



Dynamic Deep Learning

A paradigm shift in AI research and Tools

Soumith Chintala

Facebook AI Research

Overview

Today's AI



Active Research &
Future AI

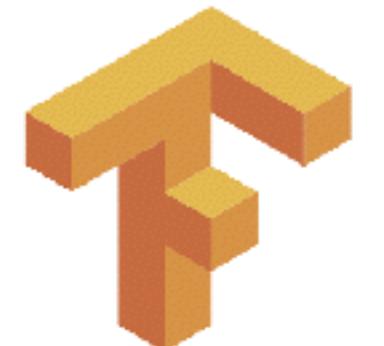


Tools for AI
keeping up with change

PYTORCH



theano



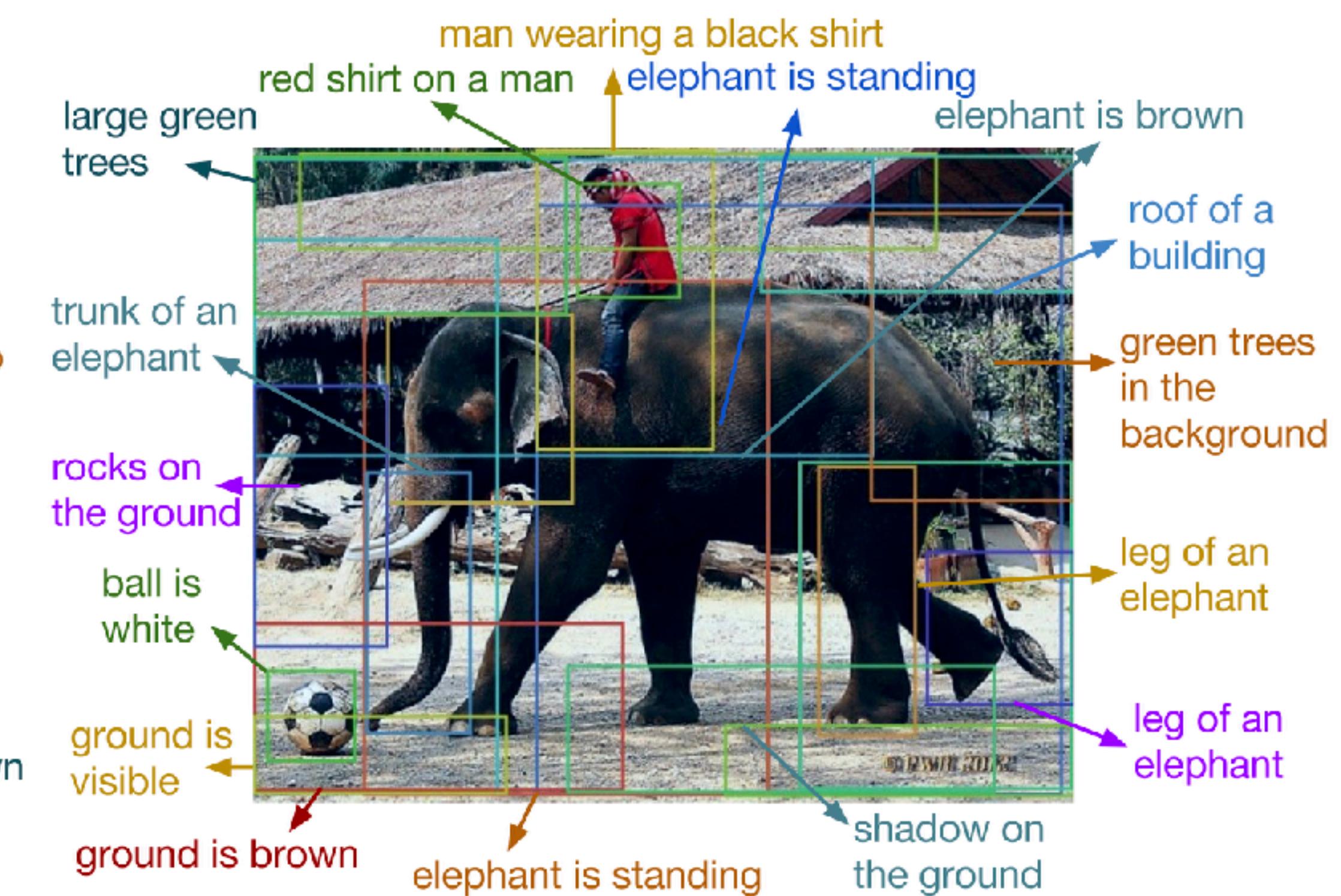
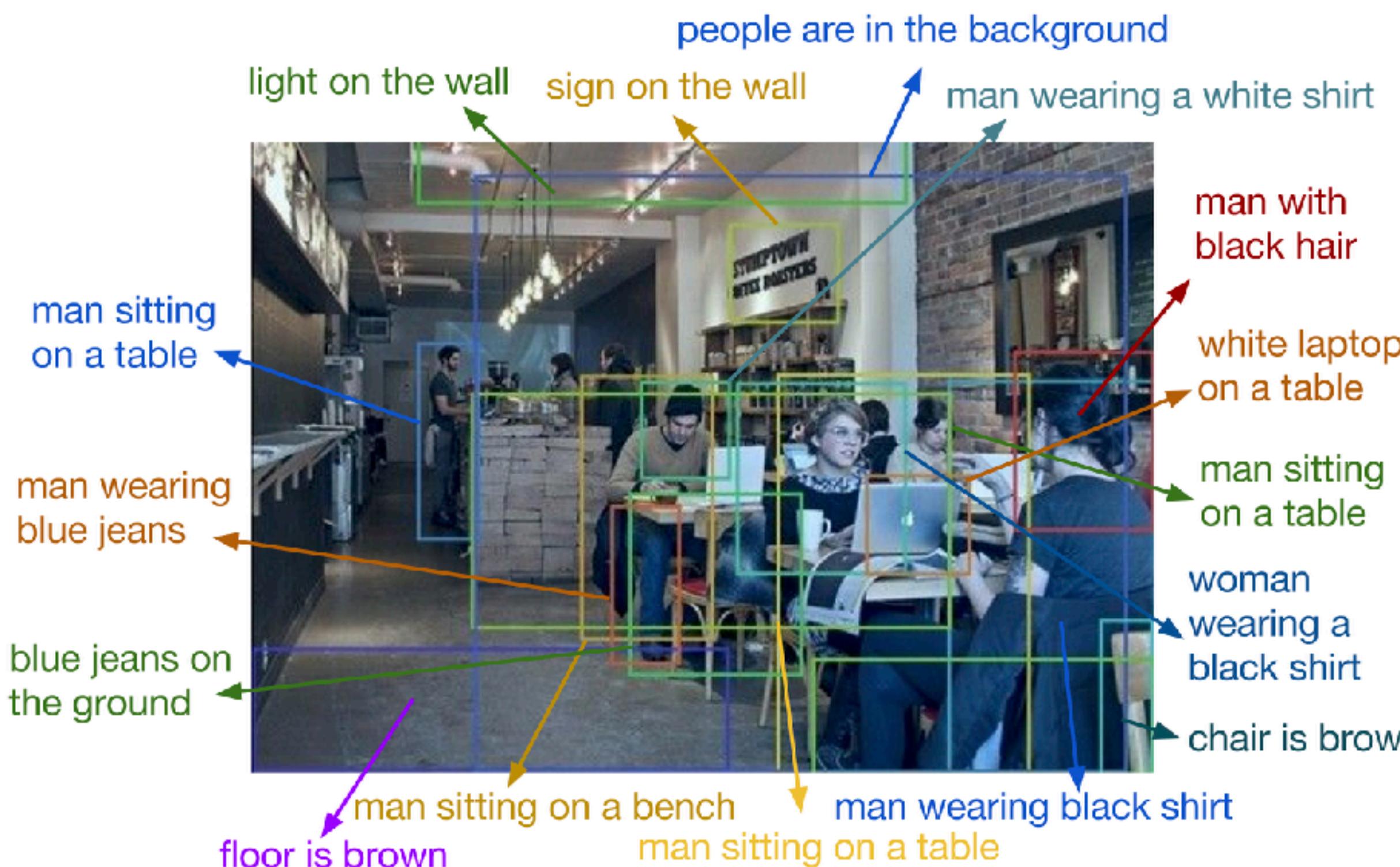
Caffe



Today's AI

DenseCap by Justin Johnson & group

<https://github.com/jcjohnson/densecap>



Today's AI

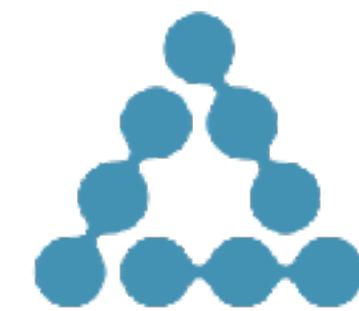
Future AI

Tools for AI

Today's AI



DeepMask by Pedro Pinhero & group



Today's AI



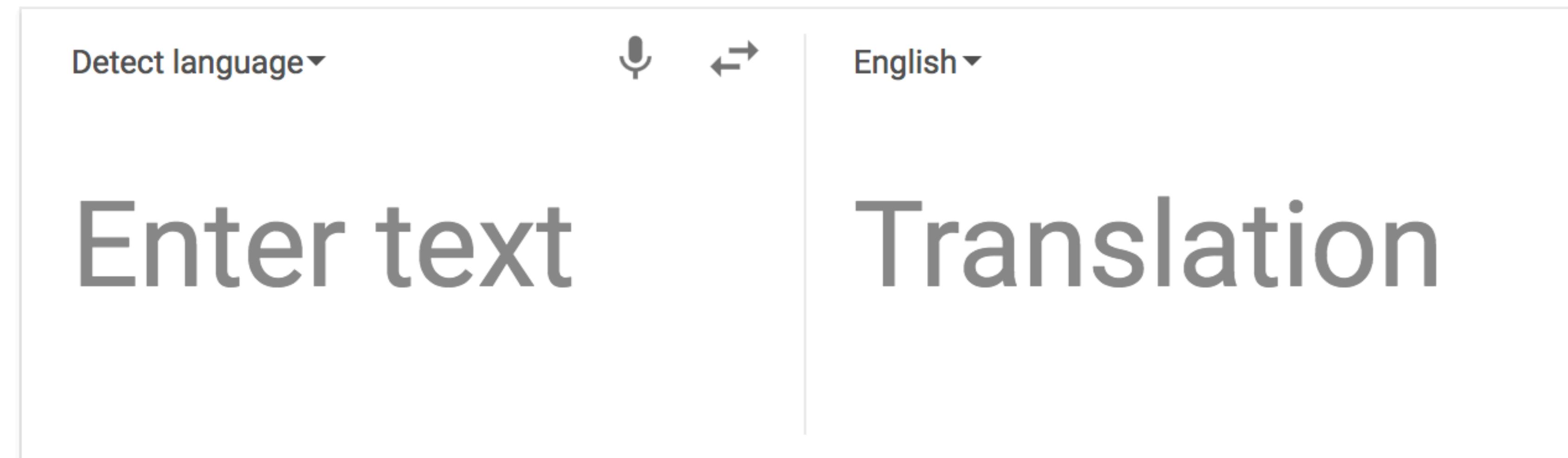
Future AI



Tools for AI

Today's AI

Machine Translation



Today's AI



Future AI



Tools for AI

Today's AI

Text Classification (sentiment analysis etc.)

Text Embeddings

Graph embeddings

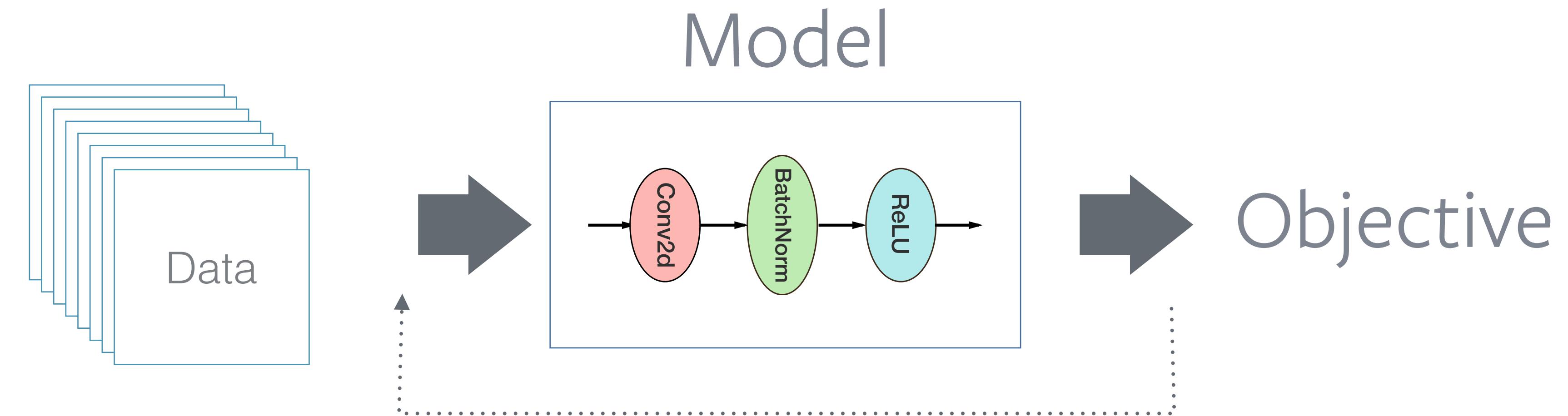
Machine Translation

Ads ranking



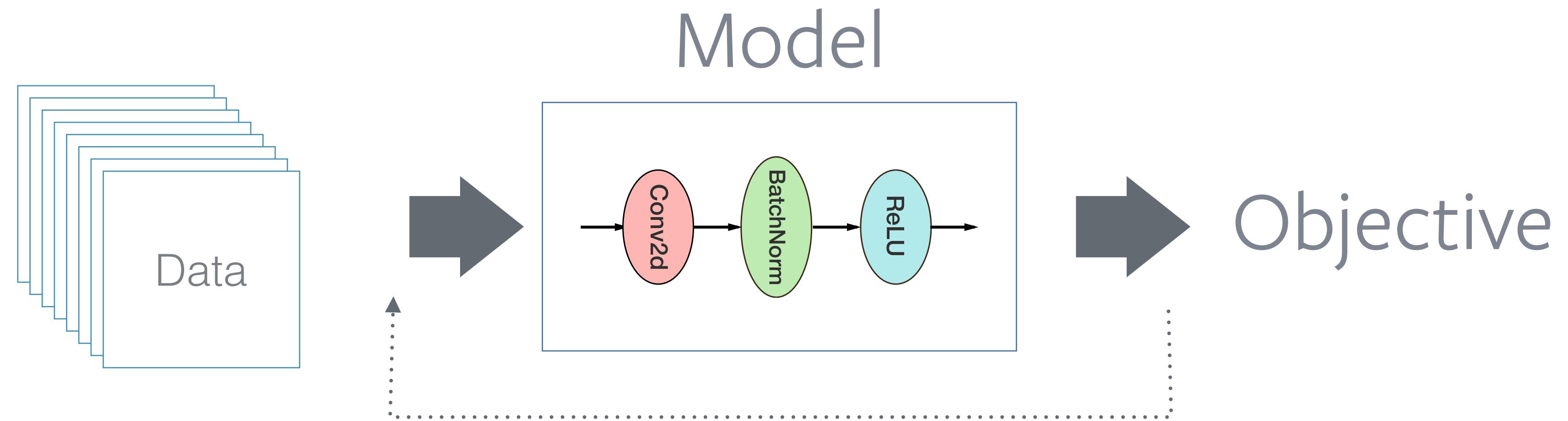
Today's AI

Train Model

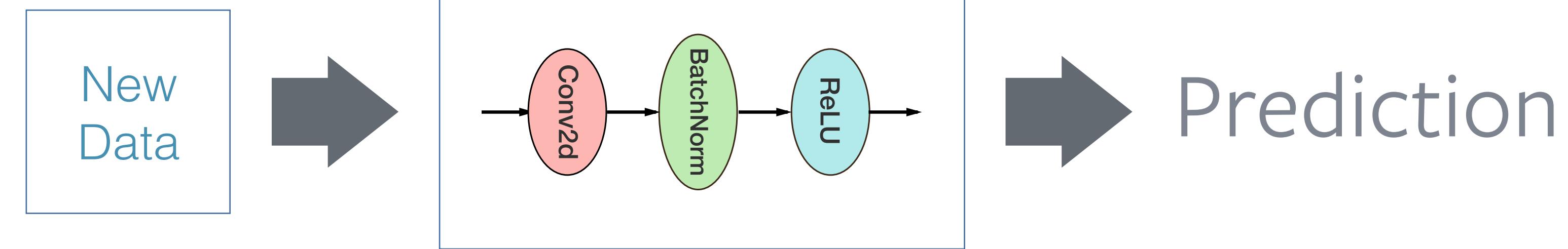


Today's AI

Train Model



Deploy & Use



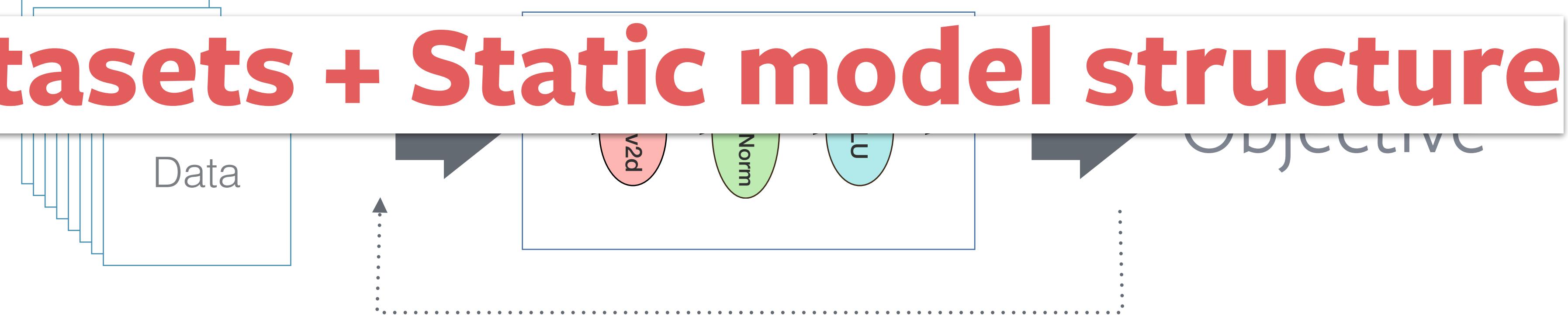
Today's AI

Future AI

Tools for AI

Today's AI

- Static datasets + Static model structure



Deploy & Use

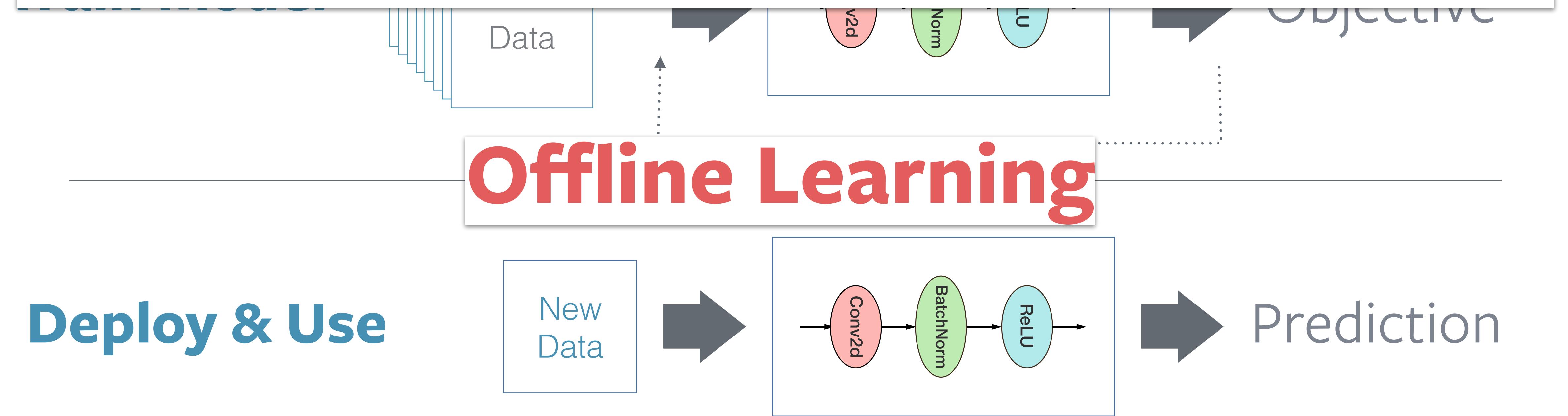


Prediction



Today's AI

- Static datasets + Static model structure



Today's AI



Future AI



Tools for AI

Current AI Research / Future AI

Self-driving Cars



Today's AI



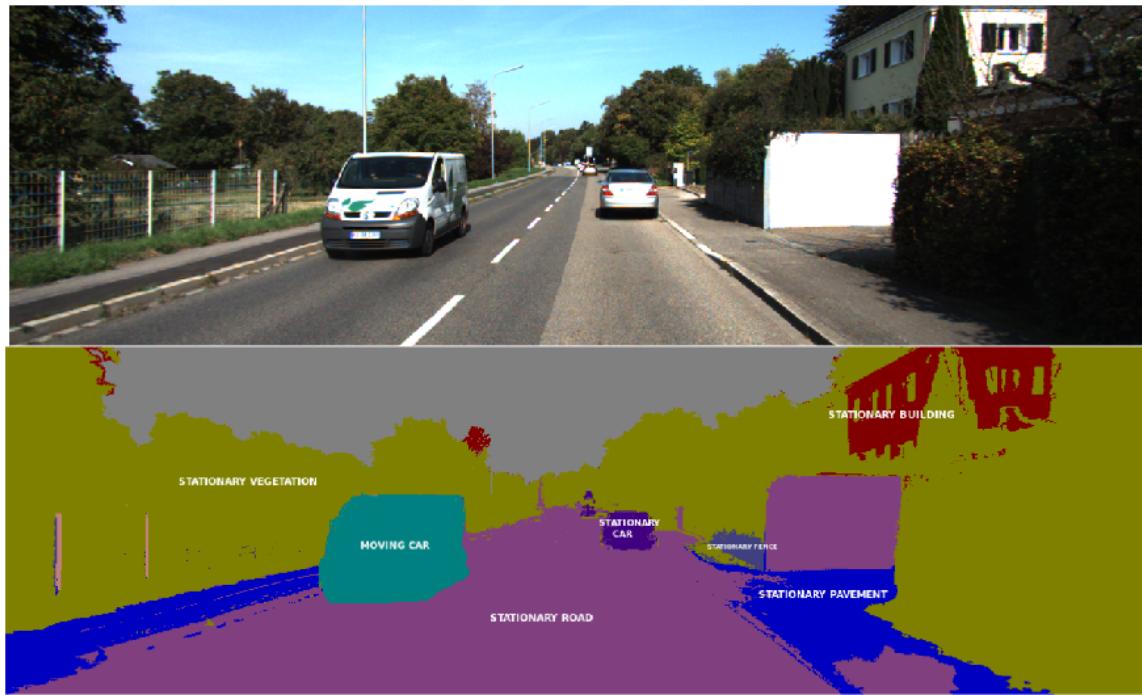
Future AI



Tools for AI

Current AI Research / Future AI

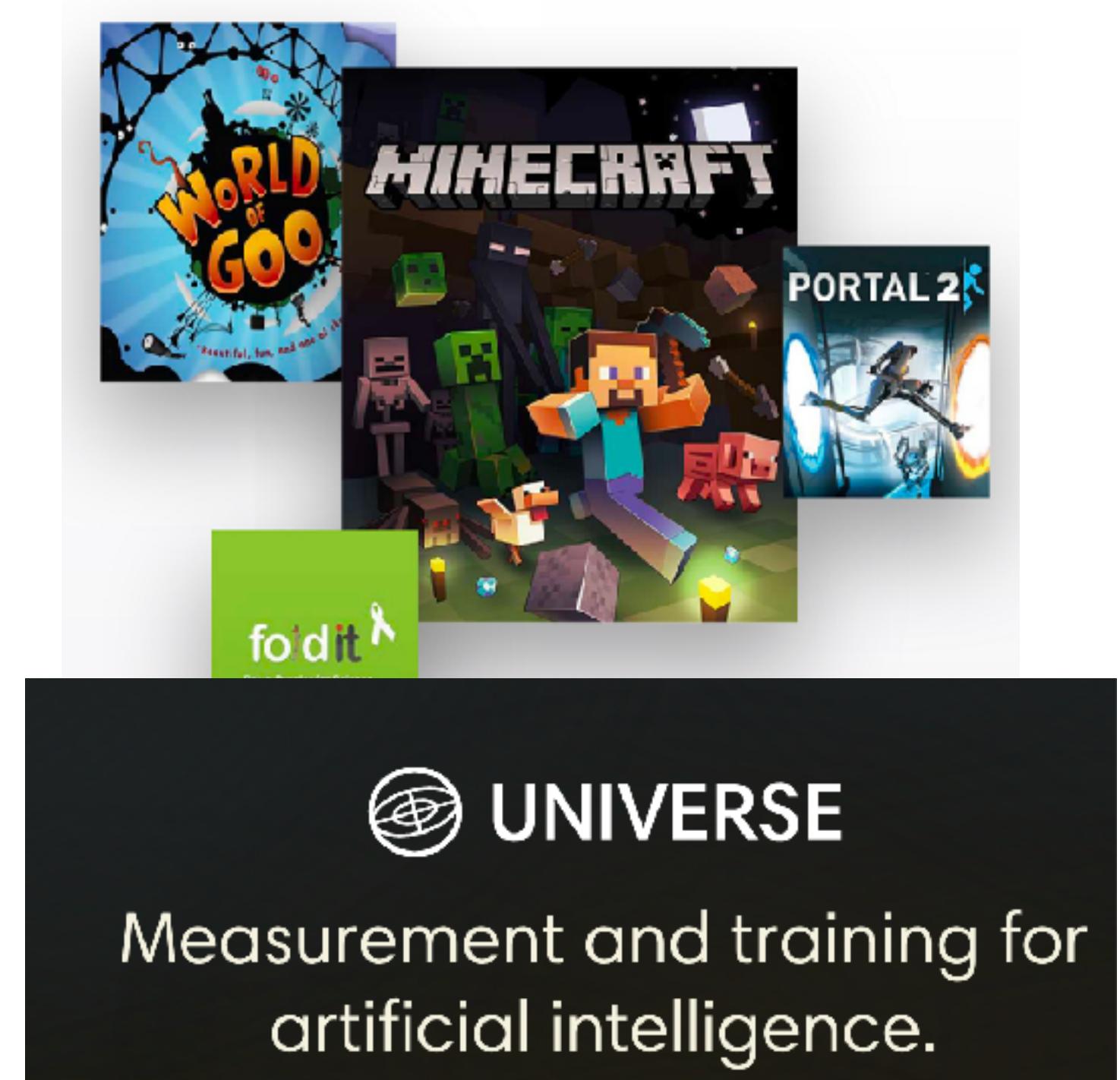
Agents trained in many environments



Cars



Video games



foldit

UNIVERSE

Measurement and training for
artificial intelligence.

Internet

Today's AI



Tools for AI

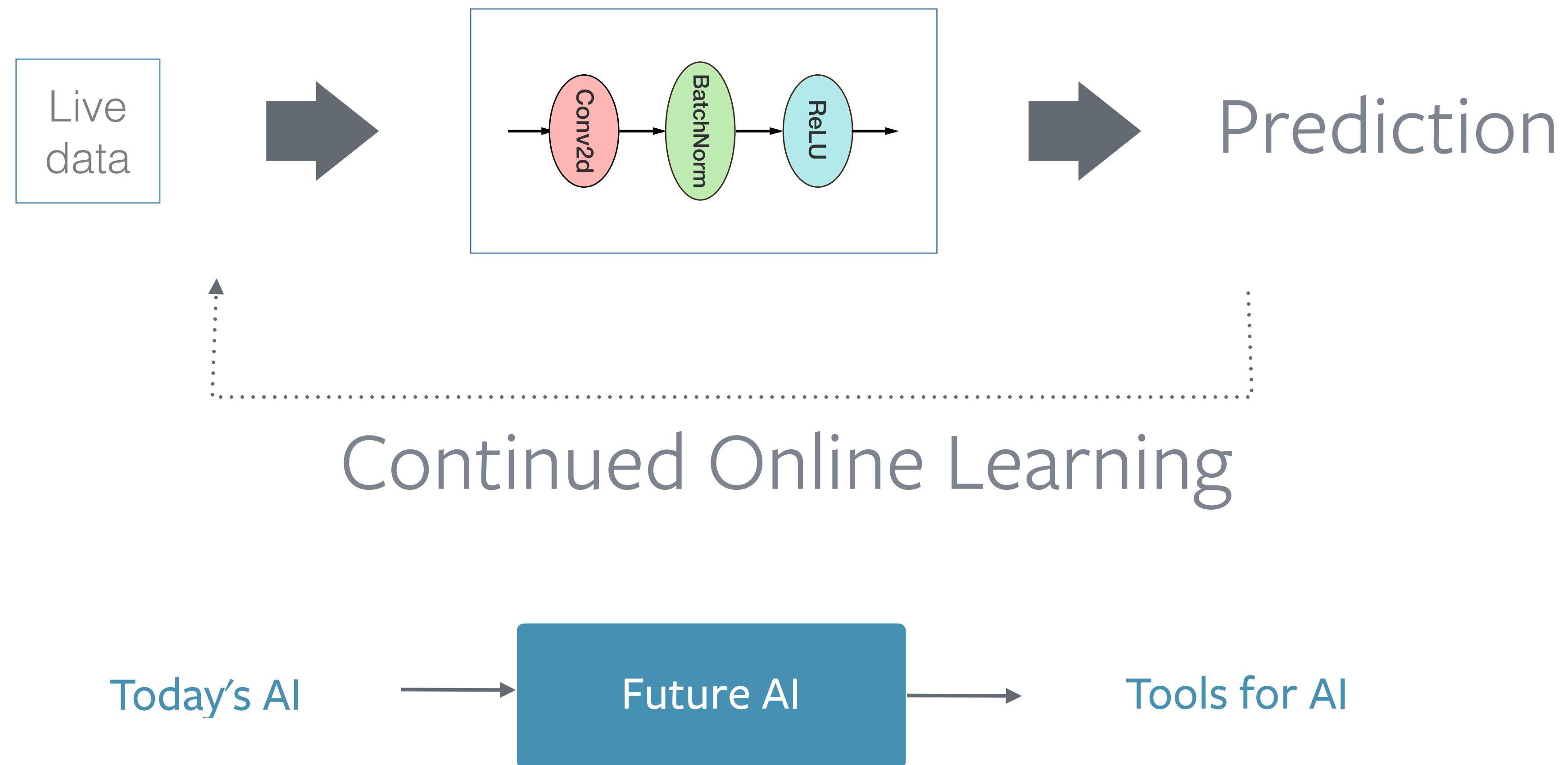
Current AI Research / Future AI

Dynamic Neural Networks

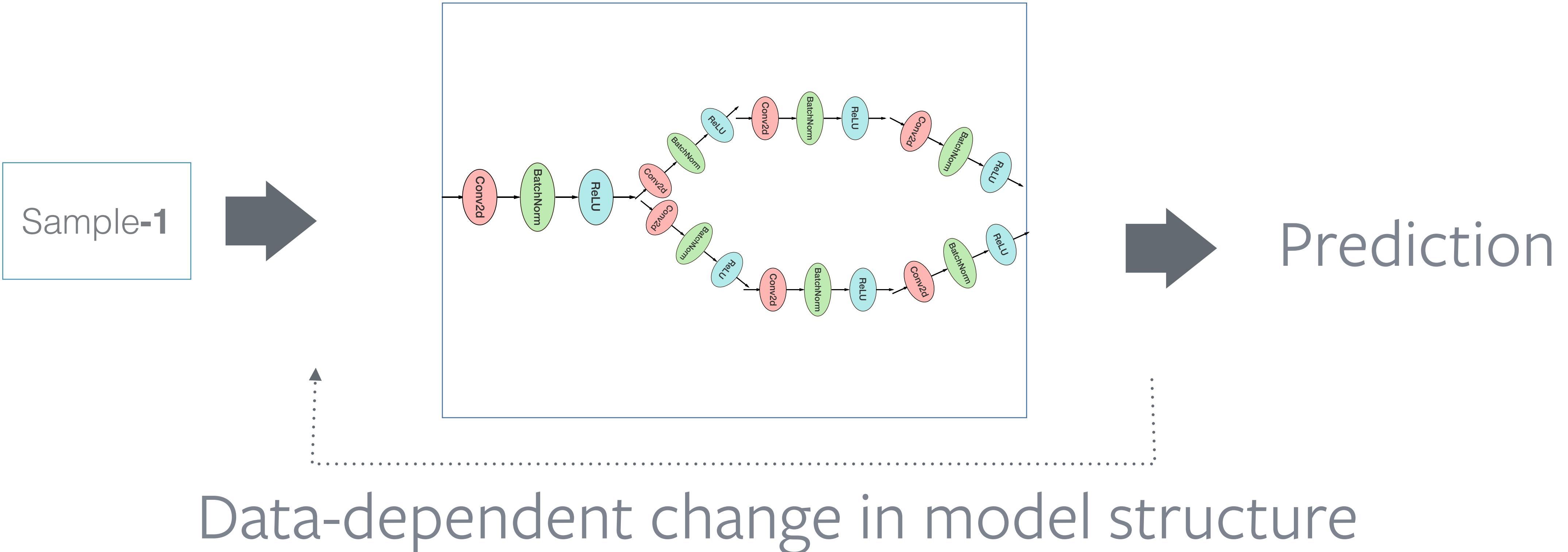
self-adding new memory or layers
changing evaluation path based on inputs



Current AI Research / Future AI



Current AI Research / Future AI

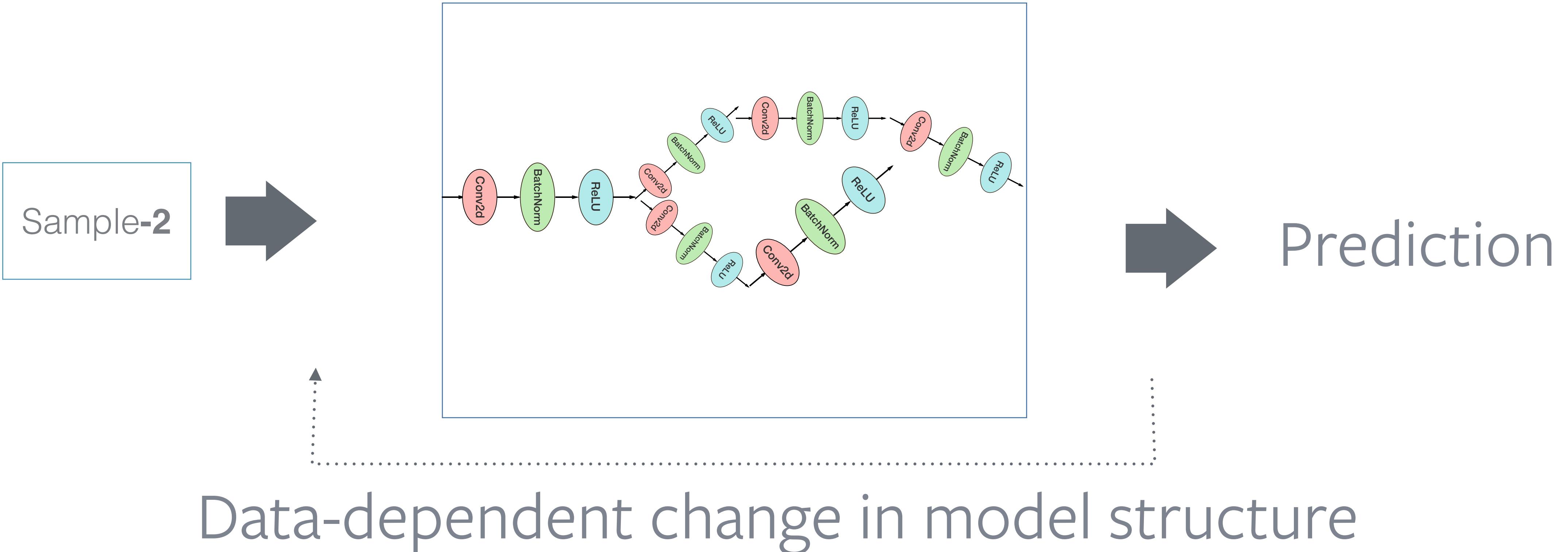


Today's AI

Future AI

Tools for AI

Current AI Research / Future AI

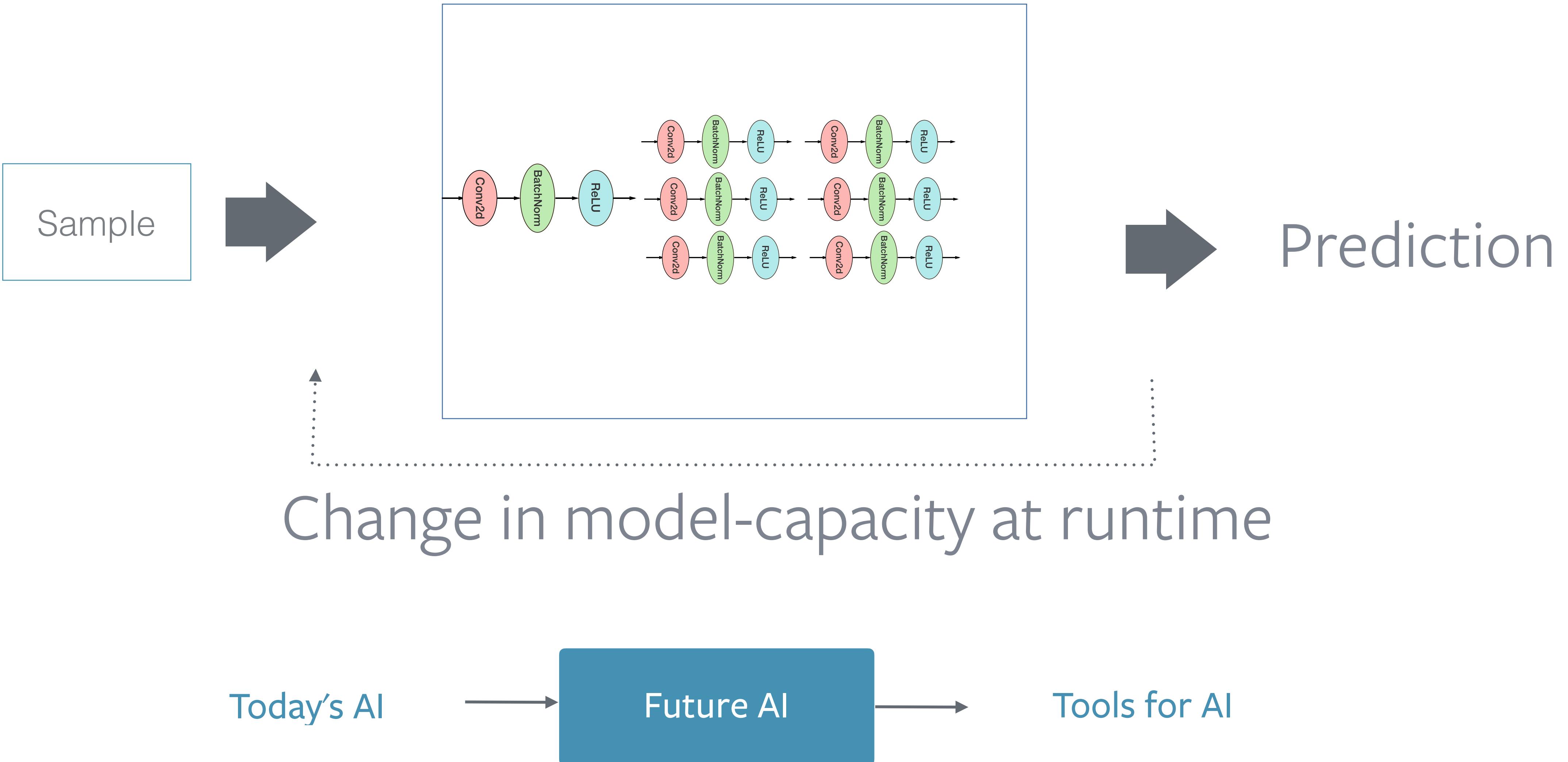


Today's AI

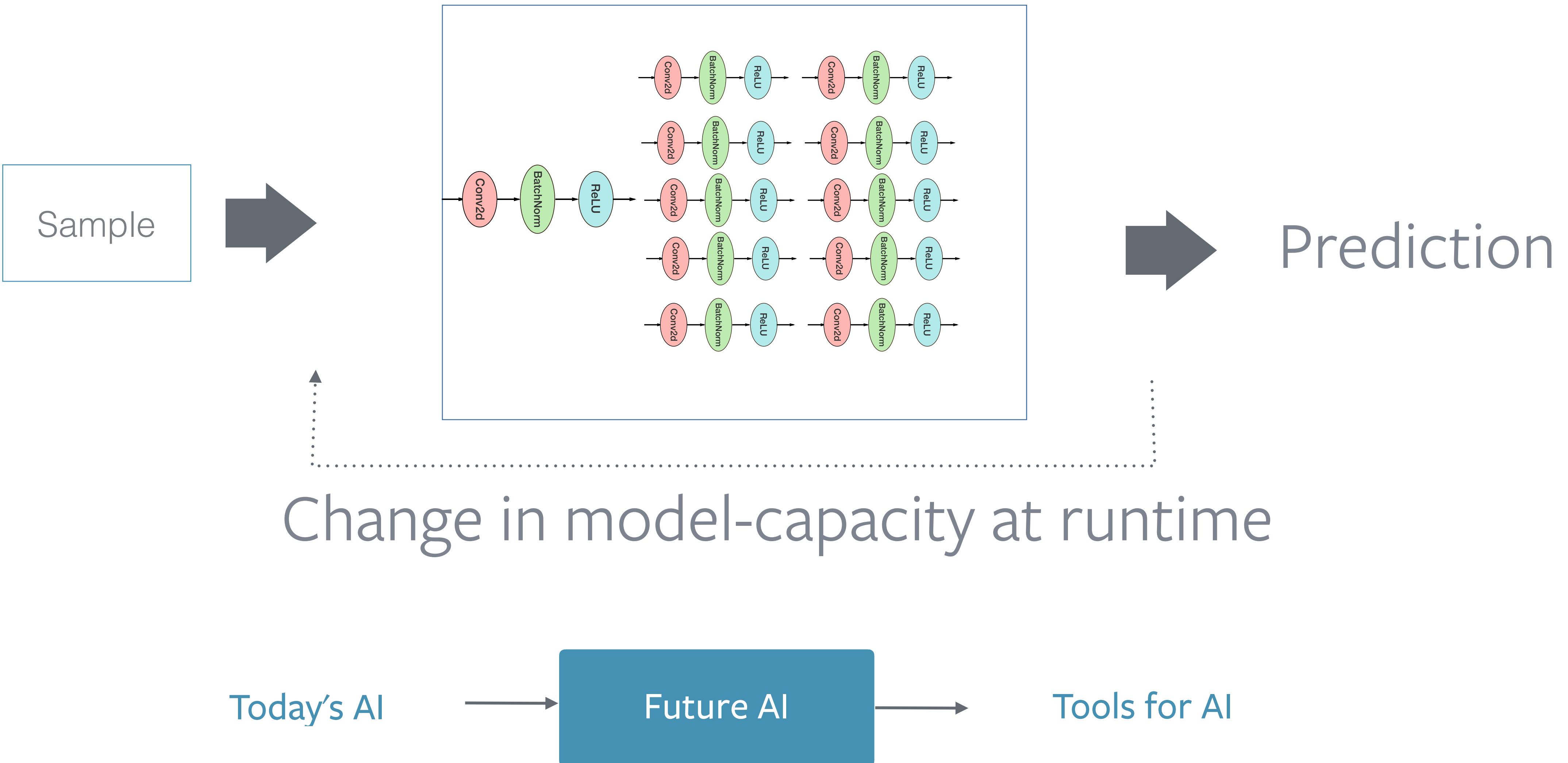
Future AI

Tools for AI

Current AI Research / Future AI



Current AI Research / Future AI



A next-gen framework for AI

- Interop with many dynamic environments
 - Connecting to car sensors should be as easy as training on a dataset
 - Connect to environments such as OpenAI Universe
- Dynamic Neural Networks
 - Change behavior and structure of neural network at runtime
- Minimal Abstractions
 - more complex AI systems means harder to debug without a simple API



Tools for AI research and deployment

Many machine learning tools and deep learning frameworks



theano

Caffe



Today's AI



Future AI



Tools for AI

Tools for AI research and deployment

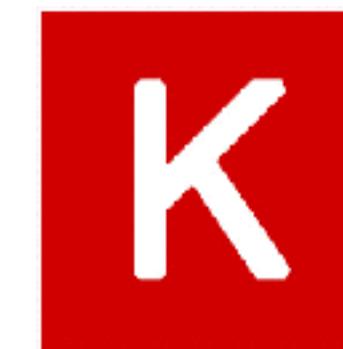
Static graph frameworks



TensorFlow



theano



Caffe



Dynamic graph frameworks



Today's AI



Future AI



Tools for AI

Dynamic graph Frameworks

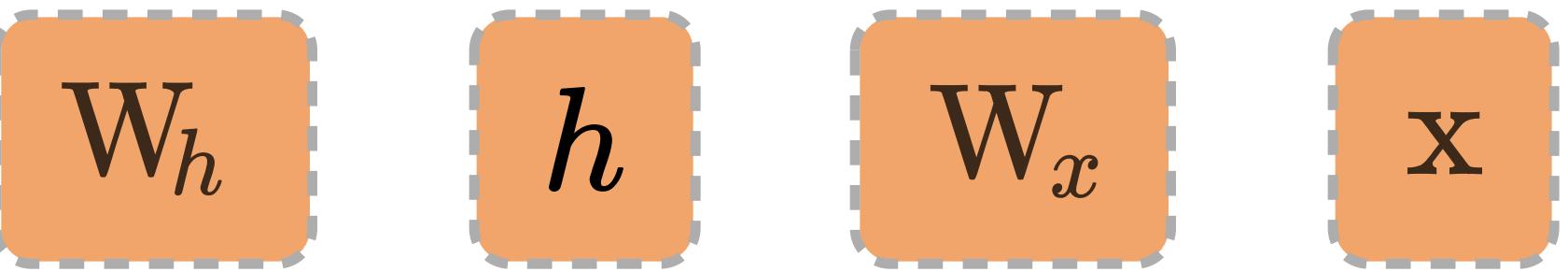
- Model is constructed on the fly at runtime
- Change behavior, structure of model
- Imperative style of programming



PyTorch Autograd

```
from torch.autograd import Variable
```

PyTorch Autograd

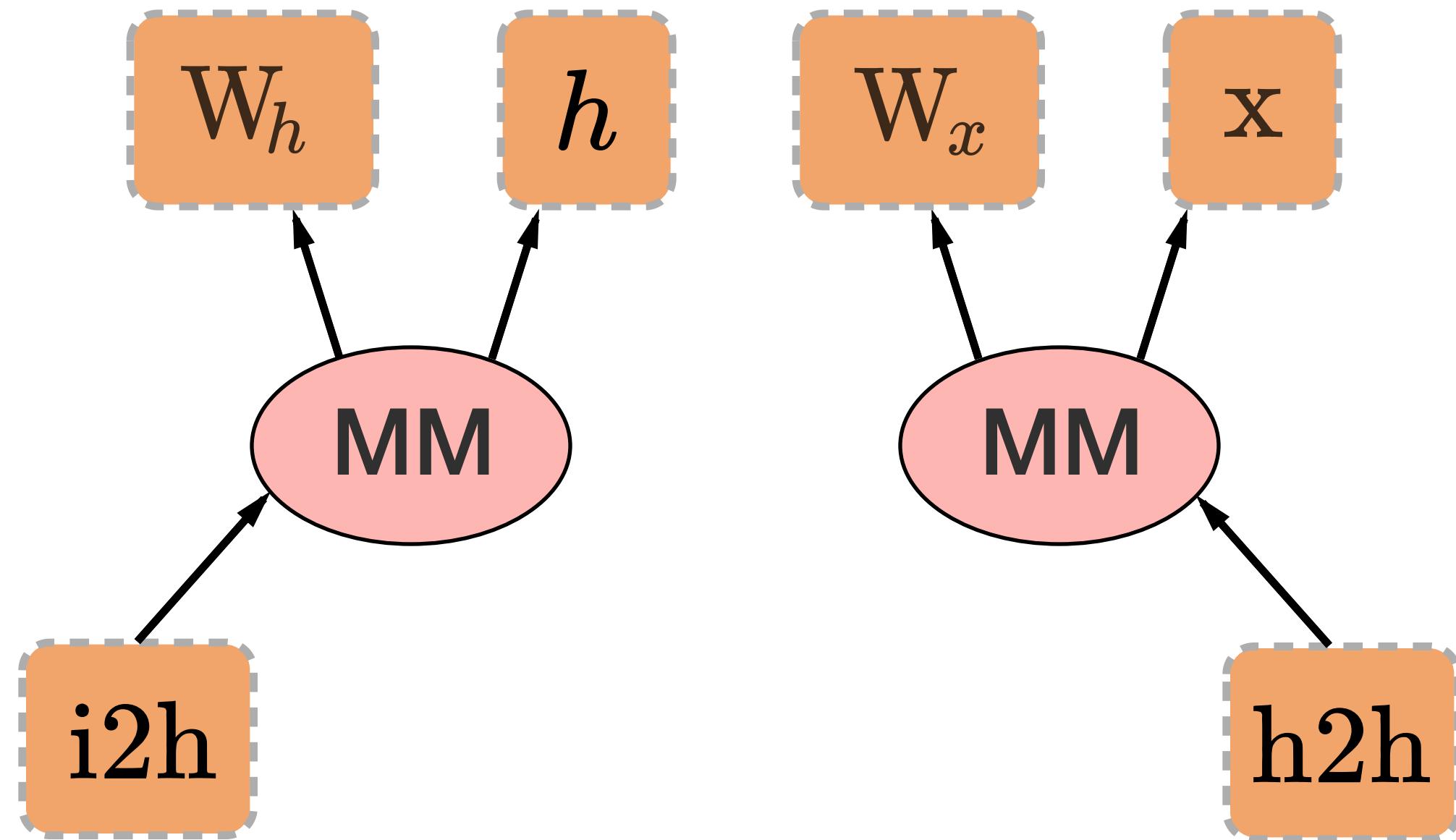


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from torch.autograd import Variable
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```
x = Variable(torch.randn(1, 10))
prev_h = Variable(torch.randn(1, 20))
W_h = Variable(torch.randn(20, 20))
W_x = Variable(torch.randn(20, 10))
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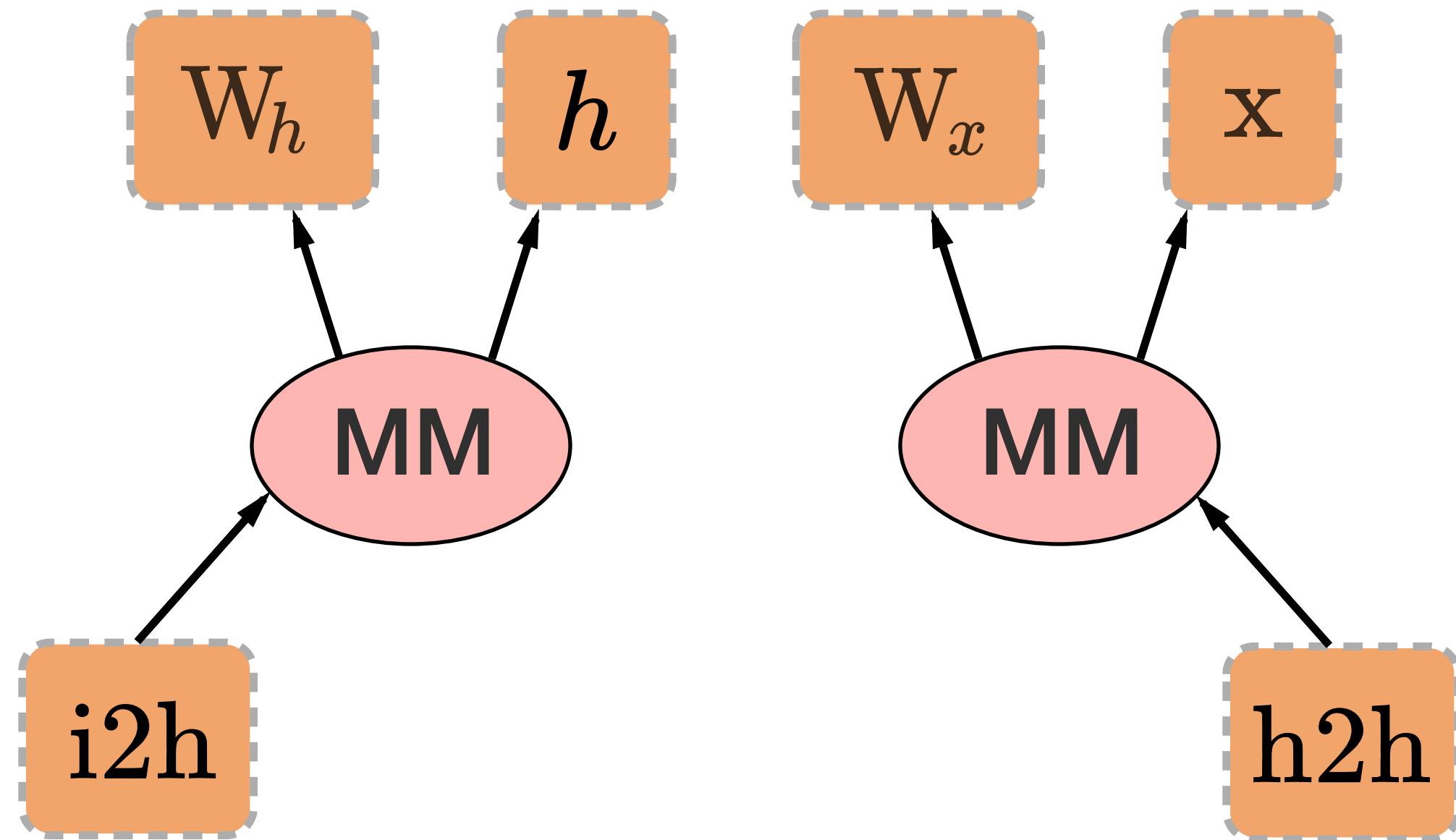
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W_x = Variable(torch.randn(20, 10))  
  
i2h = torch.mm(W_x, x.t())  
h2h = torch.mm(W_h, prev_h.t())
```



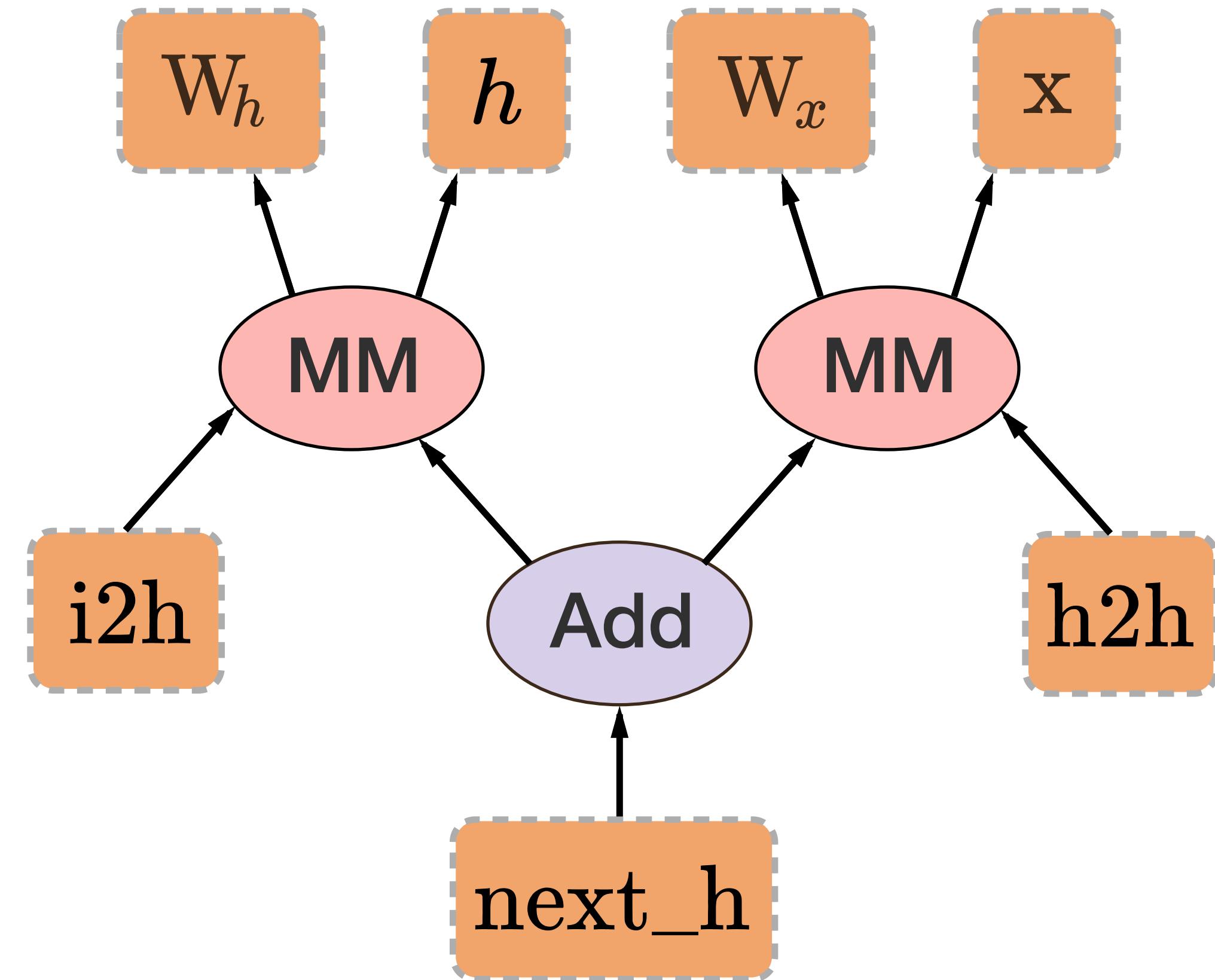
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i2h = torch.mm(W_x, x.t())  
h2h = torch.mm(W_h, prev_h.t())  
next_h = i2h + h2h
```



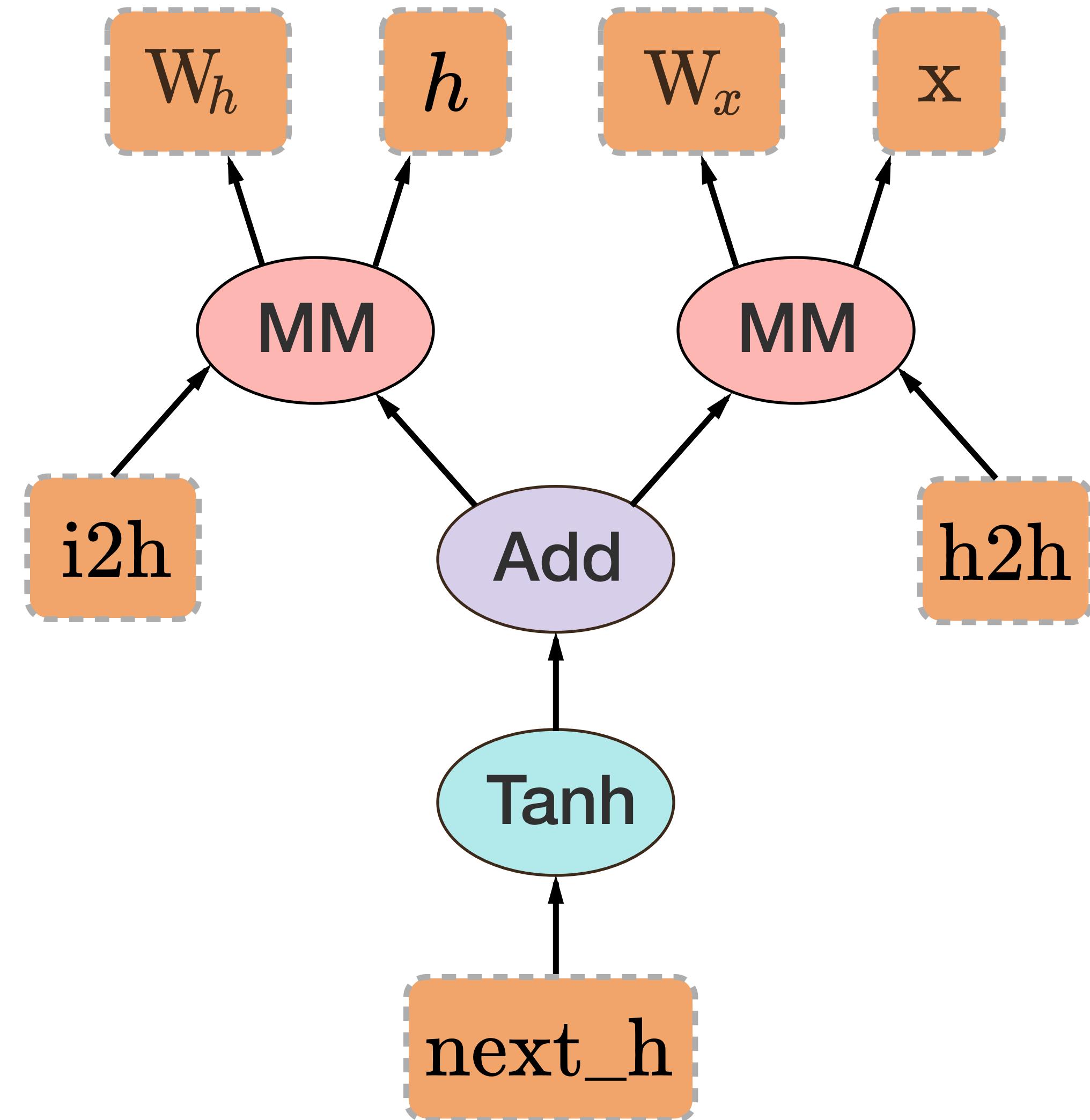
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```



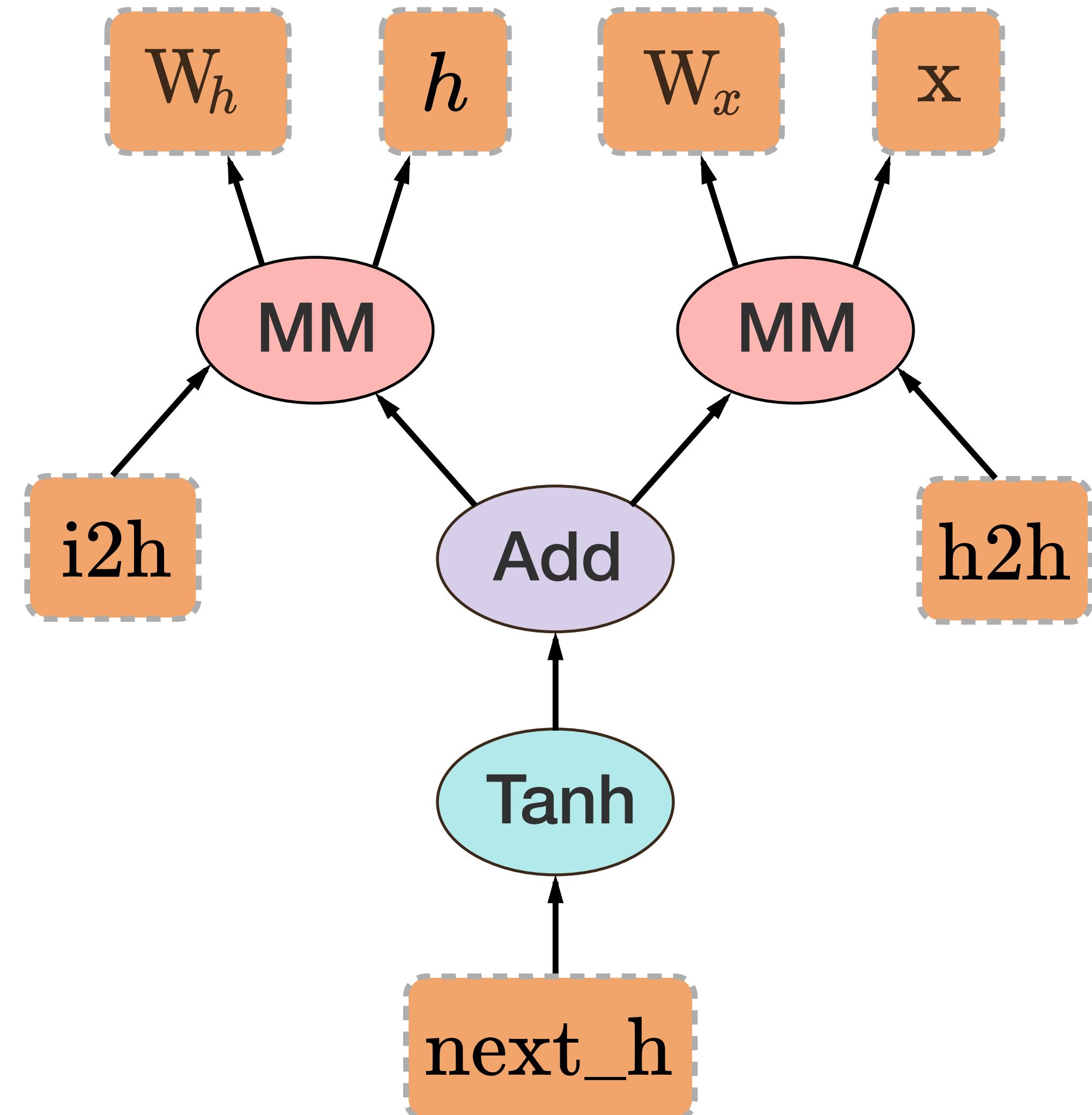
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next_h = i2h + h2h  
next_h = next_h.tanh()
```



PyTorch Autograd

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i2h = torch.mm(W_x, x.t())  
h2h = torch.mm(W_h, prev_h.t())  
next_h = i2h + h2h  
next_h = next_h.tanh()  
  
next_h.backward(torch.ones(1, 20))
```





<http://pytorch.org>

Released Jan 18th

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