

Pizza-Vision

Computer Vision and Natural Language Processing
Fueled Pizza Recommendations

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Metis 2021

**Have you
ever...**

Had a favorite pizzeria close

Moved to a new town and wanted a taste of home

Scrolled endlessly through restaurant options

Just wanted to discover something new

My story



My wife's favorite pizzeria closed

My story



My wife's favorite pizzeria closed
It did not fit neatly into a style

My story



My wife's favorite pizzeria closed
It did not fit neatly into a style
I can still find pictures online

My story



My wife's favorite pizzeria closed
It did not fit neatly into a style
I can still find pictures online

**Can I build a tool to output recommendations
based on those images?**

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01



Data

Chicagoland Yelp

Images were scraped from restaurant pages

Photos for Lou Malnati's Pizzeria - Search Results



Add photos

< All (5001) Food (3756) Inside (307) Outside (251) Menu (192) Drink (100) >

pizza



632 photos mention "pizza" Clear



Mistagged images were removed from the dataset

Photos for Lou Malnati's Pizzeria - Search Results



Lou Malnati's Pizzeria
★★★★★ 6203 reviews

Add photos

< All (5001) Food (3756) Inside (307) Outside (251) Menu (192) Drink (100) >

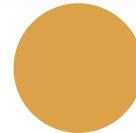
pizza



632 photos mention "pizza" Clear X



Recommended reviews were scraped from pages



Manhattan, KS

0 52 109

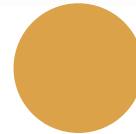


2/16/2021

2 photos 1 check-in

We tried this place on the recommendation of our Uber driver. It didn't disappoint! The appetizer, local beer, and deep dish pizza were all wonderful. We added basil to the crust and it was just amazing. Everyone should stop by.

Reviews were narrowed down to pertinent sentences



Manhattan, KS

0 52 109



2/16/2021

2 photos

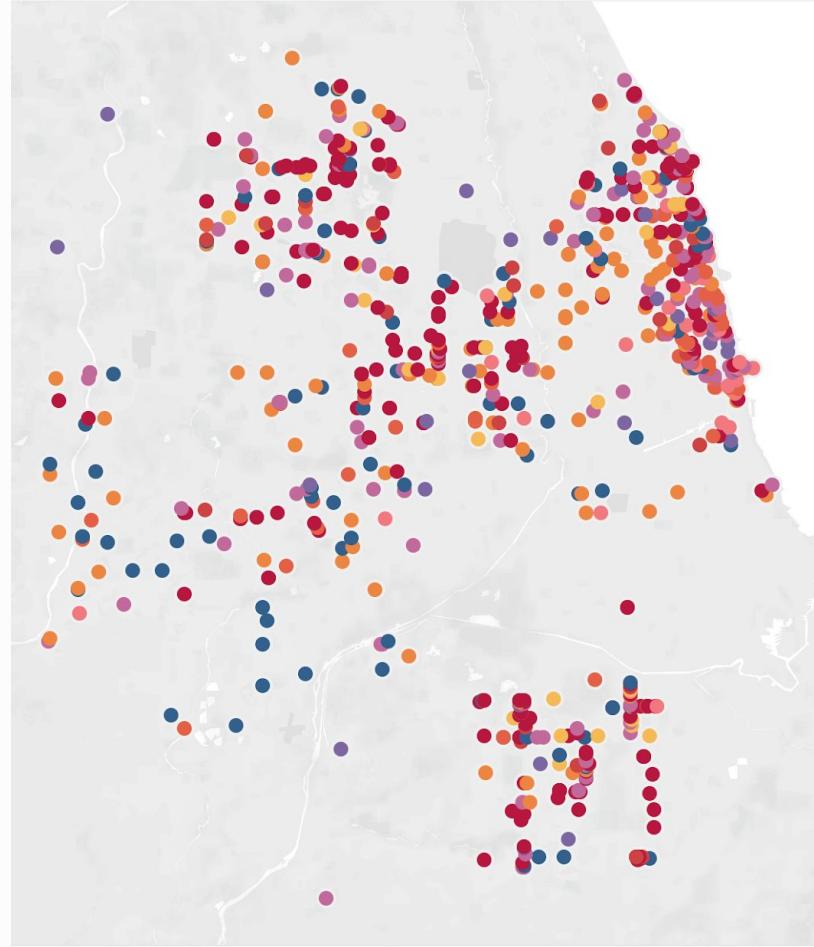
1 check-in

The appetizer,
local beer, and deep dish pizza were all wonderful. We added basil to the crust and it was just amazing.

Using images and reviews, I hoped to...

- Create or assign numerical representation of images and of reviews
- Use both representations to find similarity between restaurants to power recommendations

Distribution of restaurants around Chicago, by topic



02

Neural Nets

Image processing

Three image processing Neural Nets were tested



Pretrained Resnet

Extract weights from existing model

Fine-tuned Resnet

Added layers of training on new images before extracting

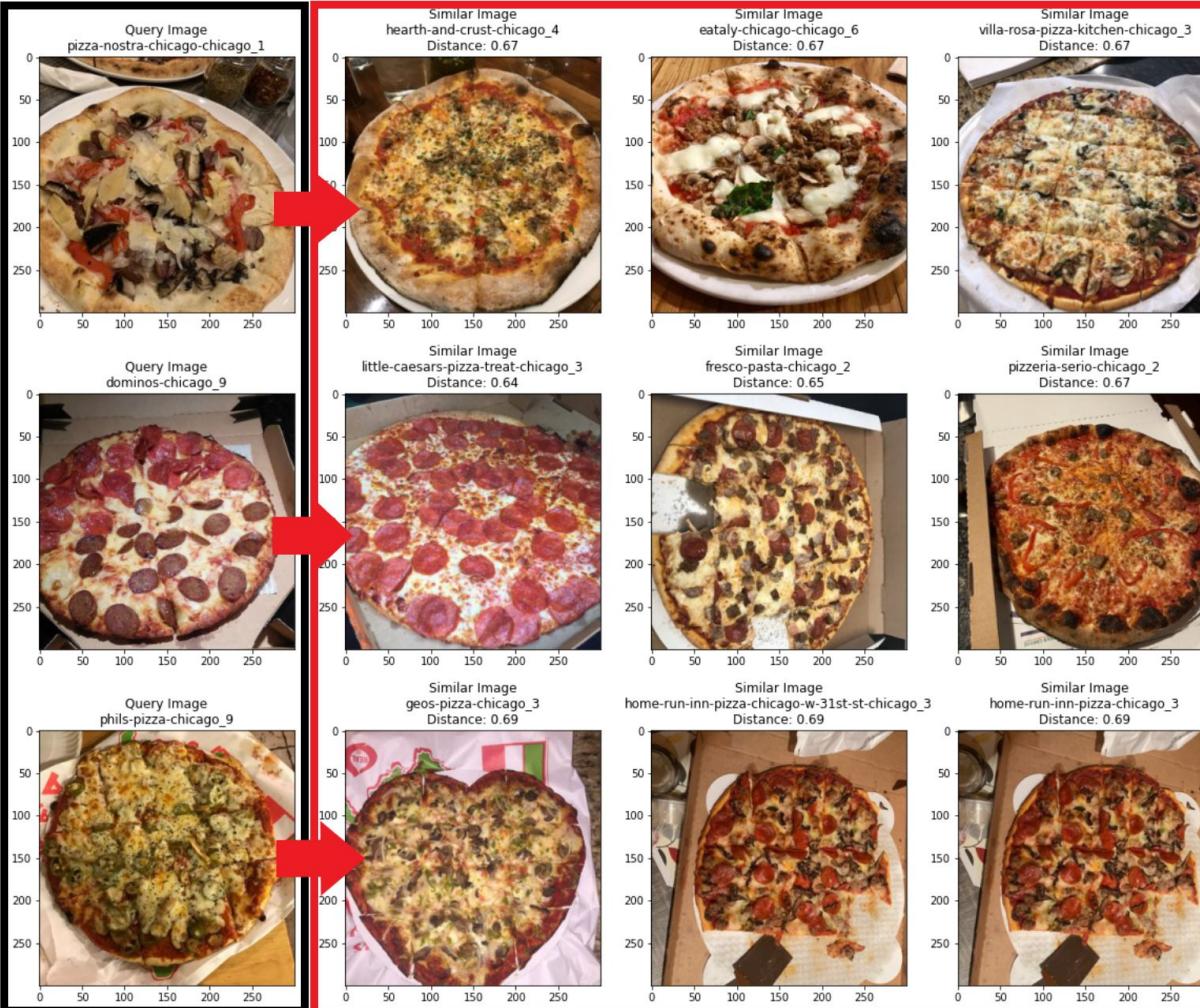
Autoencoder

Extracting embedding from coded layer

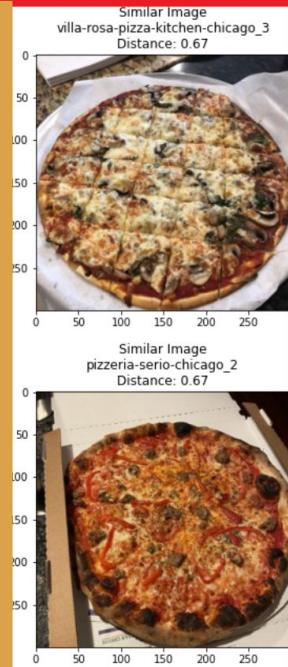
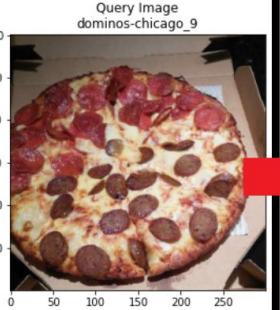
Pretrained Resnet

Provides the most consistently similar images

Pretrained
Resnet features
appeared to
most accurately
find similar
pizzas



There were still
a few troubling
outputs using
purely images



03



NLP

Text processing

Reviews were cleaned and prepared for NLP

- Combined reviews from each restaurant
- Only sentences about pizza
- Remove punctuation, numbers,
misspellings, stopwords

Natural Language Processing

- TF-IDF Vectorizer
- NMF Topic Modeling

TF-IDF

- **TF-IDF Vectorizer**
 1. Frequency of word in document
 2. Frequency of word across documents
 3. Each document is multi-thousand dimensional vector
- NMF Topic Modeling

Topic Modeling to find clusters and genres of pizzas

- TF-IDF Vectorizer
 - 1. Frequency of word in document
 - 2. Frequency of word across documents
 - 3. Each document is multi-thousand dimensional vector
- **Topic Modeling using NMF**
 - 1. **Cluster reviews into groups**
 - 2. **Identify topic by most common words**

These topics
were found
for the pizza
reviews

- TF-IDF Vectorizer
 - 1. Frequency of word in document
 - 2. Frequency of word across documents
 - 3. Each document is multi-thousand dimensional vector
- NMF Topic Modeling
 - Delivery
 - Italian
 - Deep Dish
 - Pizza Puffs
 - NY/Detroit
 - Tavern Style
 - Bar Food

04

Recommendations

Combining Efforts

Pipeline for the recommender system



User

Inputs an image and a description

Models

Extract features from the image and the description

Image Similarity

Find the 25 nearest neighbors to our image

Topic Similarity

Find the three most similar restaurants from the 25

Demo

About:

This project was built from just under 1000 scraped restaurants in the Chicago land area. The user reviews were used to create vectors across the pizza spectrum for comparisons between pizzas.

This site was created by Ethan Peikert. You can find him on [GitHub](#), [LinkedIn](#), [Twitter](#) and his website.

Pizza-Vision

A few years ago, my favorite pizza place closed and ever since, my wife and I have not been able to find a new pizza that matched the same delicious style. In an attempt to find new pizza, I created the recommendation system that finds similar images and their recommendations based on similarity to user reviews.

To use this recommender, try adding an image and a description of the pizza you want! Try to think about the style, the crust type, flavor, and more in your description.

You must add text and an image to get a recommendation

Type a couple sentences the more the better to describe your pizza

I want a thin crust pizza that has a little bit of chew but is not puffy. A thin crust with just a

Upload + Classification Example

Choose an image

Drag and drop file here
or click to upload

Browse File

Manage app

Next

- 
- Possible image improvements:
 - Higher quality
 - More consistent
 - More images
 - Use location data to help narrow results

Pizza Trials #1

Crushed



Pat's

Appendix



This project was built from just under 1000 scraped restaurants in the Chicagoland area. The user reviews were used to create vectors across the pizza spectrum for comparisons between pizzas.

This site was created by Ethan Feldman. You can find him on [GitHub](#), [LinkedIn](#), [Medium/TDS](#) and his [website](#).

Pizza-Vision

A few years ago, our favorite pizzeria closed and ever since, my wife and I have not been able to find a new pizza that matched the same innocuous style. In an attempt to find new pizza, I created the recommendation system that filters by similar images and then recommends based on similarity to user reviews.

To use this recommender, try adding an image and a description of the pizza you want. Try to think about the style, the crust type, flavors, and more in your description.

You must add text and an image to get a recommendation



Write a couple sentences (the more the better) to describe your pizza

Upload + Classification Example

Choose an image...

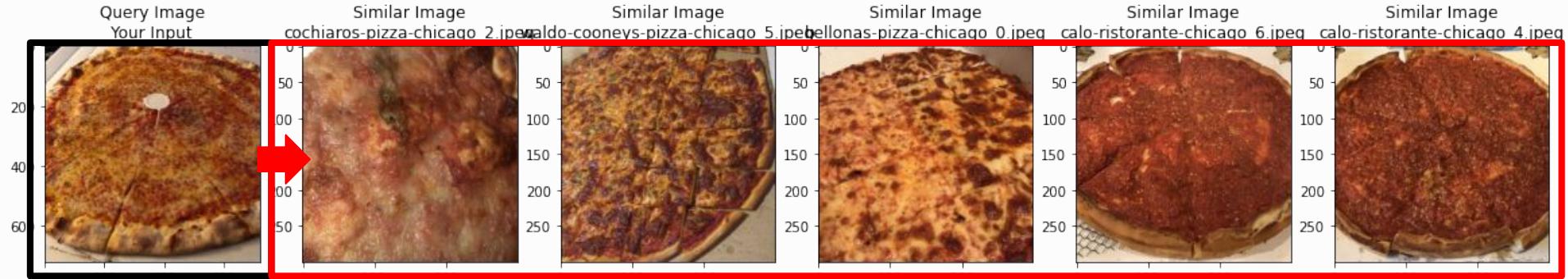


Drag and drop file here

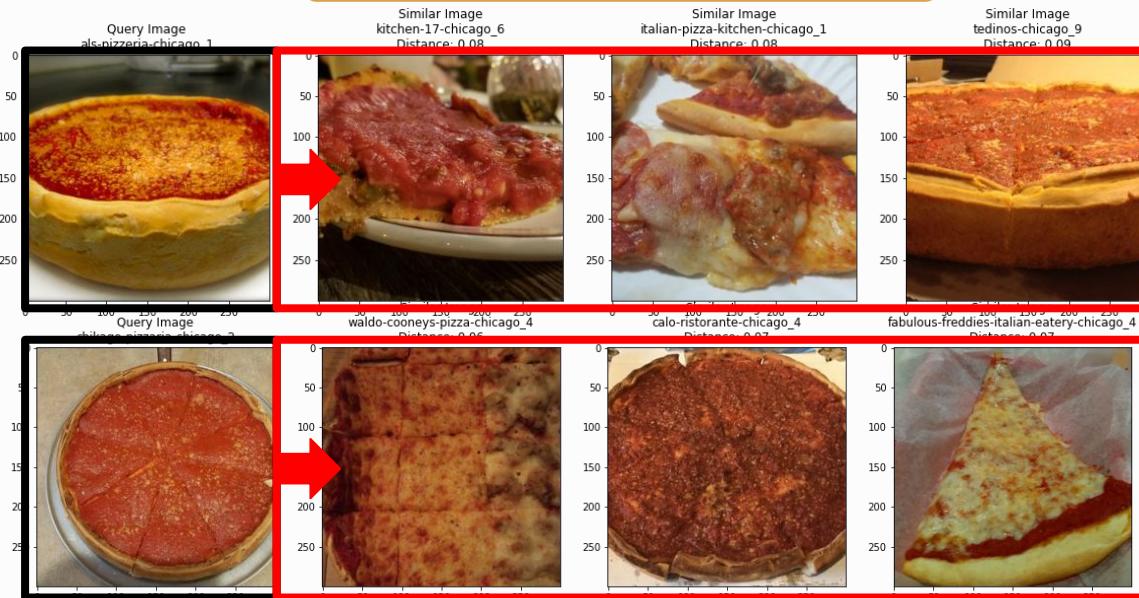
Limit 200MB per file • JPEG

Browse files

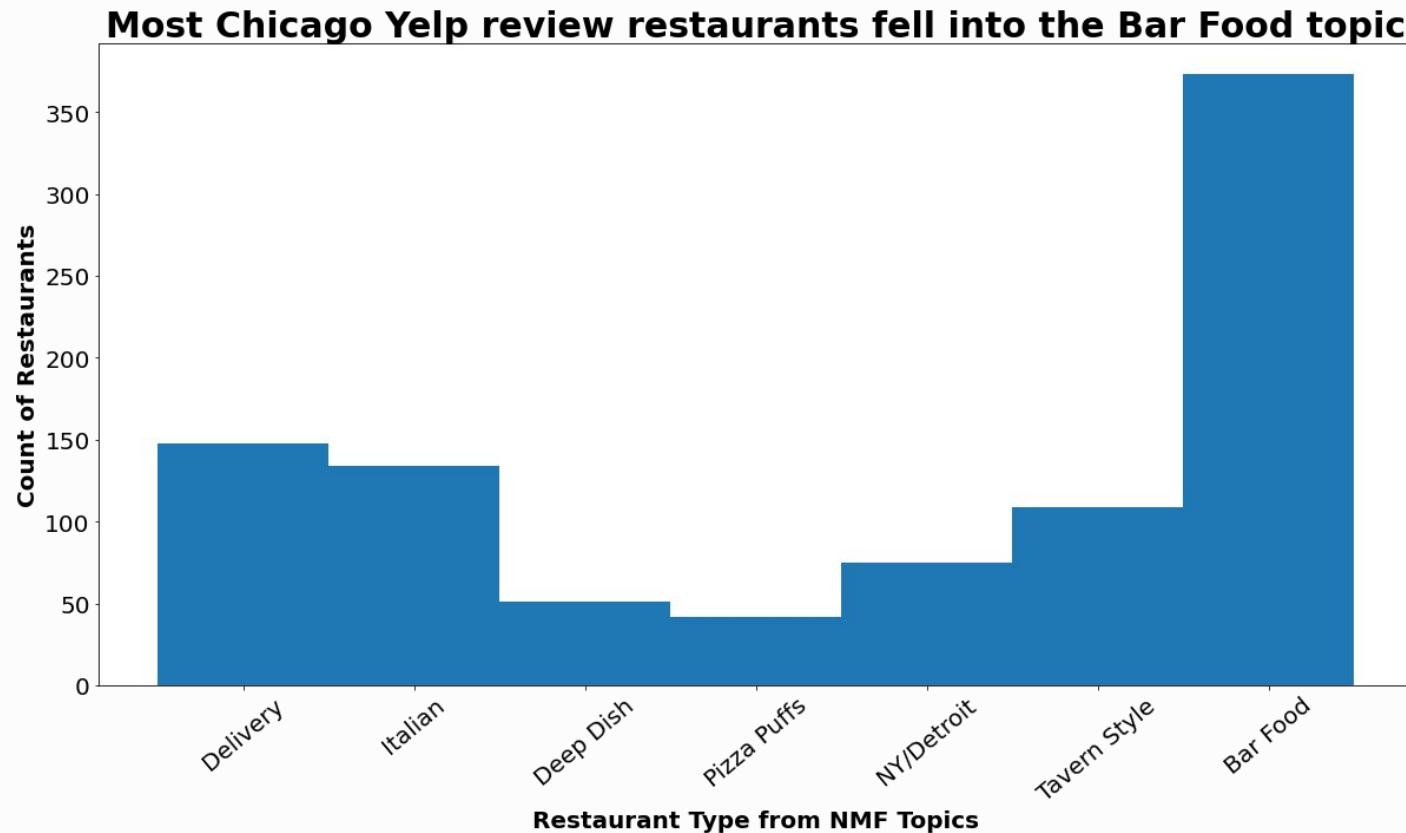
Autoencoder features did not meet the eye test



Neither did the Fine Tuned Resnet features



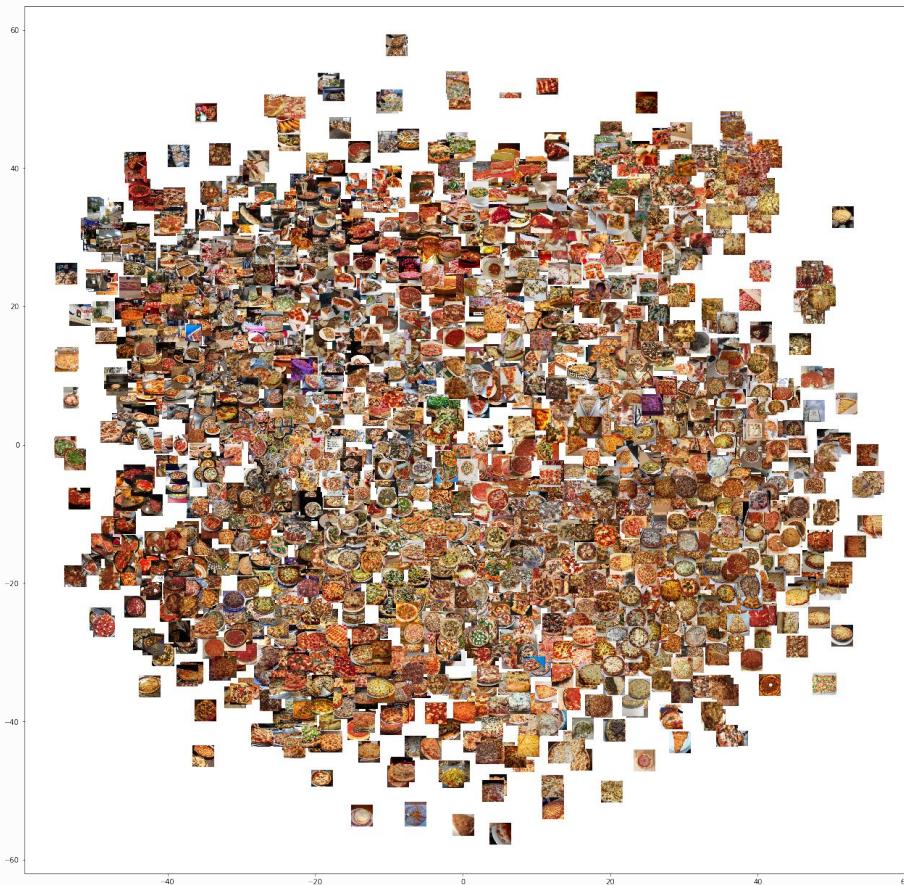
NMF Distribution



TSNE



TSNE

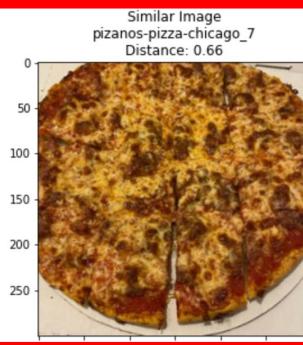
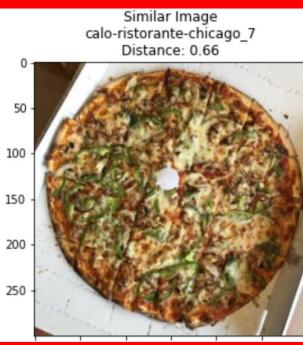
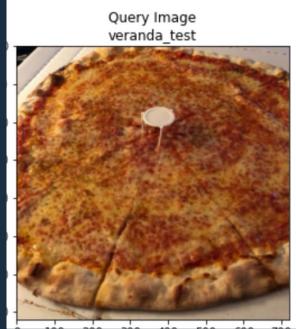


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 'cochiaros-pizza-chicago_2.jpeg',  
 'giordanos-chicago_4.jpeg']
```

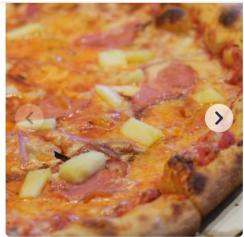


Autoencoder

Goal Pizza



Restaurants



1. Craft Pizza



\$\$ • Pizza, Salad, Italian

✓ Delivery ✓ Takeout ✓ Outdoor seating

"**Pizza** is a 7/10 and is really good! It's super greasy tho so bring a napkin. I LOVE the amount" [more](#)

[Start Order](#)

Offers takeout and delivery



2. Lou Malnati's Pizzeria



\$\$ • Pizza, Italian, Sandwiches

✓ Delivery ✓ Takeout ✓ Outdoor seating

" and preordered our **pizza** (that's a thing there...just go with it). She said, "Good choice." When I travel" [more](#)

[Start Order](#)

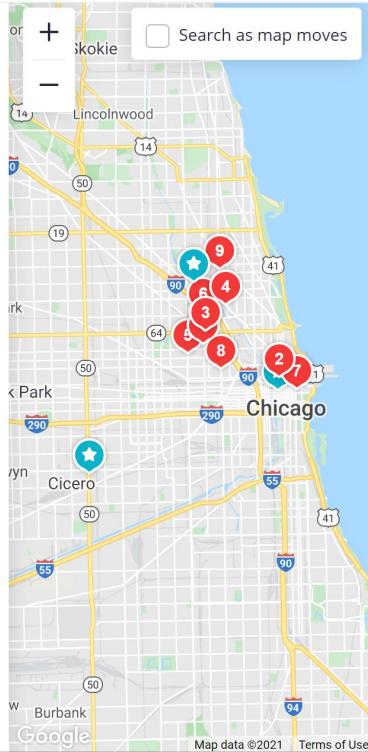
Offers takeout and delivery



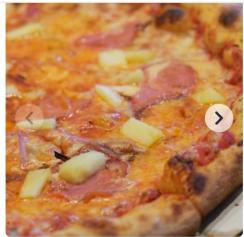
3. Piece Brewery and

(773) 772-4422

1027 W North Ave



Restaurants



1. Craft Pizza



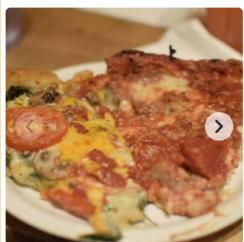
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Reviews



- Combined reviews from each restaurant
- Only sentences about pizza
- Remove punctuation, numbers, misspellings, stopwords

NLP



The pizza you liked from: Apart pizza.

Based on your input pizza I recommend you try:

Phil's Pizza located at 1102 W 35th St, Chicago, IL 60609

RoccoVino's Italian Restaurant located at 11255 W 143rd St, Orland Park, IL 60467

Aurelio's Pizza - Woodridge located at 6430 Main St, Ste 130

Images



- Autoencoder
 - Resnet
- Finetune Resnet

Goals



- Finetune Resnet on Thick/Thin Pizza Classes
 - Trained this weekend, but working on extracting features
- Combine NLP/Images to one recommendation system
- Streamlit App?