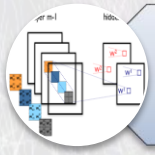
Convolutional Neural Networks

Deep Learning

November 9, 2015

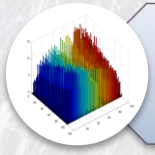
Outline

Deep Learning


Convolutional Neural Networks

CNN Layers and Architecture

Digit Recognizer (Kaggle)


Applications

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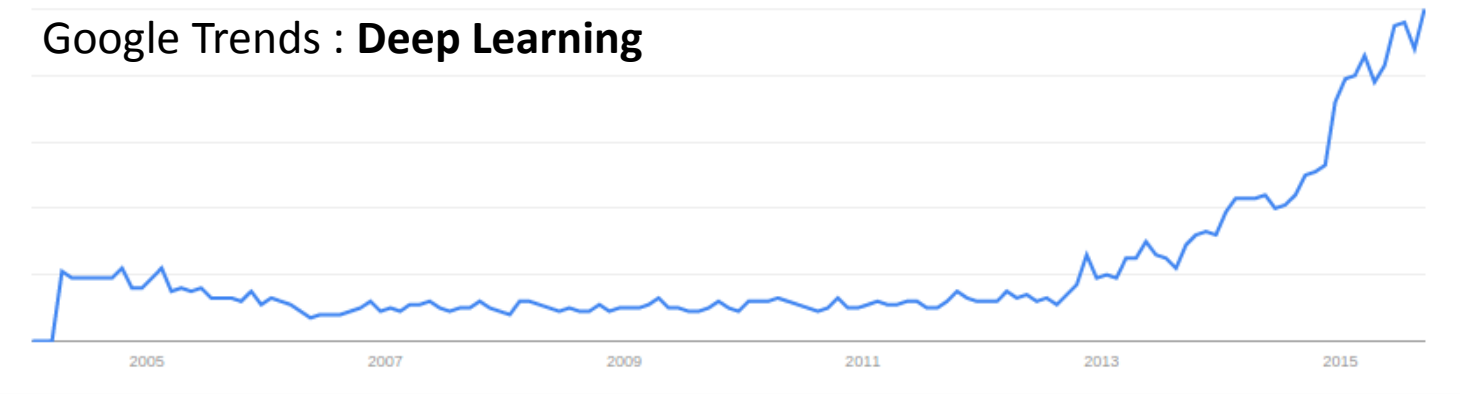
Deep Learning is Trending!



- Branch of machine learning based on modeling high level abstractions in data
- Uses multiple processing layers with complex structures (non-linear transformations)
- Learning hierarchy of concepts

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Deep Learning Winning Prediction Competitions!

Deep Learning Wins Dogs vs Cats competition on Kaggle

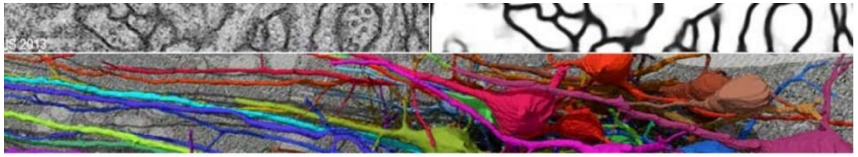
A Deep learning expert wins Kaggle Dogs vs Cats image competition with an almost perfect result.

Yann LeCun, a leading researcher on Deep Learning, who was recently hired by Facebook to head their AI Lab, reports that his former student +Pierre Sermanet won the Dogs vs Cats competition on Kaggle.

Pierre entry was amazingly good - 98.9% correct. He posted on Google+

> I just won the Dogs vs. Cats Kaggle competition, using the deep learning library I wrote during my PhD: OverFeat

Kaggle's Dogs vs. Cats Competition



Deep Learning Wins 2012 Brain Image Segmentation Contest
(first Deep Learner to win a pure image segmentation competition)

Jürgen Schmidhuber

Our Deep Learning Neural Networks (deep NN) won the ISBI'12 Challenge on segmenting neuronal structures [2], through the work of Dan Claudiu Ciresan and Alessandro Giusti - see recent NIPS paper [1].

To our knowledge, this was the first image segmentation competition (with secret test set) won by a feedforward Deep Learner. (It should be mentioned, however, that our LSTM RNN already performed *simultaneous segmentation and recognition* when they became the first Deep Leaners to win official international pattern recognition contests - in connected handwriting at ICDAR 2009 [13].)

ISBI 2012 Challenge (Brain Image Segmentation)

How bio-inspired deep learning keeps winning competitions

An interview with Dr. Juergen Schmidhuber on the future of neural networks

November 28, 2012 by Amara D. Angelica, Jürgen Schmidhuber

Dr. Jürgen Schmidhuber is Director of the Swiss Artificial Intelligence Lab, IDSIA. His research team's artificial neural networks (NNs) have won many international awards, and recently were the first to achieve human-competitive performance on various benchmark data sets.

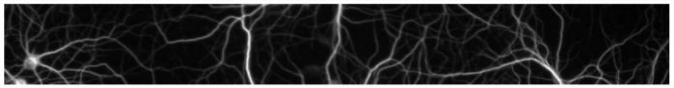
AA: In several contests and machine-learning benchmarks, your team's NNs are now outperforming all other known methods. As The New York Times noted Friday, last year, a program your team created won a pattern recognition contest by outperforming both competing software systems and a human expert in identifying images in a database of German traffic signs.

The German Traffic Sign Benchmark (credit: Institut für Neuroinformatik, Bochum)

"The winning program accurately identified 99.46 percent of the images in a set of 50,000; the top score in a group of 32 human participants was 99.22 percent, and the average for the humans was 98.84 percent," the Times pointed out. Impressive. What is the importance of traffic sign recognition in this field?

IJCNN 2011 (Traffic Sign Recognition)

Deep Learning
... moving beyond shallow machine learning since 2006!



Recent Posts

- Software Developer Position at MILA
- Deep Learning Summer School 2015 Videos
- Long Short-Term Memory dramatically improves Google Voice etc – now available to a billion users
- A Brief Summary of the Panel Discussion at DL Workshop @ICML 2015 by Kyunghyun Cho
- Recent Reddit AMA's about Deep Learning

« ICLR 2014

A new machine learning startup uses Maxout and Stochastic Pooling in their Pipeline »

Deep Learning Successes Obtained by IDSIA

IDSIA is one of the largest and oldest lab that focuses on deep learning. Their machine learning team is being led by Jürgen Schmidhuber. In the last 5 years, they had several successes on different machine learning competitions. Here are some of their recent competitive achievements in competitions and challenges:

- 22 Sept 2013: Deep neural network of the Swiss AI Lab IDSIA wins MICCAI 2013 Grand Challenge on Mitosis Detection (important for cancer prognosis etc). For more information: http://www.idsia.ch/~juergen/deeplearningwinsMICCAIgrandchallenge.html
- 1 Sept 2013: Deep neural network of the Swiss AI Lab IDSIA is the best artificial offline recogniser of Chinese characters from the ICDAR 2013 competition (3755 classes), approaching human performance. For more information: http://arxiv.org/abs/1309.0261
- 2012: Deep neural network of the Swiss AI Lab IDSIA wins brain image segmentation contest (relevant for the huge brain projects in EU and US). More information: http://www.idsia.ch/~juergen/deeplearningwinsbraincontest.html

MICCAI 2013 (Mitosis Detection)

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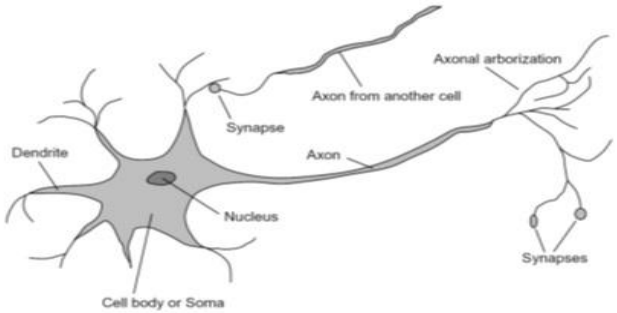
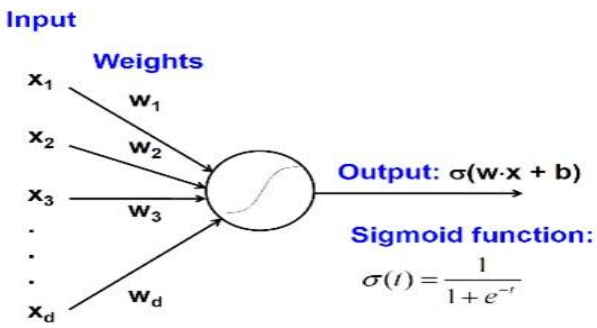
Convolutional Neural Networks

- Feed-forward back-propagation neural networks
- Inspired by biological processes
- Widely used for image and video recognition and NLP tasks
- Requires relatively little pre-processing (learns filters "**on its own**"!)



Biological Neuron



Artificial Perceptron

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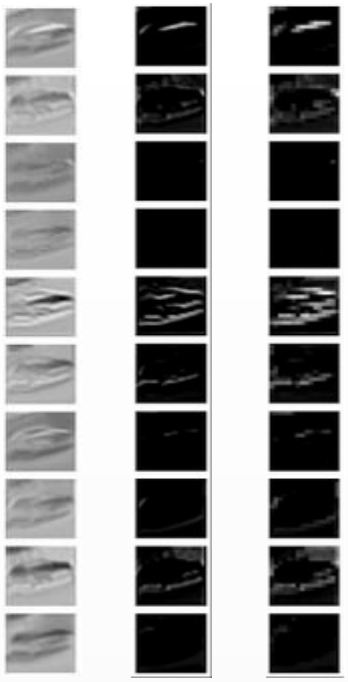
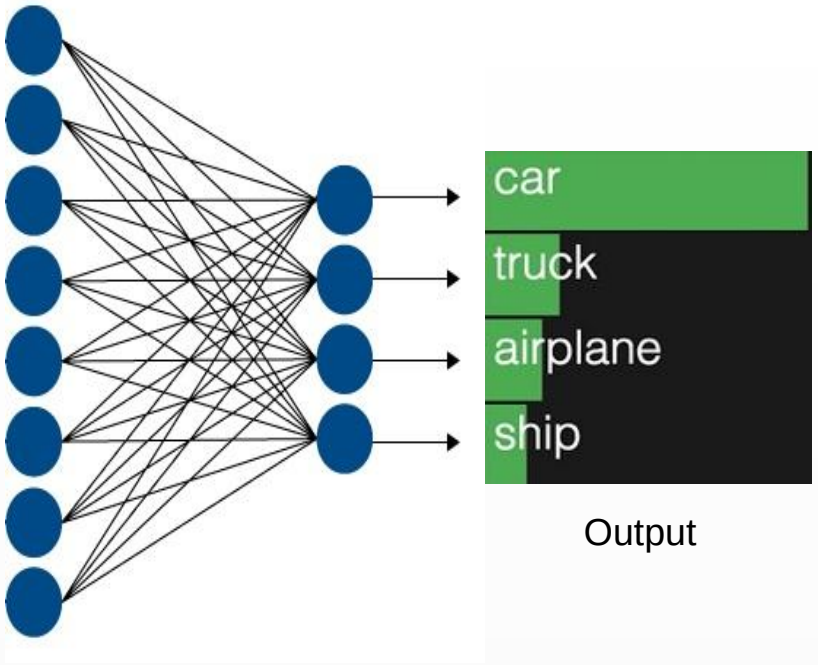
CNN : Typical Architecture

Input



Conv, ReLU and Pooling Layers



Dense-Layer and Softmax

Output

It's a very high level overview. Lot's of interesting things happen inside!

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CNN : Layers

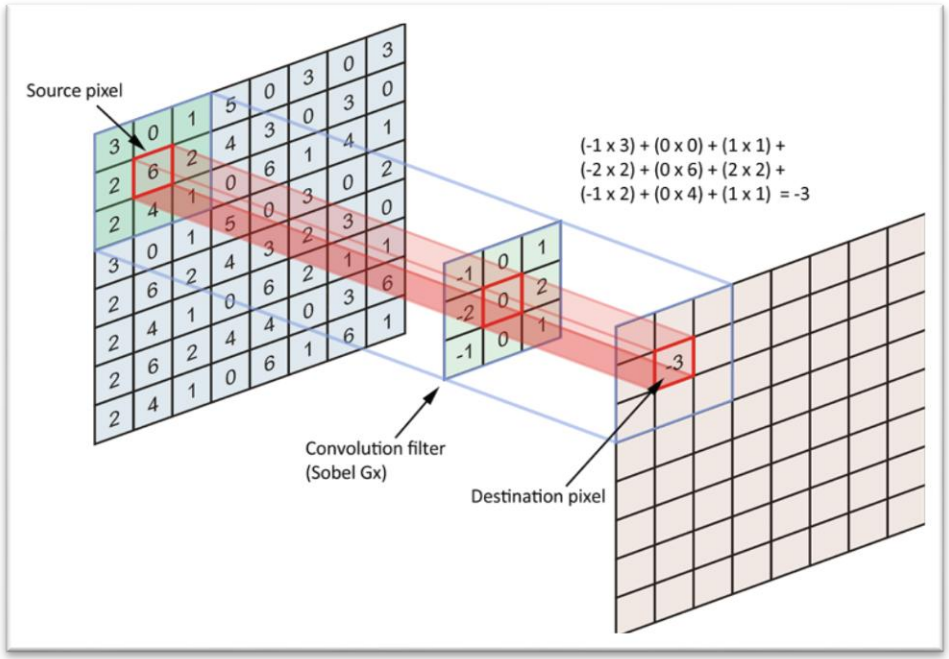
Input Image

Convolution

Non-linearity

Spatial pooling

Feature Maps



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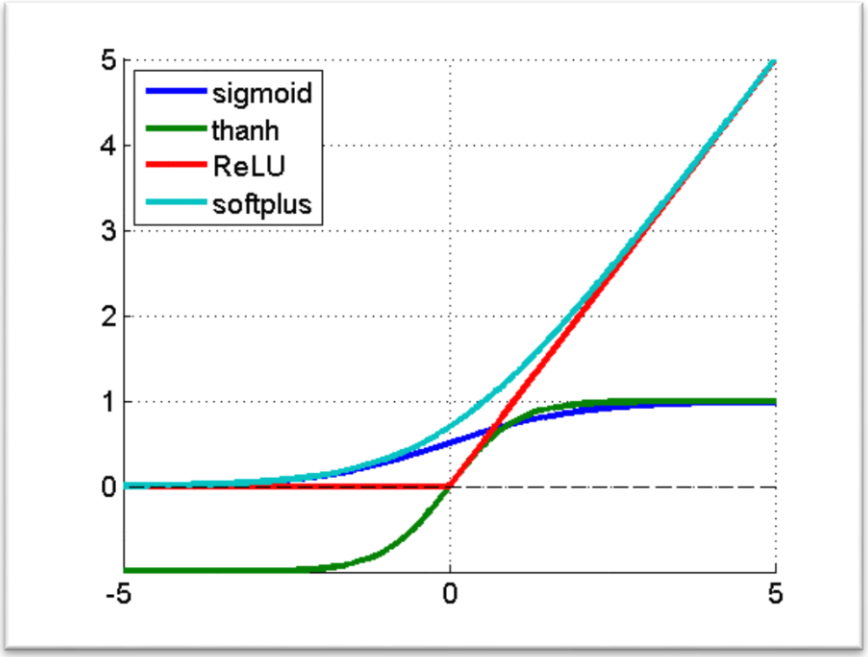

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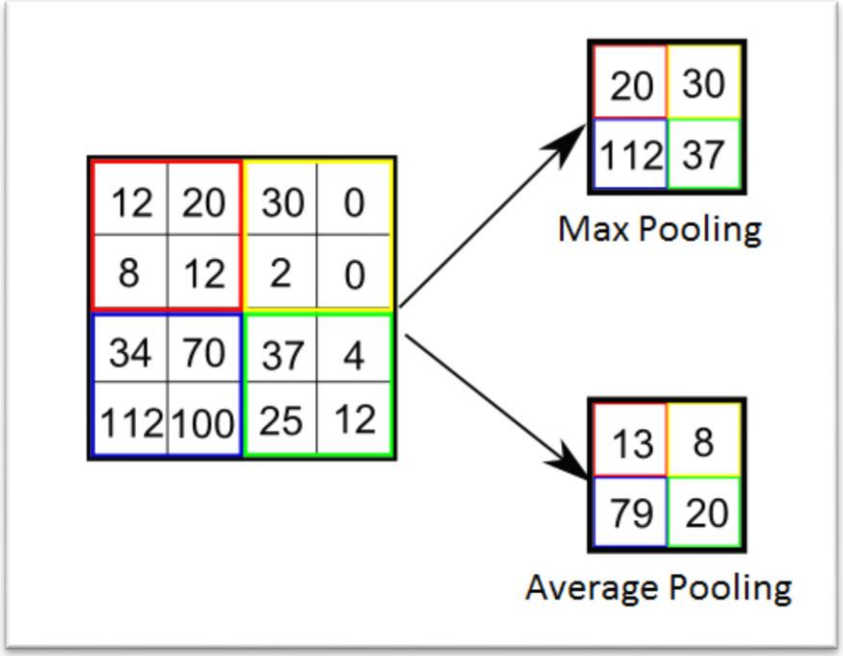

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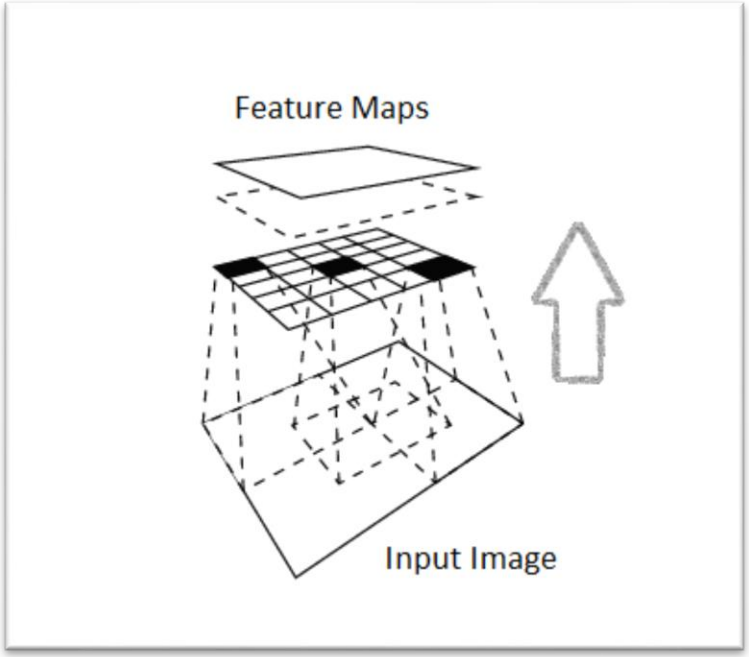

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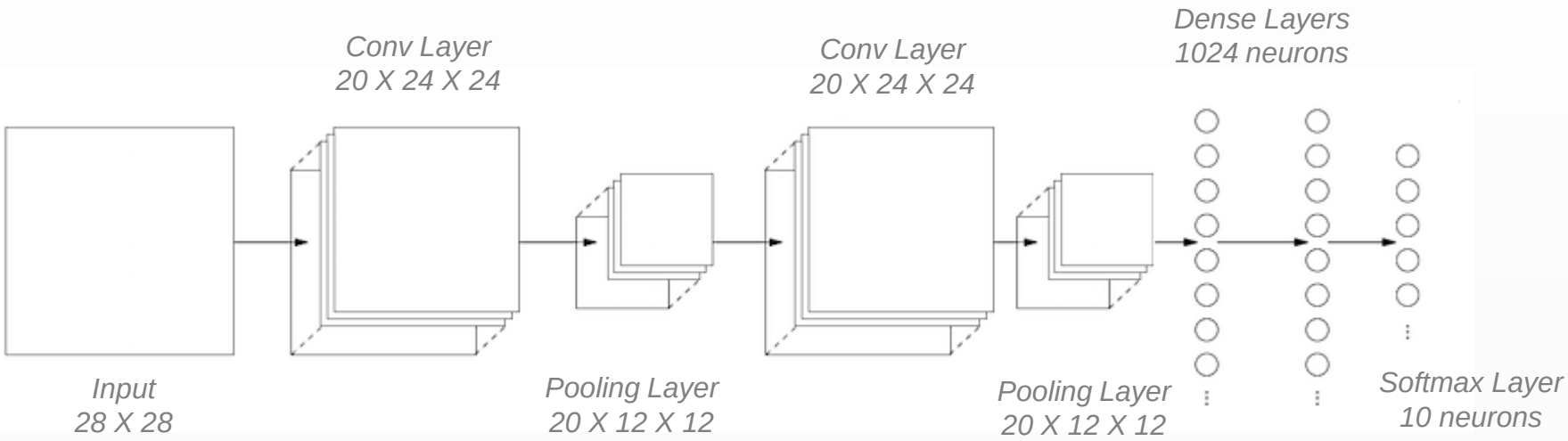
Use Case : Kaggle's Digit Recognizer Competition

- Classify handwritten digits using famous MNIST data



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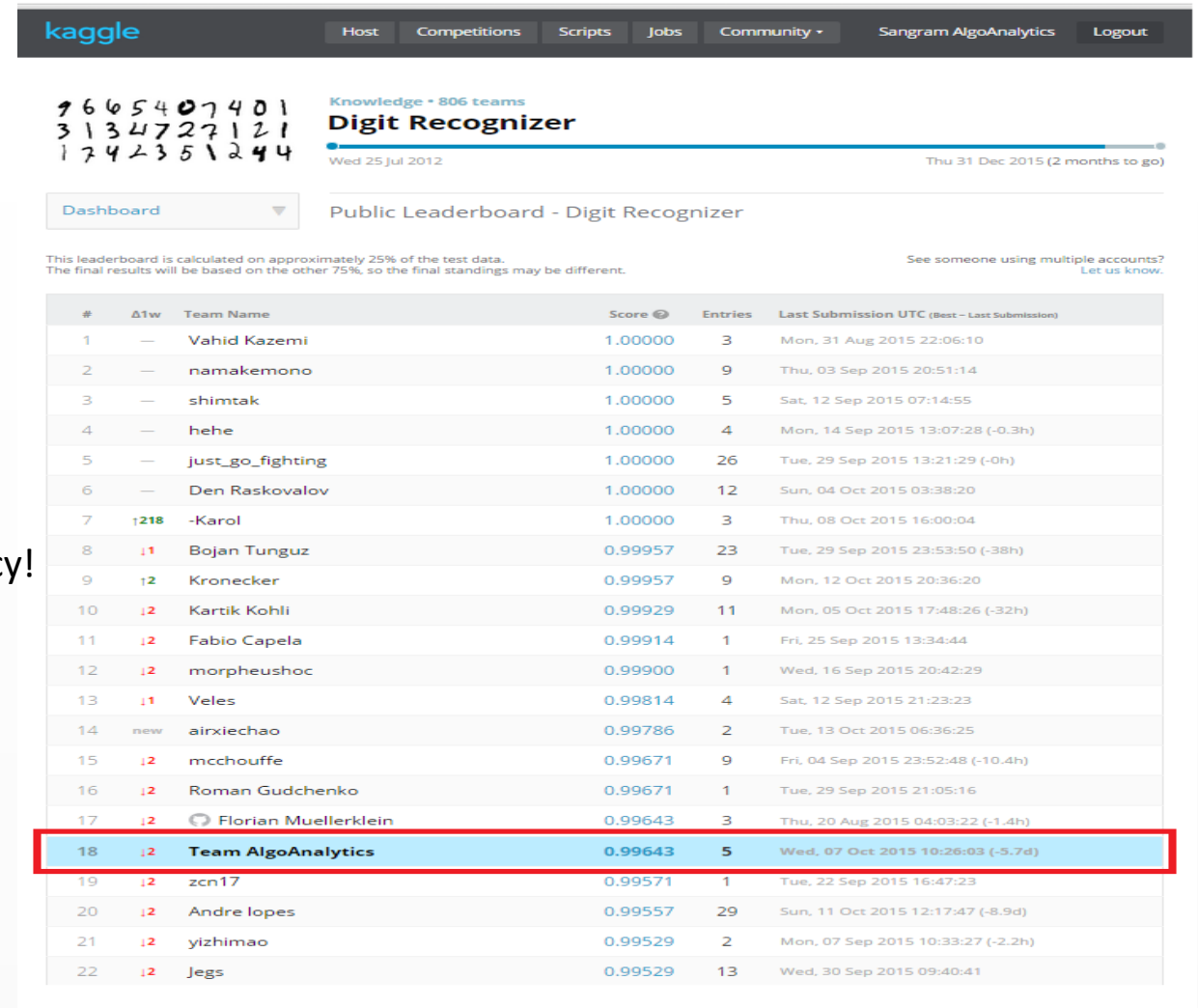
Use Case : Kaggle's Digit Recognizer Competition

99.64% accuracy!



kaggle

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Knowledge • 806 teams

Digit Recognizer

Wed 25 Jul 2012 — Thu 31 Dec 2015 (2 months to go)

Dashboard

Public Leaderboard - Digit Recognizer

This leaderboard is calculated on approximately 25% of the test data.
The final results will be based on the other 75%, so the final standings may be different.

See someone using multiple accounts? Let us know.

#	Δ1w	Team Name	Score	Entries	Last Submission UTC (Best – Last Submission)
1	—	Vahid Kazemi	1.00000	3	Mon, 31 Aug 2015 22:06:10
2	—	namakemono	1.00000	9	Thu, 03 Sep 2015 20:51:14
3	—	shimtak	1.00000	5	Sat, 12 Sep 2015 07:14:55
4	—	hehe	1.00000	4	Mon, 14 Sep 2015 13:07:28 (-0.3h)
5	—	just_go_fighting	1.00000	26	Tue, 29 Sep 2015 13:21:29 (-0h)
6	—	Den Raskovalov	1.00000	12	Sun, 04 Oct 2015 03:38:20
7	↑218	-Karol	1.00000	3	Thu, 08 Oct 2015 16:00:04
8	↓1	Bojan Tunguz	0.99957	23	Tue, 29 Sep 2015 23:53:50 (-38h)
9	↑2	Kronecker	0.99957	9	Mon, 12 Oct 2015 20:36:20
10	↓2	Kartik Kohli	0.99929	11	Mon, 05 Oct 2015 17:48:26 (-32h)
11	↓2	Fabio Capela	0.99914	1	Fri, 25 Sep 2015 13:34:44
12	↓2	morpheushoc	0.99900	1	Wed, 16 Sep 2015 20:42:29
13	↓1	Veles	0.99814	4	Sat, 12 Sep 2015 21:23:23
14	new	airxiechao	0.99786	2	Tue, 13 Oct 2015 06:36:25
15	↓2	mcchouffe	0.99671	9	Fri, 04 Sep 2015 23:52:48 (-10.4h)
16	↓2	Roman Gudchenko	0.99671	1	Tue, 29 Sep 2015 21:05:16
17	↓2	Florian Muellerklein	0.99643	3	Thu, 20 Aug 2015 04:03:22 (-1.4h)
18	↓2	**Team AlgoAnalytics**	0.99643	5	Wed, 07 Oct 2015 10:26:03 (-5.7d)
19	↓2	zcn17	0.99571	1	Tue, 22 Sep 2015 16:47:23
20	↓2	Andre lopes	0.99557	29	Sun, 11 Oct 2015 12:17:47 (-8.9d)
21	↓2	yizhimao	0.99529	2	Mon, 07 Sep 2015 10:33:27 (-2.2h)
22	↓2	Jegs	0.99529	13	Wed, 30 Sep 2015 09:40:41

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Applications of Convolutional Neural Networks

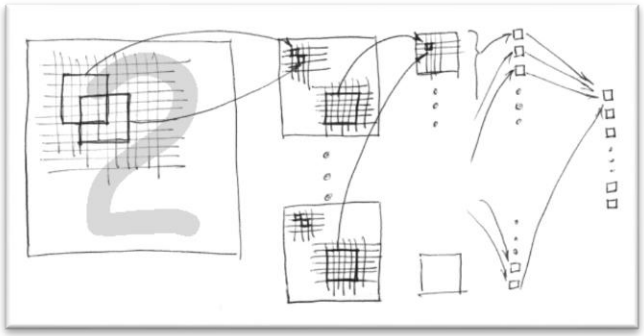

Image Recognition

Video Analysis

Natural Language Processing

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About AlgoAnalytics

- **Areas of expertise**
  - Predictive analytics consultancy
  - Algorithmic and quantitative trading in financial markets
- **About us**
  - Founded by Dr. Aniruddha Pant in 2009
  - Firm focused on the intersection of mathematics, computer science and other domains
- **Team**

Dr. Aniruddha Pant
CEO
Ph.D. (Berkeley, USA)

Control theory, Machine Learning, Analytics, Statistics

Rohit Walimbe
Sr. Quant Analyst
B.Tech, PGDM

Analytics, Finance

Mukta Pendharkar
Quant Analyst
MSc Financial Maths

Analytics, Finance

+ 6 Quantitative Analysts
with a solid foundation in mathematics and engineering

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