A UNIFIED THEORY OF EARLY VISUAL REPRESENTATIONS FROM RETINA TO CORTEX THROUGH ANATOMICALLY CONSTRAINED DEEP CNNS

Abraham Jose
ID :5068109, CAP6614
abraham@knights.ucf.edu

1 Summary

The paper studies the first stage of visual processing where it exhibits drastic difference in neural network and to emulate such effects using deep artificial neural networks. At the output of the retina, we have ganglion cell receptive field that exhibits a clear antagonistic center-surround structure which is similar to a RetinaNet with bottleneck. In the primary visual cortex, we have receptive fields sharply tuned to receptive fields and which is imitated by (Ventral Visual System Network)VVS-Net.

2 Strengths of the proposal

1. They are able to closely study the early visual processing system and was able to replicate the same model for inference in classification of objects in the scene using CIFAR dataset.
2. Used the hypothesised model to develop theories on the constraints and objectives that have driven the evolution of our visual system based on inferences.
3. The team was able to provide Retina Bottleneck model and VVS-Net model which corresponds to both types of retinal fields that could imitate the actual systems which helps the communication of optic nerves to pass through the information that could be digested by the following network.

3 Weaknesses of the proposal

1. The human or animal visual cortex system is a lot more complicated. Even pupil contraction and dilation varies the receptive fields of the information carried forward and the response for high frequency information has a bias, there could be a teacher network etc.. It is possible that the hypothesis could be incomplete because of missing information.

4 Results

The author tested the model in CIFAR-10 data-set and proved that each classes are linearly separable from the retina-net representation using the shallow VVS-Net. Also when VVSNet is shallow, the RetinaNet has to work towards extracting relevant features from the image which makes the response non-linear. And if the deeper VVS-Net is used, the RetinaNet tries to carry as much as data downstream and acts with a linear response since the VVS-Net is able to process the data using the deeper network.

5 Discussion

The RetinaNet acts as a guiding neural network for the information passed down to the VVS-network. Thus the information is controlled. How many such guiding networks are possible in our visual cortex for each different tasks?