We're Investigating the **Relationship** between **Image Classification Accuracy** and **Various Self-Supervised/Unsupervised Metrics**.

Can Effective Invariance Metrics Predict Classifier Accuracy in a Data-Centric View?

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1 Intro

- Image classification models need many images outside training to understand generalisability.
- Adding labels to images is laborious and time-consuming.
- **Exists many reliable metrics** such as Rotation Invariance (RI) for **gauging image classification accuracy.**
- We **compare** above metrics **with our own jigsaw invariance** metric.

- CIFAR-10 dataset has 60,000 images, 1 of 10 unique objects in each.
- Includes planes, frogs, boats, etc.
- Small images promote simplicity in proof of concepts such as ours.

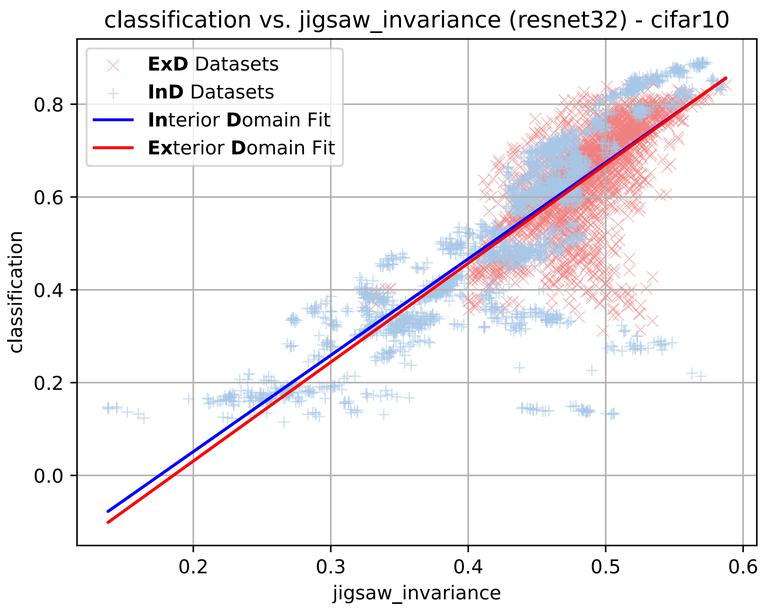
2 Data Used

- In-distribution (ID) CIFAR-10 test set + its copies via. image transforms,
- Various out-of-distribution (OOD) CIFAR-10 variants + its copies through image transforms.

3 Jigsaw Invariance (JI)

1. Classifier takes image x, outputting predicted class $\hat{y}$ and confidence $\hat{p}$.
2. Turn x into jigsaw puzzle x_t.
3. Feed x_t into model, outputting associated $\hat{y}_t$ and $\hat{p}_t$.
4. Same $\hat{y}$ and $\hat{y}_t$ with high $\hat{p}$ and high $\hat{p}_t$ implies high JI, and vice versa.
5. Take mean average JI over all images x in dataset.

4 Results



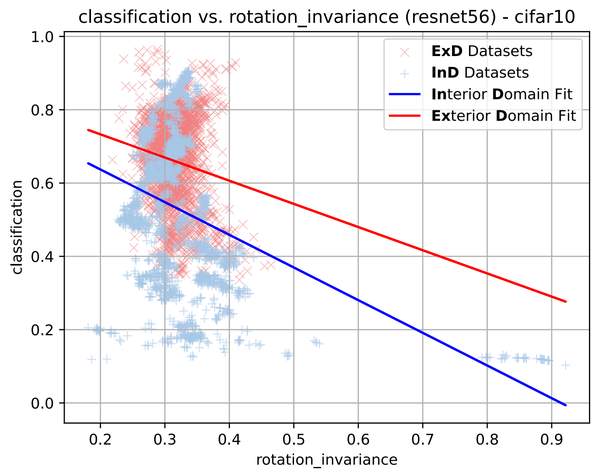
- **Weak Relationship between image classification and JI**.
- Better correlation than RI.
- Strength depends on permutations selected.
- JI and RI derive from Effective Invariance (EI). Correlation shown only when dataset fixed + each point is a model (model-centric).
- CIFAR-10 uses 32 by 32 images - small size introduces biases.
- Nuclear norm remains most effective metric for estimating classification accuracy.

5 Future Work

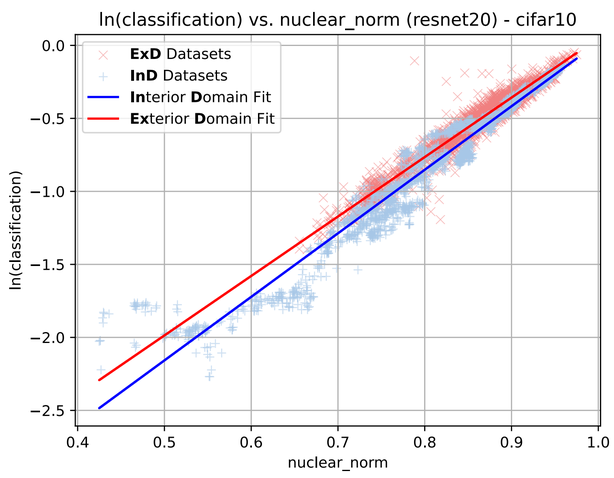
- Adopt model-centric view instead of dataset-centric,
- Use dataset with larger images, such as ImageNet,
- May obtain better comparison between JI and other metrics.

Other Metrics

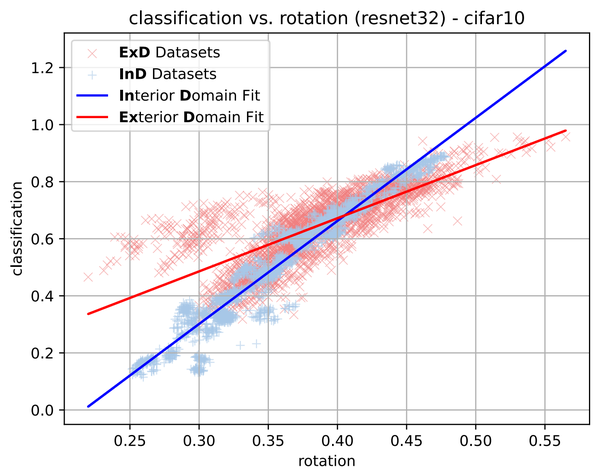
ResNet56 - Rotation Invariance



ResNet20 - Nuclear Norm with $\ln$ Classification



ResNet32 - Rotation Prediction



Other models over each metric produced similar results.

EI over a single image.

$$EI(\hat{y}, \hat{y}_t, \hat{p}, \hat{p}_t) = \mathbf{1}(\hat{y} = \hat{y}_t)\sqrt{\hat{p} \cdot \hat{p}_t}$$

EI for a whole dataset D.

$$EI_D = \frac{1}{|D|} \sum_{x \in D} EI(\hat{y}, \hat{y}_t, \hat{p}, \hat{p}_t)$$

Scan the QR code to download the paper!

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