

Applause from Max Pechyonkin and 32 others



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Nov 15

A Visual Representation of Capsule Network Computations

The new paper [Dynamic Routing Between Capsules](#) is the first published technical description of capsule networks, a neural net approach which Hinton has been [hinting at for at least five years](#) 📄.

Many discussions of the paper focus on a big picture view of how capsule networks are improvements over standard neural nets: they represent more nuanced part-whole relationships at each layer by using vectors in place of scalars. The idea is that a vector can model the “pose” of an entity, and entities with similar poses belong together. As an analogy: if you see two eyes, a mouth, and nose in a particular spacial relationship and oriented in the same direction, that's pretty good evidence for a face with the same orientation. Standard convolutional neural nets are capable of modeling similar relationships. But they do so less compactly, with a larger number of parameters or layers (and with less ability to generalize, the paper argues).

To get a better feel for exactly what capsule networks compute, I made a diagram of the capsule-to-capsule connections in the paper. This diagram is intended for those who have read the paper and are looking for a summary reference image.

A Visual Representation of Capsule Connections in Dynamic Routing Between Capsules

Each capsule computes a weighted average of input vectors. The "coupling" weights are determined on each forward pass via an iterative algorithm that acts as a sort of orientation-popularity filter. If multiple large vectors point in the same direction, they will get a large weight. Shorter vectors pointing in scattered directions will get a small weight.

The output vector is squashed so that its length can model the probability that the capsule's digit is present.



