Investigating the Performance of a Capsule Network in Digit Classification Task

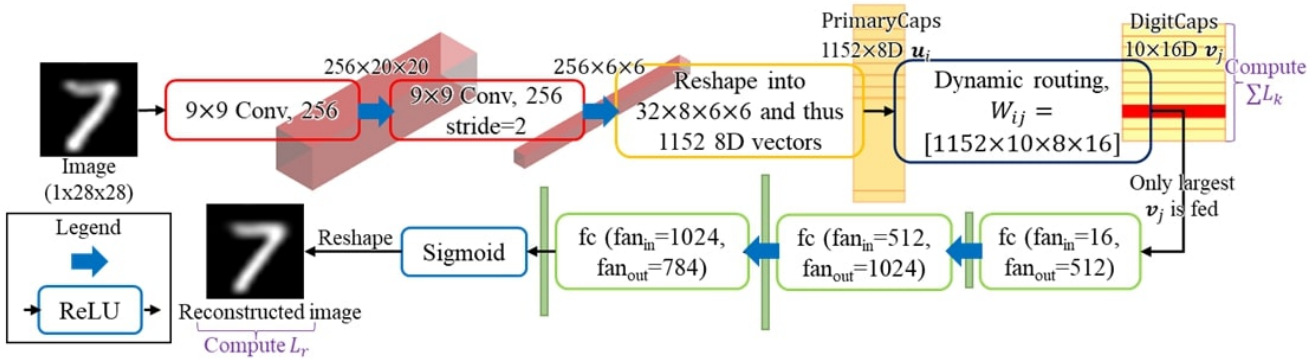
Built with

- Python
- Pytorch

Background and Description

Hinton et al. [1] and Sabour et al. [2] presented capsule network with dynamic routing, an approach closer to replicating the human vision, to resolve the fundamental limitations of CNNs: translational equivariance [3], no build-in understanding of 3D space, and Picasso problem [4].

This project designed and conducted experiments to demonstrate the effectiveness of a Capsule Network (CapsNet) in a multi-label image classification task that was not addressed in the original paper. The code is based on XifengGuo/CapsNet-Pytorch.



Results

	28 × 28 MNIST	56 × 56 MNIST	Affine transformed 56 × 56 MNIST	2-digit 56 × 56 MNIST
CNN28	99.28%	-	-	-
CapsNet28	99.62%	-	-	-
CNN56	-	97.64%	83.24%	54.66%
CapsNet56	-	98.85%	89.45%	97.05%

All networks have been trained solely on MNIST or padded MNIST. However, CapsNet is capable of performing multi-label image classification despite being trained exclusively on single-label images.

References

[1] G. E. Hinton, A. Krizhevsky, and S. D. Wang, “Transforming Auto-Encoders,” in International conference on artificial neural network, 2011, pp. 44-51, doi: 10.1007/978-3-642-21735-7_6.

[2] S. Sabour, N. Frosst, and G. E. Hinton, “Dynamic routing between capsules,” in Advances in neural information processing systems 30, 2017.

[3] L. Alzubaidi et al., “Review of deep learning: concepts, CNN architectures, challenges, applications, future directions,” Journal of Big Data, vol. 8, no. 53, Mar. 2021.

[4] J. D. Kelleher, “The Future of Deep Learning,” in Deep Learning. Cambridge, U.S: MIT Press, 2019.