**Design Proposal for the Garbage Classification System**

1. **Team Members**

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1. **System Specifications**
   1. Experimental design

Although we plan to implement convolutional neural network (CNN) models that has been pretrained on the ImageNet database and CNN models without pretraining, we tend to emphasize more on pretrained ones, since a pretrained CNN will generally perform better[1].

As for the dataset, we plan to label images to build a single-labeled training set mostly because the uncertainty and difficulties we may face if we training models on a multi-labeled training set.

Since the dataset size we will use is fairly small, we are planning to use data augmentation[2] and explicit regularization including dropout and weight decay to avoid overfitting.

* 1. Metrics to be computed

Since this is a classification job, the most important metric to tune hyperparameters and to represent training/validation score is accuracy, but we will record other classification metrics such as accuracy, precision, recall, F1-score, ROC, AUC.

* 1. Problems expected to face

**About image**

* Cell-phone photos have different quality depending on the device used to take the picture.
* Images with different resolutions.
* Model generalization to photos taken using different cell phones will be hard.

**About subjectivity in labelling dataset**

* What degree of contamination is acceptable for recyclable and for composting.

**About limitations of training set**

* Misclassification of hazardous waste into black bin, due to lack of hazardous waste class.
* Too much variability within classes.
* Misclassification caused by different packaging, shape, or graphic design.

1. **Dataset Creation**
   1. What kind of data you will use to solve the problem?

A dataset including three classes: recyclables (blue bin), composting (green bin), landfill garbage (black bin). In each class, we will have as many as needed labels for subclass, such as glass bottle, plastic bottle, tin container, Tetra Pak container, plastic jug subclasses in recyclables class.

* 1. How the data should be collected
* Object should be centralized in the photo
* Homogeneous background: we will use a write background
* One object per photo

**Reference**

[1] How to build an image classifier for waste sorting. <https://towardsdatascience.com/how-to-build-an-image-classifier-for-waste-sorting-6d11d3c9c478>

[2] Shorten, C., Khoshgoftaar, T.M. A survey on Image Data Augmentation for Deep Learning. J Big Data 6, 60 (2019). https://doi.org/10.1186/s40537-019-0197-0