# DeLINEATE: A deep learning toolbox for neuroimaging data analysis

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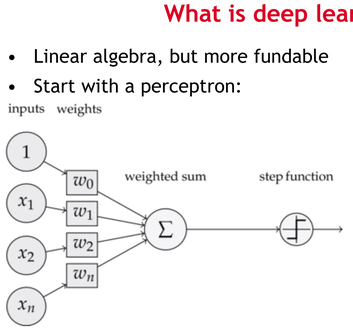
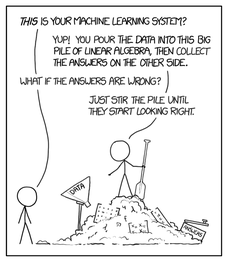
## Why?

- Many modern approaches to neuroimaging data analysis (i.e., Multivariate Pattern Analysis) rely on machine learning-based classifiers
- Classical approaches (e.g., Support Vector Machines or Logistic Regression) are inherently limited in the kinds of classification they can perform, and become computationally costly with large amount of data
- Modern neural network classifiers are more flexible and computationally tractable, at the cost of more researcher degrees of freedom without any established best practices
- To facilitate the exploration of deep learning in neuroscience, we need tools and structure for researchers to better engage with and manage additional complexity

## What is deep learning?

- Linear algebra, but more fundable
- Start with a perceptron:




https://xkcd.com/1838/

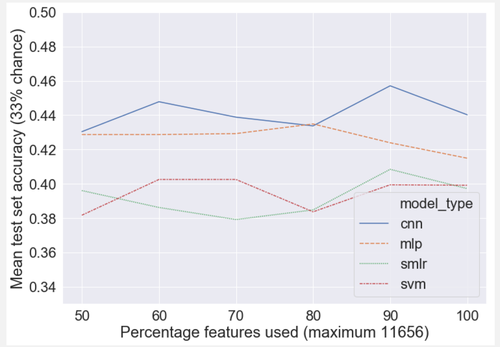
https://tex.stackexchange.com/questions/104334/tikz-diagram-of-a-perceptron

- Wire a whole bunch of them together, sprinkle in some other data transformations to taste
- Feed some feature values into the first layer, propagate results to the end
- Compare the last layer to your class labels and use backpropagation to yell at the model
- Repeat until you have solved consciousness and/or created SkyNet

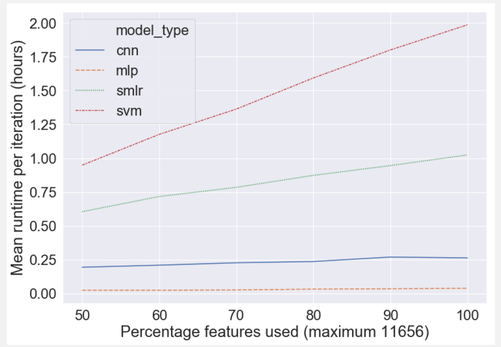
## Have questions?

- Drop us a line, we'll be happy to discuss your project or help you get set up.
- Email:
  - delineate.toolbox@unl.edu
  - kkuntzelman2@unl.edu
  - matthew.r.johnson@unl.edu
- Project website:
  - http://delineate.it
- Project git repository:
  - https://bitbucket.org/delineate/delineate

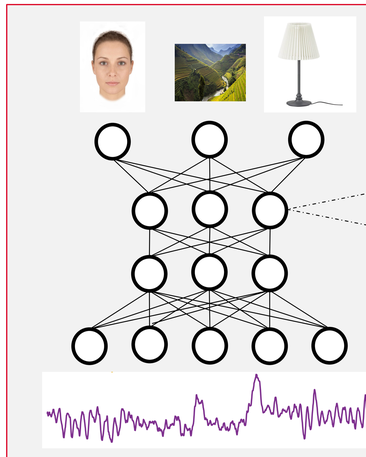
## Features



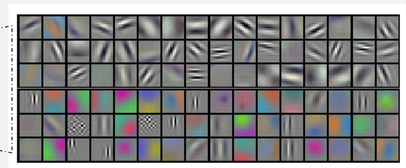

Classify simple stuff as accurately as classical MVPA!




…but way faster!



True multi-class models!



Krizhevsky et al., 2012

Rediscover feature detectors!
(yet again:
Comon, 1994;
Olshausen & Field, 1996;
Bell & Sejnowski, 1997;
etc…)


```
"model": {"layers": [
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             "units": 32,
             "kernel_regularizer": "keras.regularizers.l2(0.01)"
```
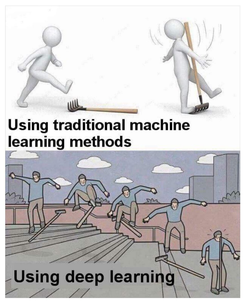

All with convenient JSON specification!
No need to write new code for a new model.




## What do you need to get started?

### Hardware

- Linux workstation (Windows should work too)
- A decent GPU (nVIDIA with CUDA capability)

### Software

- Python
- GPU drivers for parallel computing
- Theano or Tensorflow (These do the actual work but are Not Fun to interact with)
- Keras (Makes things friendlier if you know how to code)
- DeLINEATE (http://delineate.it or https://bitbucket.org/delineate/delineate/overview)

### Files

- Data
- A loader function to get your data into the right shape (you can model this off of included examples)
- JSON model specification

## Ongoing Development

- We take requests!
- Support for non-sequential models
- Support for additional backends
- Some sort of GUI, maybe, if we have to
- Better documentation
- Include prefab published models

## Talk to actual users

- Poster B100, right now
- Poster B102, right now
- Poster D104, Monday morning (gross)

## References & Acknowledgements

Comon, P. (1994). Independent component analysis, a new concept? *Signal processing*, *36*(3), 287-314.

Olshausen, B. A., & Field, D. J. (1996). Emergence of simple-cell receptive field properties by learning a sparse code for natural images. *Nature*, *381*(6583), 607.

Bell, A. J., & Sejnowski, T. J. (1997). The "independent components" of natural scenes are edge filters. *Vision research*, *37*(23), 3327-3338.

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