Deep Learning in TensorFlow for R

Chenglin Zhang

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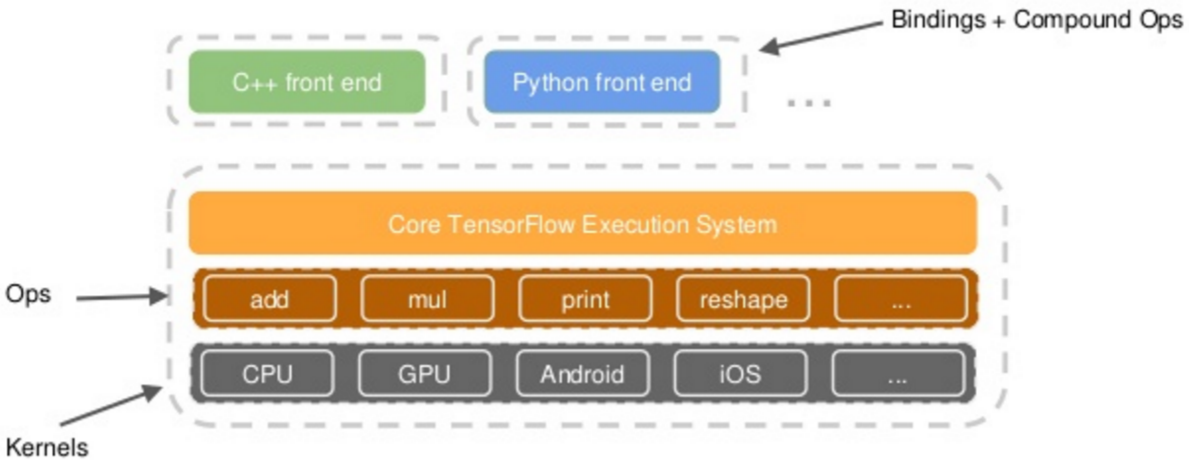
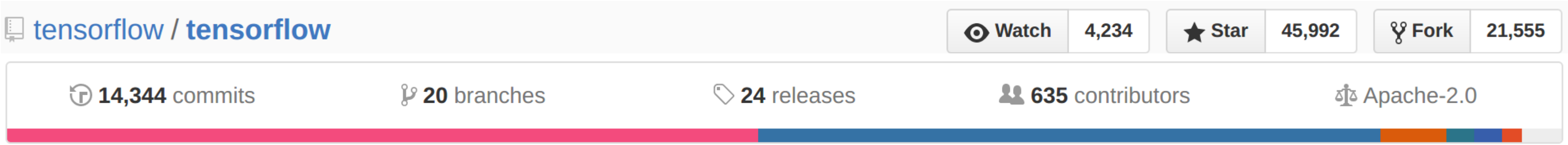
TensorFlow

- Introduced Nov 2015 from Google Brain team
- Deep learning on CPUs and GPUs
- N-d array (tensor) computation on stateful dataflow graph (flow)
- C++ kernel
- Python binding
- Android, iOS

  Respberry Pi
- Apache 2.0 license
- Open sourced at

  https://www.tensorflow.org/
  https://github.com/tensorflow/tensorflow





tensorflow / tensorflow

Watch 4,234 | Star 45,992 | Fork 21,555

14,344 commits | 20 branches | 24 releases | 635 contributors | Apache-2.0

Highlights

- Top 15 most popular GitHub repository by stars (passed Linux)

- 1 million+ binary downloads

- Used in teaching university classes

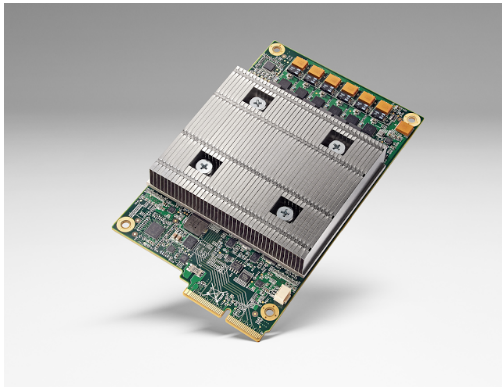
  Toronto, Berkeley, Stanford, …

- Used in companies

  Google, DeepMind, OpenAI, Twitter, Snapchat, Airbus, Uber, ...

- May 2016, Tensor Processing Unit (TPU)

- Feb 2017, TensorFlow 1.0 release
  - Production ready
  - High level Keras, tflearn interfaces
  - XLA (Accelerated Linear Algebra) experimental compiler
  - Java, Go bindings
  - tfdbg debugger



TensorFlow for R

TensorFlow R Binding Nov 2016 release from Rstudio

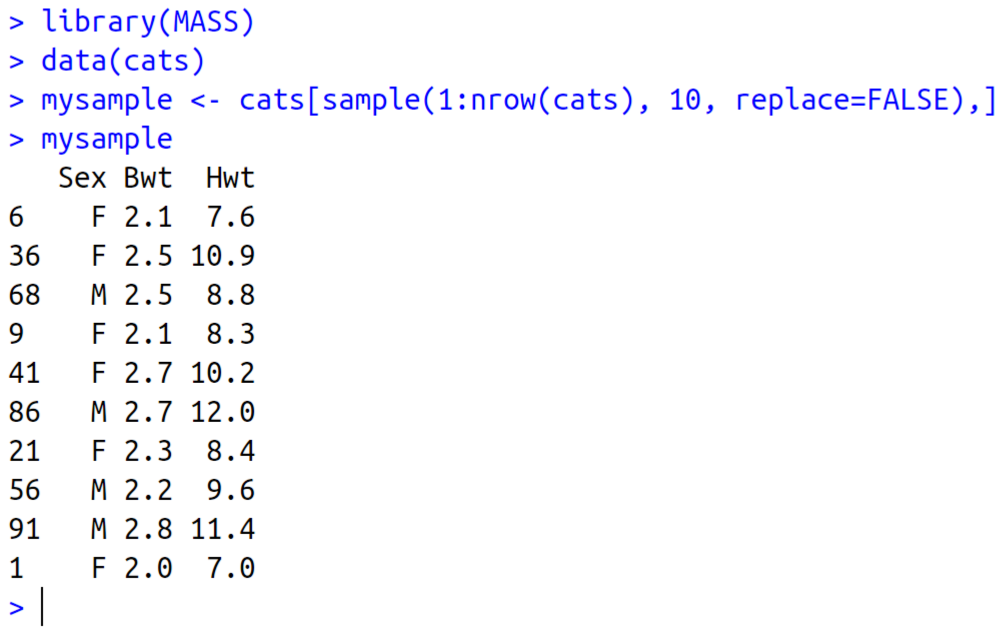
https://rstudio.github.io/tensorflow/

https://github.com/rstudio/tensorflow

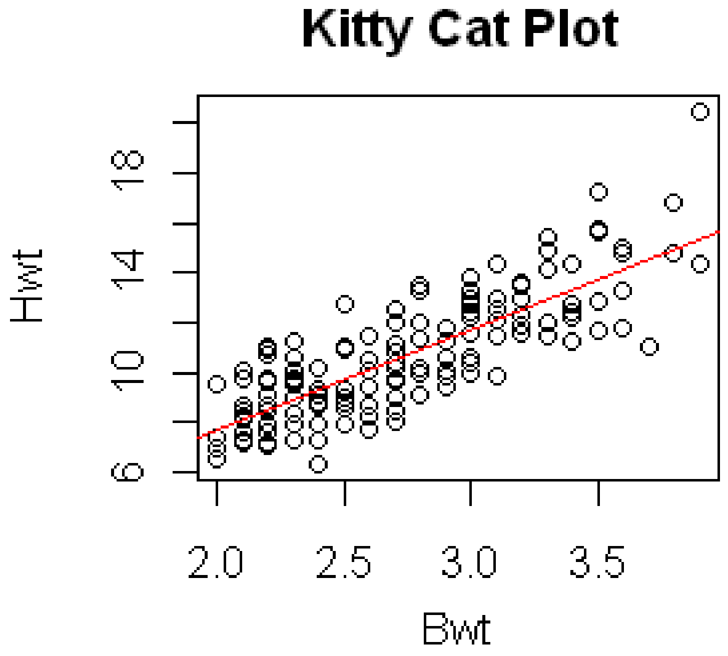
- Tensor
- Variables
- Constants
- Weights
- Biases
- Activation Function
- Loss Function
- Stochastic Decedent Differentiation
- Optimizers
- Graph
- Session
- Input Feeds
- Training
- Tests
- Output Fetches
- Tensorboard Visualization

Linear Regression

- R Jupyter Notebook #1: Demonstrate key concepts of TensorFlow for R, with a sample R cats dataset

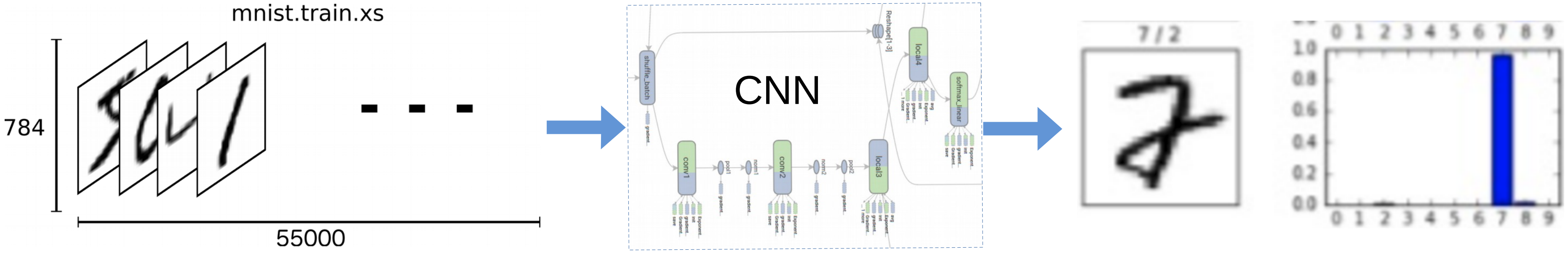


```
> library(MASS)
> data(cats)
> mysample <- cats[sample(1:nrow(cats), 10, replace=FALSE),]
> mysample
   Sex Bwt  Hwt
6    F 2.1  7.6
36   F 2.5 10.9
68   M 2.5  8.8
9    F 2.1  8.3
41   F 2.7 10.2
86   M 2.7 12.0
21   F 2.3  8.4
56   M 2.2  9.6
91   M 2.8 11.4
1    F 2.0  7.0
> |
```



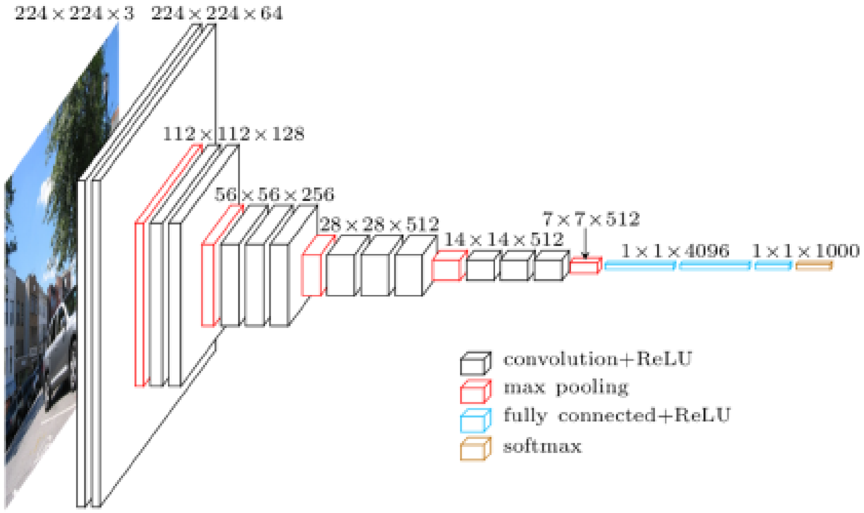
Convolutional Neural Networks

- R Jupyter Notebook #2: Demonstrate hand-written digit recognition in convolutional neural network, with MNIST dataset (10 classes)

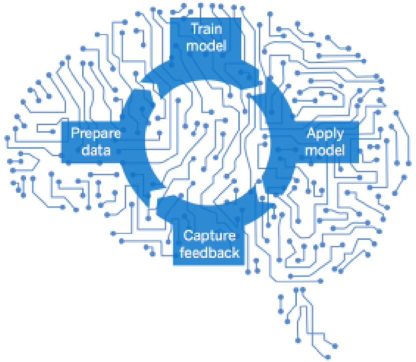


VGG 16 Pre-trained Model

- R Jupyter Notebook #3: Demonstrate image recognition in convolution neural network VGG 16, with an imagenet pre-trained model (1000 classes)



https://www.cs.toronto.edu/~frossard/post/vgg16/



Learning Workflow

- Prepare the data

  Data clean up, data normalization, handling missing values

- Select or design a learning model

  Convolutional neural networks, recursive neural networks, long short-term memory, deep belief networks, auto-encoders, sequence-to-sequence, deep-q learning, generative adversarial networks, etc

- Choose hyper-parameters

  Variable initialization, learning rates, dropouts, epochs, batch sizes, etc. Methods such as random search and grid search can be used to initialize these parameters.

- Train

  Fit the model to the data by minimizing losses or cross entropy, by stochastic gradient decent methods or extensions

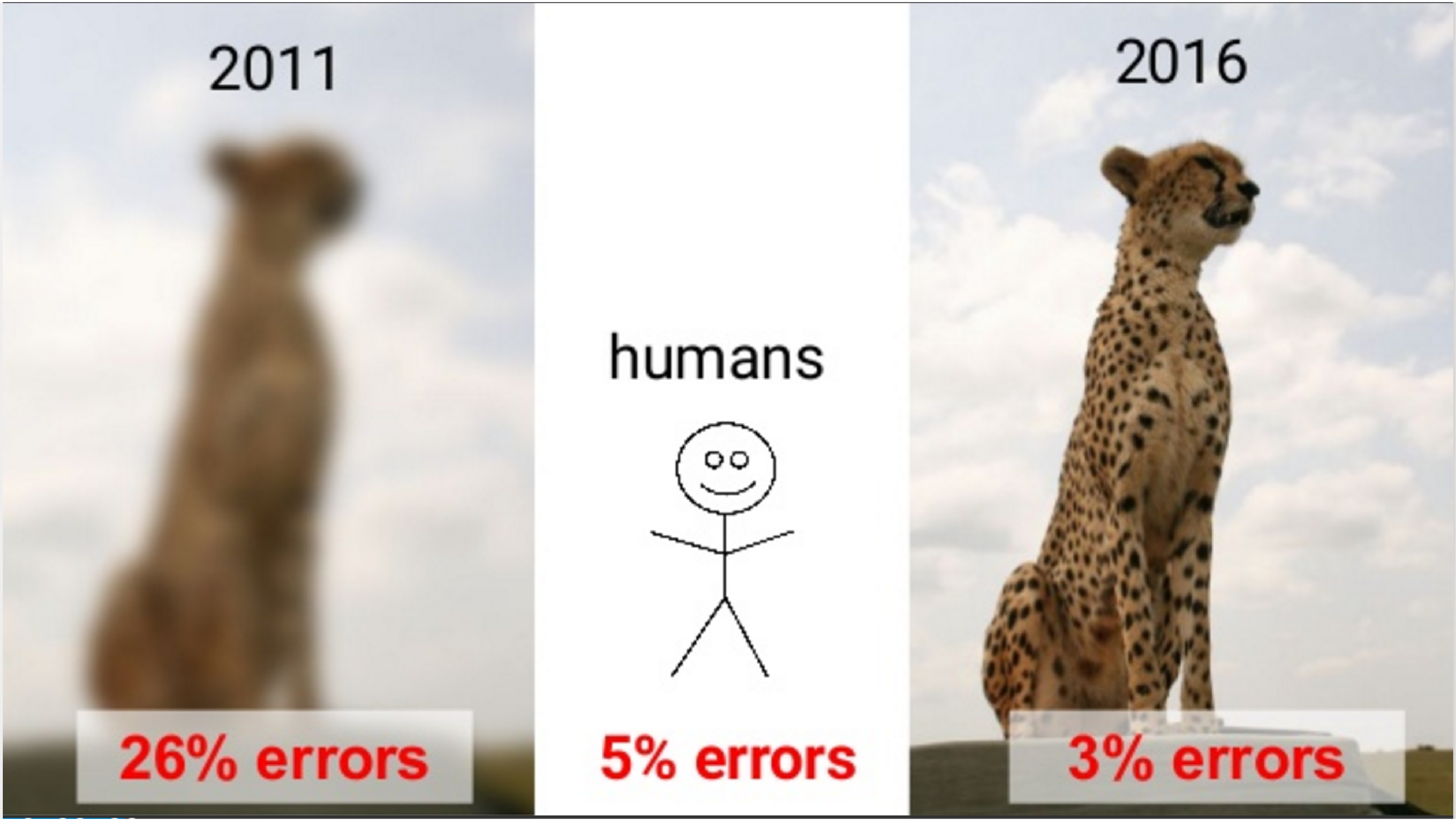
- Monitor training performance

  Maximize training and validation accuracy while avoiding over-fitting to the training data

- Prediction

  Deploy and apply trained model to predict

Accuracy Challenge



http://www.slideshare.net/AIFrontiers/jeff-dean-trends-and-developments-in-deep-learning-research

TensorFlow for R Installation

- TensorFlow Installation

  https://www.tensorflow.org/get_started/os_setup

  ```
  # Example: Ubuntu/Linux 64-bit, GPU enabled, Python 3.5
  $ export
  TF_BINARY_URL=https://storage.googleapis.com/tensorflow/linux/gpu/tensorflow_gpu-
  0.12.1-cp35-cp35m-linux_x86_64.whl
  $ sudo pip3 install --upgrade $TF_BINARY_URL
  ```

- TensorFlow for R Installation

  https://github.com/rstudio/tensorflow

  ```
  # Example: R with Tensorflow on Python 3
  Sys.setenv(TENSORFLOW_PYTHON="/usr/bin/python3")
  devtools::install_github("rstudio/tensorflow")
  ```

- Jupyter R Kernel Installation

  https://github.com/IRkernel/IRkernel

  ```
  install.packages(c('repr', 'IRdisplay', 'crayon', 'pbdZMQ', 'devtools'))
  devtools::install_github('IRkernel/IRkernel')
  IRkernel::installspec()
  ```