A Tour of TensorFlow

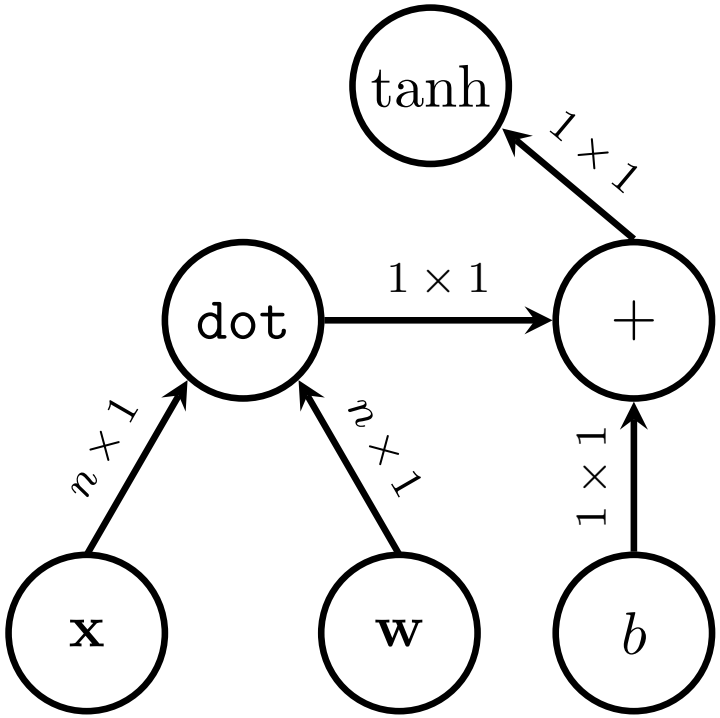
Peter Goldsborough

July 11, 2016

Contents

Computational Paradigms

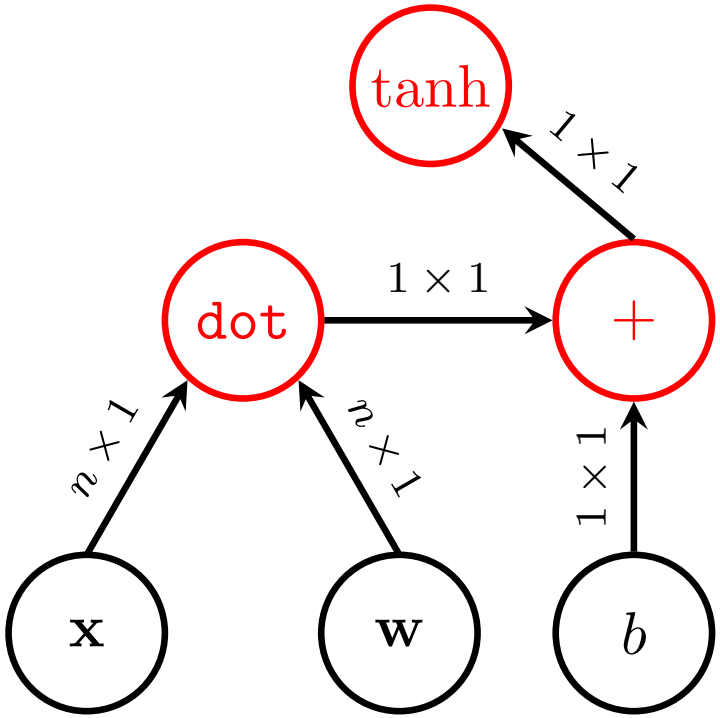
Computational Paradigms



$$\hat{y} = \tanh(\mathbf{x}^\top \mathbf{w} + b)$$

Computational Graphs

Computational Paradigms

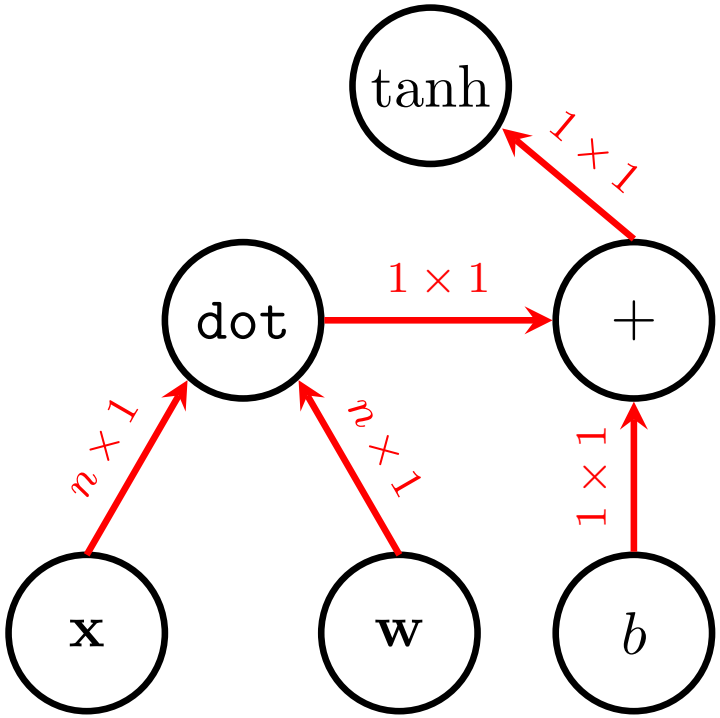


$$\hat{y} = \tanh(\mathbf{x}^\top \mathbf{w} + b)$$

Computational Graphs

1. Operations

Computational Paradigms

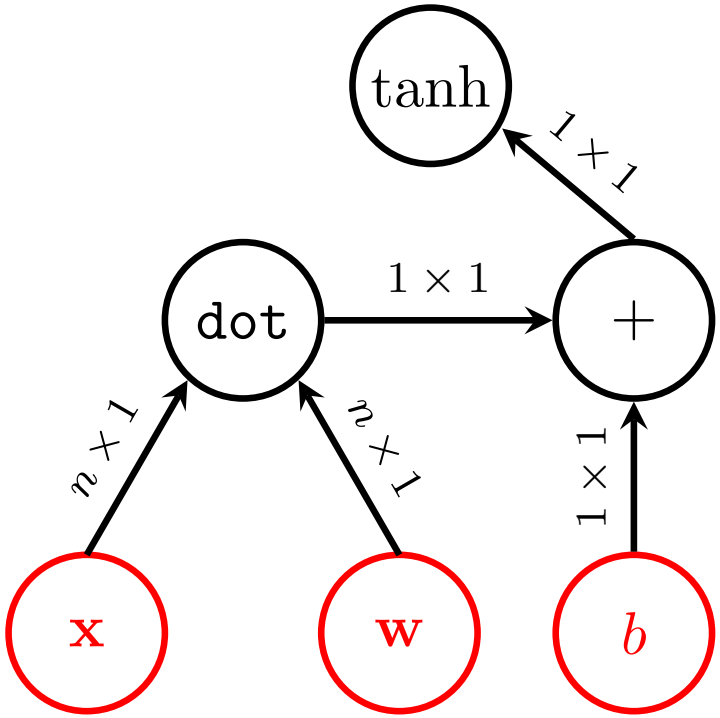


$$\hat{y} = \tanh(\mathbf{x}^\top \mathbf{w} + b)$$

Computational Graphs

1. Operations
2. Tensors

Computational Paradigms

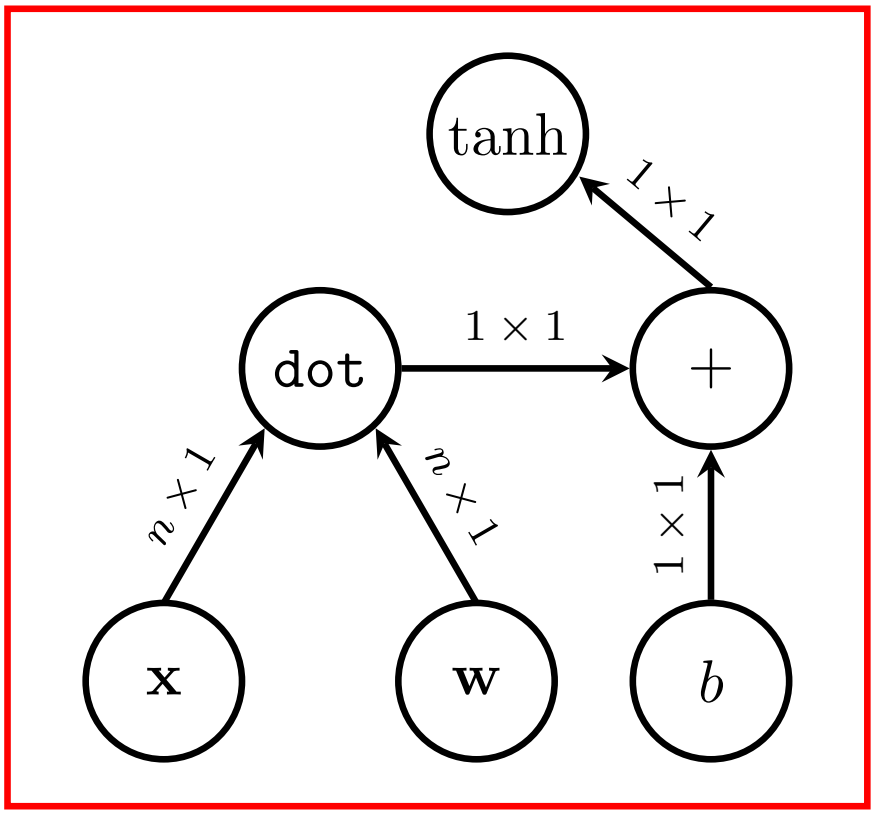


$$\hat{y} = \tanh(\mathbf{x}^\top \mathbf{w} + b)$$

Computational Graphs

1. Operations
2. Tensors
3. Variables

Computational Paradigms



$$\hat{y} = \texttt{session.run}(\tanh(\mathbf{x}^\top \mathbf{w} + b))$$

Computational Graphs

1. Operations
2. Tensors
3. Variables
4. Sessions

Execution Model

Execution Model

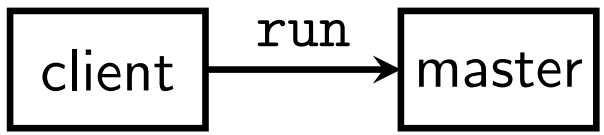
Actors

Execution Model

Actors

1. Client

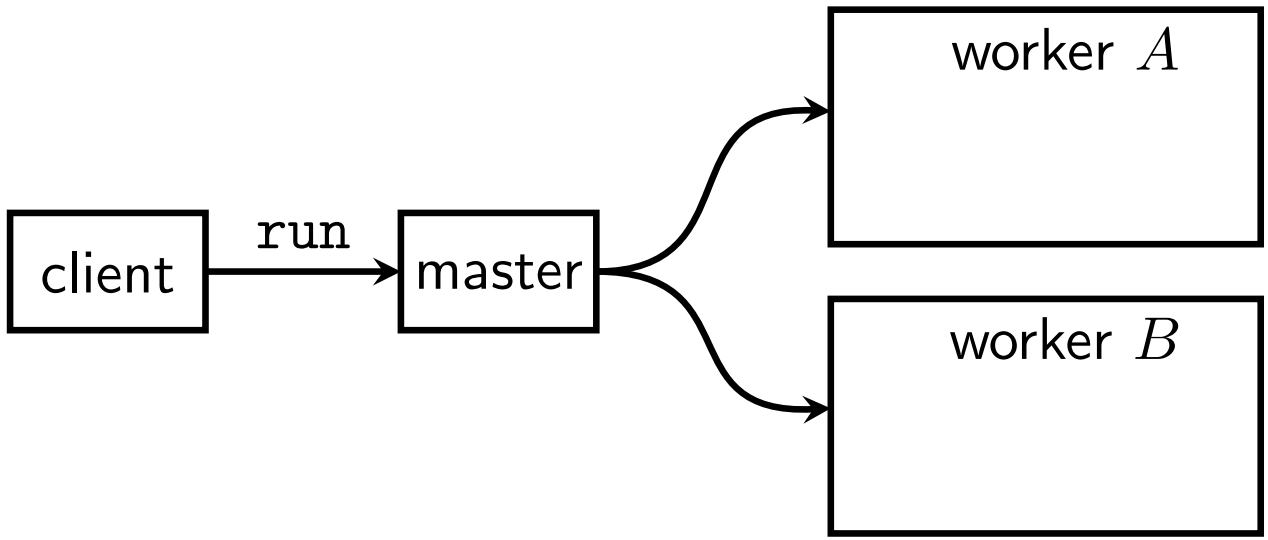
Execution Model



Actors

1. Client
2. Master

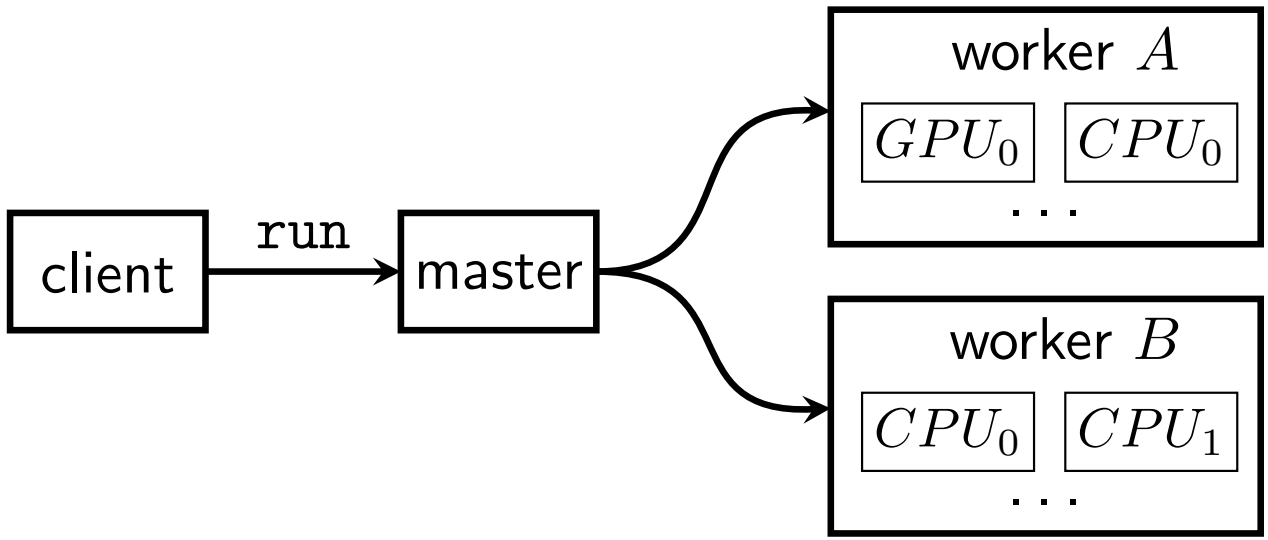
Execution Model



Actors

1. Client
2. Master
3. Workers

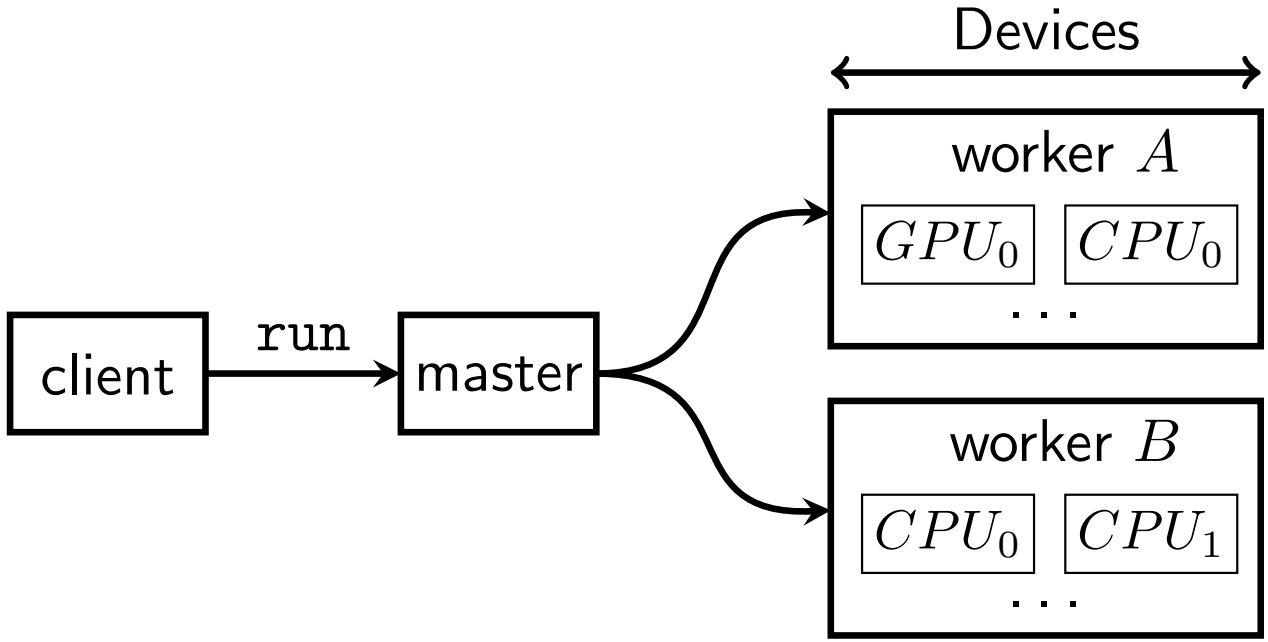
Execution Model



Actors

1. Client
2. Master
3. Workers
4. Devices

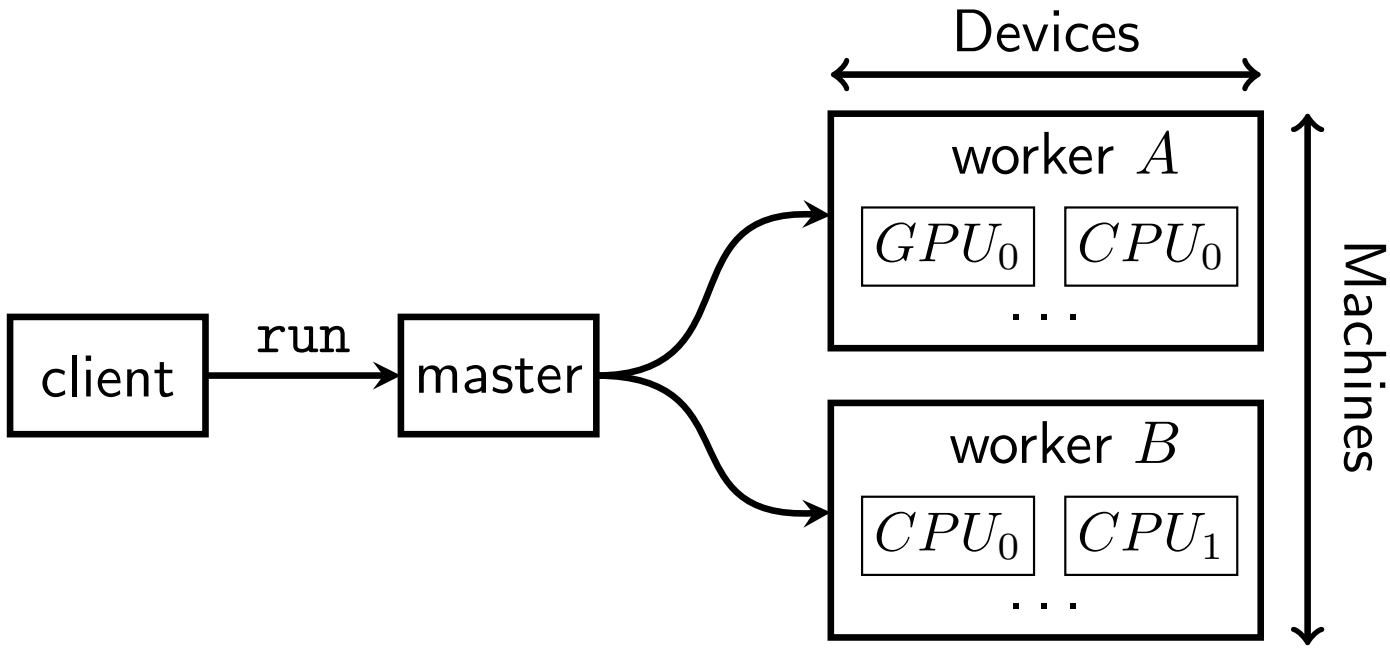
Execution Model



Actors

1. Client
2. Master
3. Workers
4. Devices

Execution Model

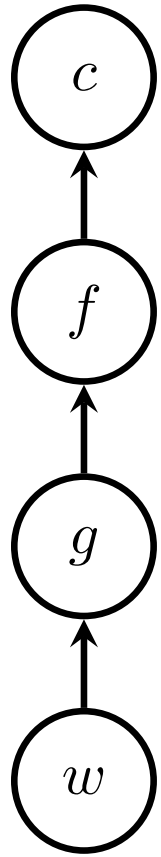


Actors

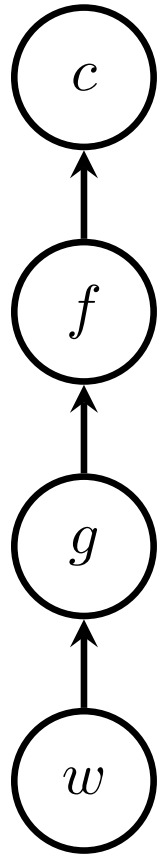
1. Client
2. Master
3. Workers
4. Devices

Back Propagation in TensorFlow

Back Propagation in TensorFlow



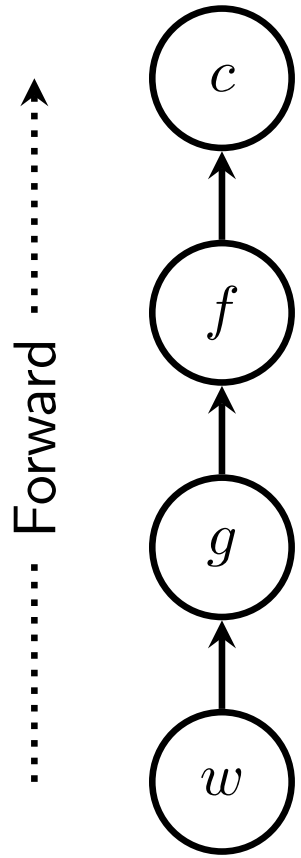
Back Propagation in TensorFlow



Symbol to Number Differentiation

Back Propagation in TensorFlow

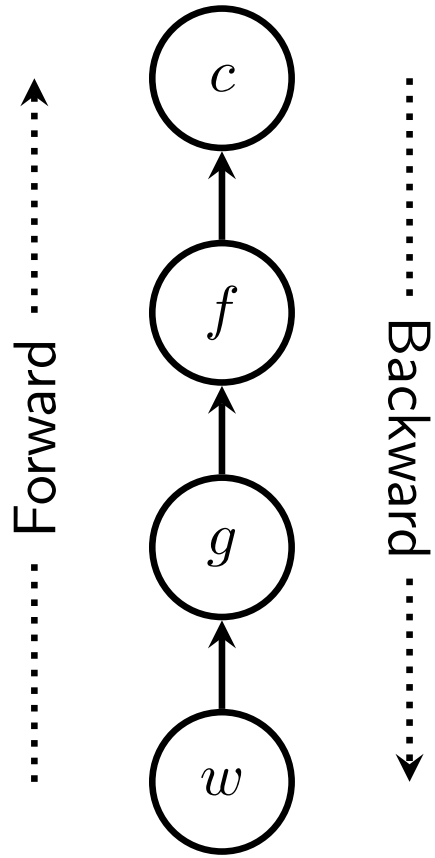
$$c = (f \circ g)(w)$$



Symbol to Number Differentiation

Back Propagation in TensorFlow

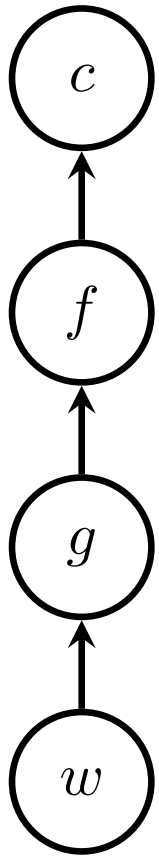
$$c = (f \circ g)(w)$$



$$\frac{\mathrm{d}c}{\mathrm{d}w} = f'(g(w)) \cdot g'(w)$$

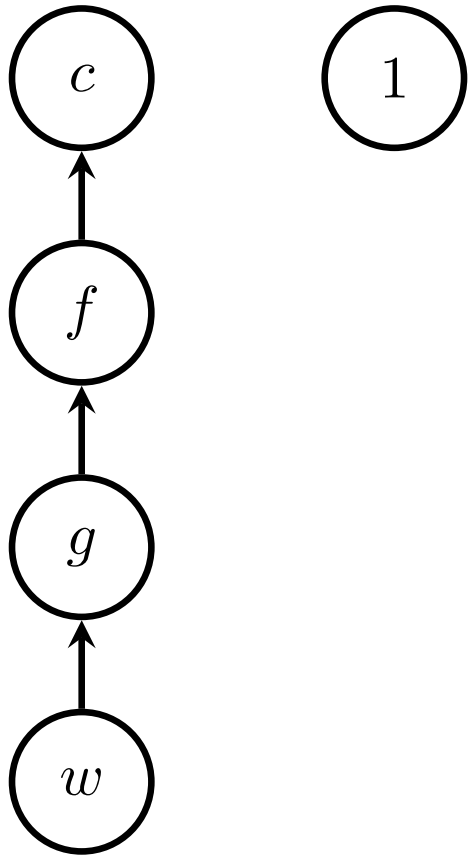
Symbol to Number Differentiation

Back Propagation in TensorFlow



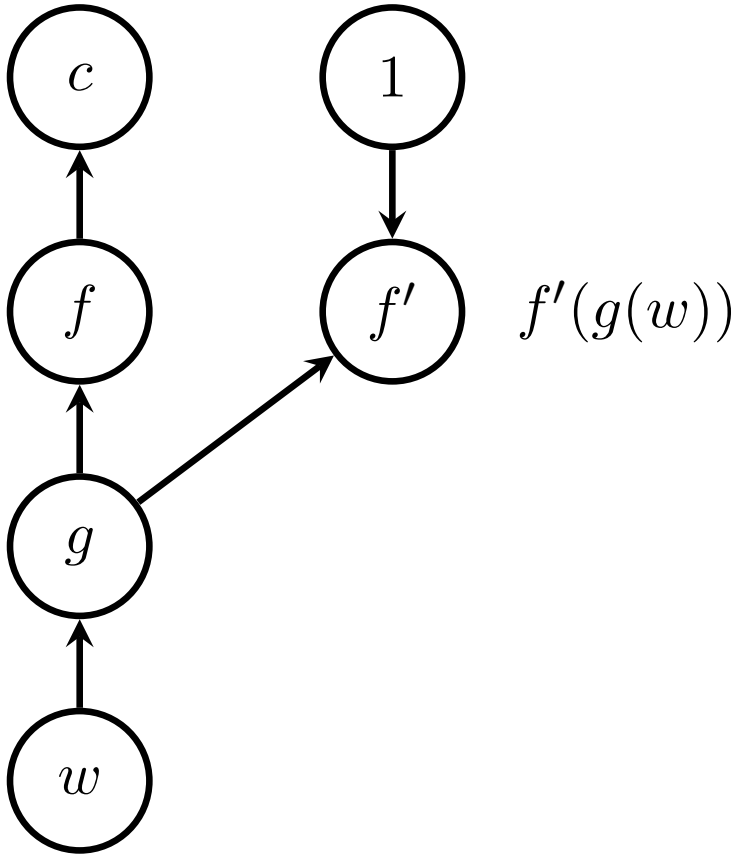
Symbol to Symbol Differentiation

Back Propagation in TensorFlow



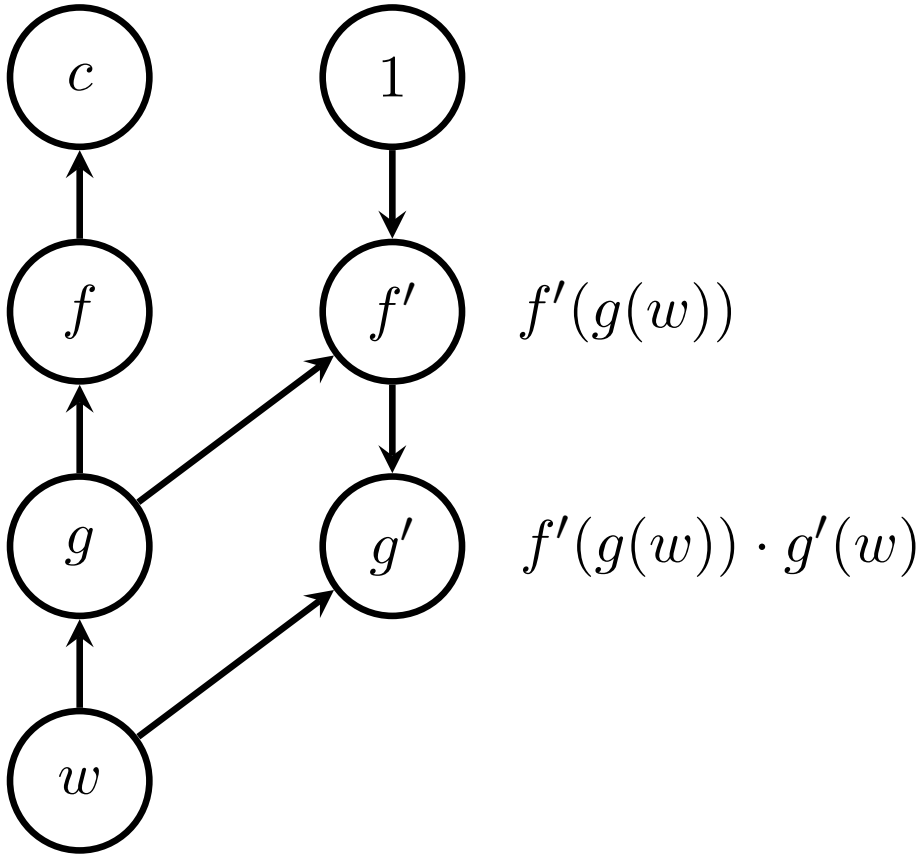
Symbol to Symbol Differentiation

Back Propagation in TensorFlow



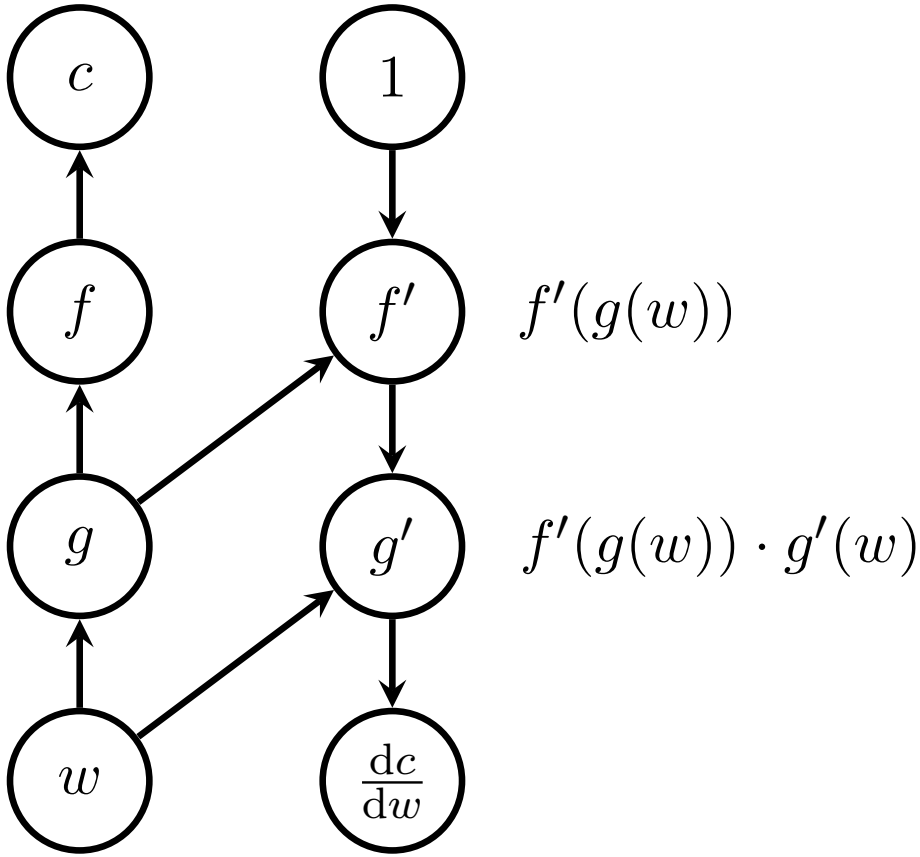
Symbol to Symbol Differentiation

Back Propagation in TensorFlow



Symbol to Symbol Differentiation

Back Propagation in TensorFlow



Symbol to Symbol Differentiation

Visualization Tools

Visualization Tools

- Deep Neural Networks have the tendency of being . . . deep

Visualization Tools

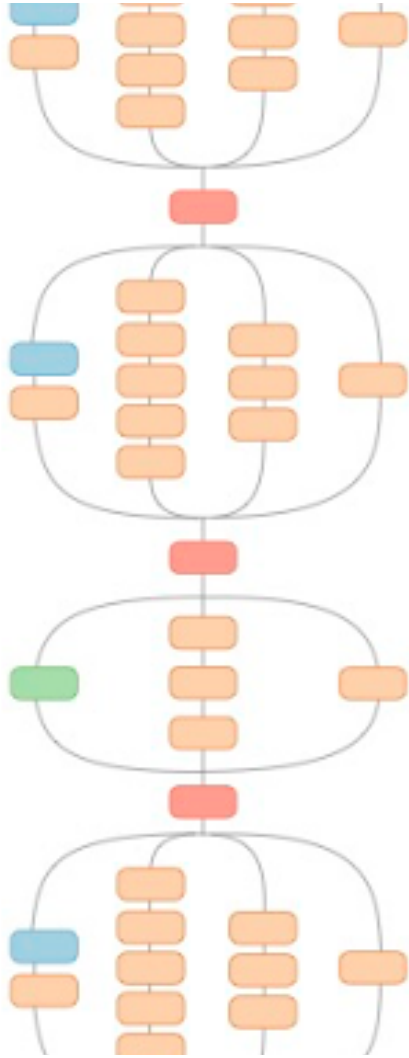
- Deep Neural Networks have the tendency of being . . . deep
- Easy to drown in the complexity of an architecture

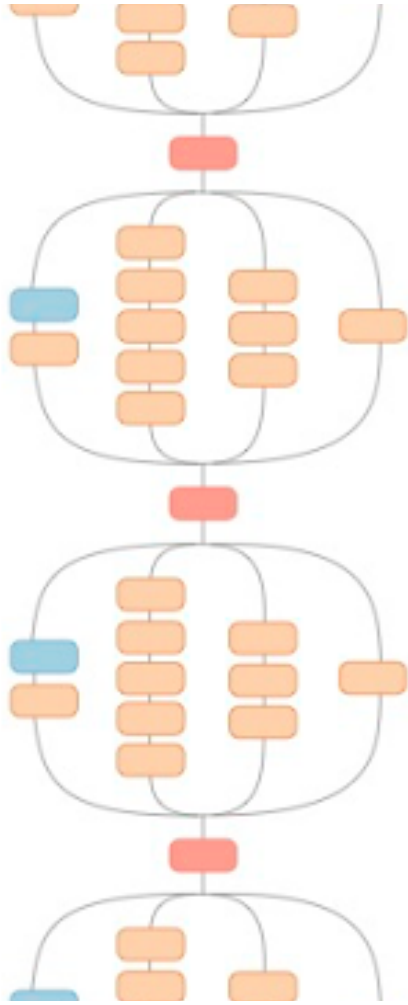
Visualization Tools

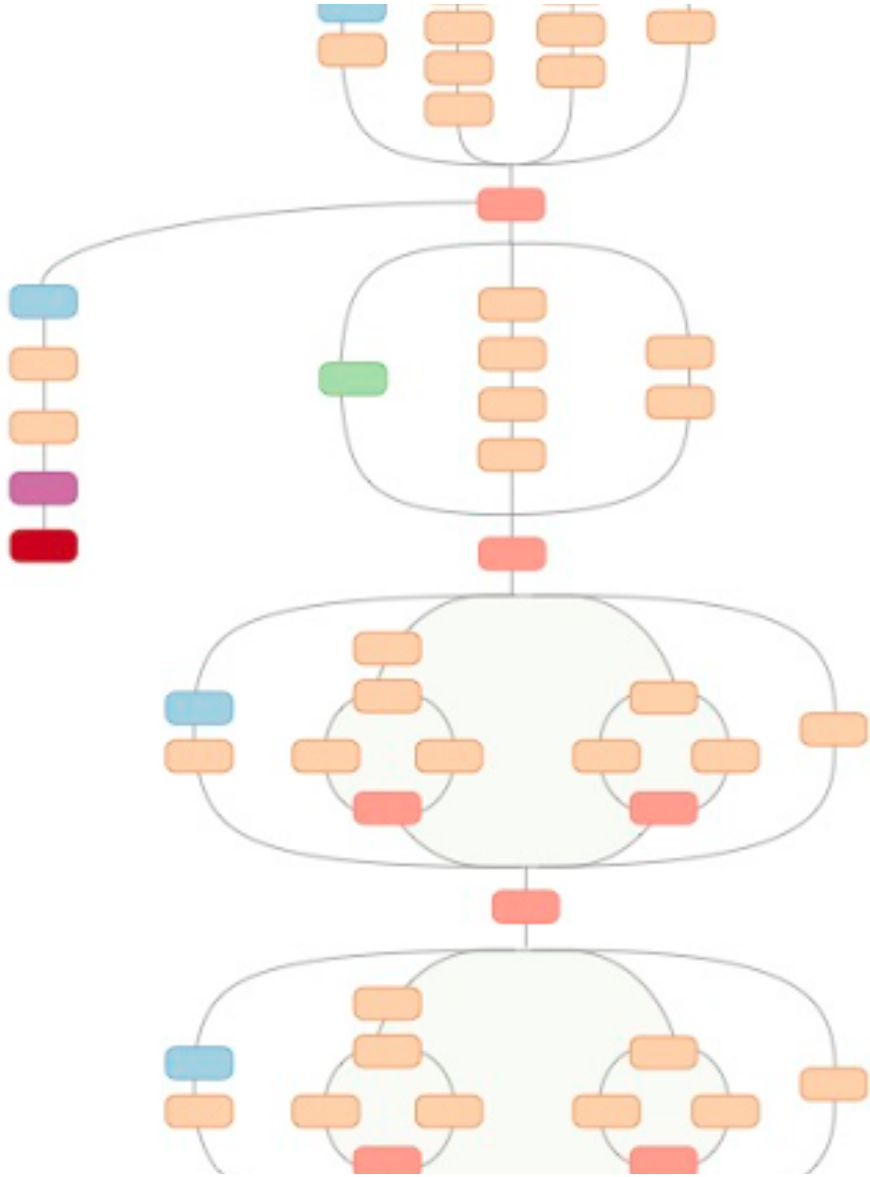
- Deep Neural Networks have the tendency of being . . . deep
- Easy to drown in the complexity of an architecture
- $>$ 36,000 nodes for Google's *Inception* model

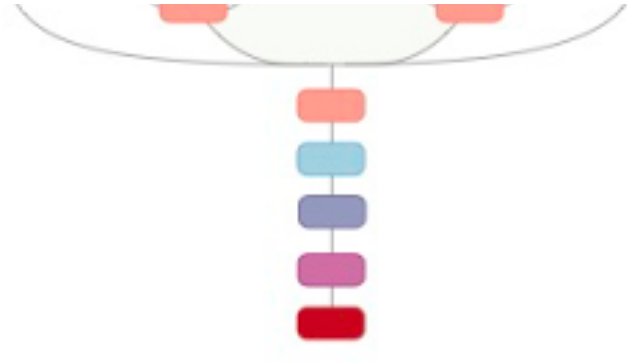
Visualization Tools

- Deep Neural Networks have the tendency of being . . . deep
- Easy to drown in the complexity of an architecture
- $>$ 36,000 nodes for Google's *Inception* model

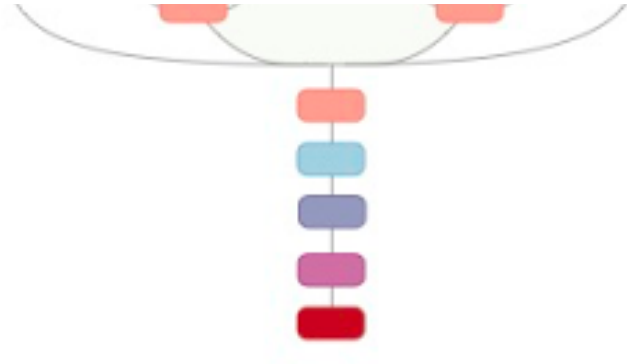








Source: http://googleresearch.blogspot.de/2016/03/train-your-own-image-classifier-with.html



Source: http://googleresearch.blogspot.de/2016/03/train-your-own-image-classifier-with.html

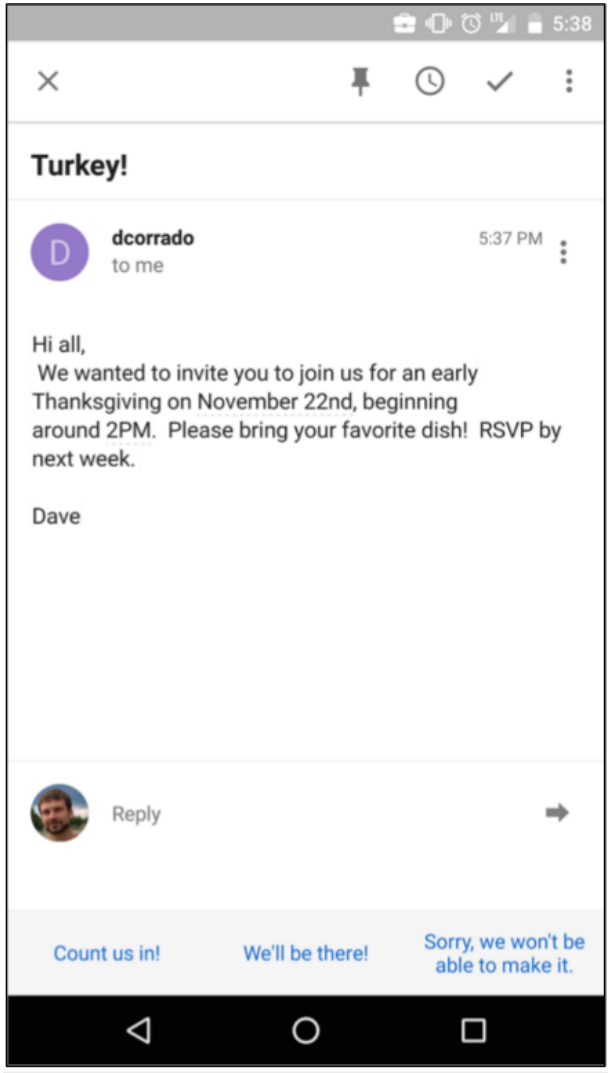
TensorBoard to the Rescue

Use Cases

Source: http://googleresearch.blogspot.de/2015/11/computer-respond-to-this-email.html

Use Cases

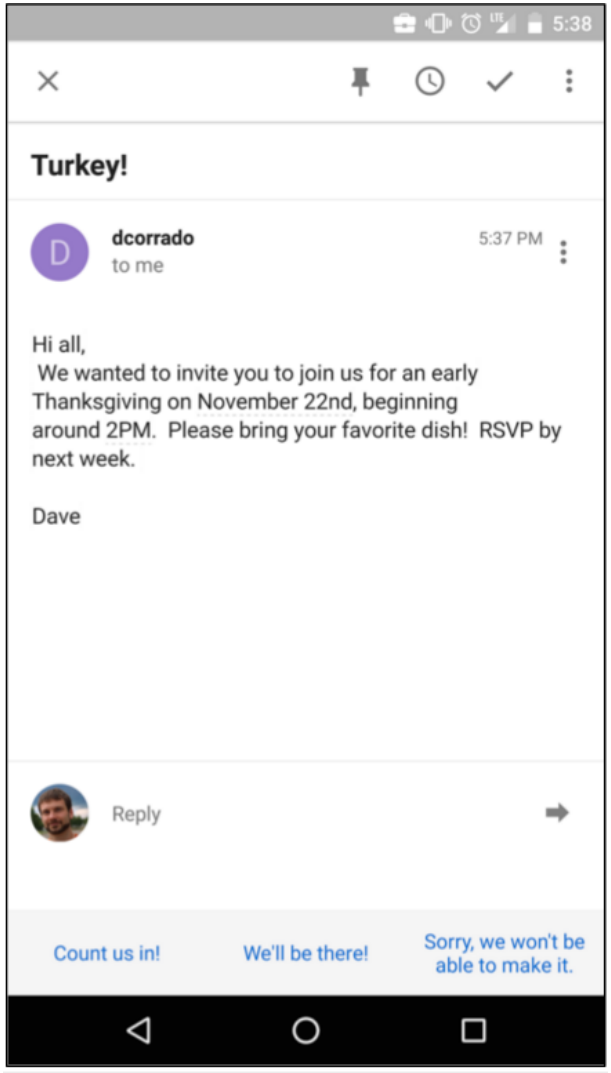
- Smart email replies in Google *Inbox*



Source: http://googleresearch.blogspot.de/2015/11/computer-respond-to-this-email.html

Use Cases

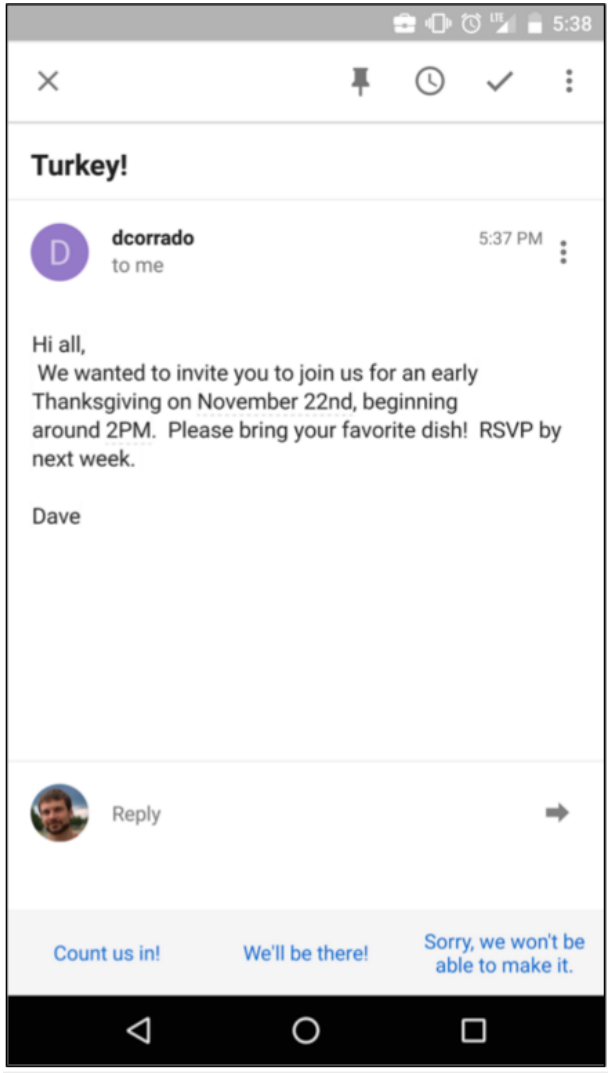
- Smart email replies in Google *Inbox*
- Emails mapped to "thought vectors"



Source: http://googleresearch.blogspot.de/2015/11/computer-respond-to-this-email.html

Use Cases

- Smart email replies in Google *Inbox*
- Emails mapped to "thought vectors"
- LSTMs synthesize valid replies



Source: http://googleresearch.blogspot.de/2015/11/computer-respond-to-this-email.html

Use Cases

Use Cases

- Google DeepMind now using TensorFlow

Use Cases

- Google DeepMind now using TensorFlow
- Already for *AlphaGo*

Source: https://deepmind.com/css/images/opengraph/alphago-logo.png

Use Cases

- Google DeepMind now using TensorFlow
- Already for *AlphaGo*
- According to a DeepMind SWE reasons are:

Source: https://deepmind.com/css/images/opengraph/alphago-logo.png

Use Cases

- Google DeepMind now using TensorFlow
- Already for *AlphaGo*
- According to a DeepMind SWE reasons are:
  - Python,

Source: https://deepmind.com/css/images/opengraph/alphago-logo.png

Use Cases

- Google DeepMind now using TensorFlow
- Already for *AlphaGo*
- According to a DeepMind SWE reasons are:
  - Python,
  - Integration with Google Cloud Platform,

Source: https://deepmind.com/css/images/opengraph/alphago-logo.png

Use Cases

- Google DeepMind now using TensorFlow
- Already for *AlphaGo*
- According to a DeepMind SWE reasons are:
  - Python,
  - Integration with Google Cloud Platform,
  - Support for TPUs,

Source: https://deepmind.com/css/images/opengraph/alphago-logo.png

Use Cases

- Google DeepMind now using TensorFlow
- Already for *AlphaGo*
- According to a DeepMind SWE reasons are:
  - Python,
  - Integration with Google Cloud Platform,
  - Support for TPUs,
  - Ability to run on many GPUs.

Source: https://deepmind.com/css/images/opengraph/alphago-logo.png

Walkthrough

Thank You