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 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)
What Does AlexNet Learn?

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

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

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

Created with gradient-ascent optimization and L2 regularization
GETTING STARTED WITH TENSORFLOW
Step Up a Level ...

Graphic from altexsoft.

Think Locally
and historically

Cameron: High Level Language Compilation for Reconfigurable Systems

Jeff Hammes, Bob Rinker, Wim Böhme, Walid Najjar, Bruce Draper, Ross Beveridge

Department of Computer Science, Colorado State University

1999

Figure 4. DDCF graph for Prewitt program after loop unrolling and array value propagation.
Tensorflow Learning Resources

- First if course, tensorflow.org …
- Then …

TensorFlow

The web contains many helpful tutorials on tensorflow. I have only begun to scratch the surface. That caveat offered, I found these helpful.

- TensorFlow 101 (Really Awesome Intro Into TensorFlow). This is a relatively long but I thought really excellent walk through to set the context for TensorFlow.
- TensorFlow Tutorial - How to use TensorFlow to Build a Neural Network. This is relatively shorter - just under 8 minutes - introduction with an emphasis on image recognition.
- Dan Aloni's blog post on Back Propagation with TensorFlow. We will use this tutorial to begin digging into the basics of using Tensorflow.
Installing with native pip

We have uploaded the TensorFlow binaries to PyPI. Therefore, you can install TensorFlow through pip.

The \texttt{REQUIRED_PACKAGES} section of \texttt{setup.py} lists the packages that pip will install or upgrade.

Prerequisite: Python

In order to install TensorFlow, your system must contain one of the following Python versions:

- Python 2.7
- Python 3.3+

If your system does not already have one of the preceding Python versions, install

...
Nitty Gritty – Installing 2

Installing with Virtualenv

Take the following steps to install TensorFlow with Virtualenv:

1. Start a terminal (a shell). You’ll perform all subsequent steps in this shell.
2. Install pip and Virtualenv by issuing the following commands:

   $ sudo easy_install pip
   $ pip install --upgrade virtualenv

3. Create a Virtualenv environment by issuing a command of one of the following formats:

   $ virtualenv --system-site-packages targetDirectory # for Python
   $ virtualenv --system-site-packages -p python3 targetDirectory

where targetDirectory identifies the top of the Virtualenv tree. Our instructions

Ended in Failure
Nitty Gritty – Installing 3

Recommended by Asa Ben-Hur!

Ended in Success

Conda

Package, dependency and environment management for any language—Python, R, Ruby, Lua, Scala, Java, JavaScript, C / C++, FORTRAN

Conda is an open source package management system and environment management system that runs on Windows, macOS and Linux. Conda installs, runs and updates packages and their dependencies. Conda enables saves, loads and switches between environments on your local computer, created for Python programs, but it can package and distribute software for other languages.

ended in success

Recommended by Asa Ben-Hur!
Using Conda

• First, install
• Next, update your unix path

[Hinton:tf/tutorials/aloni] ross% which conda
/Users/ross/anaconda2/bin/conda

• Now review basic commands
  – update
  – install
  – list
More Basics - iPython

In [1]: import tensorflow as tf

In [2]: tf.__version__
Out[2]: '1.1.0'

In [3]:
Add two (constant) Numbers

• From documentation on tf.Session
• Start thinking about a data flow graph

```python
# Build a graph.
a = tf.constant(5.0)
b = tf.constant(6.0)
c = a * b

# Launch the graph in a session.
sess = tf.Session()

# Evaluate the tensor `c`.
print(sess.run(c))
```
Add two Variables

- This is a bit more tricky
- The global variable initializer is important!

```python
In [3]: a = tf.Variable(3.0)
In [4]: b = tf.Variable(4.0)
In [5]: c = a + b
In [6]: init_op = tf.global_variables_initializer()
In [7]: sess.run(init_op)
In [8]: sess.run(c)
Out[8]: 7.0
```