Webly Supervised Learning Meets Zero-shot Learning: A Hybrid Approach for Fine-grained Classification

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Fine-grained classification: distinguish the subtle difference between subcategories.



Fine-grained classification: distinguish the subtle difference between subcategories.



Collecting training set for fine-grained classification is difficult due to two reasons.

1. There are a huge number of subcategories within each category.

14,000 bird species in the world



[Welinder et al., 2010]

Collecting training set for fine-grained classification is difficult due to two reasons.

2. Labeling subcategories requires professional knowledge.

	forehead color	black
	breast pattern	solid
	breast color	white
	head pattern	plain
	back color	white
	wing color	grey
	leg color	orange
	size	medium
	bill shape	dagger
- I -	wing shape	pointed
	primary color	white

	forehead color	red
	breast pattern	solid
A CANANA SALAR	breast color	white
ALL CONSTRUCT	head pattern	capped
ANTA COMONIA	back color	white/black
	wing color	white/black
1 STANKER DE	leg color	black
	size	medium
1 19 10 10 10	bill shape	all-purpose
A MALAN A SAN	wing shape	pointed
WARDY A ZOO		
A Participant of the second se	primary color	white/black

Collecting accurate training set is difficult, but collecting inaccurate training set (e.g., crawl from image website) is much easier.



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Learning from Web Data

There are two major issues when learning from web data.

1. label noise



Learning from Web Data

There are two major issues when learning from web data.

2. domain shift



Domain adaptation [1]: adapt f^s to f^t by addressing the domain shift.

[1] Daume, ACL 2007

Our Solution

Given an entire set of subcategories (e.g., 14,000 bird species):

1. Collect <u>a labeled subset of subcategories</u> and crawl web images for <u>the other subcategories</u>.labeled subcategories (e.g., 1,000)web subcategories (e.g., 13,000)

Entire set of subcategories = labeled subcategories + web subcategories

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2. Use <u>category-level information</u> to transfer knowledge from labeled subcategories to web subcategories, to handle the label noise and domain shift of web data.

Category-level information can be obtained based on free web data.

Category-level Information



WIKIPEDIA The Free Encyclopedia

Article Talk

Chihuahua (dog)

Contents [hide]

2.1 Appearance

5 In popular culture

2.2 Temperament

1 History

3 Health

4 Gallery

6 See also

7 References

8 External links

History [edit]

2 Description

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word vector of category name [2]



vector(king) - vector(man) + vector(woman) \approx vector(queen)

[2] Mikolov et al., NIPS 2013

A Techichi, likely the ancestor of Chihuahuas

"Chihuahuas" redirects here. For the baseball team, see El Paso Chihuahuas.

The Chihuahua /tʃi'waːwaː/ () listen) (Spanish: chihuahueño)[1] is the

Chihuahuas come in a wide variety of colors, and two coat lengths.

smallest breed of dog and is named after the state of Chihuahua in Mexico.

The Chihuahua's history is convoluted, and there are many theories surrounding the origin of the breed. Both folklore and archaeological finds show that the breed originated in Mexico. The most common theory is that Chihuahuas are descended from the Techichi, a companion dog favored by the Toltec civilization in

Origin Height Coat Litter size usually 2-5 Life span 12-20 years







Our learning model

Our Learning Model

Dictionary learning based method

Step1: \blacksquare Learn knowledge (dictionary \mathbf{D}^l) on labeled subcategories.

 $\min_{\mathbf{D}^l} \|\mathbf{X}^l - \mathbf{D}^l \mathbf{A}^l\|_F^2 + \|\mathbf{D}^l\|_F^2$

X	visual features
D	dictionary
A	word vectors



Our Learning Model

Dictionary learning based method

Step2: Transfer knowledge from labeled subcategories to web subcategories.
Handle the label noise and domain shift for web data.



 θ : assign different weights on different web training images, identify the non-outliers with the closest data distribution to test data.

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Experiments







Identified outliers and non-outliers based on our learnt weights $\boldsymbol{\theta}$



Thank you!