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Building and Training a Deep Learning Network

Deep Learning — Unit 3

Dr. Jon Krohn
jon@untapt.com

Slides available at jonkrohn.com/talks

July 28th, 2018



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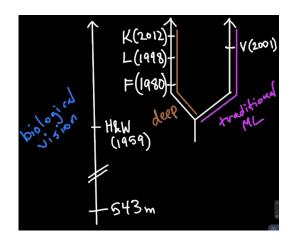
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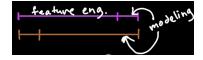
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MNIST Digits & LeNet-5

LeCun, Boutou, Bengio & Haffner (1998)



PROC. OF THE IEEE, NOVEMBER 1998

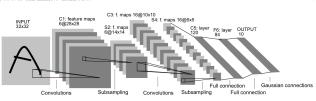


Fig. 2. Architecture of LeNet-5, a Convolutional Neural Network, here for digits recognition. Each plane is a feature map, i.e. a set of units whose weights are constrained to be identical.



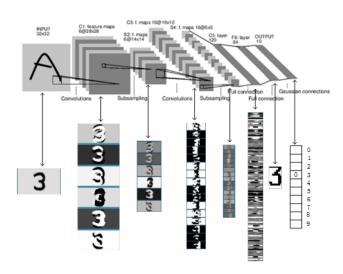
LeNet-5

LeCun, Boutou, Bengio & Haffner (1998)

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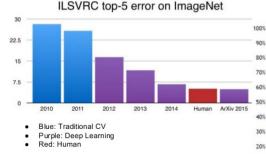
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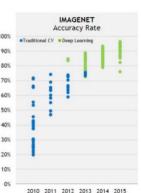
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TensorBoard

ImageNet Classification Error

ILSVRC: 1.4m, 1k object classes







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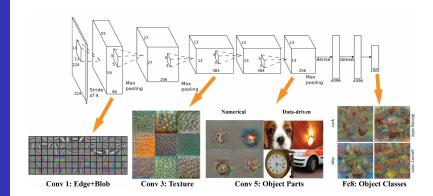
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Krizhevsky, Sutskever & Hinton (2012)

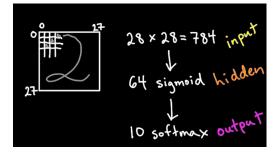




A Shallow Neural Network

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[shallow notebook]



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Interactive ANN Visualization

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- tanh neuron
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Essential Theory I Neural Units

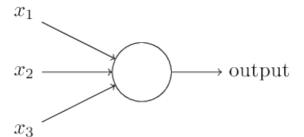
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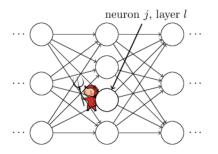
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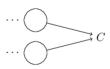
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Essential Theory II

Cost Functions, Gradient Descent, and Backpropagation







An Intermediate Neural Network

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[intermediate notebook]



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Data Sets for Deep Learning





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Tigerlity			
Tulip			W We
Sowslip	WAY.		1

Dataset	Classes	Train Samples
AG's News	4	120,000
Sogou News	5	450,000
DBPedia	14	560,000
Yelp Review Polarity	2	560,000
Yelp Review Full	5	650,000
Yahoo! Answers	10	1,400,000
Amazon Review Full	5	3,000,000
Amazon Review Polarity	2	3,600,000



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Data Sets for Deep Learning





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Crosus	
Treerliv	
Tulip (***
disease)	

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Jon Krohn, Cajoler of Datums

Home Resources

Posts Publications

Talks

Academia Applications Quotations

Open Data Sources

To train a powerful model, the larger the data set, the better -- if it's well-organised and open, that's ideal. The following repositories are standouts that meet all these criteria:

- Data.gov (home of >150k US government-related datasets),
- Govcode, a collection of government open source projects,
- the Open Data Stack Exchange, and
- · this curated list of 'awesome' public datasets
- this well-annotated list of data sets for natural language processing
- for biomedical and health data specifically, check out:
 - this University of Minnesota resource
 - this Medical Data for Machine Learning GitHub repo

For machine learning models that require a lot of labelled data, check out:

- UC Irvine's repository
- · Yahoo's massive 13TB data set comprised of 100 billion user interactions with news items
- Google's image and video data sets
- Luke de Oliveira's Greatest Public Datasets for Al blog post
- CrowdFlower's Data for Everyone

Finally, here are extensive pages on importing data from the Web into R, provided by CRAN and MRAN.



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Your Deep Learning Project I

Perspectives to approach ideating from:

- Identify a data set ⇒ use it to solve a problem
- Identify a problem that you'd like to solve ⇒ find an appropriate data set



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Your Deep Learning Project I

Perspectives to approach ideating from:

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 - [Fashion MNIST]
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- 3 a regression mode



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Weight Initialization

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- uniform
- normal
- Xavier Glorot

[Jupyter demo]



Weight Initialization

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- -

- uniform
- normal
- Xavier Glorot

[Jupyter demo]





Weight Initialization

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- uniform
- normal
- Xavier Glorot

[Jupyter demo]



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Theory III

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- · learning rate
- batch size
- second-order gradient learning
 - momentum
 - Adam



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- 3 Essential Theory IV: Unstable Gradients & Overfitting
- 4 A Deep Neural Network
- 5 TensorBoard and the Interpretation of Model Outputs



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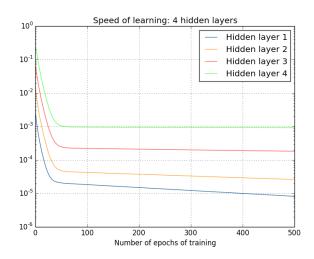
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Unstable Gradients





Unstable Gradients

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- vanishing
- exploding



Unstable Gradients

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Avoiding Overfitting

(Or, Model Generalization)

- L1/L2 regularization
- dropout
- artificial data set expansion



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Avoiding Overfitting

(Or, Model Generalization)

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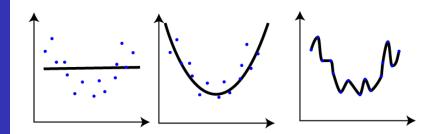
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Last, But Not Least

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TensorBoard

- more layers
 - max-pooling
 - flatten
- batch normalization avoids covariate shift; advantages:
 - initialization parameters
 - avoid neuron saturation
 - g regularizing effect



Last, But Not Least

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TensorBoard

Let's make [intermediate net] deep!



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A Doop No

A Deep Ne

- add callback as in [Deep Net in Keras Jupyter notebook]
- ② use Terminal to navigate to your logs directory
- 3 run tensorboard --logdir=. --port 6006
- 4 navigate to http://localhost:6006/ in a web browser



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