ECE 599/692 – Deep Learning

Lecture 1 - Introduction

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Different courses

• Pattern recognition (ECE471/571)
• Machine learning (CS425/528)
• Deep learning (ECE599/692)

Outline

• Instructors
  - Dr. Hairong Qi (hqi@utk.edu)
  - Dr. Arvind Ramanathan (ramanathan@ornl.gov)
• What’s the difference between different courses?
• Why deep learning?
  - Seminar works
  - Engineered features vs. Automatic features
• What do we cover?
• What’s the expectation?
  - ECE471
  - ECE599
• Programming environment
  - Tensorflow
• Preliminaries
  - Linear algebra, probability and statistics, numerical computation, machine learning basics

A bit history

• 1957 - 1962 (Rosenblatt):
  - From the Perceptron to the Toleration Perceptron to the Perceptron Computer Simulations
  - Multi-layer perceptron with fixed weights
• 1986 (Rumelhart, McClelland, McClelland): BP
• 1988 (LeCun et al.): CNN (LeNet)
• Another ~20 years
• Another ~20 years
• 2006 (Hinton et al.): DBL
• 2012 (Krizhevsky, Sutskever, Hinton): AlexNet

Why deep learning?

MLP (80’s)

LeNet (98)

Perceptron (40’s)
ImageNet Large Scale Visual Recognition Challenge (ILSVRC)

<table>
<thead>
<tr>
<th>Year</th>
<th>Top-5 Error</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>28.2%</td>
<td>Fast descriptor coding</td>
</tr>
<tr>
<td>2011</td>
<td>26.7%</td>
<td>Compressed Fisher vectors</td>
</tr>
<tr>
<td>2012</td>
<td>15.3%</td>
<td>AlexNet (8, 60M)</td>
</tr>
<tr>
<td>2013</td>
<td>14.8%</td>
<td>ZFNet</td>
</tr>
<tr>
<td>2014</td>
<td>6.67%</td>
<td>GoogLeNet (22, 4M)</td>
</tr>
<tr>
<td>2014 runner-up</td>
<td></td>
<td>VGGNet (16, 140M)</td>
</tr>
<tr>
<td>2015</td>
<td>3.57%</td>
<td>ResNet (152)</td>
</tr>
</tbody>
</table>

Human expert: 5.1%

http://ischlag.github.io/2016/04/05/important-ILSVRC-achievements/

Engineered features vs. automatic features

Need domain knowledge

End-to-end approach?

What do we cover?

- Neural networks
  - Perceptron
  - MLP
  - Backpropagation
- Feedforward networks
  - Supervised learning - CNN
  - Backpropagation
  - How to train more efficiently?
  - Issues and potential solutions
  - Unsupervised learning – AE
- Feedback networks
  - RNN
- GAN

What’s the expectation?

- ECE599 or ECE692
- Essay
- Final report
- http://web.utk.edu/~qi/deeplearning