

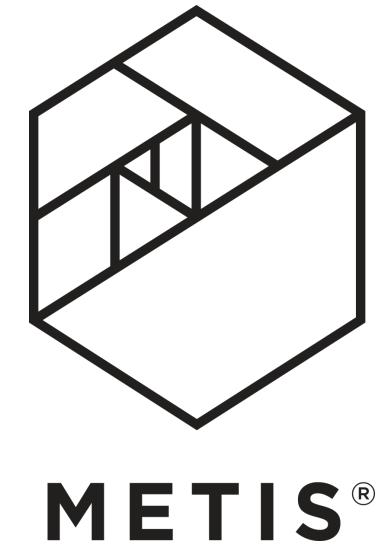
Plastic or Glass?

Deep Learning for Plastic/Glass Waste Classification

project for Metis EDA Bootcamp

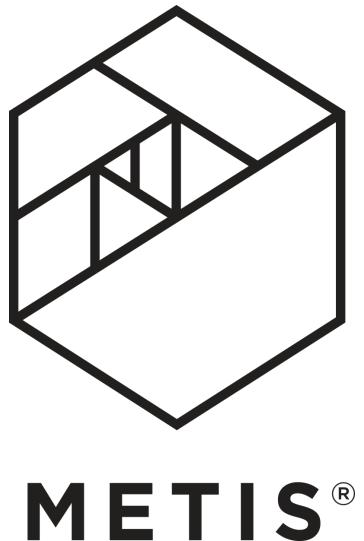
by Krystian Krystkowiak, 2022

Introduction

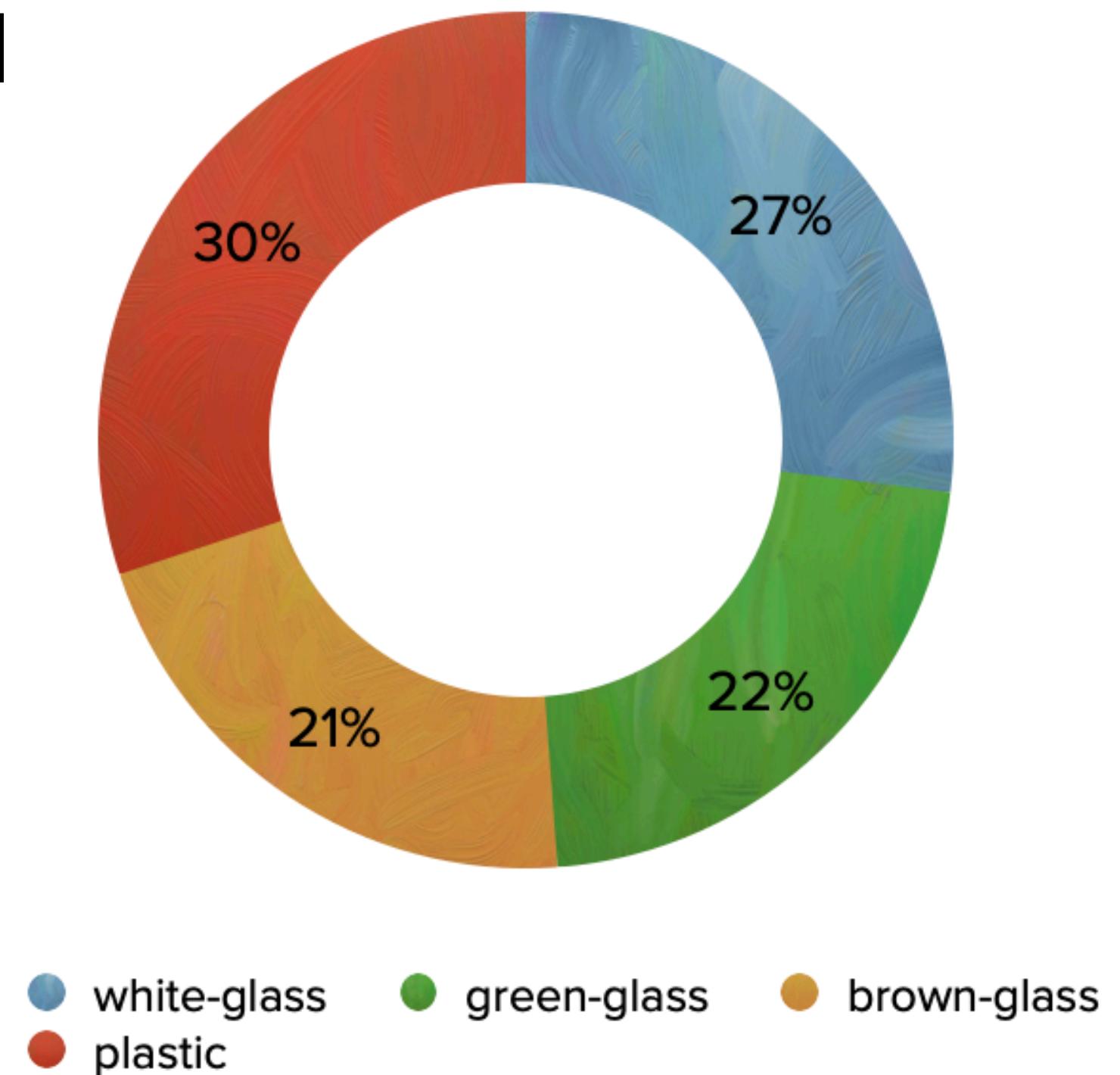
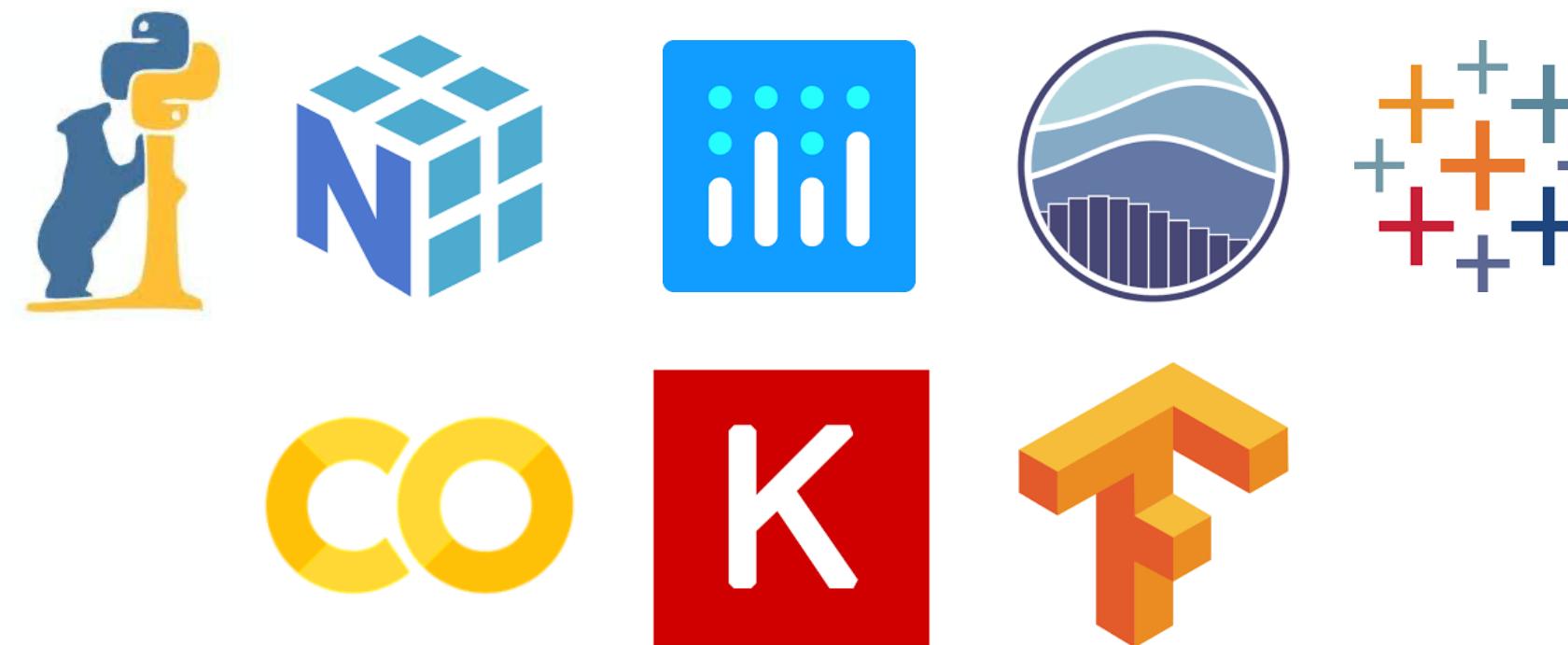


- **Garbage** is part of our ecosystem and leads to: **pollution and health issues**
- Efficient **waste management** - modern challenge
- **Innovations:** from smart containers to self-learning sorting technologies
- GOAL: **Machine learning model** capable of **classifying plastic and glass**

Methodology

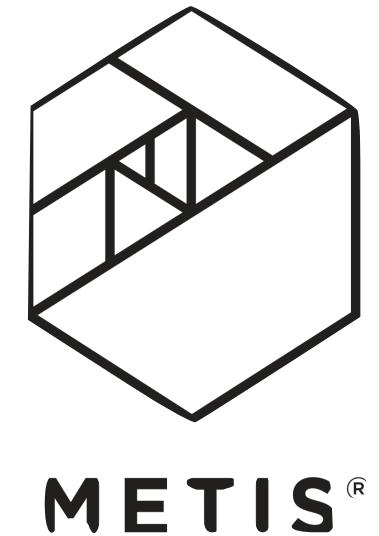
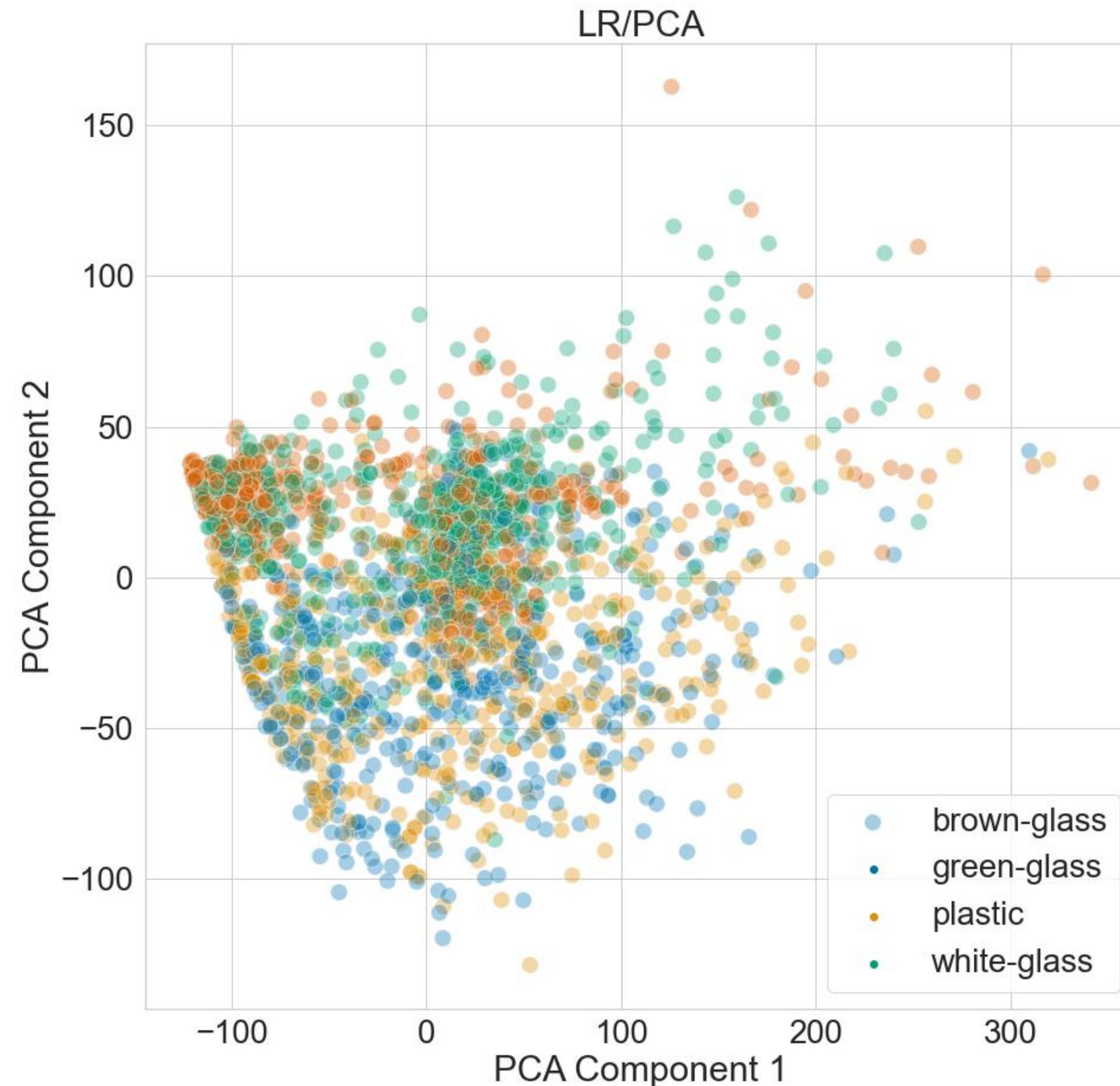


- Data from "Images dataset for classifying household garbage" (created by Mostafa Mohamed at **Kaggle**)
- **2876 images, 4 classes**: plastic (865), green-glass (629), brown-glass (607) and white-glass (775)
- Preprocessed to 71x71 RGB (faster and not lowering performance)
- Tools:



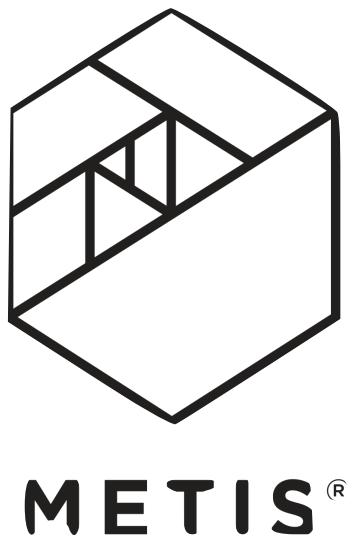
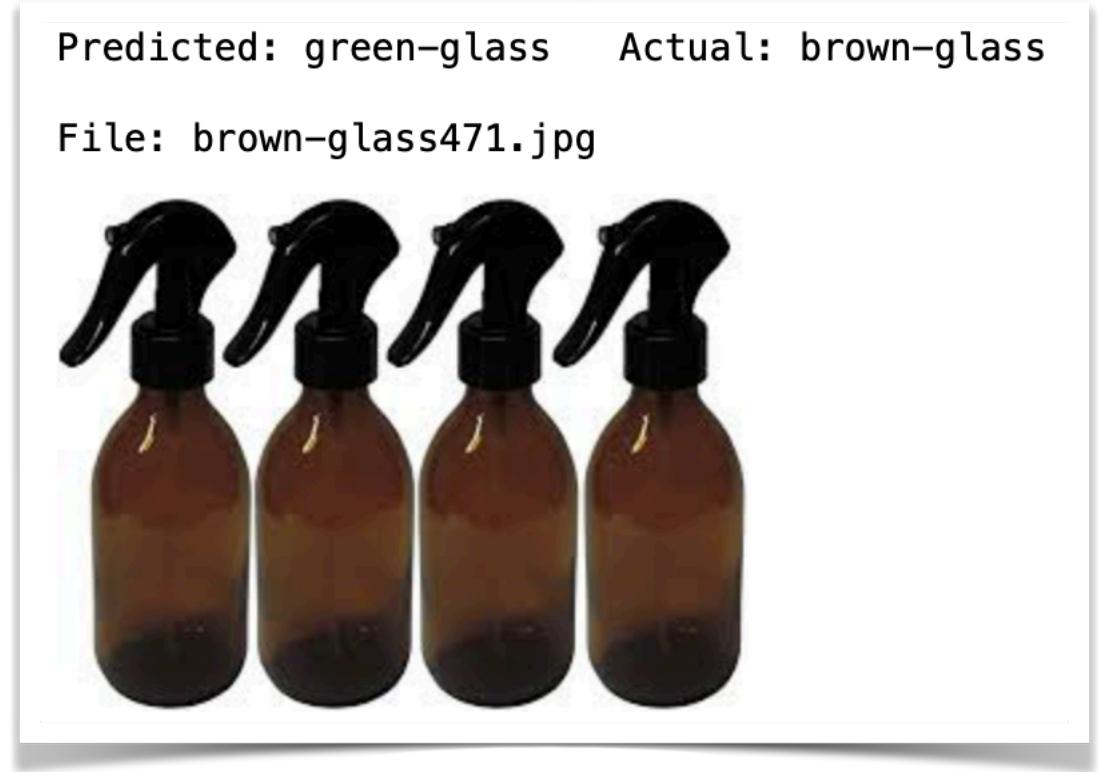
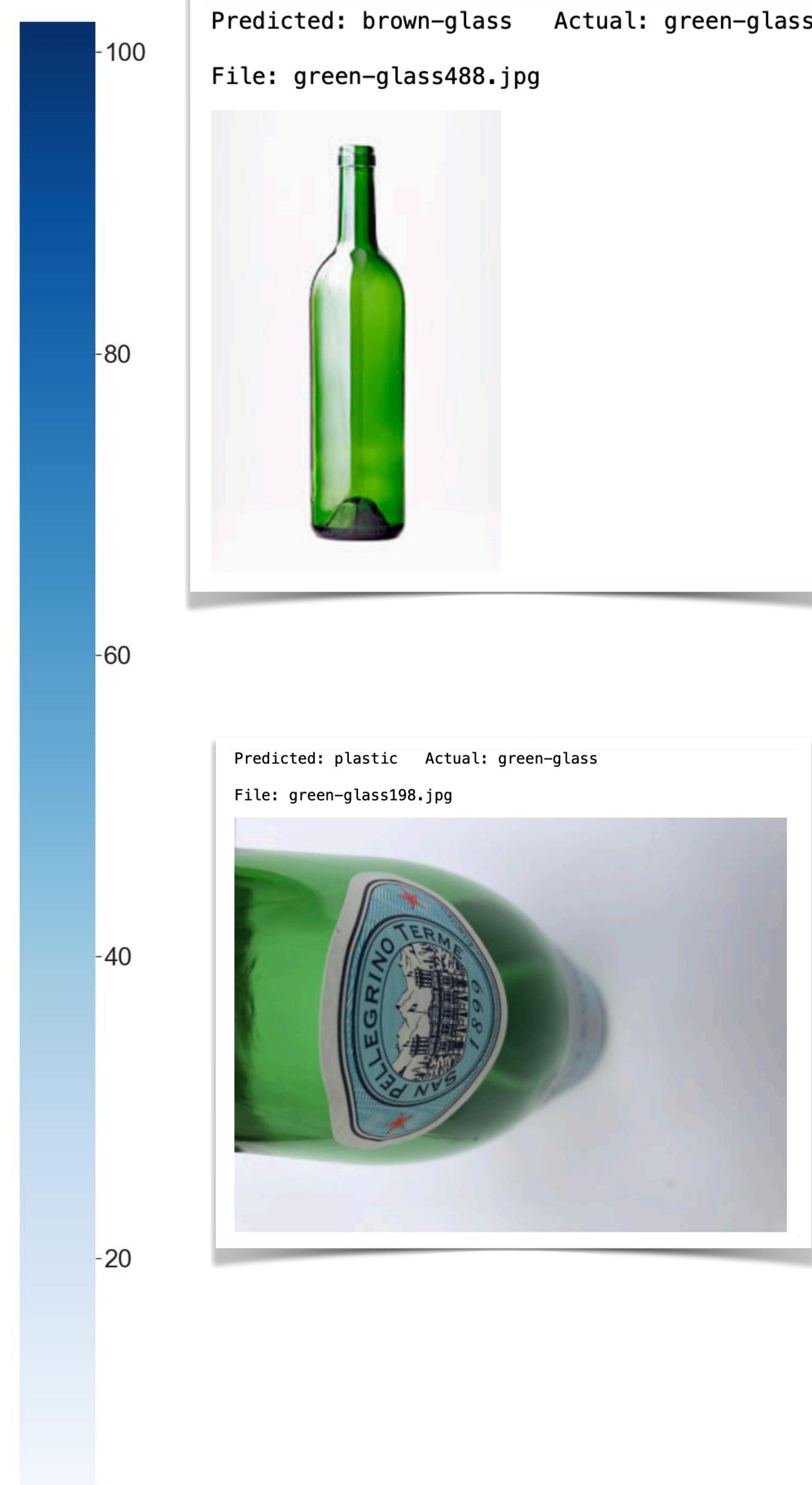
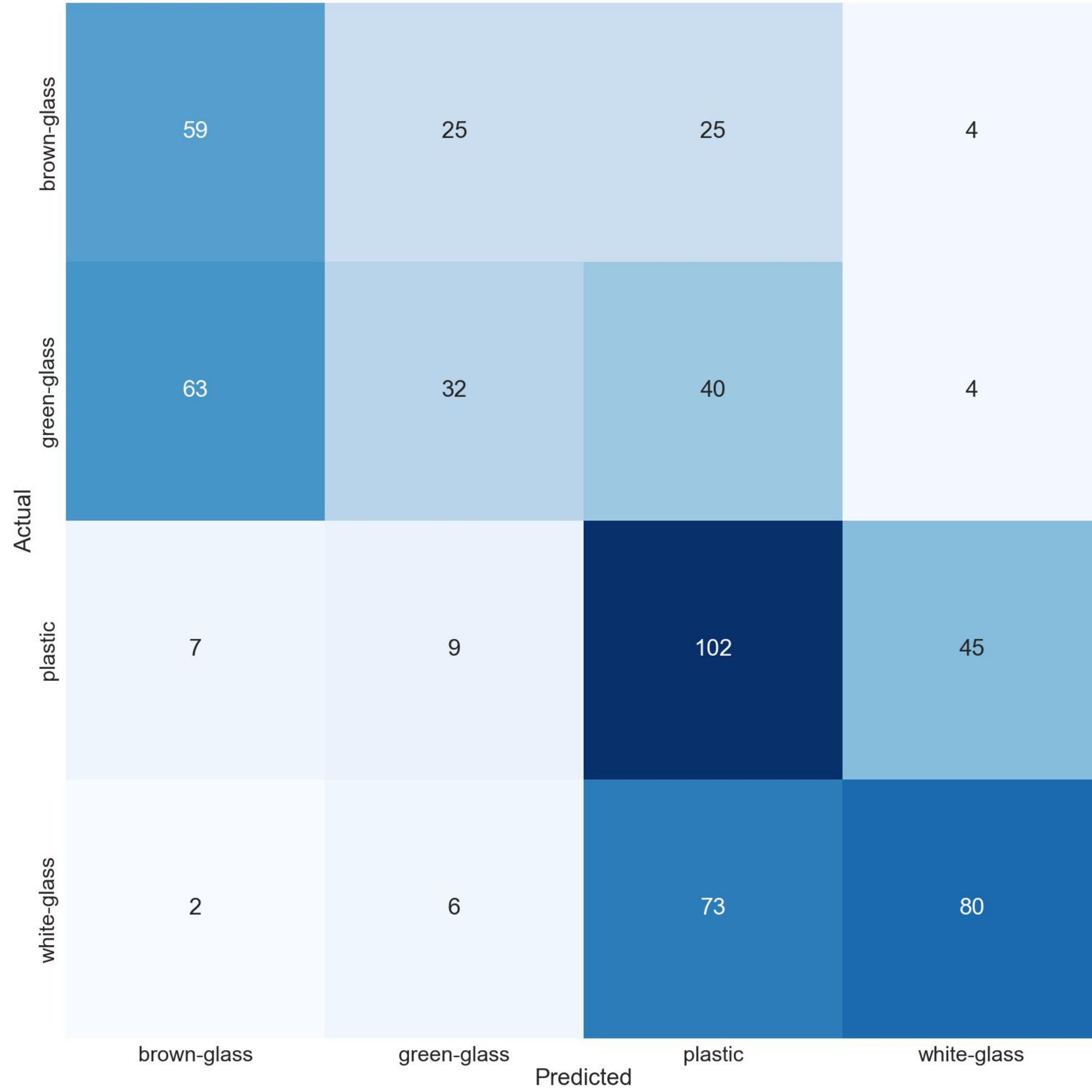
Methodology

- **Logistic Regression (baseline)**
- Metric - **F1** score
- 80%(2300 images)
20%(576 images)
Training/Validation split
- F1: 0.470 (Train)
- **F1: 0.459 (Val)**

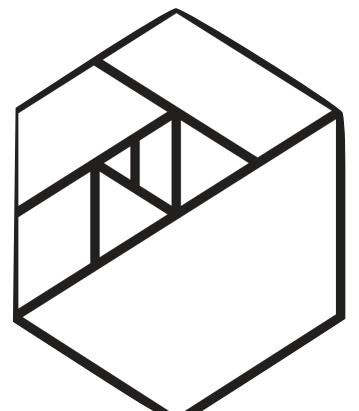


Methodology

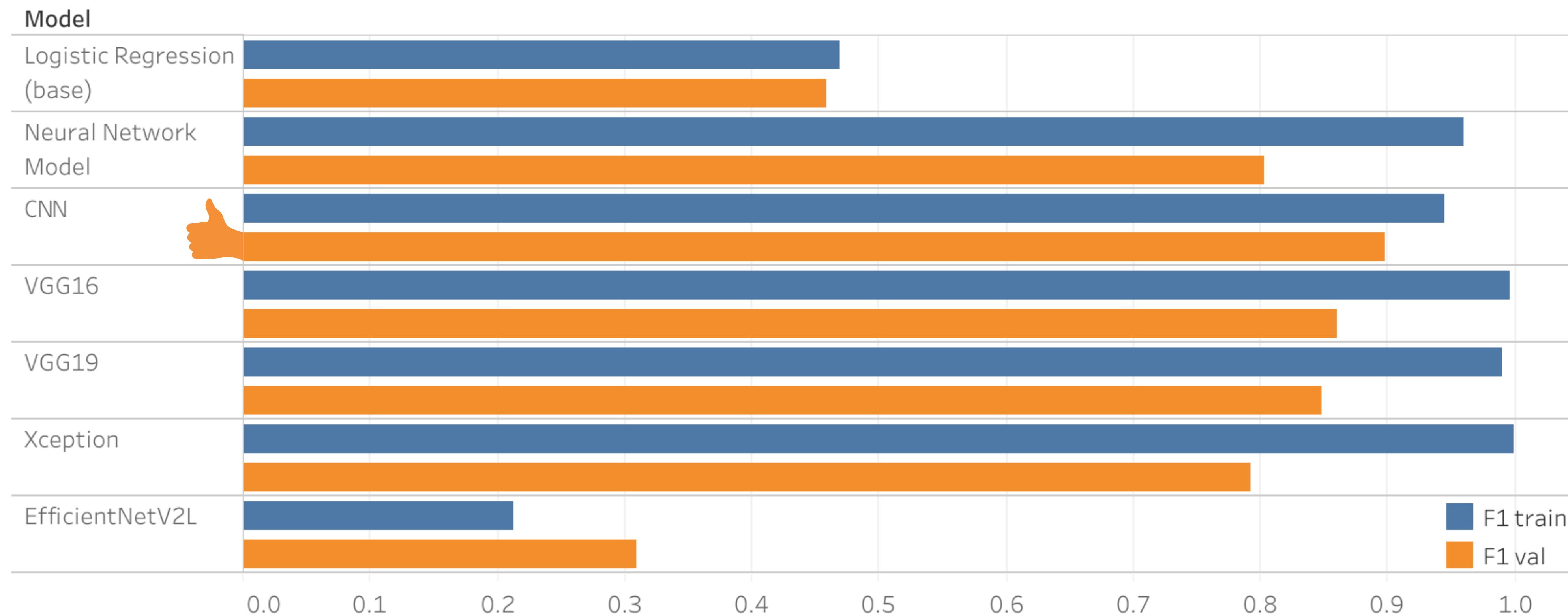
LOGISTIC REGRESSION
CONFUSION MATRIX on validation set



Results



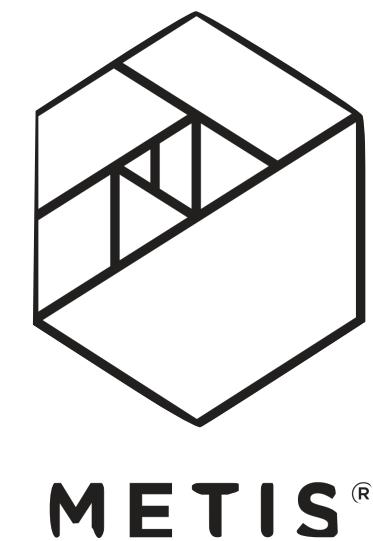
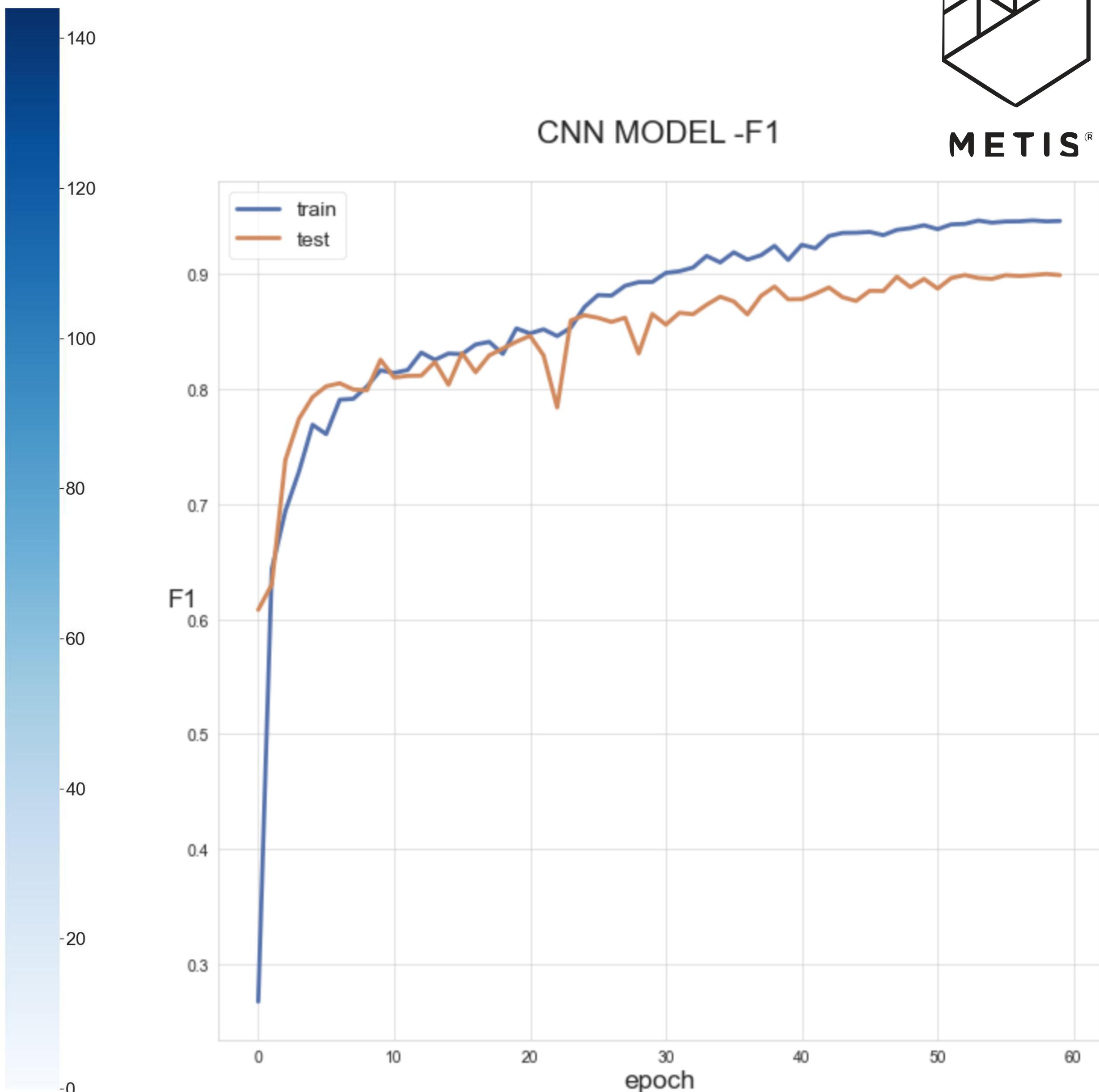
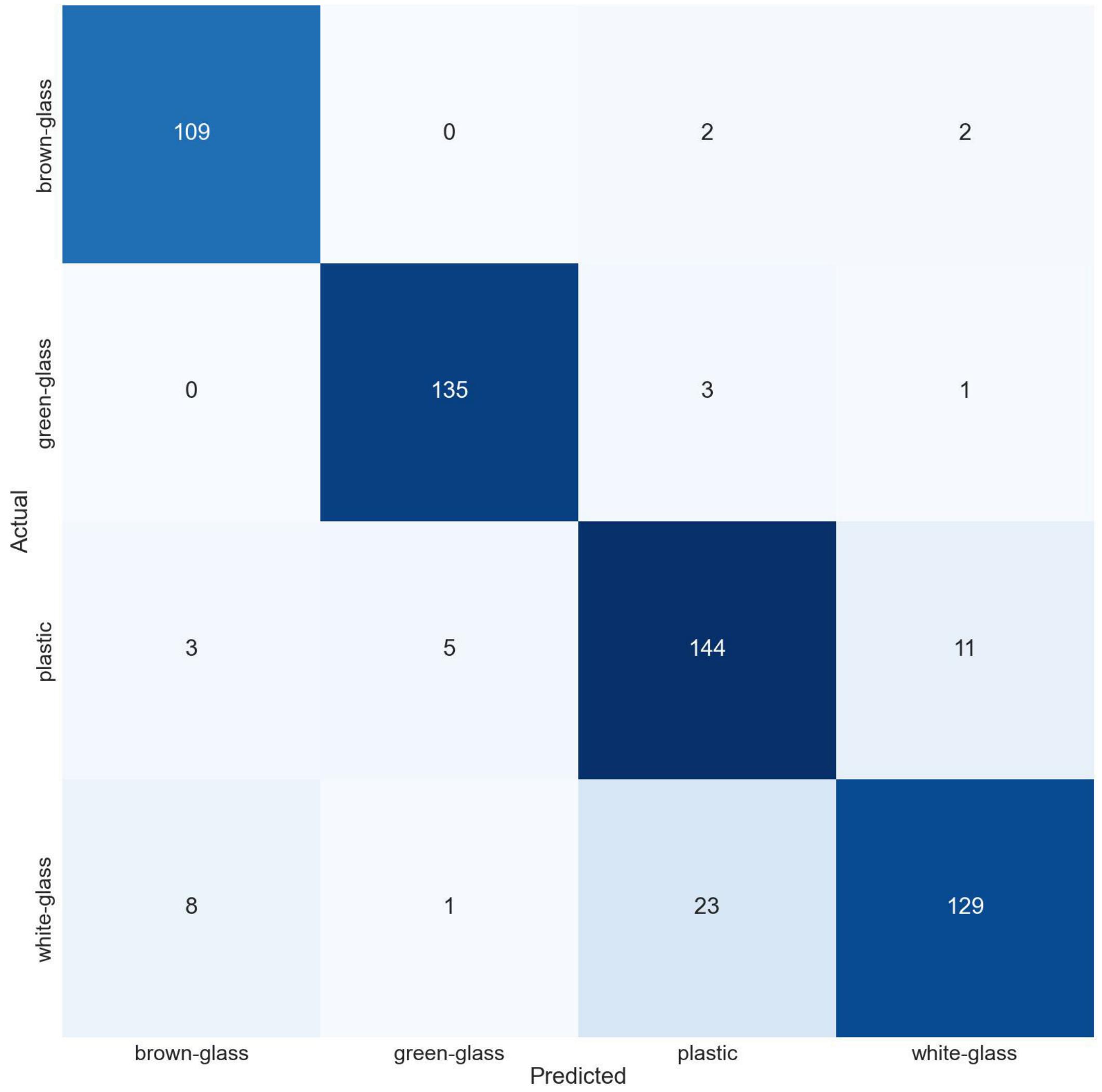
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- Convolutional Neural Network - **CNN** - **F1: 0.898 (Val)**, F1: 0.945 (Train)
- highest score, lowest overfitting

Results

CNN
CONFUSION MATRIX on validation set



Results

- Challenges:

Predicted: plastic Actual: white-glass File: white-glass61.jpg



Predicted: plastic Actual: white-glass File: white-glass439.jpg



Predicted: plastic Actual: white-glass



Predicted: white-glass Actual: plastic



Predicted: plastic Actual: white-glass



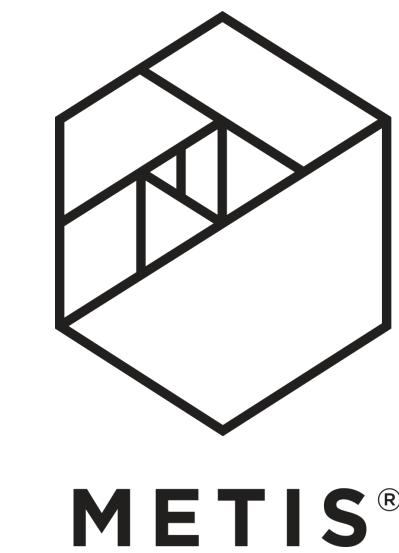
Predicted: plastic Actual: white-glass File: white-glass67.jpg



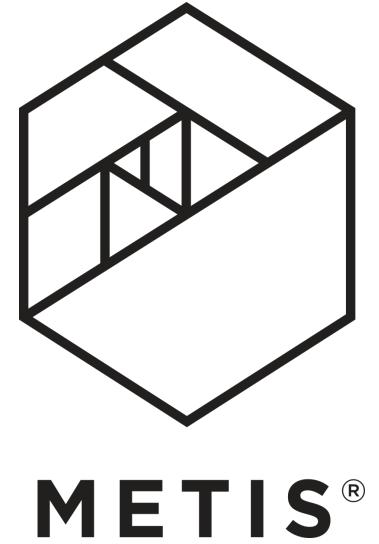
Predicted: brown-glass Actual: white-glass File: white-glass123.jpg



Predicted: plastic Actual: green-glass



Conclusions/Recommendations

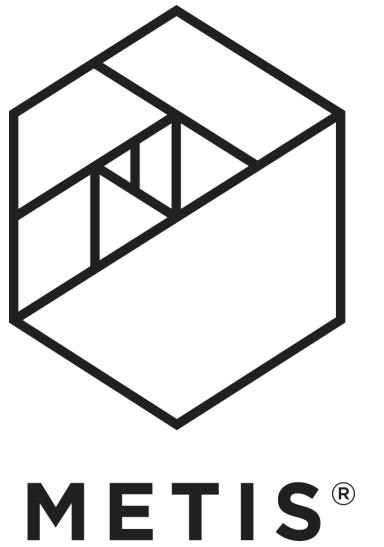


- **CNN - Convolutional Neural Network** model
- Transfer learning - not always best solution, how is it trained matters
- Constructed models are ready base for similar research



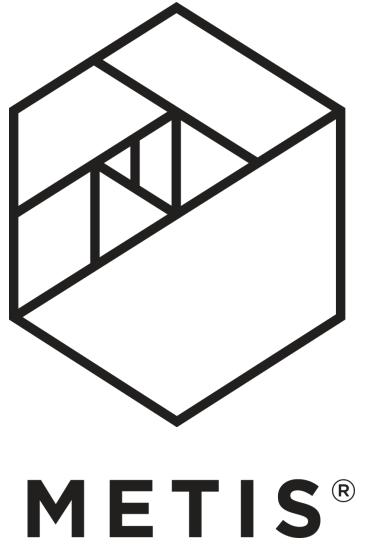
- Sort your waste and recycle!

Future Work



- Fine tuning of **CNN** and **further analysis** of challenging cases
- **More data and more types** of waste
- Application in smart containers and self-learning sorting **technologies**



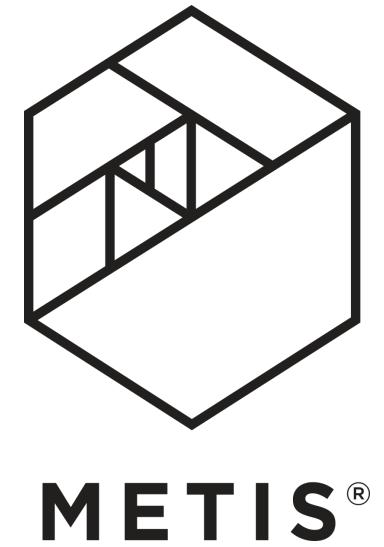


Thank you!
Questions?

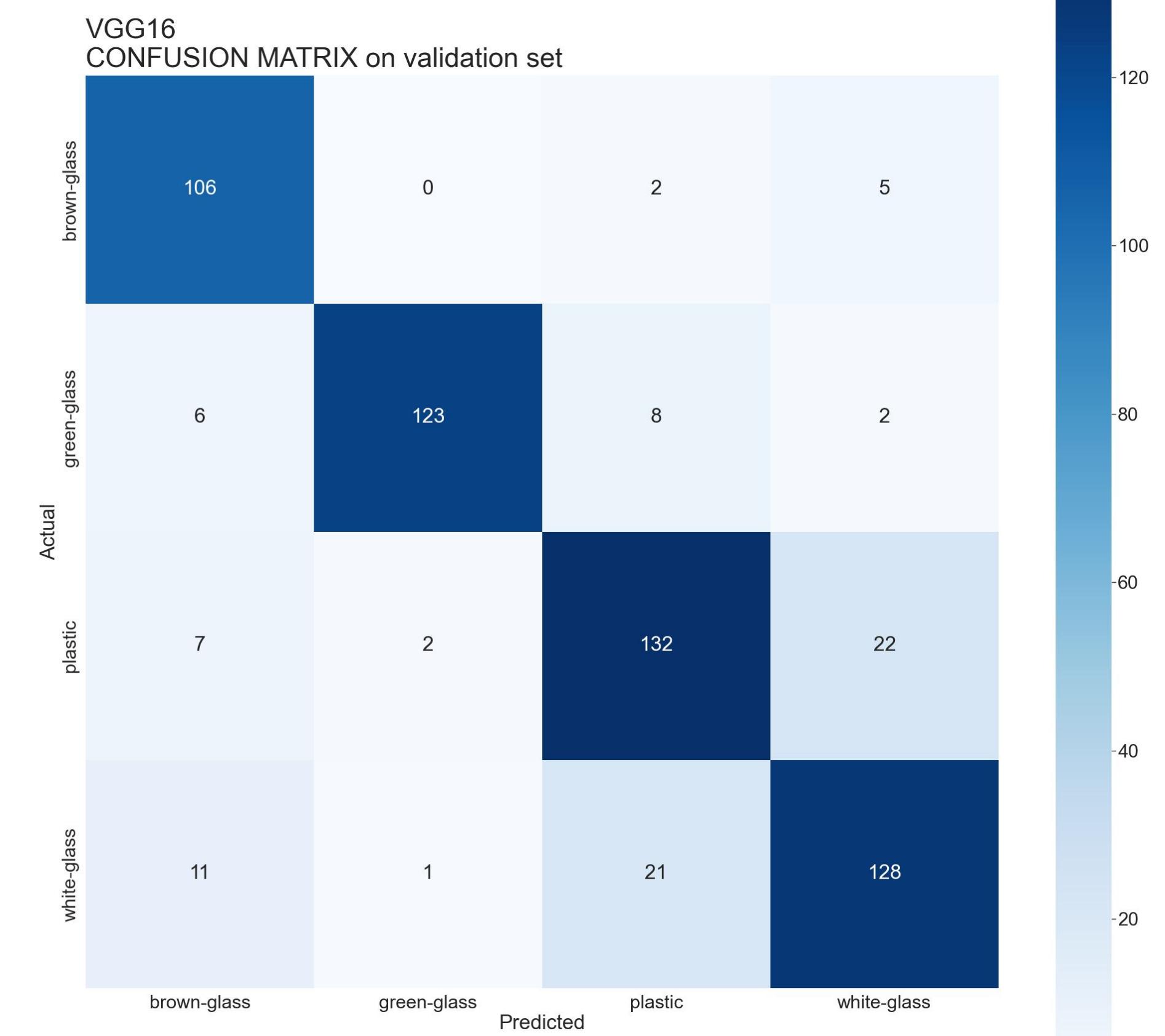
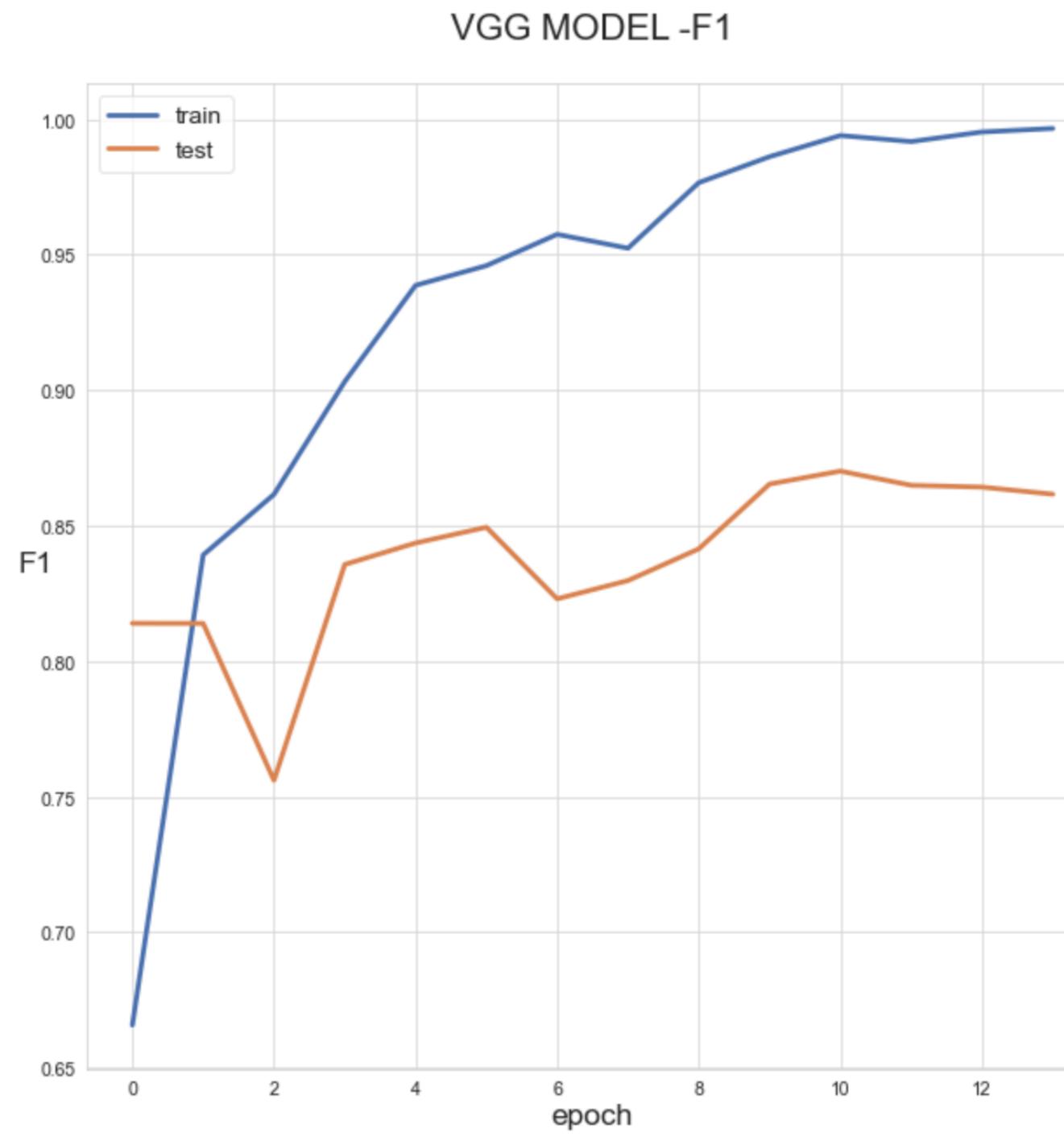
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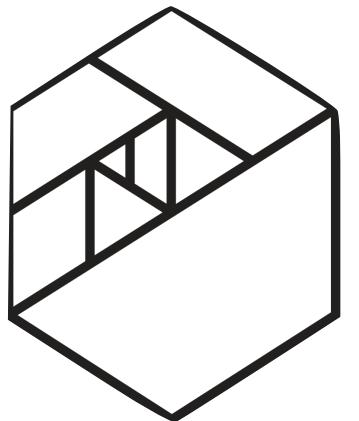
Appendix



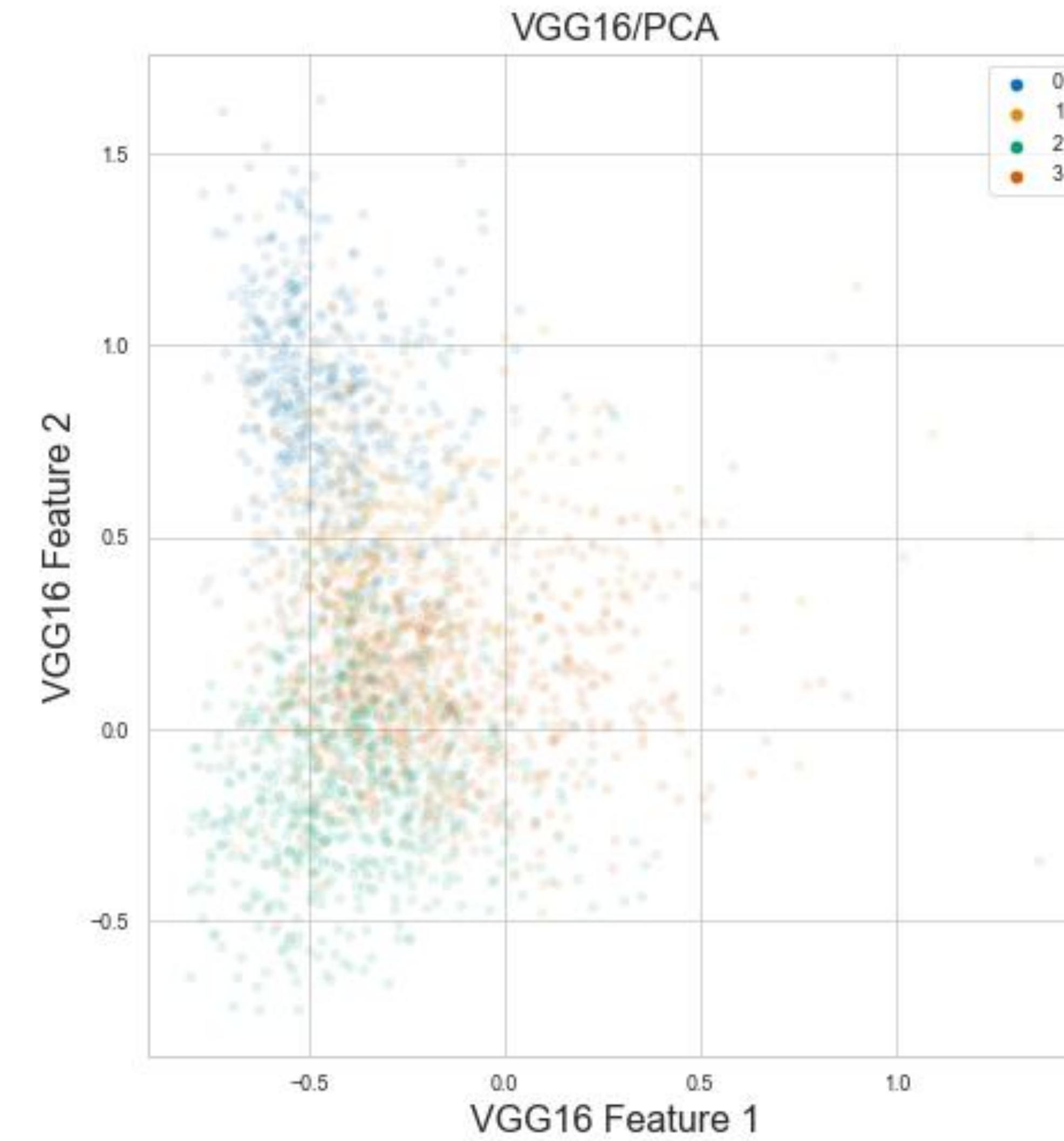
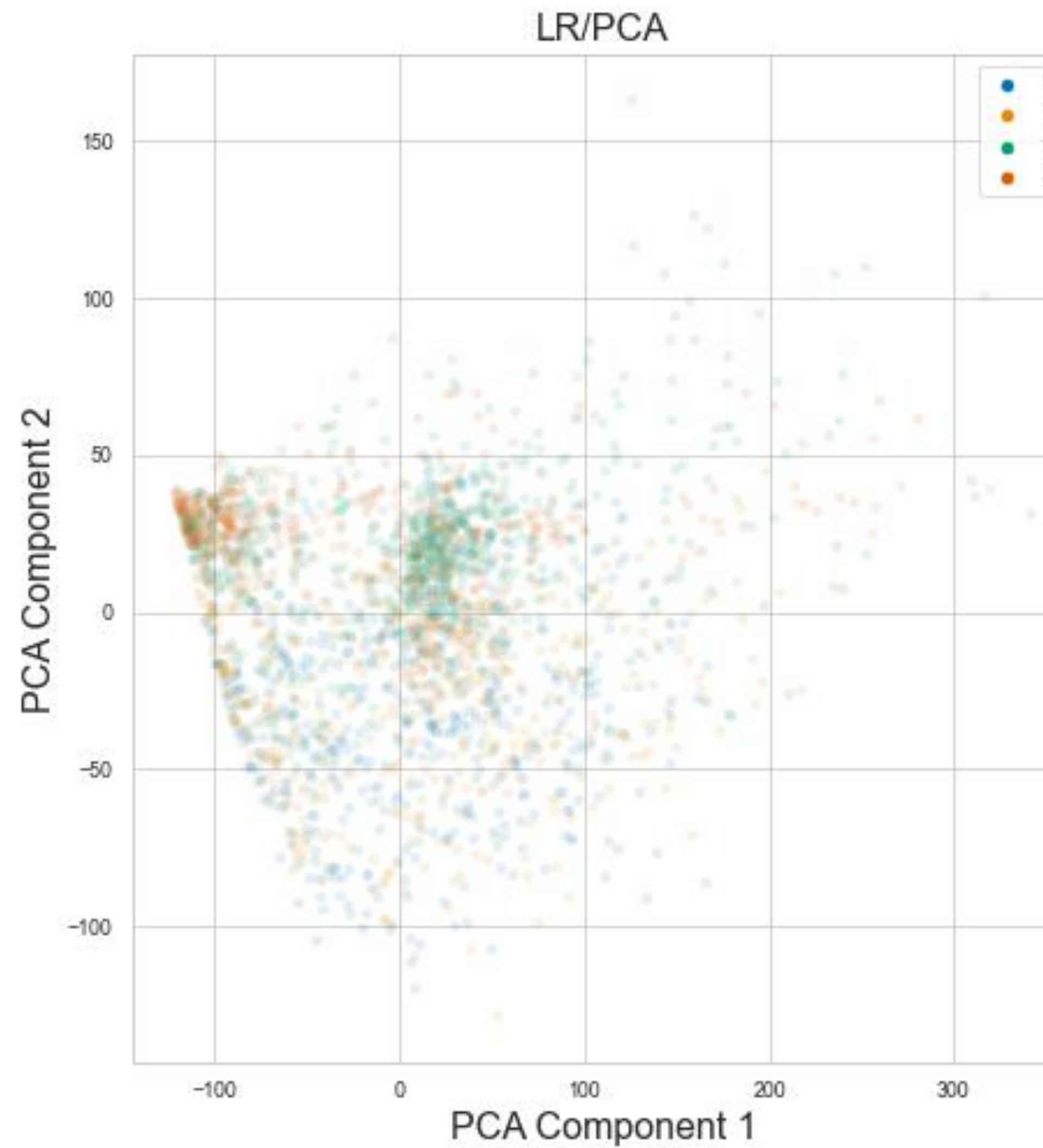
- Data link: www.kaggle.com/datasets/mostafaabla/garbage-classification
- Second "best" model: VGG16



Appendix



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Appendix

- VGG16, challenges:

Predicted: brown-glass Actual: plastic File: plastic238.jpg



Predicted: brown-glass Actual: plastic



Predicted: plastic Actual: white-glass File: white-glass607.jpg



Predicted: white-glass Actual: brown-glass



Predicted: white-glass Actual: plastic File: plastic197.jpg



Predicted: plastic Actual: white-glass File: wh



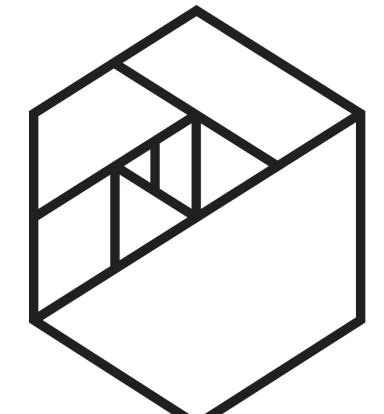
Predicted: plastic Actual: white-glass File: white-glass229.jpg



Predicted: plastic Actual: white-glass File: white-glass217.jpg



Predicted: white-glass Actual: plastic



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