

# **HYPERPARAMETER OPTIMIZATION**

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MODEL UNCERTAINTY IN MACHINE LEARNING

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# INDUCTIVE BIAS

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ASSUMPTIONS OF OUR MODELS



# NO FREE LUNCH

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HOW WELL YOU DO IS DETERMINED BY HOW  
'ALIGNED' YOUR LEARNING ALGORITHM  $P(H|D)$   
IS WITH THE ACTUAL POSTERIOR,  $P(F|D)$ .

- DAVID H. WOLPERT

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# DEEP LEARNING?

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ONLY WITH THE PROPER PARAMETERS

# PARAMETER CHOICES, A DARK ART

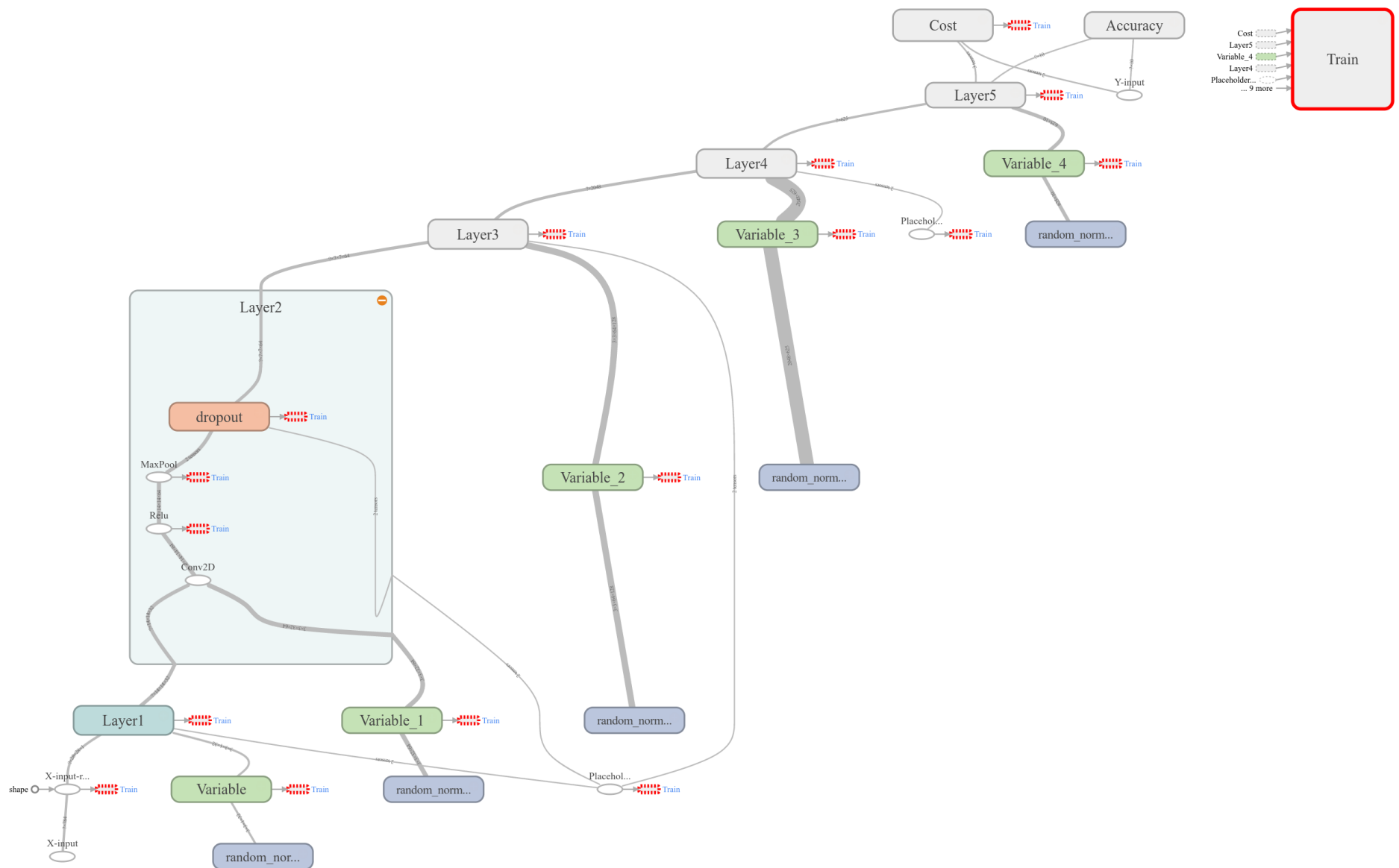
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CHILDSSTARLETS.COM

Harry Potter and the Half Blood Prince

# FIVE LAYER CONVOLUTIONAL NEURAL NETWORK



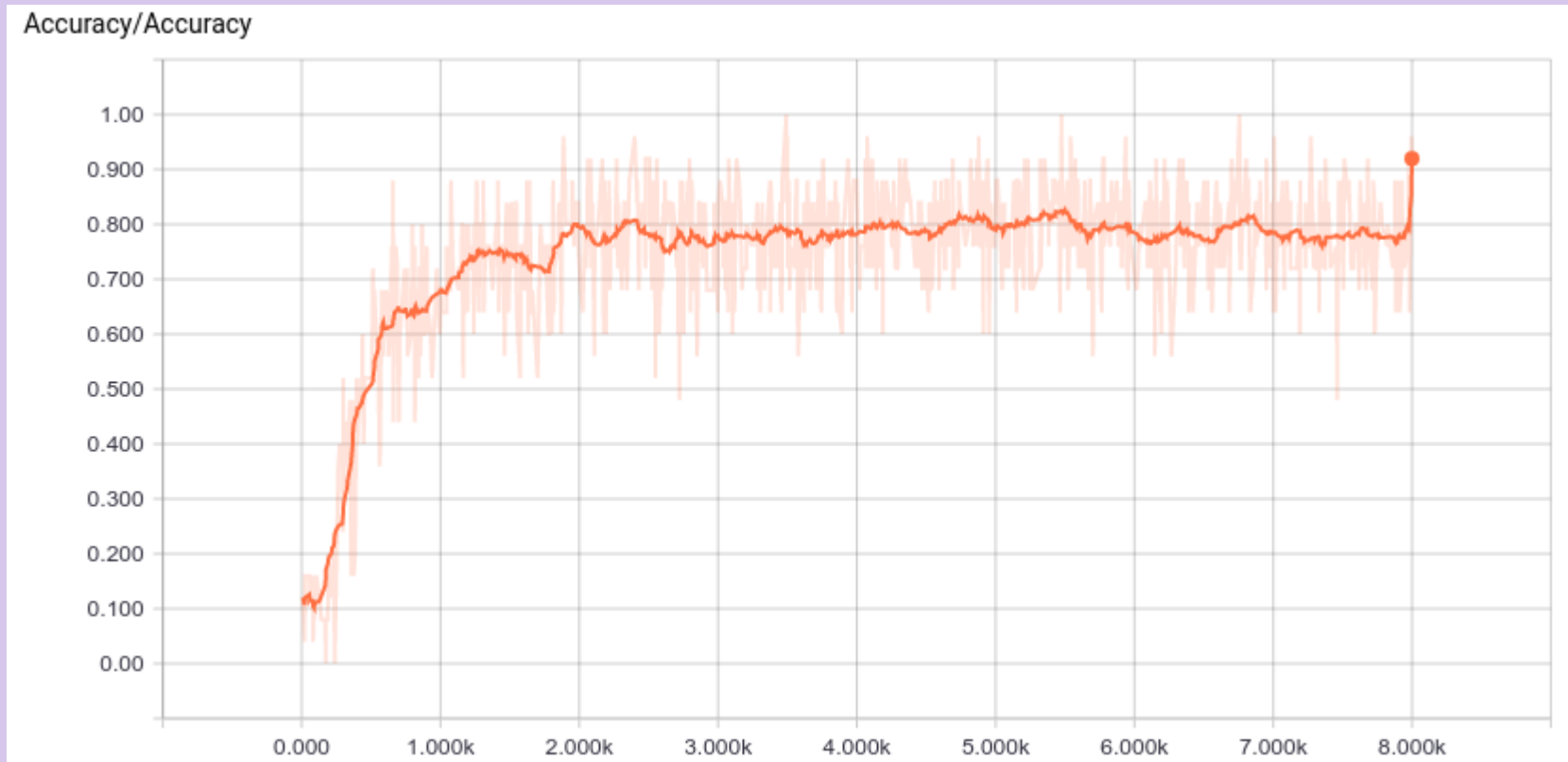
# CNN ONE PARAMETERS:

Learning Rate: 0.1;

Number of Epochs: 8000; Batch Size: 25;

Convolution Layer Dropout: 0.2; Fully Connected Layer Dropout: 0.2

**TEST ACCURACY: 0.937**



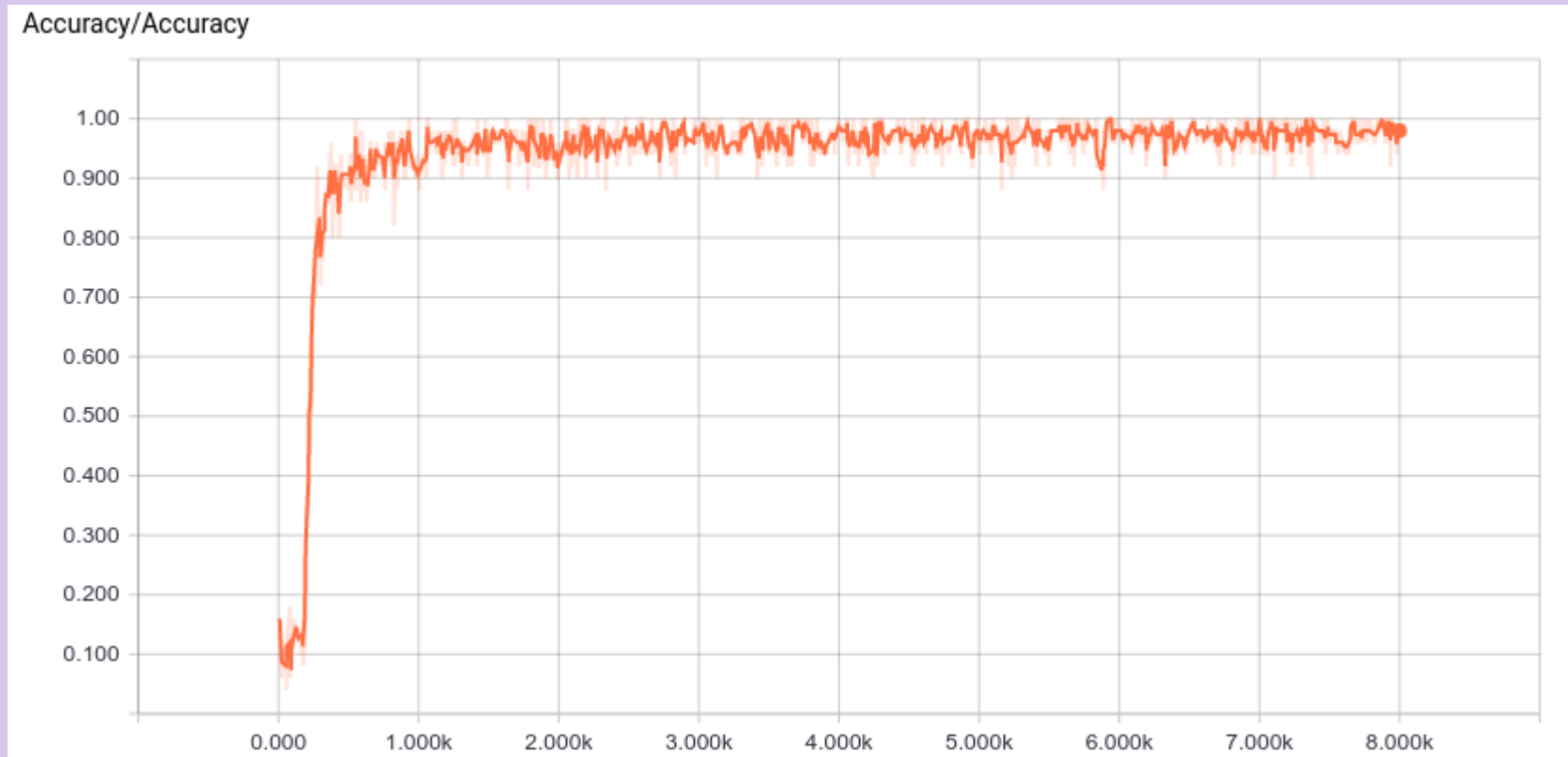
# CNN TWO PARAMETERS:

Learning Rate: 0.01;

Number of Epochs: 8000; Batch Size: 50;

Convolution Layer Dropout: 0.5; Fully Connected Layer Dropout: 0.8

**TEST ACCURACY: 0.9896**





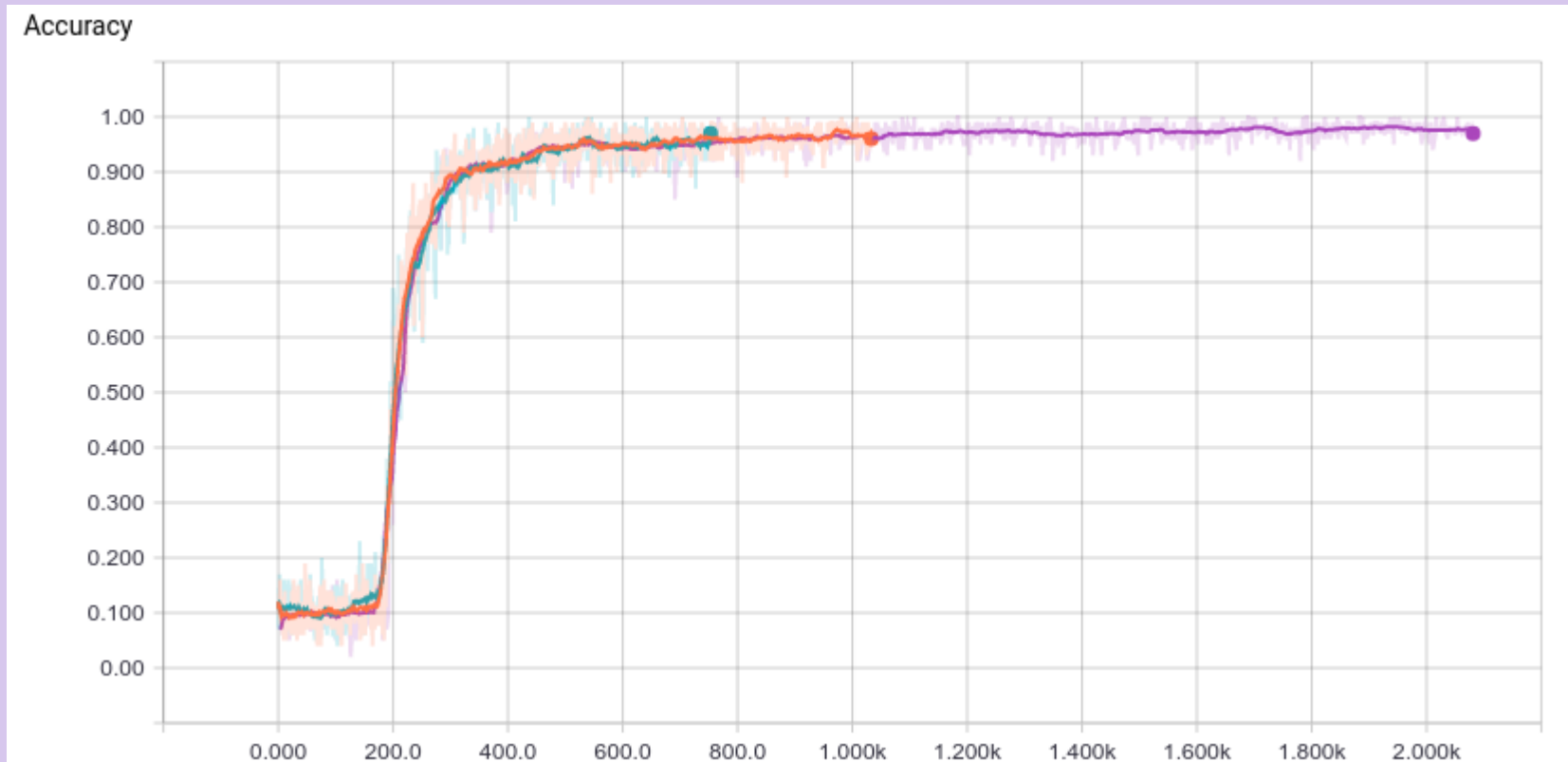
# CNN THREE PARAMETERS:

Learning Rate: 0.001;

Number of Epochs: 8000; Batch Size: 100;

Convolution Layer Dropout: 0.7; Fully Connected Layer Dropout: 0.5

**TEST ACCURACY: 0.9925**



# METHODS

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FORMALIZING OUR HYPERPARAMETER SEARCH

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# RANDOM SEARCH

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J BERGSTRÄ, Y BENGIO 'RANDOM SEARCH FOR HYPER-  
PARAMETER OPTIMIZATION' - JOURNAL OF MACHINE  
LEARNING RESEARCH, 2012



# TREE-STRUCTURED PARZEN ESTIMATORS

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HYPEROPT

BERGSTRA, JAMES S., ET AL. "ALGORITHMS FOR HYPER-  
PARAMETER OPTIMIZATION." ADVANCES IN NEURAL  
INFORMATION PROCESSING SYSTEMS. 2011.



# GAUSSIAN PROCESSES

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SPEARMINT

PRACTICAL BAYESIAN OPTIMIZATION OF MACHINE LEARNING ALGORITHMS  
JASPER SNOEK, HUGO LAROCHELLE AND RYAN PRESCOTT ADAMS  
ADVANCES IN NEURAL INFORMATION PROCESSING SYSTEMS, 2012

# **FUTURE WORK**

