PROGRAMMING IN PYTHON I

ML Modules in Python

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Copyright Statement

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MACHINE LEARNING IN PYTHON

Motivation

- Python is a go-to language for Machine Learning (ML) and Deep Learning (DL)
  - Implementation of research and production code is possible
  - Convenient usage supports quick implementation of ideas
  - There are modules that allow for fast execution on dedicated hardware

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- Python is a go-to language for Machine Learning (ML) and Deep Learning (DL)
  - Implementation of research and production code is possible
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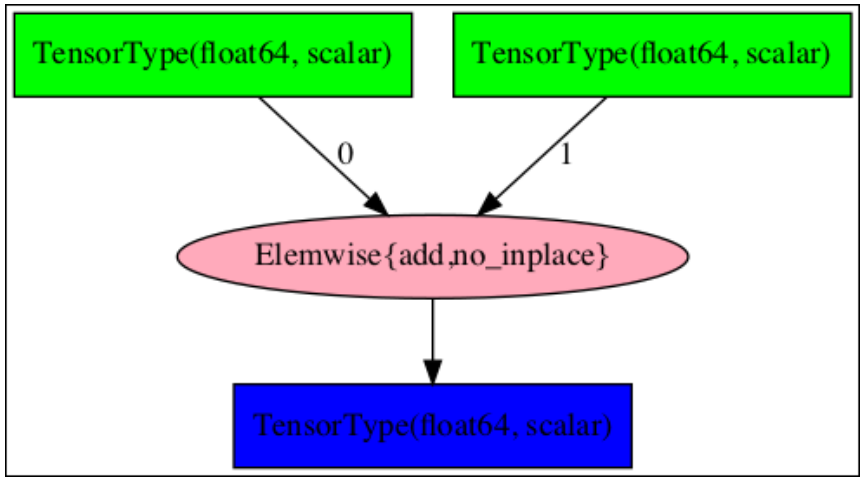
  - There are modules that allow for fast execution on dedicated hardware
- Now we will tap into modules that allow us to write optimized Python code for ML
  - Usage of dedicated hardware (CPU, GPU, TPUs)
  - Automatic differentiation (e.g., for training of DL networks)
  - Convenience functions for data loading, preprocessing, training, evaluation, ...
  - TensorFlow, **PyTorch**, ...

COMPUTATIONAL GRAPHS

Computational Graphs

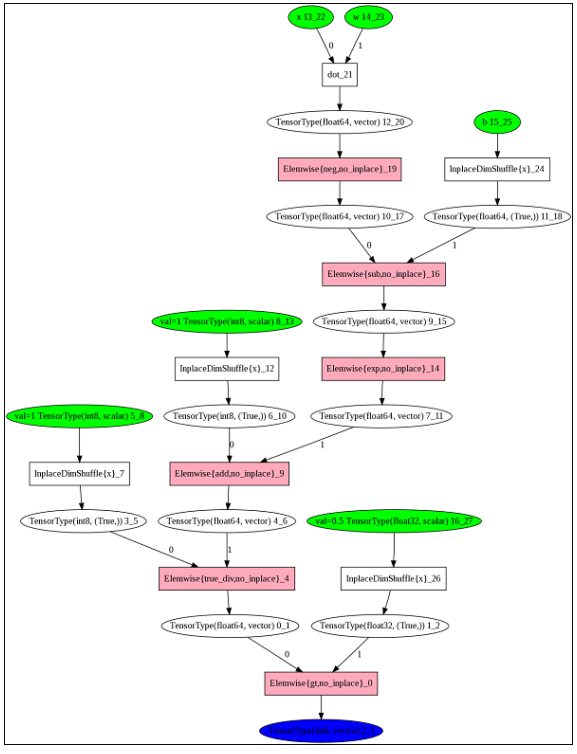
- A large part of the “magic” provided by frameworks such as TensorFlow/PyTorch is based on **computational graphs**
  - Symbolic graph of computations
  - Defines a pipeline of computations
  - Nodes in the graph can represent functions and placeholders for the data (=**tensors**)



Scalar addition as computational graph. Source: https://www.tutorialspoint.com/theano/theano_computational_graph.htm

Computational Graphs: Benefits

- Compilation of graph with optimization for dedicated devices or data types
- Automatic differentiation



More complex computational graph. Source: https://www.tutorialspoint.com/theano/theano_computational_graph.htm

AUTOMATIC DIFFERENTIATION

Automatic Differentiation

- When training artificial neural networks (NNs), we typically rely on gradient-based methods to update the weights
  - E.g.: Compute gradient of loss w.r.t. NN parameters to change parameters such that loss decreases
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- Not having to implement the chain rule formulas by hand for every NN makes our lives significantly easier
  - Combined with modular layer design, this makes NN design and training almost plug-and-play
- Computational graph contains information about functions used to compute result and allows for automatic differentiation (This makes us really happy!)

PYTHON MODULES

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- PyTorch and TensorFlow both provide many convenience functions for ML