

# Machine Learning as the Key to Personalized Curation

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<https://github.com/karyafar/openAir2015>

# Overview

Etsy

Personalized Recommendations on Etsy

Machine Learning Models @ Etsy

What's Next?

Etsy

Etsy is an online marketplace where people connect to buy and sell **unique** goods: Handmade, vintage, craft supplies

**~21M**

Active Buyers

**1.4M**

Active Sellers

**~35M**

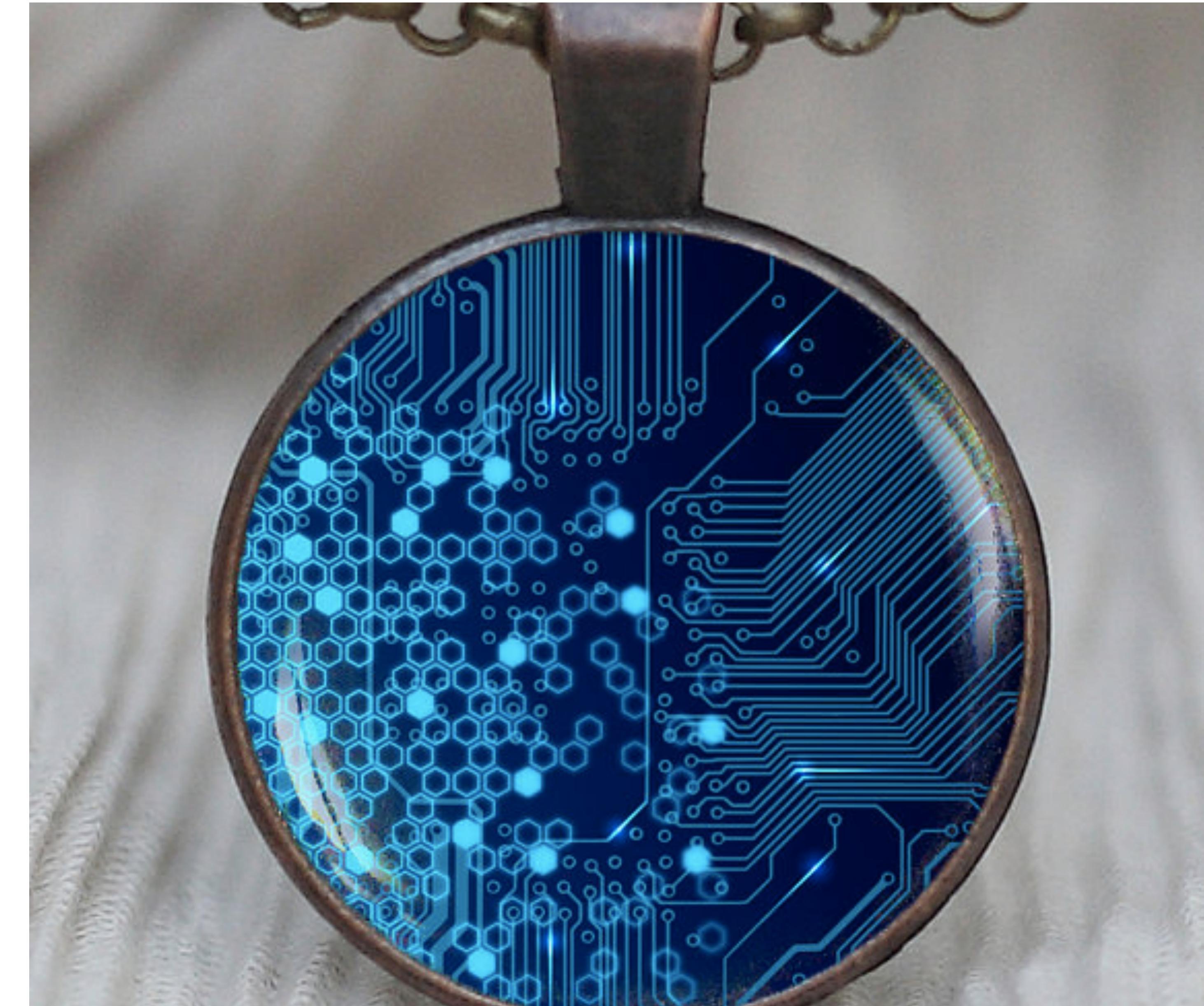
Listings

People buy and sell on Etsy from nearly every country in the world.

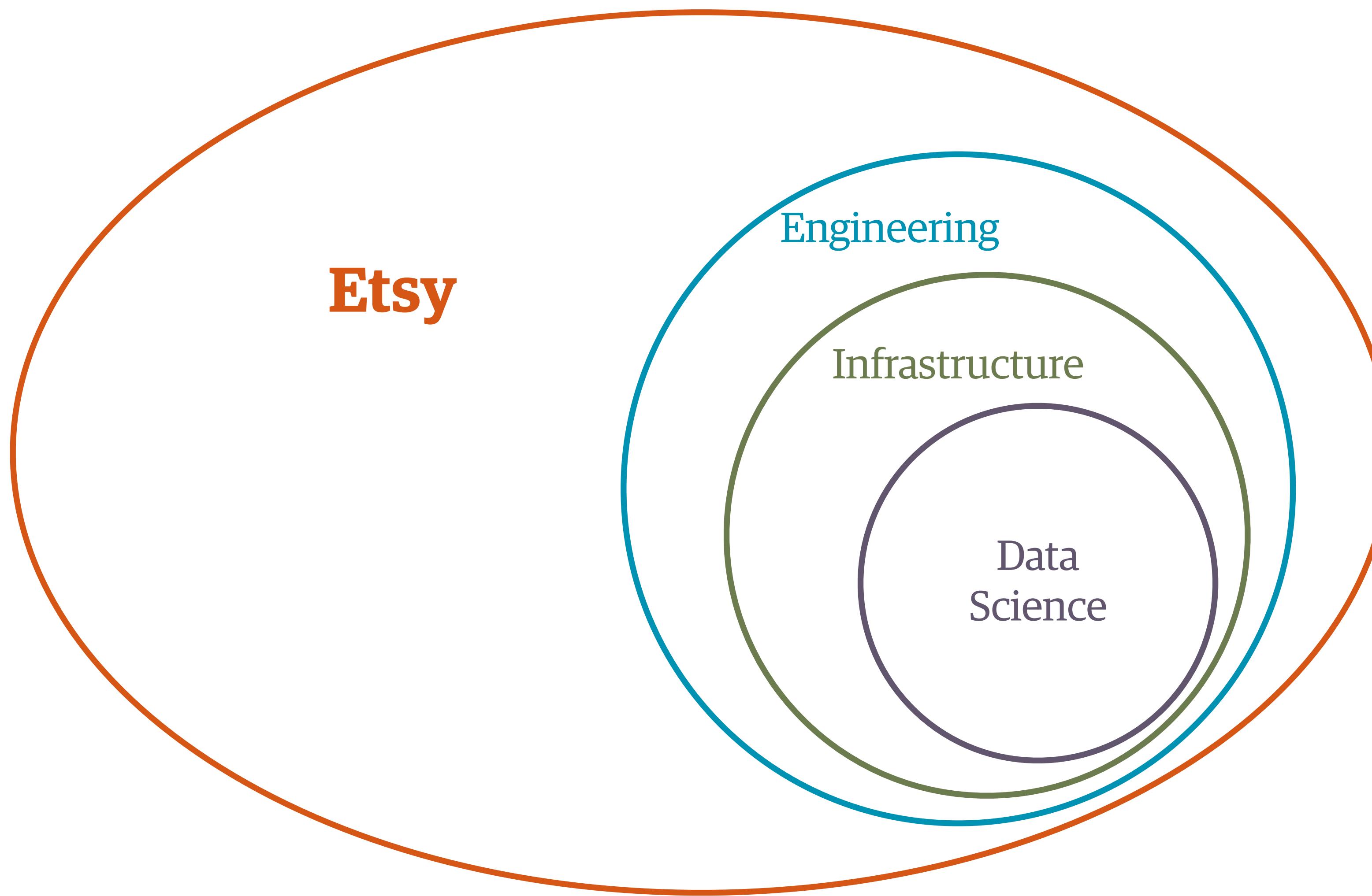
In a 2014 survey of Etsy buyers, 92% agreed that Etsy offers products they cannot find elsewhere.



PendantWorld



Circuit Board Pendant!



# Data Scientists



**Rob Hall**

Search, checkout



**Kamelia Aryafar**

Security, Marketing, Membership



**Diane Hu**

Buyer Experience, Buyer Activation  
Manufacturing



**Josh Attenberg**

Team Leader, Local



**Corey Lynch**

Search, Ads



**Andrew Clegg**

International, Ops, Security

# How do people typically use Etsy?

1

## Browse (Unintentional)

via the front page, browse pages or the activity feed

## Search (Intentional)

for a specific item

Pinterest  
Facebook  
Search Engines

...

Marketing Emails  
Including Recommendations

2

## Purchase an item

Favorite  
an item or shop, and add to collections with coherent theme/style

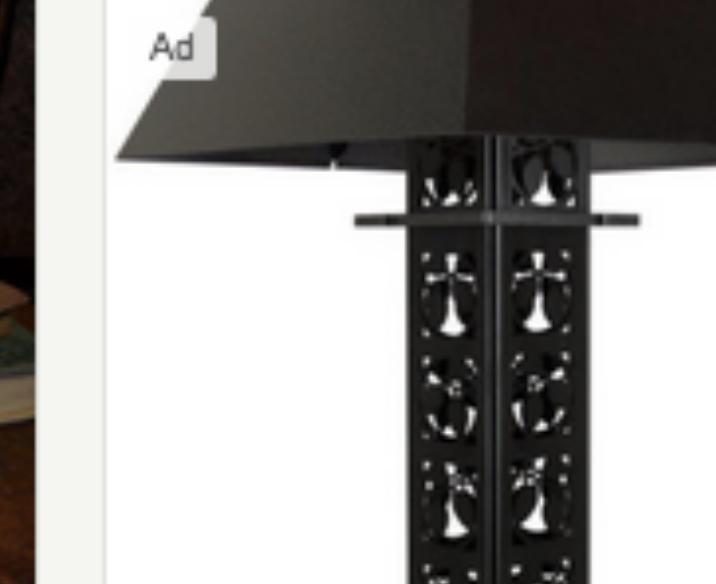
Follow  
another user with similar style/interest

# ETSY OVERVIEW

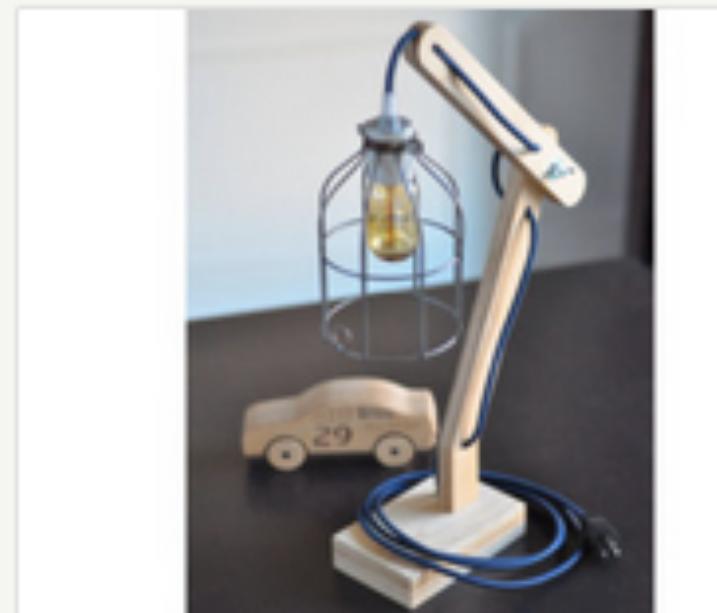
All Categories > "desk lamp" (10,756 Results)

Sort By: Relevancy ▾

 Ad  
Edison Lamp Nostalgic - Steampunk ...  
Timberson \$95.00 USD

 Ad  
Cascade Lamp by LightWater Artisans  
LightwaterArtisans \$749.00 USD

 Ad  
Brass Branches Desk Lamp w/ Marbl...  
brandonlenoir \$199.00 USD

 Ad  
Desk Lamp, Nursery Lamp, Bedside ...  
EllaMenoPeaDesign \$65.00 USD

 Ad  
Desk lamp , pastel light cyan color.....  
ILIU \$29.25 USD

 Ad  
Mid Century desk lamp vintage yello...  
rubyinthesky \$49.99 USD

 Ad  
Vintage Mid-Century Desk Lamp  
UrbanAmericana \$125.00 USD

 Ad  
Industrial Desk Lamp - Mint Green Wi...  
IndLights \$89.00 USD

 Ad  
Nintendo zapper gun desk lamp  
WarriorGameCrafts \$65.00 USD

All Categories > “desk lamp” (10,756 Results)



Edison Lamp Nostalgic - Steampunk ...

Timberson

\$95.00 USD



Cascade Lamp by LightWater Artisans

LightwaterArtisans

\$749.00 USD

# Recommendations on Etsy

# Recommendations on Etsy

Hi, Kamelia!

Following

Interactions

Looking for your shop activity?



Recently Favorited Items



New Items From Your Favorite Shops



Our Picks For You



## Item Recommendations



Blueberry Glazed Donut Watercol...

\$22.00 | DonutGalleria



Favorited by Christopher



NEW !! Stool / Seat / Ottoman / be...

\$325.94 | Habitables



Similar to some of your favorites

...

## Shop Recommendations



!!!! Summer gifts !!!! 2015

List curated by Vilma and Agne

16 items >

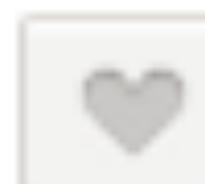


ModernSprout ★★★★★

Innovative Indoor Planters



12 items >



Favorited by Jayne

Sells items similar to your favorites

...

## User Recommendations



RABBIT  
WARREN

Elaine Swan

535 favorites

Follow



535 favorites >

 Followed by Jamie

# Marketing Emails

It's The Little Things

Etsy <emails@mail.etsy.com>  
to me ▾

May 2 (10 days ago) ★ ⏪ ⏴

Etsy

View this email online

Picked for You



Deer Ring Dish - Trinket Di...  
£4.75



Mens Squid on a Bike T S...  
£12.89



I'M AN  
**ENGINEER**  
TO SAVE TIME LET'S JUST  
ASSUME THAT I'M NEVER WRONG  
Funny Engineer T-Shirt En...  
£10.17



Womens VONNEGUT... S...  
£12.21



Energy Flow Fitted Hat ma...  
£16.96



Mens Vintage Robot Comp...  
£13.56

# Cart Recommendations

## You might also like...



Rose Gold Letter  
Necklace, Lower Case  
Letter, Rose Gold Initial,  
Rose Gold Initial  
Necklace, Initial Jewelry

By PROJECTDAHLIA

\$26.00 USD

Add to Cart



Gold Jewelry, Gold Bow  
Necklace, dainty  
handmade necklace,  
everyday, simple,  
birthday, wedding,

By PROJECTDAHLIA

\$24.00 USD

Add to Cart



Thin Gold chain necklace  
14 - 50 inch small 2mm  
gold chain oval links  
chain gold plated chain  
flat link chain ...

By acanthusjd

\$6.00 USD

Add to Cart

# Empty Cart Recommendations



Your cart is empty.

## Recommended Items



**Silver, gold, rose gold  
Bracelet- Pearl Bracelet-  
White Pearl- Dainty Silver  
Bracelet- Tiny Pearl  
Jewelry- 925...**

By West9th

**\$14.00 USD**

Add to Cart



**slip cast porcelain  
hanging crystal planter**

By Beanandbailey

**\$27.00 USD**

Add to Cart



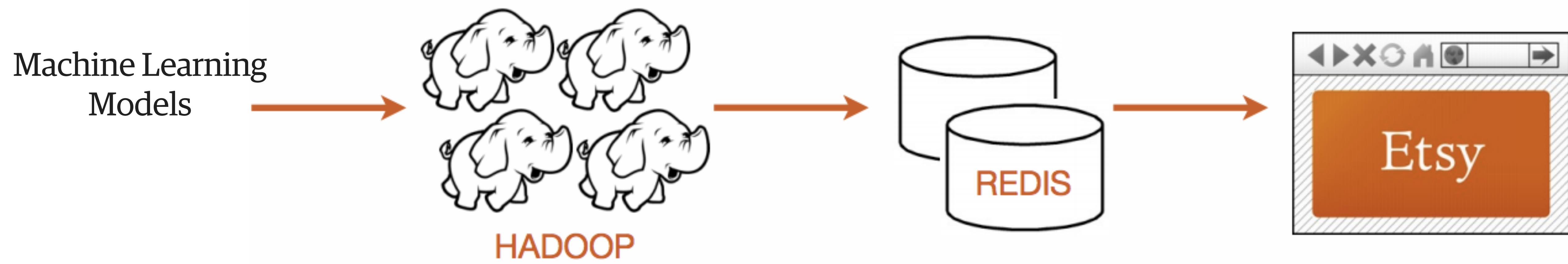
**Aqua Mint Earrings Aqua  
Dangle Earrings  
Bridesmaid Gifts Bridal  
Jewelry Drop Earrings  
Jewelry Accessories**

By LimonBijoux

**\$22.00 USD**

Add to Cart

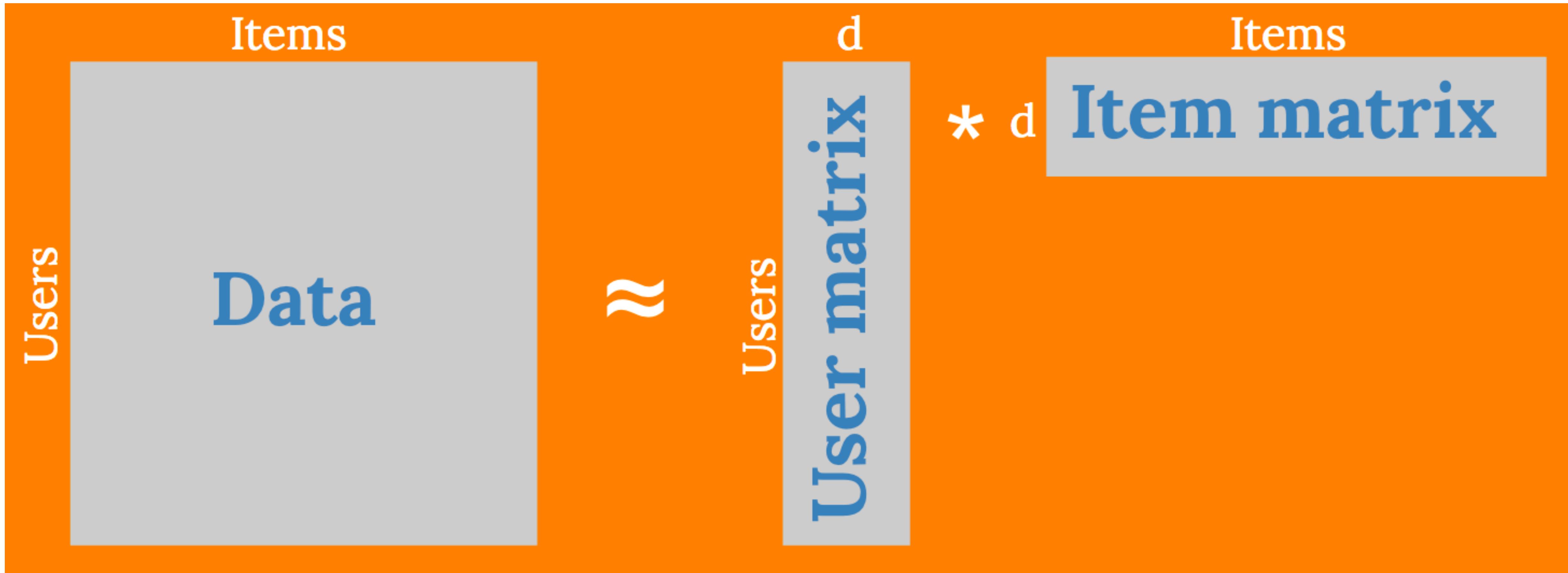
# Machine Learning Models for Personalization



# Matrix Factorization ( MF )

		Items				
						...
Users	Alice	1	1	0	0	
	Bob	0	0	1	1	
	Corey	1	0	1	0	
	...					

## Matrix Factorization ( MF )



# Users

Alice	0.9	-0.1
Bob	-0.8	0.5
Corey	0.1	0.8

# Items

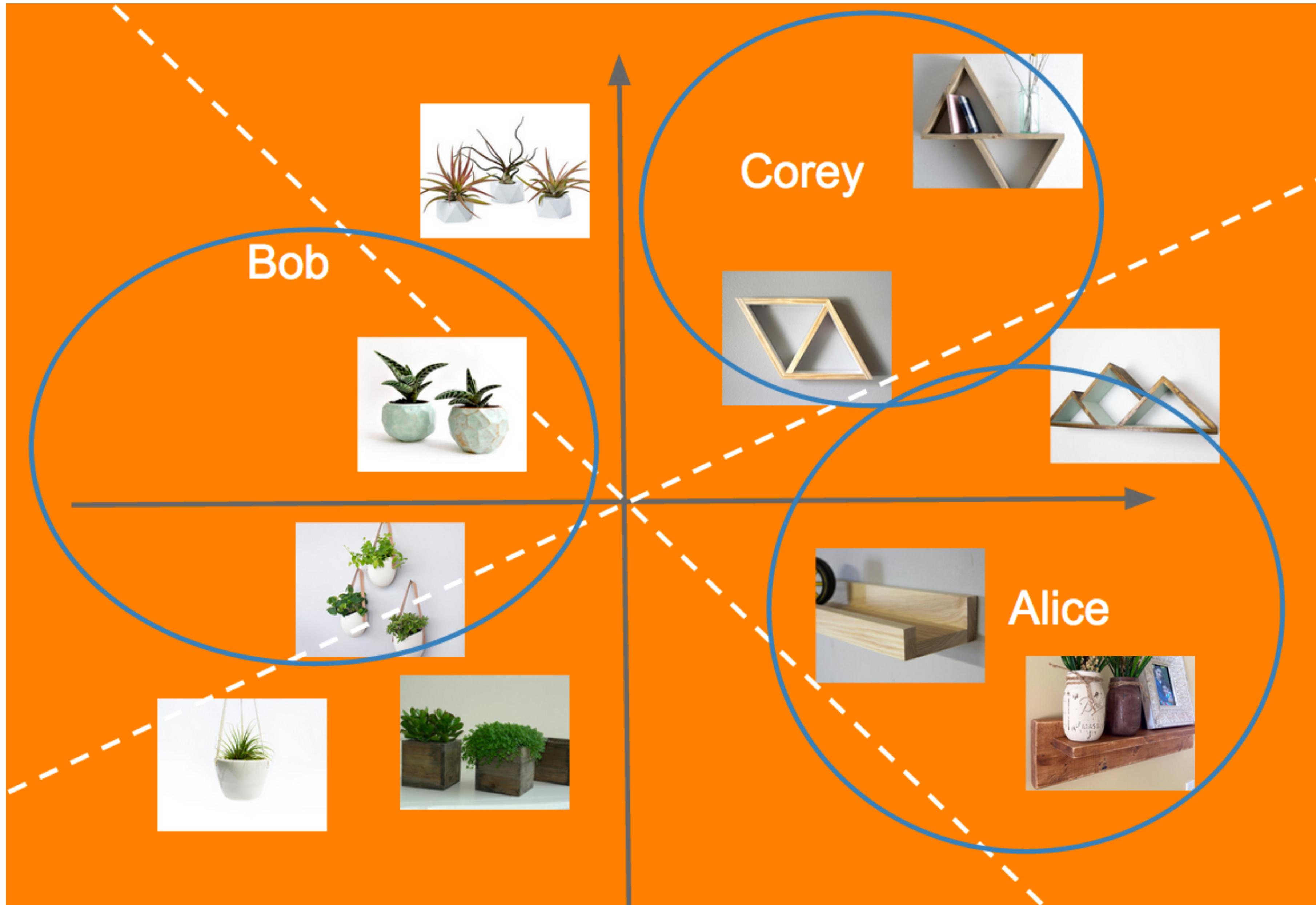
0.8	0.9	-0.7	-0.8
0.9	0.1	0.7	-0.5

score[Corey,



$$] = 0.1 * 0.9 + 0.8 * 0.1 = 0.17$$

# Locality Sensitive Hashing ( LSH )

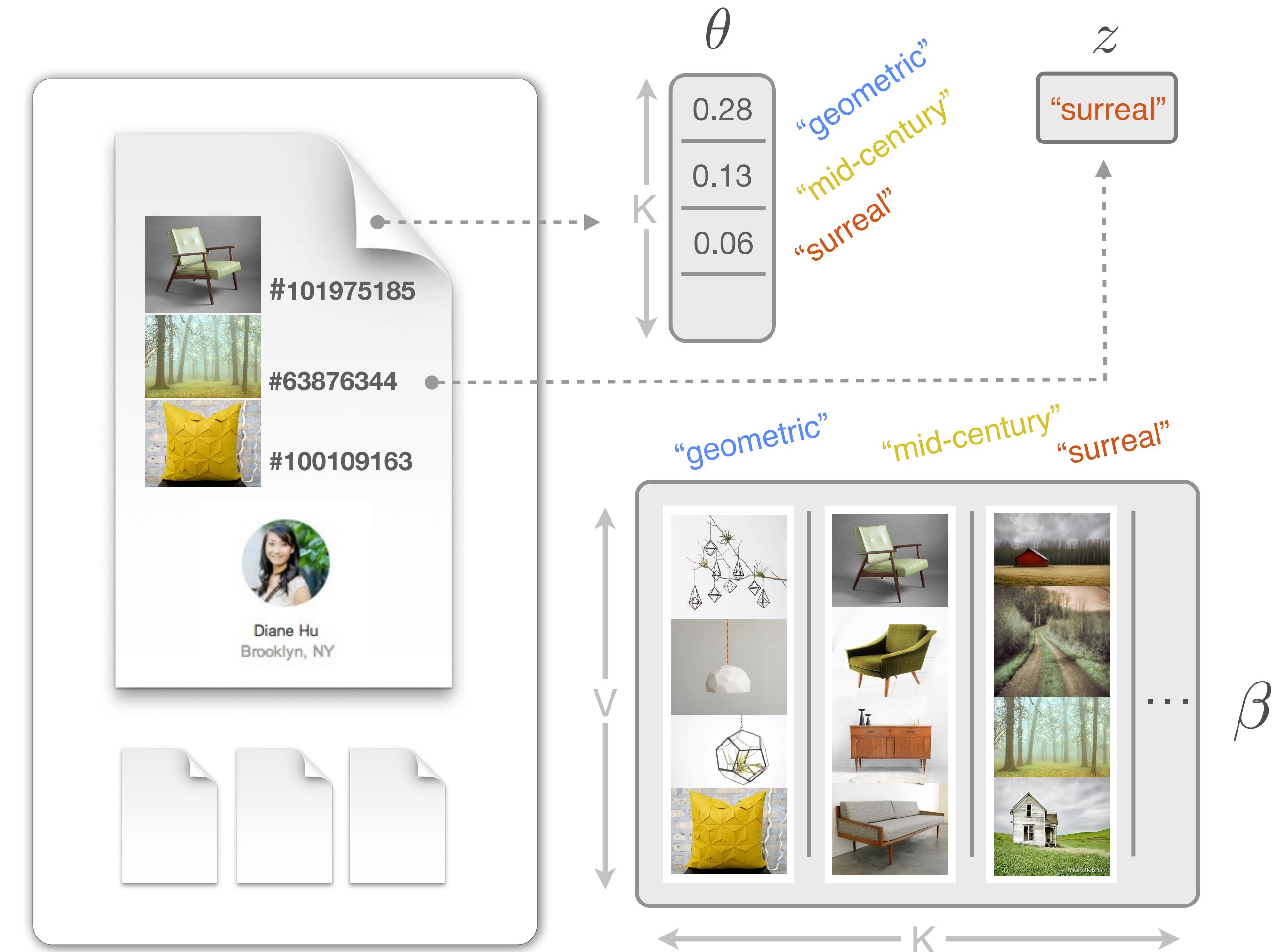


# Latent Dirichlet Allocation ( LDA )

Assume: Each user's favorited items are generated by this process:

For each user  $u$ ,

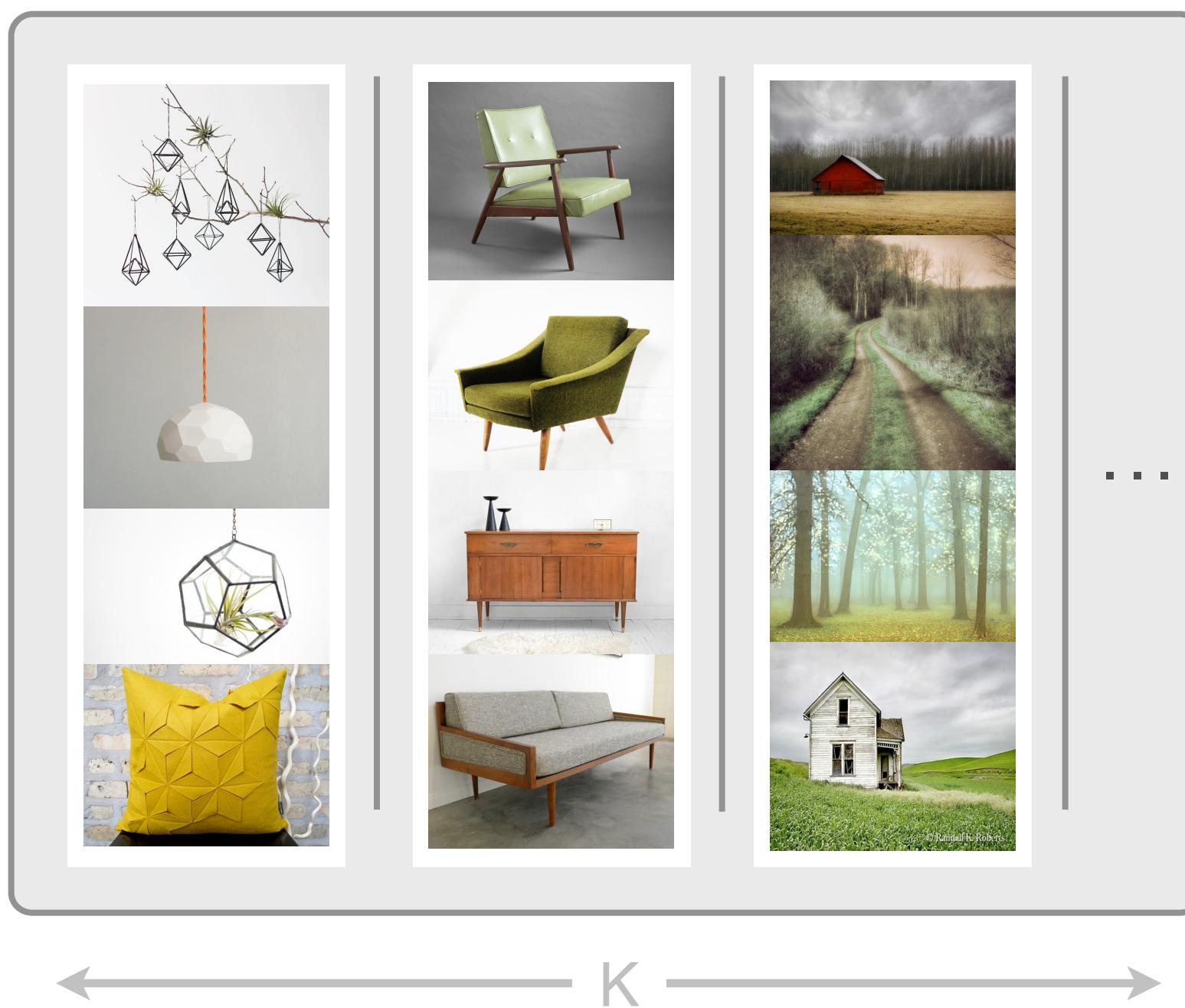
1. Draw a style profile:  
 $\theta \sim Dirichlet(\alpha)$
2. For each item,  $x_n$  that user  $u$  has favorited,
  - (a) Draw a style:  
 $z_n \sim Multinomial(\theta)$
  - (b) Draw an item:  
 $x_n \sim Multinomial(\beta_{z_n})$



# Latent Dirichlet Allocation ( LDA )

Discover popular styles on Etsy as a distribution over items

“geometric” “mid-century” “surreal”



Represent each user as a distribution over popular styles, i.e. “style profile”



## Different styles discovered by LDA

### ANIMALS



### TENTACLES



### GEOMETRIC

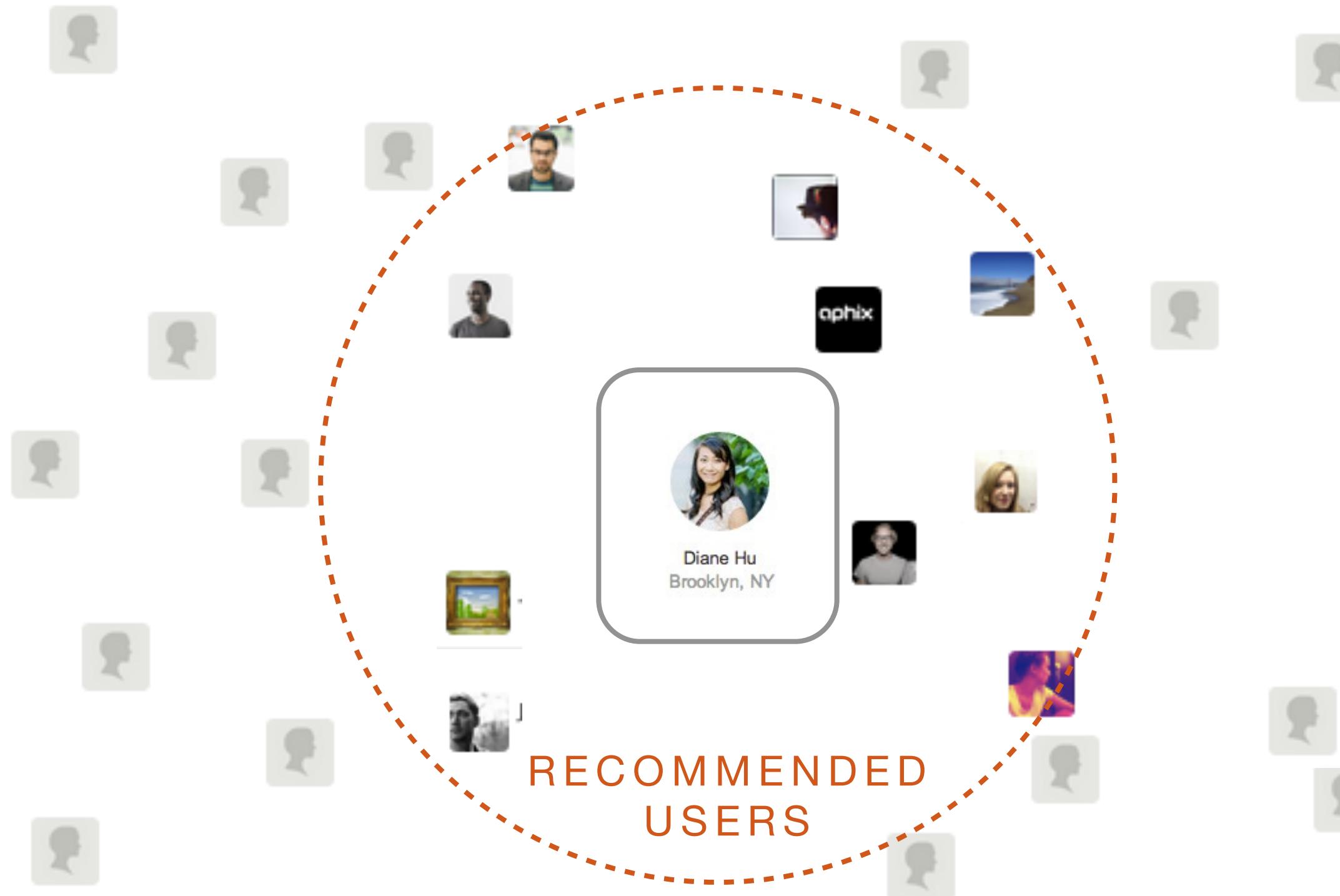


### MID-CENTURY MODERN



# User Recommendations

Given that each user has an style profile: **Recommend N users with most similar style profiles.**



**Brute-force K-NN is too expensive.** Hash similar users into the same bins, and perform K-NN within each bin

- **Locality Sensitive Hashing (LSH).** Create hash based on which side of a series of random planes the user falls onto.
- **"Top-K" Hashing.** Create hash based on set of all pairs of top-k topic indices.

# GENERATING RECOMMENDATIONS

Given that each user has an style profile: Sample items most highly weighted styles

## USER'S FAVORITES



## ITEM RECOMMENDATIONS



STYLE #428



STYLE #54



STYLE #655



STYLE #87

## Continuous Experimentation



## A/B Testing

*Example I:*

- LDA and No recommendations
- Significantly increased all business metrics

*Example II:*

- Different variants of LDA and Matrix Factorization (using Stochastic SVD)
- Matrix factorization and LDA comparable across business metrics

## Conclusion

### *Personalization through Recommendations:*

- Constantly developing new models
- A/B testing and evaluating the results

### *Sharing what we learnt:*

- Open source projects: Checkout Conjecture ( <https://github.com/etsy/Conjecture> )
- Active research involvement through publications and talks
- Code as craft talks and posts

Questions?

Thank you!

<https://github.com/karyafar/openAir2015>