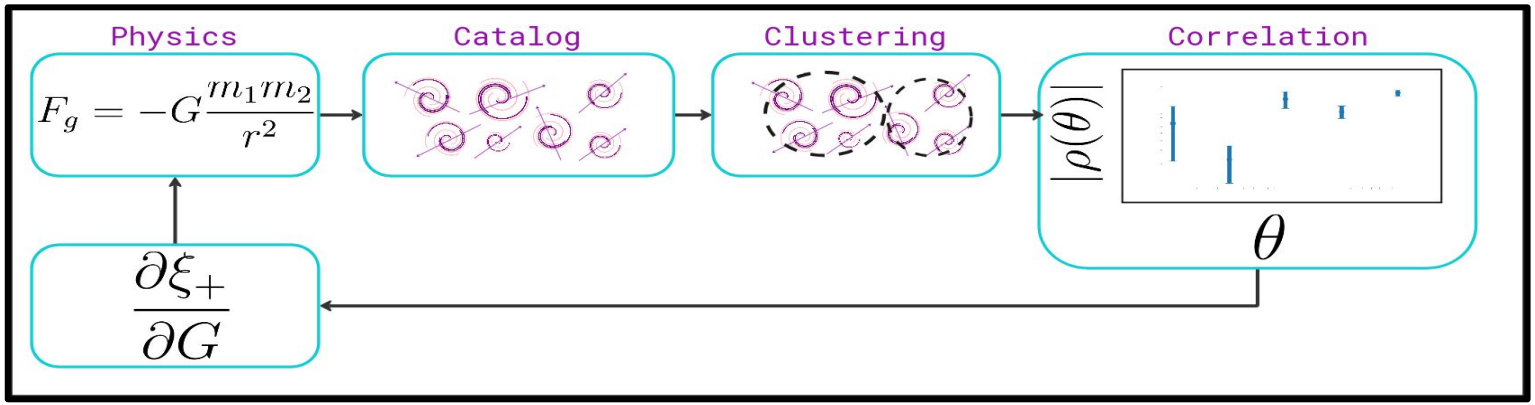
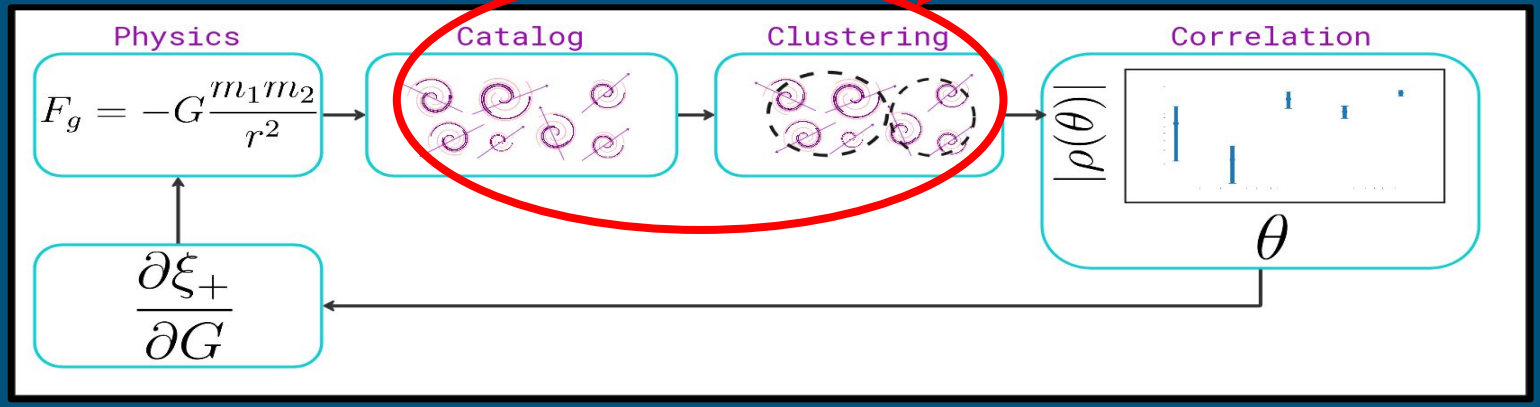
On Differentiable Correlation Functions

Edward Berman



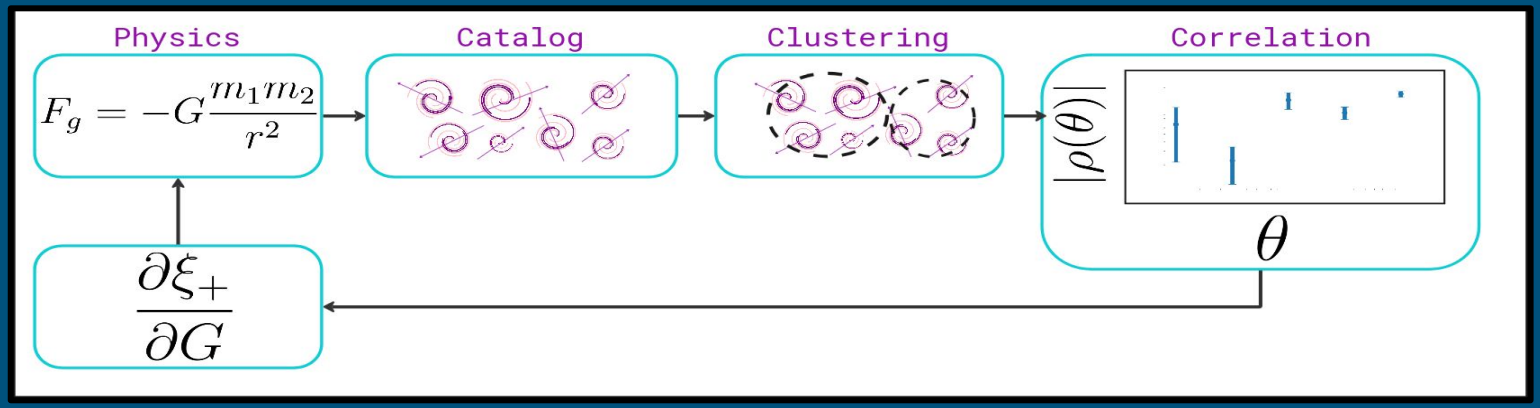
Differentiability

- **We want gradient based optimization for CFs**
- Differentiable forward models (Physics to Catalog)
- Differentiable estimators (Catalog to Correlation)



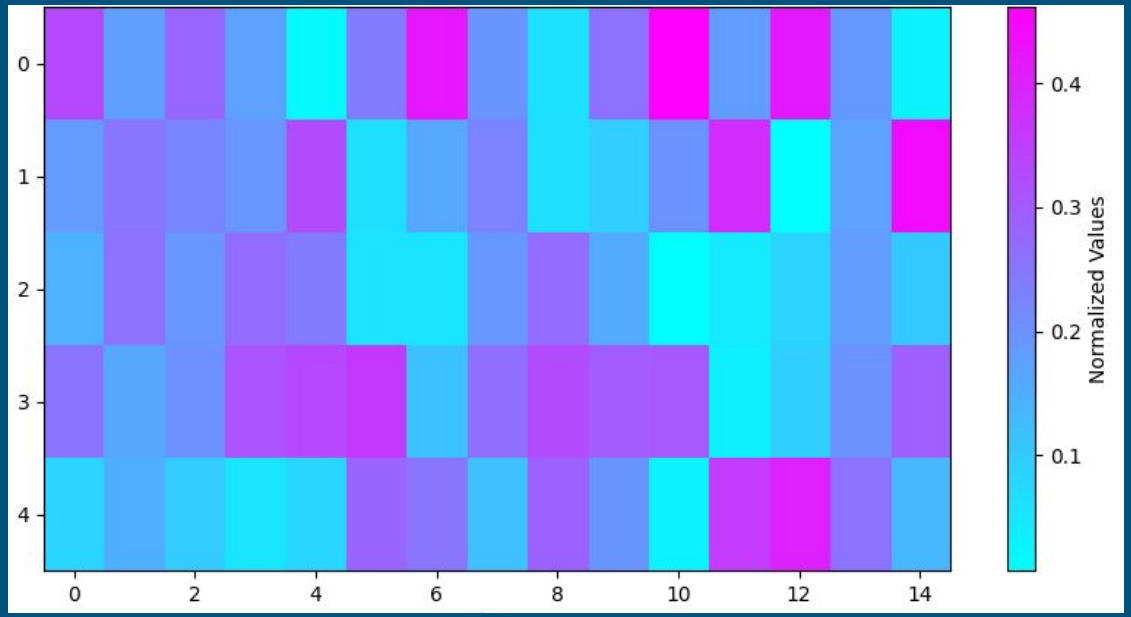
Differentiability

- We need a way to differentiate through the cluster step!!

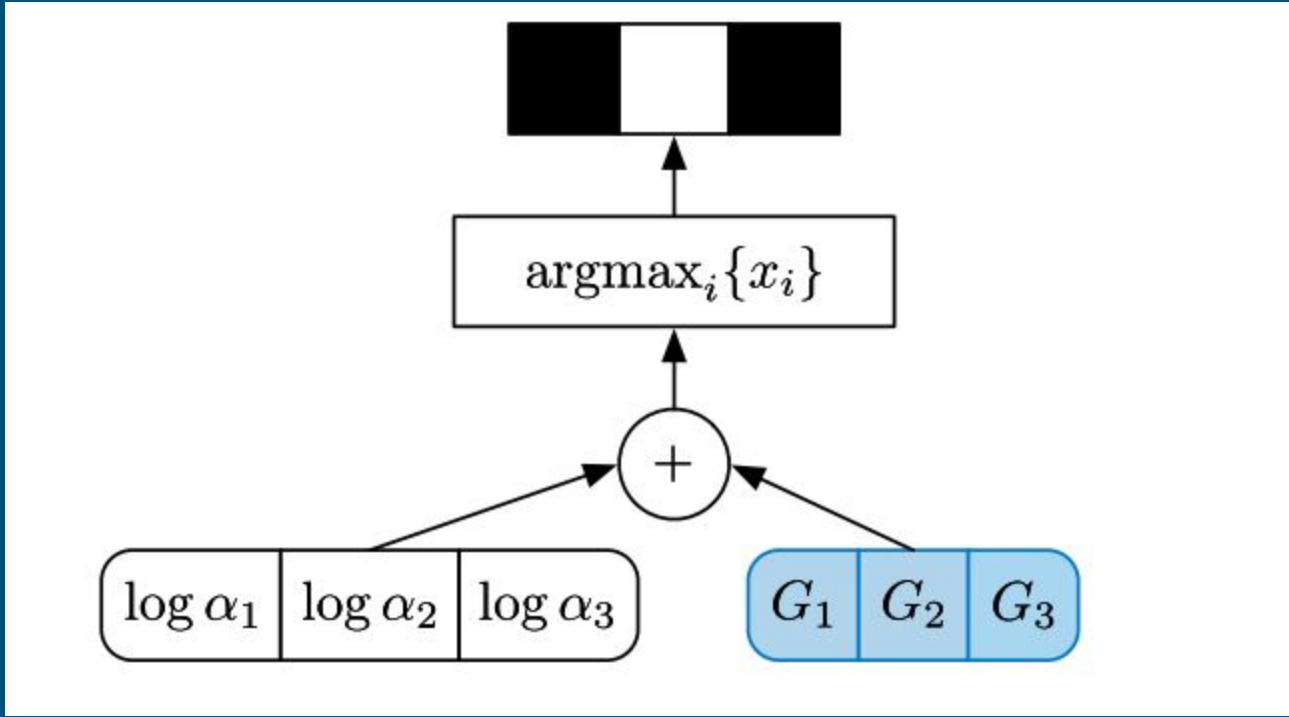


Fuzzy-c-means

- Each update step is differentiable! Avoids *argmin* function call. Results in cluster assignment probabilities

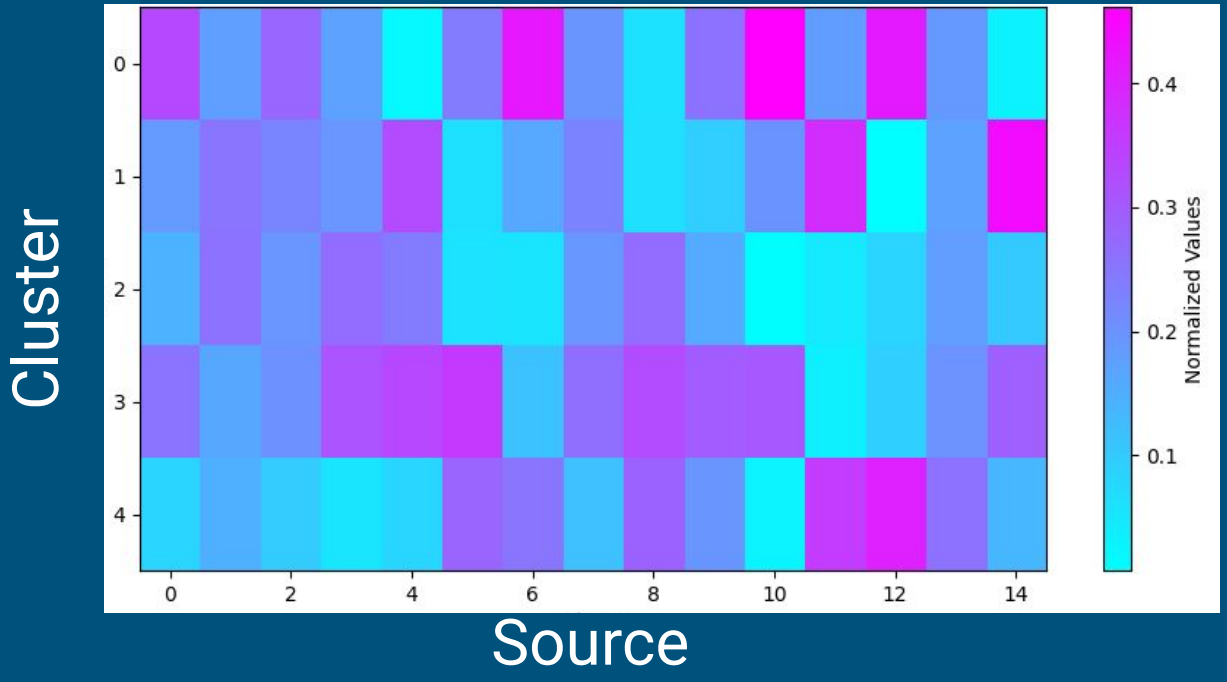


Approach 1: Gumbel-Max



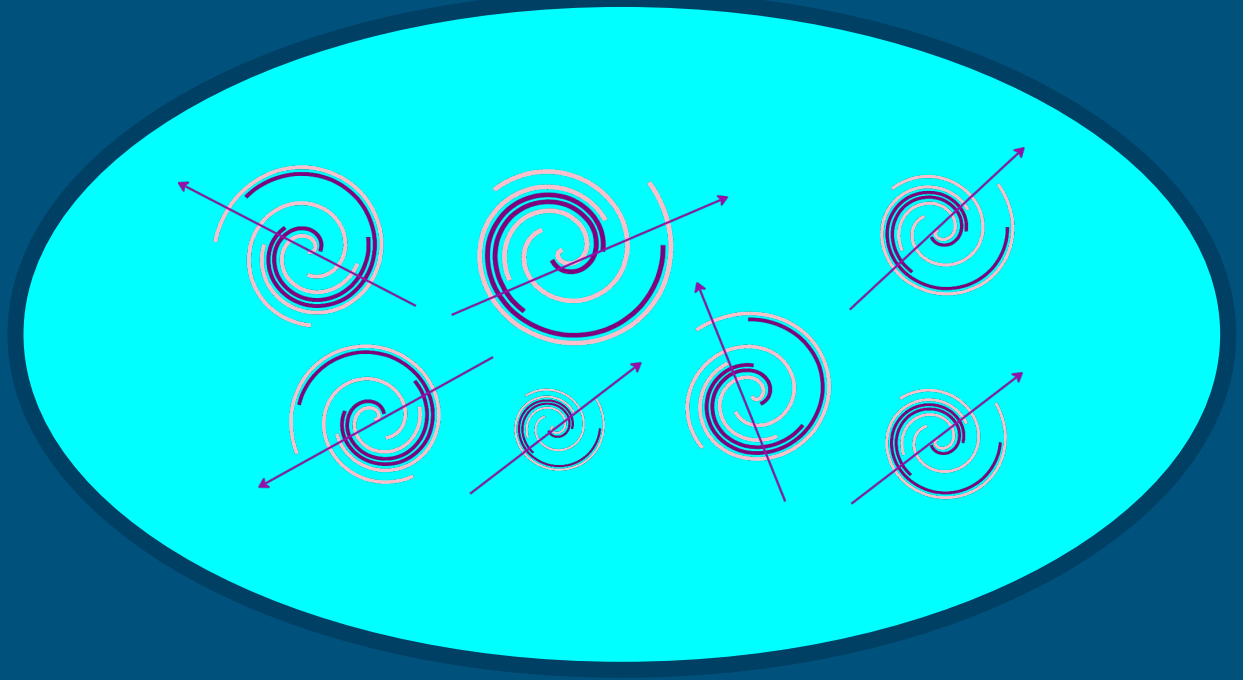
Approach 2: Weighted Averaging

- New objects are weighted averages of each column (position and quantities)



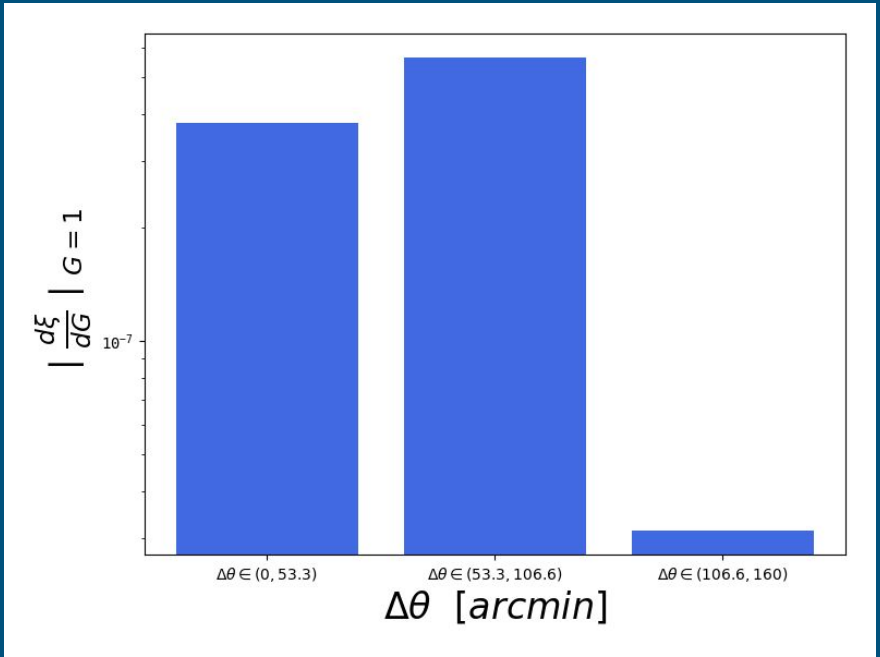
Approach 3: Skip Gradient

- Approximate gradients of individual galaxies as the gradient of the new cluster object



Differentiability

- Success!



Conclusions, contact, and thanks =]

- Correlation Functions are cool
- For more, see: https://github.com/EdwardBerman/cosmo-corr
- [Berman et al in prep.] [AAS winter session 2025]
- http://ebrmn.space/
- f(berman, ed, northeastern) where f(x,y,z) = x.y@z.edu
- Thanks for list'nin'