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모두를 위한 컴퓨터 비전 딥러닝 툴킷, GluonCV 따라하기

2-1. MXNet / Gluon Overview

김무현 데이터 사이언티스트
Amazon Machine Learning Solutions Lab

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Our mission at AWS

Put machine learning in the hands of every developer

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Customers running machine learning on AWS

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The Amazon Machine Learning stack

AI SERVICES

(App developers with little knowledge of ML)

Vision

- Amazon Rekognition Image
- Amazon Rekognition Video

Speech

- Amazon Textract — NEW
- Amazon Polly
- Amazon Transcribe

Language

- Amazon Translate
- Amazon Comprehend

Chatbots

- Amazon Lex

Forecasting

- Amazon Forecast — NEW

Recommendations

- Amazon Personalize — NEW

ML SERVICES

(ML developers and data scientists)

Amazon SageMaker

- Ground Truth — NEW
- Notebooks
- Algorithms
- Marketplace — NEW
- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning — NEW
- Training
- Optimization (Neo) — NEW
- Deployment
- Hosting

ML FRAMEWORKS & INFRASTRUCTURE

(ML researchers and academics)

Frameworks

- TensorFlow
- mxnet
- PYTORCH
- Chainer
- HOROVOD

Interfaces

- GLUON
- Keras

Infrastructure

- Amazon EC2 P3 & P3DN — NEW
- Amazon EC2 C5
- FPGAs
- AWS Greengrass
- Amazon Elastic Inference — NEW
- Amazon Inferentia — NEW

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ML FRAMEWORKS &
INFRASTRUCTURE

(ML researchers
and academics)

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What you'll learn about today

History & Motivation

Being more productive as a developer

Getting more training done, in less time

Deployment: Easy, efficient and scalable

Portability and flexibility: Languages, devices, and fra meworks

Getting started and Resources

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History

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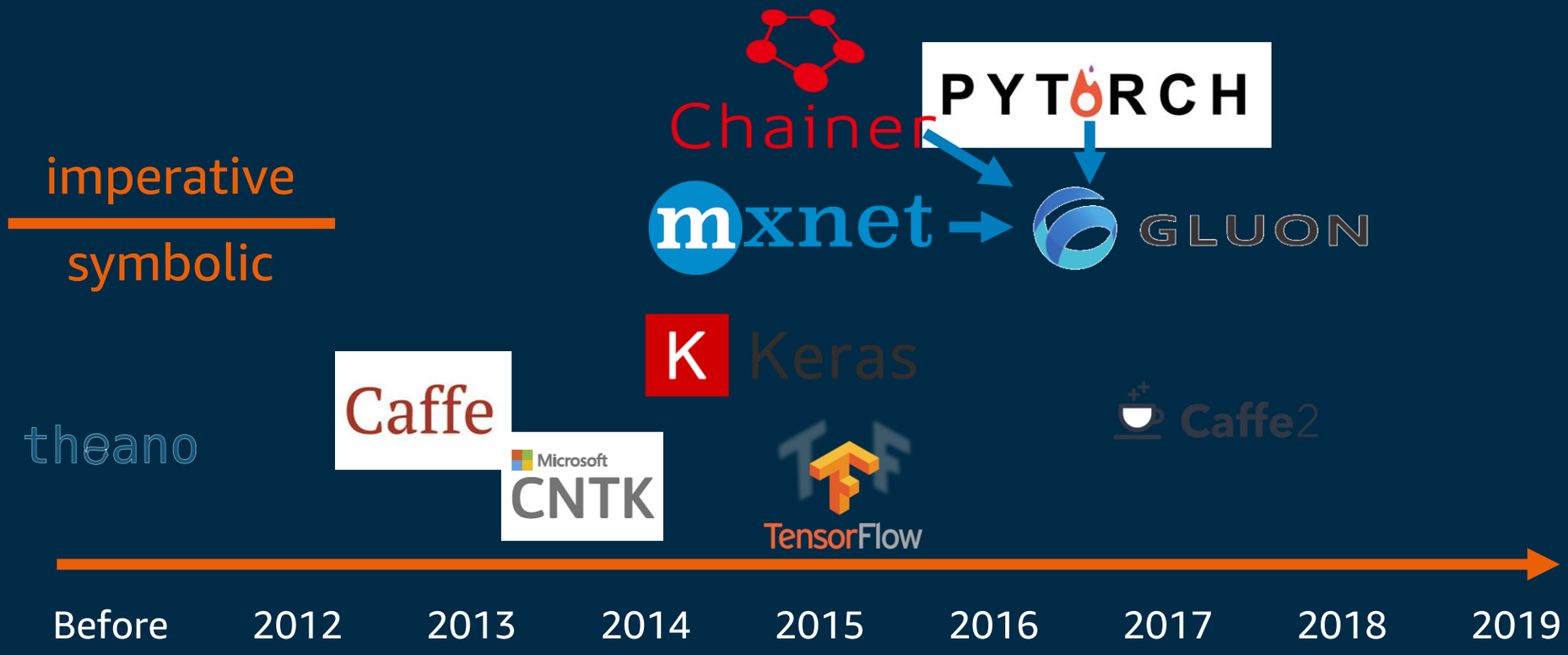
History



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MXNet and Gluon: Goals

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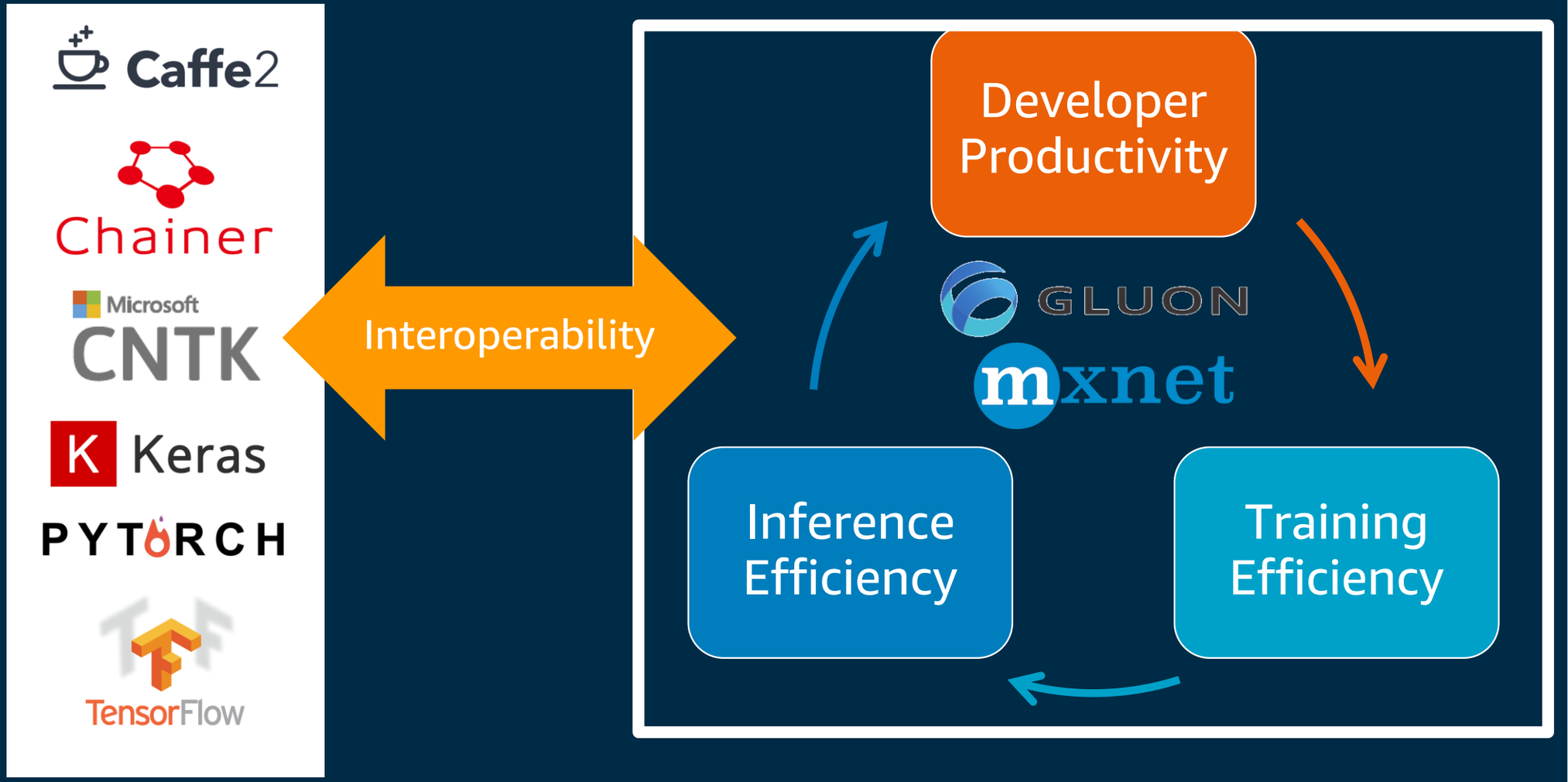
Goals



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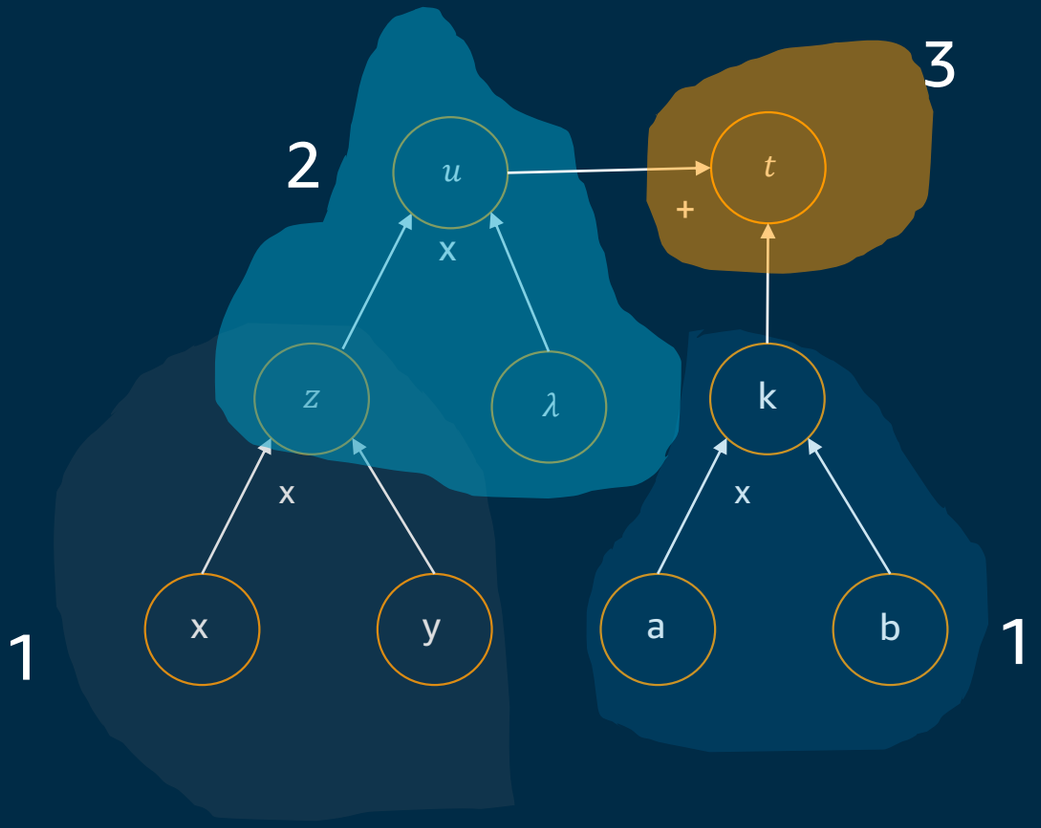
Computational dependency graph

$$z = x \cdot y$$

$$k = a \cdot b$$

$$t = \lambda z + k$$



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MXNet computational dependency graph

```
net = mx.sym.Variable('data')
net = mx.sym.FullyConnected(net, name='fc1', num_hidden=128)
net = mx.sym.Activation(net, name='relu1', act_type="relu")
net = mx.sym.FullyConnected(net, name='fc2', num_hidden=10)
net = mx.sym.SoftmaxOutput(net, name='softmax')
```

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Training

```
import logging

logging.getLogger().setLevel(logging.DEBUG)  # logging to stdout

# create a trainable module on compute context

mlp_model = mx.mod.Module(symbol=mlp, context=ctx)

mlp_model.fit(train_iter,

              eval_data=val_iter,

              optimizer='sgd',

              optimizer_params={'learning_rate':0.1},

              eval_metric='acc',

              batch_end_callback = mx.callback.Speedometer(batch_size, 100),

              num_epoch=10)
```

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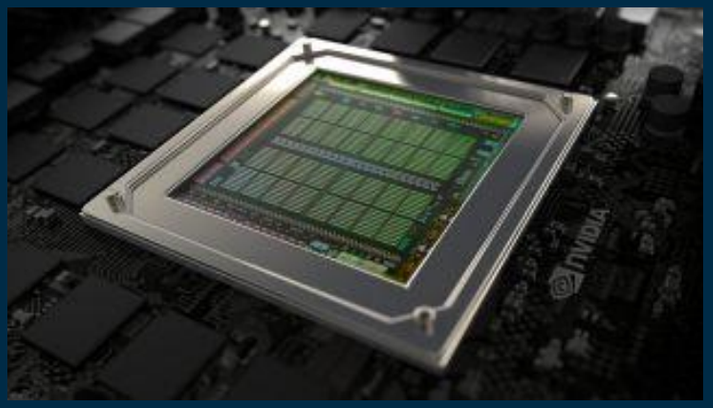
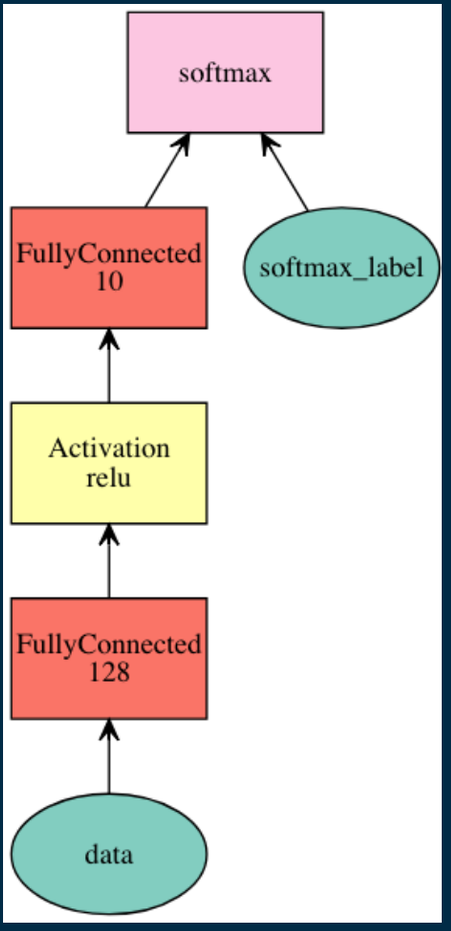
MXNet computational dependency graph

```
net = mx.sym.Variable('data')
net = mx.sym.FullyConnected(net, name='fc1', num_hidden=64)
net = mx.sym.Activation(net, name='relu1', act_type="relu")
net = mx.sym.FullyConnected(net, name='fc2', num_hidden=10)
net = mx.sym.SoftmaxOutput(net, name='softmax')
```





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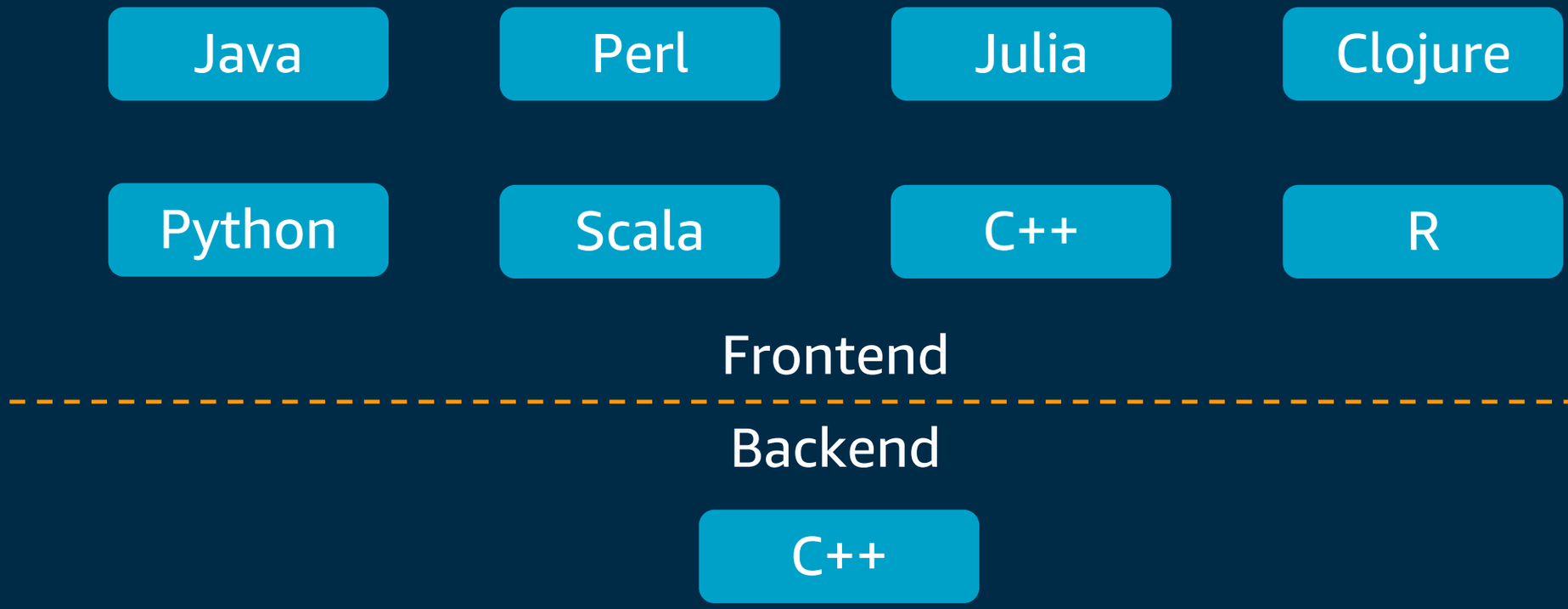
Multi-language support



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Developer Productivity

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Simple, Easy-to-Understand Code

Flexible, Imperative Structure

Dynamic Graphs

High Performance

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Network definition in Gluon

```
net = gluon.nn.HybridSequential()

with net.name_scope():

    net.add(gluon.nn.Dense(units=64, activation='relu'))

    net.add(gluon.nn.Dense(units=10))

softmax_cross_entropy = gluon.loss.SoftmaxCrossEntropyLoss()

net.initialize(mx.init.Xavier(magnitude=2.24), ctx=ctx, force_rei
nit=True)

trainer = gluon.Trainer(net.collect_params(), 'sgd', {'learning_r
ate': 0.02})
```

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Training in Gluon

```
smoothing_constant = .01
for e in range(10):
    cumulative_loss = 0
    for i, (data, label) in enumerate(train_data):
        data = data.as_in_context(model_ctx).reshape((-1, 784))
        label = label.as_in_context(model_ctx)
        with autograd.record():
            output = net(data)
            loss = softmax_cross_entropy(output, label)
        loss.backward()
        trainer.step(data.shape[0])
```

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Imperative API

Debuggable

Flexible

Scalable

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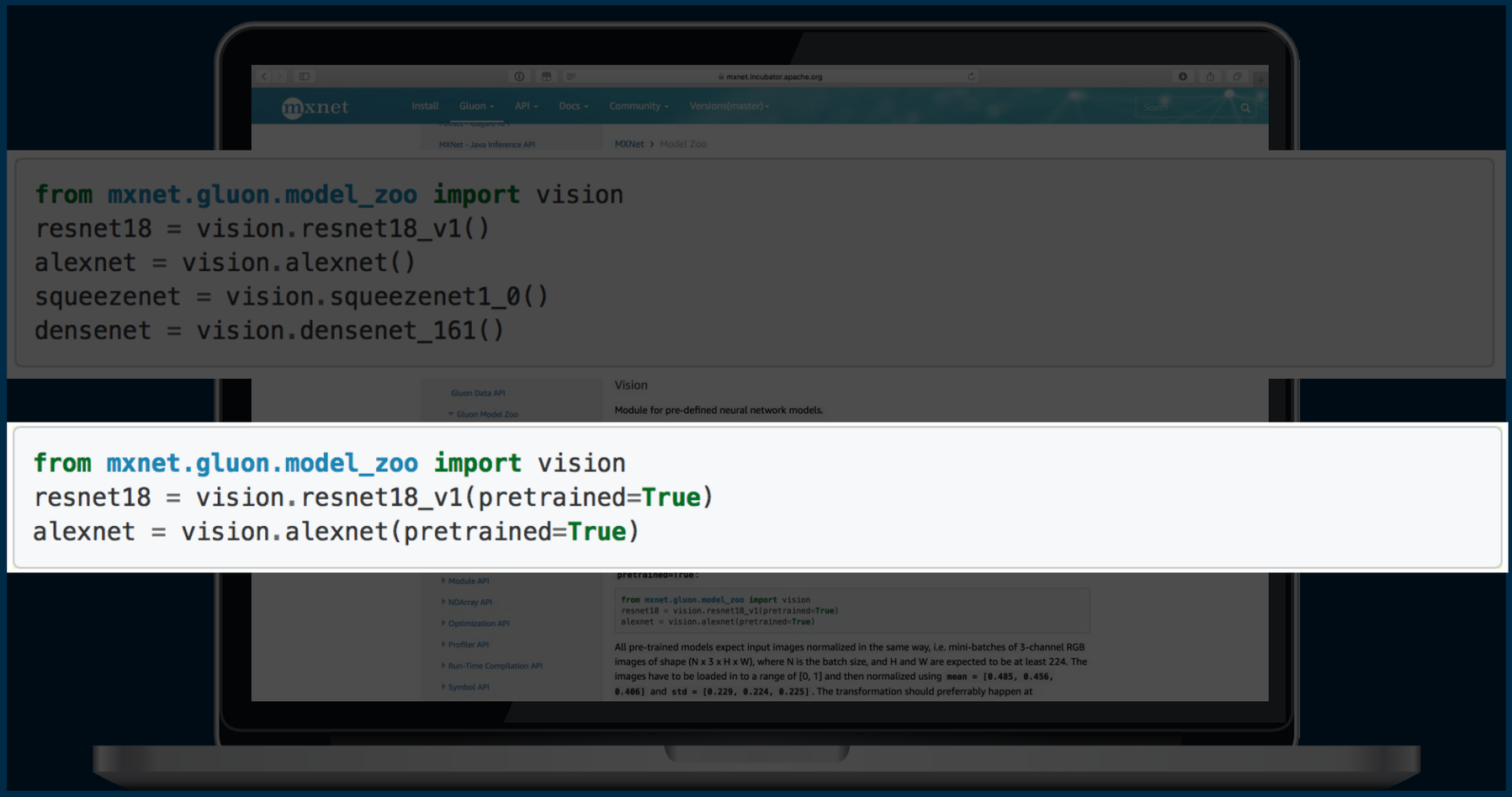
Gluon Model Zoo



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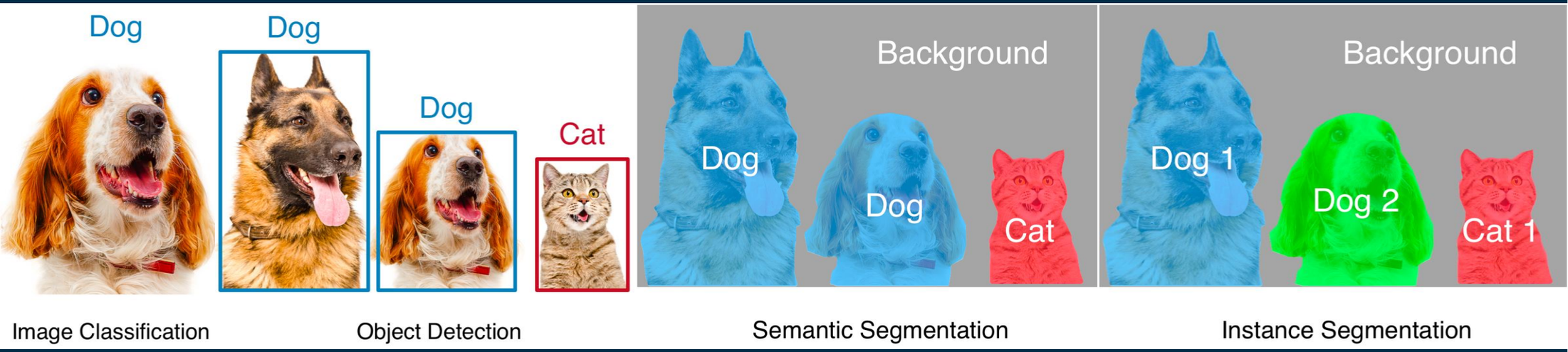
GluonCV: a deep learning toolkit for computer vision



50+ Pre-trained models, with training scripts, datasets, tutorials

https://gluon-cv.mxnet.io

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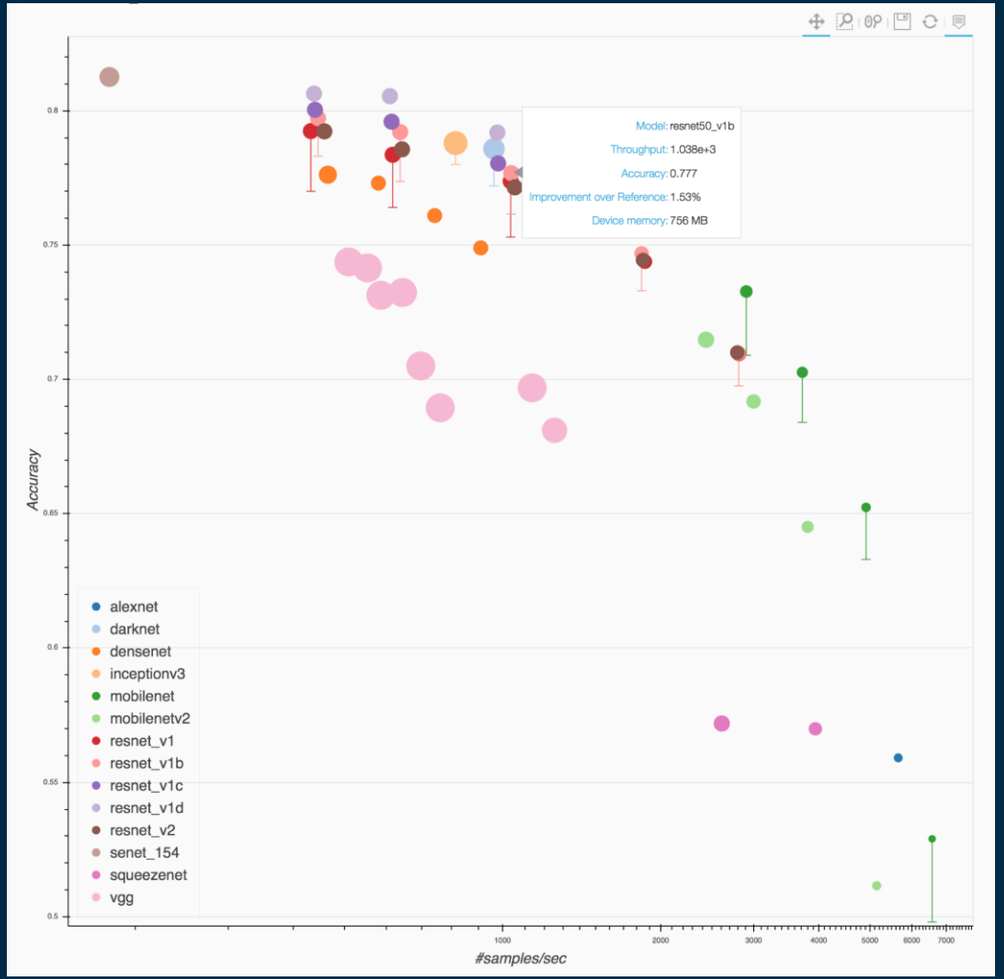
GluonCV pre-trained models



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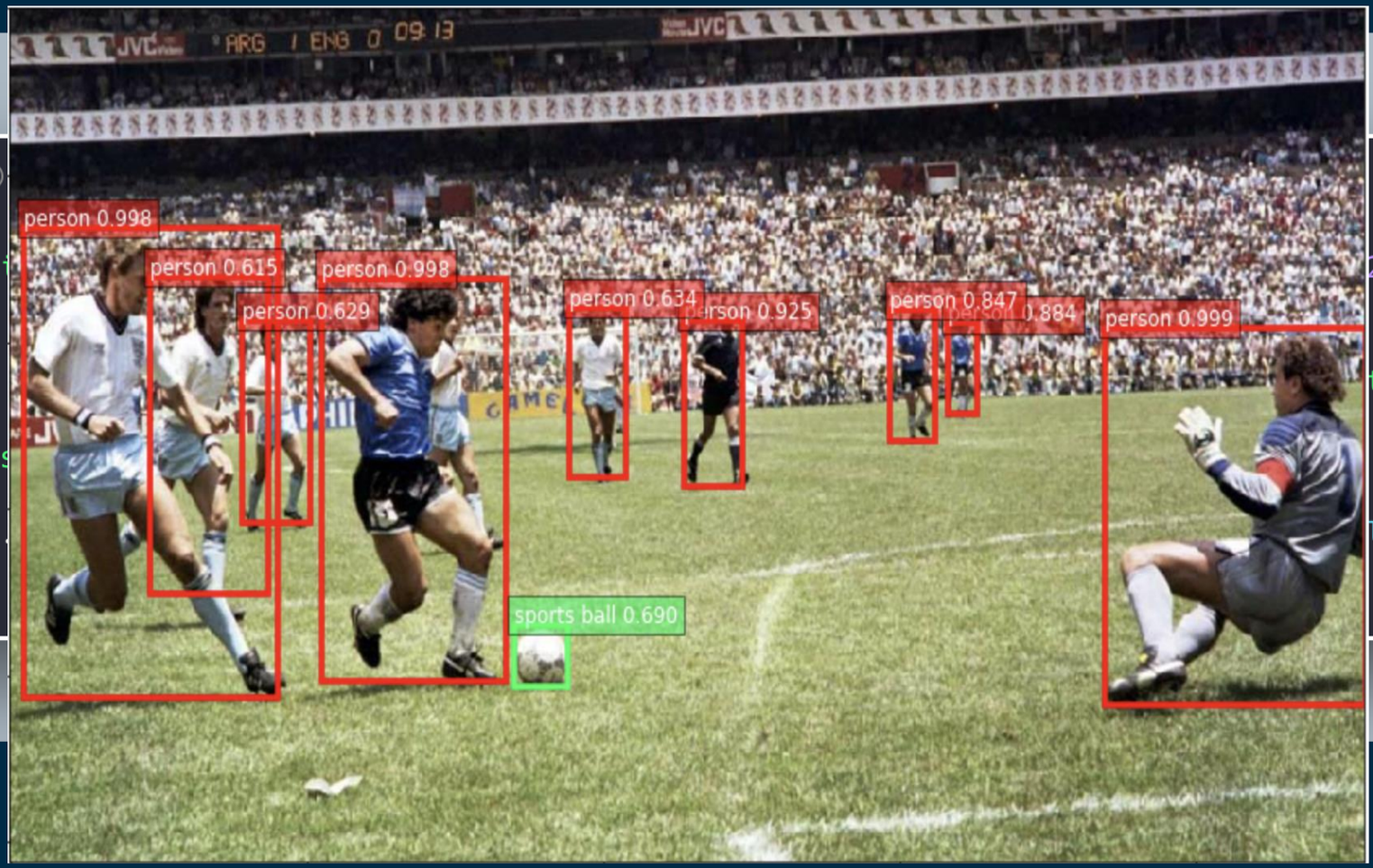
GluonCV example code



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Chick-fil-A keeps waffle fries fresh using MXNet

- Track waffle fry freshness
- Identify fries that have exceeded hold time
- Gluon Computer vision model for object detection and tracking
- A team of students with no ML expertise
- 12 months from no ML knowledge to completion

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GluonNLP: a deep learning toolkit for natural language processing

- 300+ word embedding pre-trained models
- 5 language models
- Neural Machine Translation (Google NMT, Transformer)
- Flexible data pipeline tools
- Public datasets
- NLP examples, e.g. sentiment analysis

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Training Efficiency

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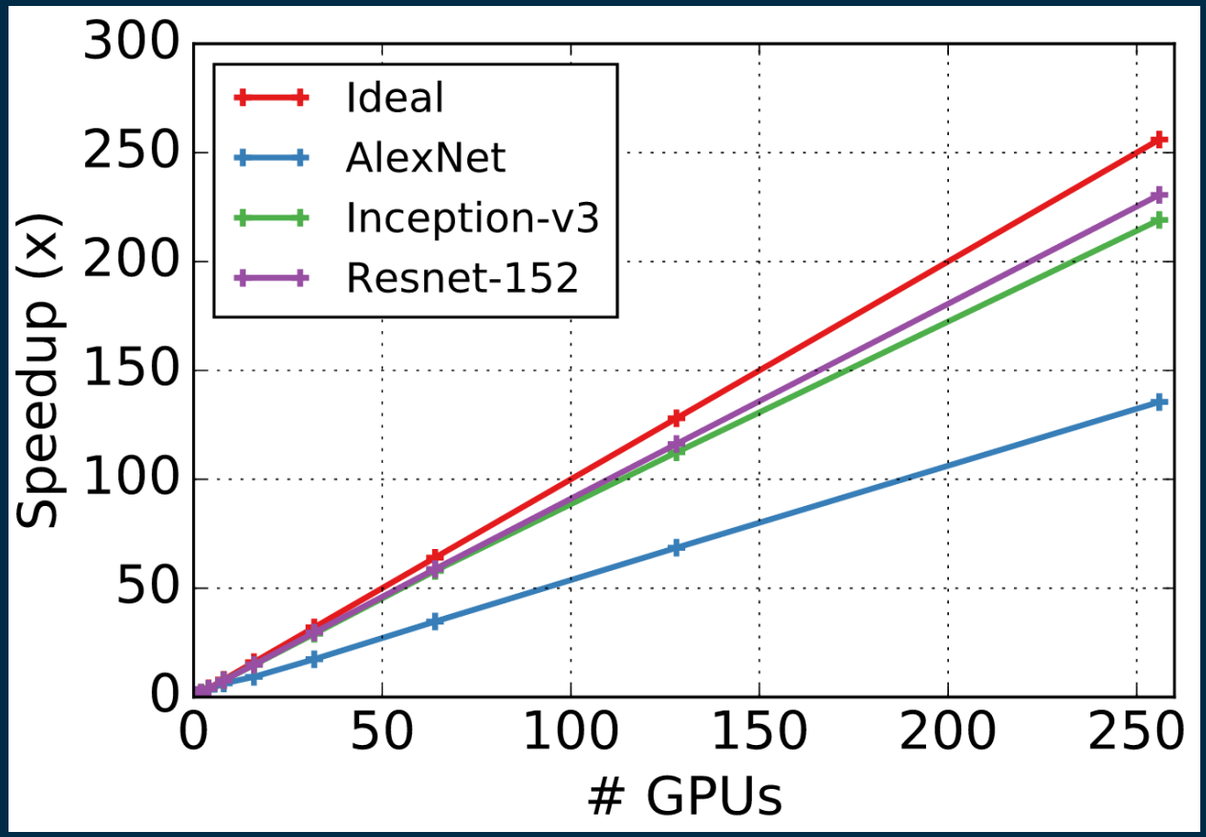
Training efficiency – 92%



https://mxnet.incubator.apache.org/tutorials/vision/large_scale_classification.html

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TuSimple uses MXNet for autonomous vehicles

- Deep Learning algorithms built with MXNet
- Computer vision and driving simulation
- MXNet teaches computers to Recognize and track objects
- Avoid collisions and prioritize safety
- Largest simulation of its kind
- Simulated a billion miles of road driving with wide range of variables and driving conditions

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Interoperability

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ONNX

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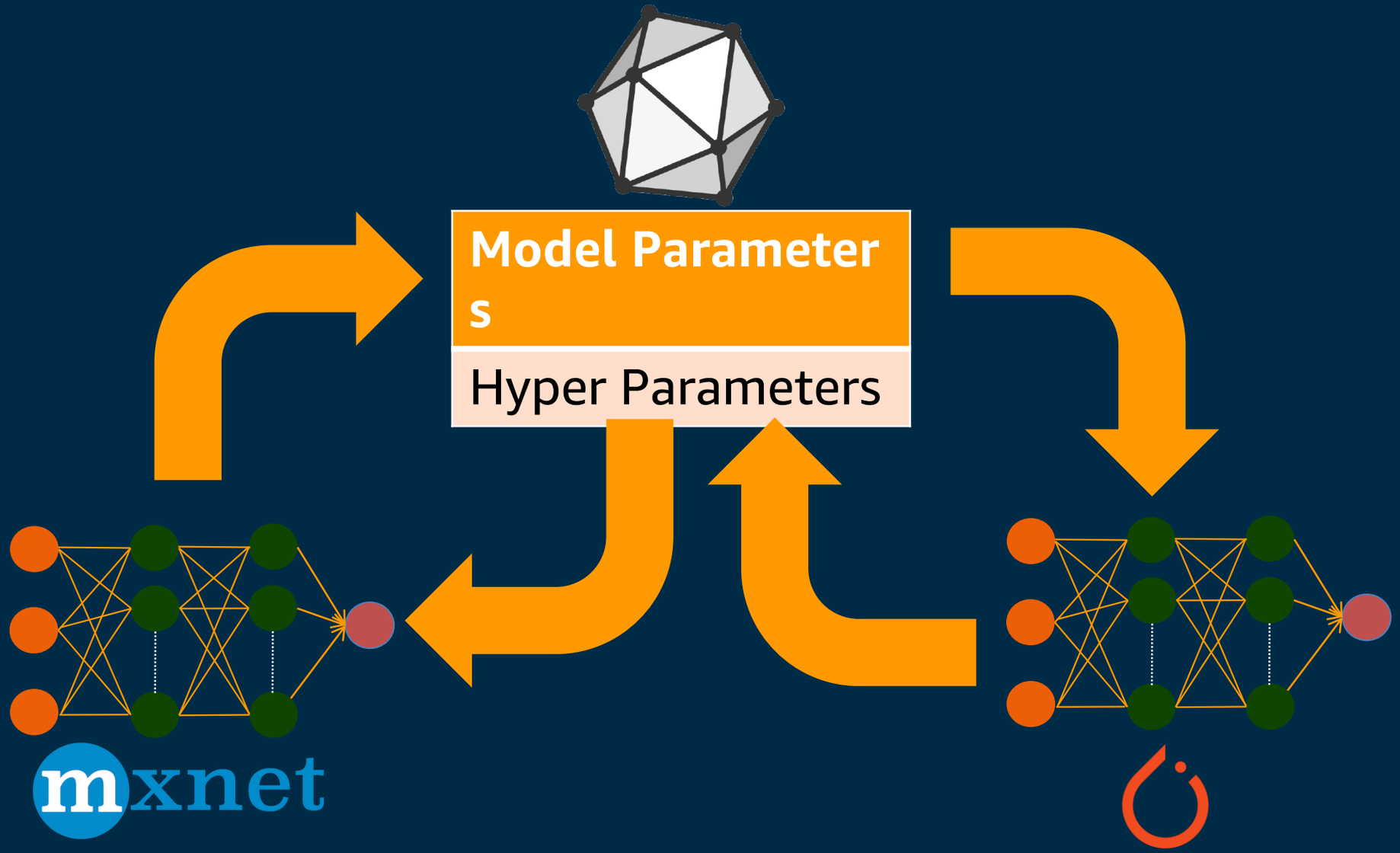
Portability with ONNX



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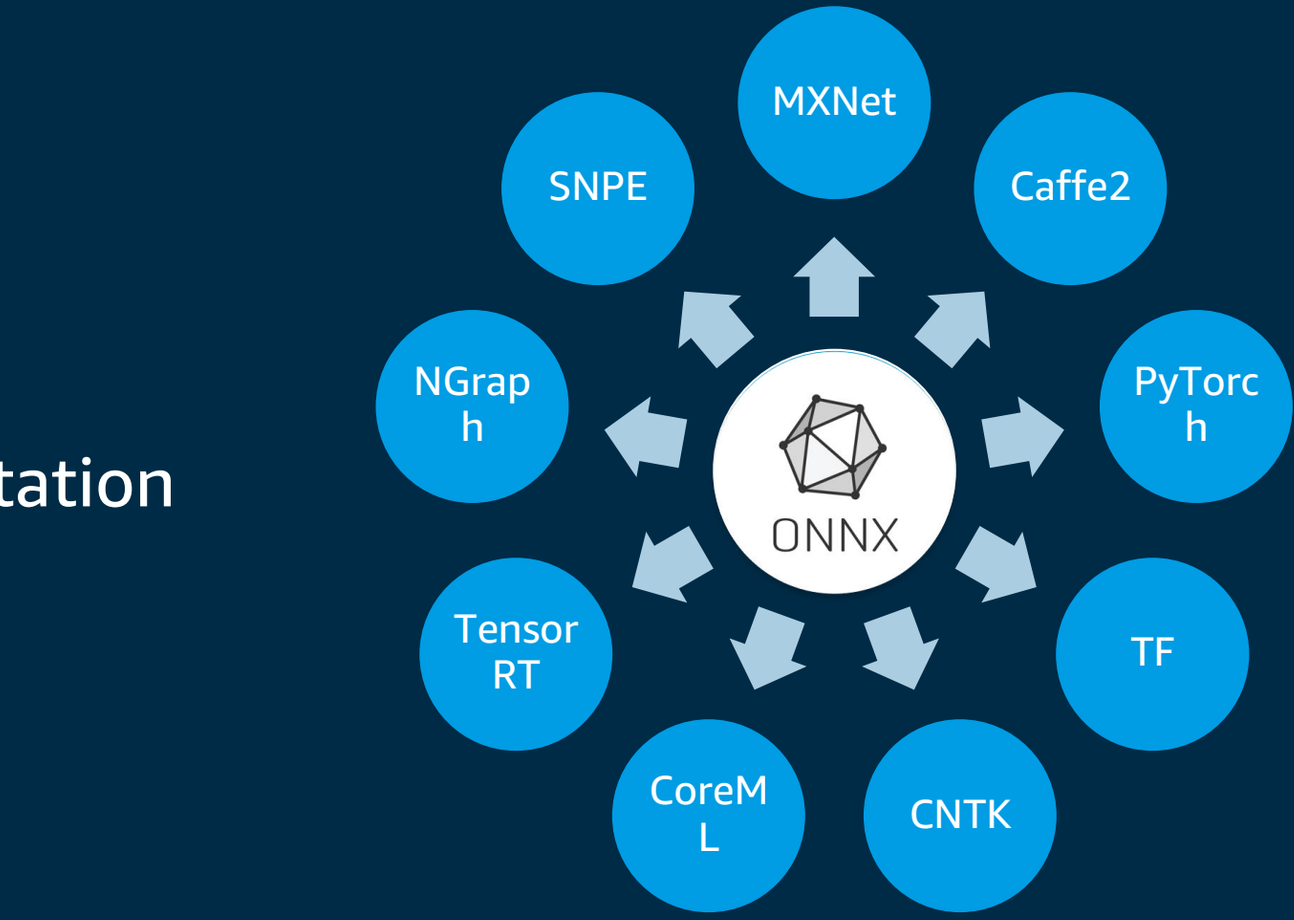
Open Neural Network eXchange - Overview

Many Frameworks

Many Platforms

ONNX: Common Intermediate Representation (IR)

- Open source
- Community driven
- Simple



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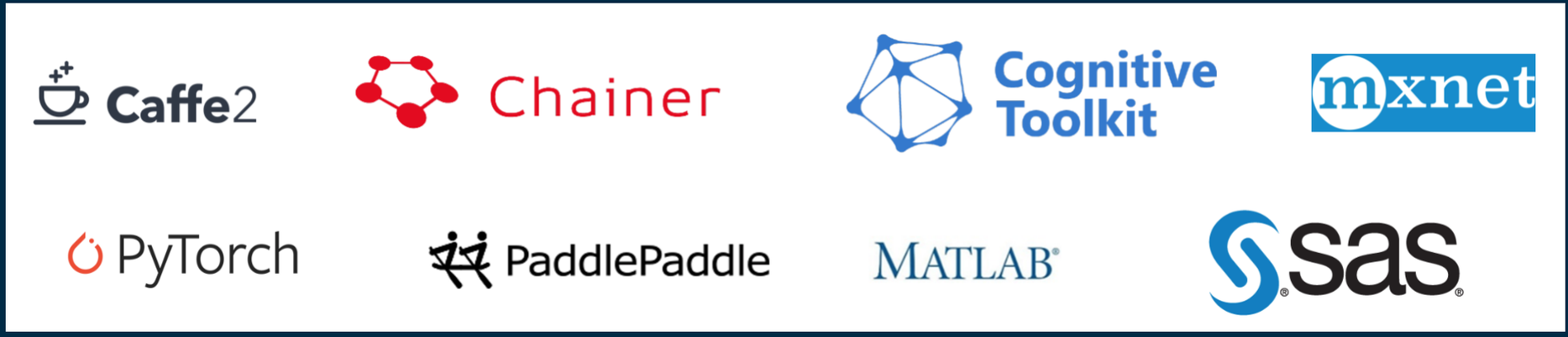
Supported tools

Frameworks:



Converters:

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Supported runtimes

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Supported compilers and visualizers

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Keras – MXNet

https://github.com/awslabs/keras-apache-mxnet

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Keras – Apache MXNet

- Deep Learning for Humans
- 2nd most popular Deep Learning framework
- Now Keras users can leverage MXNet's performance

```
pip install mxnet-(mkl|cu92)
pip install keras-mxnet
---
~/.keras/keras.json
backend: mxnet
image_data_format: channels_first
---
```

```
from keras.models import Sequential
model = Sequential()
from keras.layers import Dense
model.add(Dense(units=64, activation='relu', input_dim=100))
model.add(Dense(units=10, activation='softmax'))
model.compile(loss='categorical_crossentropy',
              optimizer='sgd',
              metrics=['accuracy'])
model.fit(x_train, y_train, epochs=5, batch_size=32)
model.train_on_batch(x_batch, y_batch)
loss_and_metrics = model.evaluate(x_test, y_test, batch_size=128)
classes = model.predict(x_test, batch_size=128)
```

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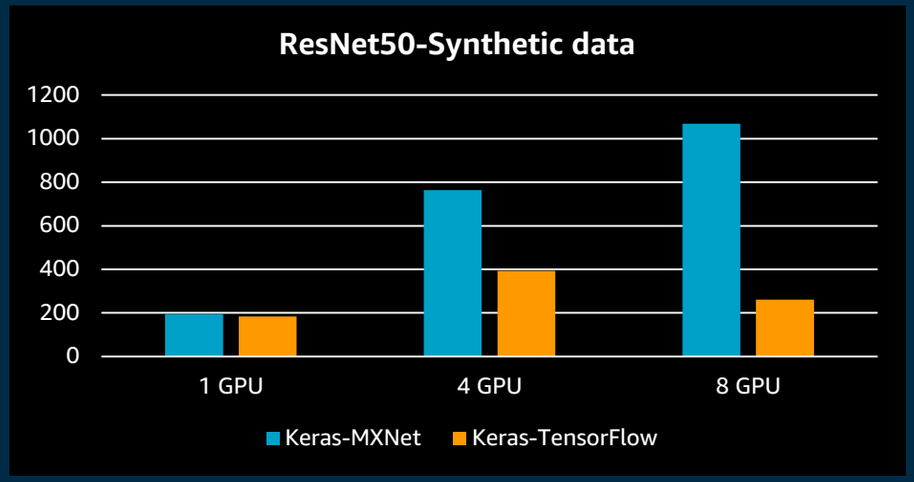
Keras benchmarks

Setup: https://github.com/awslabs/keras-apache-mxnet/tree/master/benchmark

	Training	Inference
Instance	P3.8x Large, P3.16x Large	C5.xLarge, C4.8xLarge
Network	ResNet50v1	ResNet50v1
Batch size	32 * Num of GPUs	32
Image size	3*256*256	3*256*256



GPUs	Keras-MXNet [Image/sec]	Keras-TensorFlow [Image/sec]	Speed Up
1	194	184	1.05
4	764	393	1.94
8	1068	261	4.09

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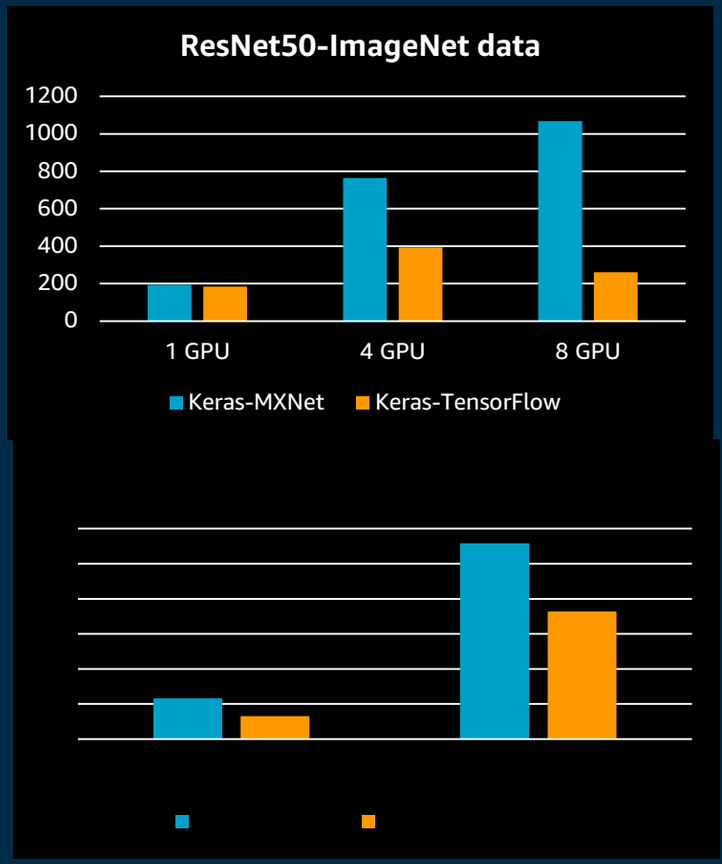
Keras benchmarks



GPUs	Keras-MXNet	Keras-TensorFlow	Speed Up
1	135	52	2.59
4	536	162	3.30
8	722	211	3.42

Instance	Keras-MXNet	Keras-TensorFlow	Speed Up
C5.X Large	5.79	3.27	1.782
C5.8X Large	27.9	18.2	1.53

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Inference

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Model Server

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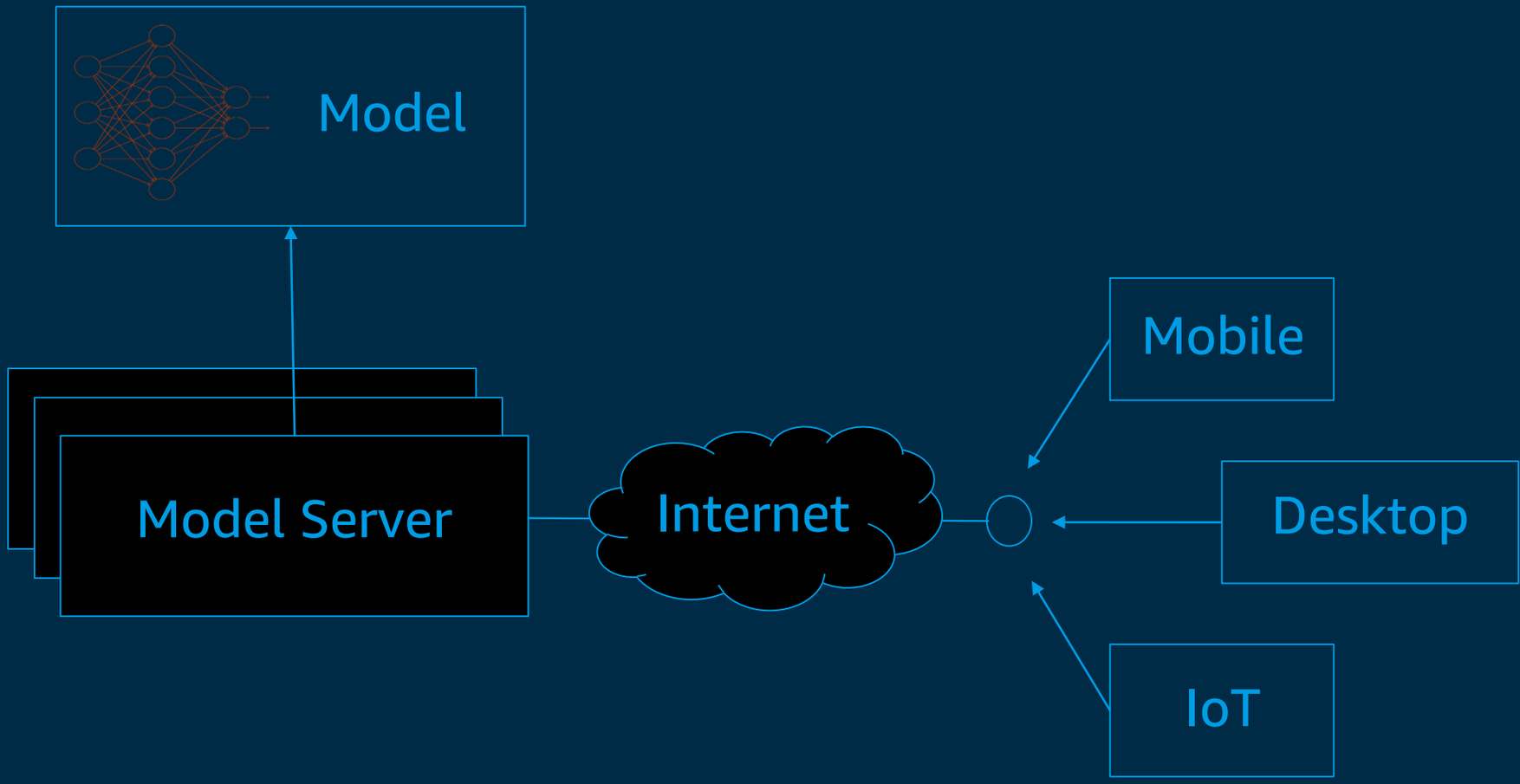
What does a model server look like?

So what does a deployed model looks like?



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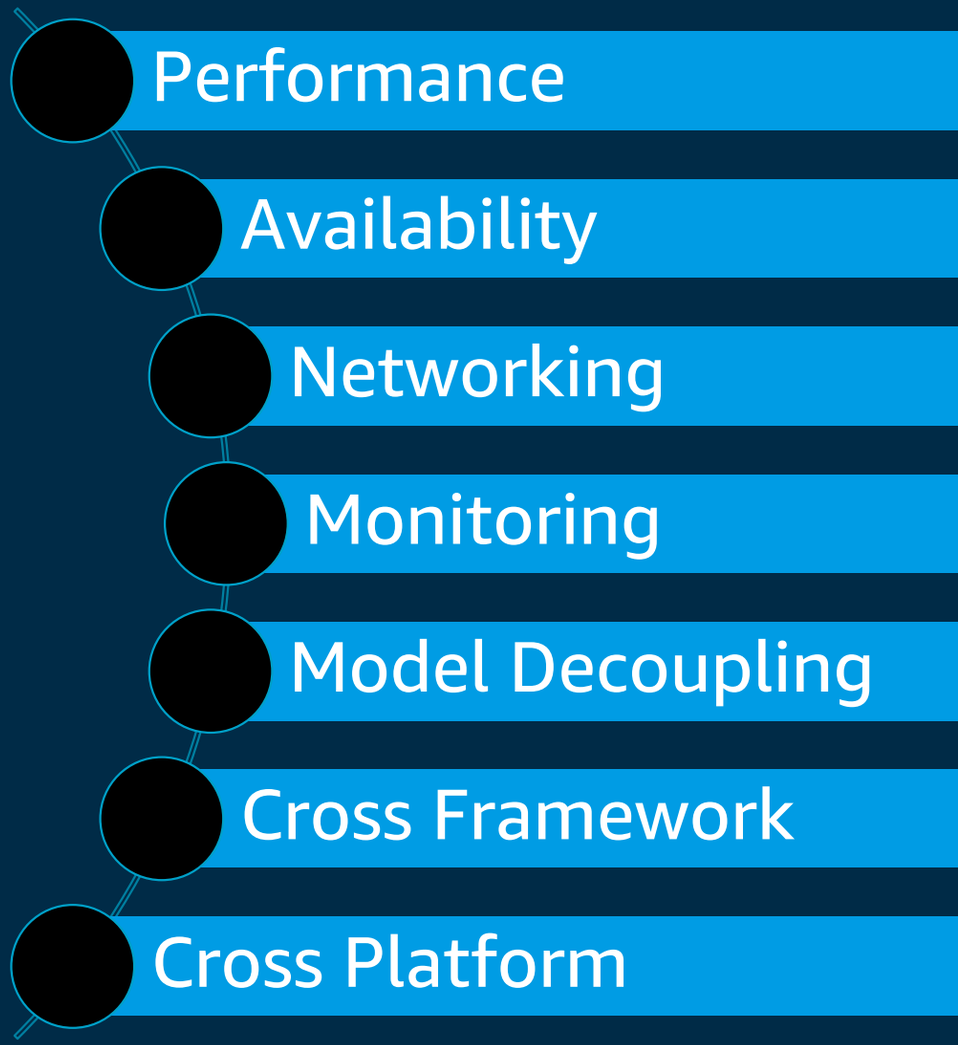
The Undifferentiated Heavy Lifting of Model Serving



Model Archive

Trained Network

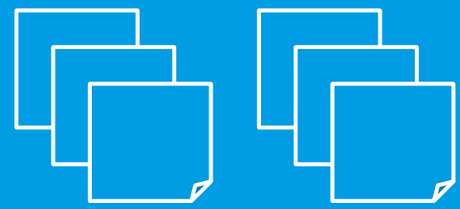
Model Signature

Custom Code

Auxiliary Assets

Model Export CLI

Model Archive



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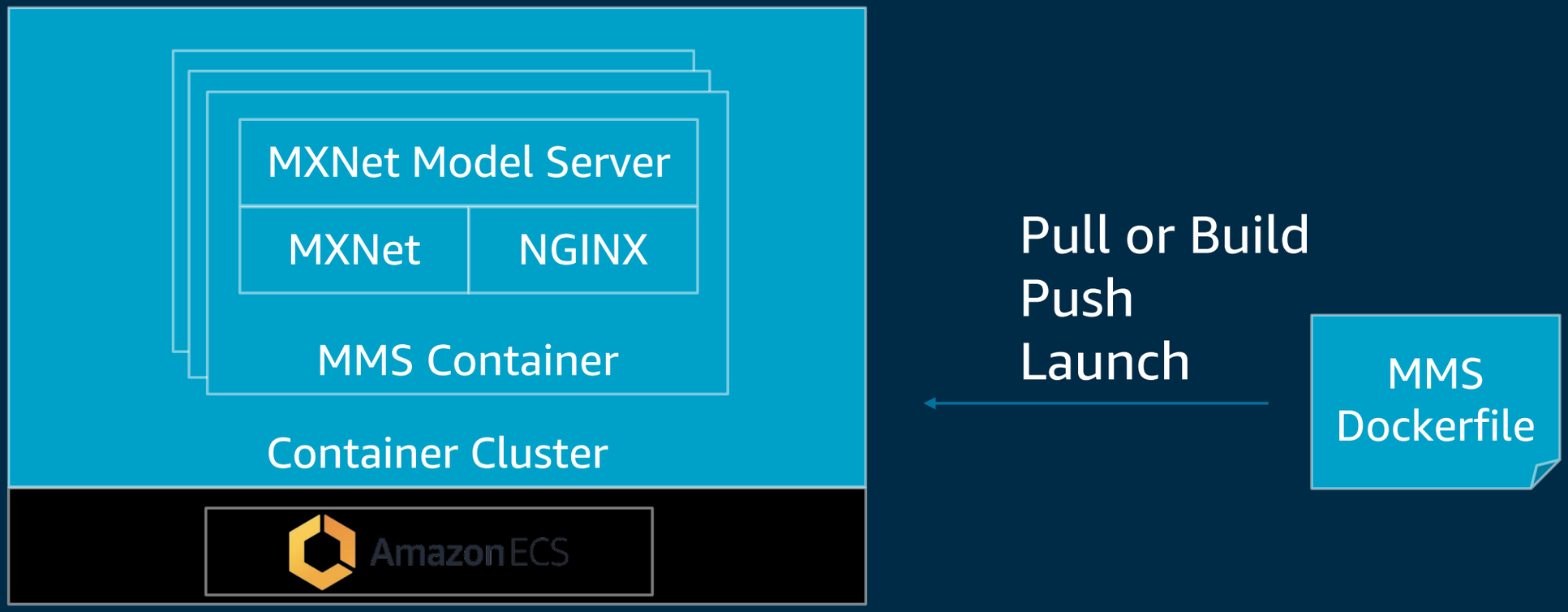
Containerization

Lightweight virtualization, isolation, runs anywhere



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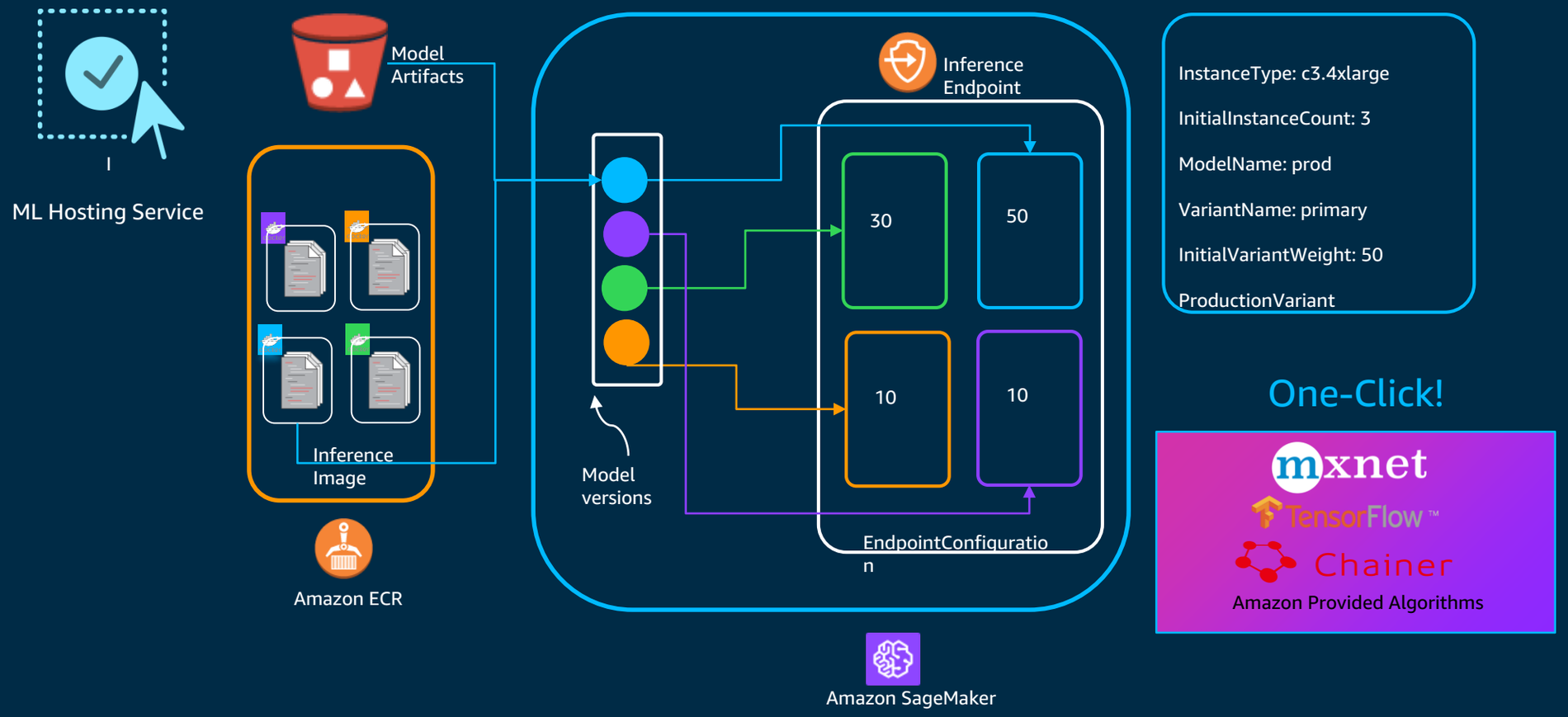
Deployment with Amazon Sage Maker



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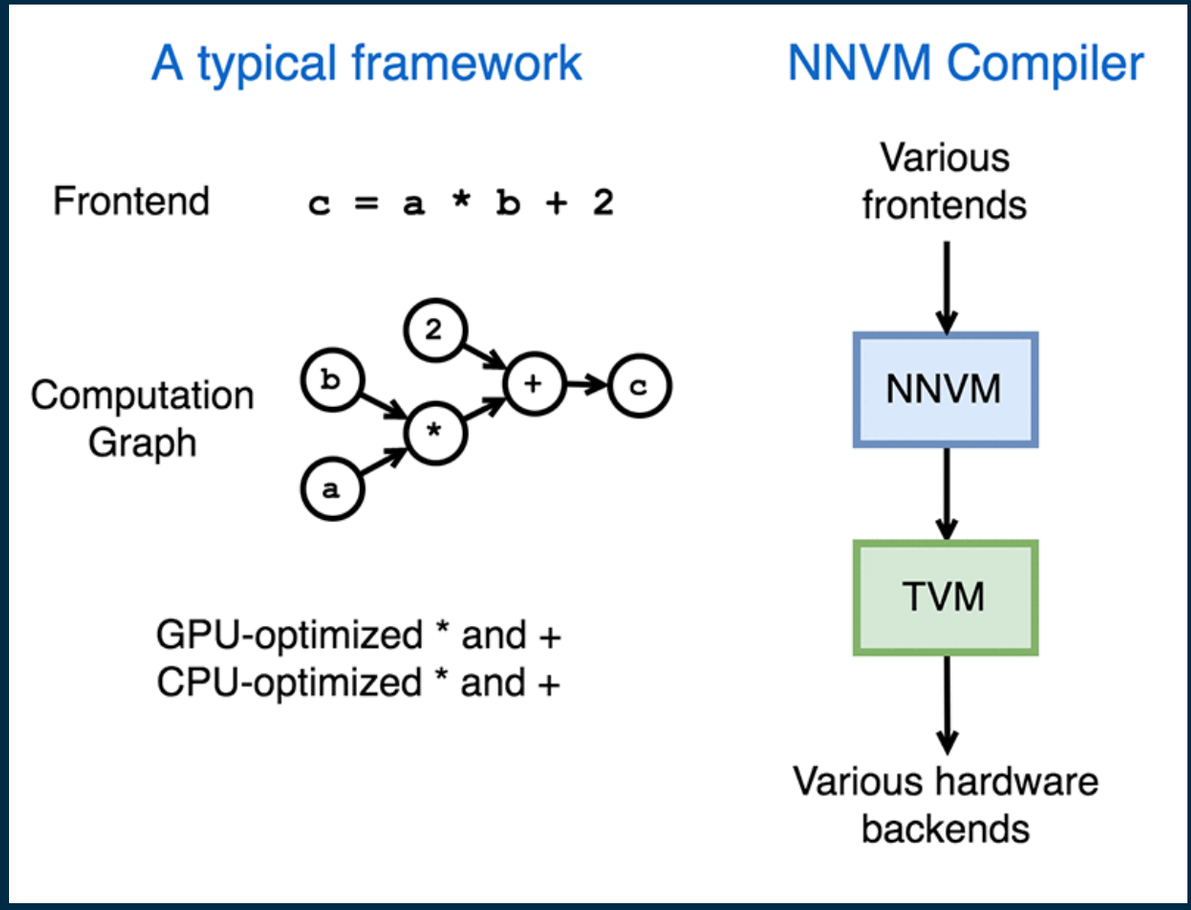
TVM and NNVM



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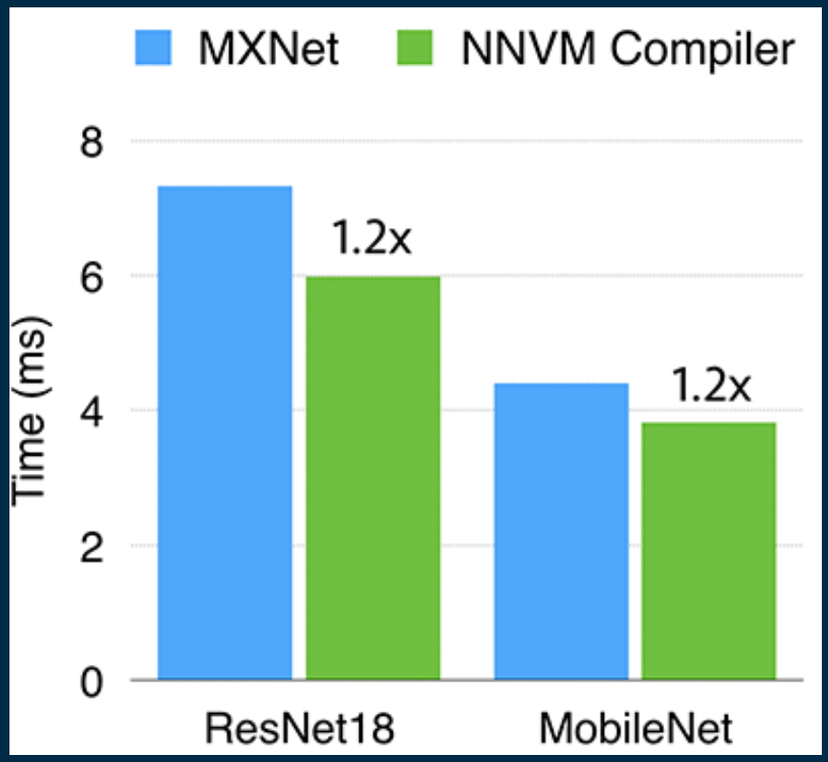
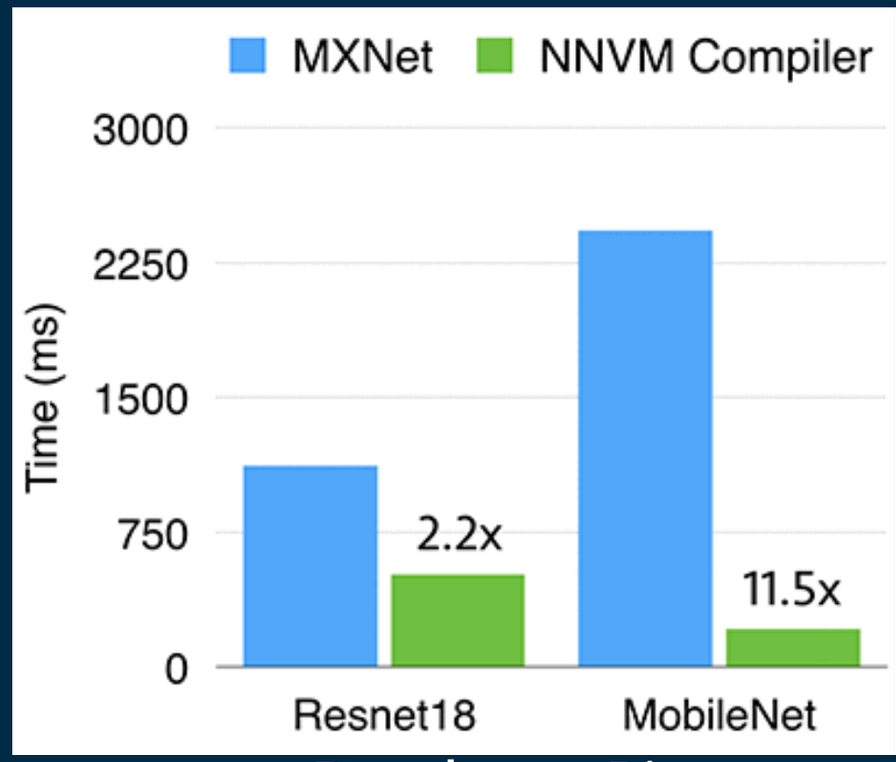
Inference efficiency – TVM/NNVM



NVIDIA GPU



Raspberry Pi

https://aws.amazon.com/blogs/machine-learning/introducing-nnvm-compiler-a-new-open-end-to-end-compiler-for-ai-frameworks/

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Amazon SageMaker Neo

Train once, run anywhere with 2x the performance

Get accuracy and performance

Automatic optimization

Broad framework support

Broad hardware support

KEY FEATURES

Open-source Neo-AI device runtime and compiler under the Apache software license; 1/10th the size of original frameworks

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Deep Learning acceleration

CUDA & CuDNN

pip install mxnet-cu92

TensorRT

pip install mxnet-tensorrt-cu92

MKL, MKLML & MKLDNN

e.g. pip install mxnet-mkl

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Now it’s Your Turn!

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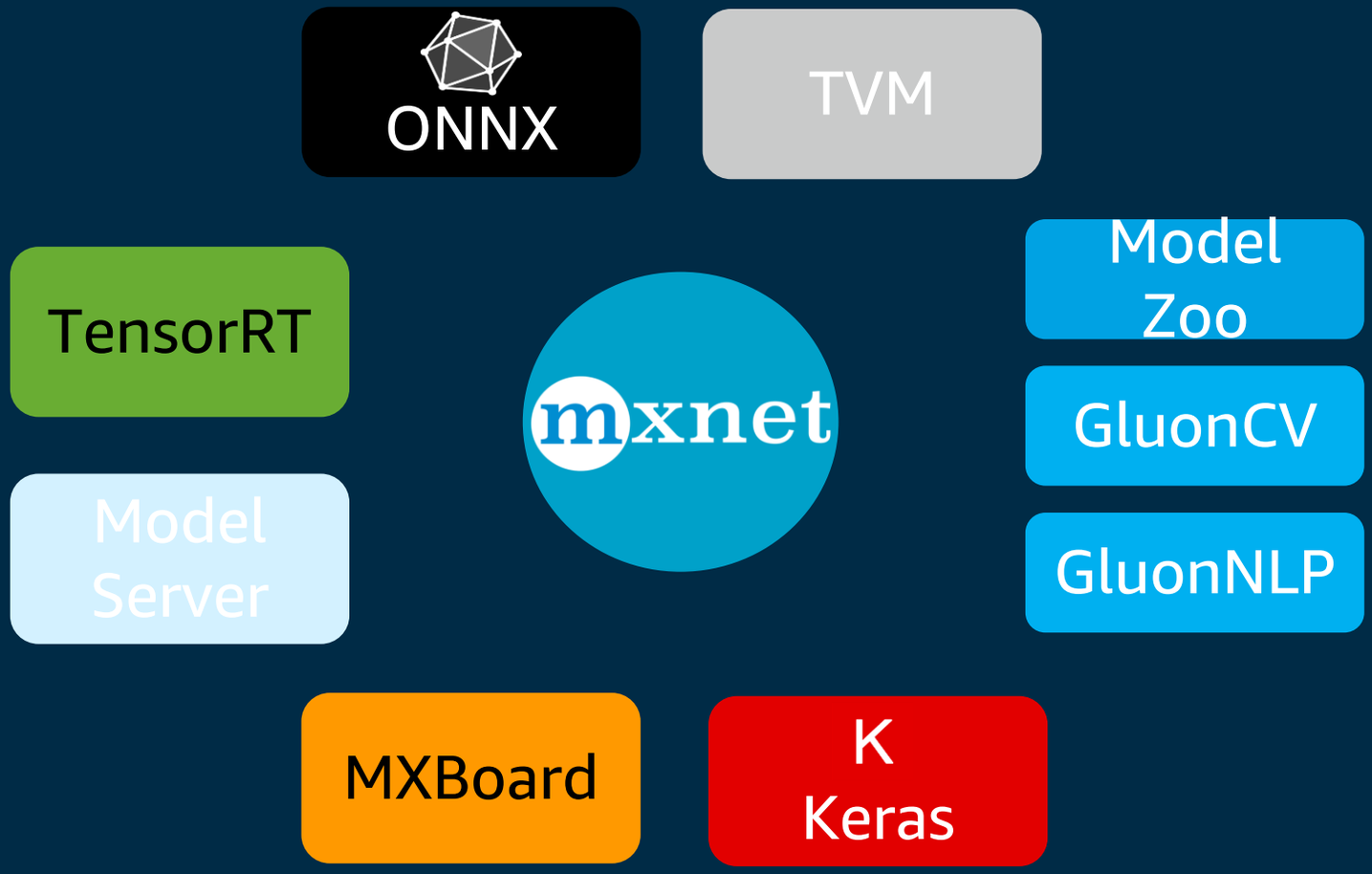
Apache MXNet ecosystem



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Apache MXNet customers

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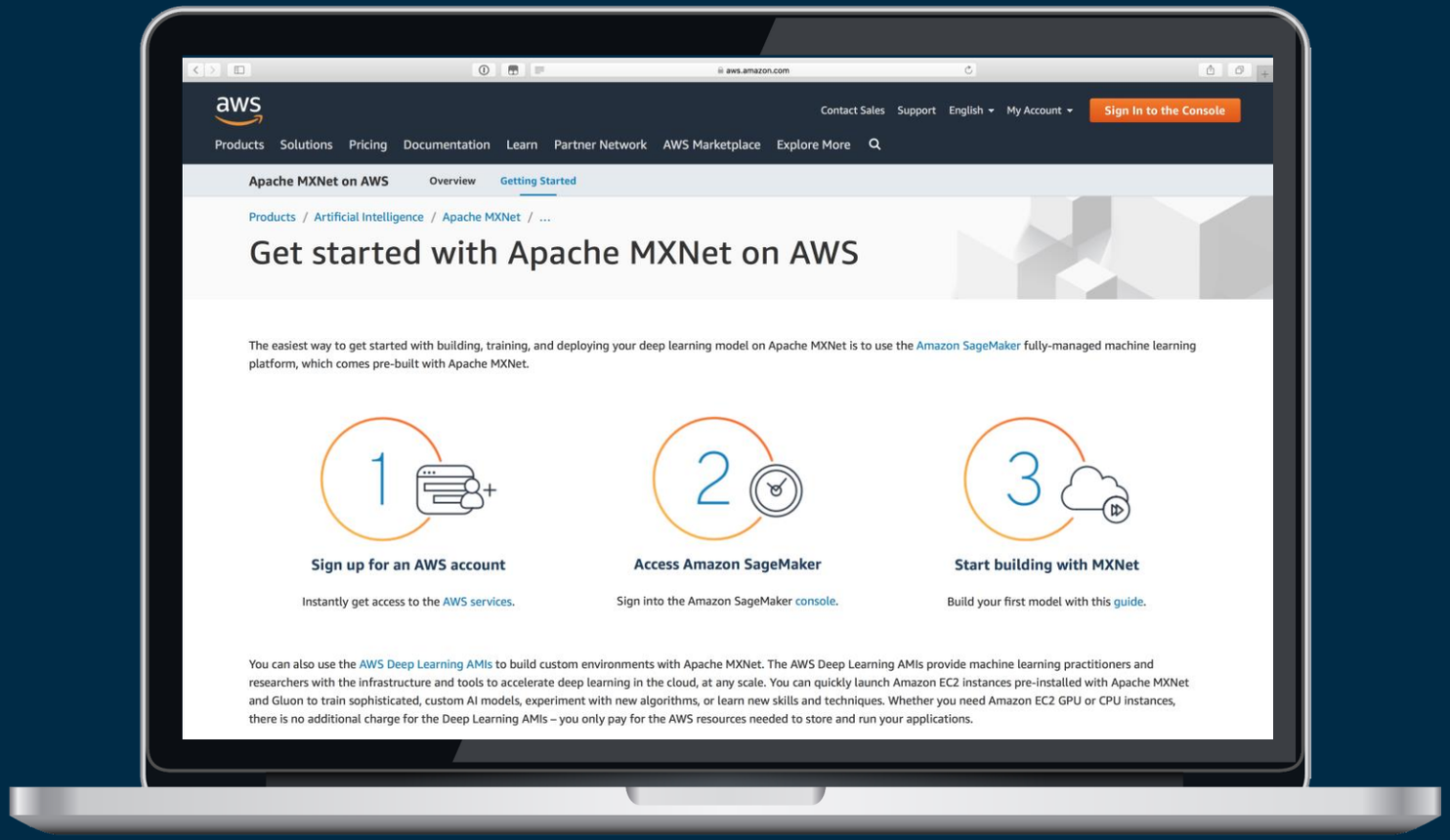
Getting started with Apache MXNet on AWS



https://aws.amazon.com/mxnet/get-started/

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Using Apache MXNet with AWS ML services

- Amazon SageMaker: aws.amazon.com/sagemaker
- Amazon SageMaker Neo: aws.amazon.com/sagemaker/neo
- Amazon SageMaker Reinforcement Learning: aws.amazon.com/about-aws/whats-new/2018/11/amazon-sagemaker-announces-support-for-reinforcement-learning
- Amazon Elastic Inference: aws.amazon.com/machine-learning/elastic-inference
- AWS IoT Greengrass ML Inference: aws.amazon.com/greengrass/ml
- Dynamic Training with Apache MXNet on AWS: https://aws.amazon.com/about-aws/whats-new/2018/11/introducing-dynamic-training-with-apache-mxnet/

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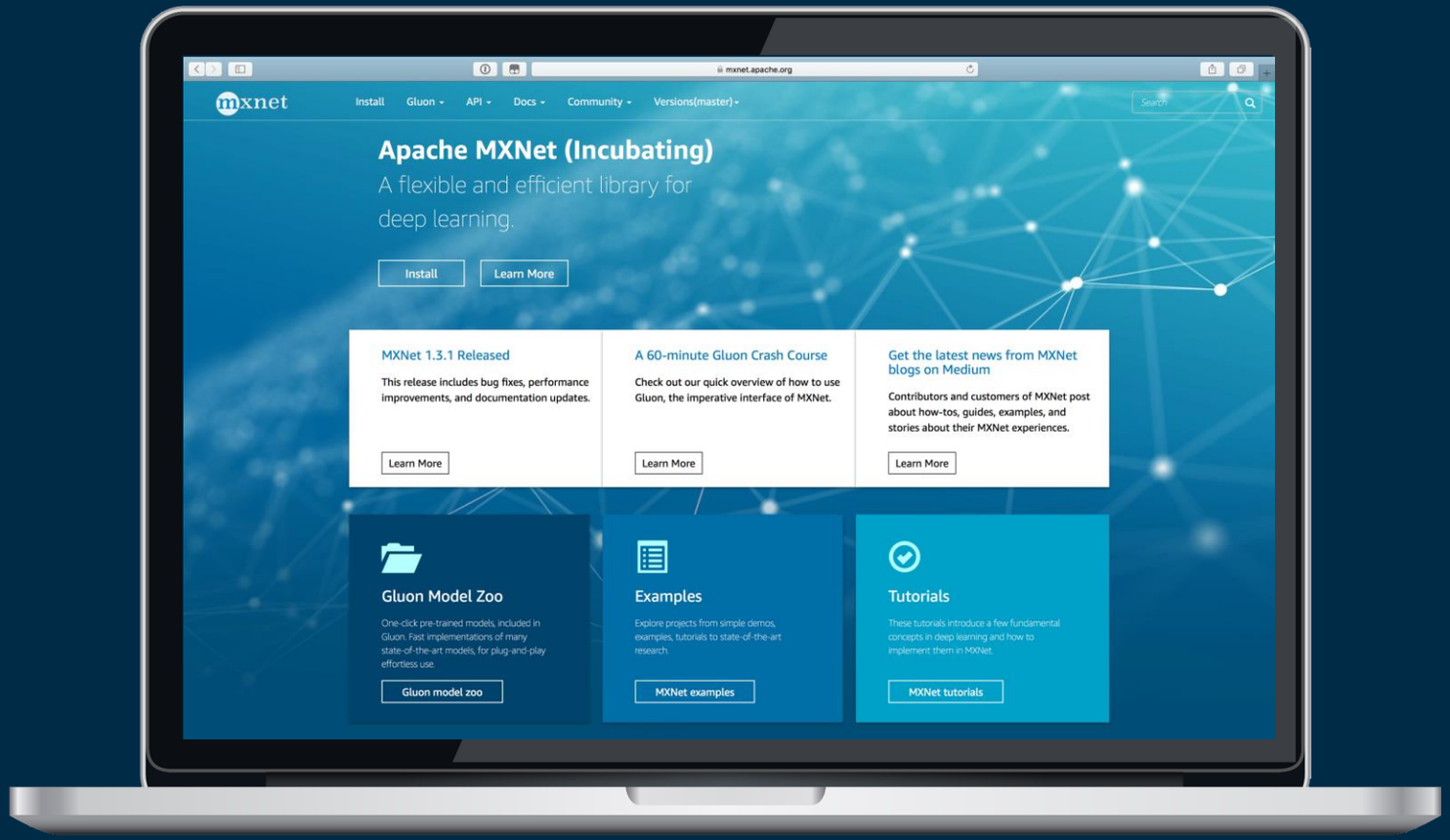
Project home page



https://mxnet.apache.org

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Staying in touch

- GitHub: github.com/apache/incubator-mxnet
- Discussion forum: discuss.mxnet.io
- Blog: medium.com/apache-mxnet
- SlideShare: slideshare.net/apachemxnet
- Twitter: @ApacheMXNet
- YouTube : youtube.com/apachemxnet
- Reddit: r/mxnet/
- Meetup: meetup.com/pro/deep-learning-with-apache-mxnet

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Contact us!

mxnet-info@amazon.com

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Summary

- Efficient distributed training
- Portability
- Efficient Inference
- Inference on Edge

- Easy Coding
- Easy Debugging
- Toolkits for Rapid Prototyping

Amazon SageMaker

- End-2-End Plarform
- Zero Setup
- Distributed Training
- AB/Testing
- Scalable Endpoints
- Automatic Model Tuning

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DEV DAY

Thank you!

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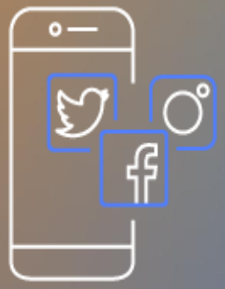
DEV DAY
SEOUL

19.09.26

여러분의 피드백을 기다립니다!

강연 평가 및 설문 조사
QR 코드를 통해 AWS DEV DAY SEOUL에 대한 여러분의 의견을 공유해주세요.
강연 평가 및 설문 조사에 참여해 주신 분께는 등록데스크에서 특별한 기념품을 드립니다.

강연 영상
AWS DEV DAY SEOUL 강연 영상은 행사 종료 후 메일로 공유드릴 예정입니다.



#AWSDEVDAYSEOUL
소셜미디어에 행사 참여 소감을 공유해주세요!

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