A combinatorial neural code is a subset of the power set $2^{[n]}$. A neural code is convex if it is the intersection pattern of convex open sets in $\mathbb{R}^d$. Convex neural codes arise in the brain from the activity of cells with convex receptive fields, such as hippocampal place cells. In order to better understand convex receptive field coding in the brain, we are interested in characterizing which neural codes are convex. Despite considerable progress, the problem remains wide open. Here, we show that a code has a realization with convex polytopes if and only if it is the image of a representable oriented matroid under a neural code morphism. We show that most previously known examples of non-convex codes are non-convex because they are not the image of any oriented matroid under a code morphism. However, we can construct new examples of non-convex codes using non-representable oriented matroids. This is joint work with Alex Kunin and Zvi Rosen.

**Related Links:**
- Background: What can topology tell us about the neural code?, by Carina Curto
- Background: Lectures on matroids and oriented matroids, by Victor Reiner
- Background: Oriented matroids, by Jürgen Richter-Gebert and Günter M. Ziegler
Seminar

Related Fields:
- Combinatorics
- Discrete Geometry
- Geometric Combinatorics

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