

# Recycling Contamination

## + Mitigation via Machine Learning

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github/gitlab: billy-horn



# Introduction

- Wishful Recycling
- **15-17%** contamination rate ( $\frac{1}{6}$ )\*
- Equates to **10,000 tons** of\* contaminants annually

\*SOURCE:

<https://www.voiceofsandiego.org/topics/news/the-city-sends-about-15-percent-of-the-recycling-it-collects-to-the-dump/>



# Introduction

- Financial viability at risk\*
- Higher contamination rate  
= less recyclables
- Recyclable items are sent  
to landfills



\*SOURCE:

<https://mediaroom.wm.com/the-battle-against-recycling-contamination-is-everyones-battle/>

# Problem Statement

- **Problem:** Recycling *can be* a **PITA**
- **Mitigation:** Build app that categorizes images of trash
- **Target Audience:** City of San Diego + recycling subcontractors (but DSIR-1019 dry-run)

# Overview

- MVP - Minimum Viable Product
- Data
- ML Model
- Issues + Recommendations

MVP:

Minimum Viable Product

# MVP

- Build reasonable ML image classifier model
- Deployable (port to app)
- Classifies images into 6 categories:
  - Plastic
  - Glass
  - Paper
  - Metal
  - Cardboard
  - Trash



# OSCAR

**O**stensibly

**S**mart

**C**omputer

**A**ided

**R**ecycler







# Data



# Data Set

- 2,500+ Total Images
- 6 Target Labels
- Curated by Stanford students\*

cardboard



paper



plastic



plastic



cardboard



glass



plastic



glass



metal



\*SOURCE:  
<https://github.com/garythung/trashnet>

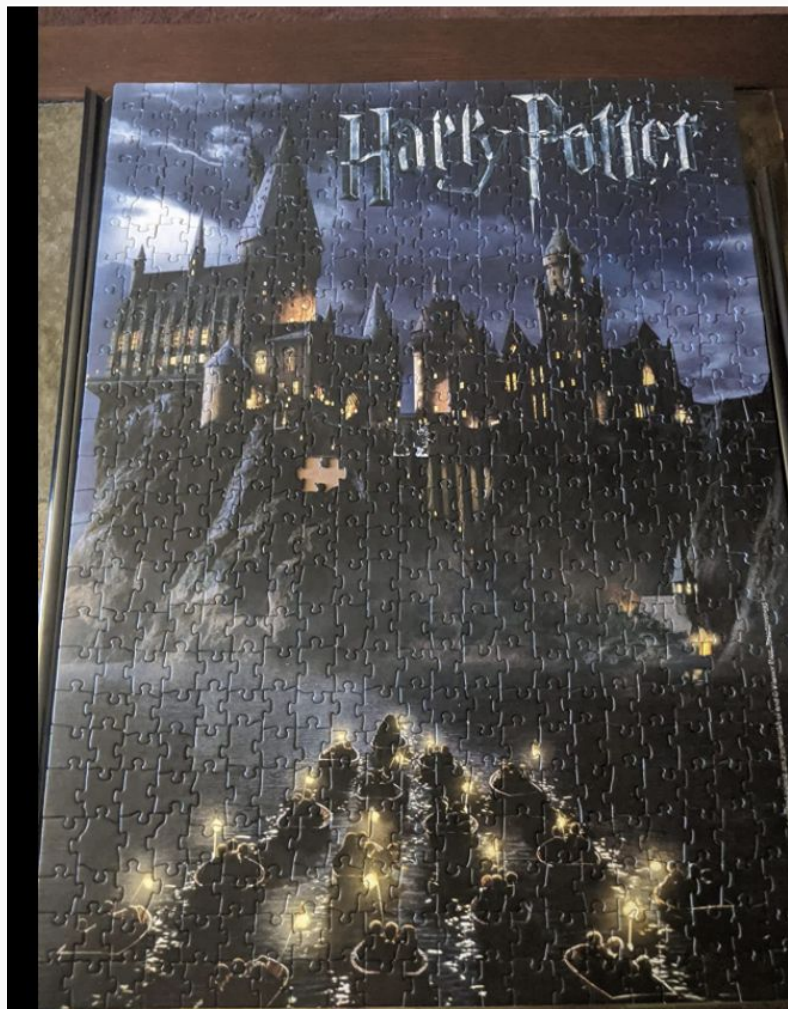


# Model:

# Convolutional Neural Network

# Convolutional Neural Network Analogy

- Each piece is image in data set
- Sections of puzzle are your target categories
- Find where puzzle piece fits by identifying key features in piece



# Convolutional Neural Network Analogy

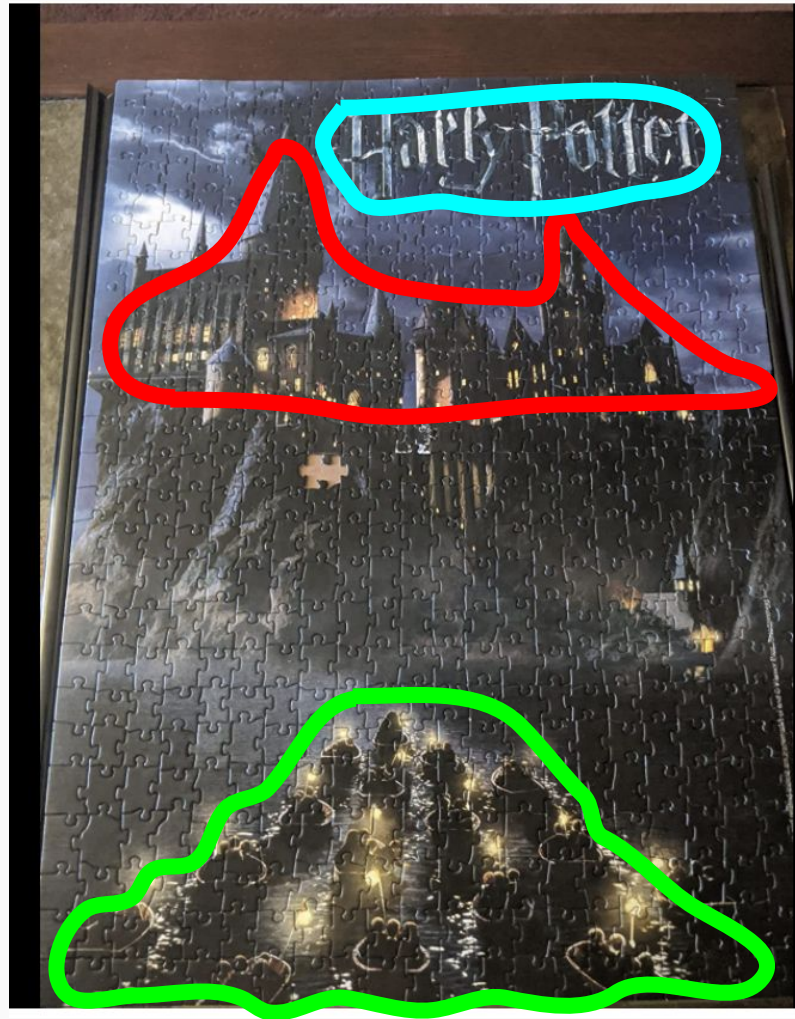
- Each piece is image in data set
- Sections of puzzle are your target categories
- Find where puzzle piece fits by identifying key features in piece





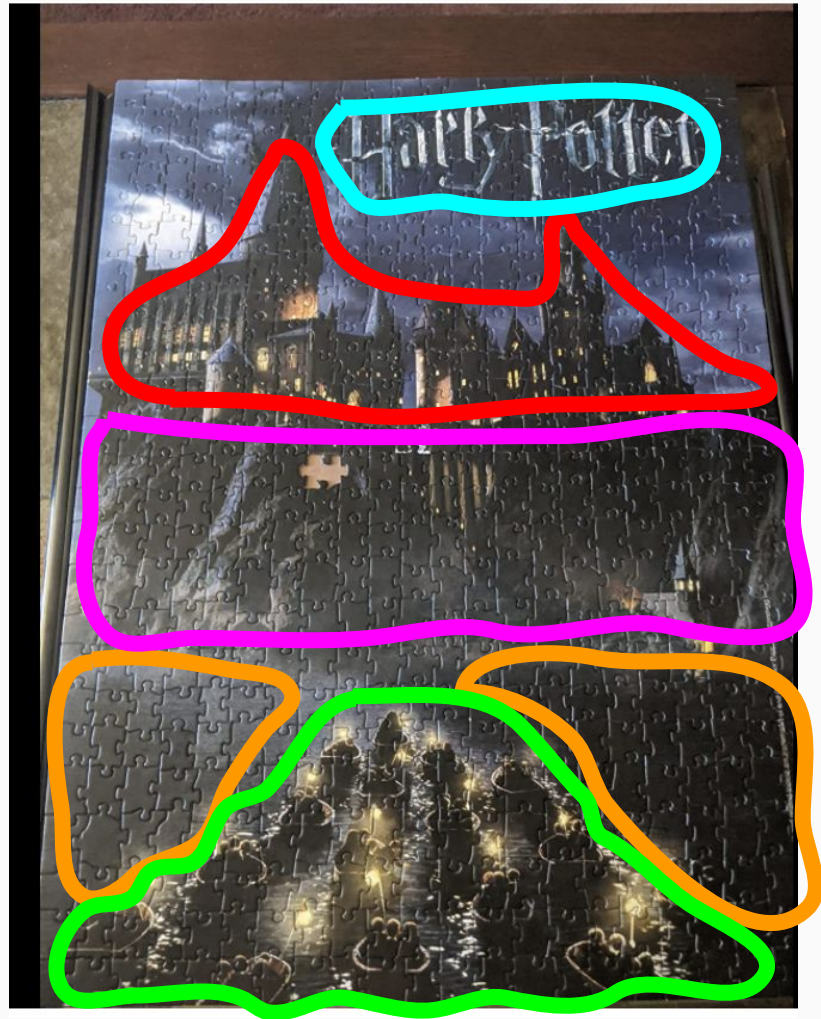
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**Training:** Tell model where piece goes



**Holdout:** model guesses where piece goes





# Model Results

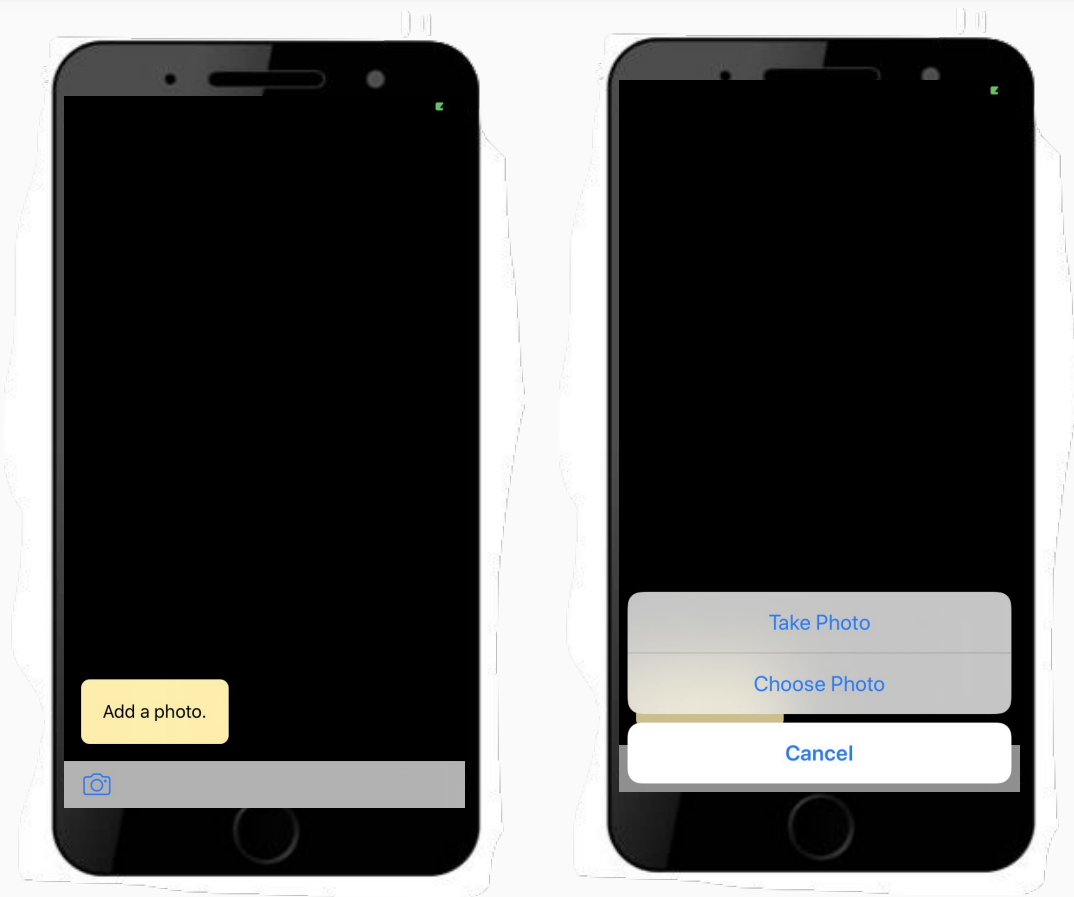
- Accuracy on holdout data:
  - 89%
- Accuracy misleading. Look at minority class:
  - Trash Class Precision:
    - 25%



# App



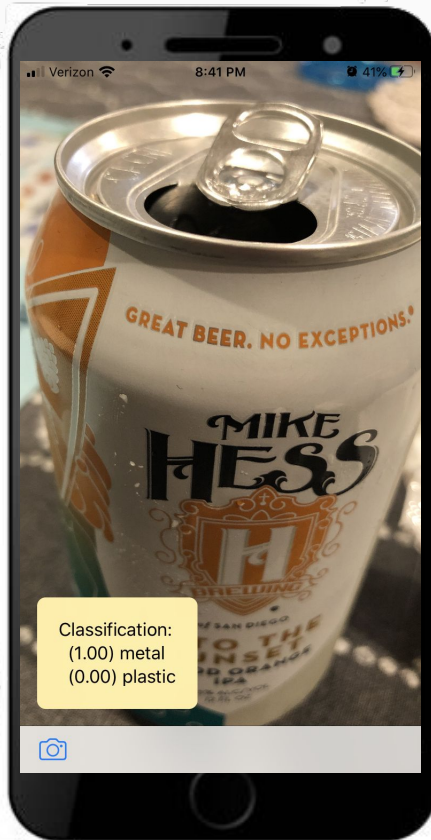
# App (iOS only for Now)



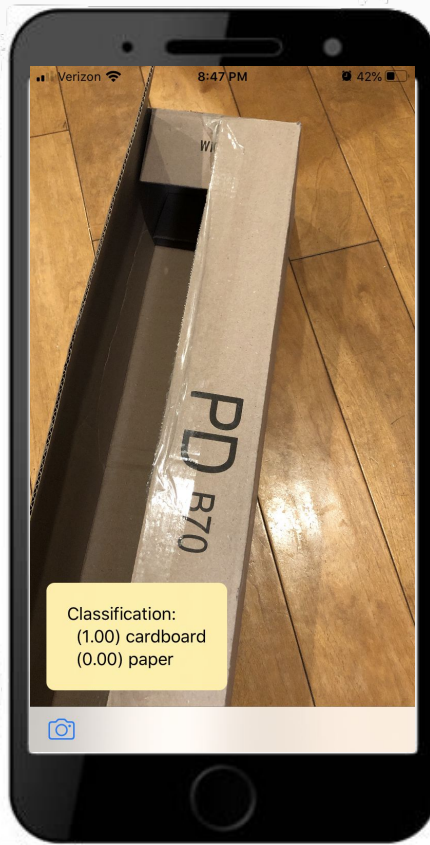


# App (iOS only for Now)

**RIGHT**



**RIGHT**



**WRONG**





# Recommendations for Addressing Issues w/ App



# Recommendations to Address Issues

- **Built-in Education w/ App:**
  - App is not the ultimate decision maker
  - Soiled Recyclables
- **Crowd-Sourced Data Set (Website):**
  - Packaging shape constantly changing
  - Need more robust data set







# Thank you for your attention!

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[github/gitlab: billy-horn](https://github.com/billy-horn/gitlab)





End