Understanding a Restaurant’s Digital Footprint on Social Media

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Agenda

Topic Overview

- Business Opportunity
- Product Idea
- Yelp Data Set
- Technical Challenges

Data Preparation & Preprocessing

Model Overview

- Network Architecture
- Challenges & Solutions

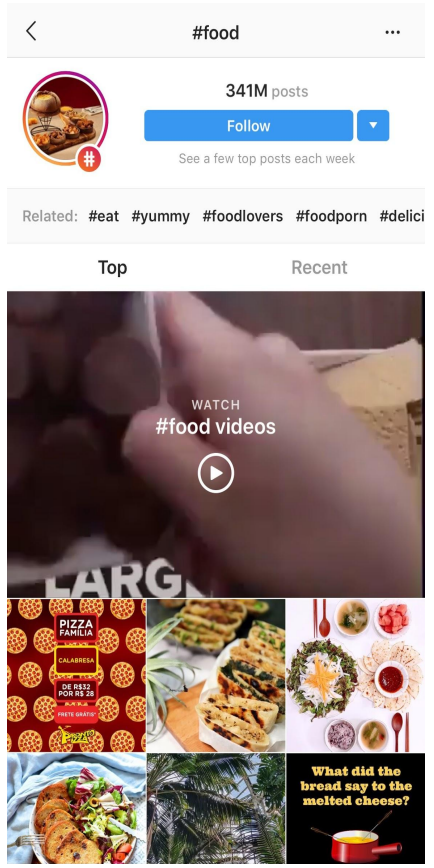
Model Performance

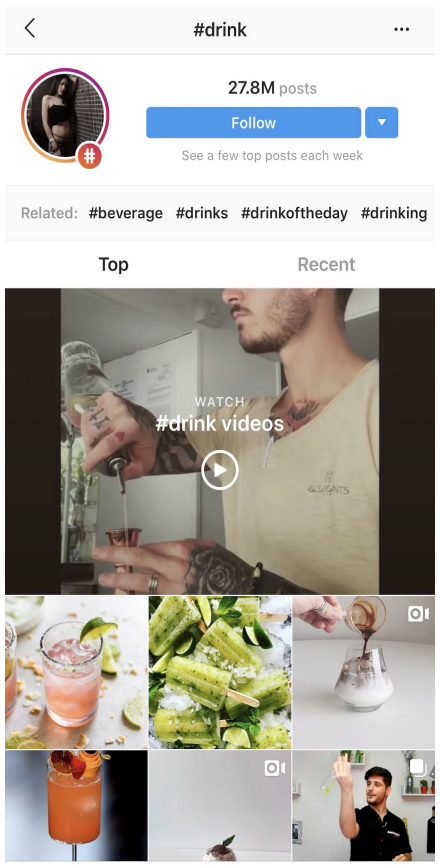
- Model Evaluation
- Key Learnings
- Next Steps

Live Demo

Business Opportunity

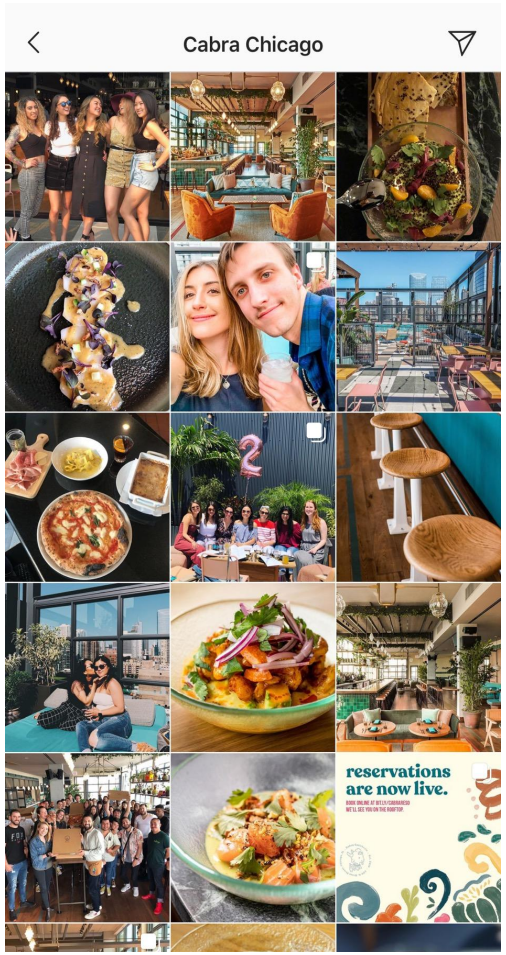
- There are over 341M posts for #food and 199M posts for #foodporn on Instagram
- When choosing a restaurant, **Gen Z and Millennials are 99 percent more likely to rely on social media and online reviews than Gen X and Boomers.**
- **Nearly 72% of customers have used Facebook to make restaurant decisions,** based on comments and images that have been shared by other users.
- A one-star increase in a restaurant's Yelp rating can result in as much as a **9 percent increase in revenue**.
- **Conclusion - The images and posts people share about restaurants matter, and there is a lot of value for restaurants to understand their digital footprint on social media.**

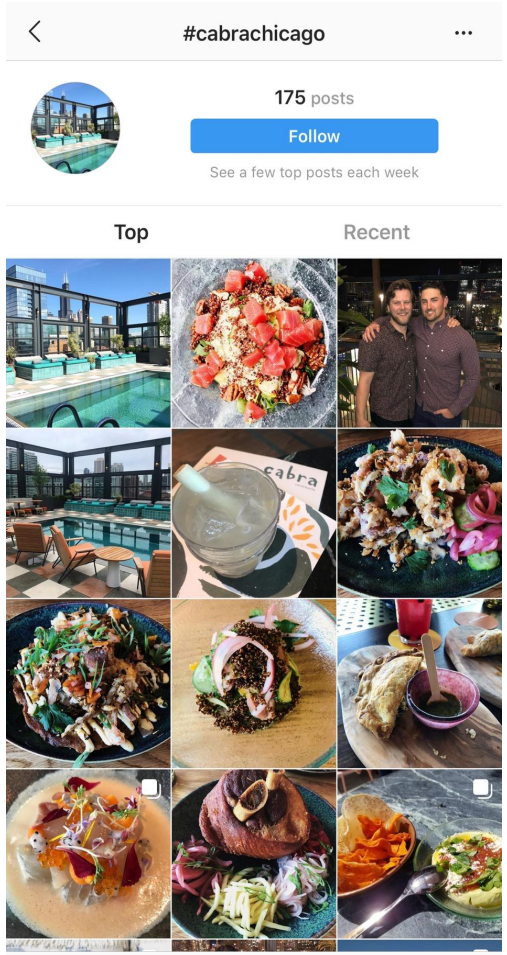




https://www.reviewtrackers.com/restaurant-social-media-statistics/

Product Idea

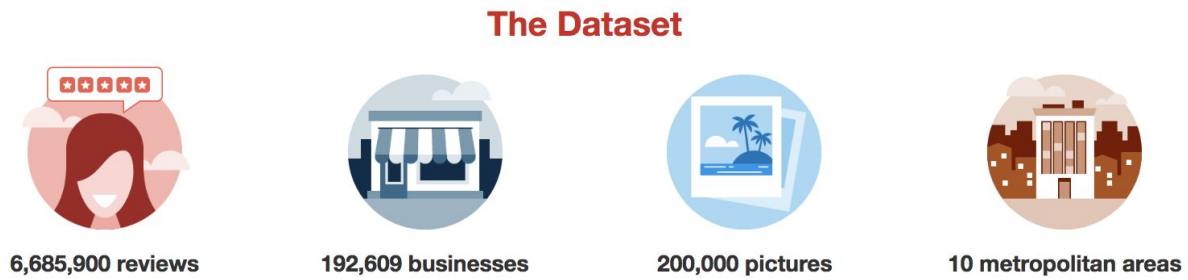




- For a given restaurant, scrape all the images shared on social media (Instagram location tag, restaurant hashtag, Facebook location tag, etc.)
- Use Convolutional Neural Network (CNN) to classify all the images into the following categories - food, drink, inside, and outside and return the summary statistics to the restaurant

CABRA CHICAGO	Food	Drink	Inside	Outside
Images Shared	1,345	564	670	324

Yelp Dataset



Yelp has an all-purpose dataset online for an ongoing competition, which has 200,000 images and over 66M reviews collected from 10 major cities across the US

Total Size of Dataset

Category	Number of Images
Food	114,874
Drink	18,121
Inside	52,448
Outside	11,534
Menu	3,023

Randomly Selected

Train/Test Split: 10%

Randomly Selected

Full Set for Train/Test

Category	Number of Images
Food	5,500
Drink	5,500
Inside	5,500
Outside	5,500

Reduced Set for Train/Test

Category	Number of Images
Food	11,000
Drink	11,000

Yelp Dataset

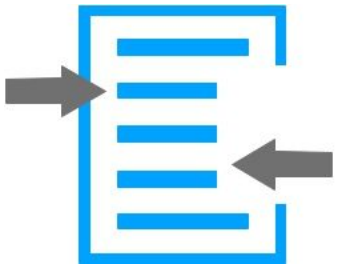
Food

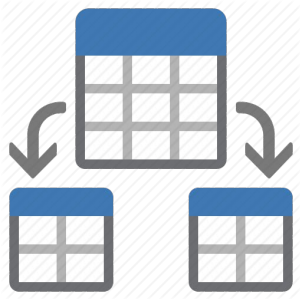
Drink

Inside

Outside

Data Preparation





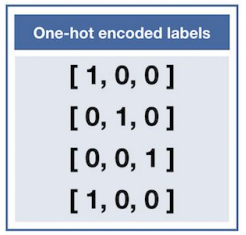


Image Resize → Pickling → Appending Images and Labels in NP Array → Train Test Split → One-hot Encoding → Normalize RGB Values

Technical Challenges

Technical Challenges	Solution
Loading all 20,000 images at once was difficult and caused the notebook to timeout	Loaded images in smaller batches of 1,000 at a time
Once the images were in numpy arrays dividing them by 255 to normalize the RGB values took up a lot of computational memory and often caused the notebook to timeout	Cleared up the memory by deleting all older variables and normalized only one array at a time
The whole process of loading images and normalizing was the most time consuming and computationally intensive step	To minimize the number of times we did this we pickled the normalized numpy arrays

Model Overview: Challenges & Solutions

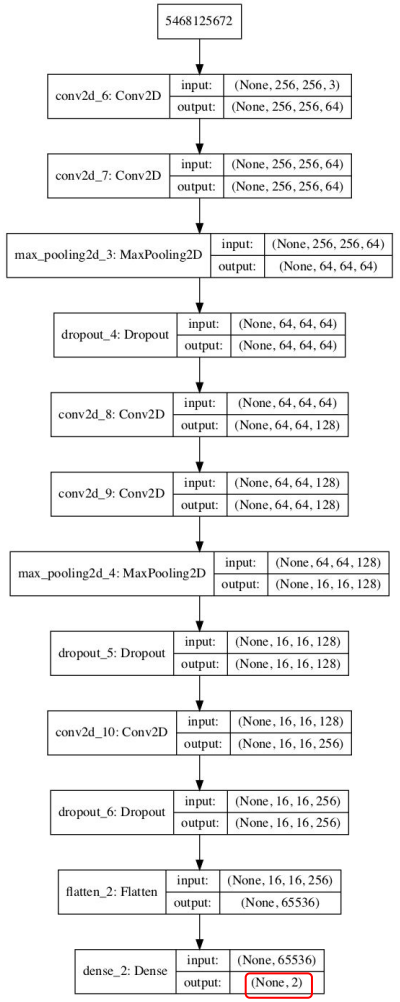
Technical Challenges	Solution
Size of data set (moving files, collaborating, manipulating)	Build model on a subset of the original data
Computing Power	Test code on google collab, run on 32GB RAM desktop
Processing Images	Pickling numpy arrays post processing (e.g. after normalizing intensities)
Getting stuck in local minima	Hyperparameter tuning
Reproducibility of results	Proper seed selection, saving model weights

Model Overview: Architecture and Optimizers

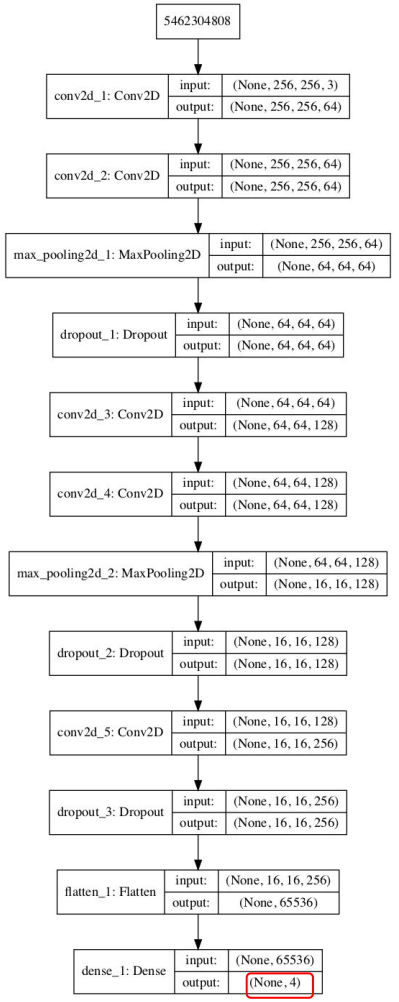
- CNN Architecture:
  - 5 x 2d convolution layers
  - 2 x max pooling Layers
  - 3 x dropout layers
  - 1 x flatten layer
  - 1 x dense layer

- Optimizers
  - RMSprop (Similar to gradient descent with momentum)

- Early Stopping with Patience 10



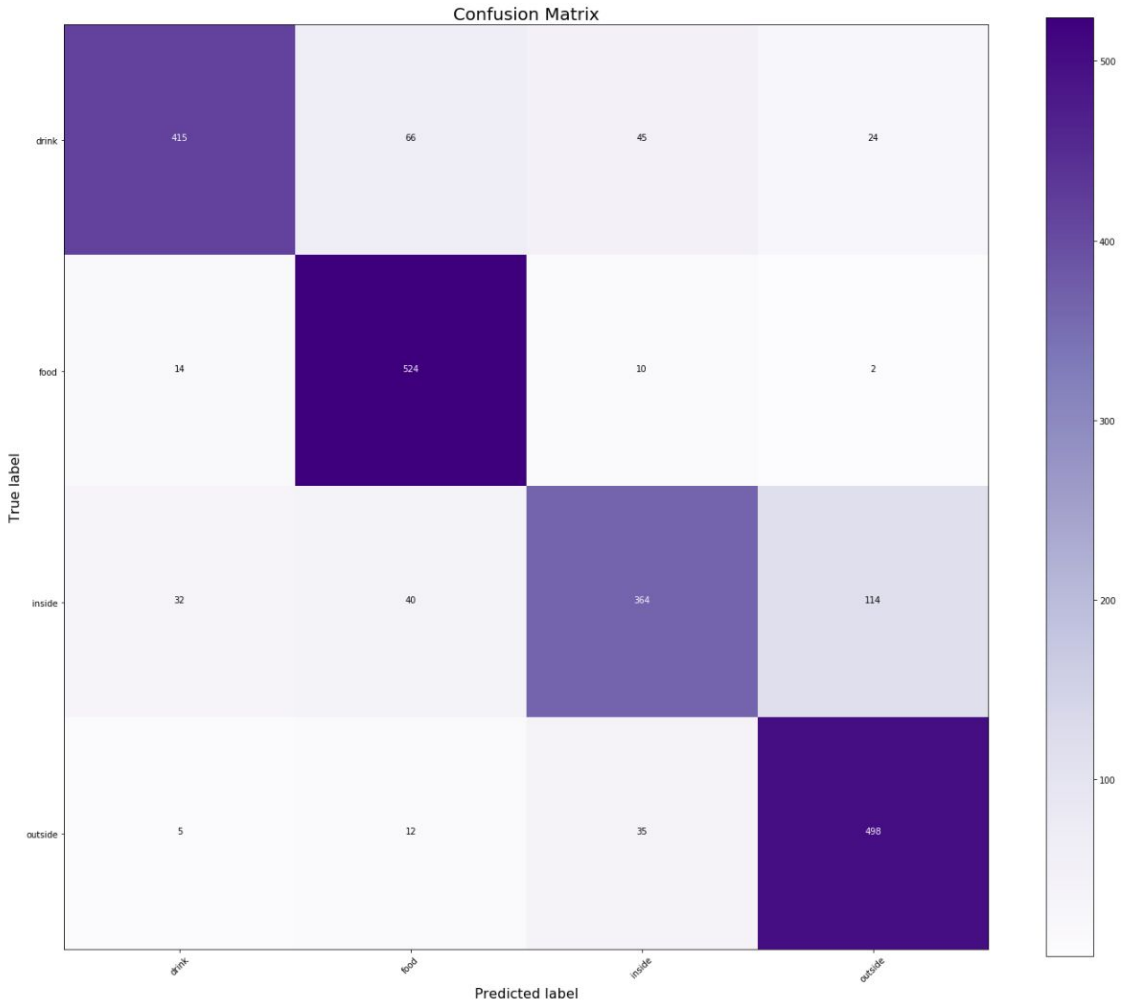
Food/Drink



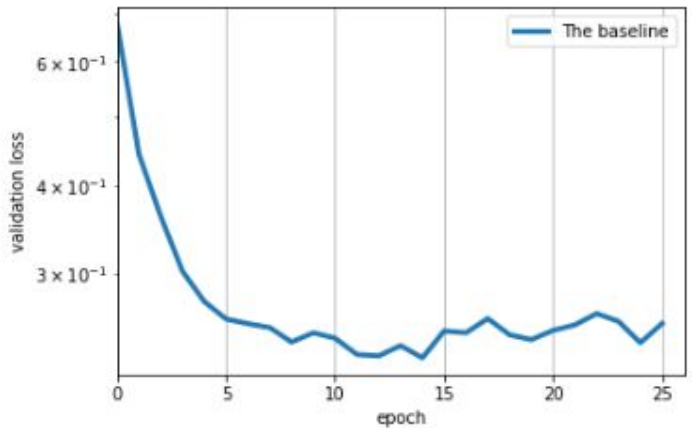
Food/Drink/Inside/Outside

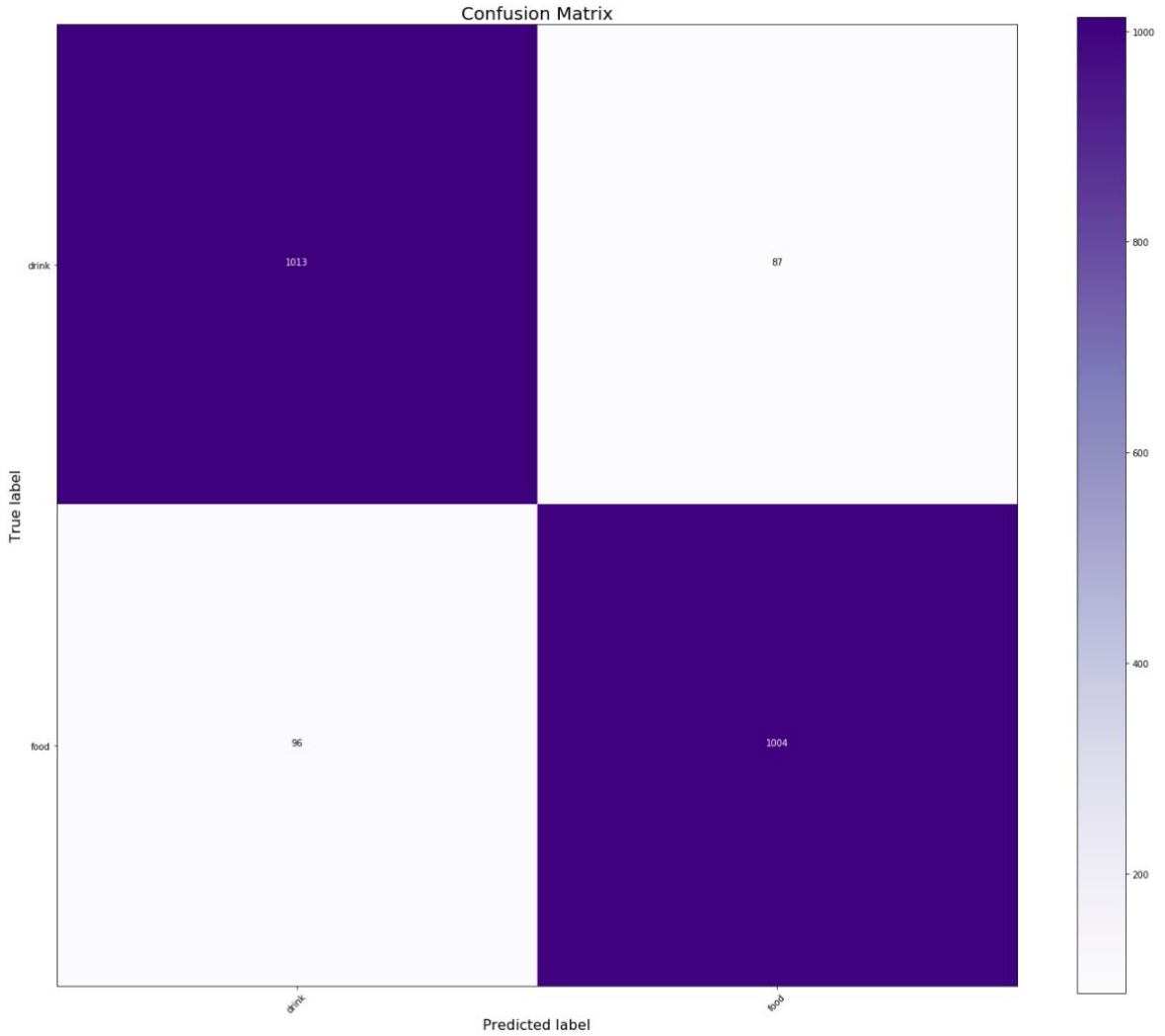
Model Performance: Full Model Performance

- Test Accuracy: 81.864 %
- Early Stopping Final Epoch:
  - Patience 10
  - 22/200
  - loss: 0.4044
  - acc: 0.8584
  - val_loss: 0.5052
  - val_acc: 0.8186
- Decision to focus on food and drink



Model Performance: Baseline Reduced Model





- Test Accuracy: 91.682 %

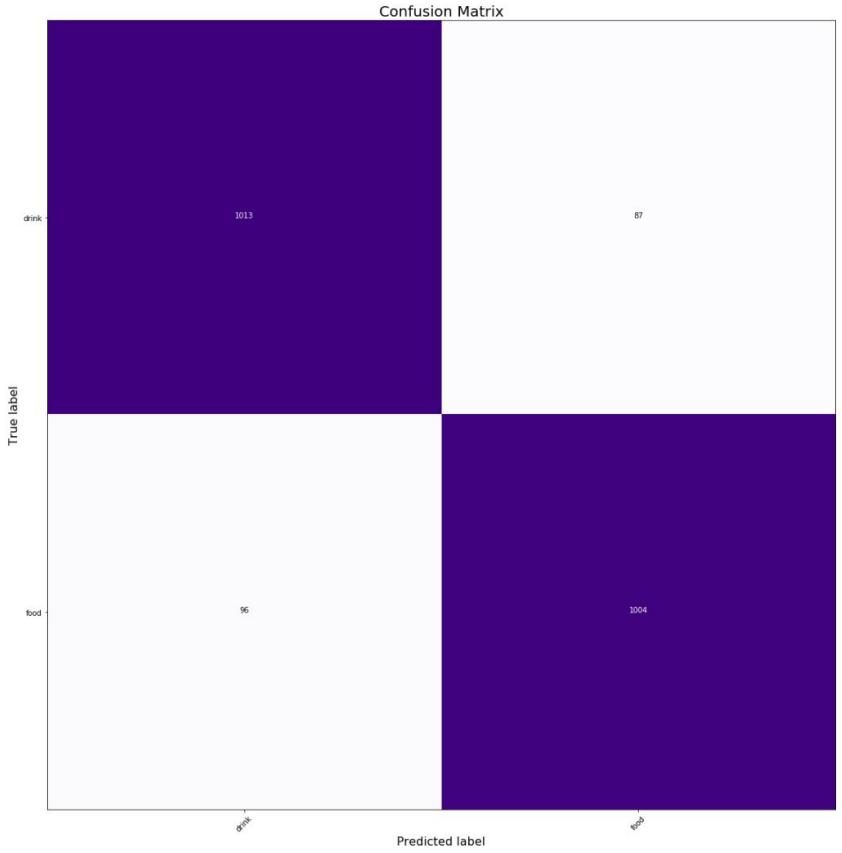
- Early Stopping Final Epoch:
  - Patience 10
  - 26/200
  - acc: 0.9344
  - val_loss: 0.273
  - val_acc: 0.91682

Model Performance: Reduced Model Lr Tuning

```
Train on 19800 samples, validate on 2200 sampl
Epoch 1/200
19800/19800 [==============================] - val_acc: 0.5000
Epoch 2/200
19800/19800 [==============================] - val_acc: 0.5000
Epoch 3/200
19800/19800 [==============================] - val_acc: 0.5000
Epoch 4/200
19800/19800 [==============================] - val_acc: 0.5000
Epoch 5/200
19800/19800 [==============================] - val_acc: 0.5000
Epoch 6/200
16192/19800 [=======================>......] -
```

lr = 0.01

NOT ABLE TO LEARN



lr = 0.001

Test Accuracy: 91.682 %

Early Stopping Final Epoch:

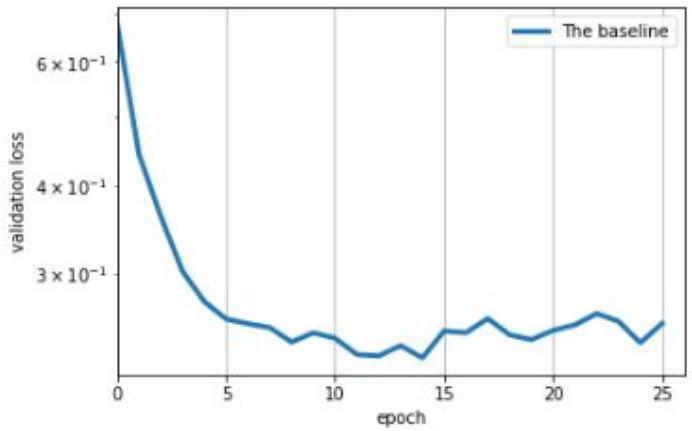
val_acc: 0.91682

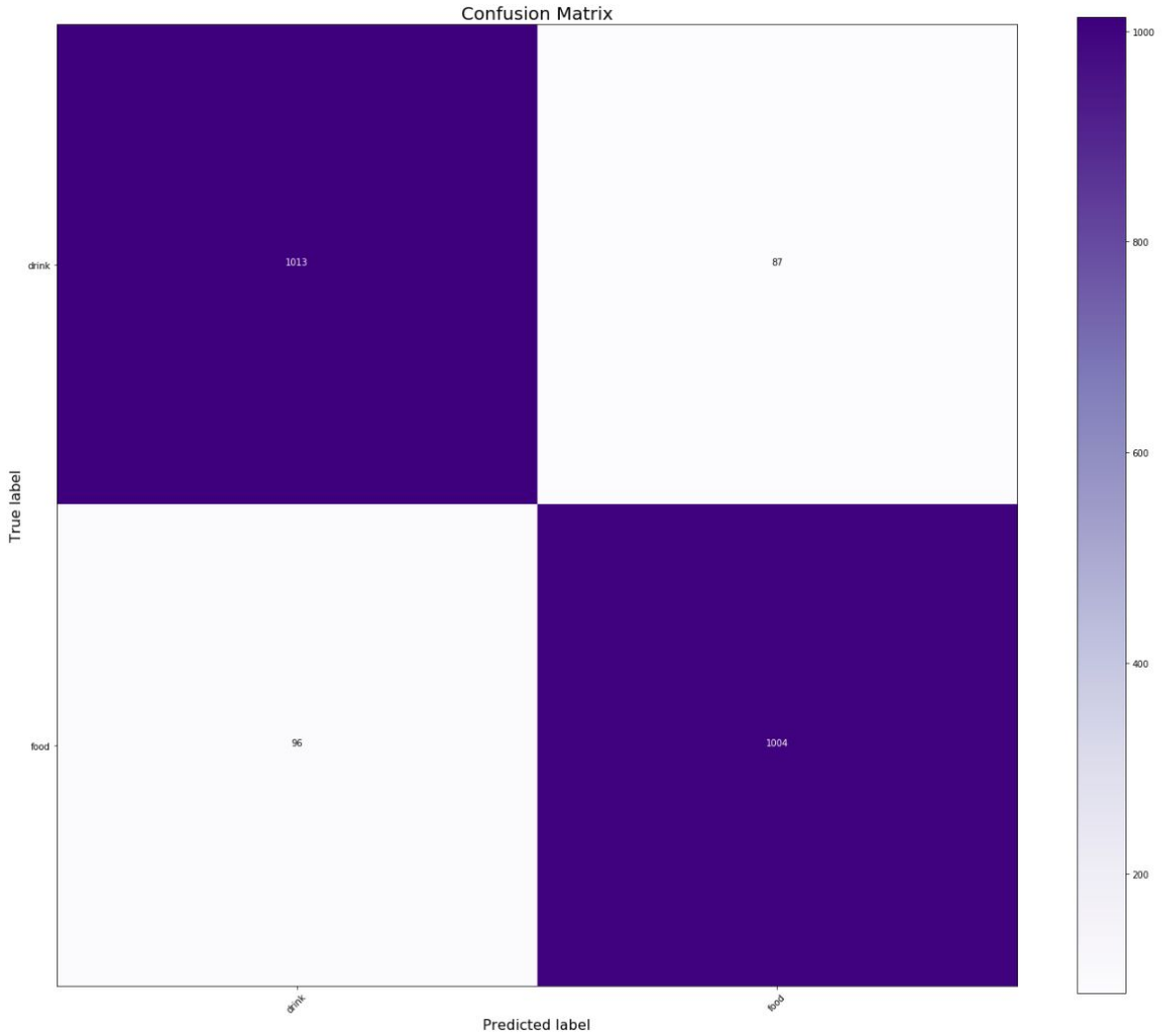
```
acc: 0.6753 - val_loss: 1.2097 - val_acc: 0.1836
acc: 0.8210 - val_loss: 1.9805 - val_acc: 0.1609
acc: 0.8640 - val_loss: 2.6822 - val_acc: 0.1782
acc: 0.8895 - val_loss: 3.4823 - val_acc: 0.1095
acc: 0.9036 - val_loss: 3.4999 - val_acc: 0.1068
acc: 0.9152 - val_loss: 3.4988 - val_acc: 0.1300
acc: 0.9234 - val_loss: 4.8904 - val_acc: 0.1077
acc: 0.9298 - val_loss: 4.0178 - val_acc: 0.0995
acc: 0.9345 - val_loss: 5.2254 - val_acc: 0.0650
```

lr = 0.0001

OVERFIT

Model Performance: Finalized Model





- Test Accuracy: 91.682 %

- Early Stopping Final Epoch:
  - Patience 10
  - 26/200
  - acc: 0.9344
  - val_loss: 0.293
  - val_acc: 0.91682

Model Performance: Key Learnings

- Opportunity to explore a real-world image classification problem
- Experience tuning neural network hyperparameters
- Effectively handling larger scales of unstructured data (200k images)

Model Performance: Next Steps

- Continue to build and test model with larger data sets
- Add additional classes to existing model
- Expand beyond restaurants to appeal to a broader set of businesses
- Also explore Natural Language Processing to build a more robust suite of insights from user posts

Demo

Questions?