Using Brain-Score to Evaluate and Build Models for Brain-Like Object Recognition

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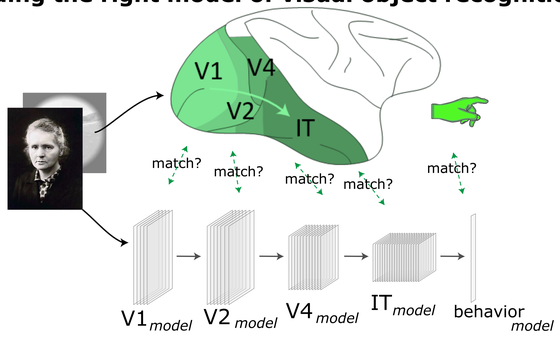
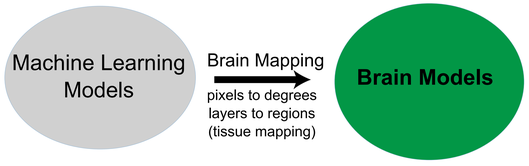
Finding the right model of visual object recognition



Our **Goal**: find a highly predictive model of the ventral stream
Data and Metrics ("Benchmarks") evaluate candidate models on their brain similarity
Brain-Score.org is a platform that pools benchmarks and model candidates to accelerate progress

A "Brain Model" API to experiment on models

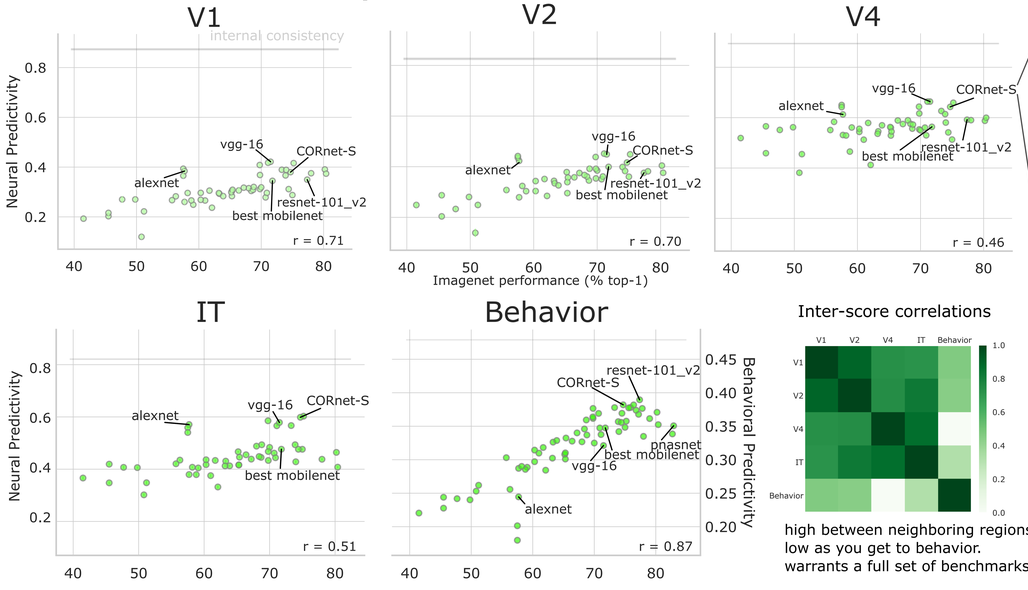
Model candidates for brain processing expose an interface that lets us treat them like in an experimental setting:
* **perform_task** (e.g. passive fixation, match-to-sample)
* **start_recording** (e.g. V1, IT)
* **look_at** (images)



Brain-Score.org enables community science

* data is **pooled and curated** across labs, providing unprecented constraints on models
* all models are tested on the same benchmarks, making **scores directly comparable**
* new metrics can **dynamic**ally be integrated
* **pool of model hypotheses** to test on new data

Models are "halfway there" for our current set of benchmarks

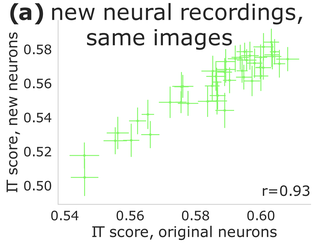


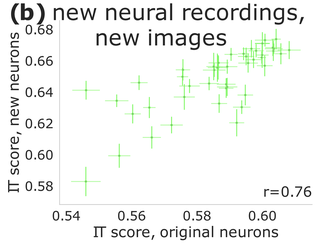
Inter-score correlations

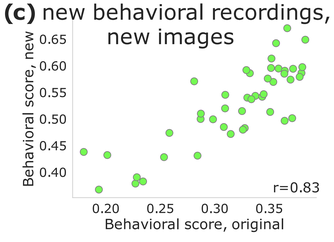
high between neighboring regions, low as you get to behavior. warrants a full set of benchmarks

Scores generalize across images and neurons

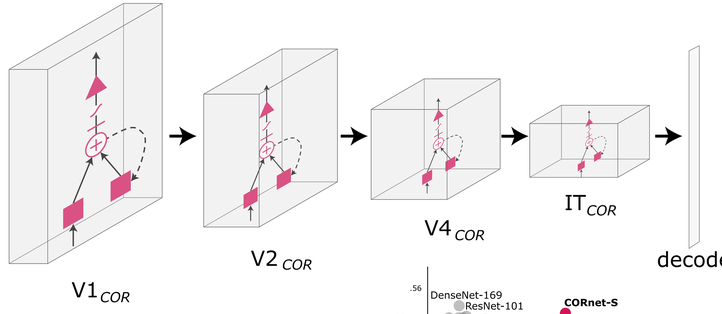
By evaluating models across a range of benchmarks, we expect them to also generalize to the (n+1)-th benchmark. Model scores obtain on the current set of benchmarks generalize well across neurons (a), images and neurons (b), and images and behavior (c).



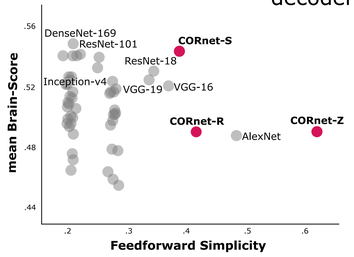




CORnet: an anatomically simplistic model of brain processing, built using Brain-Score

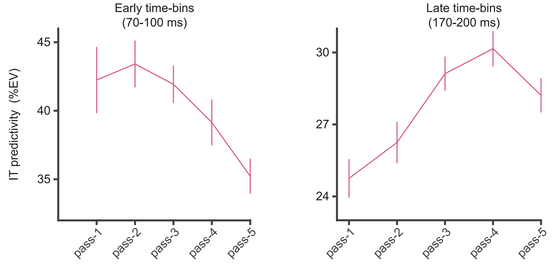


We built CORnet as an anatomically pre-mapped model with simplified processing:
* **fewer layers** than comparable networks
* within-region **recurrence**
* **shared circuit motif** across areas
* all the while maintaining **top Brain-Score**



CORnet predicts temporal dynamics

Kar et al, Nature Neuroscience 2019 (in press)



Summary

Brain-Score.org is a community-driven platform that interfaces between modeling and experiments by testing a pool of models on a pool of benchmarks. CORnet is a successful use of that platform to build an anatomically simplified model.

Future Work

* fine-grain temporal benchmarks
* inactivation benchmarks
* <your benchmark here>

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bioRχiv.org/content/10.1101/407007v1
bioRχiv.org/content/10.1101/408385v1

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V1, V2 neural data from Freeman, Ziemba, Movshon et al, 2013 V4, IT from Majaj, DiCarlo et al, 2015
Behavioral data, metric from Rajalingham, DiCarlo et al, 2018 Neural metric from Yamins et al, 2014