



Garbage Classification

Image Classification Based on Deep Learning

MSBA 7011 – Group A9

15/ 04/ 2020



Work Allocation



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6	Zhang Xiao	3035675634	PPT Slides Making, Video Clipping



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Part 1



Introduction

Introduction

Background of garbage classification

By 2022, every city in China at the prefecture level and above should have at least one district where all household garbage is classified, and by 2025 they should have their own household garbage sorting and disposal systems. Garbage classification has become a common topic that people would encounter in their everyday life.



Sort manually



Sort by AI

“Other garbage-stained plastic”

Classification Rule

Kitchen Waste

Perishable garbage generated by households and individuals, including leftovers, leftovers, vegetable leaves, peels, eggshells, tea residues, soup residues, bones, waste food, and kitchen waste, etc.

Other Waste

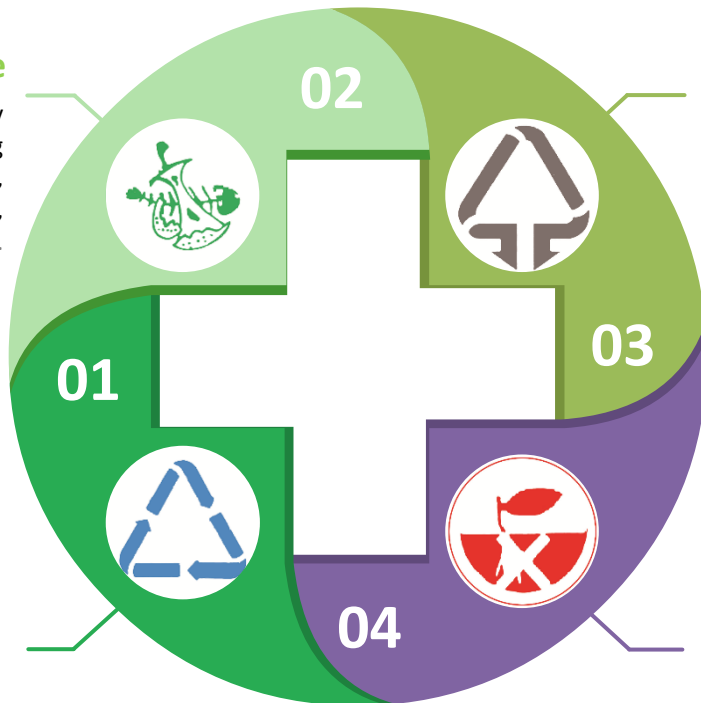
In addition to the above three types of garbage, other household garbage, such as diapers, dust, cigarette butts, disposable snack boxes, damaged flower pots and dishes, wallpaper, etc.

Recyclable

Waste suitable for recycling and resource utilization, including waste glass, metal, plastic, paper, fabric, furniture, electrical and electronic products, and annual flowers and oranges, etc.

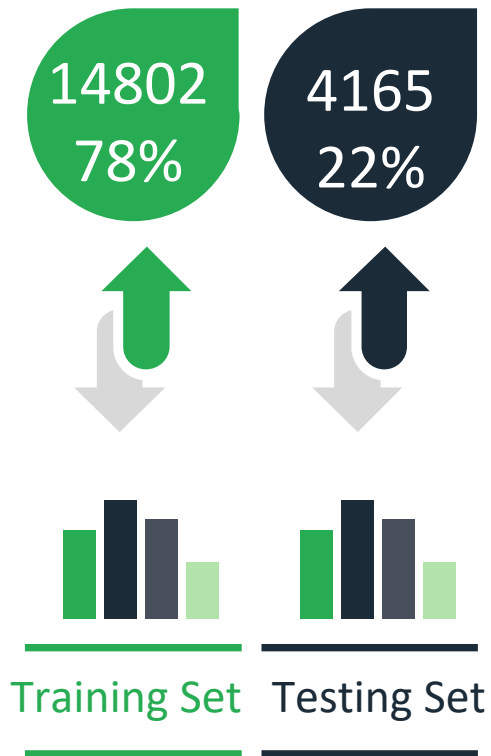
Harmful Waste

Wastes that cause direct or potential harm to human health or the natural environment and should be specially disposed of, including waste batteries and waste fluorescent tubes, etc.





Exploratory data analysis



1 Training Set

Format:

garbage images (.jpg)

and corresponding label files (.txt)

Source:

https://modelarts-competitions.obs.cn-north-1.myhuaweicloud.com/garbage_classify/dataset/garbage_classify.zip

2 Testing Set

Format:

garbage images (.jpg)

and corresponding label files (.txt)

Source:

https://pan.baidu.com/s/1SulD2MqZx_U891JXel2-2g password: epgs



Label: 0



Label:12

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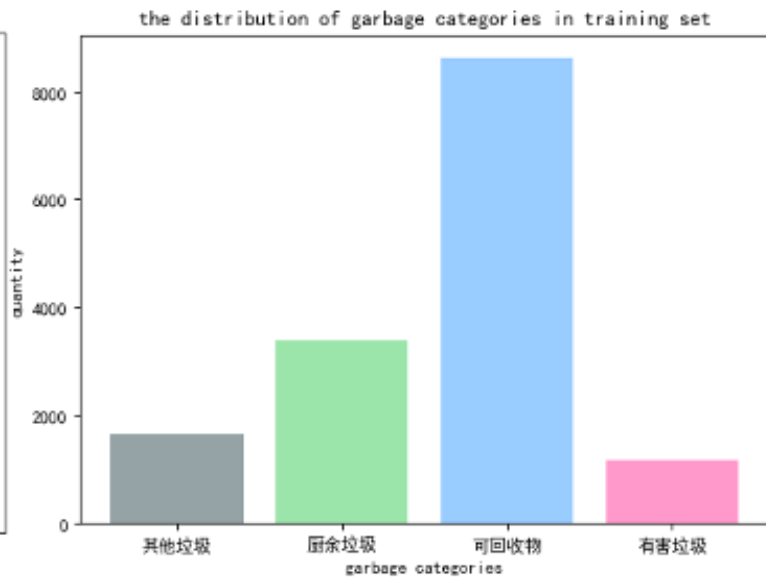
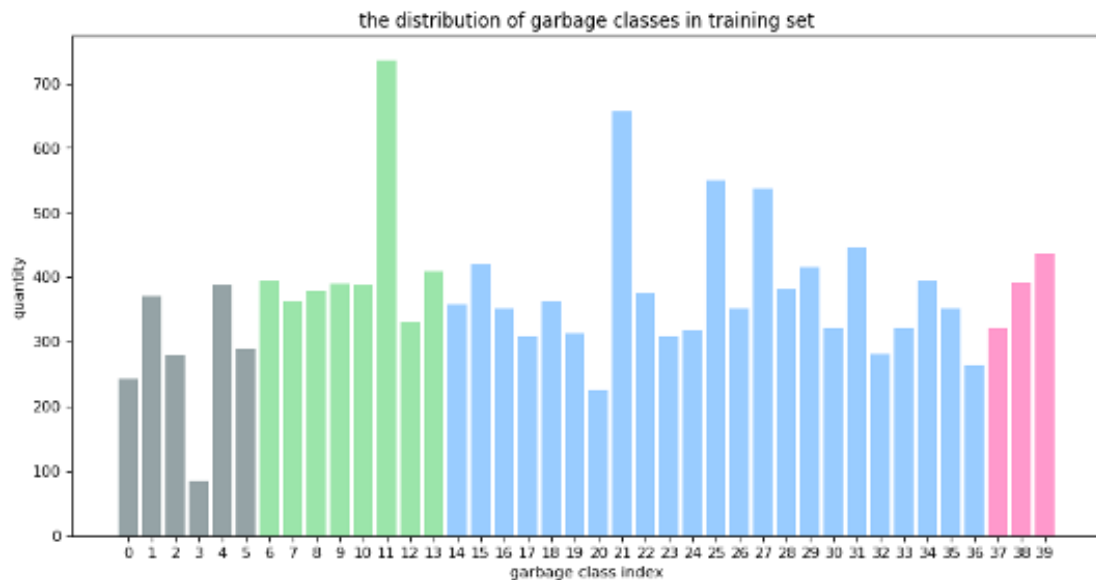
Classification Rule

Format:
Jason file

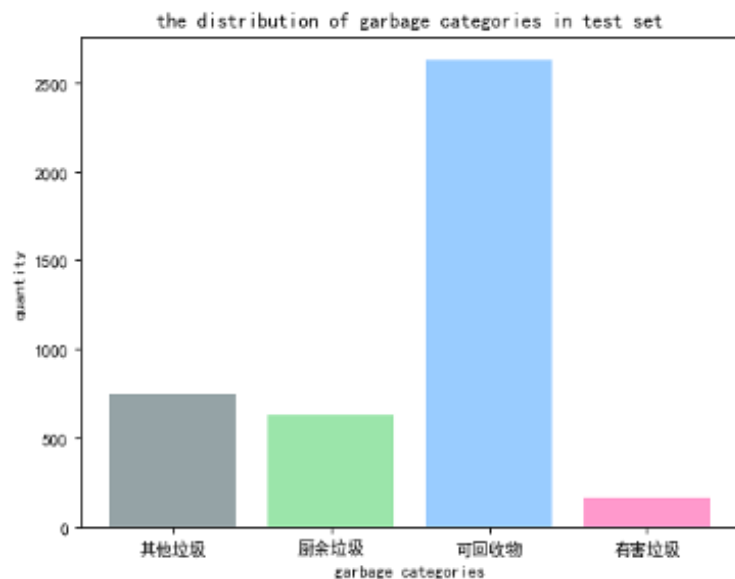
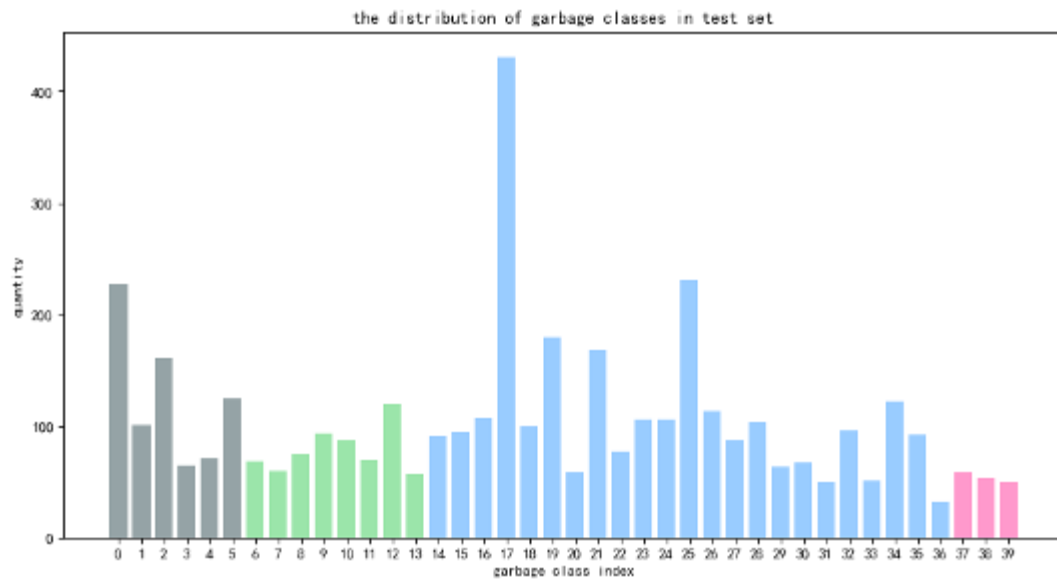
Content:
4 categories of
garbage, and 40
sub-categories
or classes

"0": "其他垃圾/一次性快餐盒"	"11": "厨余垃圾/菜叶菜根",	"21": "可回收物/插头电线",	"31": "可回收物/调料瓶",
"1": "其他垃圾/污损塑料"	"12": "厨余垃圾/蛋壳",	"22": "可回收物/旧衣服",	"32": "可回收物/酒瓶",
"2": "其他垃圾/烟蒂",	"13": "厨余垃圾/鱼骨",	"23": "可回收物/易拉罐",	"33": "可回收物/金属食品罐",
"3": "其他垃圾/牙签",	"14": "可回收物/充电宝",	"24": "可回收物/枕头",	"34": "可回收物/锅",
"4": "其他垃圾/破碎花盆及碟碗",	"15": "可回收物/包",	"25": "可回收物/毛绒玩具",	"35": "可回收物/食用油桶",
"5": "其他垃圾/竹筷",	"16": "可回收物/化妆品瓶",	"26": "可回收物/洗发水瓶",	"36": "可回收物/饮料瓶",
"6": "厨余垃圾/剩饭剩菜",	"17": "可回收物/塑料玩具",	"27": "可回收物/玻璃杯",	"37": "有害垃圾/干电池",
"7": "厨余垃圾/大骨头",	"18": "可回收物/塑料碗盆",	"28": "可回收物/皮鞋",	"38": "有害垃圾/软膏",
"8": "厨余垃圾/水果果皮",	"19": "可回收物/塑料衣架",	"29": "可回收物/砧板",	"39": "有害垃圾/过期药物"
"9": "厨余垃圾/水果果肉",	"20": "可回收物/快递纸袋",	"30": "可回收物/纸板箱",	
"10": "厨余垃圾/茶叶渣",			

The Distribution of Garbage Classes and Categories in Training Set



The Distribution of Garbage Classes and Categories in Testing Set





Part 3



Modeling

Method and Platform

- **Method**

- To use Pytorch in Python to train and test our convolutional neural network
- To choose transfer learning of Resnet18, Resnet50 and ResNext50(32x4d)

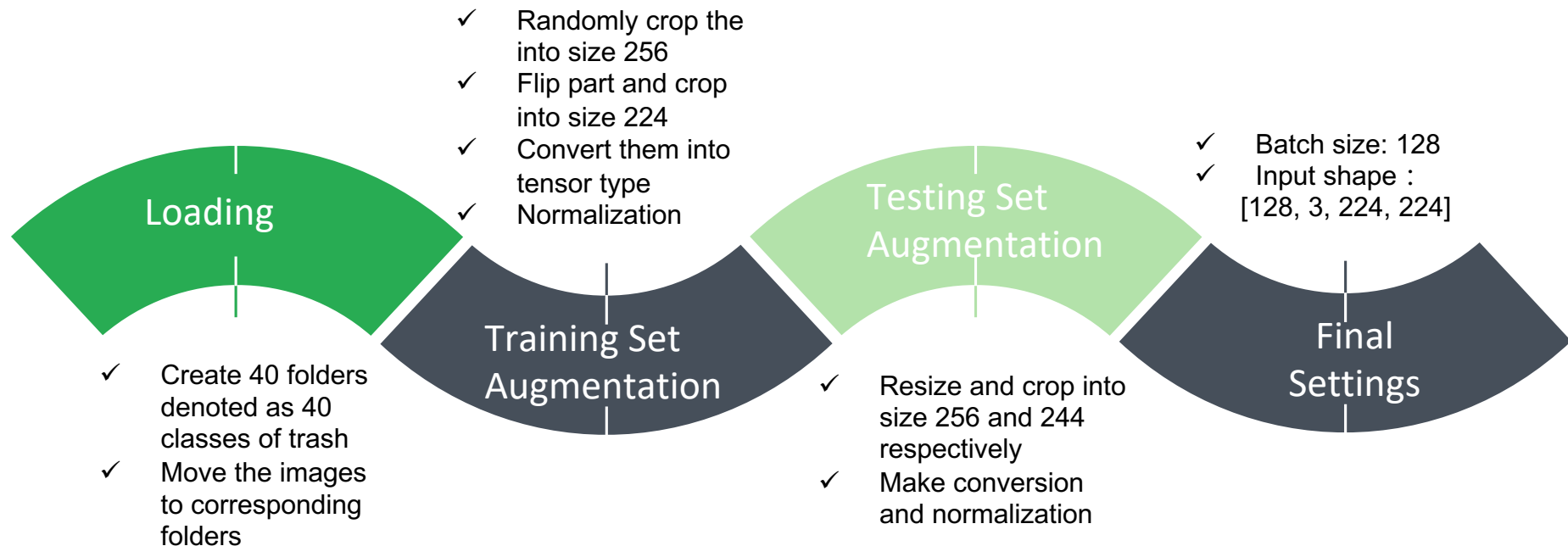
- **Platform**

- To use Google Colab (GPU mode) to load images and train above models after data preparation.



Data Preparation and Loading

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Select the best network among ResNet18, ResNet50 and ResNext-50

Model	ResNet-18 / ResNet-50 / ResNext-50					
Optimizer	Adam			SGD		
Learning rate	0.01	0.001	0.0001	0.01	0.001	0.0001

-
- Initialize the network with a pretrained network
 - Freeze the parameters firstly
 - Improve the performance by tuning optimizer and learning rate parameters, fixing weight decay = $5e-4$.
 - Try finetuning the convnet (not freeze the parameters) after selecting the best network



Part 4



Results

Results

Model	ResNet-18					
Optimizer	Adam			SGD		
Learning rate	0.01	0.001	0.0001	0.01	0.001	0.0001
Testing accuracy (%)	78.06	80.58	79.11	81.01	79.06	72.89

Model	ResNet-50					
Optimizer	Adam			SGD		
Learning rate	0.01	0.001	0.0001	0.01	0.001	0.0001
Testing accuracy (%)	80.93	84.48	84.93	N/A	84.22	84.98

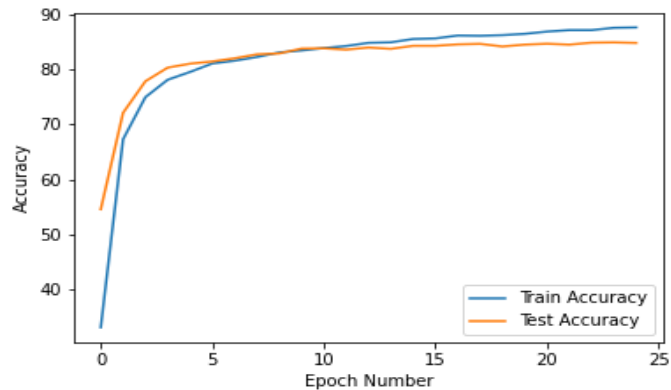
Model	ResNeXt-50					
Optimizer	Adam			SGD		
Learning rate	0.01	0.001	0.0001	0.01	0.001	0.0001
Testing accuracy (%)	N/A	84.43	84.98	N/A	84.73	N/A

When freezing the parameters and training the models, we observe that ResNext-50 has the best performances, with test accuracy of around 85%.

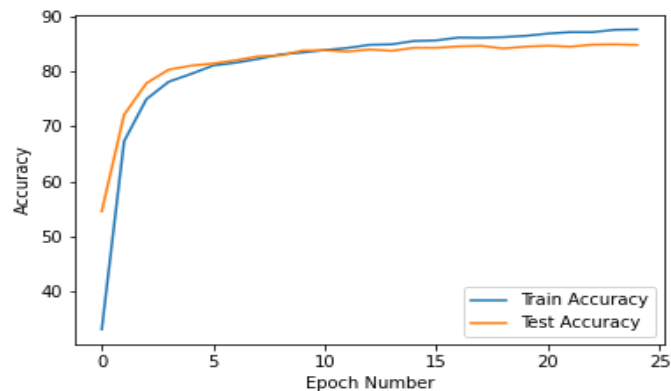
Results

Model	ResNeXt-50					
Optimizer	Adam			SGD		
Learning rate	0.01	0.001	0.0001	0.01	0.001	0.0001
Testing accuracy (%)	N/A	84.43	84.98	N/A	84.73	N/A

ResNeXt50 (Adam, learning rate=0.0001)



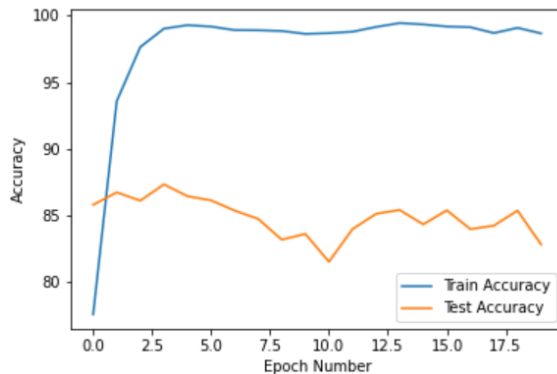
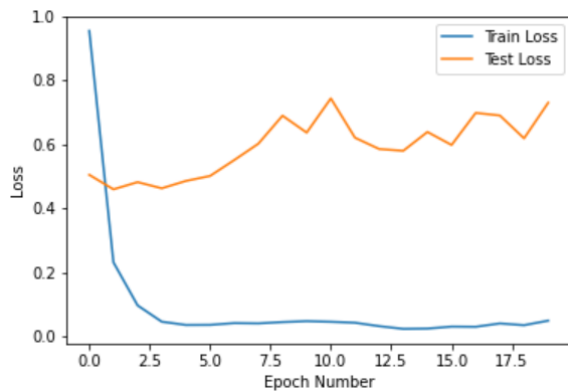
ResNeXt50 (SGD, learning rate=0.001)



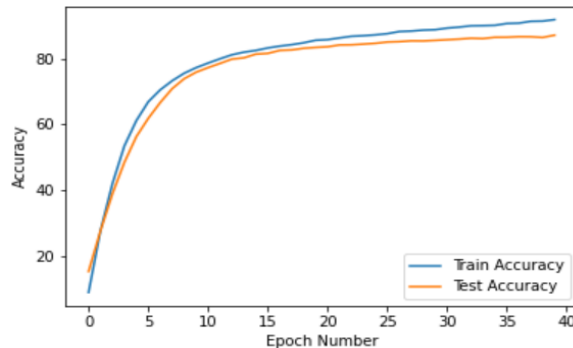
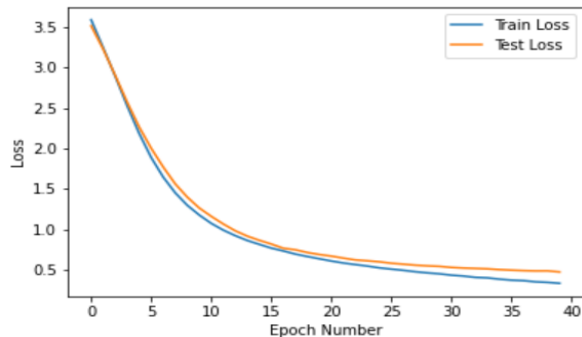
Results

finetuning the convnet on ResNext50

ResNeXt50 (Adam, learning rate=0.0001)



ResNeXt50 (SGD, learning rate=0.0001)



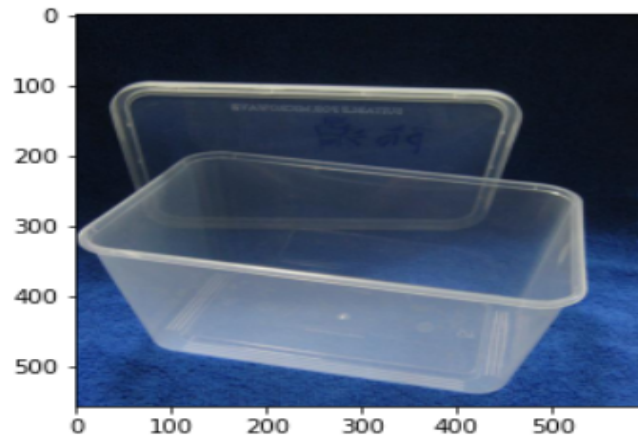
Model	ResNext50(32 x4d)
Optimizer	SGD
Scenarios	Finetuning the convnet
Learning rate	0.0001
Weight Decay	5e-4
Epoch	40
Testing accuracy (%)	87.18%

Results

Save the model parameters as 'pth' file for future prediction

Reload the model

Predict



Prediction in progress
0 其他垃圾/一次性快餐盒

Prediction Example



Part 5



Summary

Limitations & Future Work

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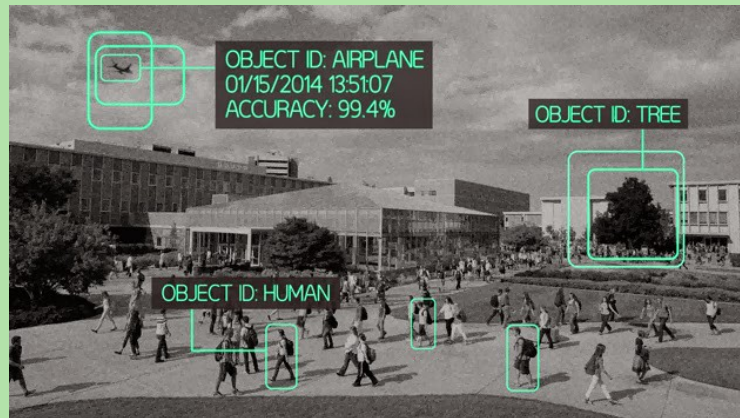


recognizing
different
components from
a whole subject

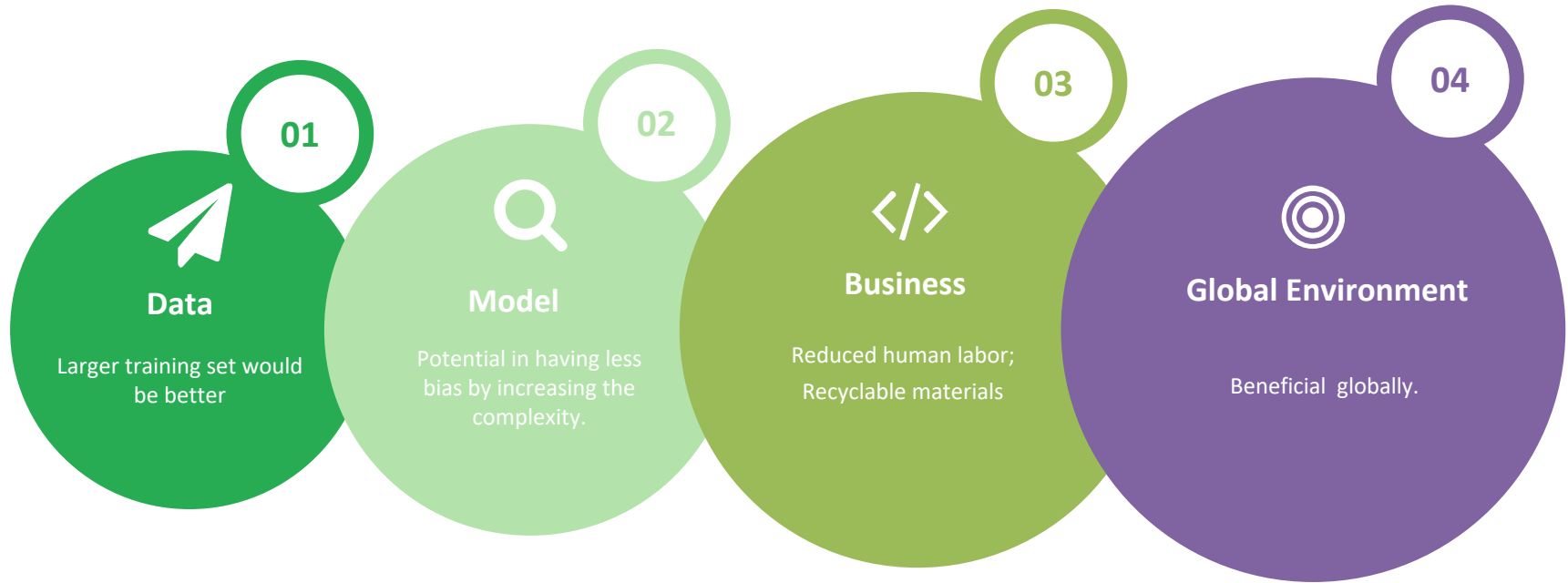


disruptions in the
picture

Image recognition



Summary



Thanks!

