

NLB 2021 Winning Submission

Approach and Methods



AE.STUDIO



AE Studio in 60 seconds...

- AE = Agency Enterprise (as in human agency)

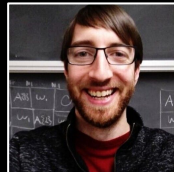
"We believe that technology should increase rather than decrease human agency."

- Product Development and Data Science Consulting Firm
- Working to build software to support BCI research

BCI Team



Darin
Sleiter



Mike
Vaiana



Joshua
Schoenfield



Sumner
Norman



Diogo de
Lucena



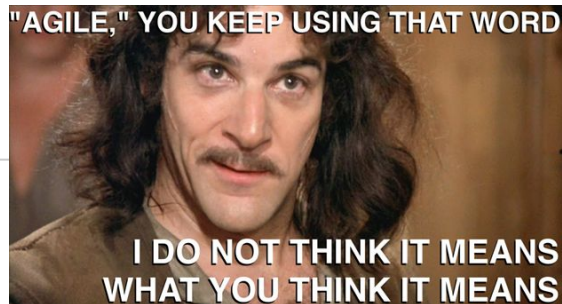
Approach and Process

Agile Software Development

- What can we achieve in the time we have?
 - ~~Novel ML algorithm~~
 - ~~Implement paper from scratch~~
 - **Adapt open source code from paper**

Data Science

- We used best practices for delivering an ML *product*
- Enumerated possible improvements
 - Picked the ones with the best trade-off between speed and expected improvement



Nice paper

GitHub
Link

Written in
your favourite
framework

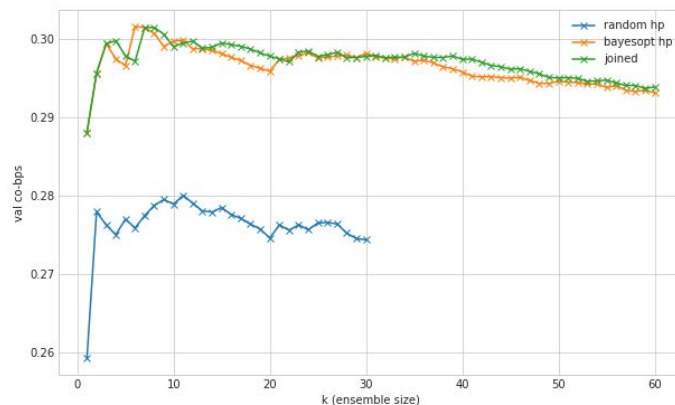
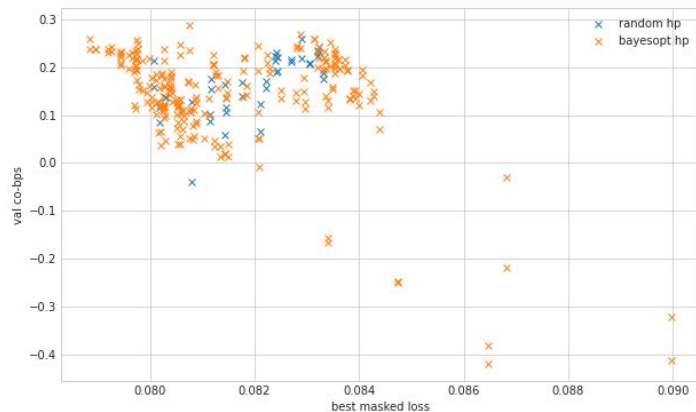
Runs smoothly on
your system
without error or
dependency issues



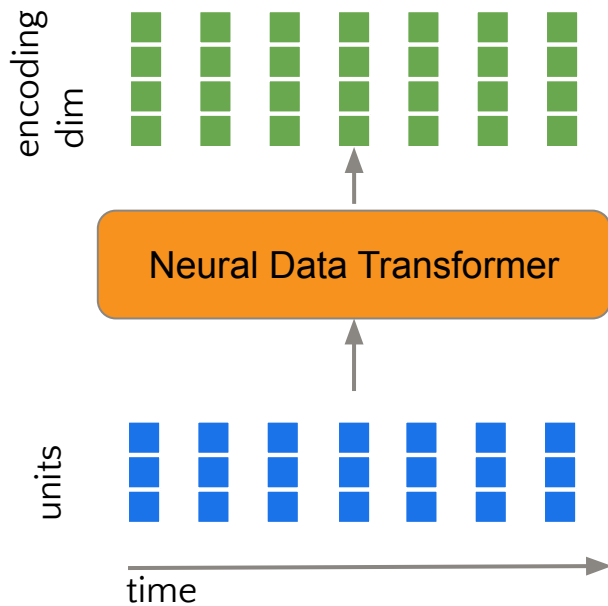
Methods

Neural Data Transformer [1] Ensemble

- For each dataset we ensembled 7–21 NDT models
- Candidates for ensembling were created by training 100+ NDT models with Bayesian hyperparameter optimization on each dataset



NDT in 60 seconds...



$$W \times \begin{bmatrix} \text{green} \\ \text{green} \\ \text{green} \\ \text{green} \end{bmatrix} = \begin{bmatrix} \text{yellow} \\ \text{yellow} \end{bmatrix}$$

Final rate predictions* (yellow) are a learned matrix (W) times the encoded vector (green).

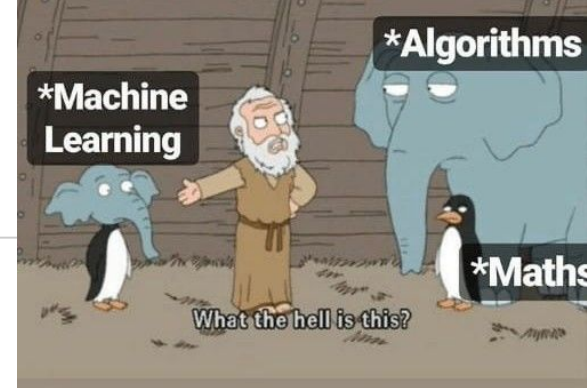
*technically these are $\log(\text{rates})$





What didn't work for us...

- AutoLFADS[1] / LFADS [2]
 - We weren't able to reproduce or beat the AutoLFADS leaderboard results with our own implementation.
- Stacking
- Per-neuron ensembles



[1] A large-scale neural network training framework for generalized estimation of single-trial population dynamics
Mohammad Reza Keshtkaran, Andrew R. Sedler, Raed H. Chowdhury, Raghav Tandon, Diya Basrai, Sarah L. Nguyen, Hansem Sohn, Mehrdad Jazayeri, Lee E. Miller, Chethan Pandarinath
bioRxiv 2021.01.13.426570; doi: <https://doi.org/10.1101/2021.01.13.426570>

[2] Pandarinath, C., O'Shea, D.J., Collins, J. *et al.* Inferring single-trial neural population dynamics using sequential auto-encoders. *Nat Methods* 15, 805–815 (2018). <https://doi.org/10.1038/s41592-018-0109-9>



Join Us! ae.studio/join-us

- **Join our heady team. We're looking for:**
 - BCI Data Engineers
 - BCI Data Scientists
 - and more.

- **The AE Studio BCI Team is currently exploring a range of academic collaborations...let's partner!**
 - **Contact Diogo:** diogo@ae.studio



Links

- AE.Studio
 - <https://github.com/agencyenterprise/ae-nlb-2021/blob/master/approach.md>
 - <https://github.com/agencyenterprise/ae-nlb-2021>
 - <https://ae.studio/brain-computer-interface>
 - <https://ae.studio/join-us>
- Neural Data Transformers
 - <https://doi.org/10.51628/001c.27358>
 - <https://github.com/snel-repo/neural-data-transformers>
- AutoLFADS/LFADS
 - <https://doi.org/10.1101/2021.01.13.426570>
 - <https://snel-repo.github.io/autolfads/>
 - https://github.com/lyprince/hierarchical_lfads