Convolutional Neural Networks (Part 2)

CS 510
Lecture #23
April 3rd, 2017

Announcements

- PA4 is due Monday, April 17th
- Test #2 will be Wednesday, April 19th
- Test #3 is Monday, May 8th at 8AM
  - Just 1 hour long
  - University schedule says 7:30...

AlexNet: The Start of a Revolution

Convolutional Neural Nets

- Convolutional layers
  - Local, translation insensitive layers
  - Small number of re-used weights
- Pooling layers
  - Similar to image pyramid
  - No weights at all
- ReLu transfer function
  - Non-linear
  - Avoids vanishing derivatives

AlexNet Performance (2012)

- Results reported for ILSRCV 2010
  - A test set based on ImageNet
  - 1000 image classes (random = 99.9% error rate)
- Results reported for Top-1 & Top-5
  - Output activation orders responses
  - Top-1: best response only
  - Top-5: is correct answer among top 5 responses?
- Error rates
  - Top-1: 37.5% (62.5% correct)
  - Top-5: 17% (83% answers within top 5)

What Does AlexNet Learn?

- Layer #1 Convolution masks:
What about other AlexNet layers?

Analyzing a CNN

- Performance tells you how well it learns
- Analysis tells you what it learns
- Analysis methods still under development
- For any node n:
  - Identify the training samples generating the highest activations
  - Compute $\frac{\partial C}{\partial n}$, use gradient ascent to create maximal activation image
    - Images do not look “real”
    - Add additional constraints (like minimizing L2) to create smooth inputs

Gradient-ascent Analysis

- Images generated by using partial derivatives to create images that maximize activations
- These images also use L2 regularization to avoid images that look like white noise

Final Layer Features

- Images created with gradient-ascent optimization and L2 regularization