Classifying dogs using PAWS
Semi-supervised fine-grain classification
Introduction | Learning with sparsely labeled data

Challenge: fine-grain classification with sparsely labeled datasets

Given: a large set of unlabeled data, and a small set of labeled data

Goal: learn good visual representations that generalize to unseen data

Semi-supervised learning by using labeled data

1. Pre-train with both labeled and unlabeled data
2. Fine-tune with labeled data
### Datasets | CIFAR-10 and ImageNet

<table>
<thead>
<tr>
<th>CIFAR-10</th>
<th>ImageNet</th>
<th>Stanford Dogs</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 classes</td>
<td>1000 classes</td>
<td>120 classes</td>
</tr>
<tr>
<td>60K images</td>
<td>1.2M images</td>
<td>20K images</td>
</tr>
</tbody>
</table>

Figures of CIFAR-10, ImageNet, and Stanford Dogs datasets
Method | Predicting view Assignments With Support samples

Figure of PAWS architecture from PAWS Github repository, Assran et al.
## Experiments

Fine-tuning while amount of labeled data

PAWS SNN accuracy did not significantly drop as sparsity became very large

<table>
<thead>
<tr>
<th>Labeled : Unlabeled Ratio</th>
<th>Epochs</th>
<th>Training Accuracy</th>
<th>Validation Accuracy</th>
<th>Delta to Best Val Acc.</th>
<th>Top 1 Accuracy</th>
<th>Top 5 Accuracy</th>
<th>Delta to Best Top 1 Acc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:1 Ratio</td>
<td>30</td>
<td>87.56%</td>
<td>83.30%</td>
<td>0.00%</td>
<td>59.42%</td>
<td>87.13%</td>
<td>0%</td>
</tr>
<tr>
<td>1:2 Ratio</td>
<td>30</td>
<td>87.51%</td>
<td>81.89%</td>
<td>-1.41%</td>
<td>56.45%</td>
<td>85.72%</td>
<td>-2.97%</td>
</tr>
<tr>
<td>1:5 Ratio</td>
<td>30</td>
<td>87.40%</td>
<td>80.96%</td>
<td>-2.34%</td>
<td>53.7%</td>
<td>83.73%</td>
<td>-5.72%</td>
</tr>
<tr>
<td>1:10 Ratio</td>
<td>30</td>
<td>87.34%</td>
<td>80.86%</td>
<td>-2.44%</td>
<td>52.52%</td>
<td>83.08%</td>
<td>-6.9%</td>
</tr>
<tr>
<td>1:25 Ratio</td>
<td>30</td>
<td>86.80%</td>
<td>81.20%</td>
<td>-2.10%</td>
<td>52.18%</td>
<td>81.63%</td>
<td>-7.24%</td>
</tr>
</tbody>
</table>
Analysis | Saliency Maps

Learned representations of fine-grain classes with high sparsity
Analysis | Confusion Matrices

As sparsity increased, class 3 and 89 generated significant false predictions.

Class 3 — Maltese

Class 89 — Bernese Mountain Dog
Conclusion | PAWS is viable for fine-grain classification

PAWS can use sparsely labeled data to effectively learn a new fine-grain class

Performance diminished when using very sparse labels (>1:5)

Future work is to fine-tune on other fine-grain datasets
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