Waste Classification:

Using Neural Networks

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Why Garbage?

- 292.4 million tons generated in 2018
  - 146.1 million ended up in landfills
- 4.9 lbs generated per person
  - Up 33.8% from 3.3 lbs in 1980
- Global issue – land, water, air pollution
  - Risk of contamination and toxins

What Can Be Done?

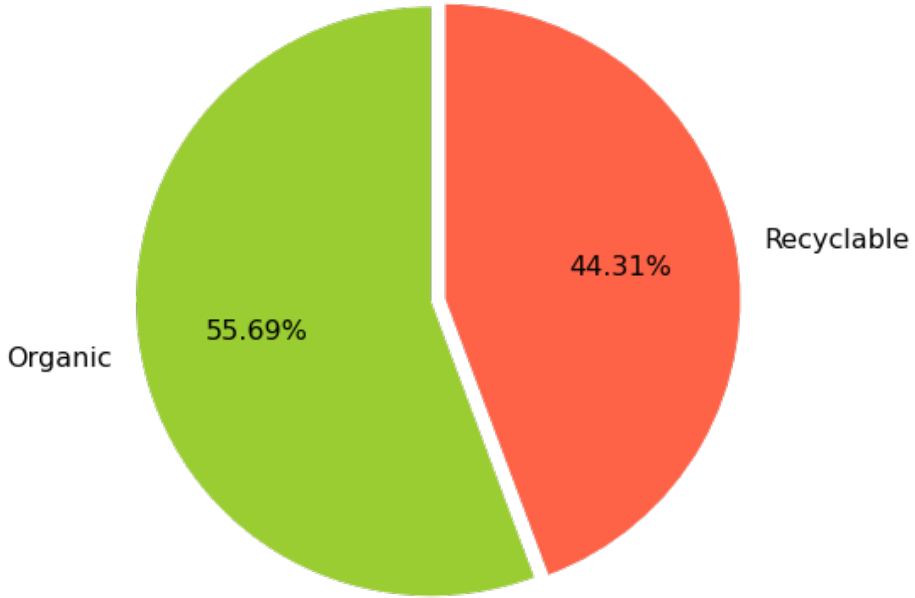
- Motivation: Create a deep learning model environmental and waste management industries can leverage to improve recycling efforts
  Waste Management & Republic Services

- Goal: Identify whether an object is organic or recyclable
  With high accuracy up from 67.5%

Data & Methodology

- **Organic vs Recyclable**
  25K+ Total Images
  22K+ Training
  2500+ Test

- **Various images & sizes**
  Width x Height x RGB



Data & Methodology

- **Image Augmentation**
  Rescale & Resize
- **Reshape Input Values**
  2D → 1D
- **Train, Validation, Test**
  Datasets

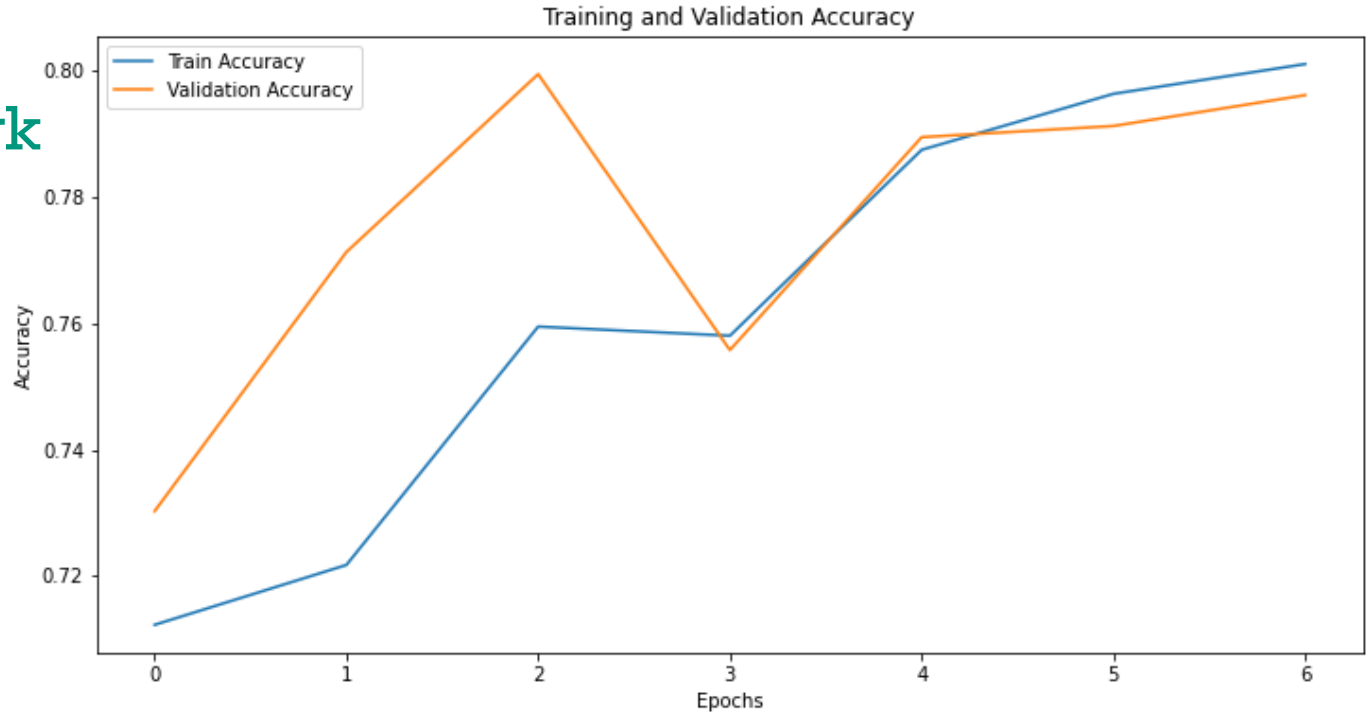
Findings & Results

Model Type	Parameters	Accuracy	Loss
Non-Deep Learning Random Forests	-	62.5%	-
Non-Deep Learning Logistic Regression	-	62.5%	-
Feed Forward Neural Net	3,932,401	86.4%	37.5%
Convolutional Network #1	4,129,505	82.5%	56.7%
Convolutional Network #2	4,200,163	82.6%	40.8%

- Activation
  ReLU & Sigmoid
- Loss Function
  Binary Cross-Entropy
- Optimizer
  Adam

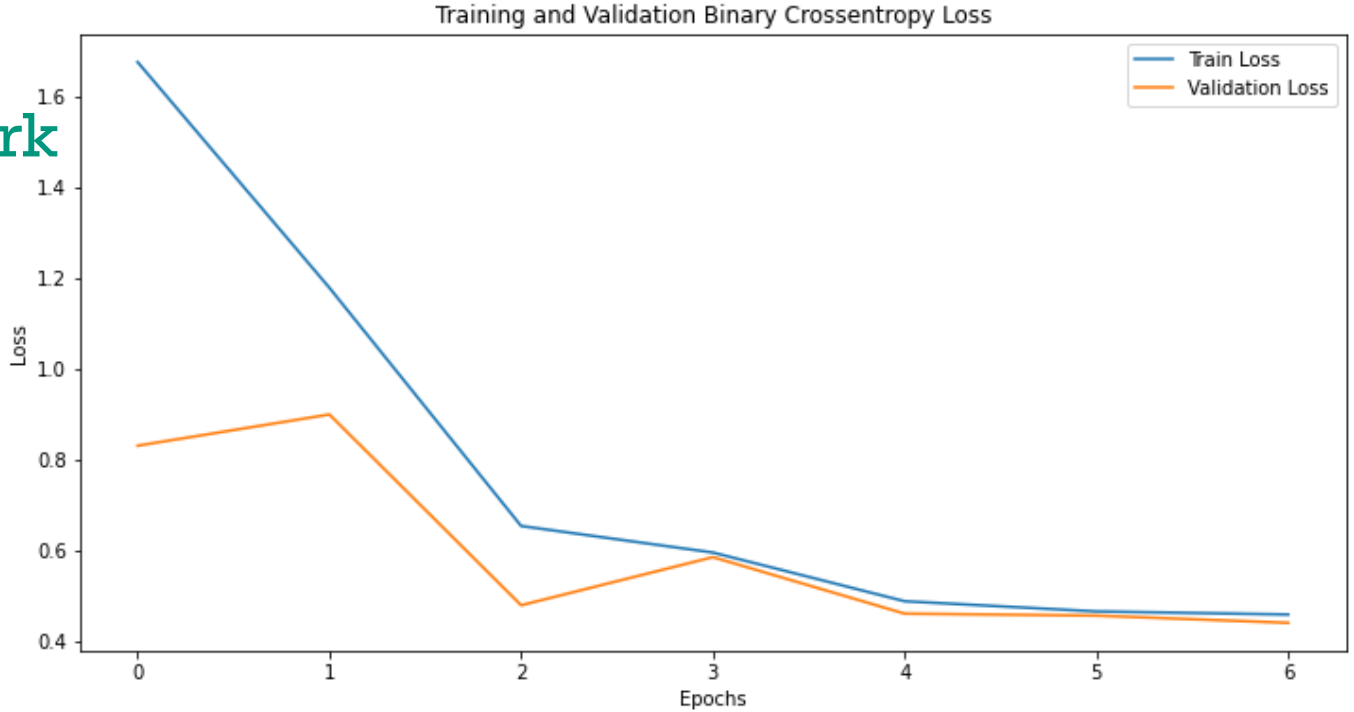
Findings & Results

- Feed Forward Neural Network Accuracy



Findings & Results

- Feed Forward Neural Network
  - Loss



Conclusion

- Best performing model:
  Feed Forward Neural Network
- What does this mean?
  Additional modeling required as CNNs are expected to perform better

Potential Future Work

- **CNN Optimization**
  VGG-16, Inception, ResNet

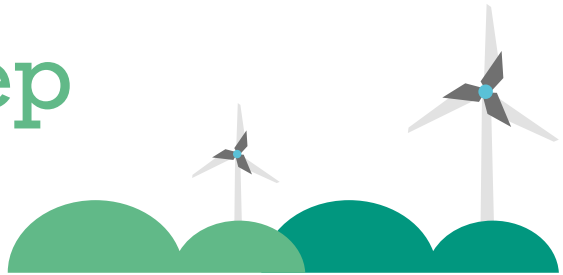
- **Transfer Learning**
  ImageNet

- **Autoencoders, Transformers, Reinforcement Learning, GANs**

Thank You

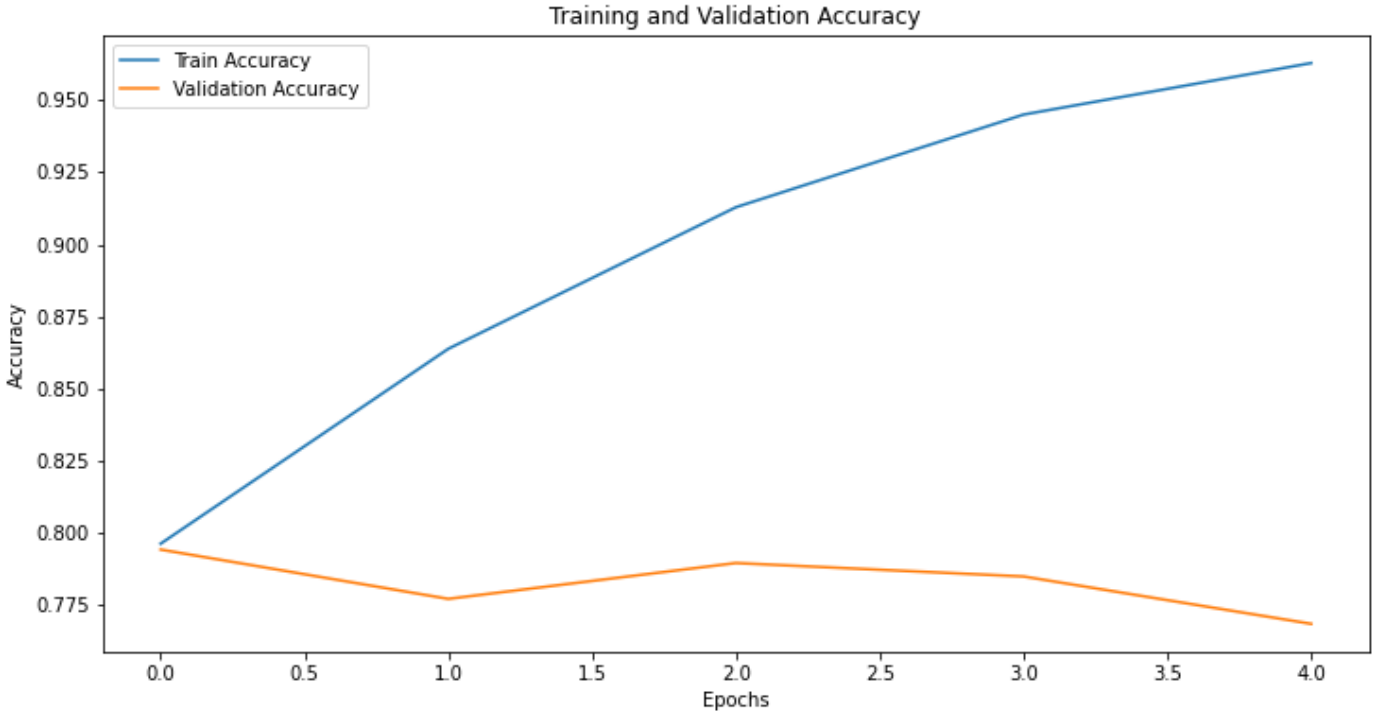
Questions?

metis 2022 sep



Appendix

- CNN #1
  - Accuracy



Appendix

- CNN #1
  - Loss

Appendix

- CNN #2
  Accuracy

Appendix

- CNN #2
  - Loss