# Improving your neural network

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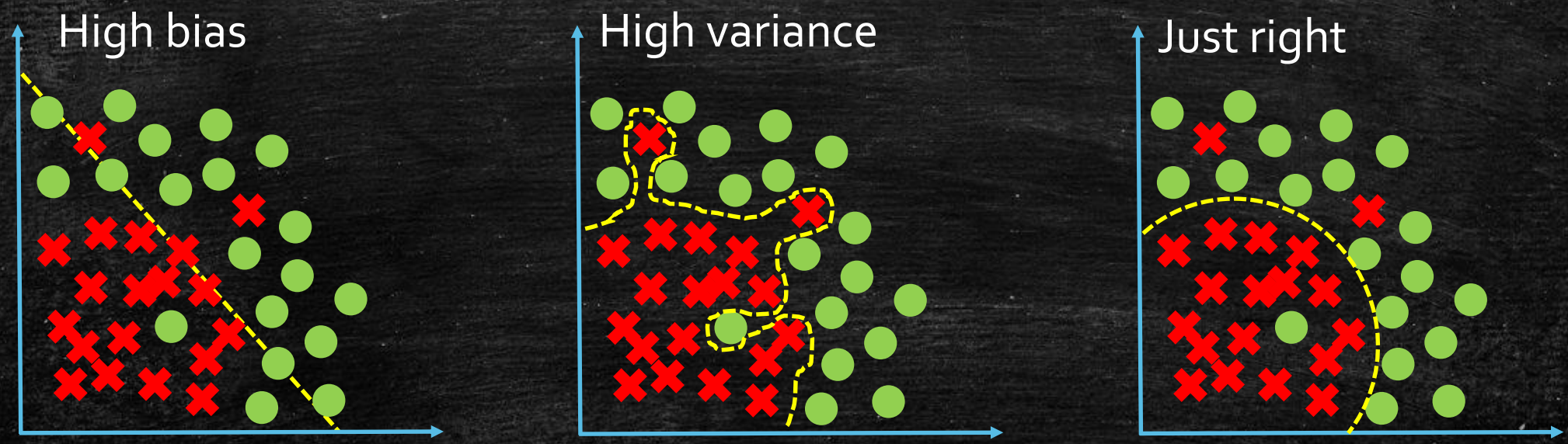
# Factors to consider when trying to improve neural network

- Data quality
- Data partitioning
- Hyperparameter tuning
- Regularization
- Data augmentation

# What is a good neural network model?

- A model that has low bias and low variance.



# Parameters vs Hyperparameters

- A machine learning **model** is the definition of a mathematical formula with a number of parameters that need to be **learned** from the data. That is the crux of machine learning: fitting a model to the data.
- Some parameters express "higher-level" properties of the model such as its complexity or how fast it should learn. They are called **hyperparameters**. Hyperparameters are usually fixed before the actual training process begins.

# Hyperparameters

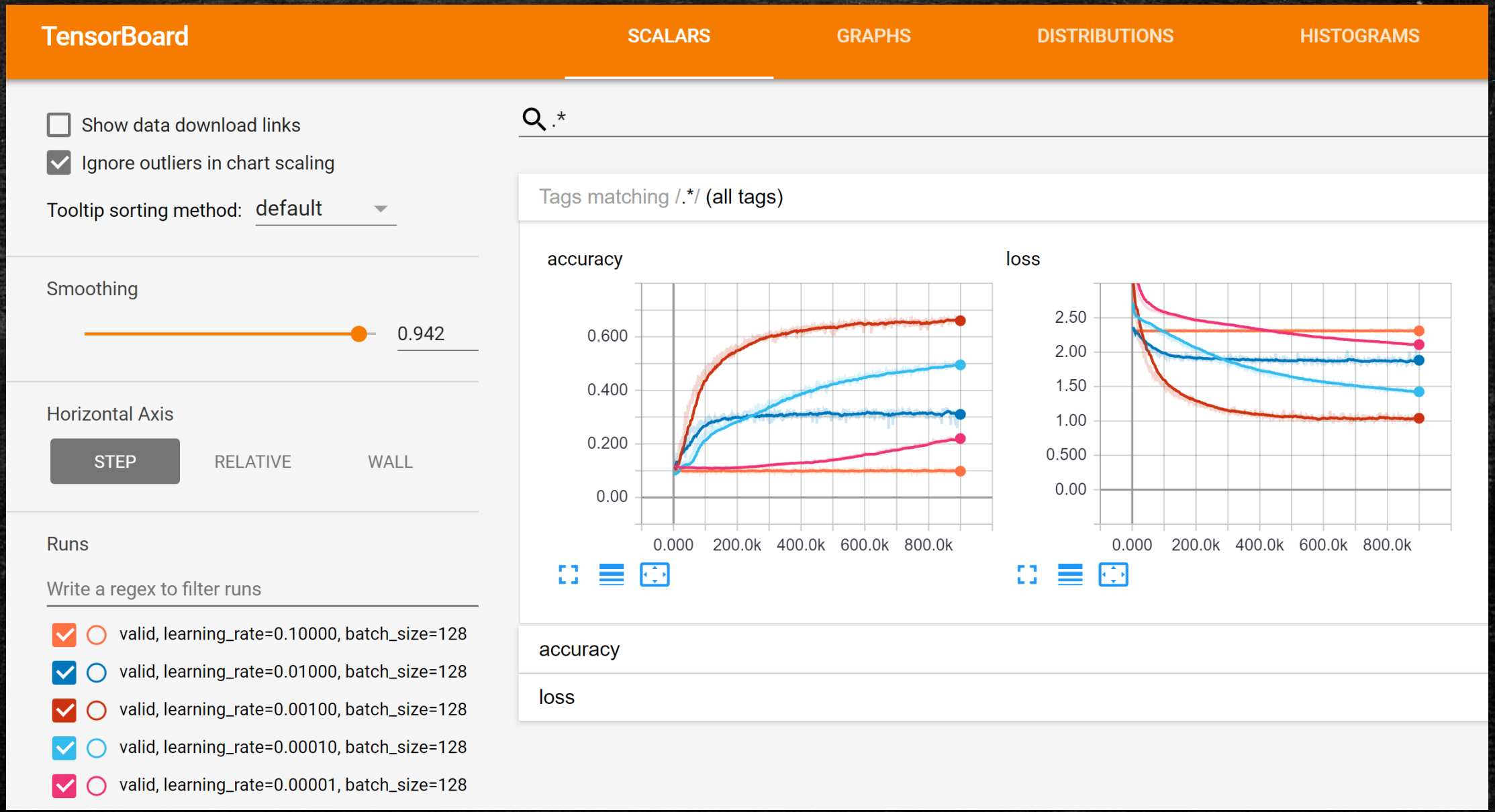
- Learning rate
- Learning rate decay rate
- Parameters of optimizers
- Number of hidden layers
- Number of hidden units
- Mini-batch size

# Important rules in hyperparameter tuning

- It's very difficult to get an intuition on appropriate hyperparameters in advance, so the key is to explore hyperparameters space efficiently.
- Begin with a small subset of data  if you have a very large dataset.
- Change hyperparameters one at a time.

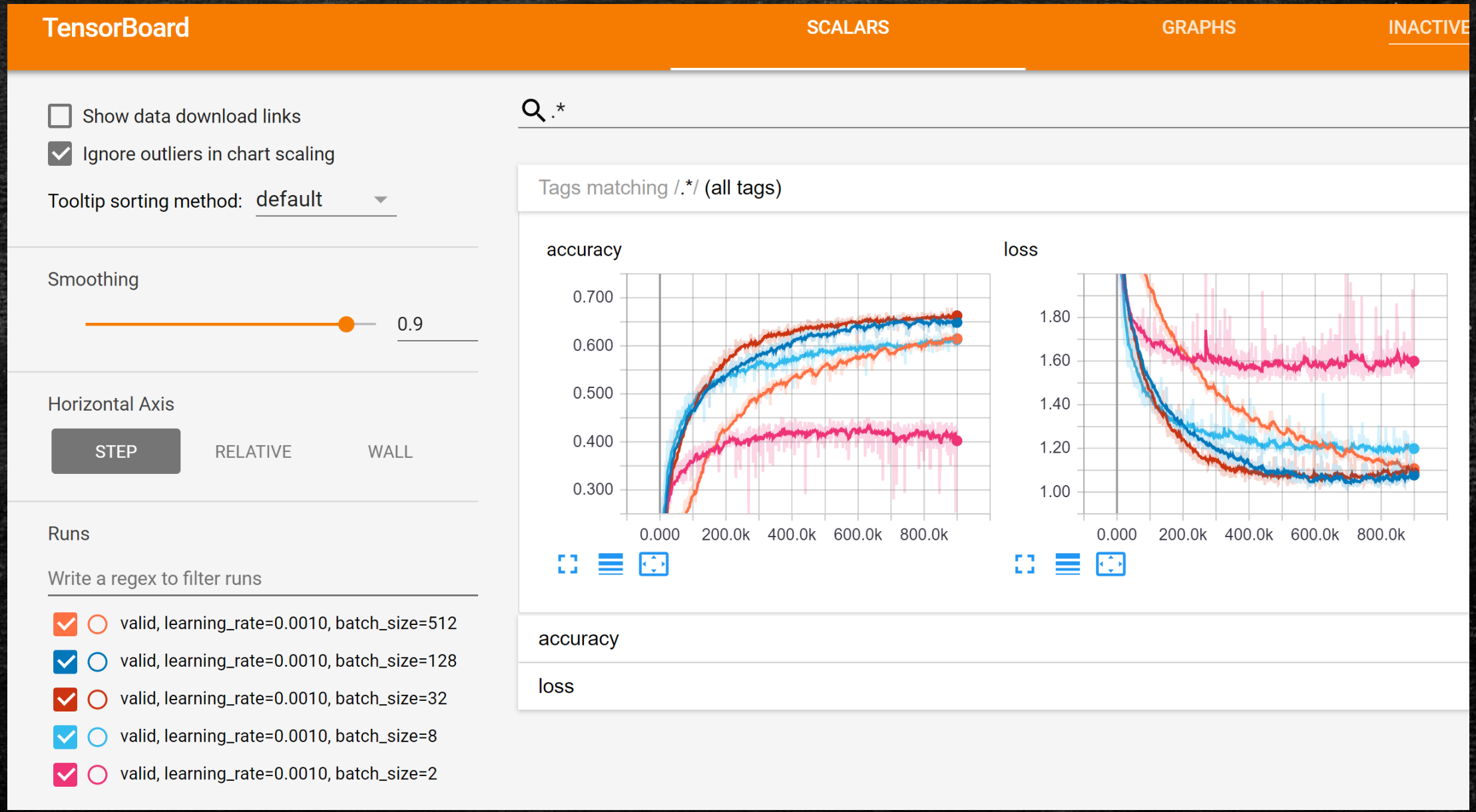
# Choosing appropriate learning rate

Example:
CIFAR-10
7-layer CNN
Adam Optimizer



# Choosing Minibatch Size

Example:
CIFAR-10
7-layer CNN
Adam Optimizer



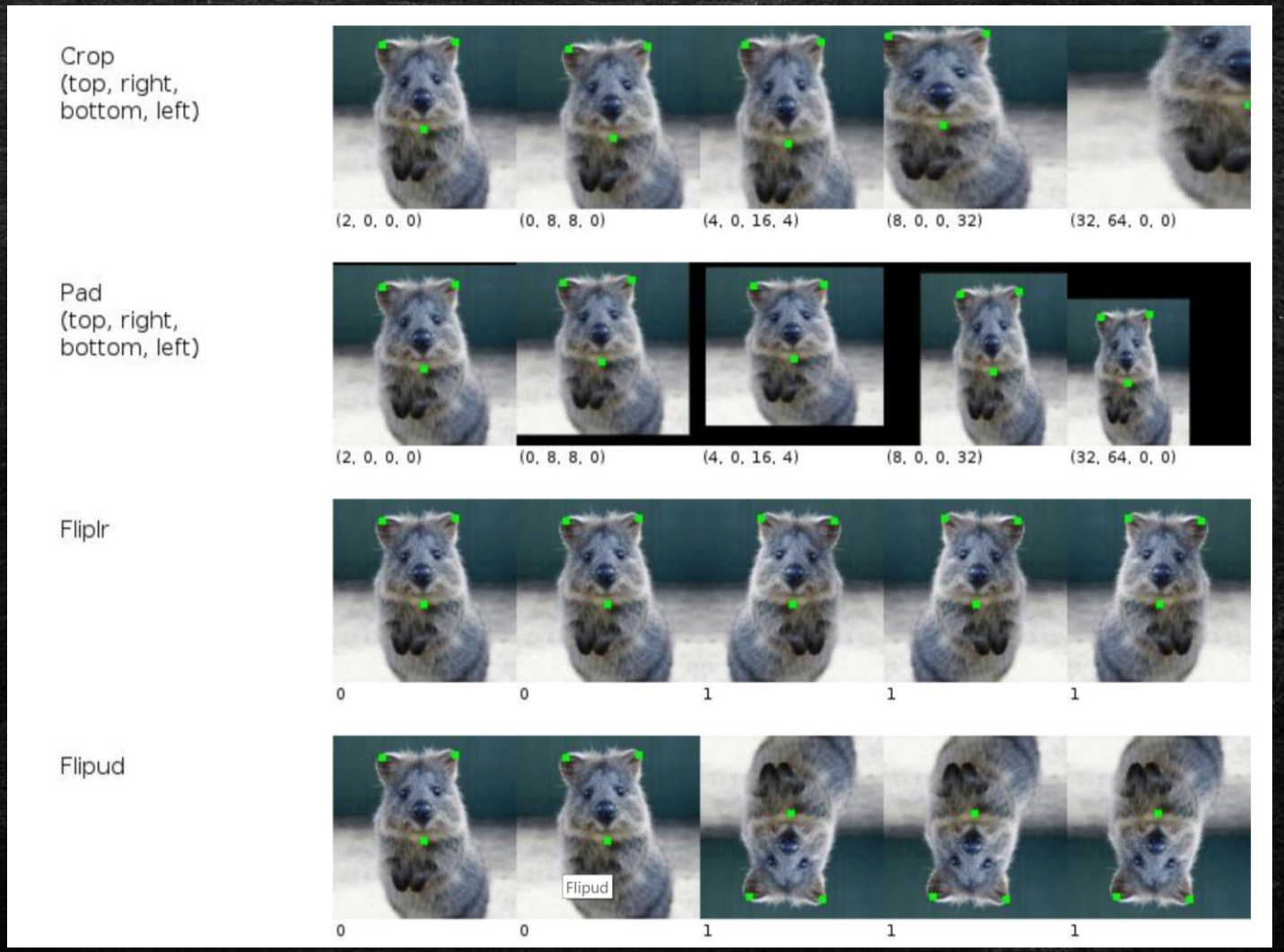
# Methods for Hyperparameter Tuning

- Grid search
  - Curse of dimensionality
- Random search
  - Lack of *a priori* knowledge
- Bayesian optimization
  - https://cloud.google.com/blog/big-data/2017/08/hyperparameter-tuning-in-cloud-machine-learning-engine-using-bayesian-optimization
  - http://papers.nips.cc/paper/4522-practical-bayesian-optimization

# Data Augmentation

- Apply some form of transformation to the training data ( but not label ) to increase the size of effective training set.
- Regarding CNN for image recognition, it means:
  - Using image processing to manipulate input image to increase effective training set

# Some examples of data augmentation




https://github.com/aleju/imgaug

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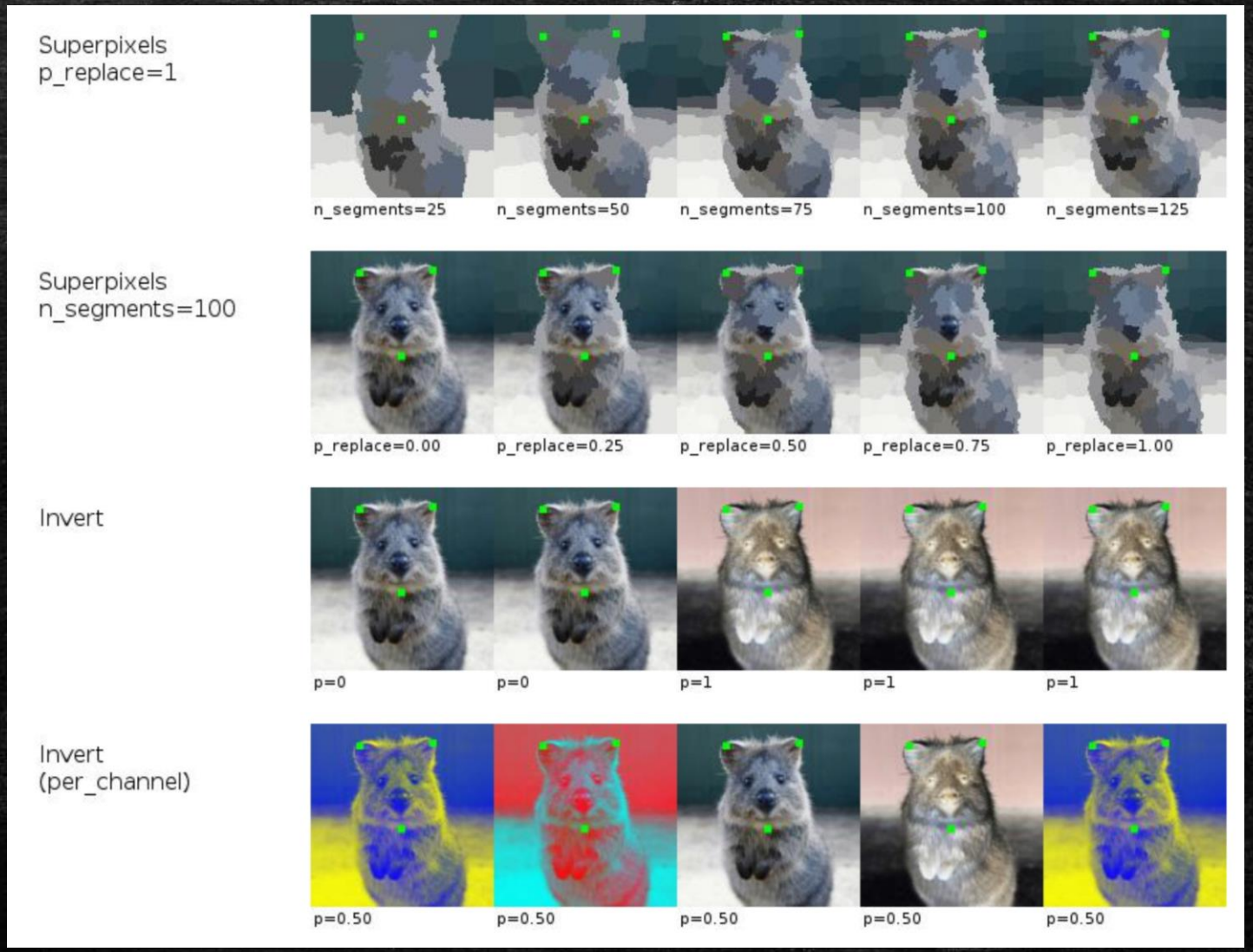


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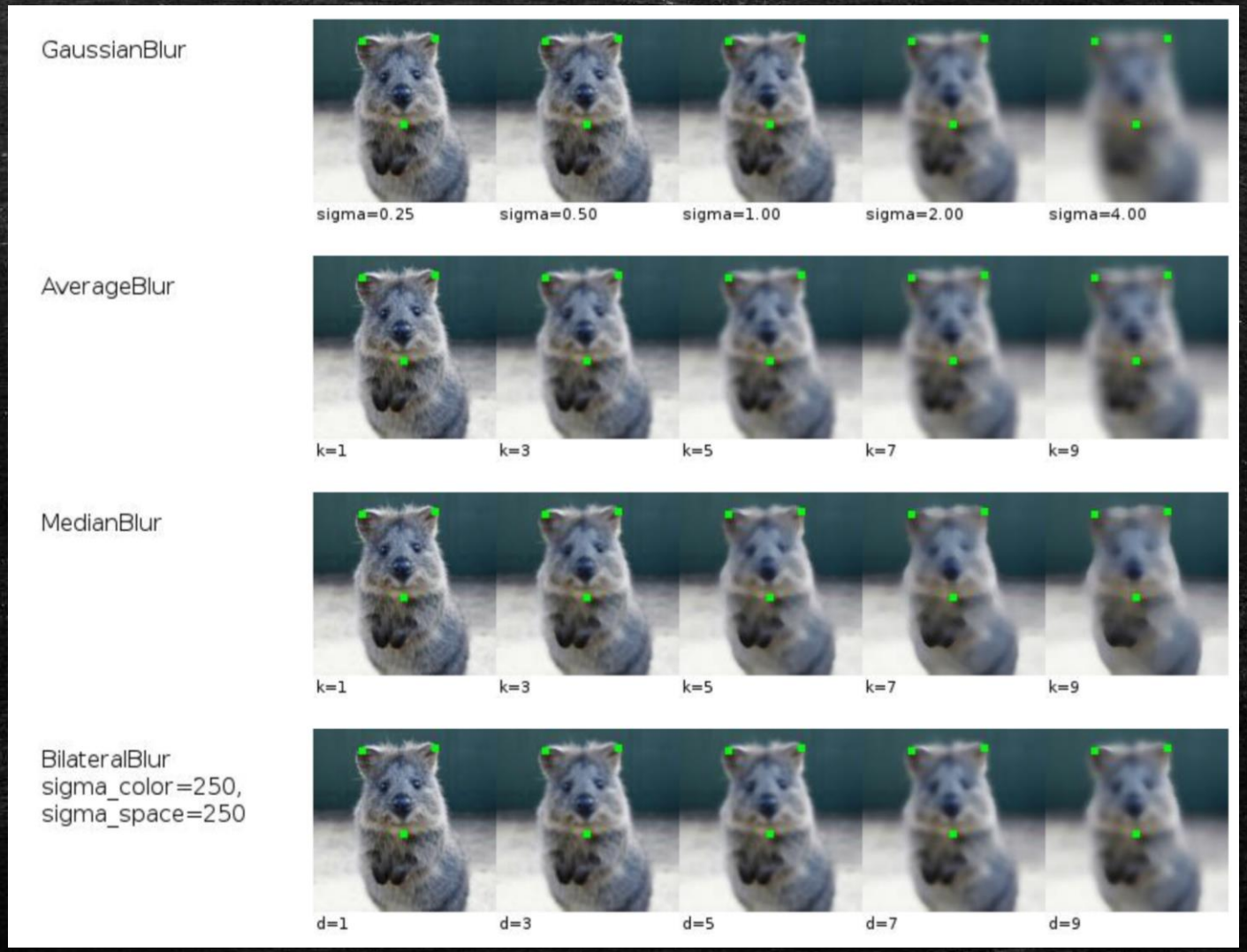


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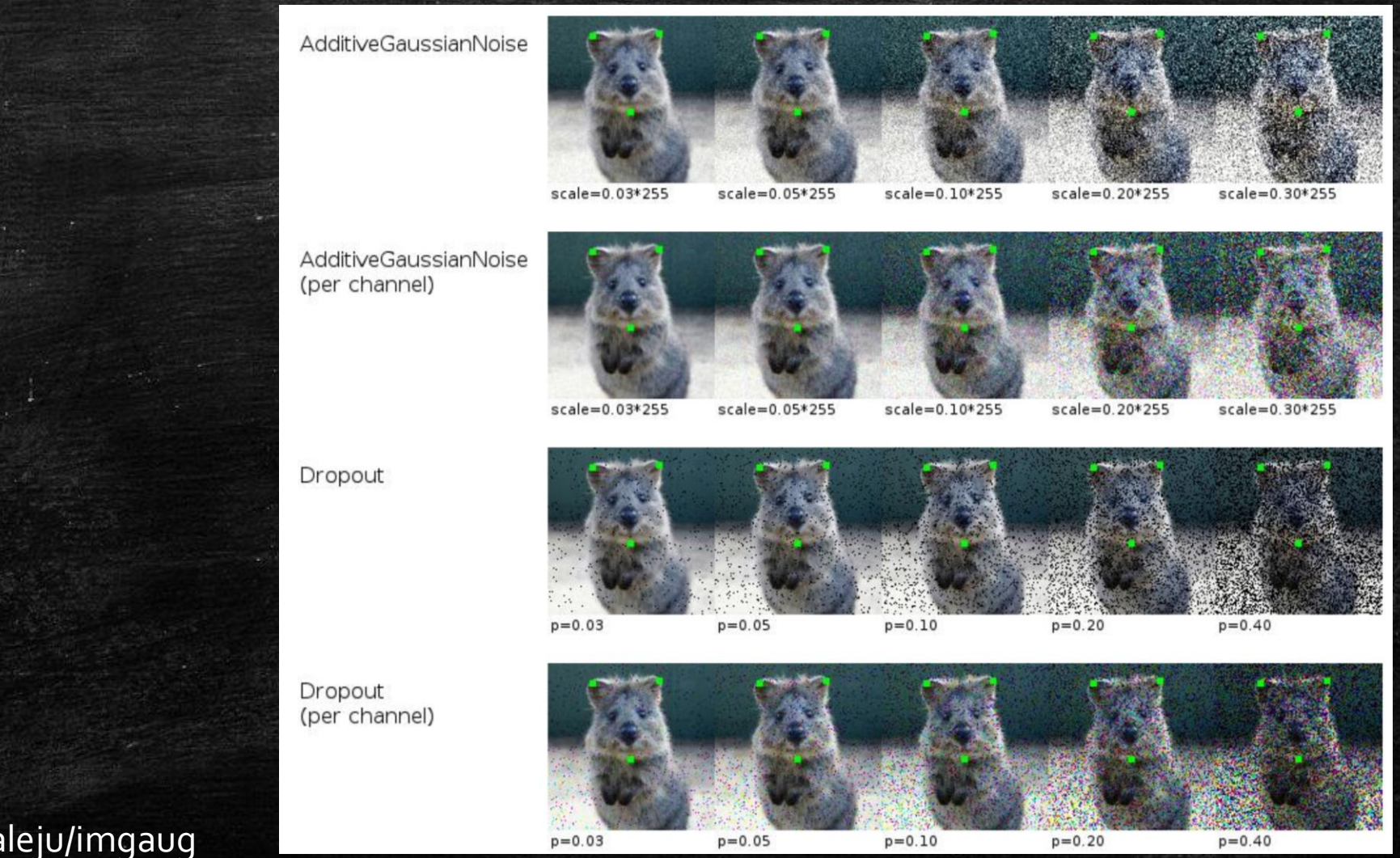


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