WASTE IMAGE CLASSIFICATION

Python for Data Science | Final Project

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RESEARCH PROBLEM

Problem Statement

Separating recyclable waste is a tedious task

Confusing recycling guidelines

Human error

Recycling contamination

SOLUTION

Description

A computer vision-based waste management system

Scan, identify, and sort

SOLUTION

Objective

Train machine learning model using images of different types of recyclable waste to accurately classify an image into one of the waste categories

SOLUTION

Assumptions

1. Images show one or more items of the same waste category
2. Categories in compliance with recycling guidelines
3. Images in the training set are accurately classified

METHODOLOGY

Overview

Data
custom dataset

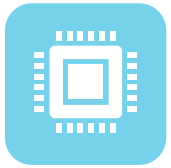
Model
Convolutional Neural Network

Tool
Jupyter Notebook

Model Architecture
ResNet50

Python Package
fastai

Processor
CPU



METHODOLOGY

Process Overview

1 **Data collection**

Carefully viewed and downloaded images

Stored data on an easily available online platform

2 **Dataset preparation**

Imported and loaded images

Split data into training and validation sets

Augmented data

3 **Model training**

Trained model using transfer learning

Retrained model with optimized hyperparameter

4 **Model evaluation**

Summarized and visualized prediction results on validation set

METHODOLOGY

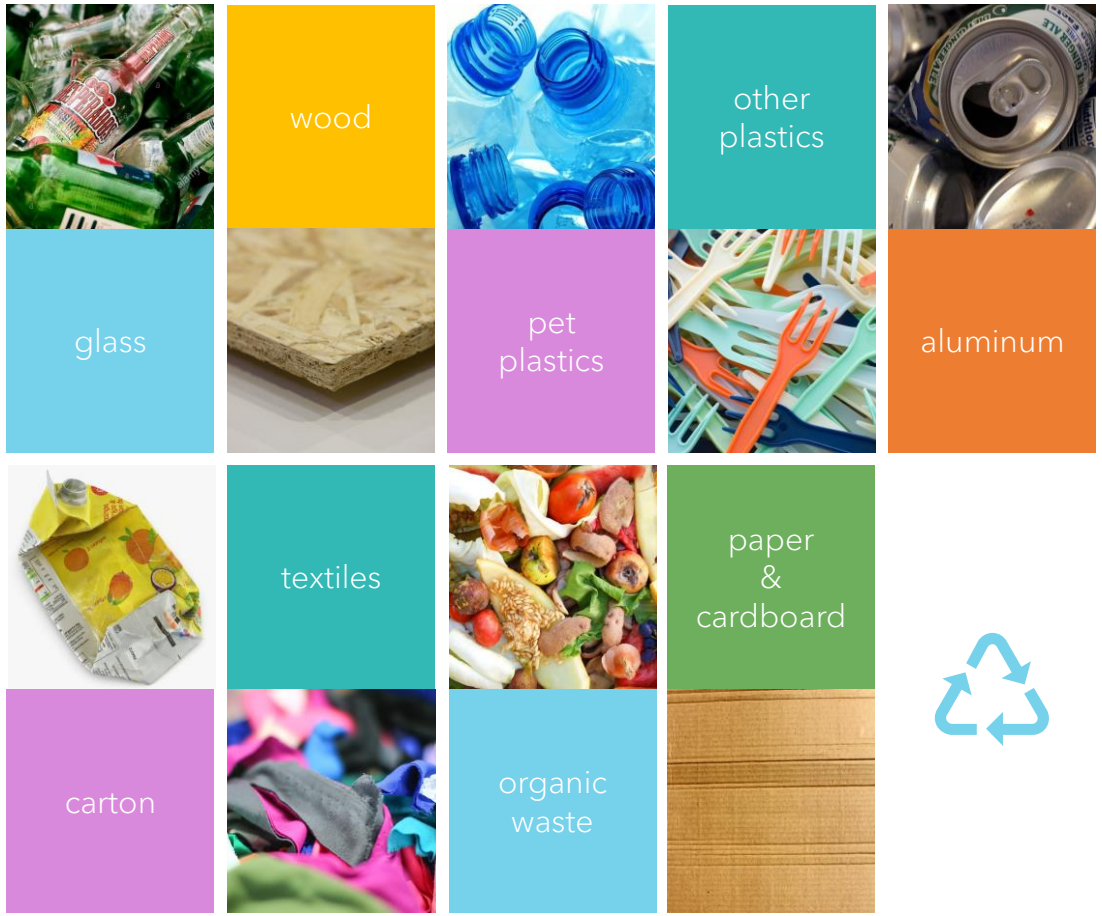
Data Collection

9
classes

appr. 350
handpicked images per class

Google Images
source

Kaggle
storage



METHODOLOGY

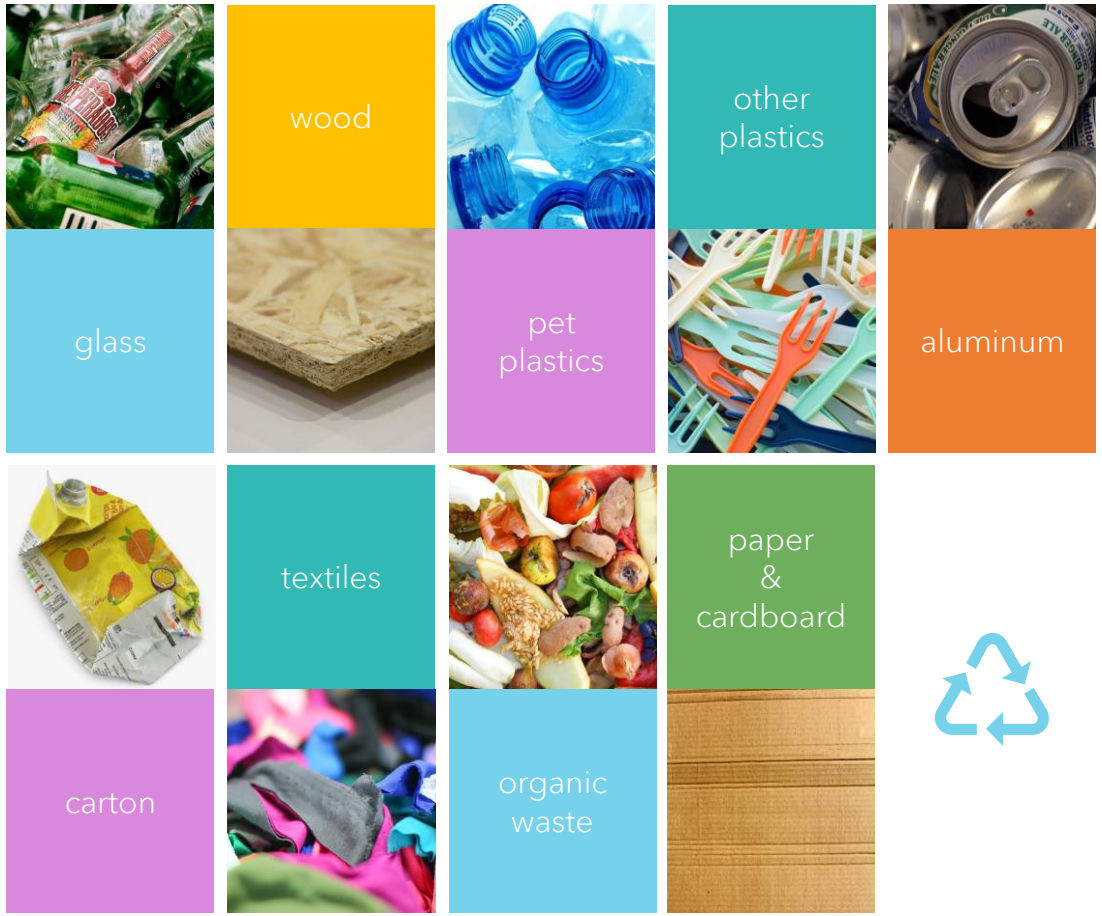
Dataset Preparation

80%
training set

20%
validation set

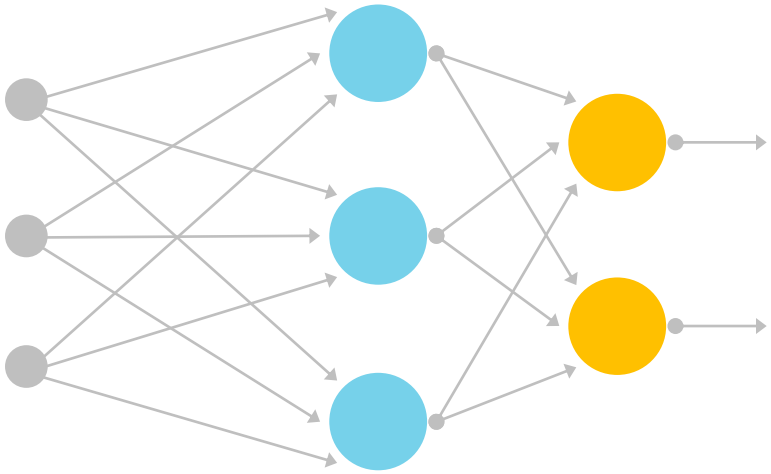
Resize
item transformations

Aug_transforms; no flip
batch transformations



METHODOLOGY

Model Training



Convolutional Neural Network

Deep learning algorithm used to analyze image objects

ResNet50

Residual network variant with 50 layers (48 Convolution layers , 1 MaxPool, and 1 Average Pool layer) used for transfer learning

Learning rate optimization

The most important neural network hyperparameter
Optimizing the trade-off between the rate of convergence and overshooting

METHODOLOGY

Model Evaluation

Stage 1

89,9%

accuracy

Learning rate optimization

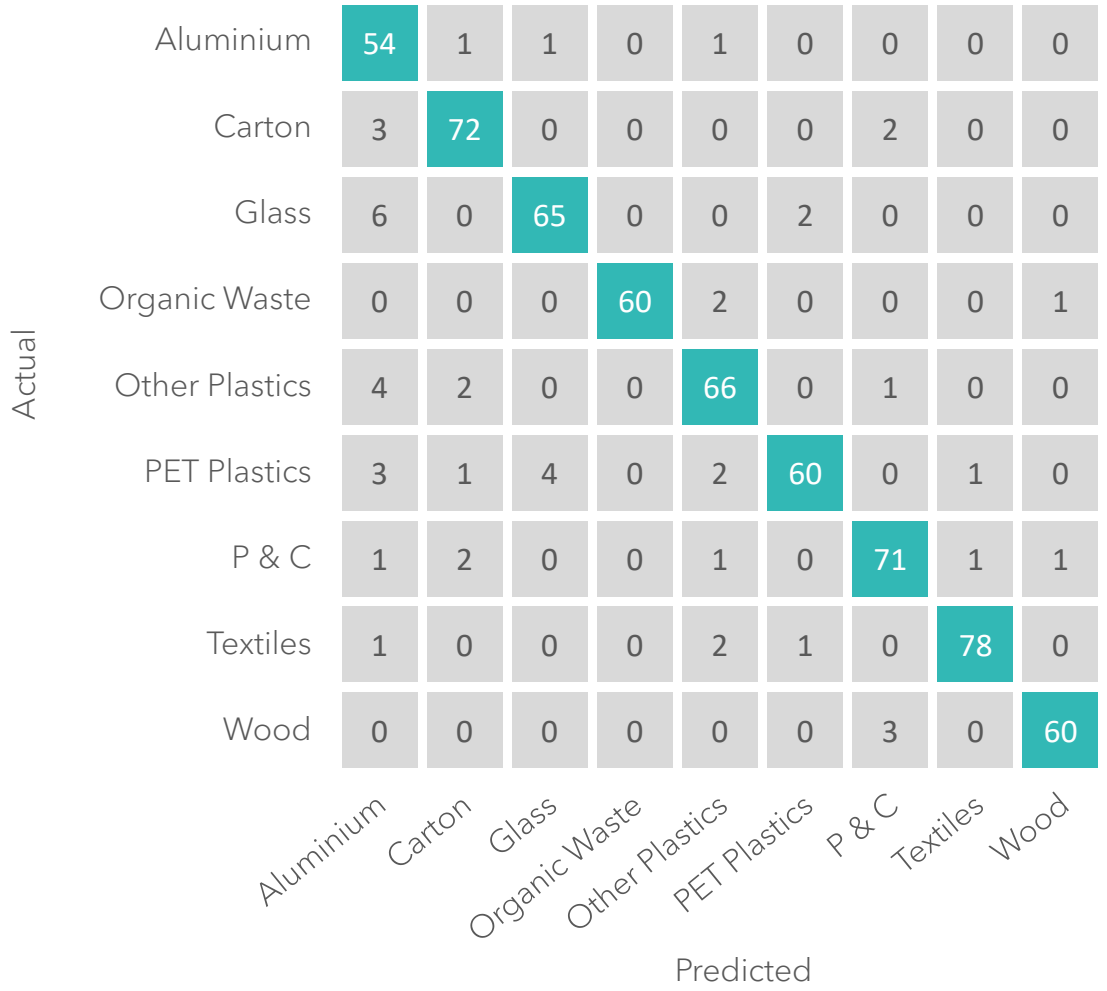
Stage 2

92,1%

accuracy

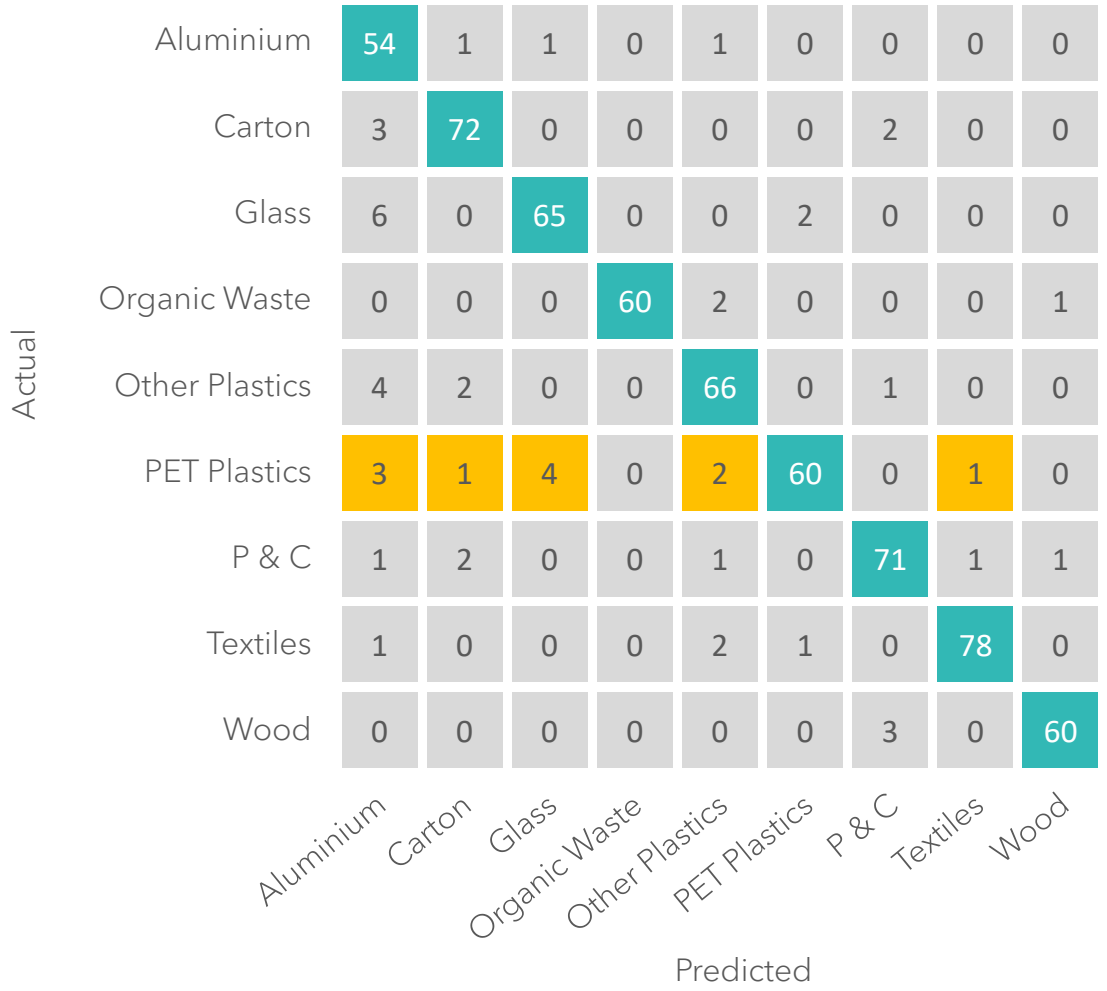
RESULTS

Testing



RESULTS

Testing



RESULTS

Testing

pet plastics

glass

Most confused
PET Plastics and Glass

Problem
Difficult to differentiate even by human eye

FUTURE IMPROVEMENTS

Methodology Improvements

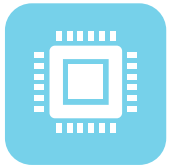
Data
custom dataset

Model
Convolutional Neural Network

Tool
Jupyter Notebook

Model Architecture
ResNet50

Python Package
fastai



Processor
CPU

FUTURE IMPROVEMENTS

Methodology Improvements

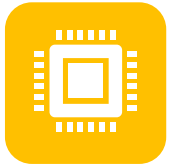
Data
bigger and better dataset

Model
Convolutional Neural Network

Tool
Google Collab

Model Architecture
ensemble modeling

Python Package
fastai



Processor
GPU

FUTURE IMPROVEMENTS

Methodology Improvements

Assumptions

better waste classification criteria

more/less waste categories

Data

increase number of images

more HD images

consistent background behind items

Model

ensemble learning or other CNN architectures

multi-label classification

overfitting techniques: regularization,…

GitHub Code:
Waste_Image_Classification

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