The Fundamentals Of Neural Networks
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Machine Learning

Web Development

Computer Security
Neural Network

“A computer system modeled on the human brain and nervous system”
Infinitely flexible function

All-purpose parameter fitting

Fast and scalable
How are Neural Networks different?
Applications

- Self Driving Cars
- Language Translation
- Sentiment Analysis
- Text Generation
- Image Generation
- Object Classification
- Neuroscience
- Image Enhancement
- Audio Transcription
- ...and much more!

Pattern Recognition Tasks

**WHEN A USER TAKES A PHOTO, THE APP SHOULD CHECK WHETHER THEY'RE IN A NATIONAL PARK...**

SURE, EASY GIS LOOKUP.
GIMME A FEW HOURS.

...AND CHECK WHETHER THE PHOTO IS OF A BIRD.

I'LL NEED A RESEARCH TEAM AND FIVE YEARS.

IN CS, IT CAN BE HARD TO EXPLAIN THE DIFFERENCE BETWEEN THE EASY AND THE VIRTUALLY IMPOSSIBLE.
\[ f(x) = \frac{1}{1 + e^{-x}} \]
\[ \text{net}_{h1} = w_1 \times i_1 + w_2 \times i_2 + b_1 \times 1 \]

\[ \text{net}_{h1} = 0.15 \times 0.05 + 0.2 \times 0.1 + 0.35 \times 1 = 0.3775 \]

\[ \text{out}_{h1} = \frac{1}{1 + e^{-\text{net}_{h1}}} = \frac{1}{1 + e^{-0.3775}} = 0.593269992 \]
How do we get these weights?
How do we get these weights?

Gradient Descent and Backpropagation
\[ E_{\text{total}} = \sum \frac{1}{2} (\text{target} - \text{output})^2 \]
INPUT

1

0.4

0.3

0.2

0.9

0.5

1

0.8

0.3

0.5

0.9

0.8

0.69

target: 0

calculated: 0.77

HIDDEN

1

0.73

2

0.79

1.2

0.77

OUTPUT
Workshop

Build your own network!

http://tinyurl.com/mq7s7od
Neural Networks can get a lot more complex
Convolutional Neural Networks
Output: vehicle control
Fully-connected layer
Fully-connected layer
Fully-connected layer

Convolutional feature map 64@1x18
Convolutional feature map 64@3x20
Convolutional feature map 48@5x22
Convolutional feature map 36@14x47
Convolutional feature map 24@31x98
Normalized input planes 3@66x200
Input planes 3@66x200
Recurrent Neural Networks
Reinforcement Learning
Workshop

Build an RNN!

http://tinyurl.com/jvvm2d9
Next Steps

- Keras - Neural Network LEGO coding
- Tensorflow - Efficient tensor computation library
- fast.ai - Developer focused Neural Network course
- Deep Learning Book - Rigorous Neural Networks
Thanks!
Sources

http://cs231n.github.io
http://www.fast.ai
https://xkcd.com
https://stevenmiller888.github.io
https://commons.wikimedia.org
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