ToddlerNet: Data Diversity vs View Diversity

Presenters : Kshama Nitin Shah , Kemmannu Vineet Rao

Motivation

- What is more important for representation learning data diversity vs view diversity?
- Toddlers learn with multiple views of a small number of objects
- What kind of learning objective do we need for such view-diverse category limited data?

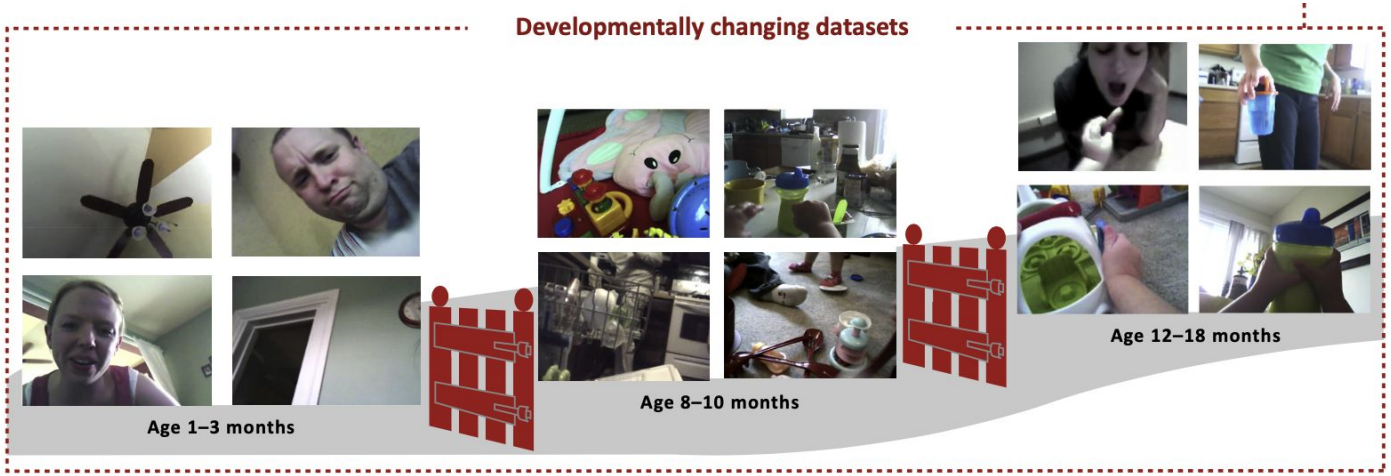
Introduction

- Toddlers have wide-ranging knowledge of the world before learning to speak
- Question to address - better learning objective or better statistics in the form of inductive biases present in the learning data around them?
- Data determined by viewpoint, infant / toddler position, partial scene, curriculum based

Related Work

Infant curriculum learning

- Infant training set changes as the sensorimotor abilities of the infants develop
- Changing environments forms a curriculum

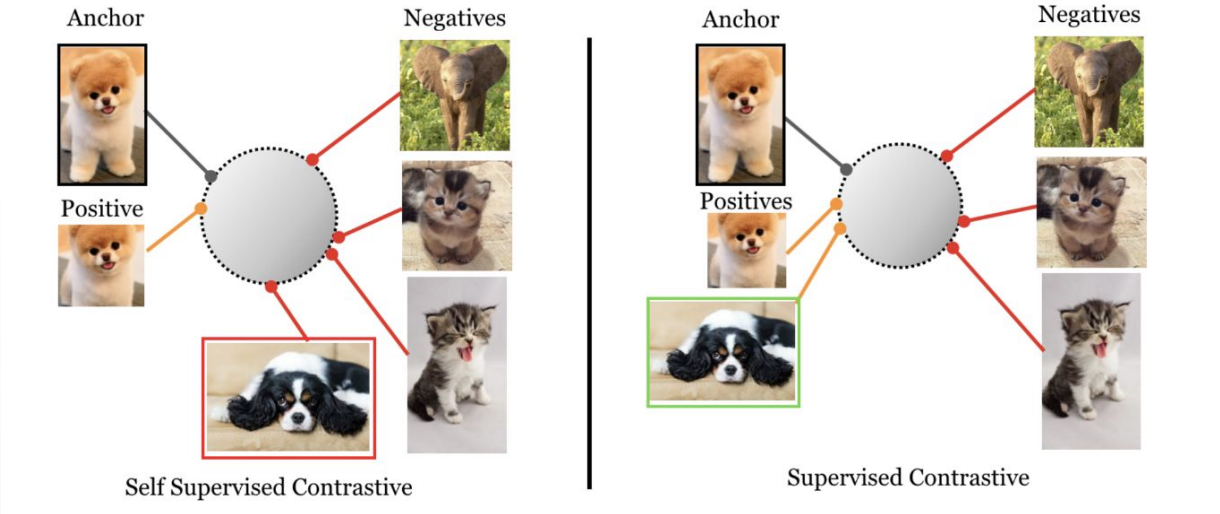


Smith, Linda B., Swapnaa Jayaraman, Elizabeth Clerkin, and Chen Yu. ‘The Developing Infant Creates a Curriculum for Statistical Learning’. *Trends Cogn. Sci.* 22, no. 4 (April 2018): 325–36.

Related Work

Supervised Contrastive Learning

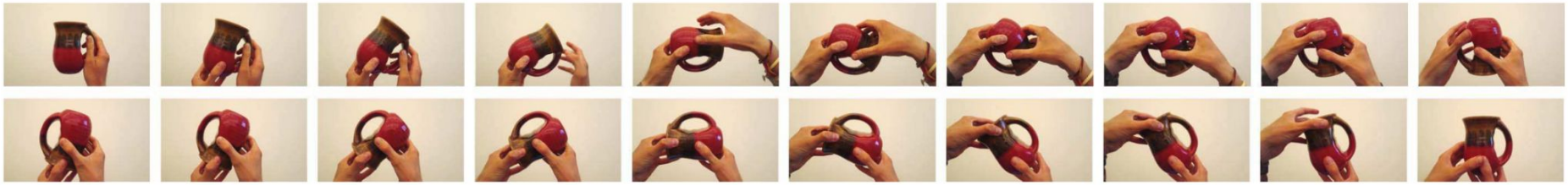
- Goal of contrastive learning : positive and negative pairs
-



Khosla, Prannay, Piotr Teterwak, Chen Wang, Aaron Sarna, Yonglong Tian, Phillip Isola, Aaron Maschinot, Ce Liu, and Dilip Krishnan. ‘Supervised Contrastive Learning’. *CoRR* abs/2004.11362 (2020).

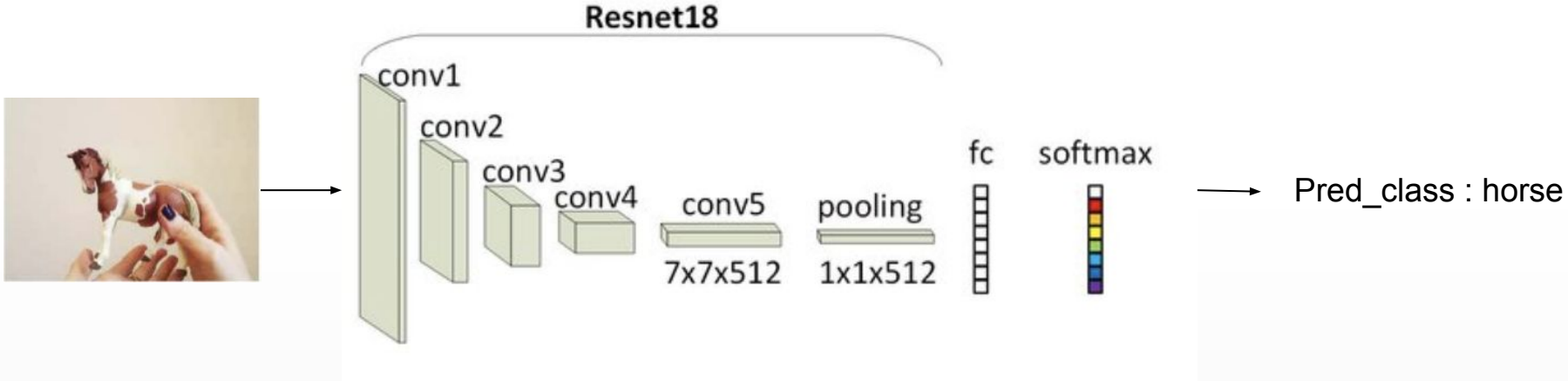
Methodology : Datasets Used
ToyBox

Methodology : Datasets Used
ToyBox - Multiple Views

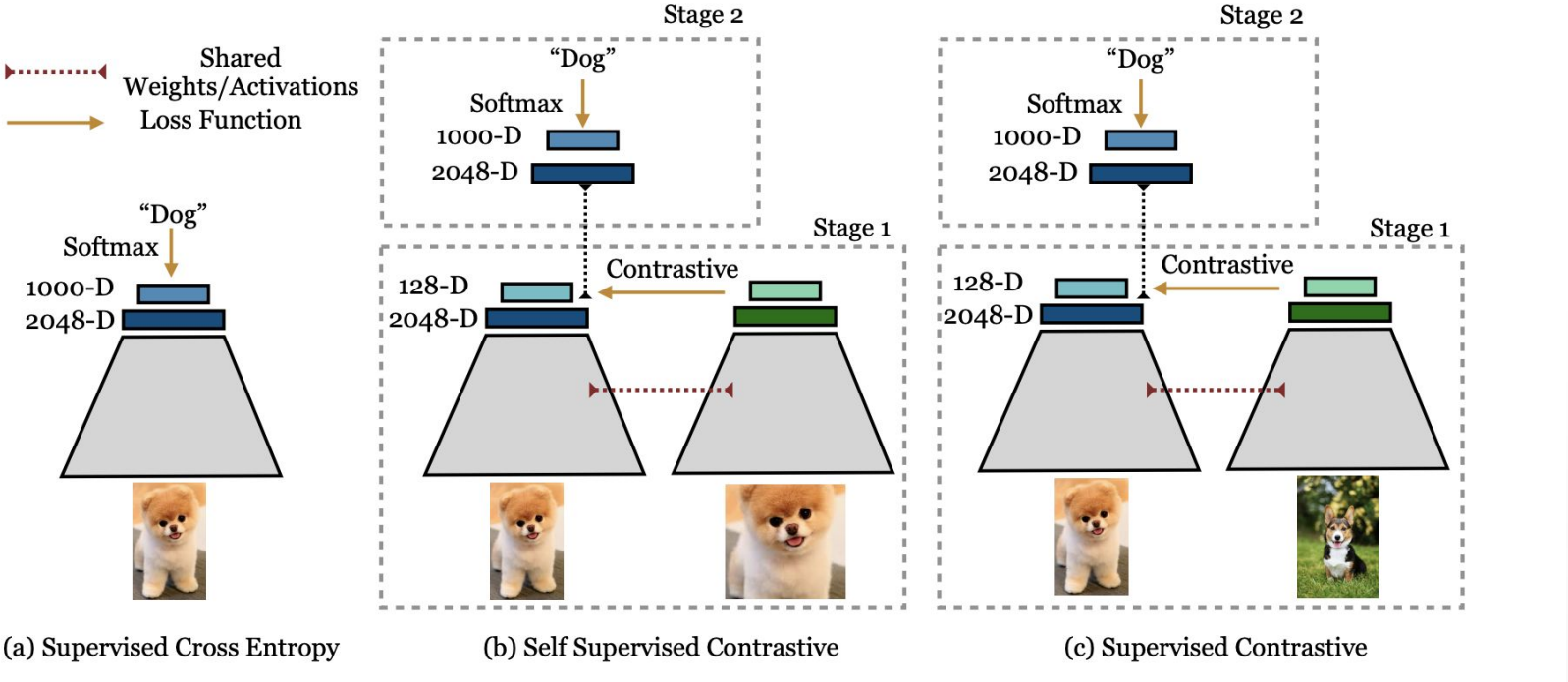


Methodology : Datasets Used
ToyBox vs CIFAR

Methodology : Supervised Learning



Methodology : Supervised Contrastive Learning



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Results:Quantitative

Supervised Learning
Classification Accuracies

Dataset	Model	Accuracy
CIFAR10	ResNet-18	92.68%
ToyBox	ResNet-18	97.56%

Results:Quantitative

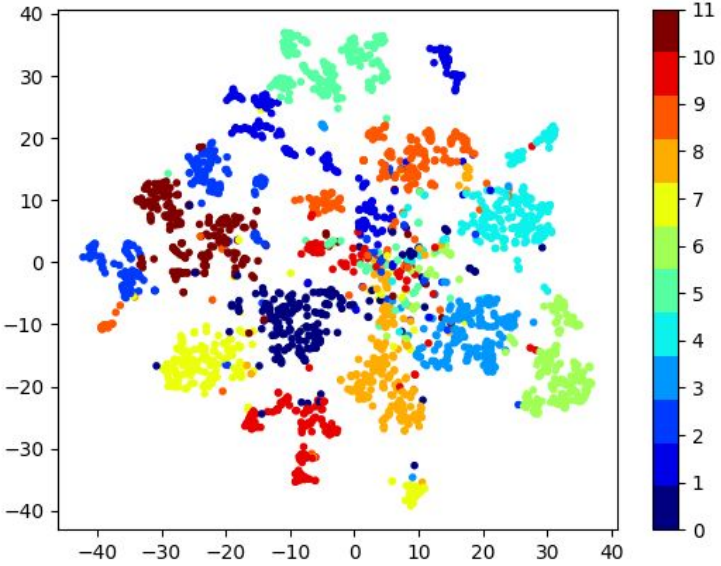
Supervised Contrastive Learning
Classification Accuracies

Dataset	Model	Accuracy
CIFAR10	ResNet-18+Linear Classifier	94.64%
ToyBox	ResNet-18+Linear Classifier	96.39%

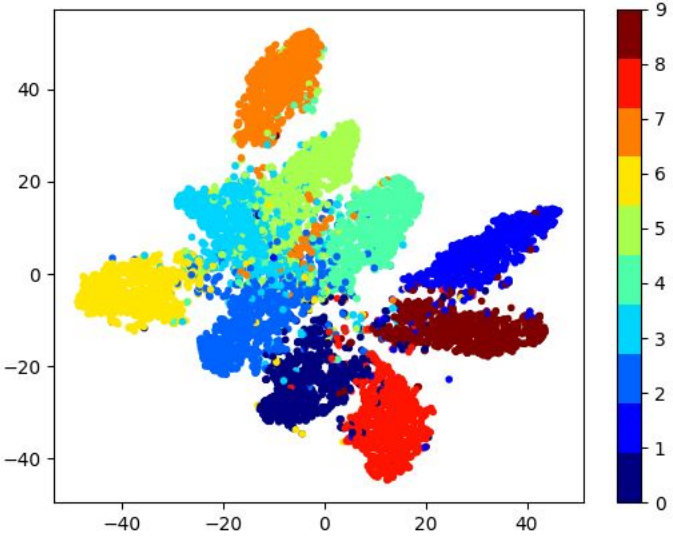
Results:Qualitative

Supervised Learning
t-SNE

ToyBox Dataset



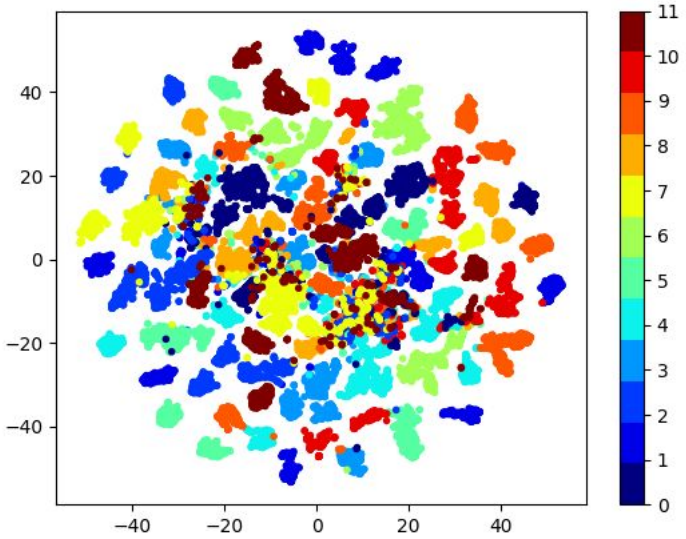
CIFAR-10 Dataset



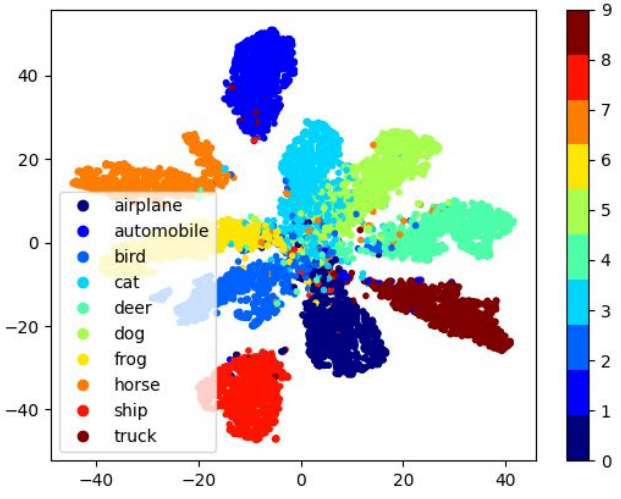
Results:Qualitative

Supervised Contrastive Learning
t-SNE

ToyBox Dataset



CIFAR-10 Dataset



Conclusion

- ToyBox Dataset outperforms CIFAR10 for both learning objectives
- Supervised Contrastive learning objective outperforms Supervised Learning using Cross Entropy Loss
- Not just the data, but learning objective matters for learning that promotes generalizable performance

Thank You!