Image Classification With Semi- Supervised Learning

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Stat 453 | SP21

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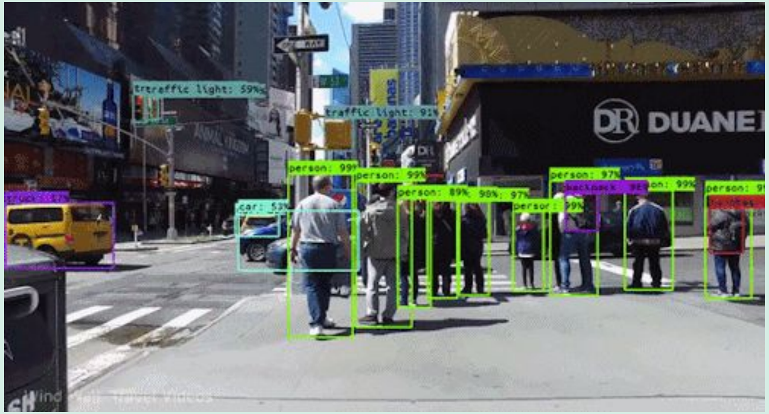
INTRODUCTION

INTRODUCTION



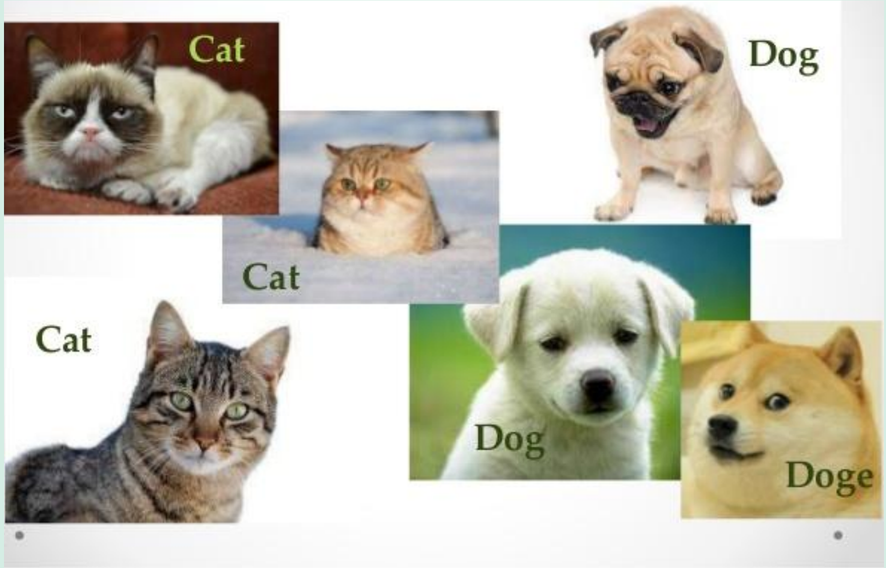
What is an Image Classification?

- Defining set of target classes and train a model to recognize them using labels

Most popular learning methods for Image Classification?

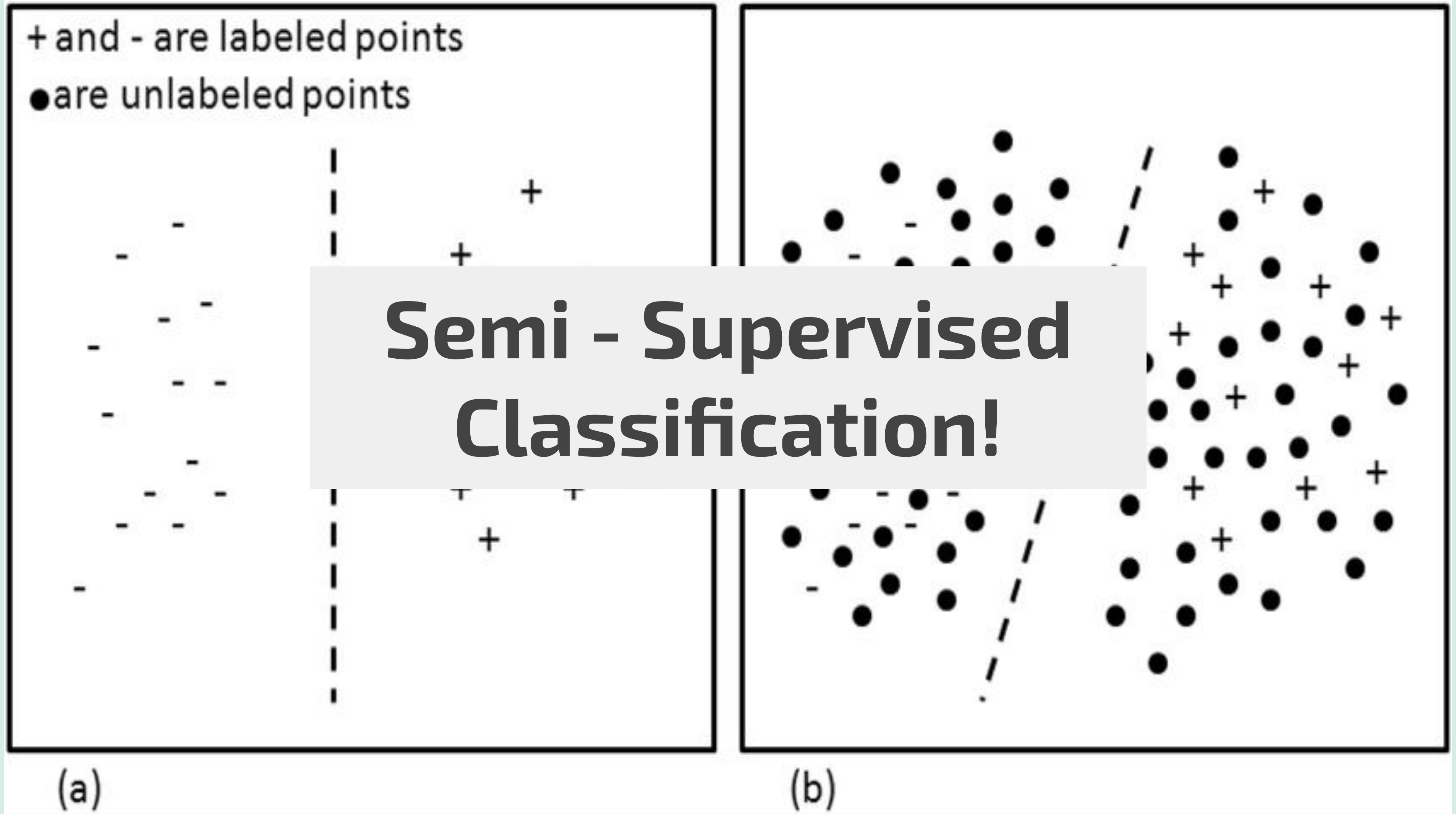
- CNN

INTRODUCTION



Types of Image Classification

- Supervised Classification
- Unsupervised Classification
- Object-based Image Analysis


+ and - are labeled points
● are unlabeled points
Semi - Supervised
Classification!
(a)
(b)

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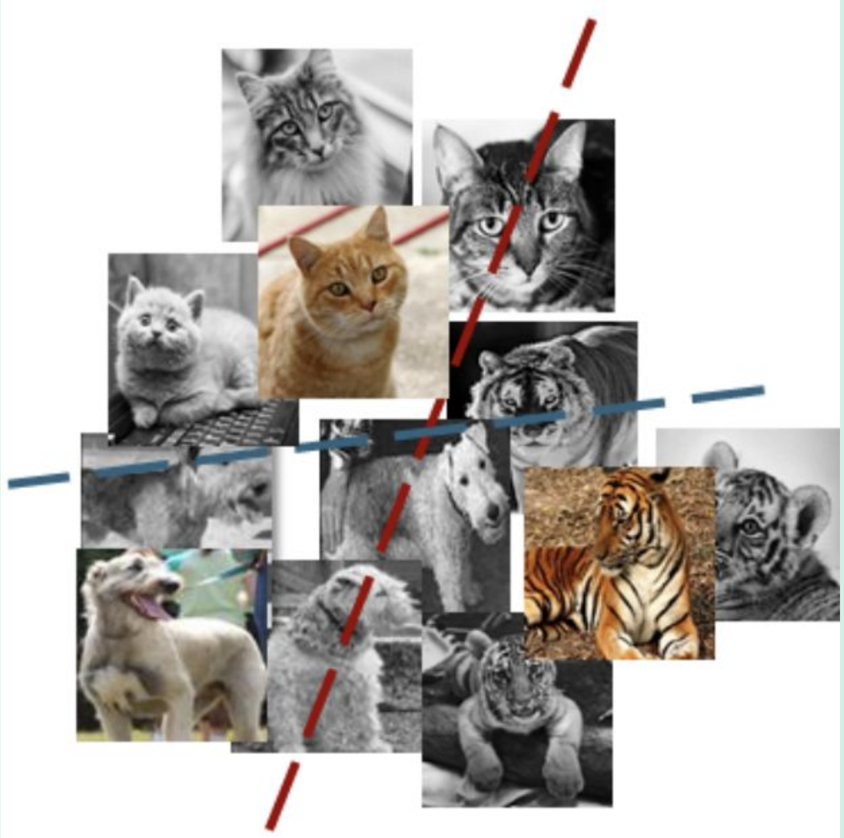
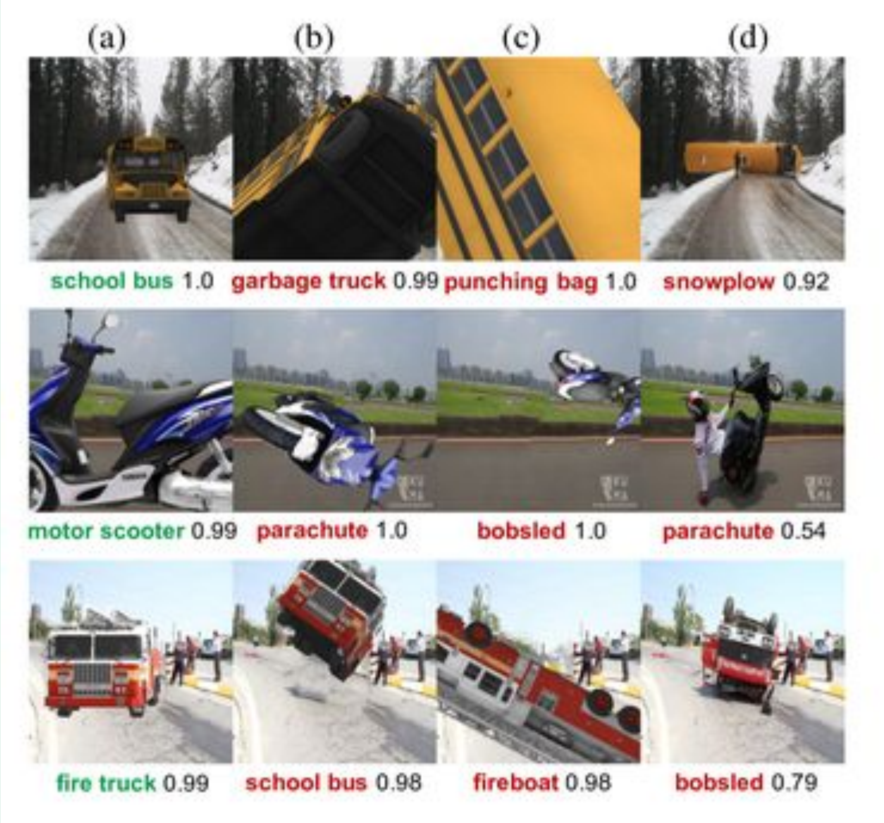
MOTIVATION

MOTIVATION




(a)
(b)
(c)
(d)
school bus 1.0
garbage truck 0.99
punching bag 1.0
snowplow 0.92
motor scooter 0.99
parachute 1.0
bobsled 1.0
parachute 0.54
fire truck 0.99
school bus 0.98
fireboat 0.98
bobsled 0.79

MOTIVATION

“Minimizing combined loss function of autoencoder and classifier”

?

“Modeling joint distribution of an input vector and target class”

MOTIVATION

“Minimizing combined loss function of autoencoder and classifier”

Less Accurate
Complicated
Slow

“Modeling joint distribution of an input vector and target class”

Motivation

How to create simple yet accurate image classification method?

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RELATED-WORK

Related Work:
Summary

**"For Unlabeled data (Pseudo Labels),
Choose the class with maximum predicted
probability just like the true labels"**

Dong-Hyun Lee, 2013

In another word,
We provide artificial label to the unlabeled data by
choosing the most likely predicted label

Related Work:
Why We Chose This Article - 1)

Classification Error on MNIST Test Set

METHOD	100	600	1000	3000
NN	25.81	11.44	10.7	6.04
SVM	23.44	8.85	7.77	4.21
CNN	22.98	7.68	6.45	3.35
TSVM	16.81	6.16	5.38	3.45
DBN-rNCA	-	8.7	-	3.3
EmbedNN	16.86	5.97	5.73	3.59
CAE	13.47	6.3	4.77	3.22
MTC	12.03	5.13	3.64	**2.57**
dropNN	21.89	8.57	6.59	3.72
+PL	16.15	5.03	4.30	2.80

+PL = Pseudo - Label section

- **Highly accurate among small sets of data**

(Smallest Error in each 100, 600, 1000, 3000 labeled data is highlighted in blue)

Related Work:
Why We Chose This Article - 2)

ple method that gives good but not optimal results. David Thaler and Lukasz Romaszko both observed that learning the sparse filtering features on the combination of the labeled and unlabeled data worked *worse* than learning the features on just the labeled data. This may be because the labeled data was drawn from the more difficult portion of the SVHN dataset. Dong-Hyun Lee [8] finished second in the contest, having independently rediscovered entropy regularization [9]. This very simple means of semi-supervised learning proved surprisingly effective and merits more attention. In third place, Dimitris Athanasakis and John Shawe-

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DATASETS

Datasets

Labeled training set

➔ 200 labels


Class labels
n02124075
n04067472
n04540053
n04099969
n07749582

Unlabeled training set

➔ 90000(450*200) images

Validation set

➔ 10000 images

Name	Label				
val0.JPEG	n03444034	0	32	44	62
val1.JPEG	n04067472	52	55	57	59
val2.JPEG	n04070727	4	0	60	55
val3.JPEG	n02808440	3	3	63	63
val4.JPEG	n02808440	9	27	63	48
val5.JPEG	n04399382	7	0	59	63

Table 2. Validation images and labels

Test set

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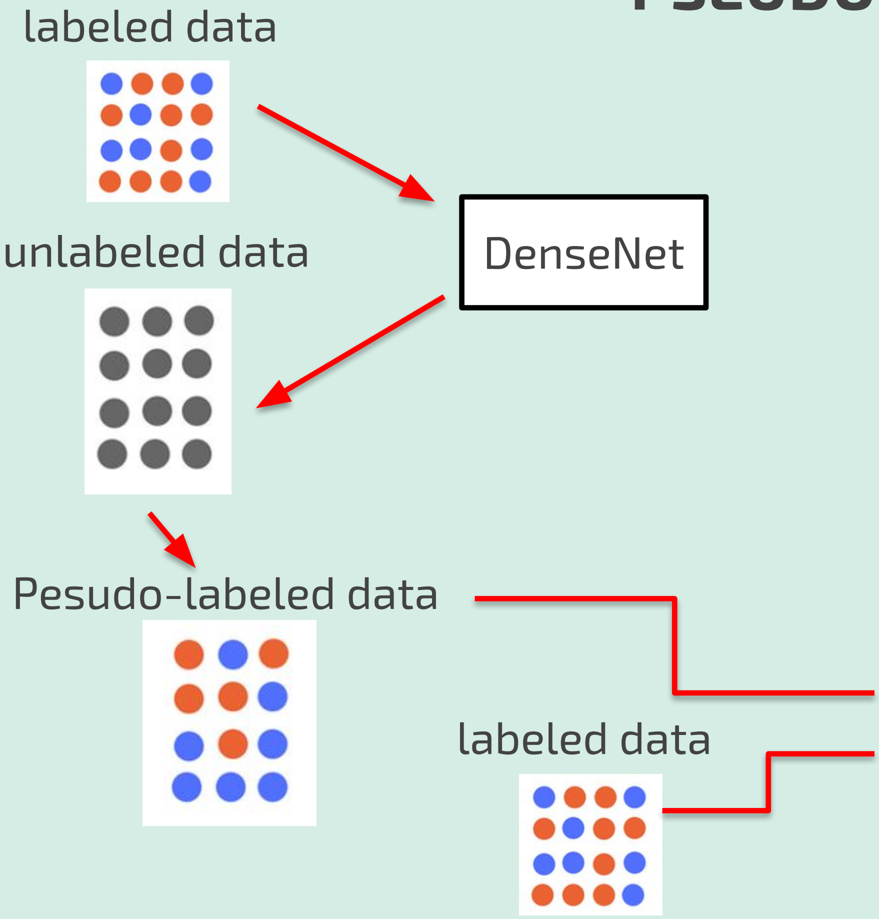
MODELS & METHODS

PSEUDO - LABEL



1. Train the model with labeled data

2. Use the trained DenseNet to predict labels for the unlabeled data

3. Retrained the DenseNet with the pseudo and labeled datasets together

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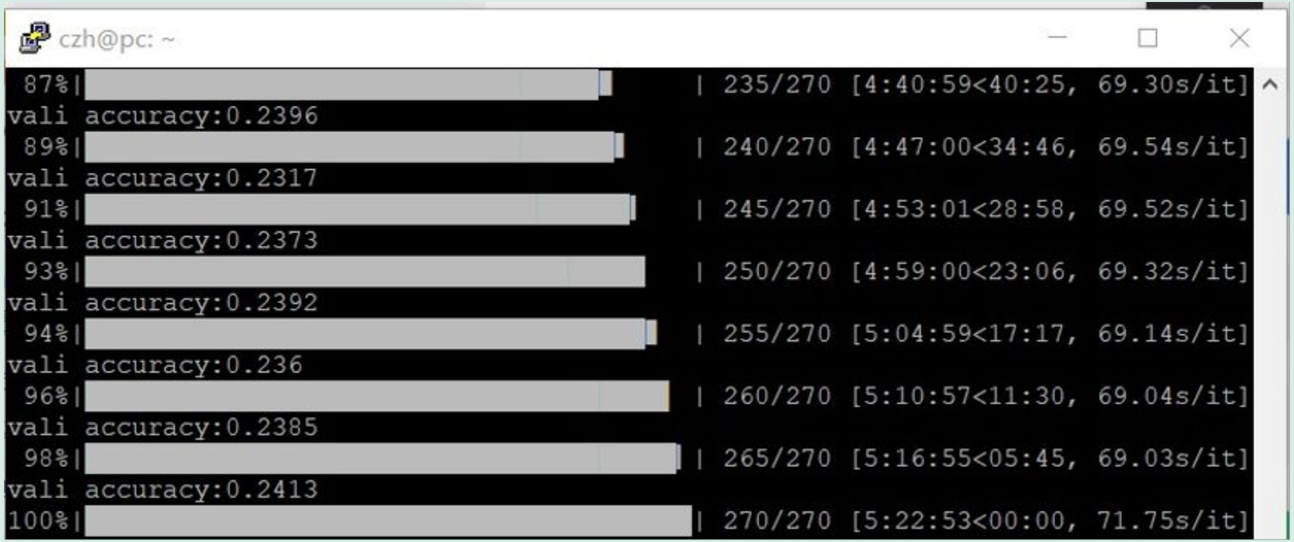
RESULTS & CONCLUSION

RESULTS


czh@pc: ~
87%| | 235/270 [4:40:59<40:25, 69.30s/it]
vali accuracy:0.2396
89%| | 240/270 [4:47:00<34:46, 69.54s/it]
vali accuracy:0.2317
91%| | 245/270 [4:53:01<28:58, 69.52s/it]
vali accuracy:0.2373
93%| | 250/270 [4:59:00<23:06, 69.32s/it]
vali accuracy:0.2392
94%| | 255/270 [5:04:59<17:17, 69.14s/it]
vali accuracy:0.236
96%| | 260/270 [5:10:57<11:30, 69.04s/it]
vali accuracy:0.2385
98%| | 265/270 [5:16:55<05:45, 69.03s/it]
vali accuracy:0.2413
100%| | 270/270 [5:22:53<00:00, 71.75s/it]

THANK YOU!

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