THE BIN CONUNDRUM

Image-Based Waste Sorting

Data Knyts

Tanmay Jain, Ayush Raina, Siddhartha Haldar, Anirban Banerjee

MOTIVATION

Have you ever been confused where to throw trash?

PROBLEM STATEMENT

The Garbage Problem

Waste sorting is critical for increasing the amount of waste that can be recycled.

However, it is often impractical to sort large quantities of waste by hand.

GOALS & AIM

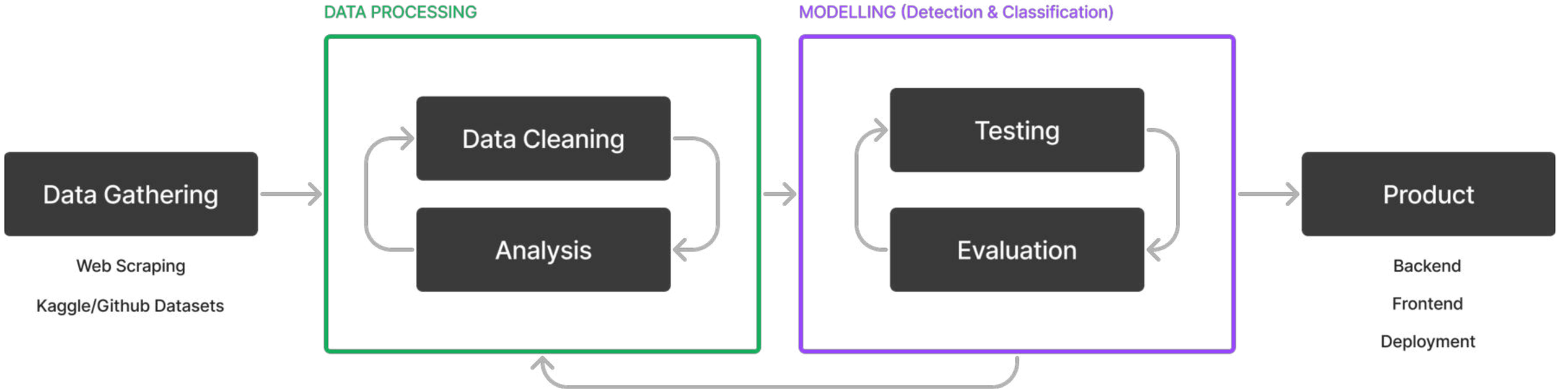
Our Intention

- Can we improve waste sorting by using a neural network to identify which waste products are compostable and/or recyclable?

- Via comparative analysis, which neural network provides the best results for identifying waste? Are some better than others in certain scenarios?

- Can we improve this process by utilizing active learning procedures?

METHODOLOGY & TOOLS



Selenium 4

GitHub

kaggle

scikit learn

OpenCV

PyTorch

TensorFlow

Flask

DigitalOcean

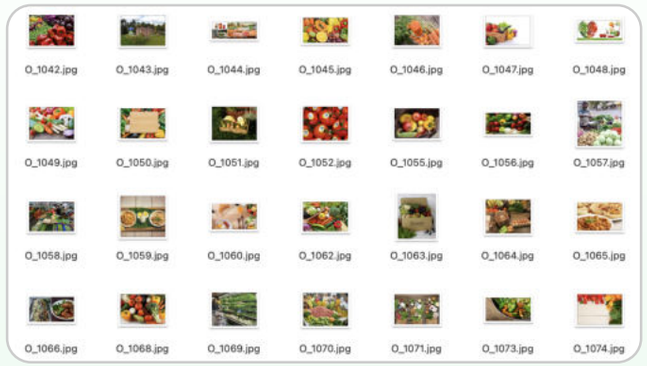
docker

DATA

Annotated Data

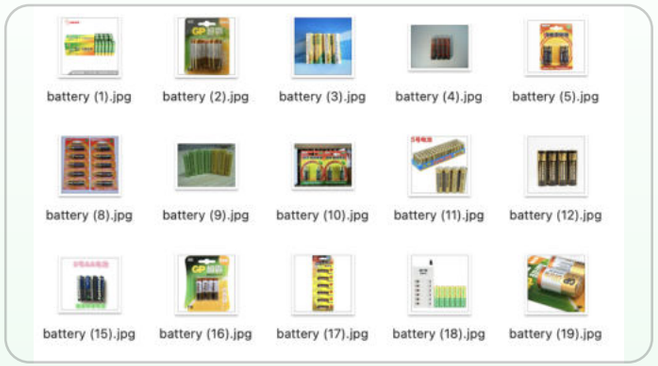
Taco Dataset

Non-Annotated Data



4+ Sets Kaggle/GitHub

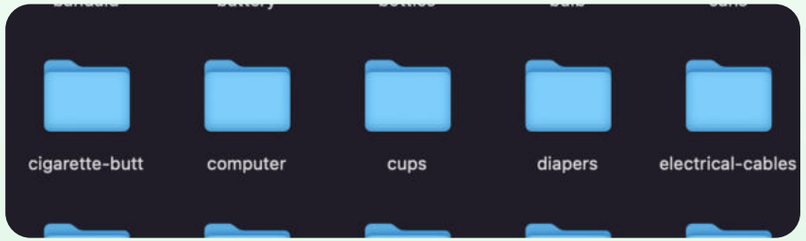
Scraped Data



20K+ images scraped

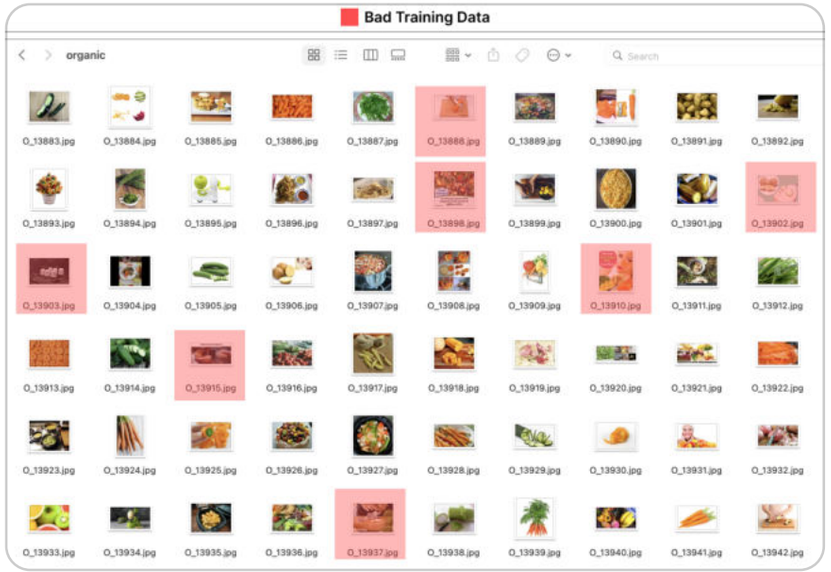
```
Dataset: 44,200 items
Size: 3.91 GB
```

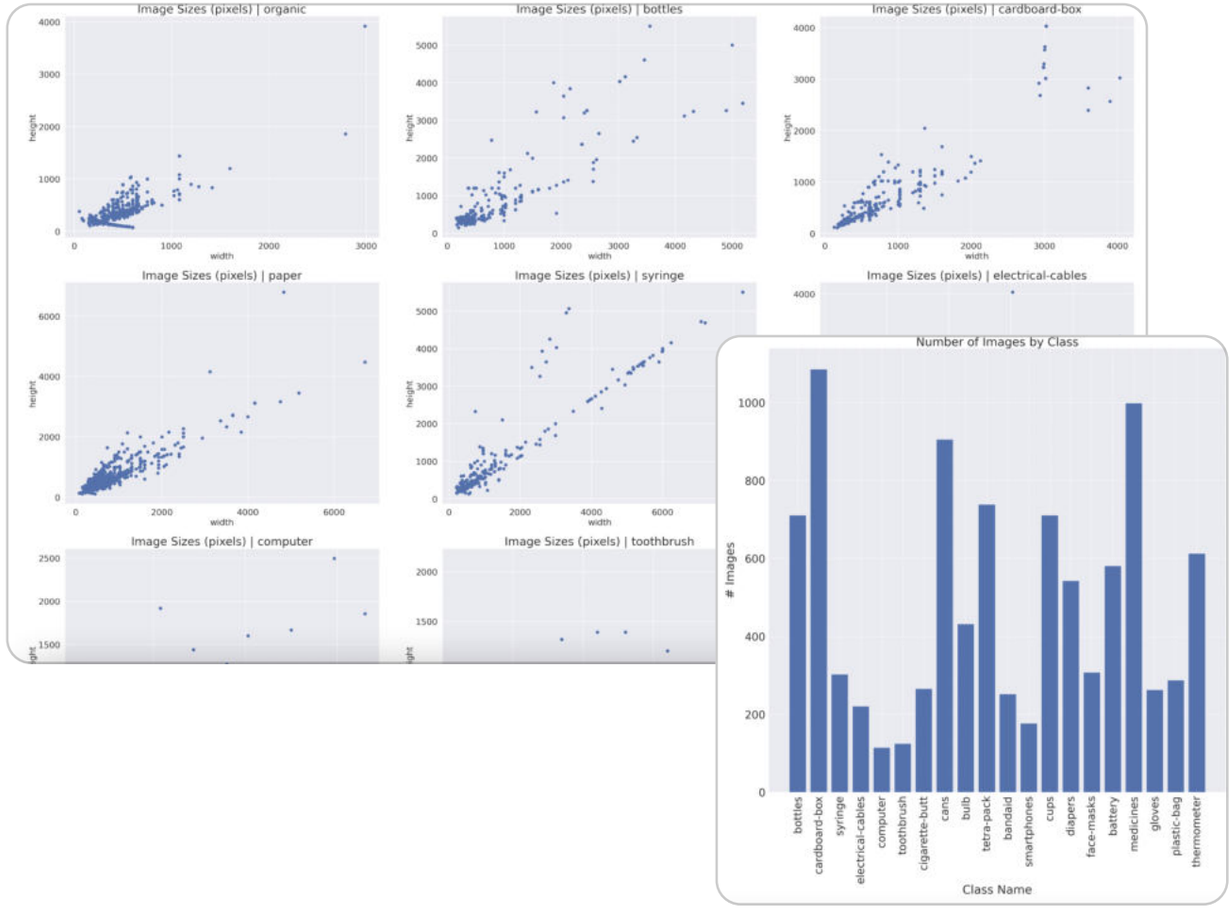
Total Size



22 Classes

CLEANING & PROCESSING





MODELS

CLASSIFICATION

- Vgg16
- Resnet18
- Inception-v3
- SqueezeNet

DETECTION

- Mask R-CNN
- Backbone: Resnet50

```
model_vgg.classifier = nn.Sequential(*list(model_vgg.classifier.children())[:-1] + [nn.Linear(num_ftrs,len(all.clas

model_vgg = model_vgg.to(device)

criterion = nn.CrossEntropyLoss()

# Observe that only parameters of final layer are being optimized as
# opposed to before.
optimizer_vgg = optim.SGD(model_vgg.classifier.parameters(), lr=0.001, momentum=0.9)

# Decay LR by a factor of 0.1 every 7 epochs
exp_lr_scheduler = optim.lr_scheduler.StepLR(optimizer_vgg , step_size=7, gamma=0.1)

checkpoint_path = "./checkpoints/vgg16_all_simply/"

model_vgg = train_model(all_dataSets, all_dataLoader, model_vgg, criterion, optimizer_vgg,
                        exp_lr_scheduler, checkpoint_path, num_epochs=25, device=device)
```

```
ncy expressed in bytes should be converted to RGBA images
  warnings.warn(
/home/tanmay/miniconda3/lib/python3.9/site-packages/PIL/Image.py:945: UserWarning: Palette images with Transpare
ncy expressed in bytes should be converted to RGBA images
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train Loss: 0.2312 Acc: 0.9318

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  warnings.warn(

val Loss: 0.3085 Acc: 0.9196
```
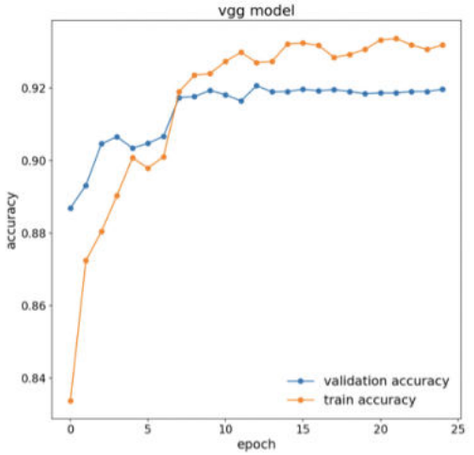
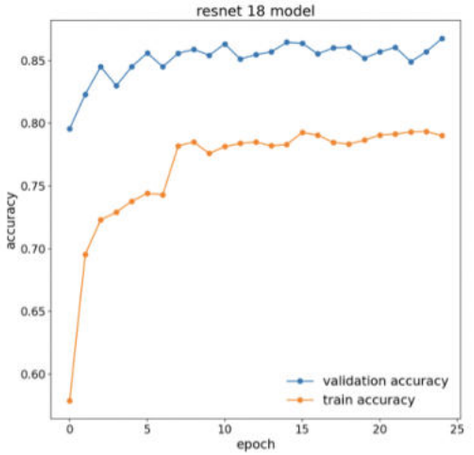
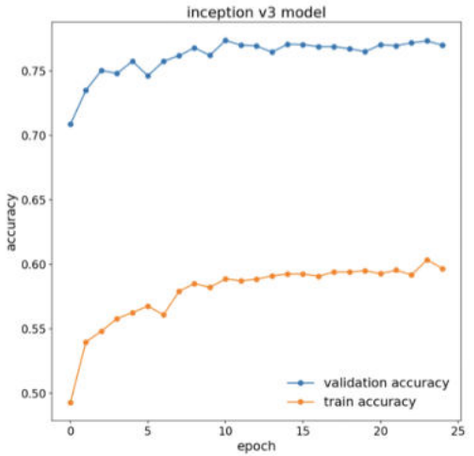
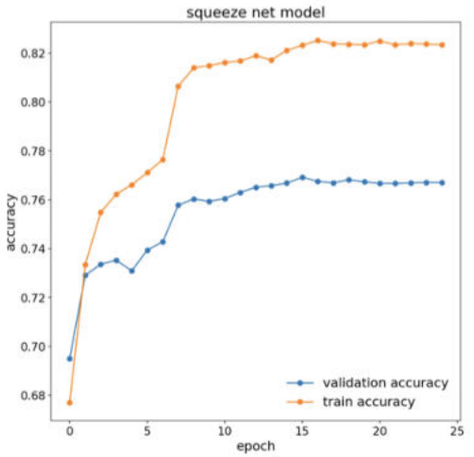
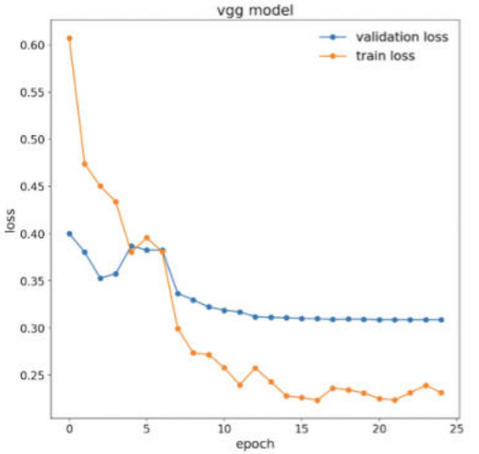

EVALUATION

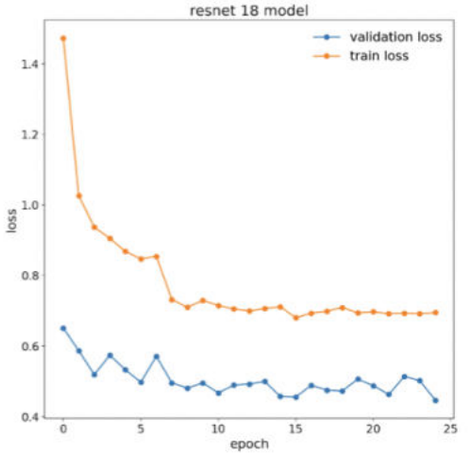

vgg model
accuracy
epoch
validation accuracy
train accuracy


resnet 18 model
accuracy
epoch
validation accuracy
train accuracy


inception v3 model
accuracy
epoch
validation accuracy
train accuracy


squeeze net model
accuracy
epoch
validation accuracy
train accuracy


vgg model
loss
epoch
validation loss
train loss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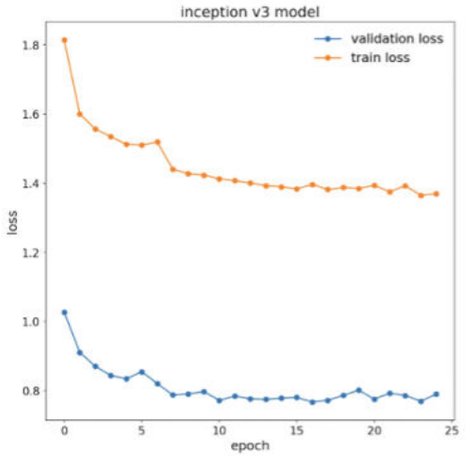
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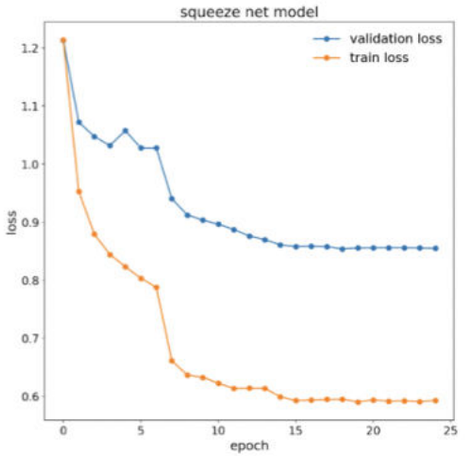

squeeze net model
loss
epoch
validation loss
train loss

RESULTS

What works well?

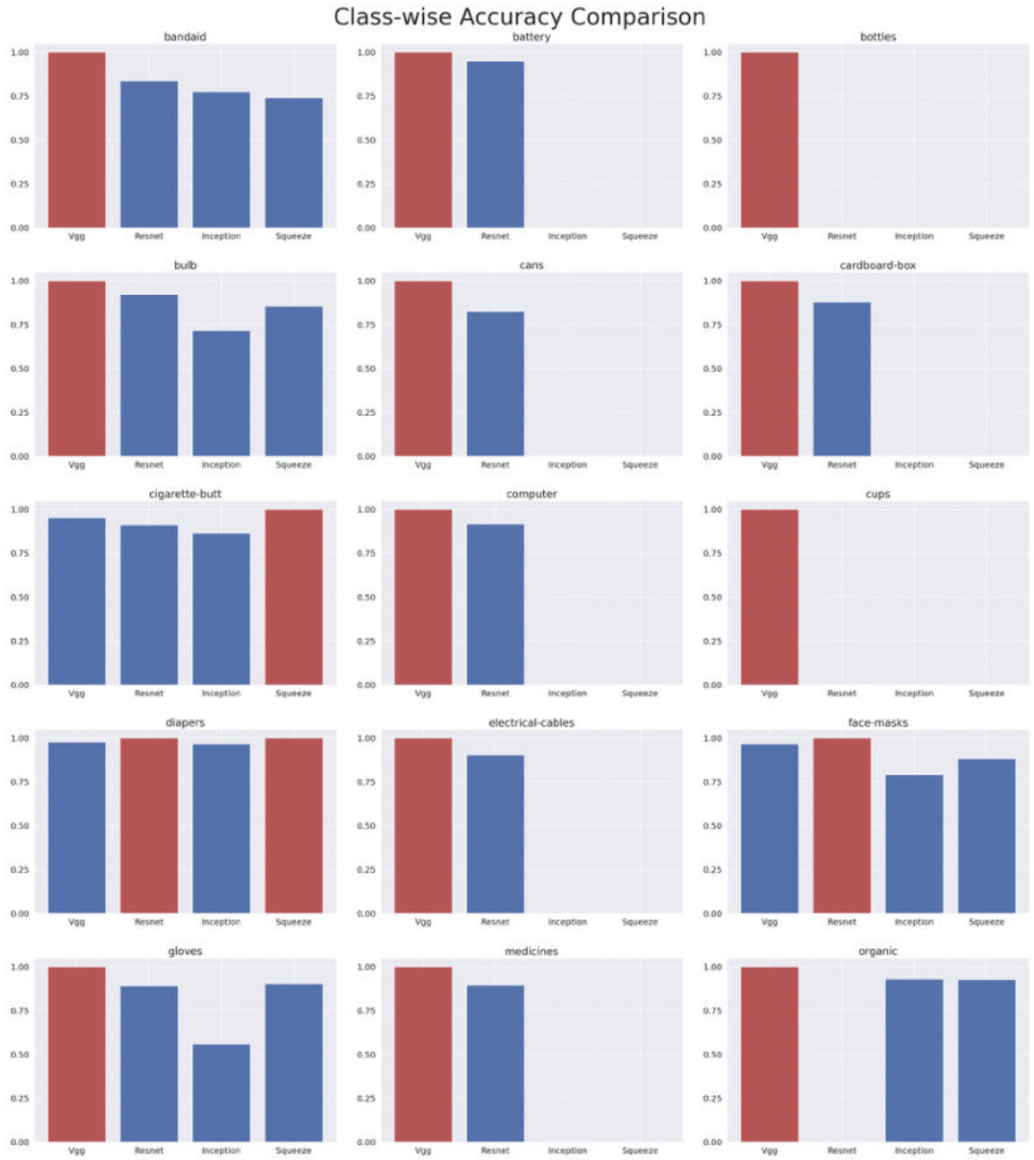
- Classification of items: bandaid, electronics, face masks, cups, organic, etc.
- Detection of items: cigarettes, bottles, cups.
- Detection on bounding boxes.

What doesn’t?

- Limited training for detection: items detected but unable to classify.
- Bias for organic classification

BEST MODEL

VGG16 with **93%** Overall accuracy

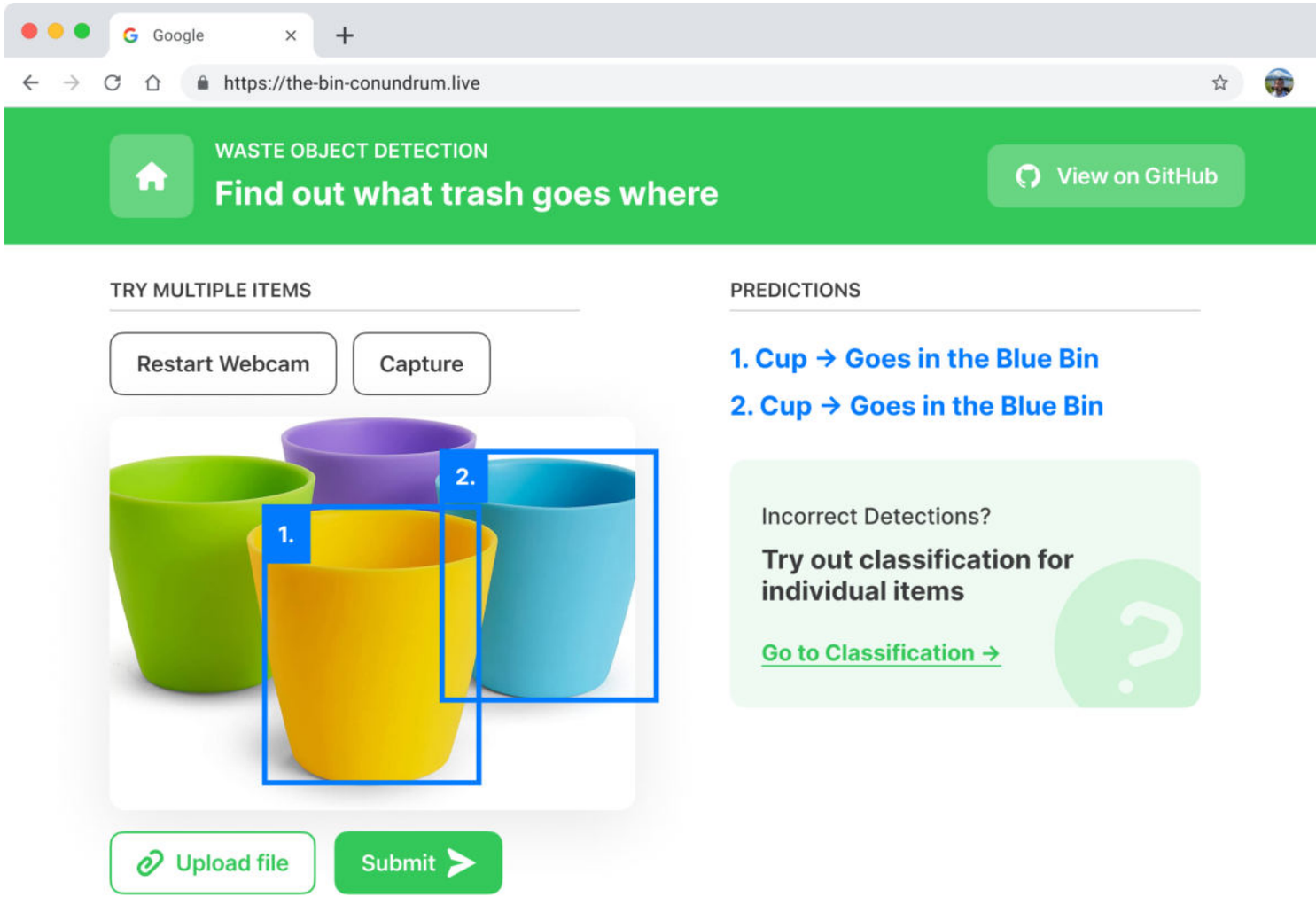


DATA PRODUCT

Our data product is a web app that integrates the classification and detection models into a single comprehensive system.

TRY IT OUT! 🎉

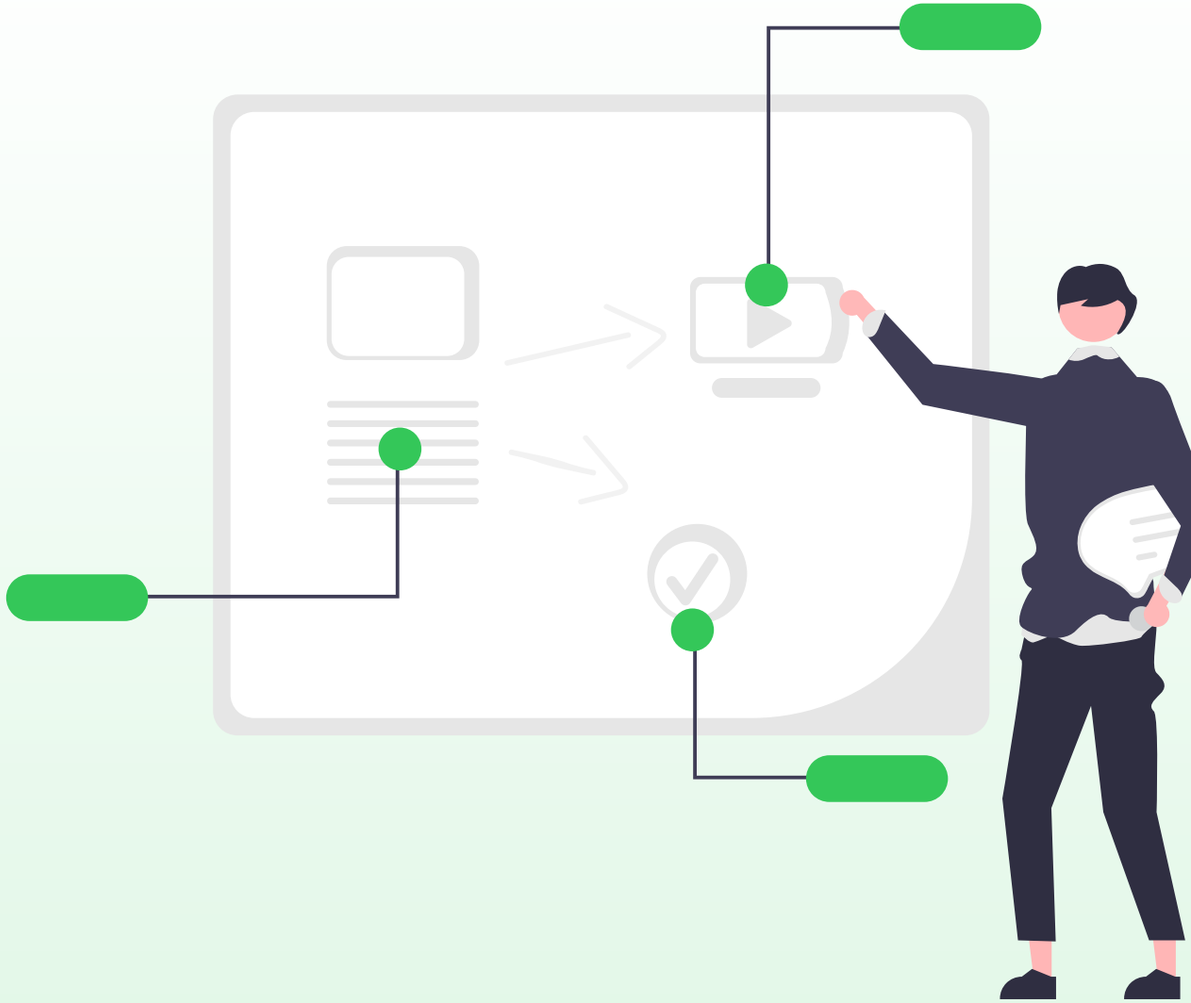
https://the-bin-conundrum.live



LEARNINGS

Even when working with pre-existing datasets, outliers and faulty data can still be present.

Checkpointing is of critical value when models have long training times.



FUTURE WORK

What we have incorporated:

Dataset Creation

- Keeping a track of every image sent on the web-app and storing those predictions.

What we plan to:

Active Learning

- Apply active (human-in-the-loop) learning for the dataset created and retrain our models.

Thank you

Data Knyts

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