

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

40M

Users

1M

Shops

26M

Listings

9

Languages

200

Countries

Meet the Data Scientists



Josh Attenberg



Rob Hall



Kamelia Aryafar



Diane Hu



Corey Lynch



Andrew Clegg

How do people typically use Etsy?



Landing pages

1

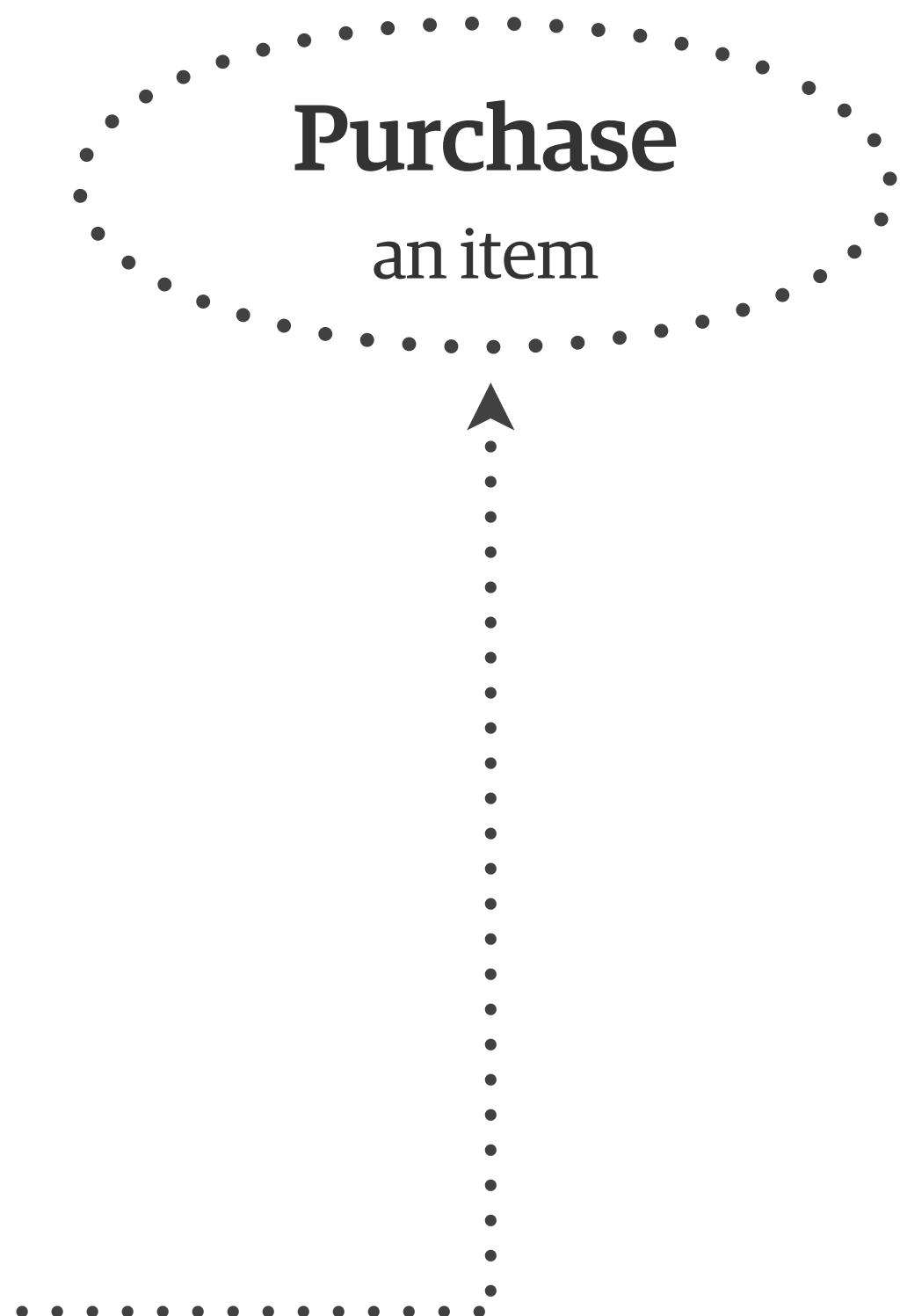
Pinterest
Facebook
GPLA

2

Marketing Emails
Including Recommendations

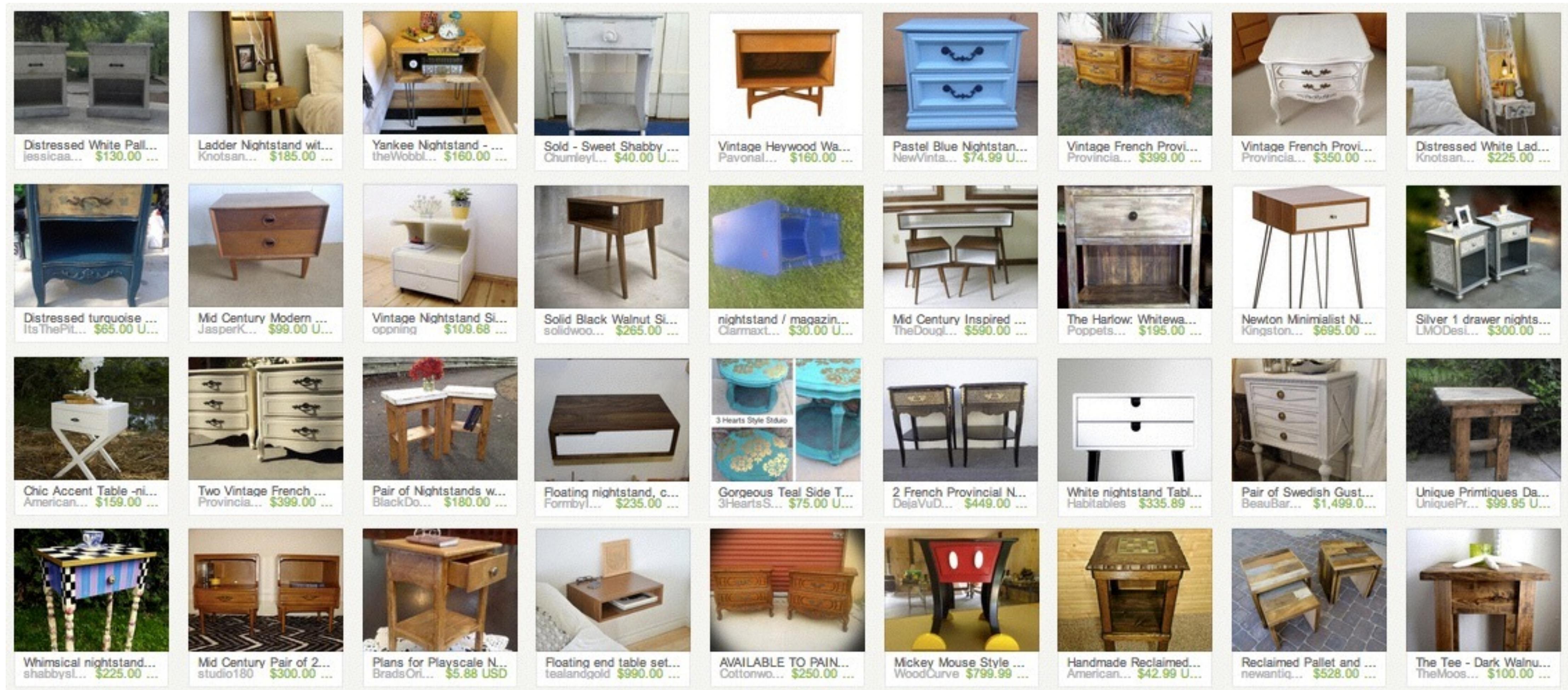
Click on Listings

Landing Pages



How do people decide what to buy?

Example: search results for “nightstand” - 100+ pages



What Personalization Looks Like on Etsy

Recommendations
for **multiple intents**

Enhance browsing
experience, not just
purchases

Recommendations
for **multiple content
types**

Develop unified method
for recommending
shops, items, users

Recommendations
based on **visual styles**

Identify user styles and
interests in a visually
transparent way

Recommendations on Etsy

The screenshot displays a vertical scrollable feed of recommendations on the Etsy platform. At the top, there is a horizontal banner featuring six different items: a colorful graphic of small icons forming a shape, a cartoon illustration of a train and sea creatures, a tank top with mathematical symbols, two framed purple octopus prints, a comic book style 'COMIC' poster, and a dark, stylized creature illustration.

New Items From Your Favourite Shops

The first recommendation section shows six items from favorite shops: a cable-knit sweater labeled "The European Line in Double Knitting", a decorative mask with gold and black patterns, a wooden ring, three tacos on a wooden board with dipping sauces, a blue bicycle wheel, and a wooden box containing a notebook and a pair of scissors.

Our Picks For You

The second recommendation section shows five items: a sticker featuring the Powerpuff Girls, a sticker of a black cat, a sticker of a dog wearing a green hat in a white cup, a sticker of a character with curly hair, and a small image of a Hello Sanrio character.

The third recommendation section shows a grid of 128 items from the seller "adesigngeek" (A DESIGN GEEK), which includes vinyl posters and graphics. The items feature various pop culture and geeky designs, such as Disney princesses, Star Wars characters, and superhero icons.

Mandrie ★★★★★
Minnesota, United States

Sells items similar to your favourites

adesigngeek ★★★★★
A DESIGN GEEK
vinyl posters graphics

Sells items similar to your favourites

Marketing Similar Items

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

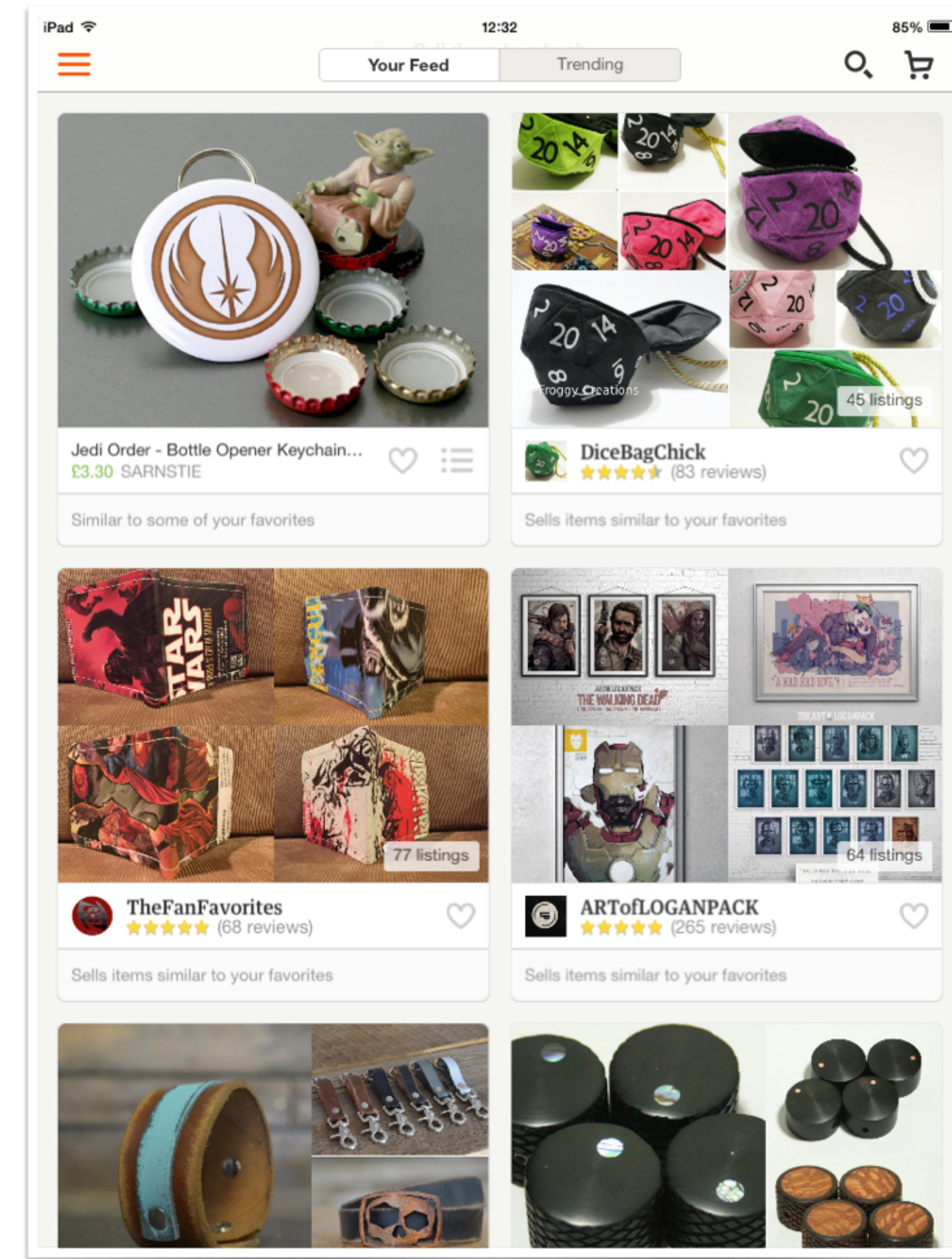


Energy Flow Fitted Hat ma...
£16.96



Mens Vintage Robot Comp...
£13.56

Showing Recommendations in Mobile

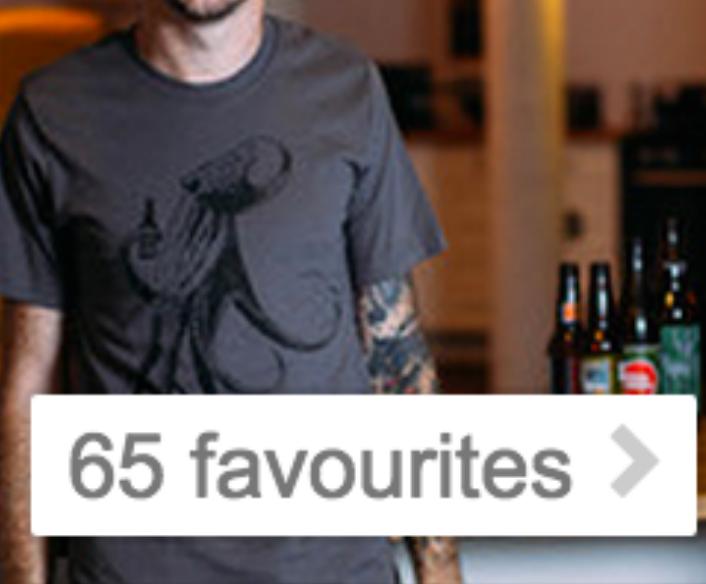


Recommendations on Etsy



Richie Rivera
65 favourites

Follow

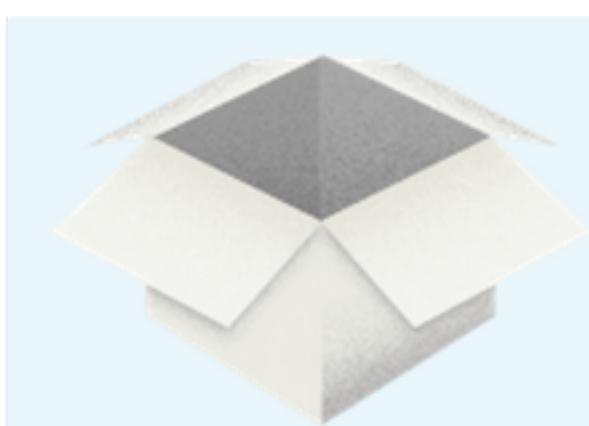


65 favourites >

Has favourites we think you'll enjoy

•••

Recommendations on Etsy



Your cart is empty.

Recommended Items



Mens CAT in a Hat Funny Vintage Newsboy T Shirt tee - American Apparel Tshirt - S M L XL (15 Color Options)

By lastearth

£12.54 GBP

Add to Cart



Folk Punk Buttons

By PatchTrash

£0.66 GBP

Add to Cart



Mens T-Shirt - Vintage Hot Air Balloons American Apparel Mens American Apparel Shirt - Available in sizes S, M...

By friendlyoak

£12.54 GBP

Add to Cart



Mens Hammerhead Shark on a BICYCLE SHIRT - American Apparel T Shirt xs s m l xl xxl (custom colors)

By darkcycleclothing

£15.84 GBP

Add to Cart



Mens TShirt - Rib Cage and Lungs - Natural History American Apparel Screen Print

By darkcycleclothing

£15.84 GBP

Add to Cart



World War Two Bomber Planes - Men's Graphic Tee

By CrawlspaceStudio

£15.84 GBP

Add to Cart

Trending Items

Explore shoppers' top finds from around the marketplace.



Shelf for bathroom Floating shelf Wall...
babytriumph

£11.22 GBP



Paws - laser engraved rolling pin, em...
RollingWoods

£21.72 GBP



White Rabbit Figurine by Bonjour Po...
BonjourPoupette

£26.39 GBP



Personalized Groomsmen's Gift Whi...
hostandtoaststudio

£35.63 GBP



in a bird's eye view lamp. Pendant la...
PETULAPLAS

£46.19 GBP



Pottery Honey Pot - Polka Dot Sea f...
FringeandFettle

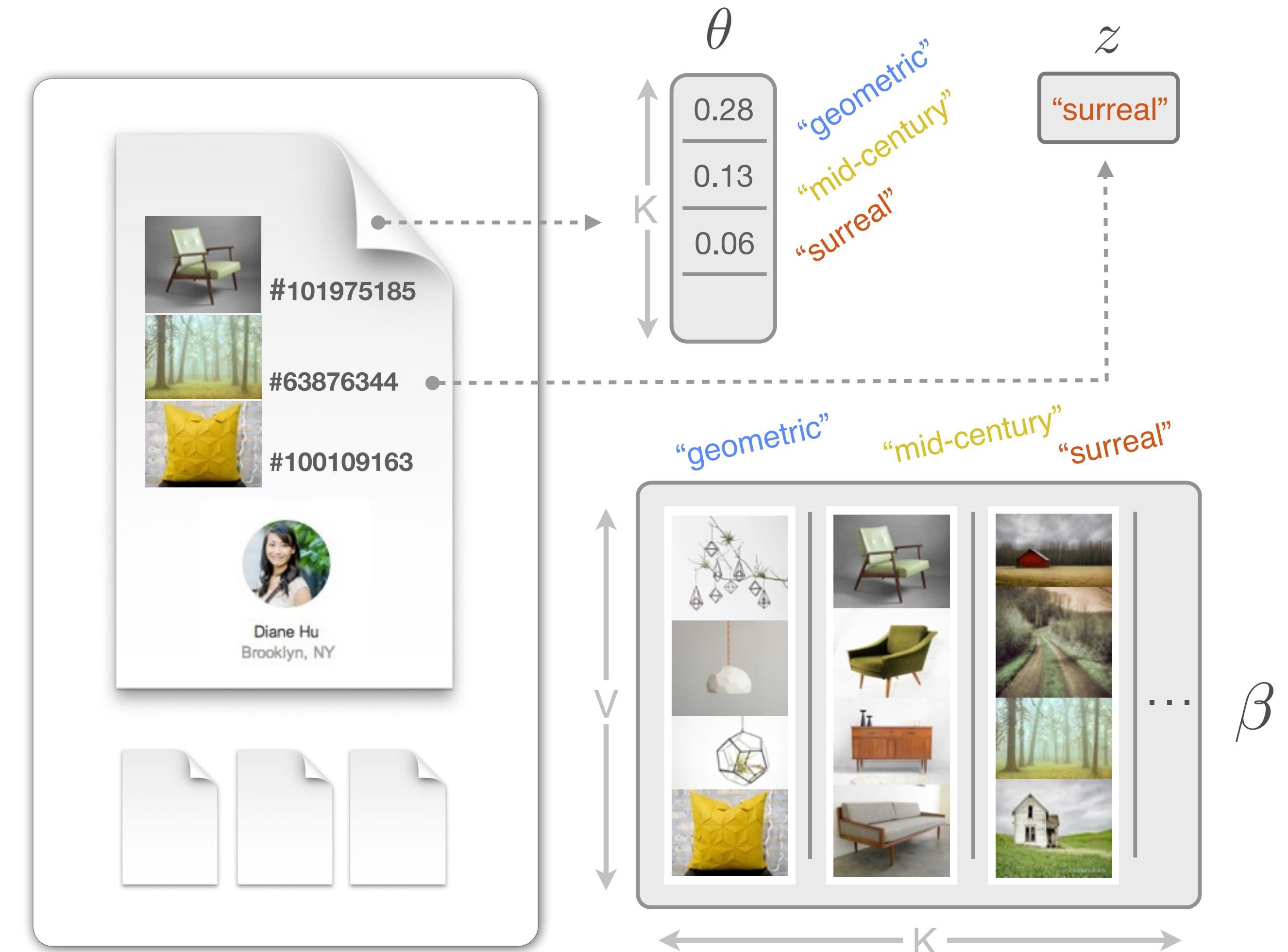
£31.67 GBP

Latent Dirichlet Allocation (LDA) for Discovering Styles

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) for Discovering Styles

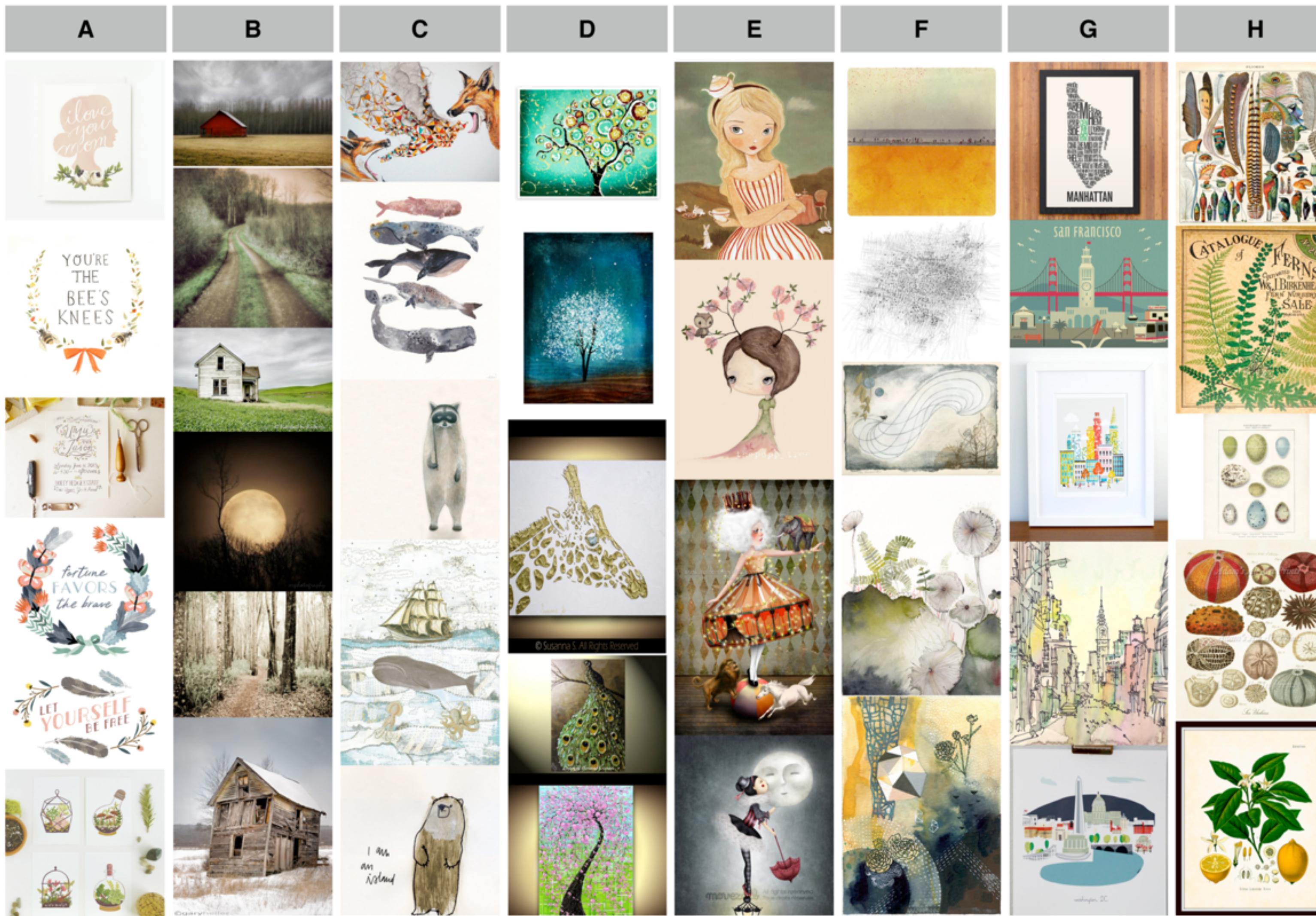
Discover popular styles on Etsy as a distribution over items



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



Different styles discovered by LDA



Example of learned styles that contain art prints:

A = Botanical

B = Surreal landscapes

C = Whimsical

D = Acrylic/Abstract

E = French Dolls

F = Whimsical/Abstract

G = Cities

H = Vintage

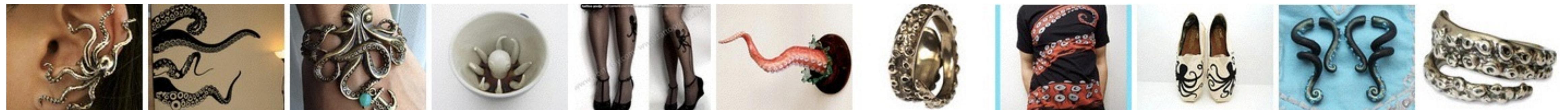
DISCOVERING USER STYLES

Different styles discovered by LDA

ANIMALS



TENTACLES



GEOMETRIC

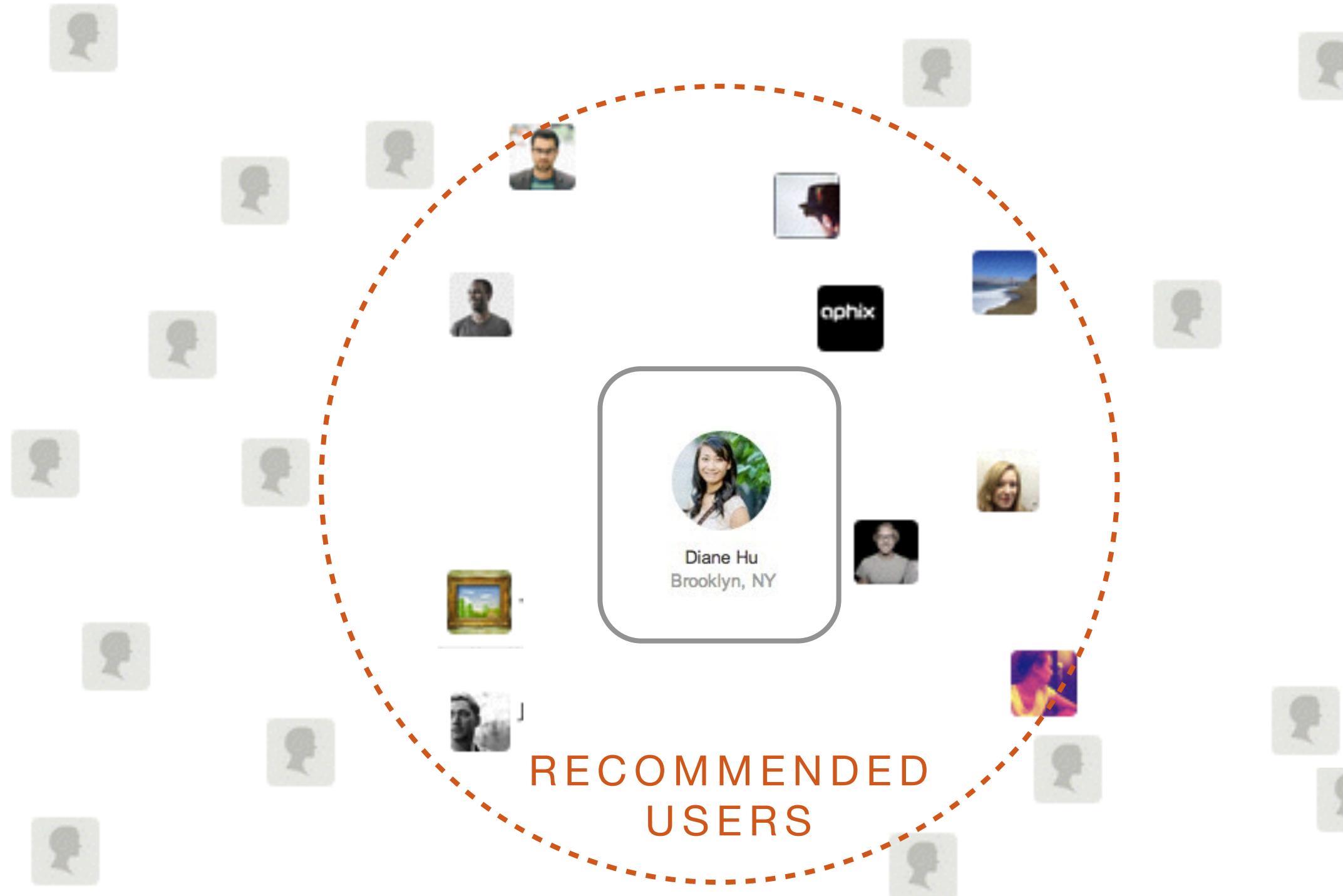


MID-CENTURY MODERN



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.

Item Recommendations

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

USER'S FAVORITES



ITEM RECOMMENDATIONS



STYLE #428



STYLE #54



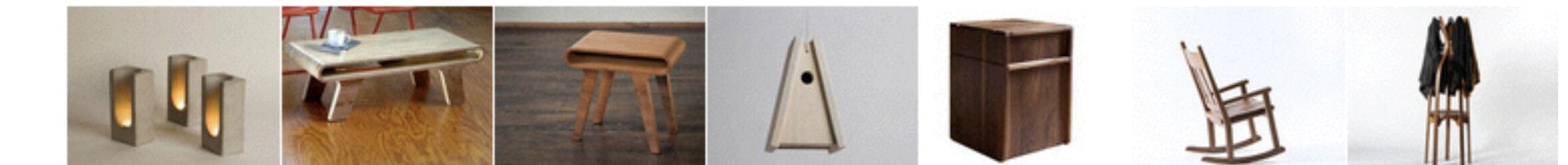
STYLE #655



STYLE #87

Shop Recommendations

Re-learn topic models substituting item ids with shop ids. **Sample shops from highly weighted styles**



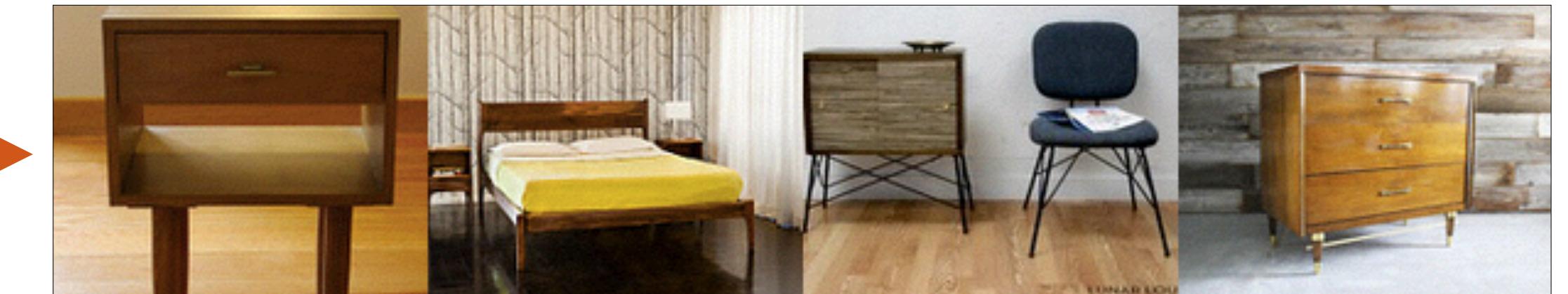
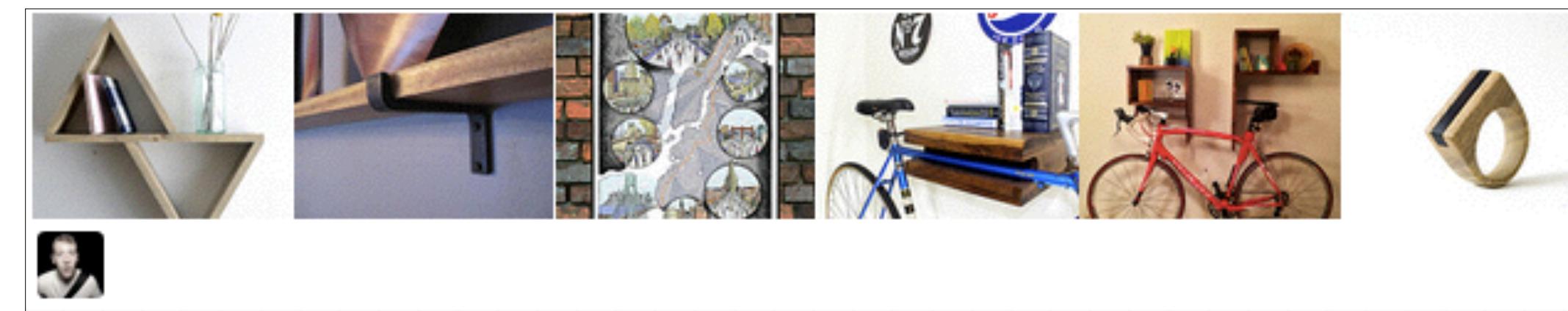
Shop Recommendations

Re-learn topic models substituting item ids with shop ids. **Sample shops from highly weighted styles**



Recommending Styles within Categories

Find how overall styles translate into specific categories



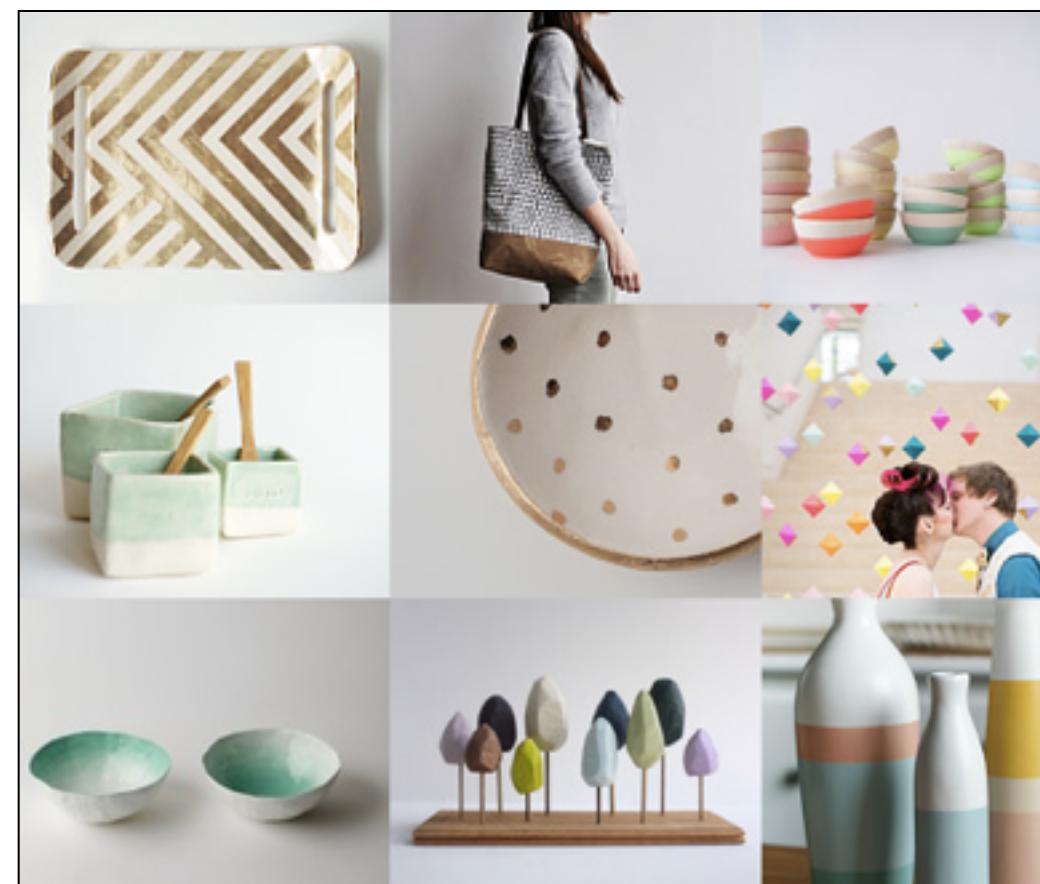
Visualizing Related Topics

Learn topic correlations from users' style-profiles.

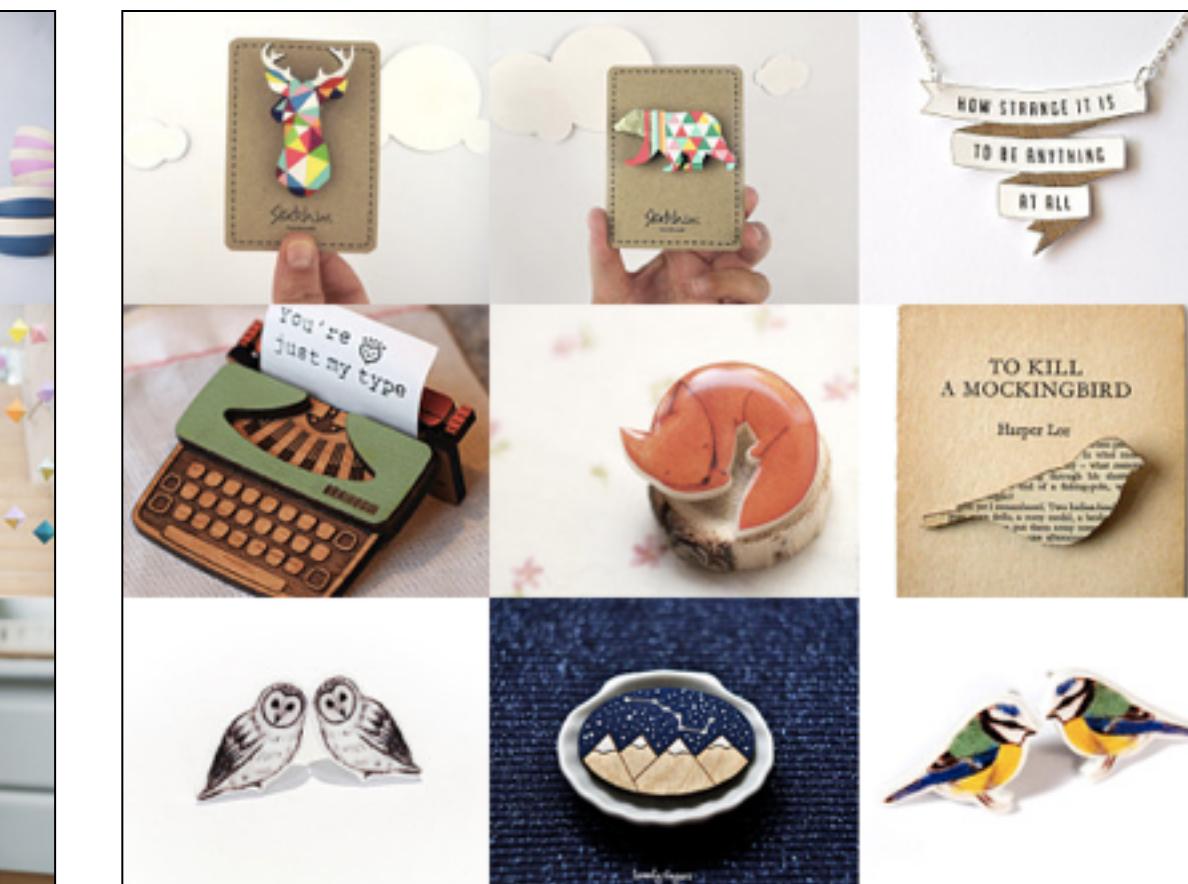
STYLE #1



STYLE #2



STYLE #3



STYLE #4

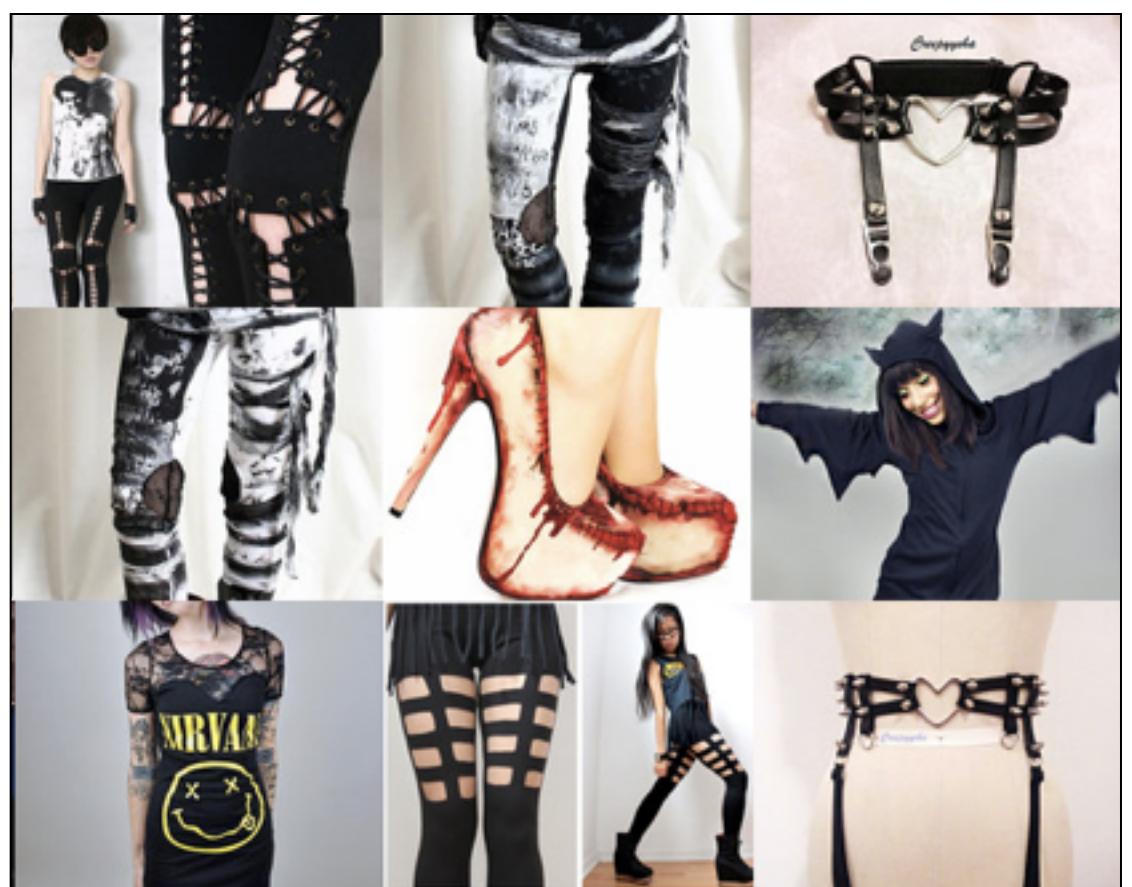


“Bright, Whimsical”

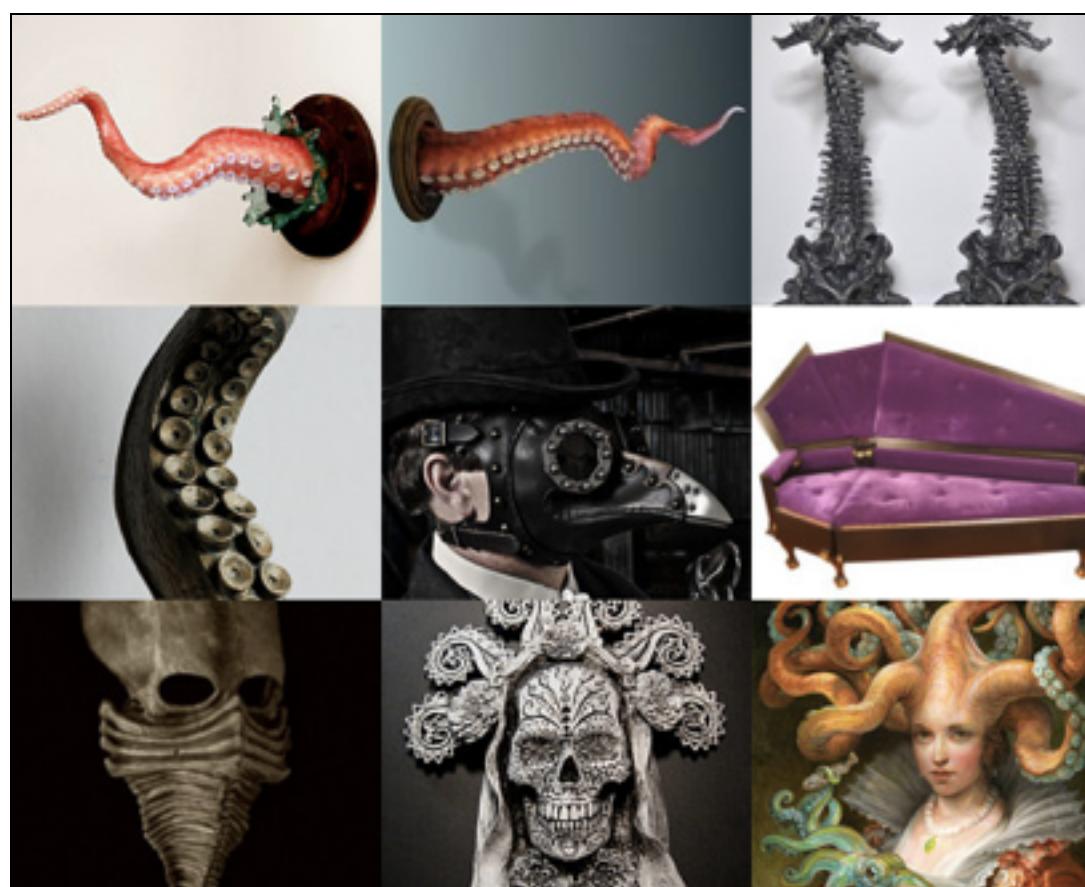
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Learn topic correlations from users' style-profiles.

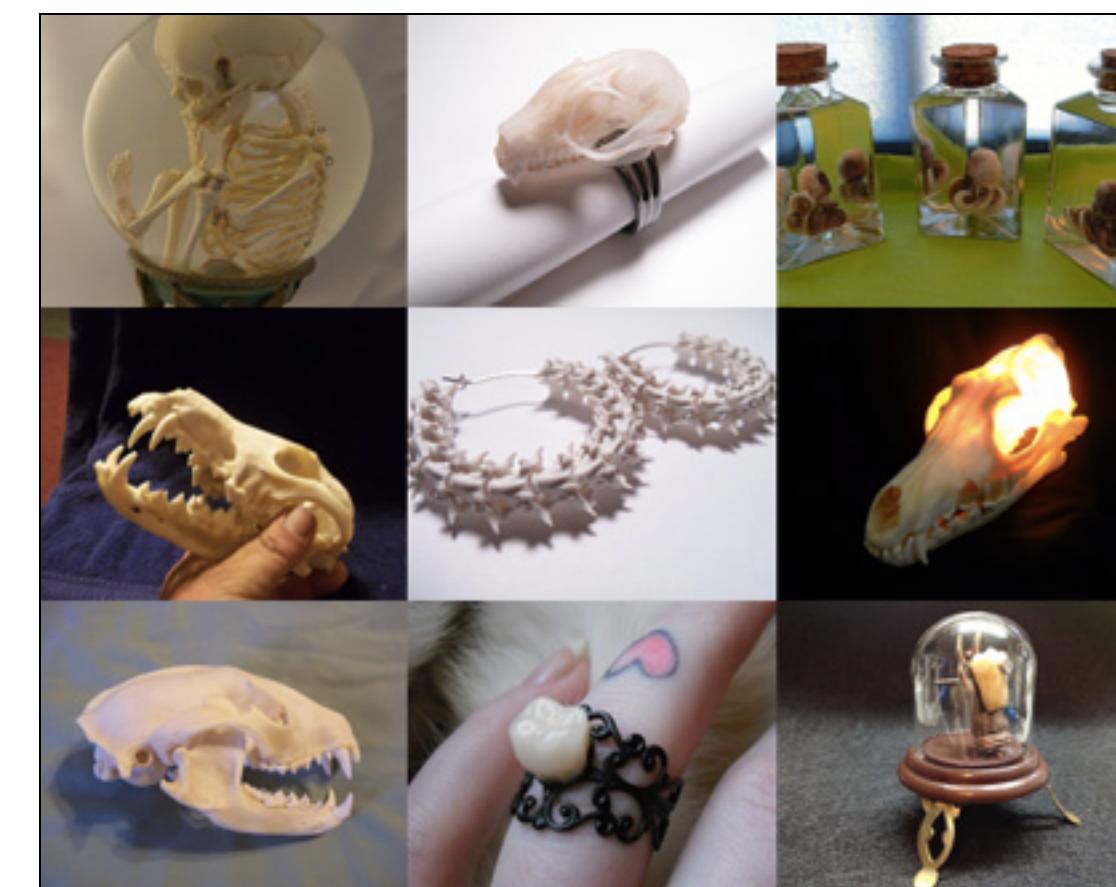
STYLE #1



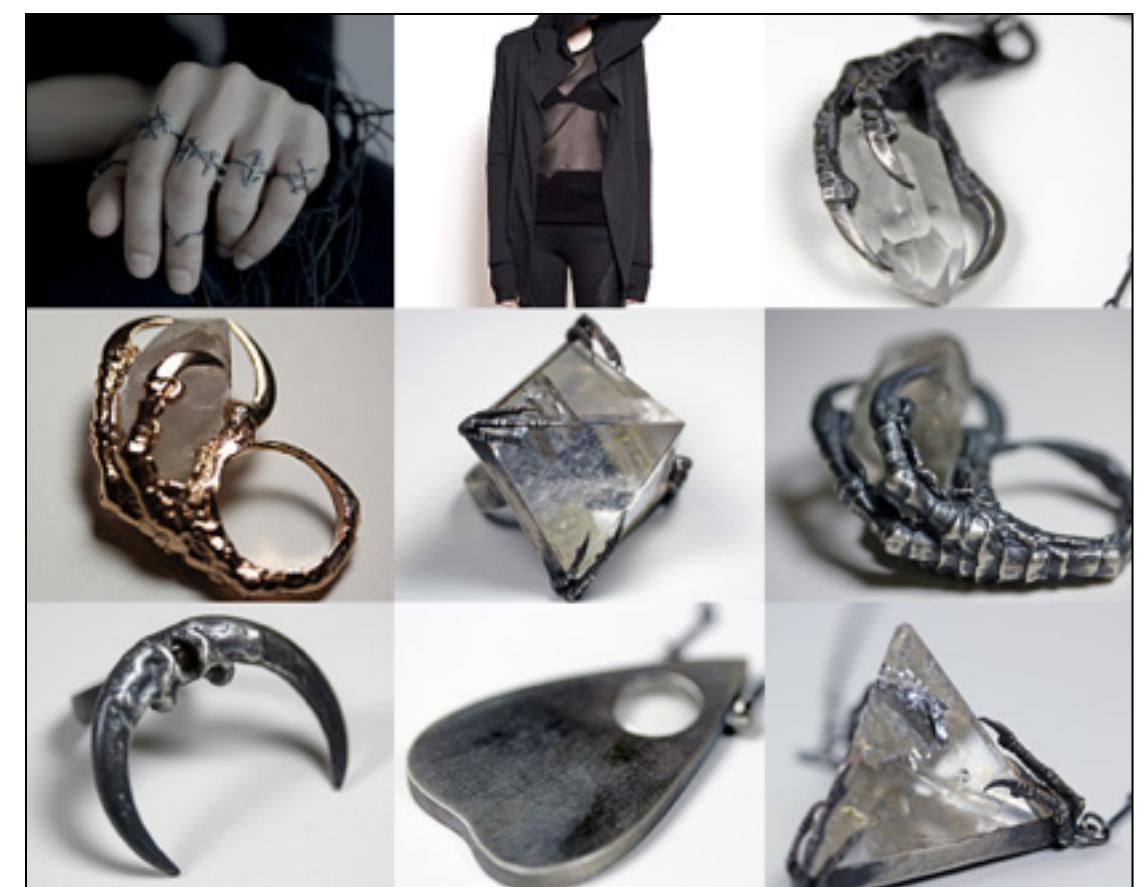
STYLE #2



STYLE #3



STYLE #4

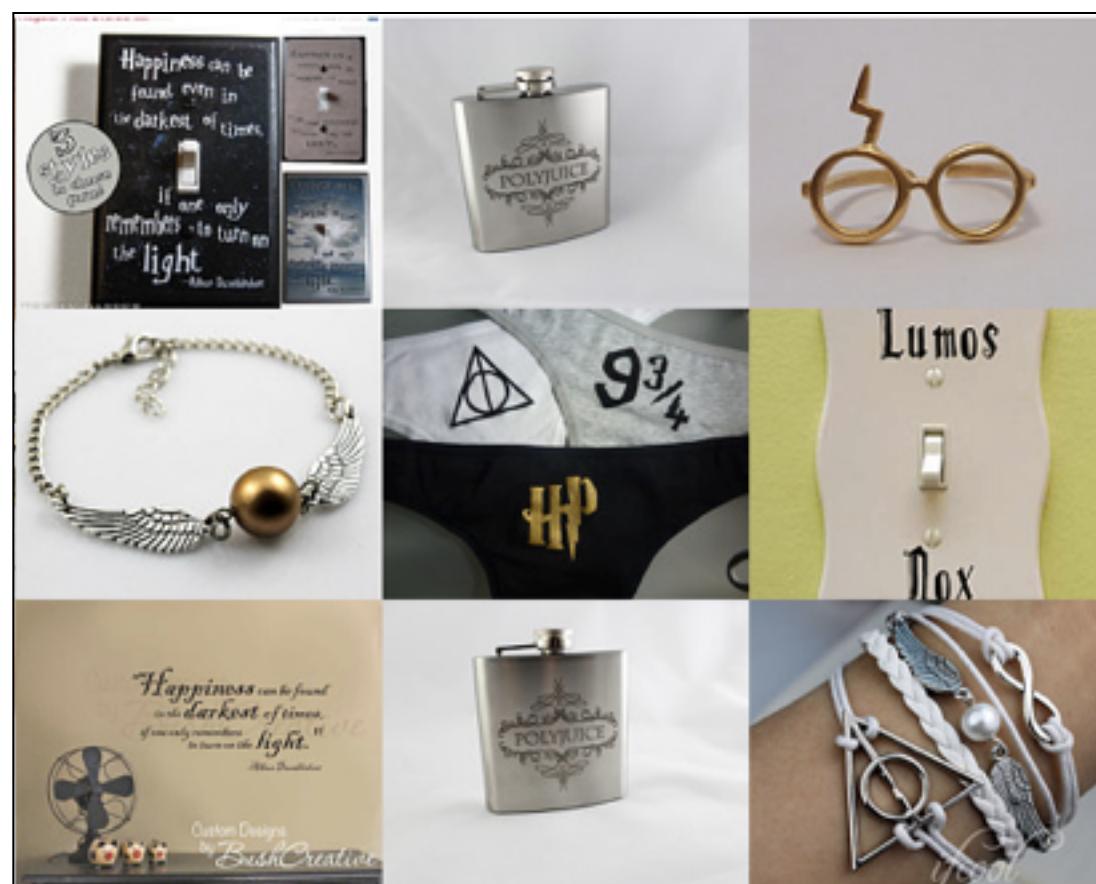


“Gothic Punk”

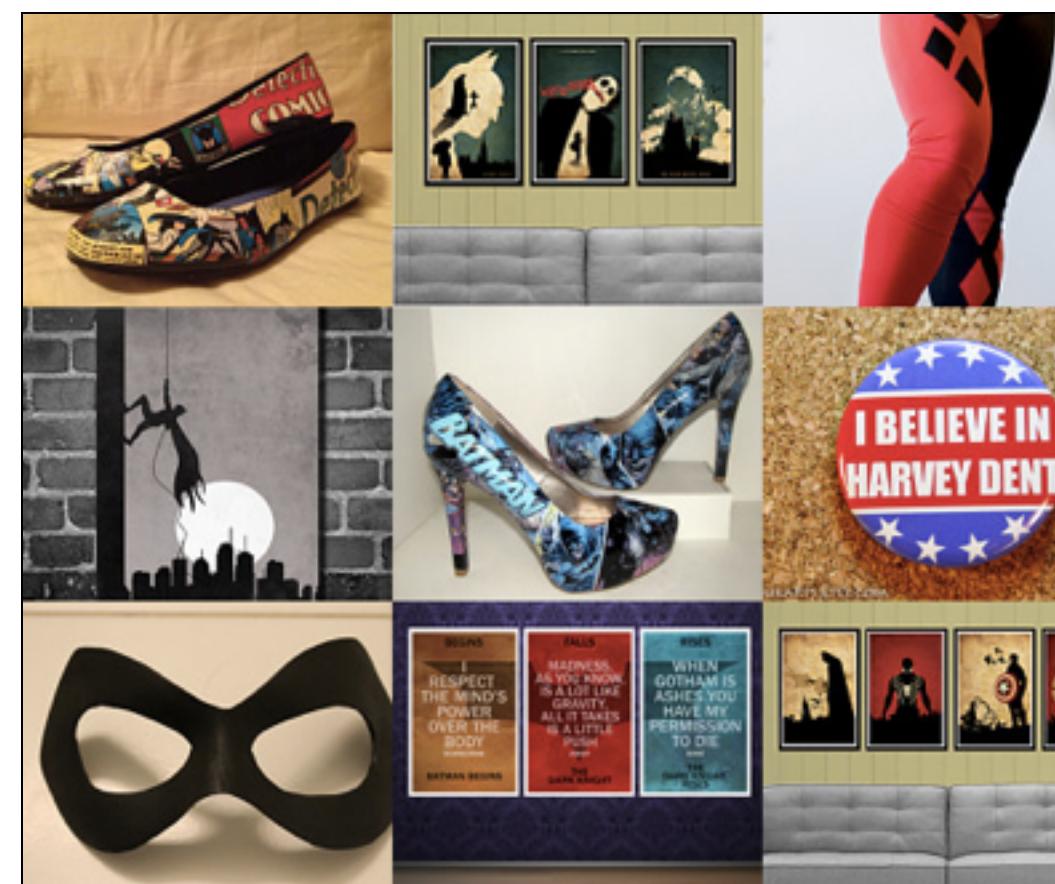
Visualizing Related Topics

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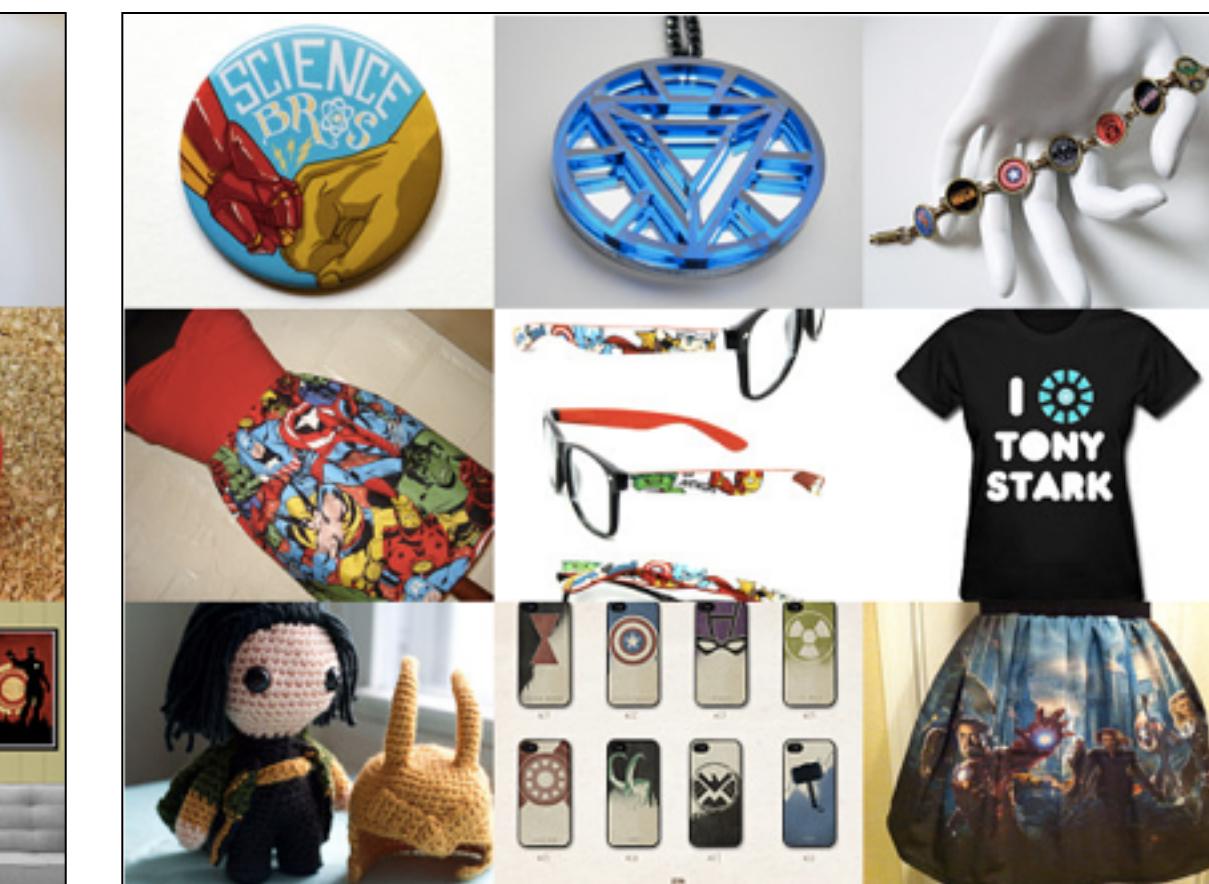
STYLE #1



STYLE #2



STYLE #3



STYLE #4



“Sci-fi/Fantasy”

Recommendations in the Activity Feed

Etsy Search for items or shops Search Browse Etsy

Your Feed Following Interactions Looking for your shop activity?

Our Picks For You

Crochet Jellyfish Baby Mobile, Nu... \$192.28 USD | kckshop FAVORITED BY CHRISTOPHER

midcentury8 ★★★★★ Los Angeles, California Sells items similar to your favorites

Recent Blog Posts See more Editors' Picks: Desert Dreams Read the post

Real Weddings: A DIY Backyard Brunch Read the post

Browse

Trending Items Back to School Gift Ideas Mobile Accessories

Featured Shop See more artemer Read the interview

128 items >

78 items >

More Ways to Shop

Categories Gift Cards Colors Treasury Shop Local

JennSki ★★★★★ Jenn Ski Art Sells items similar to your favorites

ANUT WATTANARUJ Bangkok, Thailand Follow

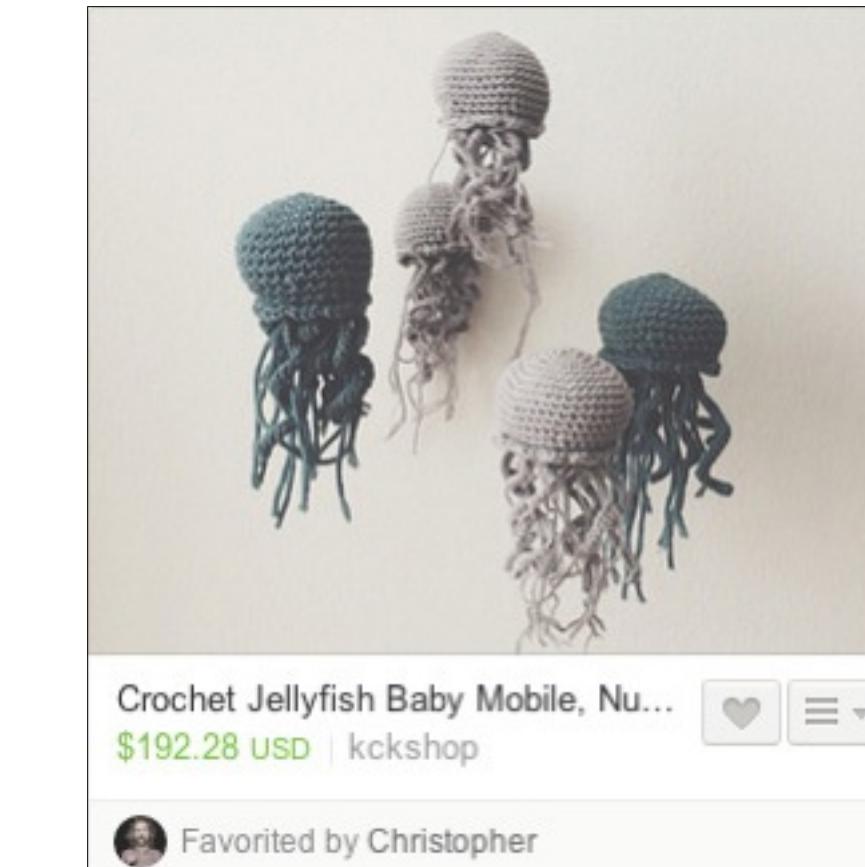
koen mini coffee table with hairsin... \$275.00 USD | birdloft Similar to some of your favorites

Molecule Puzzle \$12.50 USD | siamcollection Similar to some of your favorites

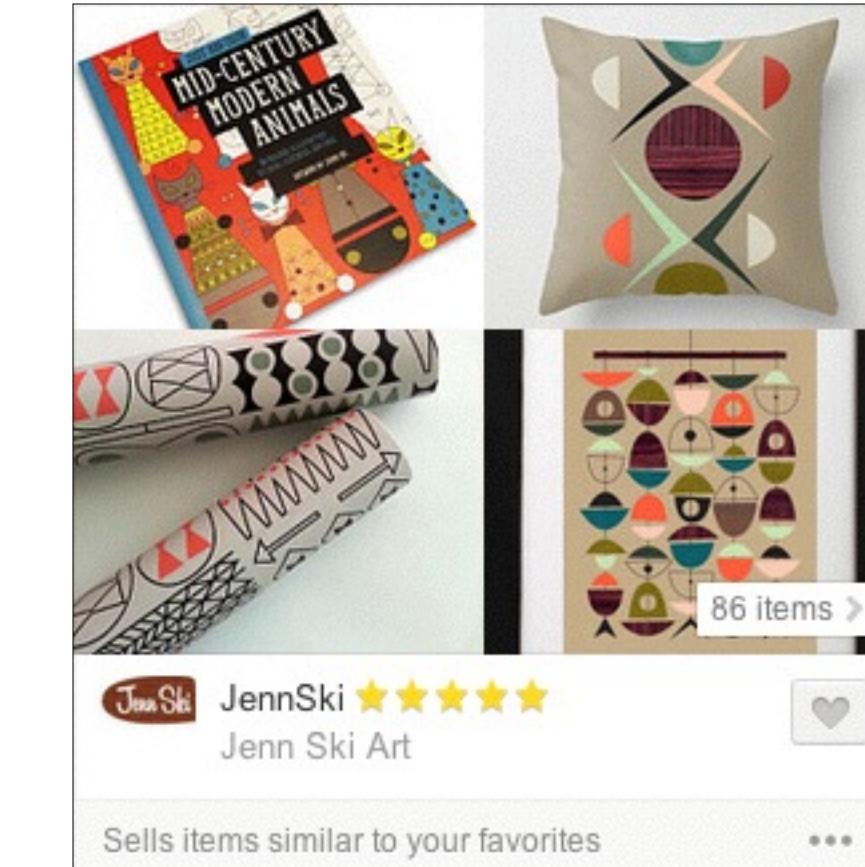
Has favorites we think you'll enjoy

72 favorites >

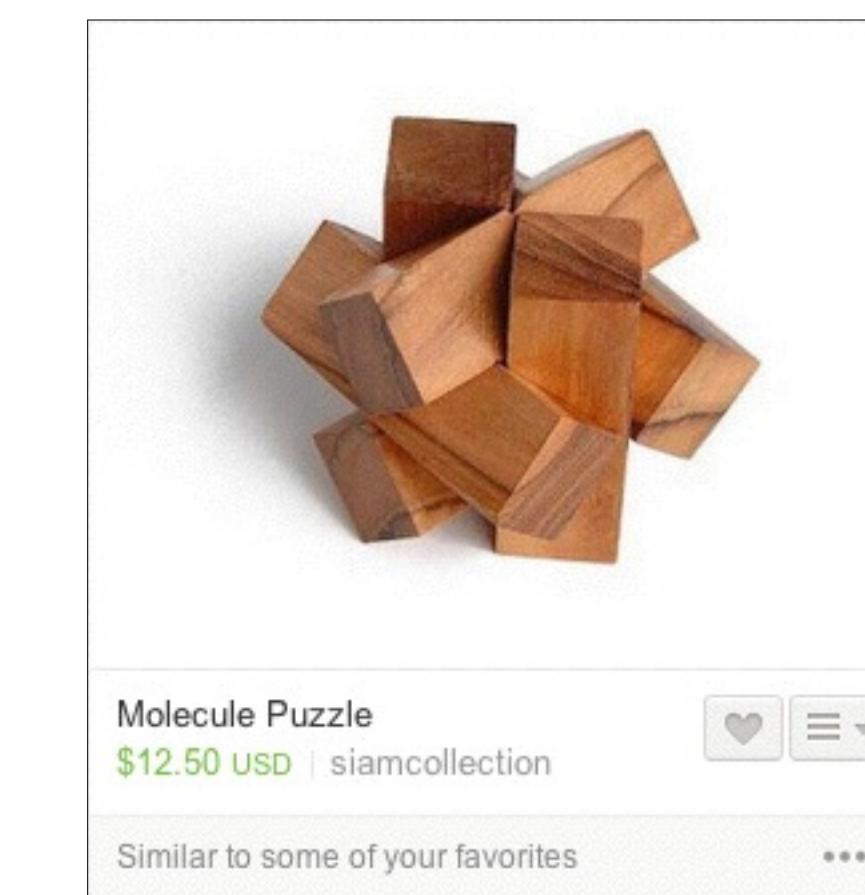
ORGANIC



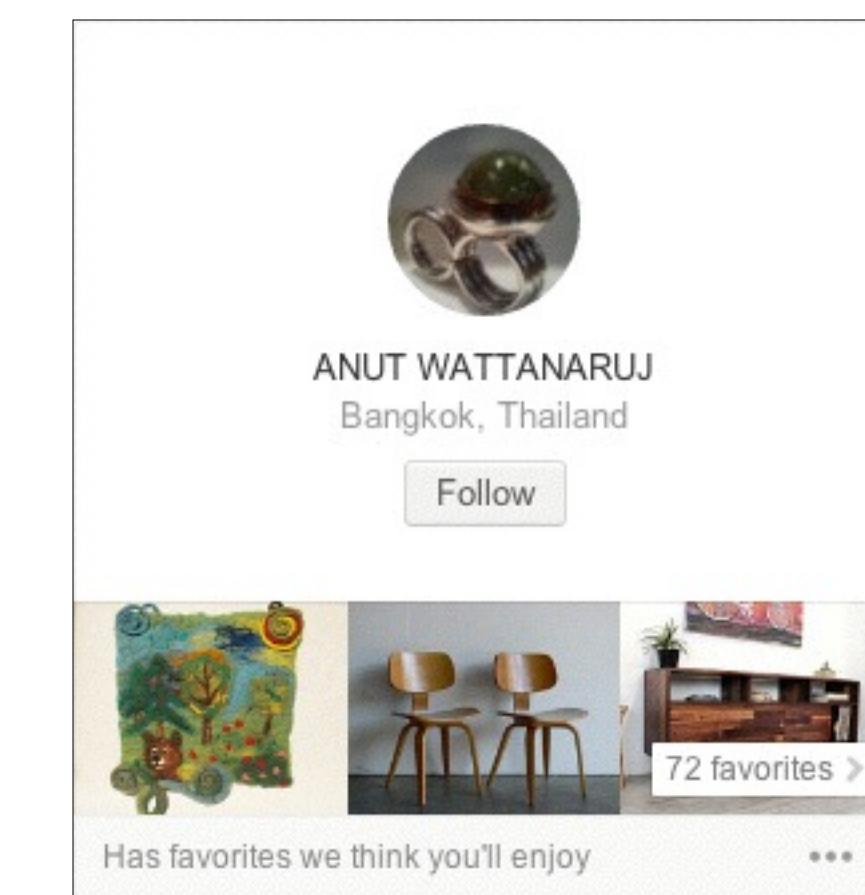
SHOP REC



ITEM REC



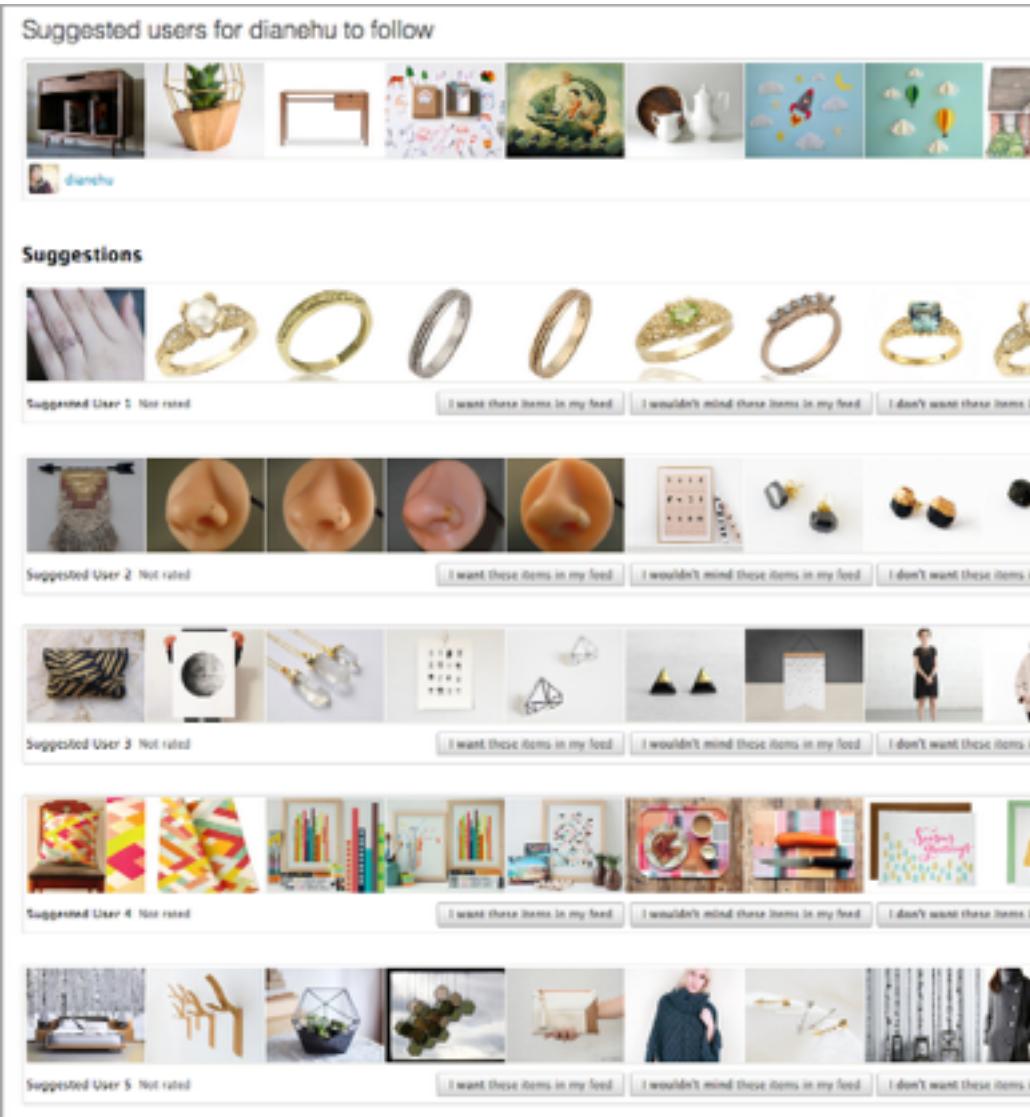
USER REC



User Recommendation Experiments

Side-by-Side User Study

- Randomly interleave user recs from 3 algorithms: (1) LDA, (2) TF-IDF w/ Cosine Similarity, (3) Triadic Closure
- User rated each recommendation positive, neutral, negative
- LDA was overwhelming winner



A/B Testing in Activity Feed

Phase One:

- LDA vs. No recs
- Significantly increased all business metrics

Phase Two:

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

Questions?

Thank you!

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