Convolutional Neural Networks (Part 2)

CS 510
Lecture #23
April 3rd, 2017

Colorado State University

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…

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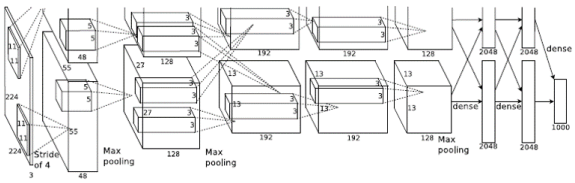
AlexNet : The Start of a Revolution



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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

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AlexNet Performance (2012)

- Results reported for ILSCRV 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)

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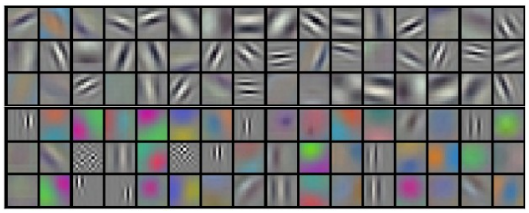
What Does AlexNet Learn?

- Layer #1 Convolution masks:



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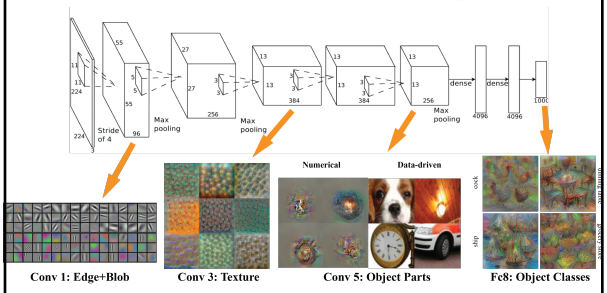
What about other AlexNet layers?



http://vision03.csail.mit.edu/cnn_art/

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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 $\partial C/\partial n$, use gradient ascent to create maximal activation image
    - Images do not look "real"
    - Add additional constraints (like minimizing L2) to create smooth inputs

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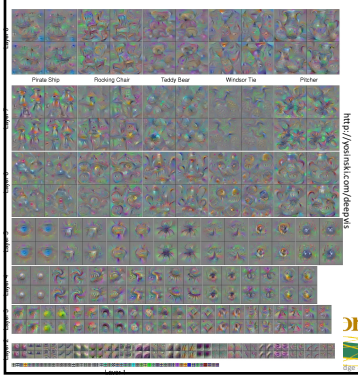
Gradient-ascent Analysis



http://yosinski.com/deepvis

- 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

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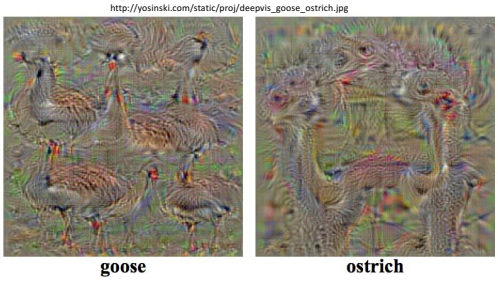
Final Layer Features

http://yosinski.com/static/proj/deepvis_goose_ostrich.jpg



goose **ostrich**

Created with gradient-ascent optimization and L2 regularization

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