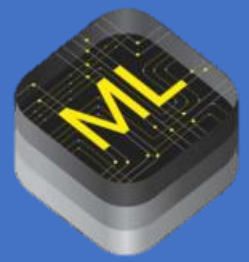
MMDNN:
Deep Learning Model Interoperation

https://github.com/Microsoft/MMdnn

Want to try DNNs?

You can choose



TENS OF THEM!

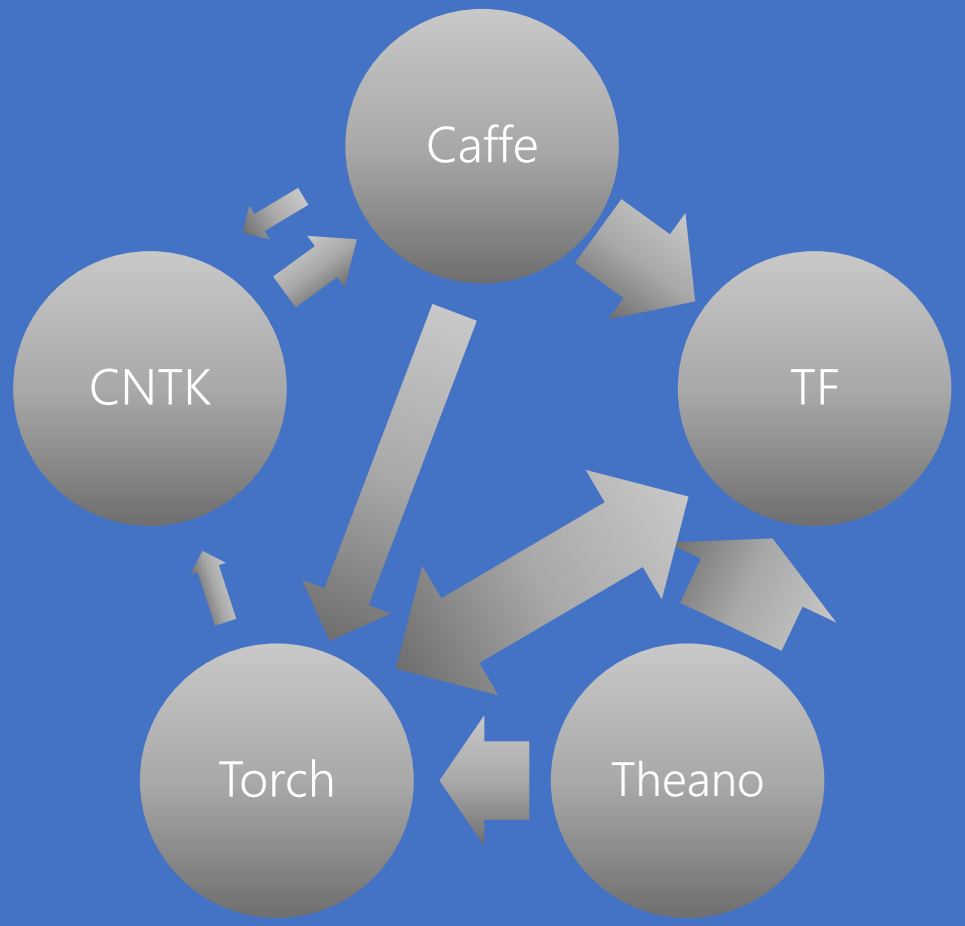
How to interoperate and collaborate?

People keep asking

Looking for Model Interoperation

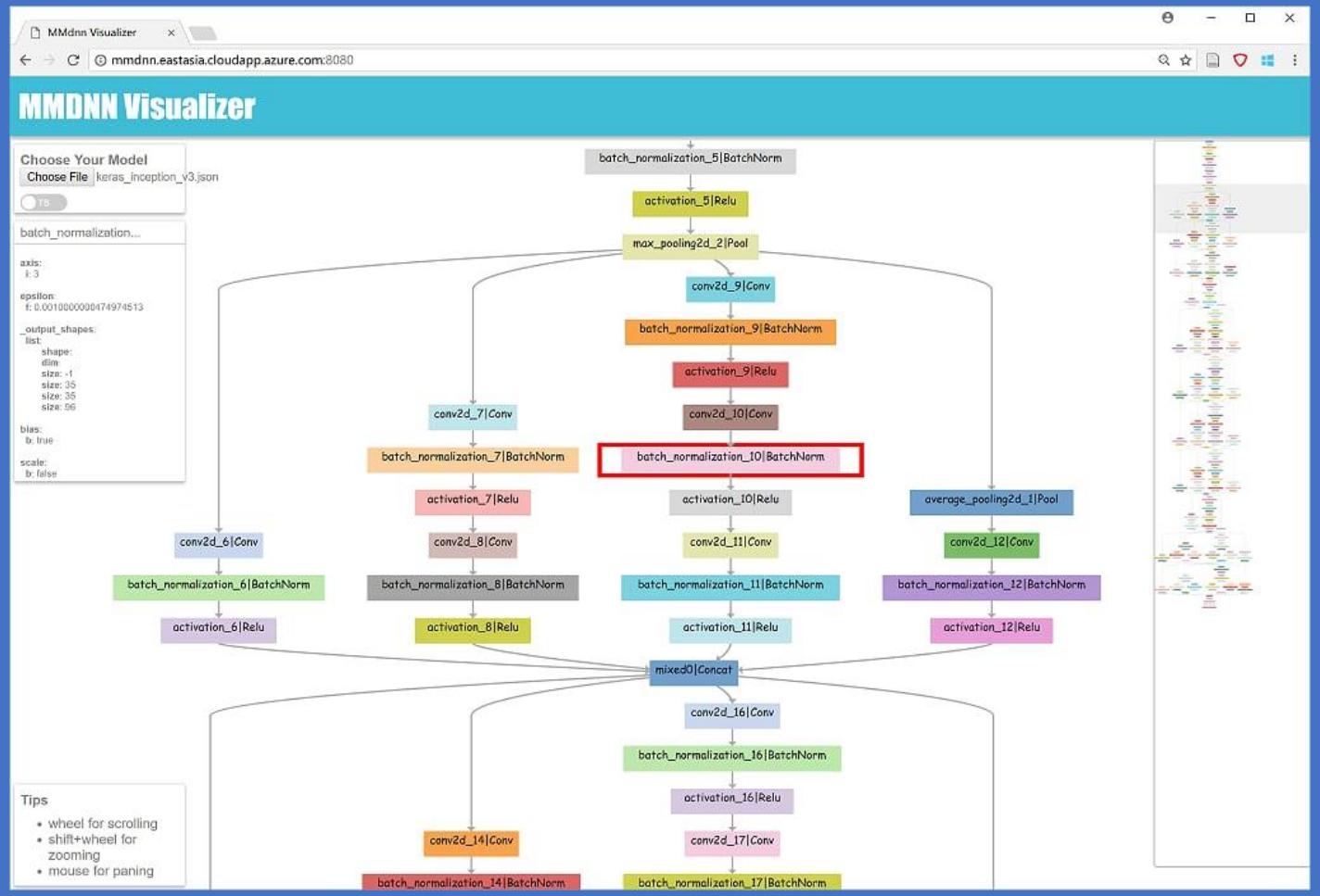
We mine search queries in Bing

- Universal Visualization and Editing
- Training/Inference Code Snippet Gen
- Pre-trained Model Converter
- Compatibility Testing

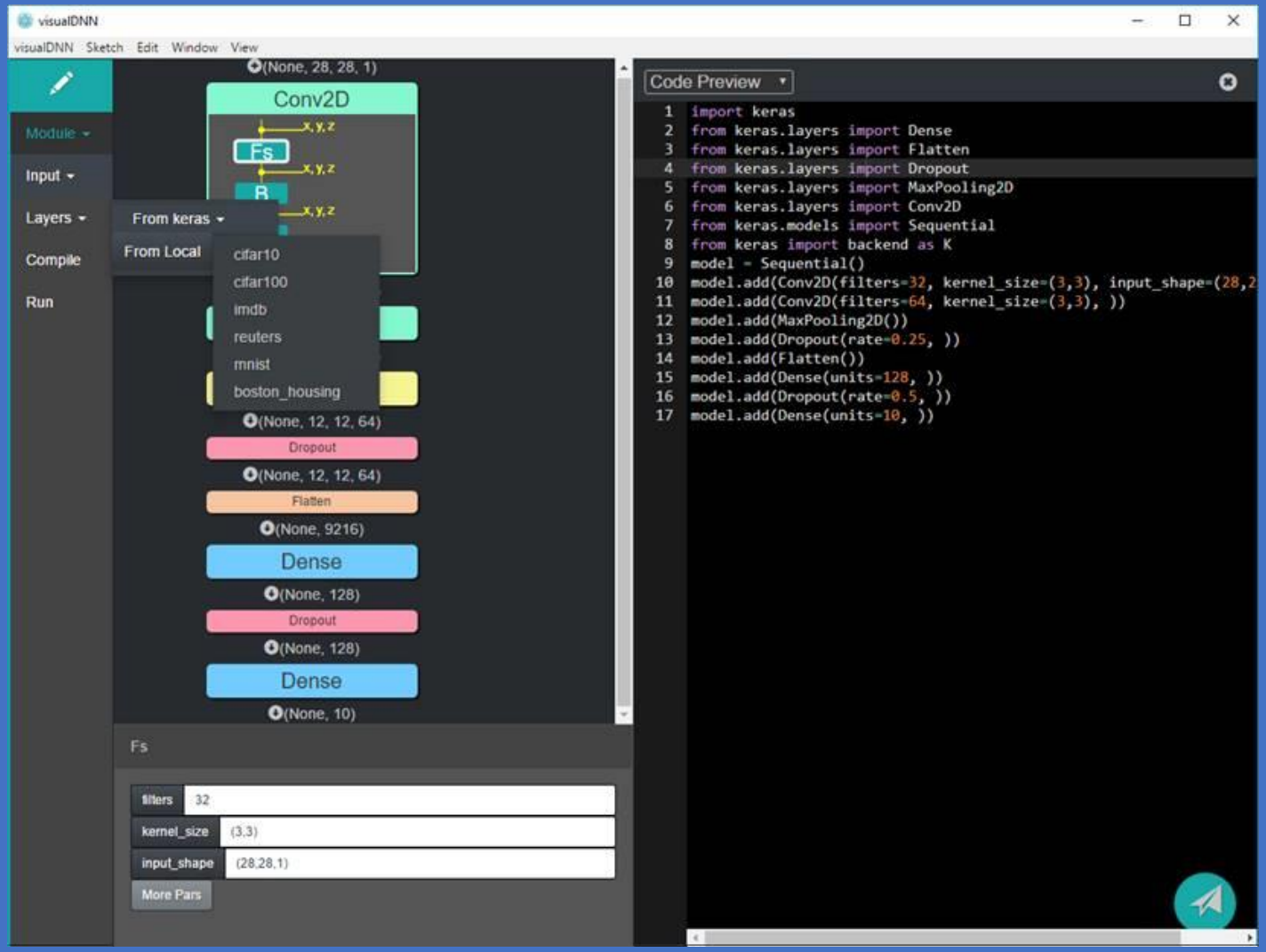


* Bigger the arrow, more popular the trend is.

Visualization and Editing



Visualization and Editing



Code Gen and Model Zoo

Generate code from one framework to others

```
name: "GoogleNet"
layer {
  name: "data"
  type: "Input"
  top: "data"
  input_param { shape: { dim: 10 di
}
layer {
  name: "conv1/7x7_s2"
  type: "Convolution"
  bottom: "data"
  top: "conv1/7x7_s2"
  param {
    lr_mult: 1
    decay_mult: 1
  }
  param {
    lr_mult: 2
    decay_mult: 0
  }
  convolution_param {
```

Caffe → TensorFlow, PyTorch, CNTK

```
def KitModel(weight_file = None):
class KitModel(nn.Module):


    def __init__(self, weight_file):
        super(KitModel, self).__init__()
        global __weights_dict
        __weights_dict = load_weights(weight_file)

        self.conv1_7x7_s2 = self.__conv(2, name='conv1/7x7_s2', in_channels=3, out_channels=64, kernel_size=(
        self.conv2_3x3_reduce = self.__conv(2, name='conv2/3x3_reduce', in_channels=64, out_channels=64, kernn=(1,), gro
        self.conv2_3x3 = self.__conv(2, name='conv2/3x3', in_channels=64, out_channels=192, kernel_size=(3, 33x3_reduce)
        self.inception_3a_3x3_reduce = self.__conv(2, name='inception_3a/3x3_reduce', in_channels=192, out_chdilation=(1
        self.inception_3a_5x5_reduce = self.__conv(2, name='inception_3a/5x5_reduce', in_channels=192, out_ch
        ...

    def forward(self, x):
        conv1_7x7_s2_pad = F.pad(x, (3, 3, 3, 3))
        conv1_7x7_s2    = self.conv1_7x7_s2(conv1_7x7_s2_pad)
        conv1_relu_7x7  = F.relu(conv1_7x7_s2)
        pool1_3x3_s2_pad = F.pad(conv1_relu_7x7, (0, 1, 0, 1), value=float('-Inf'))
        pool1_3x3_s2    = F.max_pool2d(pool1_3x3_s2_pad, kernel_size=(3, 3), stride=(2, 2))
        ...
    inception_3a_relu_1x1 = layers.Activation(activation = ops.relu, name = 'inception_3a/relu_1x1')(inception_3a_1x1)
```

Code Gen and Model Zoo

Models	Caffe	Keras	Tensorflow	CNTK	MXNet	PyTorch	CoreML
Inception V1	√	√	√	√	√	x (No LRN)	√
Inception V3	×	√	√	√	√	√	√
Inception V4	√						
ResNet V1 50	×	√	√	o	√	√	√
ResNet V2 152	√	√	√	√	√	√	
VGG 19	√	√	√	√	√	√	√
MobileNet_v1	×	√	√	o (only Relu)	×	×	√
Xception	×	√	√	×	×	×	
SqueezeNet	√	√	√	√	√	×	

Model Conversion

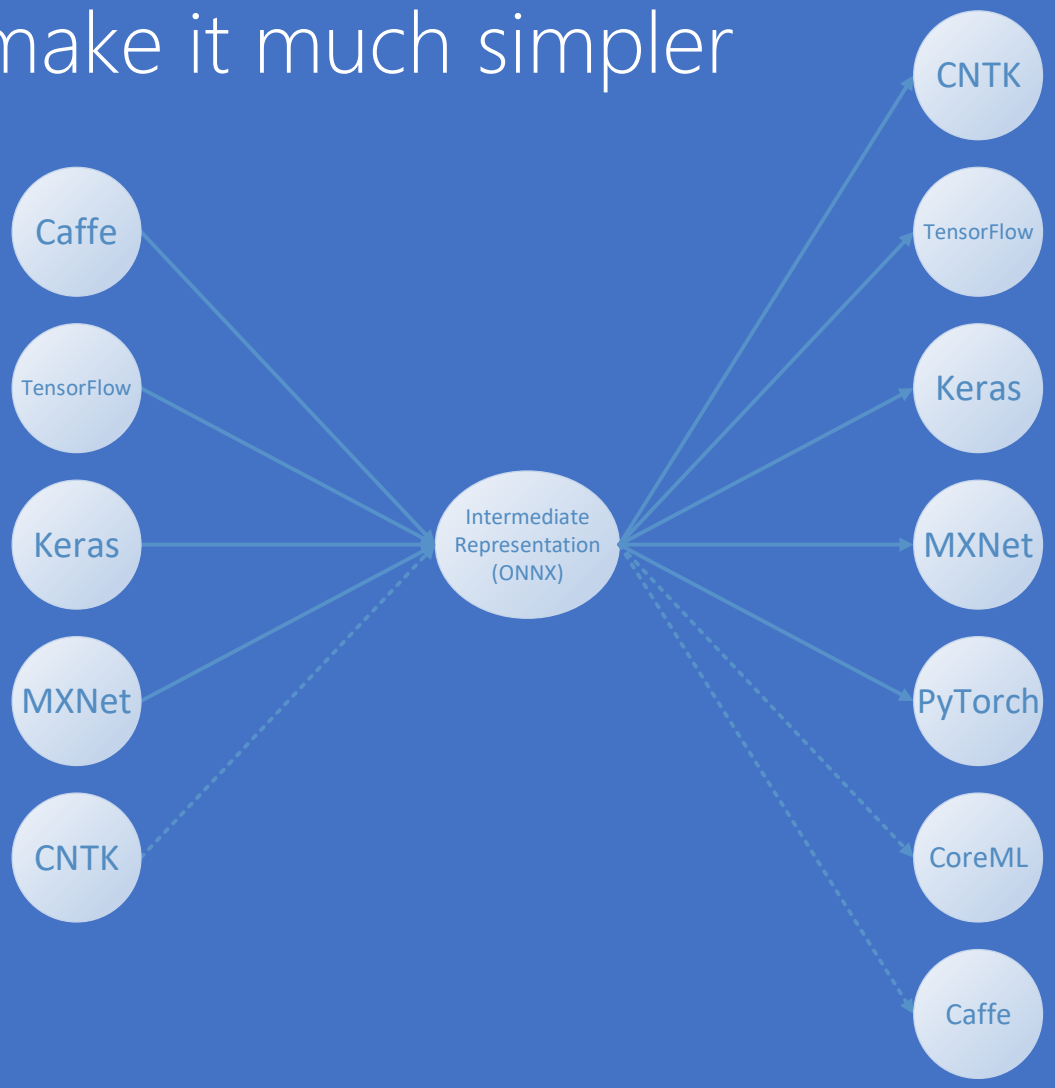
Before MMdnn, we have to make it one by one.

$O(n^2)$

convertor	mxnet	caffe :sparkles:	caffe2	CNTK	theano/lasagne	neon	pytorch:sparkles:	torch	keras :sparkles:			chainer	coreML/iOS :sparkles:
mxnet	-	MMdnn MXNet2Caffe Mxnet2Caffe	None	MMdnn	None	None	MMdnn	None	MMdnn			None	mxnet-to-coreml MMdnn
caffe :sparkles:	mxnet/tools/caffe_converter ResNet_caffe2mxnet MMdnn	-	CaffeToCaffe2	crosstalkcaffe/CaffeConverter MMdnn	caffe_theano_conversion caffe-model-convert caffe-to-theano	caffe2neon	MMdnn pytorch-caffe-darknet-convert pytorch-resnet	googlenet-caffe2torch mocha	caffe_weight_converter caffe2keras nn_tools keras caffe2keras Deep_Learning_Model_Converter MMdnn	pytorch-caffe-darknet-convert	MMdnn nn_tools caffe-tensorflow	None	CoreMLZoo apple/coremltools MMdnn
caffe2	None	None	-	ONNX	None	None	ONNX	None	None	None	None	None	None
CNTK	MMdnn	MMdnn	ONNX	-	None	None	ONNX MMdnn	None	MMdnn	None	MMdnn	None	MMdnn
theano/lasagne	None	None	None	None	-	None	None	None	None	None	None	None	None
neon	None	None	None	None	None	-	None	None	None	None	None	None	None
pytorch :sparkles:	None	pytorch2caffe pytorch-caffe-darknet-convert	onnx-caffe2	ONNX	None	None	-	None	pytorch2keras nn-transfer	pytorch-caffe-darknet-convert	pytorch2keras (over Keras)	None	onnx-coreml
torch	None	fb-caffe-exts/torch2caffe mocha trans-torch th2caffe	None	None	None	None	convert_torch_to_pytorch	-	None	None	None	None	torch2coreml torch2ios
keras :sparkles:	MMdnn	MMdnn nn_tools	None	MMdnn	None	None	MMdnn nn-transfer	None	-	None	nn_tools convert-to-tensorflow keras_to_tensorflow keras_to_tensorflow MMdnn	None	apple/coremltools :sparkles: model-converters keras_models MMdnn
darknet	None	pytorch-caffe-darknet-convert	None	None	None	None	pytorch-caffe-darknet-convert	None	None	-	darkflow lego_yolo	None	None
tensorflow :sparkles:	MMdnn	MMdnn nn_tools	None	crosstalk MMdnn	None	None	pytorch-tf MMdnn	None	model-converters nn_tools convert-to-tensorflow MMdnn	None	-	None	tfcoreml MMdnn
chainer	None	None	None	None	None	None	chainer2pytorch	None	None	None	None	-	None
coreML/iOS :sparkles:	None	None	None	None	None	None	None	None	None	None	None	None	-

Model Conversion

With MMdnn, we make it much simpler



O(n)

Github: https://github.com/Microsoft/MMdnn

Model Visualizer: http://mmdnn.eastasia.cloudapp.azure.com:8080/