Mine the Fine: Fine-Grained Fragment Discovery

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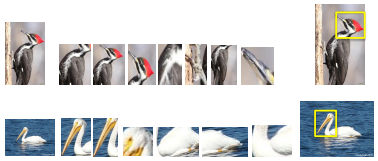
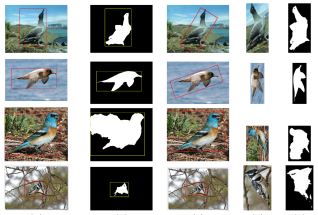
Goal

- Learn discriminative fragments of an object, given bounding box around the object (no part annotations)
- Learn fine-grained classifier based on fragments

Motivation



Preprocessing



(a) Original
(b) GrabCut Mask
(c) Best Rectangle
(d) Oriented rectangle
(e) Oriented mask.

Note that often, even for bad mask, the alignment by the best oriented rectangle is acceptable.

Global Information

Interior of Bounding Box Captures Color

Context Captures Habitat

Algorithm

Algorithm 1: Discover Discriminative Fragment Sets

Data: T_i: Train Set for Category $i \in \{1, ..., n\}$
Data: V_i: Validation Set for Category $i \in \{1, ..., n\}$
Result: D: Top r most discriminative fragment sets from each category
for $i = [1, ..., n]$ **do**
  $F_{T_i} \Leftarrow$ Extract fragments for training set i;
  $F_{V_i} \Leftarrow$ Extract fragments for validation set i;
  for $f \in F_{T_i}$ **do**
    $S_f = \{f\}$ Initialize the set with the fragment;
    for t=[1,...,T] **do**
      $W_f^{new} \Leftarrow$ train lda(S_f);
      $S_f^{new} \Leftarrow$ detect add top m (W_f, F_{T_i}, m);
    $AUC_f \Leftarrow$ compute AUC on val(W_f, F_{V_i})
$D = \{\}$ Discovered Discriminative Fragment Sets;
for $i = [1, ..., n]$ **do**
  $D^{new} \Leftarrow$ Add top r sets with least AUC_f where $f \in F_{T_i}$
Return D

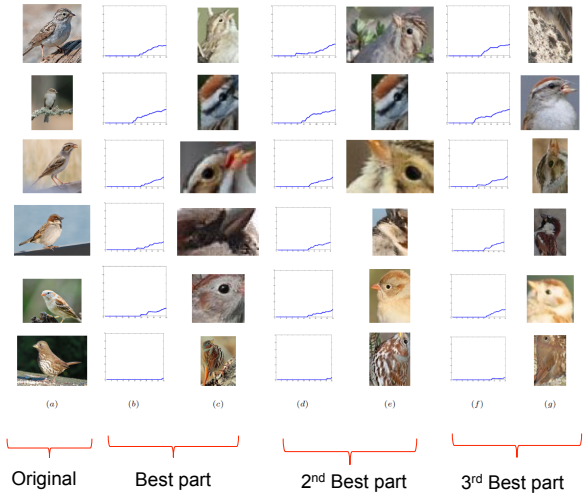
$$w \propto S^{-1}(\mu_+ - \mu_-)$$

$$H(Y|k) = \sum_{y=1}^{n} p(y|k) \log_2 p(y|k)$$

Experiments

Sparrows

Illustration of top-3 mined fragments based on area under class entropy vs top-k retrievals curve. Lower area is desired for higher precision.

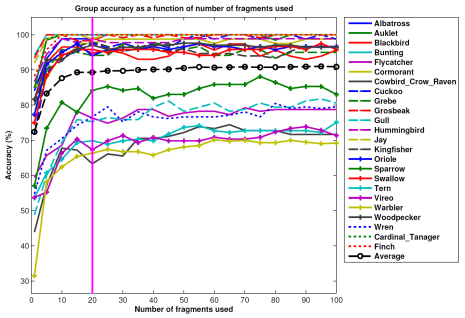


Experiments (contd.)

Table 2. Average group accuracy before and after fine-tuning the CNN for selected groups

Group Name	fg bbox	fg bbox + vert. fragments	Finetuned CNN?	unnorm. max	norm. max	fg bbox + unnorm. max	fg bbox + norm. max	Top 50 Fragments
Gull	68.24	62.35	N	77.06	76.47	78.24	**80.59**	-
			Y	71.76	77.65	70.59	80.00	**100.00**
Kingfisher	84.67	86.67	N	91.33	92.00	92.00	**94.67**	-
			Y	92.00	93.33	92.00	93.33	**100.00**
Oriole	75.63	86.55	N	90.76	93.28	91.60	**95.80**	-
			Y	93.28	93.28	94.12	**97.48**	96.52
Sparrow	53.67	55.37	N	70.62	74.58	72.88	**75.71**	-
			Y	83.05	82.49	80.23	81.92	**100.00**
Swallow	65.83	73.33	N	89.17	**91.67**	89.17	**91.67**	-
			Y	**96.67**	**96.67**	95.83	95.83	77.78
Tern	43.54	48.80	N	66.03	67.94	62.20	**68.90**	-
			Y	71.77	73.68	72.73	74.64	**98.77**
Vireo	59.30	60.80	N	71.86	72.86	73.37	**73.87**	-
			Y	77.39	**78.39**	**78.39**	77.39	72.22
Warbler	66.89	66.89	N	-	-	-	-	-
			Y	69.73	68.78	69.59	71.22	**98.78**
Woodpecker	94.67	95.27	N	92.31	91.72	92.31	**95.86**	-
			Y	93.49	94.08	93.49	**96.45**	95.83
Wren	68.57	60.95	N	70.95	67.62	70.48	**71.43**	-
			Y	73.81	73.81	72.86	76.67	**99.17**
Average	68.10	69.70	N	72.01	72.81	72.22	**74.85**	-
			Y	82.29	83.22	81.98	84.49	**93.91**

Classification Accuracy vs #parts



Contributions & Future Work

- Method to discover discriminative fragments
- Reduce/eliminate redundant discovered parts

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