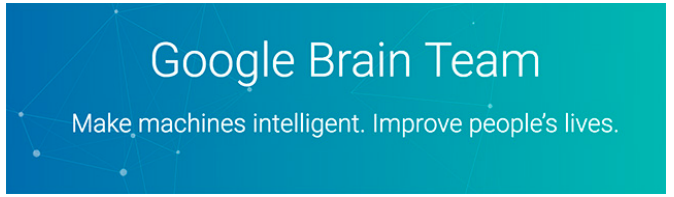
Pytorch vs. Tensorflow

What is Pytorch?

- **Pytorch**
  - python based deep learning library for researching and developing Deep learning models
  - origin from lua-based deep learning library, Torch.
  - Pytorch is written by native python language. (Not a simple set of wrapper to support Python)
  - Actively used at Facebook
  - essentially a GPU enabled version for NumPy with higher-level functionality for building and training deep neural networks.

What is Tensorflow?

- **Tensorflow**



  - a Deep learning library for researching, developing, and distributing deep learning models.
  - developed by Google Brain and actively used at Google.
  - a programming language embedded within Python
    (Tensorflow codes are complied into a graph by Python and then run by the Tensorflow execution engine)

Difference - Adoption

- **Tensorflow**
  - well documented
  - many users
  - many tutorials are available
  - hundreds of implemented and trained models on github
- **Pytorch**
  - quickly getting its momentum
  - still in beta version (currently v. 0.2.0)
  - nice documentation and official tutorials
  - several computer vision architectures available

Difference – Graph definition

- Both frameworks operate on tensors and view models as a directed acyclic graph(DAG).
- They are different in a way to define DAGs.

- **Tensorflow**
  - Use **Static graph**
    (Graph is defined before a model can run.)
  - All communication is performed via **tf.session** and **tf.Placeholder**
  - support limited dynamic inputs

- **Pytorch**
  - Use **Dynamic graph**
    (Graphs can be defined, changed, and executed as model runs)
  - Being **tightly integrated with Python** language, give more native and free way to work with models.
  - Dynamic neural net like RNNs can benefit from this dynamic approach

Difference – Data loading

- **Tensorflow**
  - relatively not intuitive for data loading.
  - adding preprocessing code in parallel into Tensorflow graph is not straight-forward.
- **Pytorch**
  - APIs for data loading are well designed.
  - a data loader takes a dataset and produces an iterator over the dataset.
  - Parallelizing data loading is simple.

Difference – Debugging

- **Tensorflow**
  - Need to use a special debugging tool, **tfdbg**
  - **tfdbg** allows to evaluate tensorflow expressions at runtime and browse all tensors and operations in session scope.
- **Pytorch**
  - Graph is defined at runtime
  - You can use your favorite Python debugging tools such as **pdb, ipdb, Pycharm debuggers**.

Difference – Visualization

- **Tensorflow**
  - has its own visualization tool **Tensorboard**.
  - Tensorboard can
    - display model graph
    - plot scalar variables
    - visualize distributions and histograms
    - visualize images
    - visualize embeddings
    - play audio
- **Pytorch**
  - Currently, no equivalent for Tensorboard.
  - Integrations to tensorboard exist
  - standard plotting tools (matplotlib, seaborn) can be used

Difference – Serialization

- Both frameworks provides simple way to saving and loading models
- **Tensorflow**
  - **Tf.Saver** object provides easy way to save models and check-points.
  - Entire graph can be saved as a protocol buffer.
  - Graph can be loaded in other supported languages (C++, JAVA)
- **Pytorch**
  - provides simple API that can save all the weights of a model.

Difference – Custom extensions

- Building or binding custom extensions written in C, C++ or CUDA is doable in both frameworks

- **Tensorflow**
  - requires more boilerplate code for custom extensions.

- **Pytorch**
  - You can make extensions by simply write an interface and correponding implementation for each of the CPU and GPU versions.

Difference – Deployment

- **Tensorflow**
  - **Tensorflow Serving** provides a easy way to deploy models
  - models can be deployed into embeded system or mobile platforms.
  - Provide high performance server-side deployments
  - support **Distributed training**
- **Pytorch**
  - For a small-scale server-side deployments are easy to wrap using Flask web server.
  - support **Distributed training**

Summary

- Both frameworks provides useful abstractions to reduce repeated codes and speed up the model development.
- **PyTorch**
  - provides flexible dynamic graph definition
  - more 'pythonic' way for developing and debugging
  - an object-oriented approach.
  - PyTorch is better for rapid prototyping in research, and small scale projects.
- **Tensorflow**
  - provide great visualization and deployment tools.
  - A good choice if you develop a model for production and deploying on mobile platforms
  - Tensorflow is better for large-scale deployments especially when cross-platform and embedded deployment is a consideration