Hey everyone,

The topic for this week is the mean-field framework for analyzing signal propagation in neural networks, which works in the limit that the width of the layers go to infinity. Most of this material comes from the following papers, with the relevant sections below:

[Exponential expressivity in deep neural networks through transient chaos](https://papers.nips.cc/paper/6322-exponential-expressivity-in-deep-neural-networks-through-transient-chaos)

* Section 2 (introduction of the first of the two central concepts the paper studies, namely the *iterative length map*)
* Section 3 (extending the iterative length map, which considers a single input, to the *iterative correlation map*, which considers two inputs)

[Deep information propagation](https://arxiv.org/abs/1611.01232)

* Section 2 (recap of the first paper above)
* Section 3 (exploring how some of the central properties from the first paper - namely, the fixed points of the dynamical system introduced - influence trainability)
  + Note: Skip section 3.1.
* Section 4 (applying the same analysis introduced in the first paper, but to gradients that propagate backwards through a network rather than inputs propagating forward)

We’ve found these papers to be quite dense, so while you’re free to read them (especially the relevant sections discussed above), we think a better strategy is to work through the problem set for this week which is designed to teach you the material in a more pedagogical way. After that, we recommend trying to read the above papers again; with the knowledge you gain from the problem set, this reading should go much more smoothly.

Part of the problem set focuses on a simple dynamical system. For a nice reference on dynamical systems, see the following thread on dynamical systems:

<https://mathinsight.org/intoduction_dynamical_system>

This whole thread is useful, but a particular page which might be helpful is the one on stability:

<https://mathinsight.org/equilibria_discrete_dynamical_systems_stability_idea>

These threads aren’t really required readings, though. Just putting them here in case you find them useful references for that part of the problems etc.