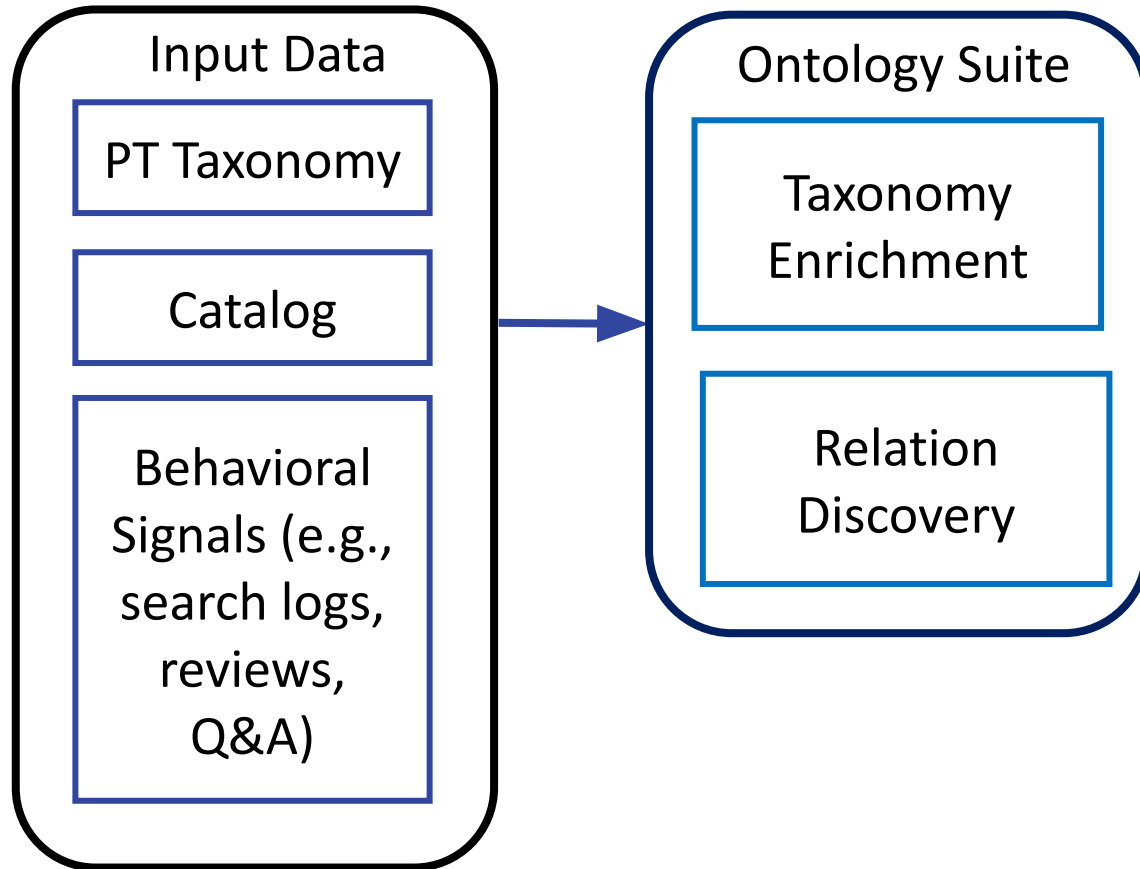
- #Types ↑ 3X
- Defect rate ↓ up to 68 percent points



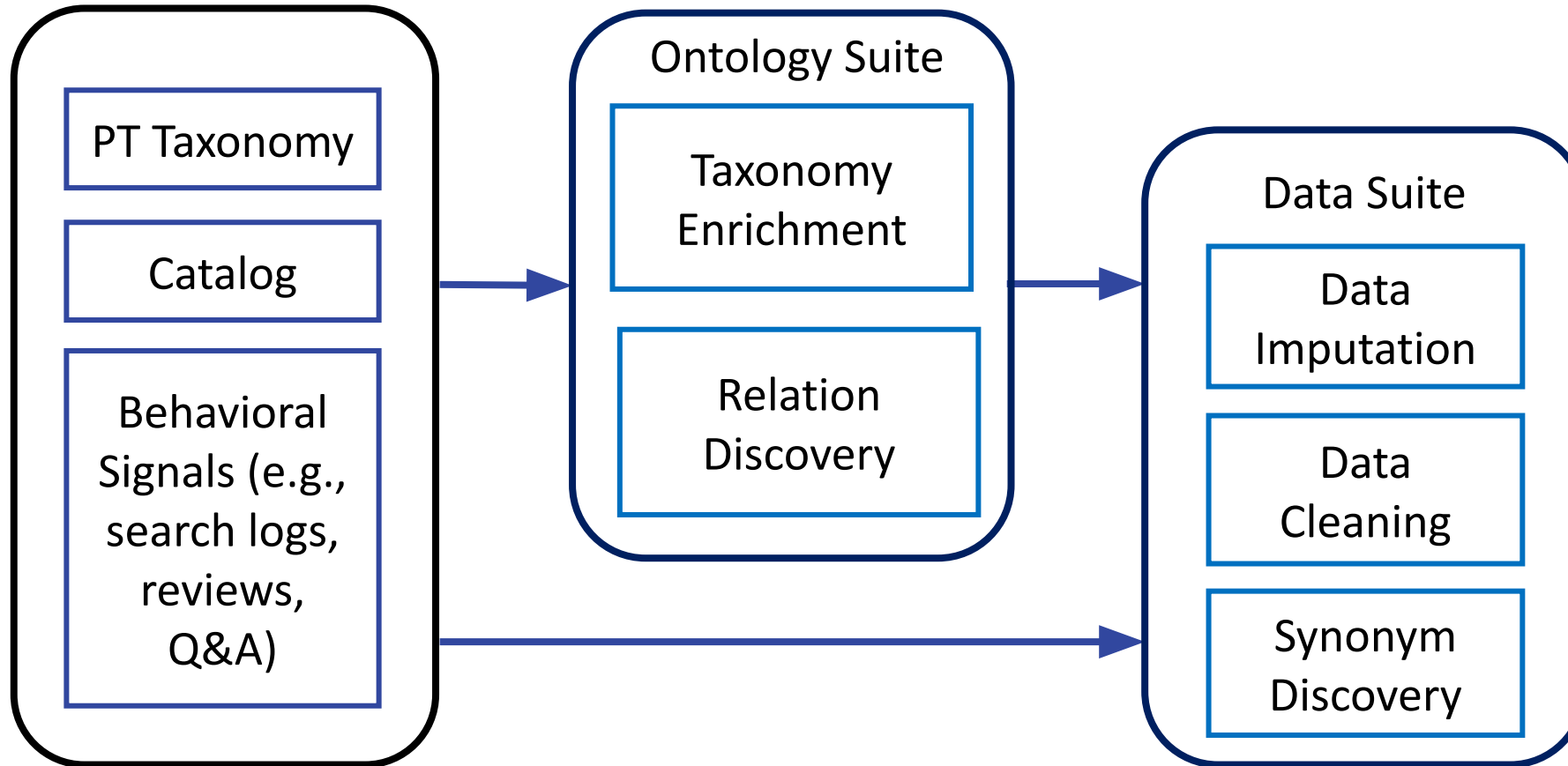
Amazon AutoKnow: Self-Driving Product Knowledge Collection



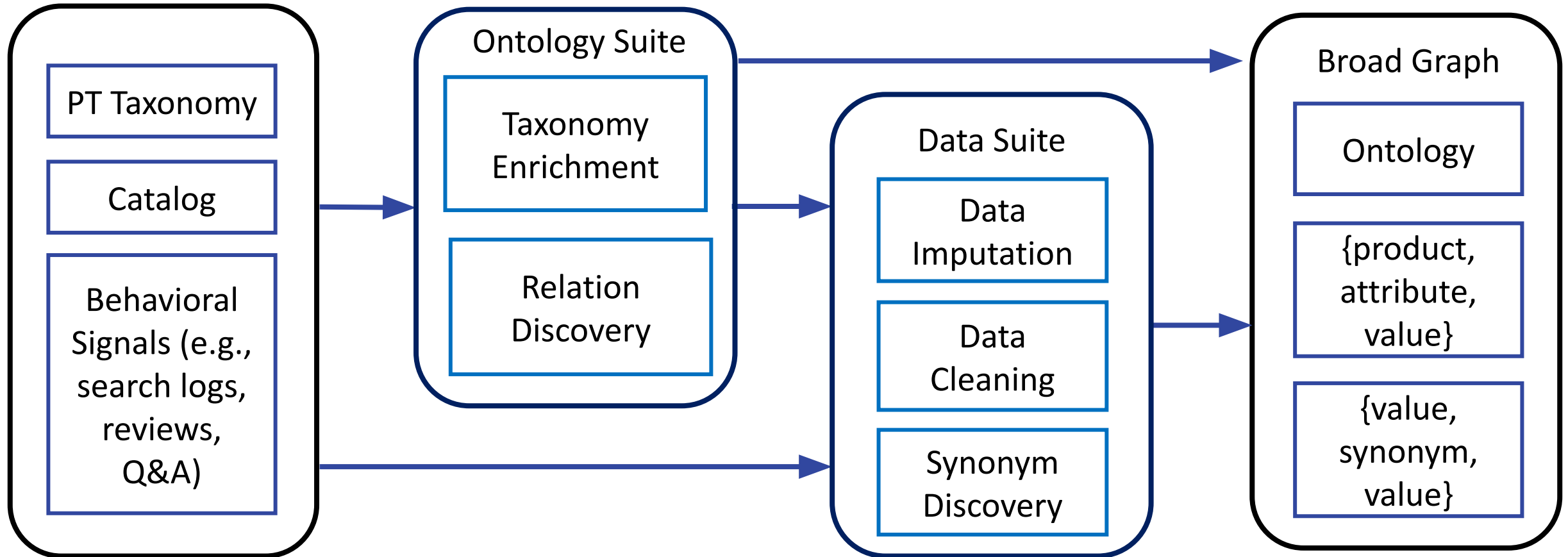
Amazon AutoKnow: Self-Driving Product Knowledge Collection



Amazon AutoKnow: Self-Driving Product Knowledge Collection



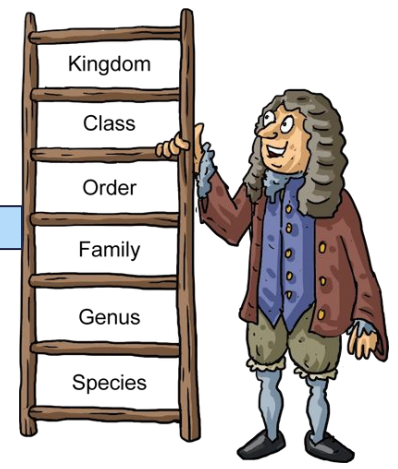
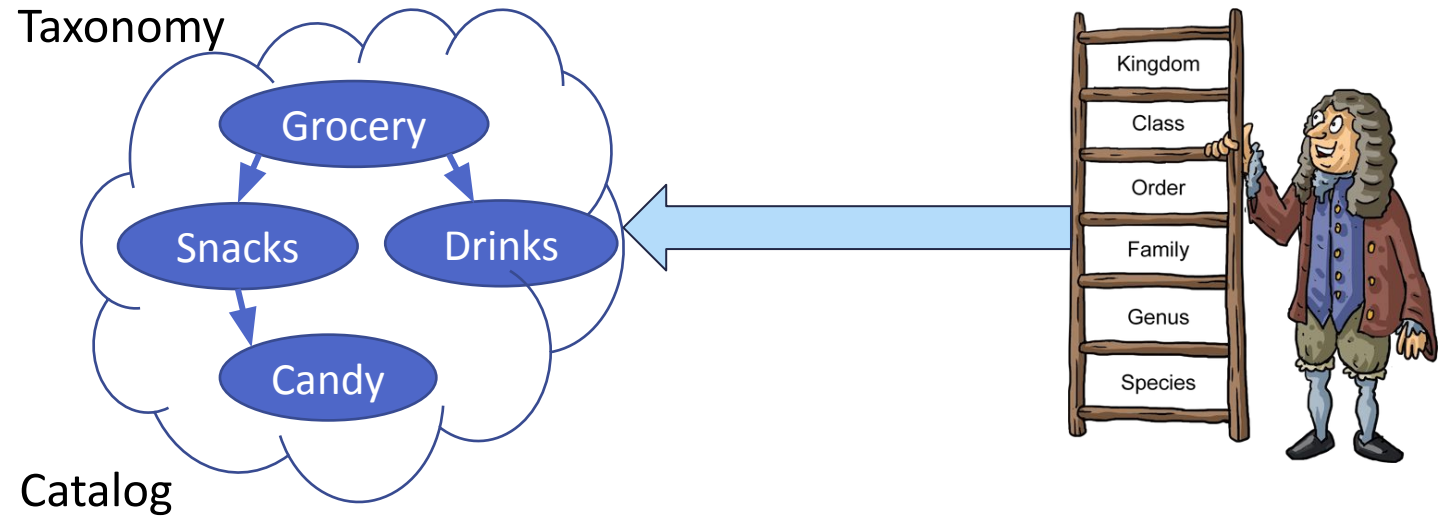
Amazon AutoKnow: Self-Driving Product Knowledge Collection



Self Driving to Navigate a Large Space

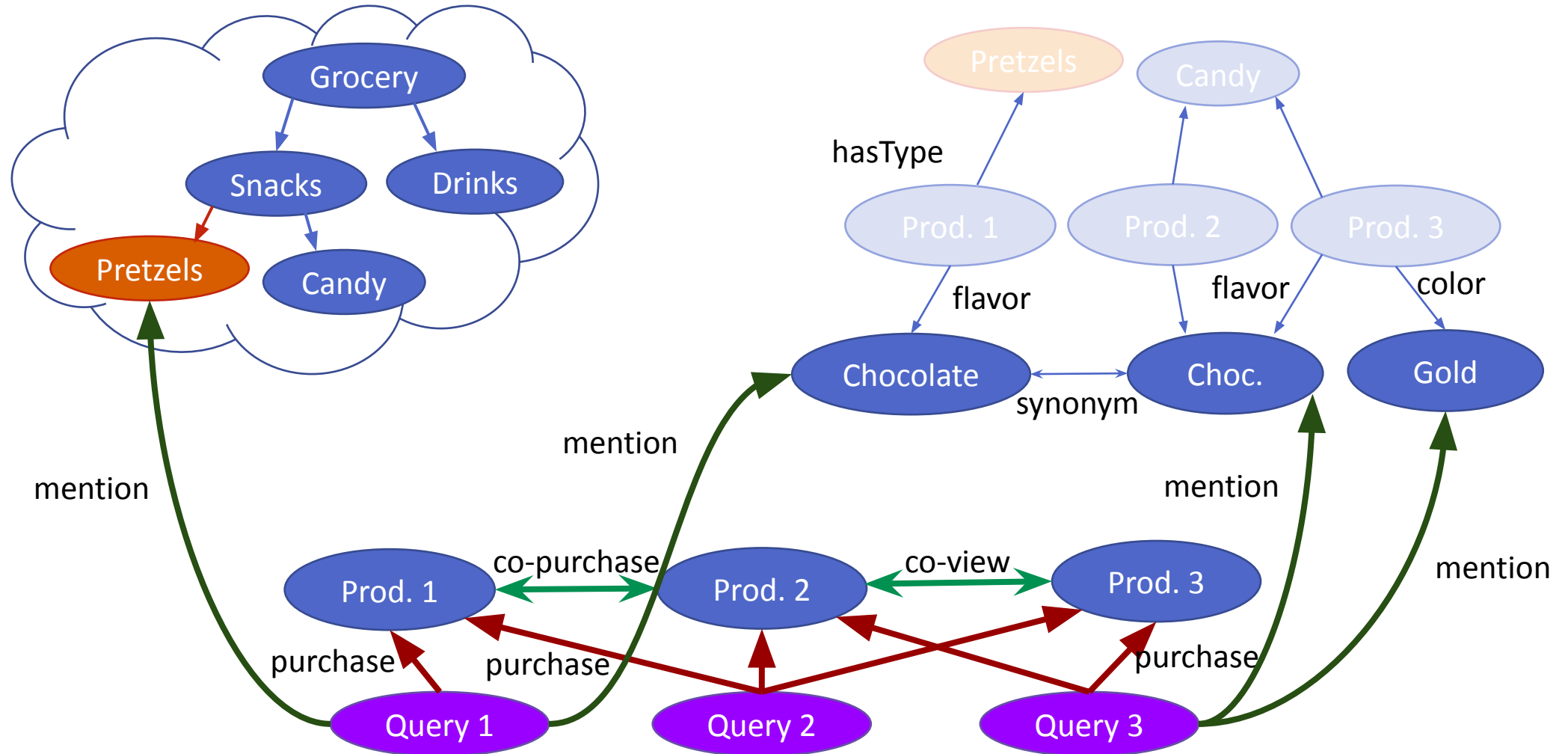
- **Automatic:** Fully ML-based
- **Annotation free:** Weak learning based on existing Catalog data and user behavior
- **One-size-fits-all:** Few taxonomy-aware models
- **Self guidance:** Identify important attributes and categories to focus efforts

Key Intuition I. Learning w. Limited Labels Generated from Existing Catalog Data

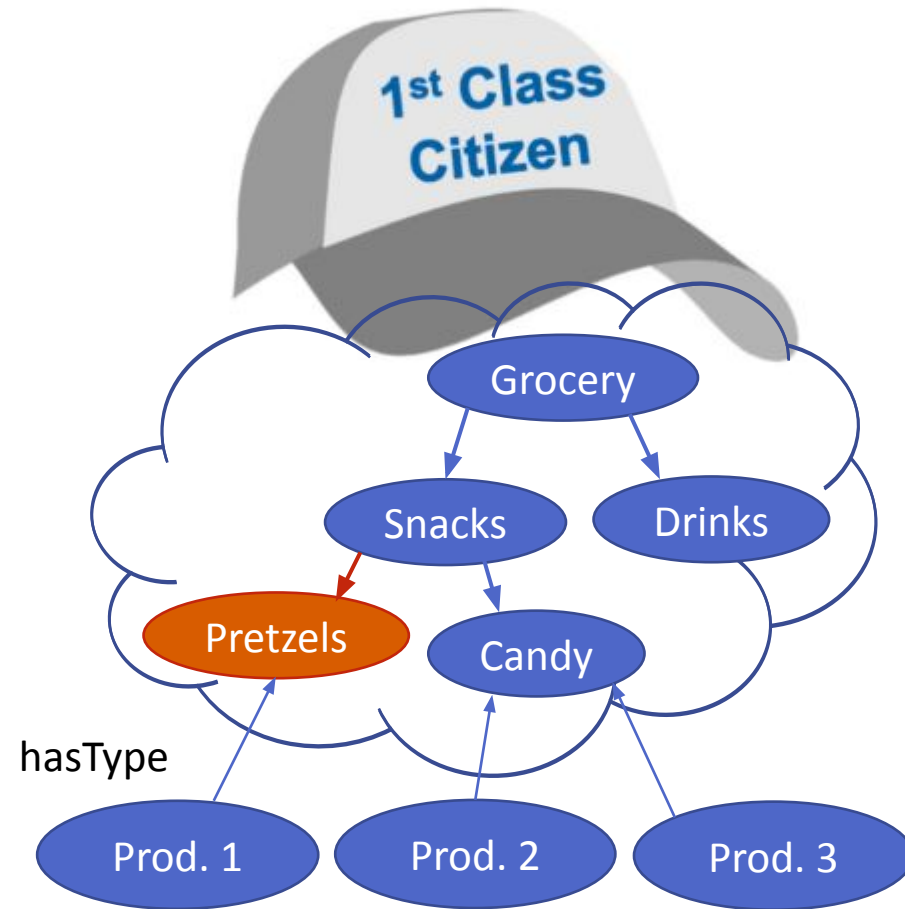


Product	Type	Flavor	Color
Product 1	Snacks	<i>Cherry</i>	
Product 2	Candy	?	?
Product 3	Candy	<i>Choc.</i>	<i>Gold</i>

Key Intuition II. Rich Customer Behavior

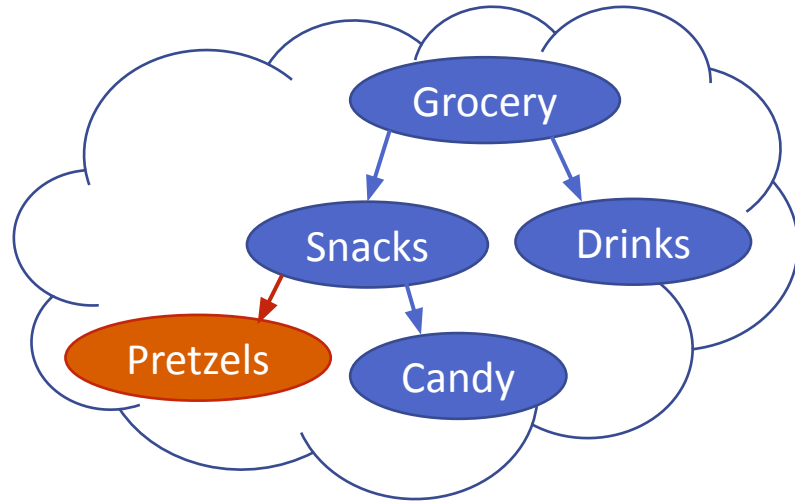


Key Intuition III. Product Categories as First-Class Citizen in Modeling

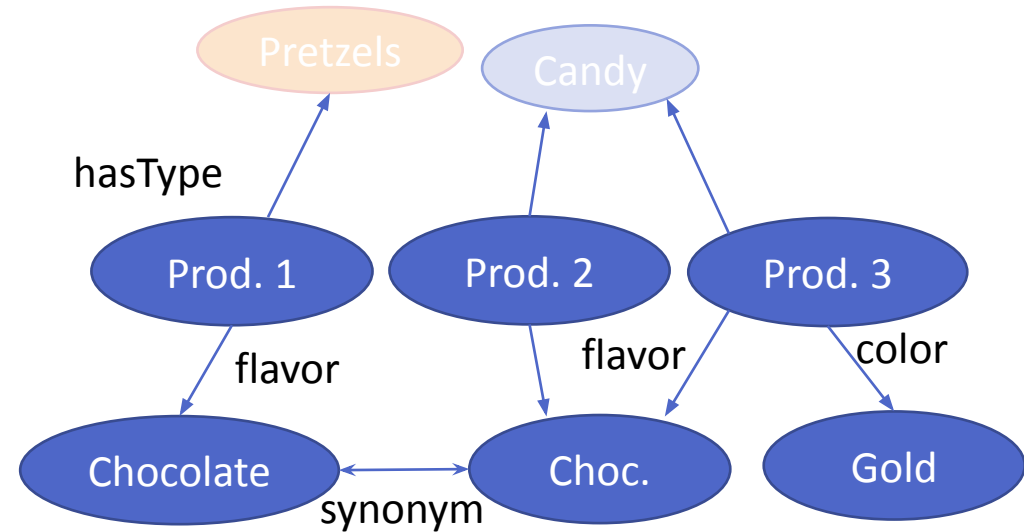


Key Intuition IV. Leverage Graph Structure

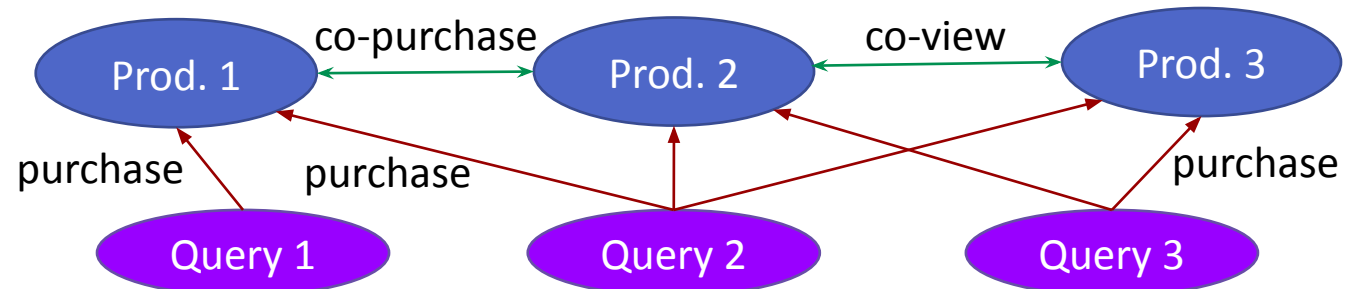
Taxonomy is a tree



KG is a graph



Customer behavior forms a graph



Key Intuition V. Leverage Different Modals

Beauty & Personal Care > Makeup > Face > Highlighters & Luminizers



Roll over image to zoom in

B07V551YSF

Ownest 2 Colors Highlighter Stick, Shimmer Cream Powder
Waterproof Light Face Cosmetics, Creamy Self Sharpening
Crayon Stick Highlighter

Brand: Ownest

★★★★☆ 308 ratings | 4 answered questions

Price: \$9.99 (\$9.99 / Count) FREE Shipping on orders over \$25.00 shipped by Amazon or get Fast, Free Shipping with Amazon Prime & FREE Returns

Get \$60 off instantly: Pay \$0.00 upon approval for the Amazon Rewards Visa Card. No annual fee.

Returnable until Jan 31, 2021

Color: A

Brand	Ownest
Color	A
Rug Size	Light
Item Form	Stick
Skin Tone	Light

About this item

- **[Makeup Highlighter]** Creamy texture and radiant glow finish, feel beautiful on your skin and they gave off the most radiant most amazing highlight ever. These cream highlighter sticks provide a subtle glow that is perfect for everyday use.
- **[Clever Design]** The top of the stick is flat and wide enough to highlight your cheekbones with one swipe, and the edge can be used to apply color precisely to the bridge of the nose, cupid's bow, and brow bone with relative ease.
- **[Long Lasting&Waterproof]** Long lasting, water-tight, sweatproof. Let you keep the perfect makeup all day long without worrying about getting caught in the rain or pushed into a pool.
- **[Easy to apply]** The shimmer sticks are quick and easy to apply. You just twist up the product and swipe it wherever you would like to illuminate.
- **[Perfect Gift for Girls]** Two popular everyday colors, suit for various occasions. Unique design, lightweight, easy to carry. Suit for personal use or send as gift.

ambiguous item_form:
stick

Key Techniques in AutoKnow

Techniques \ Component	<i>AK-Taxonomy</i>	<i>AK-Relations</i>	<i>AK-Imputation</i>	<i>AK-Cleaning</i>	<i>AK-Synonyms</i>
Graph structure	X		X		
Taxonomy signal			X	X	
Distant supervision	X		X	X	
Behavior information	X	X			X



Deliver the Data Business

1,000,000,000



Deliver the Data Business

1

High
precision
models

Deliver the Data Business

1,000

High
precision
models

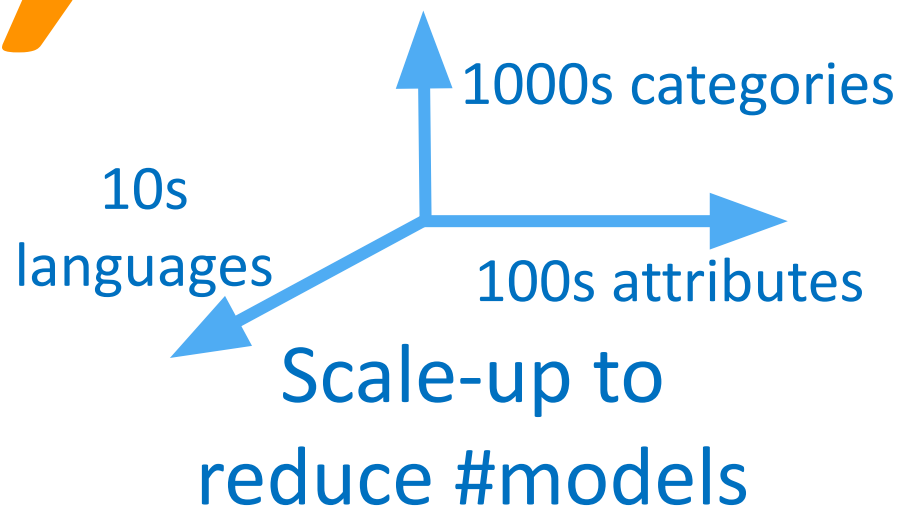
E2E pipeline
+ AutoML
to reduce
modeling cost

Deliver the Data Business

1,000,000

High
precision
models

E2E pipeline
+ AutoML
to reduce
modeling cost

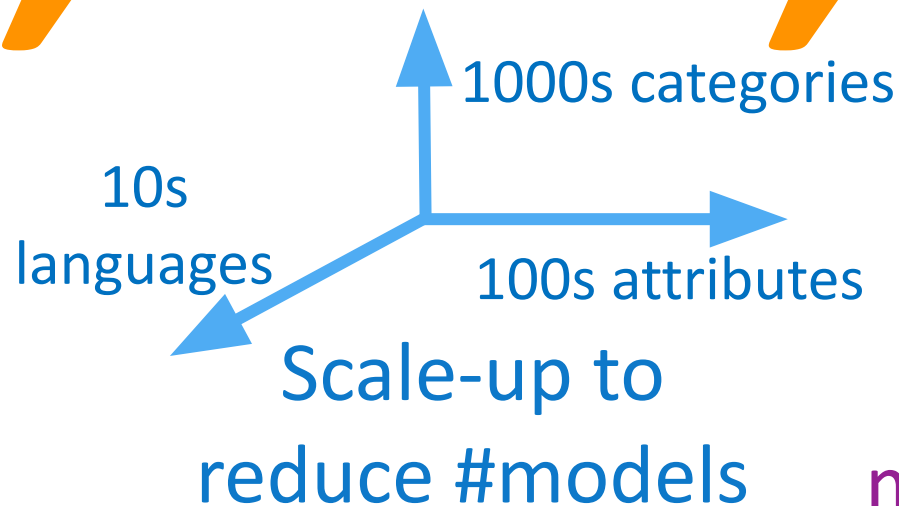


Deliver the Data Business

1,000,000,000

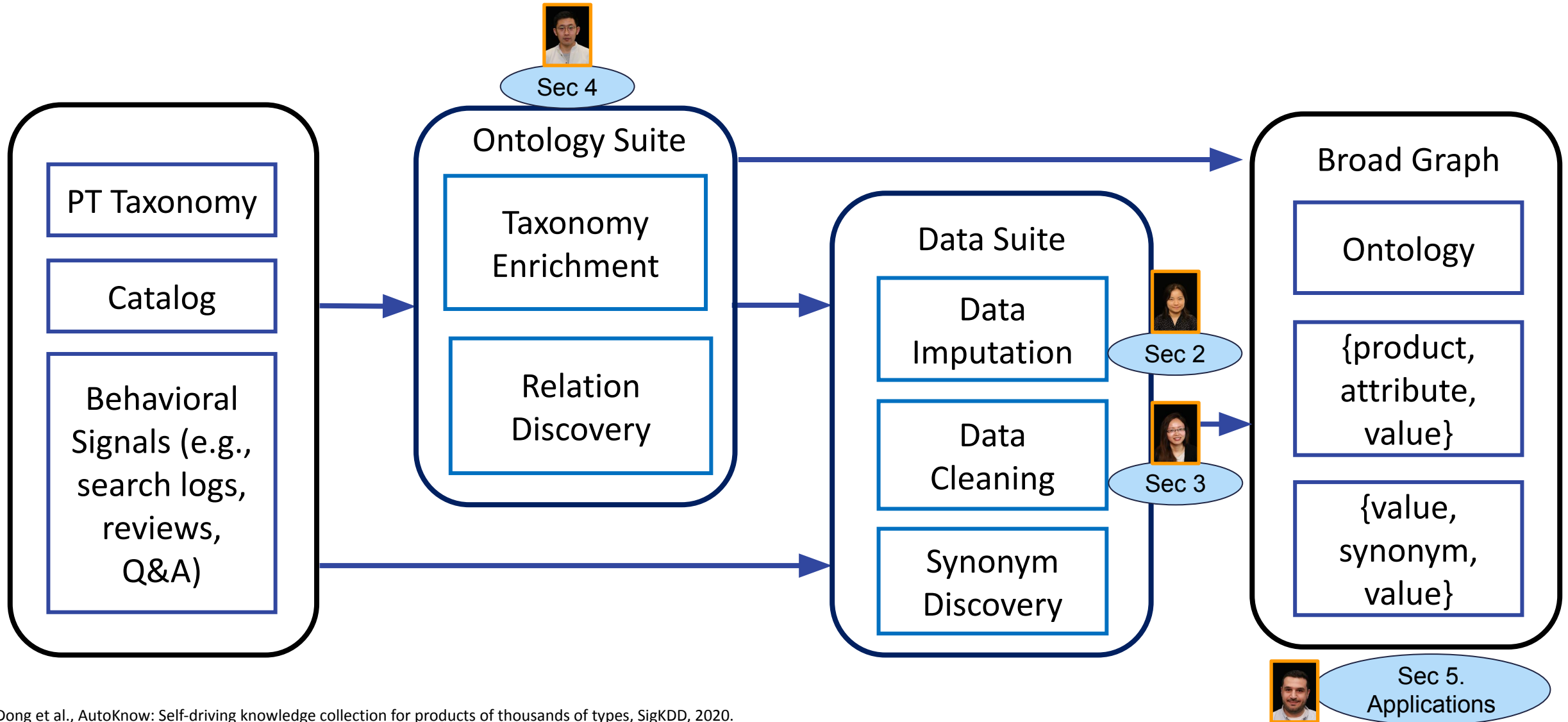
High precision models

E2E pipeline + AutoML to reduce modeling cost



Higher yield from multi-modal models

Tutorial Structure



Section Structure

- Problem Definition

What are unique challenges for PG beyond generic KGs?

- Short answer -- key intuition

What are key intuitions for building product KGs?

- Long answer -- details

What are practical tips?

- Reflection/short-answer

Can we apply the techniques to other domains?

Key Questions We Answer in This Tutorial

- Q1. What are unique challenges to build a product knowledge graph and what are solutions?
- Q2. Are these techniques applicable to building other domain knowledge graphs?
- Q3. What are practical tips to make this to production?