

Deep Learning Workshop

with

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Harrison McCain
FOUNDATION

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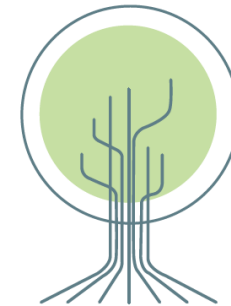
My thanks to the following for funding ...



**Digital Research
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**ACADIA INSTITUTE
FOR DATA ANALYTICS**
digital harvest

Who am I?

- Danny Silver, Acadia University
- Nova Scotia, Canada
- PhD, Univ. Western Ontario
- 2014-pres: Director, Acadia Institute for Data Analytics
- 2005-pres: PI, Lifelong Machine Learning and Reasoning Lab
- 2007-2013: Director, School of Computer Science
- 2007-2009: President, Canadian AI Association (CAIAC)
- 2013-2018: Hon. Colonel, RCAF, 415 S, 14 Wing Greenwood



Our TAs for this session ..

- Sahil Chhabra
- Aaron Mishkin



HOW TO GET STARTED:

- Moodle/Session Materials/ Deep Learning
- <https://www.hpc-training.org/xsede/moodle/mod/page/view.php?id=4428>

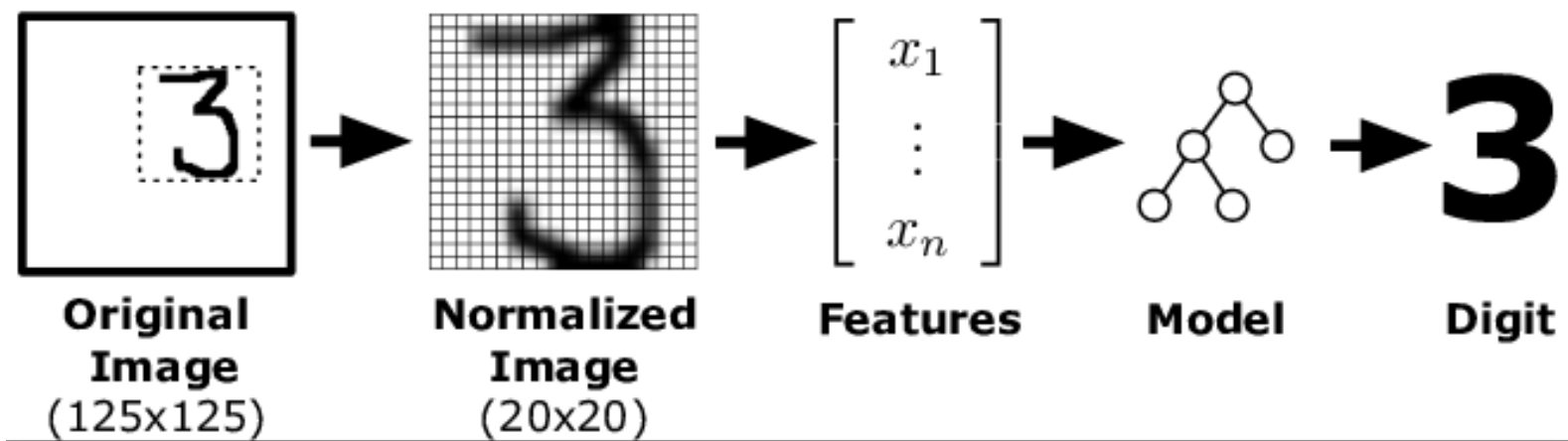
Agenda

- 9:00 - Welcome, Logistics, Overview
- 9:10 - Review of Colaboratory
- 9:20 - Basic BP ANNs & Intro to Tensorflow/Keras
- 10:00 - Building Deep Networks
- 10:45 - Break
- 10:50 - Convolution neural networks (CNNs) for classifying images
- 11:30 - Recurrent neural networks (LSTMs) for learning sequences
- 12:10 - Summary and Farewell

Deep Learning Overview

Deep Learning Overview

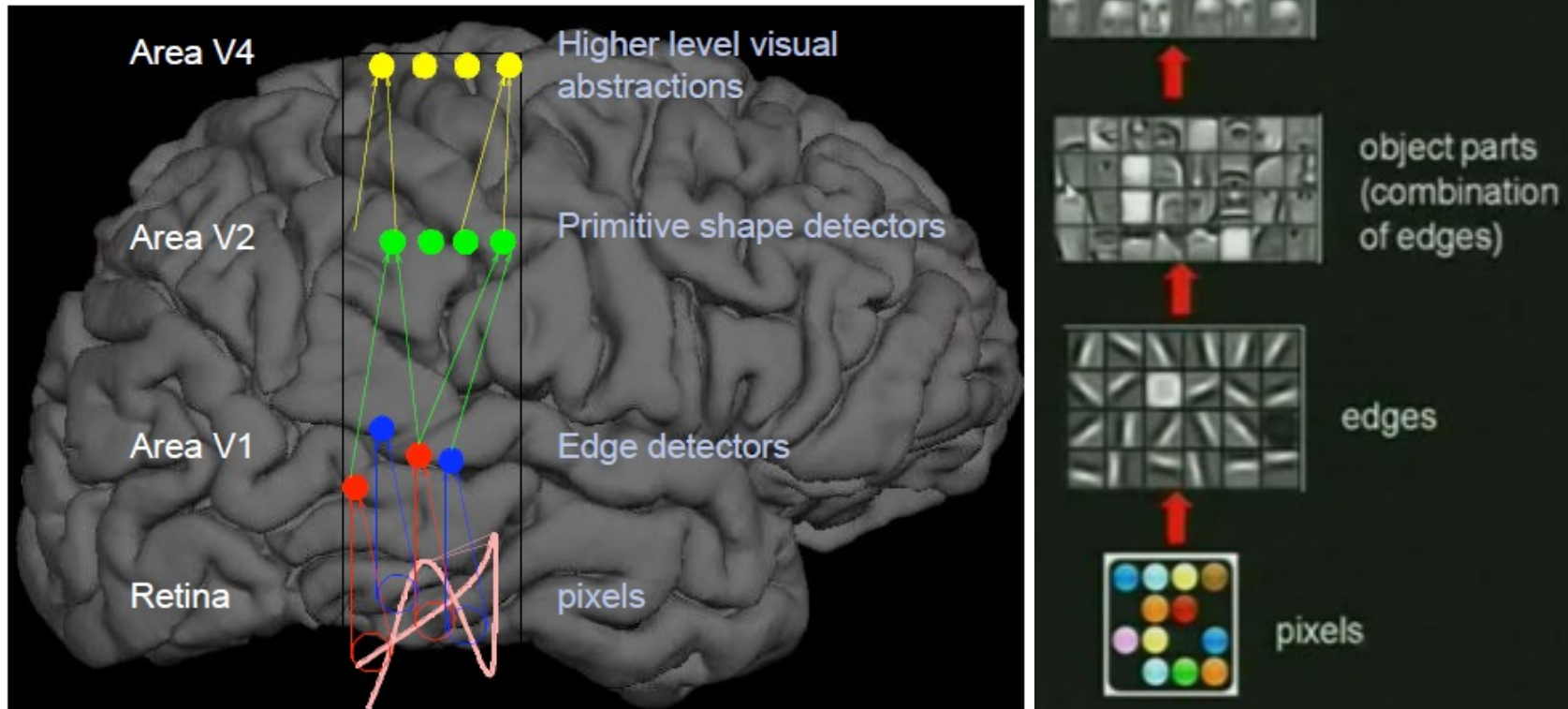
- Traditionally (until 2012), statistical modeling and machine learning used manually created features as inputs



- Artificial neural network models were shallow (just a couple of layers)

Deep Learning Overview

- A deep learning network can learn multiple levels of features from unlabeled data
- Simulating human sensory modalities



Deep Learning Overview

- Multiple layers work to build an improved feature space
 - Lowest hidden layer learns 1st order features (e.g. edges...)
 - Upper hidden layers learn higher order features (comb. of lower features)
 - Some models learn hidden node representations in an unsupervised manner and discover general features of the input space (DBN)
 - Some models learn features in a supervised manner based on architected networks (CNN)
 - Final layer of transformed features flow into final supervised layer(s) and trained as one large network

Why Deep Learning

- Biological Plausibility – e.g. Visual Cortex
- Hastad proof - Problems which can be represented with a polynomial number of nodes with k layers, may require an exponential number of nodes with $k-1$ layers (e.g. parity)
- Highly varying functions can be efficiently represented with deep architectures - less weights to update than a less efficient shallow representation
- Sub-features created in deep architecture can potentially be shared between multiple tasks – transfer and lifelong machine learning

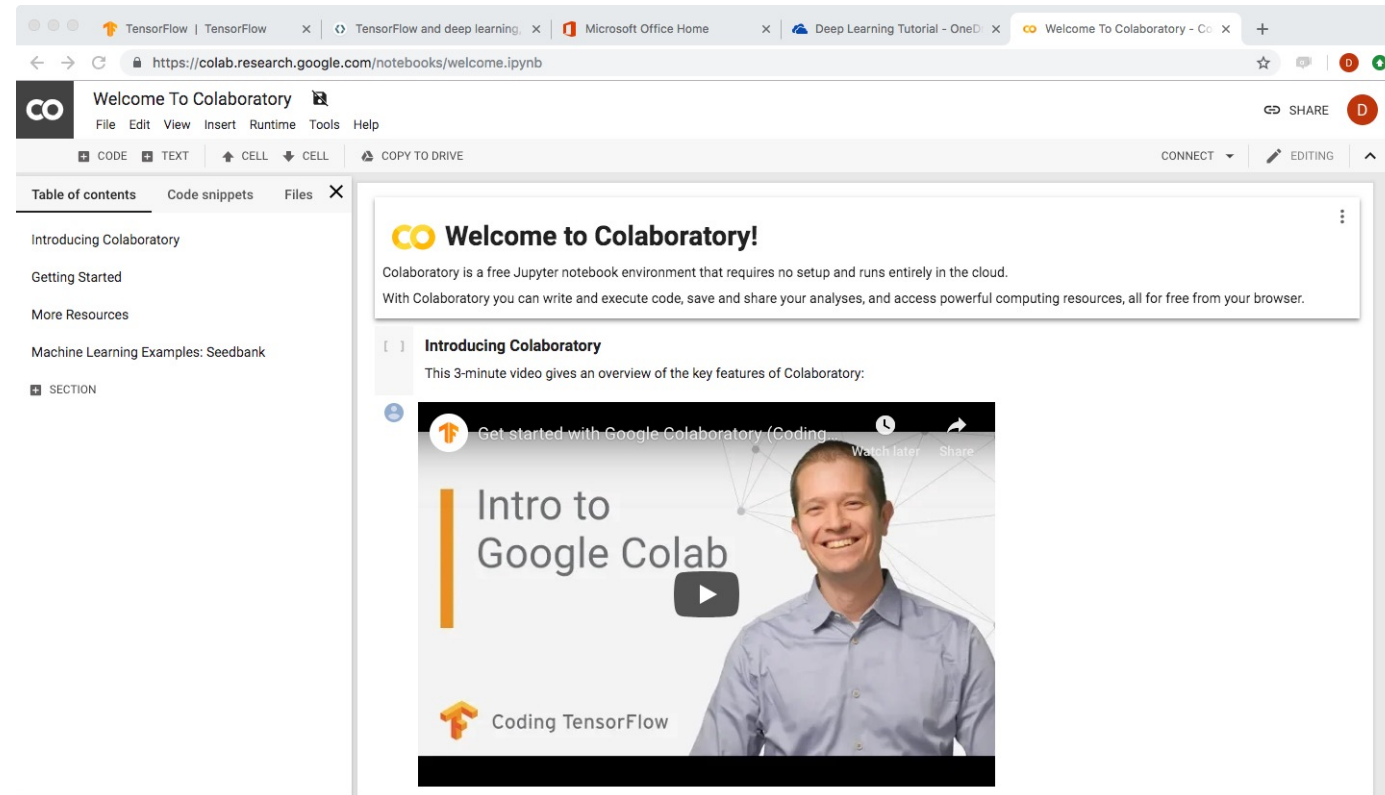
History of Deep Learning Networks

- 1980 - Fukushima – Neo-Cognitron
- 1986 - Rumelhart et al. backpropagation networks
- 1989 – LeCun - Convolutional Neural Nets for images (but hard to train)
- 1990s - Interest subsides as other models are introduced – SVMs, Graphical models, etc. – each their turn...
- 2006 - Deep Belief Networks (Hinton) and Stacked Autoencoders (Bengio) – Unsupervised pre-training followed by supervised learning
- 2012 - Initial successes with supervised approaches which overcome vanishing gradient and are more general applicable
- 2013 – Schmidhuber - Deep recurrent neural networks (LSTMs, GRUs)
- 2014 – Deep CNNs become better than humans for object recog in images

Google's Colaboratory

What is Colaboratory?

- A free Jupyter notebook environment
- Requires no setup and runs entirely in the cloud
- You can write and execute code
- Save and share your analyses
- Access powerful computing resources
- All for free from your browser
- [Overview of Colaboratory](#)



References:

The Major Research Groups (two of which are Canadian):

- <https://www.deeplearning.ai/>
- <https://www.cs.toronto.edu/~hinton/>
- <https://mila.quebec/en/person/bengio-yoshua/>
- <http://yann.lecun.com/>
- <http://people.idsia.ch/~juergen/>

Other Links:

- <https://www.coursera.org/courses?languages=en&query=machine+learning+andrew+ng>
- <http://www.deeplearningbook.org/>
- <http://neuralnetworksanddeeplearning.com/>