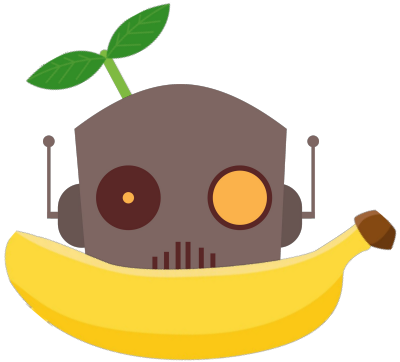
# BananaBot

## AI Compost Sorter



By Kevin Dixson, Katie Seidl, and Cameron Priest

# Purpose

To develop a technology that can help limit the amount of compost in landfills

- **US is global leader in food waste**
  - 80 billion pounds of food ( ~219 pounds of waste per person)
  - 30-40 percent of the US food supply
- **95% end up in landfills without being composted**
  - This is bad because when compost is decomposed in landfills, there is not enough oxygen for it to decompose aerobically, so it produces an excess of methane.
  - Methane is a potent greenhouse gas, and 20% of global warming can be attributed to methane concentrations

# Background

# Trash / Recycling Bots

- **Some separate at landfills**
  - **Ex. SamurAI**: an AI recycling bot that is implemented at landfills and put above conveyor belts to rapidly sort out recycling from trash

- **Some don't use computer vision**
  - **Ex. MIT's recycling bot**: can determine if something's recyclable based off of touch!

- **The ones that do handle compost are smart trash cans**
  - **Clean robotics trashbotZero**: collects and sorts compost, trash, and recycling (clean robots' other two trashbots only do trash & recycling)
  - **Oscar the AI Trash robot**: a big display and camera that will recognize what is in your hand and tell you the correct bin to put it in
  - **Alphabet** is developing one too

# Experience

- None of us had any prior experience with Machine Learning or Convolutional Neural Networks when choosing our project
- Homework 5 and Dr. Ventura's lectures on CNNs helped guide us

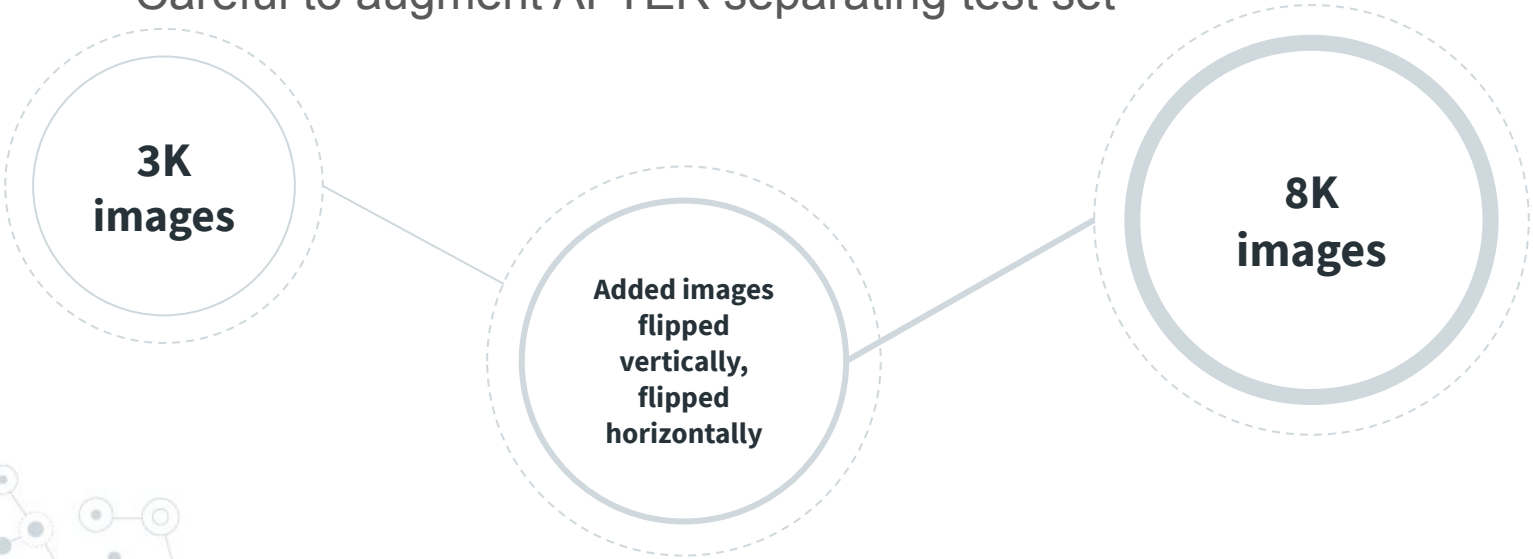
# Data

# Dataset

- Created our own dataset with a combination of our own images, google images, and trashnet's images for the non-compostable classes
  - **Compostable**: bananas, persimmons, strawberries
  - **Non-compostable**: cardboard, glass, metal, paper
- Had sub classes for each fruit
  - ie. persimmonPeels, wholePersimmon, bananaPeel etc.
  - A peel doesn't look like its fruit- easier to differentiate

# Details

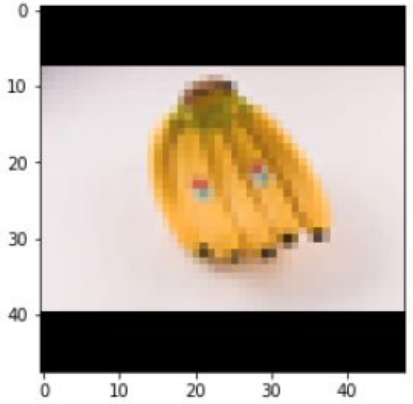
- Stored zip files of all our image classes on Google Cloud
- Used data augmentation so we could have a bigger dataset
    - Careful to augment AFTER separating test set



# Method

# Method

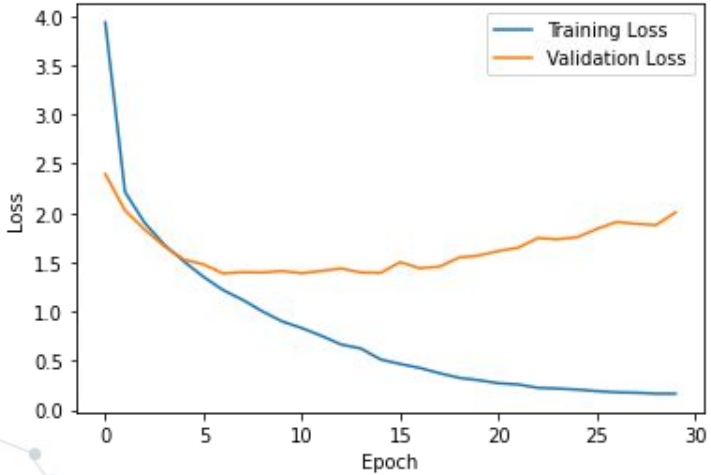
- Download each class from google cloud
- Categorize each class
- Add padding if image isn't square, and make all images the same size
- Separate data set into 80% training, 10% testing, 10% validation
- Augment the data (flipped horizontally and vertically)
- Build CNN with Keras
    - 4 convolutions each with 32 channels
    - 5 Dense layers
    - Softmax activation

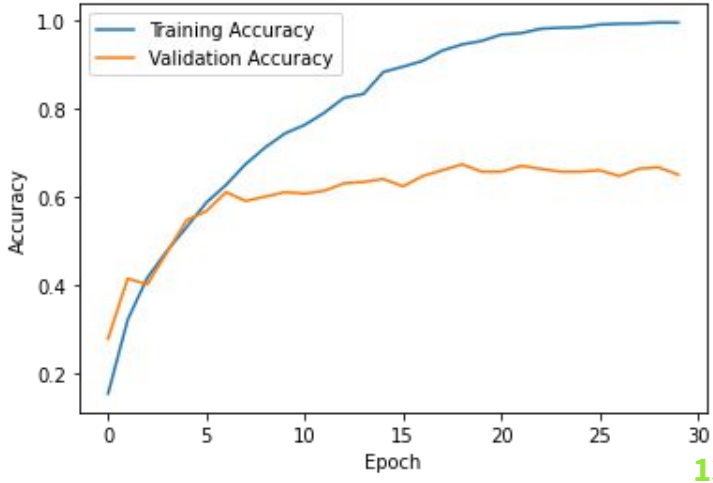


# Evaluation

# Evaluation

- 10% of each class contributed to validation set
  - Run after each epoch for debugging and training insight
- 10% of each class contributed to test set
  - Run the CNN on the data set after training



# Results

99.80%

Training Accuracy

69.44%

Testing Accuracy

# Improvements

- Needed more data to make it even more accurate
  - Data augmentation!
- Similarities in misclassifications
  - Normal bananas misclassified as banana peels
  - Banana peels as bunches
  - Rotten bananas misclassified as strawberries
  - Fruits can be grouped together, trash can be grouped together

301

Test Images

294

Correct Classifications

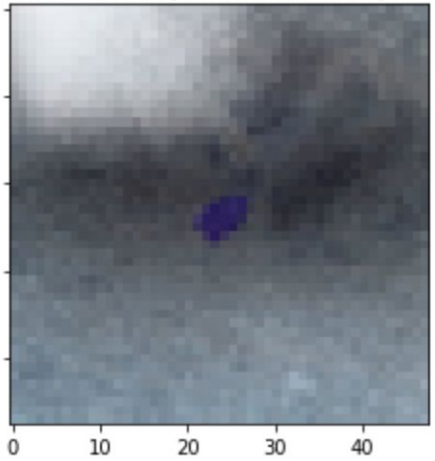
7

Incorrect Classifications

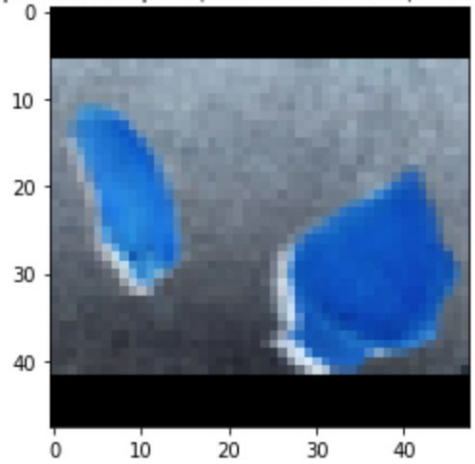
97.67%

Compostability Accuracy

Label: persimmon leaves | Pred: cardboard | Certainty: 96%




Label: persimmon peel | Pred: cardboard | Certainty: 81%



# Outlook

# Expectations and Growth

- Happy with results
- Bit too ambitious in the beginning, we weren't able to meet all our proposed primary features, as creating a dataset is very time consuming
- All learned so much, since we had no experience prior to this class

# Future Works

- Expand data set to include all categories of food scraps and leftovers, and green waste
- Implement open set recognition
  - “Class not found”
- Figure out how to use our dataset to accurately recognize items from a zoomed out view of multiple items on a conveyor belt
  - Our data set is pretty cropped and centered
- Make the physical components of BananaBot

# References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https://www.rts.com/resources/guides/food-waste-america/

https://www.machinexrecycling.com/samurai/

https://venturebeat.com/2019/04/10/mit-robot-sorts-recycling-and-trash-by-touch/

https://venturebeat.com/2019/11/21/alphabets-trash-sorting-robots-have-reduced-office-waste-contamination-to-less-than-5/

# Questions?

# Thank you!