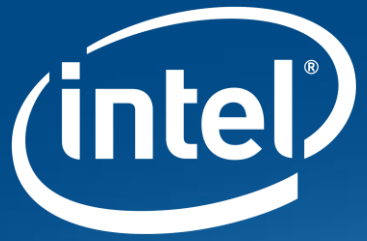

ACCELERATE DEEP LEARNING INFERENCE USING INTEL TECHNOLOGIES

INTRODUCTION: SMART VIDEO

April 2020

SMART VIDEO WORKSHOP OVERVIEW

INTRODUCTION

1. Introduction to Intel technologies for deep learning inference
2. Hardware acceleration techniques

Each module contains a hands-on lab exercise that introduces various Intel technologies to accelerate computer vision application with hardware heterogeneity.

INTEL® DISTRIBUTION OF OPENVINO™ 101

2. Basic End-to-End Object Detection Example

HARDWARE ACCELERATION ON LAPTOP AND DEVCLOUD

3./4./5. Hardware Acceleration with CPU, Integrated GPU, Intel® Movidius™ NCS, FPGA

OPTIMIZATION

6. Optimization Tools and Techniques

APPLICATION

7. Advanced Video Analytics

CUSTOM LAYERS

8. Custom layers

OPTIMIZATION NOTICE

Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness or any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice. Notice Revision #20110804.

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Performance estimates were obtained prior to implementation of recent software patches and firmware updates intended to address exploits referred to as "Spectre" and "Meltdown." Implementation of these updates may make these results inapplicable to your device or system.

Cost reduction scenarios described are intended as examples of how a given Intel-based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction.

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No computer system can be absolutely secure.

Tests document performance of components on a particular test, in specific systems. Differences in hardware, software, or configuration will affect actual performance. Consult other sources of information to evaluate performance as you consider your purchase. For more complete information about performance and benchmark results, visit www.intel.com/performance.

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A detailed discussion of the factors that could affect Intel's results and plans is included in Intel's SEC filings, including the annual report on Form 10-K.

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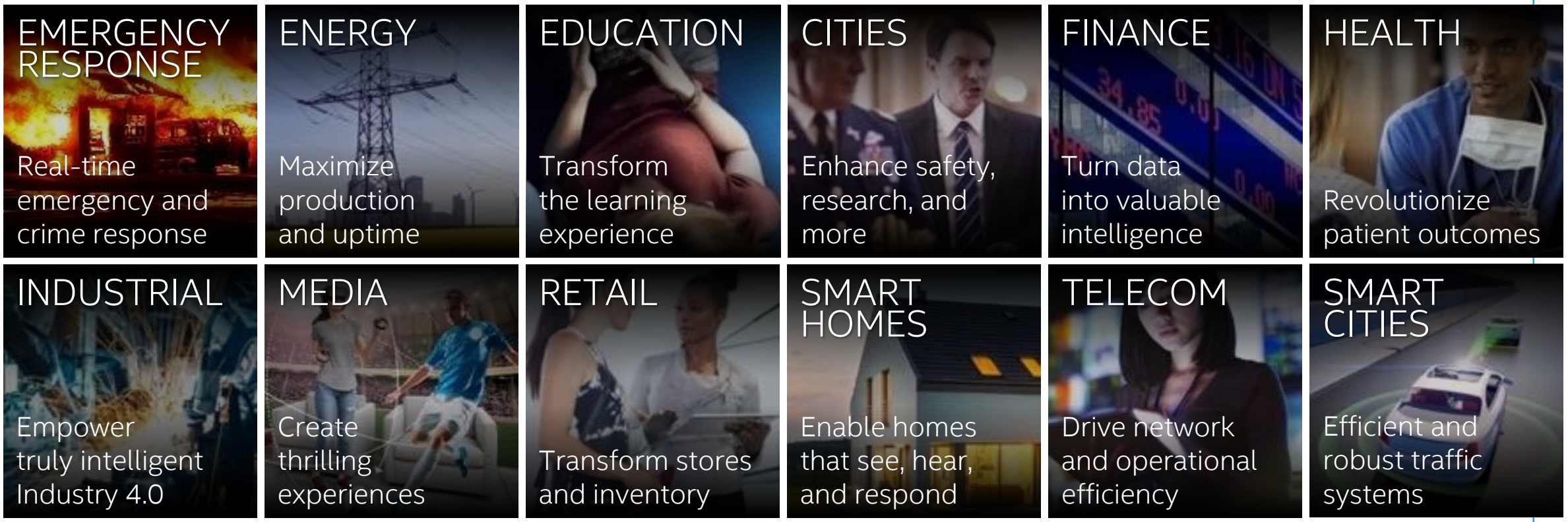
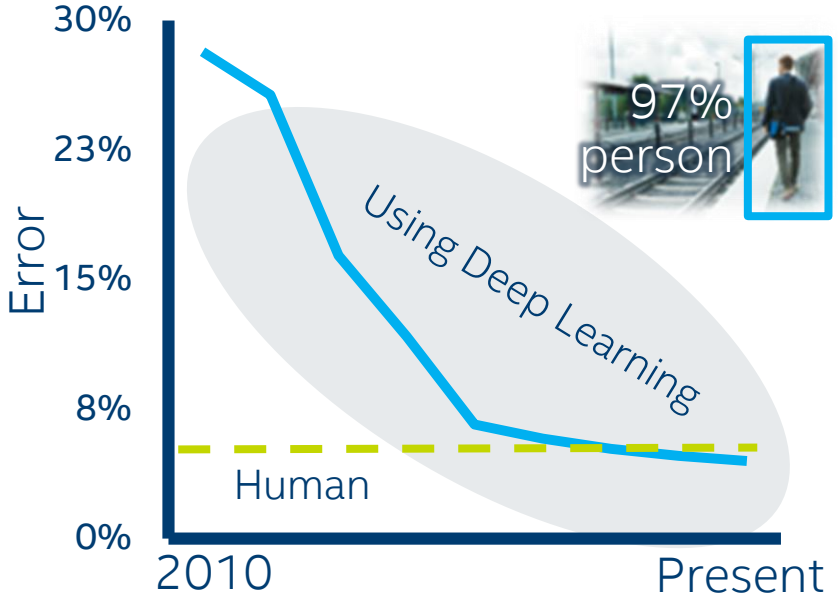
AI IS CHANGING EVERY MARKET



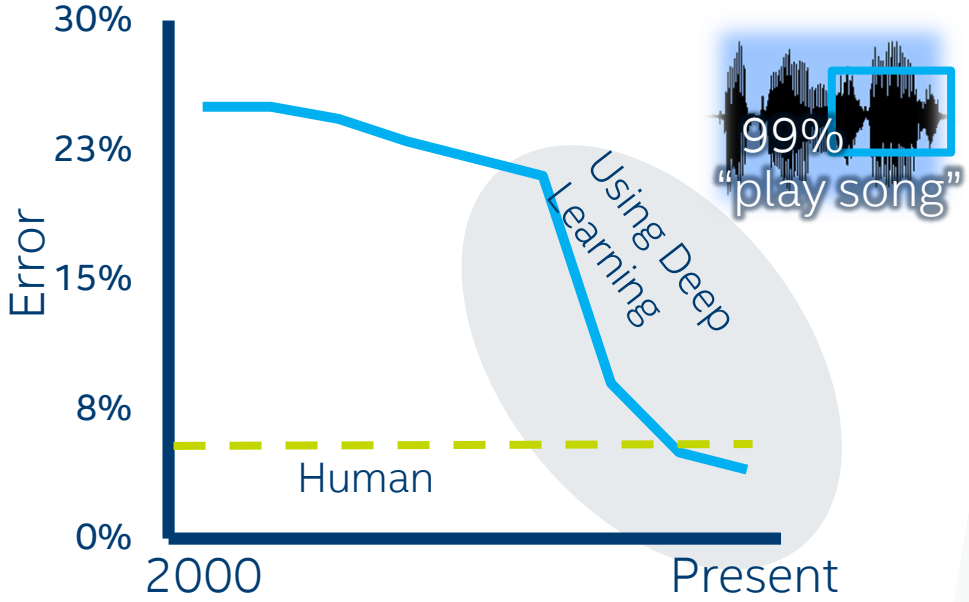
DEEP LEARNING BREAKTHROUGHS AND OPPORTUNITIES

Machines able to meet or exceed human image and speech recognition

Image Recognition



Speech Recognition



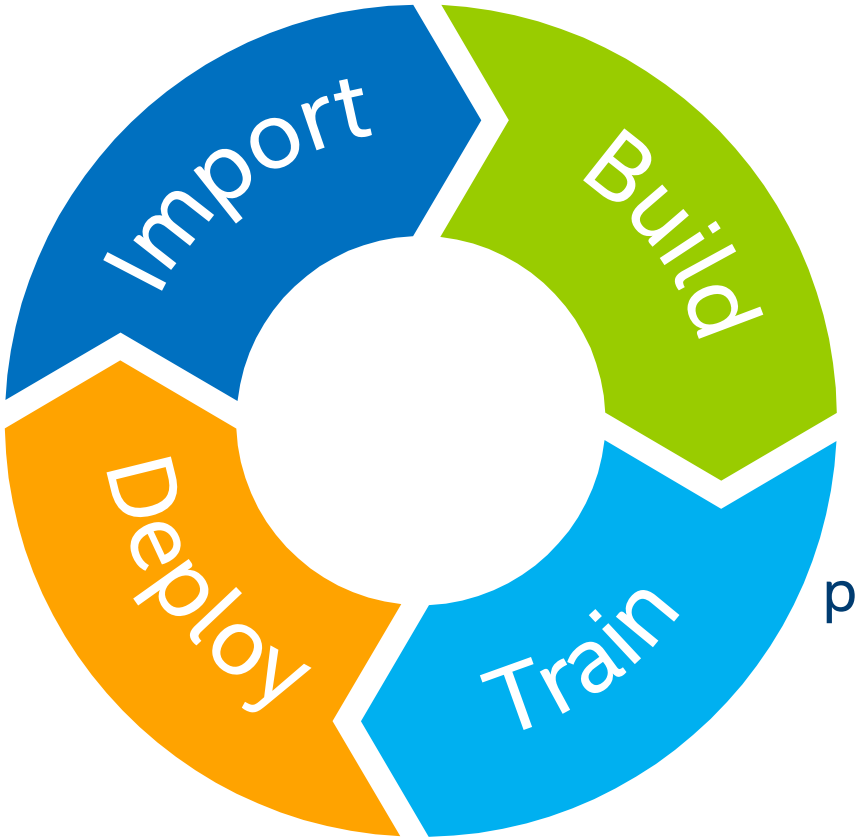
ADDITIONAL ECONOMIC IMPACT DRIVEN BY AI
$13 TRILLION IN 2030

Source: ILSVRC ImageNet winning entry classification error rate each year 2010-2016 (Left), https://www.microsoft.com/en-us/research/blog/microsoft-researchers-achieve-new-conversational-speech-recognition-milestone/ (Right)
Source: https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning

DEEP LEARNING DEVELOPMENT CYCLE

Data acquisition and organization

Create models



Integrate trained models with application code

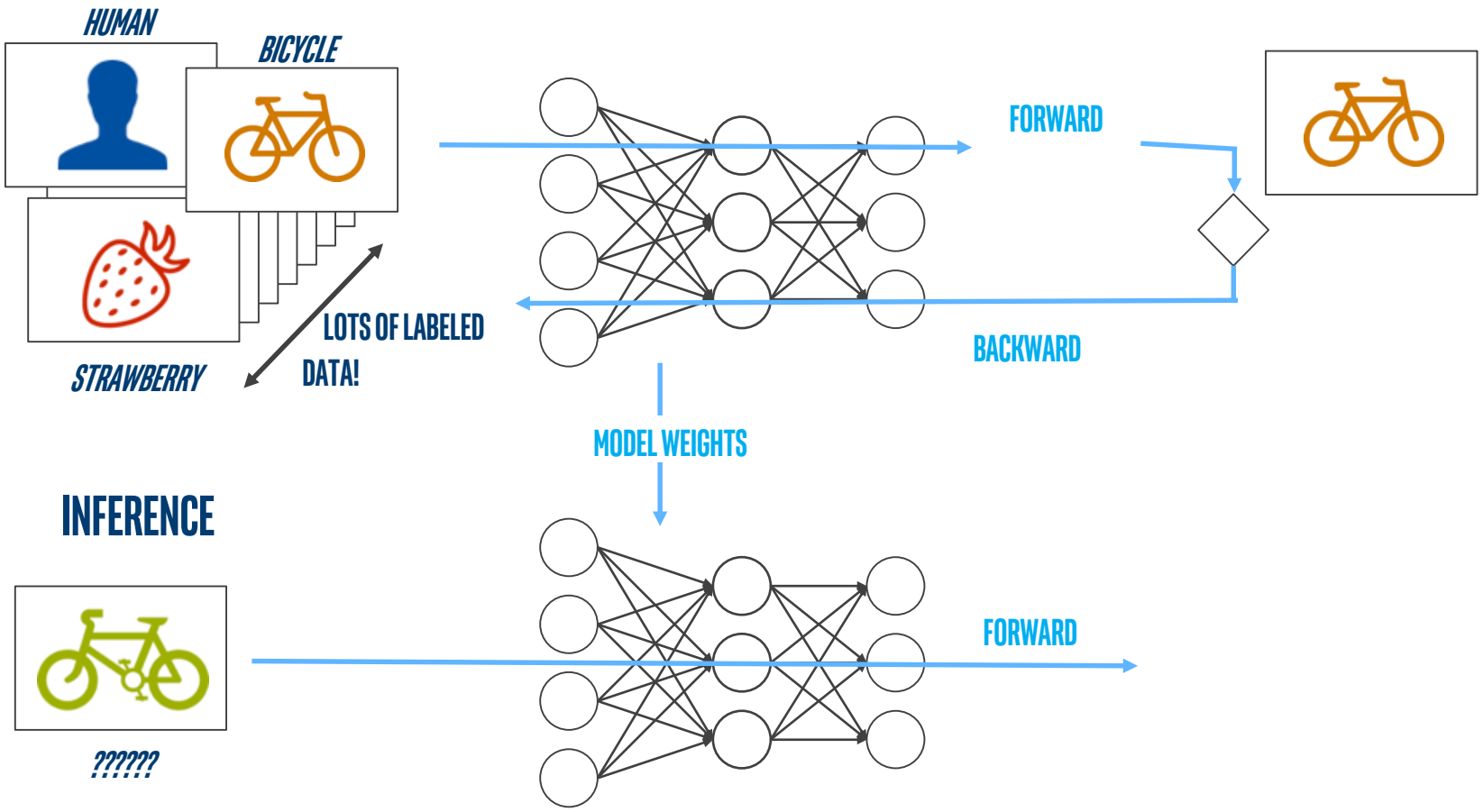
Adjust models to meet performance and accuracy objectives

Intel® Distribution OpenVINO™ Toolkit Provides Deployment from Intel® Edge to Cloud

intel

DEEP LEARNING: TRAINING VS. INFERENCE

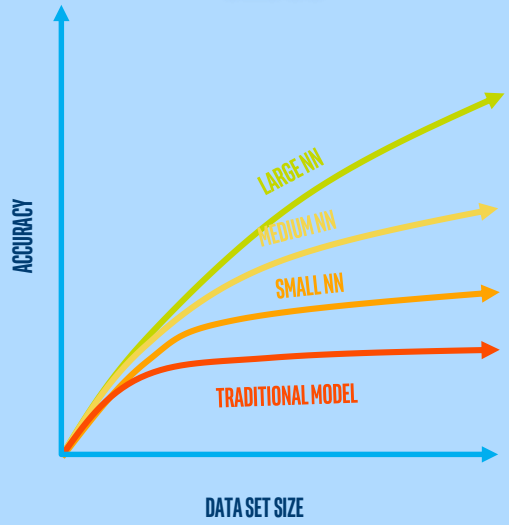
TRAINING



INFERENCE

DID YOU KNOW?

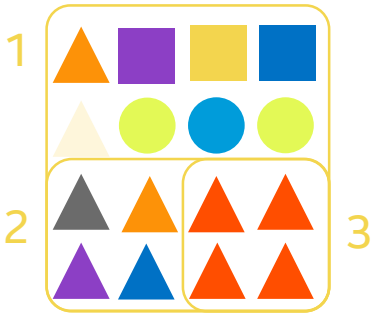
Training requires a very large data set and deep neural network (many layers) to achieve the highest accuracy in most cases



AI COMPUTE CONSIDERATIONS

How do you determine the right computing for your AI needs?

WORKLOADS

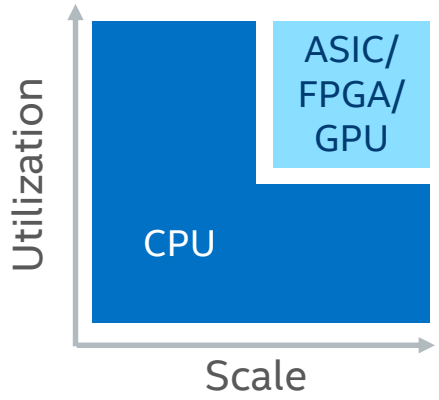


What is my workload profile?

REQUIREMENTS

What are my use case requirements?

DEMAND

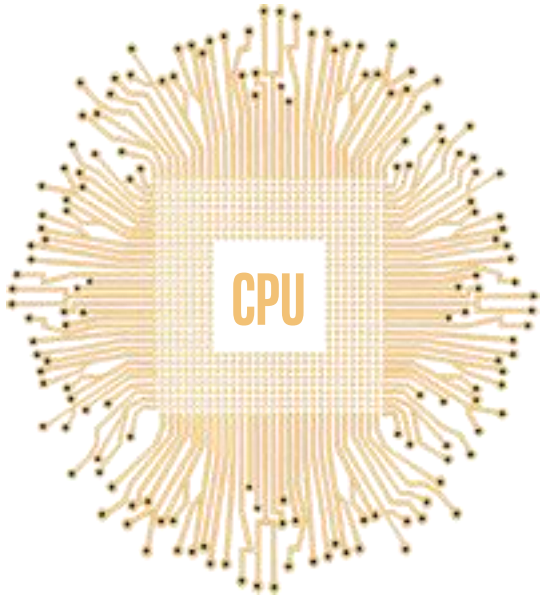


How prevalent is AI in my environment?

OpenVINO

WHY INTEL AI COMPUTE?

MAXIMIZE



Get the most out of the foundation for AI from the CPU leader

OPTIMIZE

Choose the right compute for you from the one with all the options

SIMPLIFY

OPTIMIZED SW
DATA PIPELINE
ANALYTICS & AI
SUPPORT
MOVE/STORE

Reduce “moving parts” by building on an optimized AI platform

LEAD

Lead your industry by aligning with the builder of next-gen AI solutions

INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT

Tool Suite for High-Performance, Deep Learning Inference

Faster, more accurate real-world results using high-performance, AI and computer vision inference deployed into production across Intel® architecture from edge to cloud

High-Performance,
Deep Learning Inference

Streamlined Development,
Ease of Use

Write Once,
Deploy Anywhere

INSIDE INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT

Deep Learning

Intel® Deep Learning Deployment Toolkit

Model Optimizer
Convert & Optimize

IR

Inference Engine
Optimized Inference
+ samples

IR = Intermediate Representation file

Open Model Zoo

- Intel & Public Pretrained Models
- Demos
- Model Downloader
- Accuracy Checker

- Deployment Manager
- Post Training Optimization Toolkit
- Benchmark App
- DL Workbench
- DL Streamer — New

Traditional Computer Vision

- OpenCV*
- Samples

For Intel® CPU & GPU/Intel® Processor Graphics

Tools & Libraries

Increase Media/Video/Graphics Performance

- **Intel® Media SDK** Open Source version
- **OpenCL™ Drivers & Runtimes**

For GPU/Intel® Processor Graphics

Optimize Intel® FPGA (Linux* only)

- **FPGA RunTime Environment** (from Intel® FPGA SDK for OpenCL™)
- **Bitstreams**

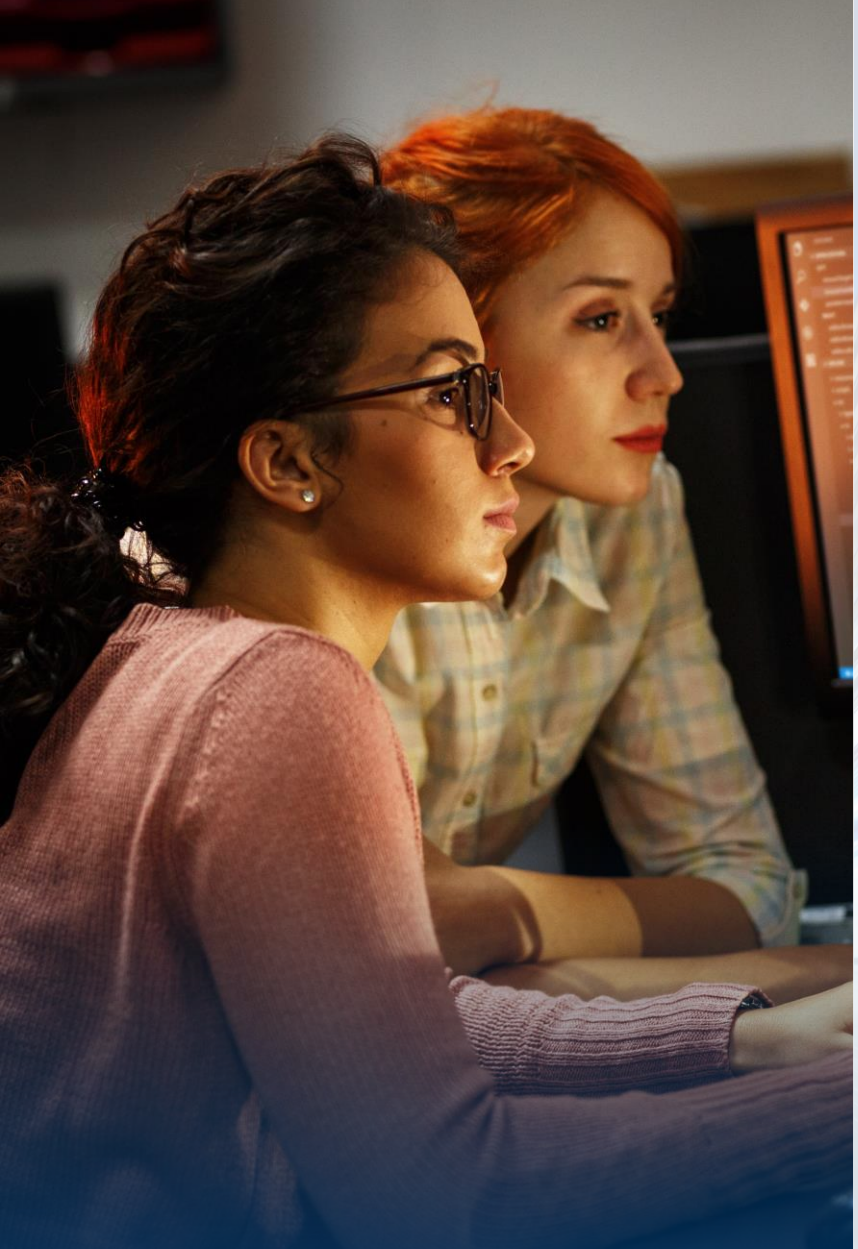
OS Support: CentOS* 7.4 (64 bit), Ubuntu* 16.04.3 LTS (64 bit), Microsoft Windows* 10 (64 bit), Yocto Project* version Poky Jethro v2.0.3 (64 bit), macOS* 10.13 & 10.14 (64 bit)

Intel® Architecture-Based Platforms Support

Intel® Vision Accelerator Design Products & AI in Production/ Developer Kits

An open source version is available at 01.org/openvinotoolkit (some deep learning functions support Intel CPU/GPU only).


DEPLOY DEEP LEARNING SOLUTIONS WITH INTEL®
DISTRIBUTION OF OPENVINO™ TOOLKIT
1. BUILD
2. OPTIMIZE
3. DEPLOY



1. BUILD

2. OPTIMIZE

3. DEPLOY

BREADTH OF SUPPORTED FRAMEWORKS MAXIMIZES DEVELOPMENT

Supported Frameworks and Formats ▸ https://docs.openvinotoolkit.org/latest/_docs_IE_DG_Introduction.html#SupportedFW
Configure the Model Optimizer for your Framework ▸ https://docs.openvinotoolkit.org/latest/_docs_MO_DG_prepare_model_Config_Model_Optimizer.html

1. BUILD

2. OPTIMIZE

3. DEPLOY

FROM OPTIMIZATION TO DEPLOYMENT

OpenVINO

Model Optimizer

- A Python-based tool to import trained models and convert them to Intermediate Representation
- Optimizes for performance or space with conservative topology transformations
- Hardware-agnostic optimizations

Development Guide
https://docs.openvinotoolkit.org/latest/_docs_MO_DG_Deep_Learning_Model_Optimizer_DevGuide.html

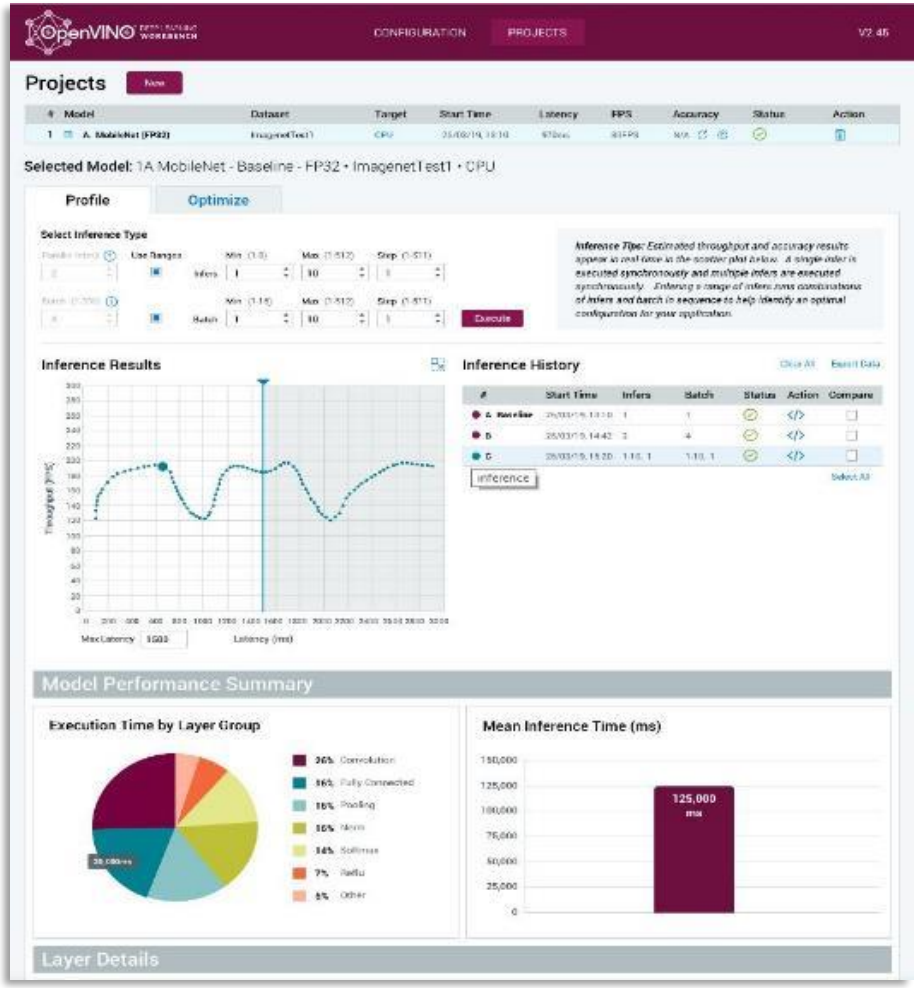
Inference Engine

- High-level, C/C++ and Python, inference API
- Interface is implemented as dynamically loaded plugins for each hardware type
- Delivers best performance for each type without requiring users to implement and maintain multiple code pathways

Development Guide
https://docs.openvinotoolkit.org/latest/_docs_IE_DG_Deep_Learning_Inference_Engine_DevGuide.html

Deep Learning Workbench

- Web-based, UI extension tool of the Intel® Distribution of OpenVINO™ toolkit
- Visualizes performance data for topologies and layers to aid in model analysis
- Automates analysis for optimal performance configuration (streams, batches, latency)
- Experiment with int8 or Winograd calibration for optimal tuning
- Provide accuracy information through accuracy checker
- Direct access to models from public set of Open Model Zoo



Development Guide
https://docs.openvinotoolkit.org/latest/_docs_Workbench_DG_Introduction.html

TOOLS TO SPEED UP TEST CYCLES AND DEVELOPMENT

[NEW] Post-training Optimization

- Reduce model size into low precision data types, such as INT8
- Reduces model size while also improving latency

Deployment Manager

- Generate an optimal, minimized runtime package for deployment
- Deploy with smaller footprint compared to development package

Model Analyzer

- Provides theoretical data on models: computational complexity (flops), number of neurons, memory consumption

Accuracy Checker

- Check for accuracy of the model (original and after conversion) to IR file using a known data set

Benchmark App

- Measure performance (throughput, latency) of a model
- Get performance metrics per layer and overall basis

Model Downloader

- Provides an easy way of accessing a number of public models as well as a set of pre-trained Intel models

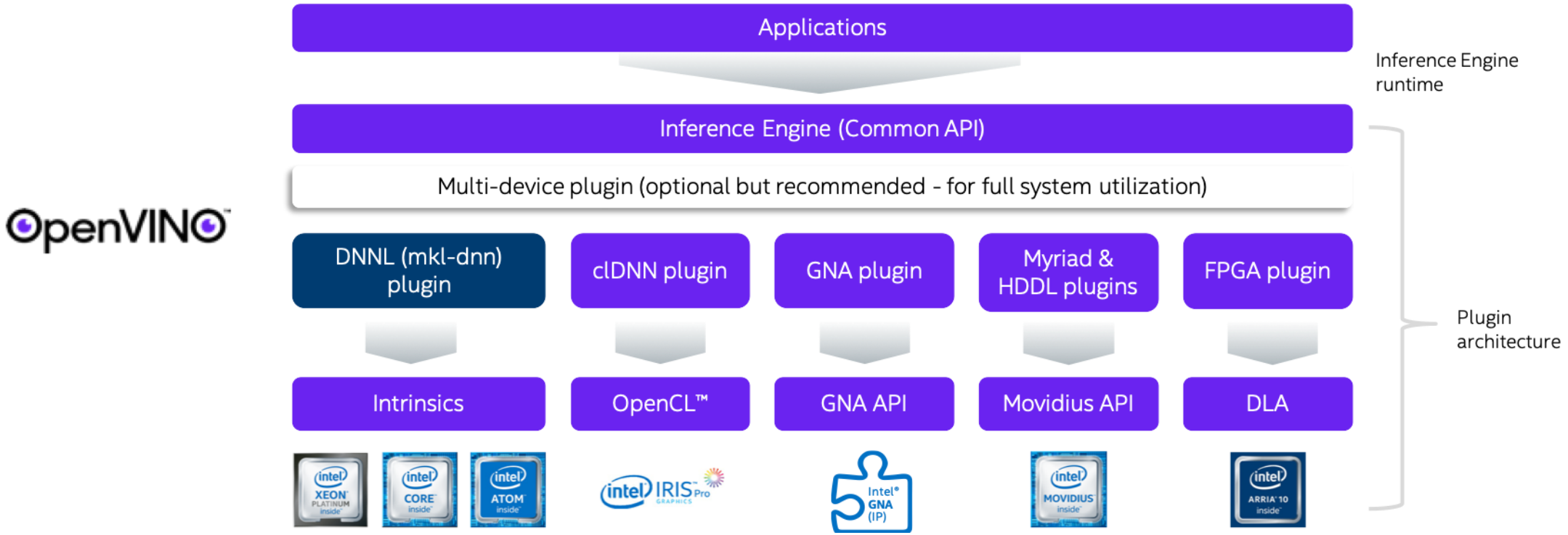
Get Started ▸ https://docs.openvinotoolkit.org/latest/_docs_IE_DG_Tools_Overview.html –or- by using the Deep Learning Workbench

1. BUILD

2. OPTIMIZE

3. DEPLOY

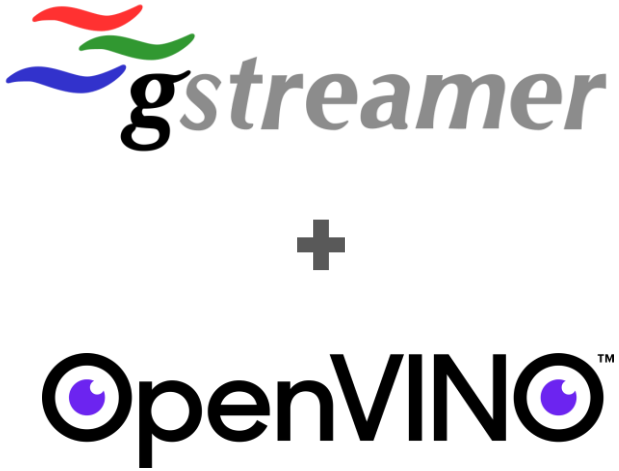
INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT
WRITE ONCE, DEPLOY ANYWHERE



Deep Learning Streamer

- Intel® Distribution of OpenVINO™ toolkit **Deep Learning (DL) Streamer**, now part of the default installation package
- Enables developers to **create and deploy** optimized streaming media analytics pipelines across Intel® architecture from edge to cloud
- Optimal pipeline interoperability with a familiar developer experience built using the **GStreamer*** multimedia framework

Learn More
https://docs.openvinotoolkit.org/latest/index.html#toolkit_components



SPEED UP DEVELOPMENT USING THE OPEN MODEL ZOO

Open source resources with pre-trained models, samples and demos

Computer Vision

Object detection

Object recognition

Reidentification

Semantic segmentation

Instance segmentation

Human pose estimation

Image processing

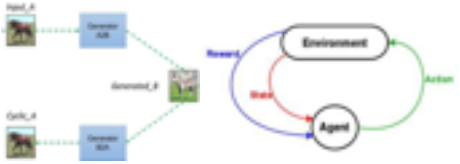
Audio, Speech, Language

Text detection

Text recognition

Recommender

Action recognition



Other

(Data Generation, Reinforcement Learning)

Compression models

Image retrieval

And more..

PRE-TRAINED MODELS

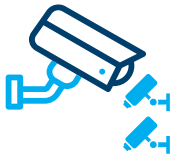
https://github.com/opencv/open_model_zoo

SPEED UP DEVELOPMENT USING THE OPEN MODEL ZOO

Open source resources with pre-trained models, demos, and tools

The Open Model Zoo demo applications are console applications that demonstrate how you can use your applications to solve specific use-cases.

Smart Classroom
Recognition and action detection demo for classroom settings



Multi-Camera, Multi-Person
Tracking multiple people on multiple cameras for public safety use cases

Gaze Estimation
Face detection followed by gaze estimation, head pose estimation and facial landmarks regression.

Super Resolution
Enhances the resolution of the input image

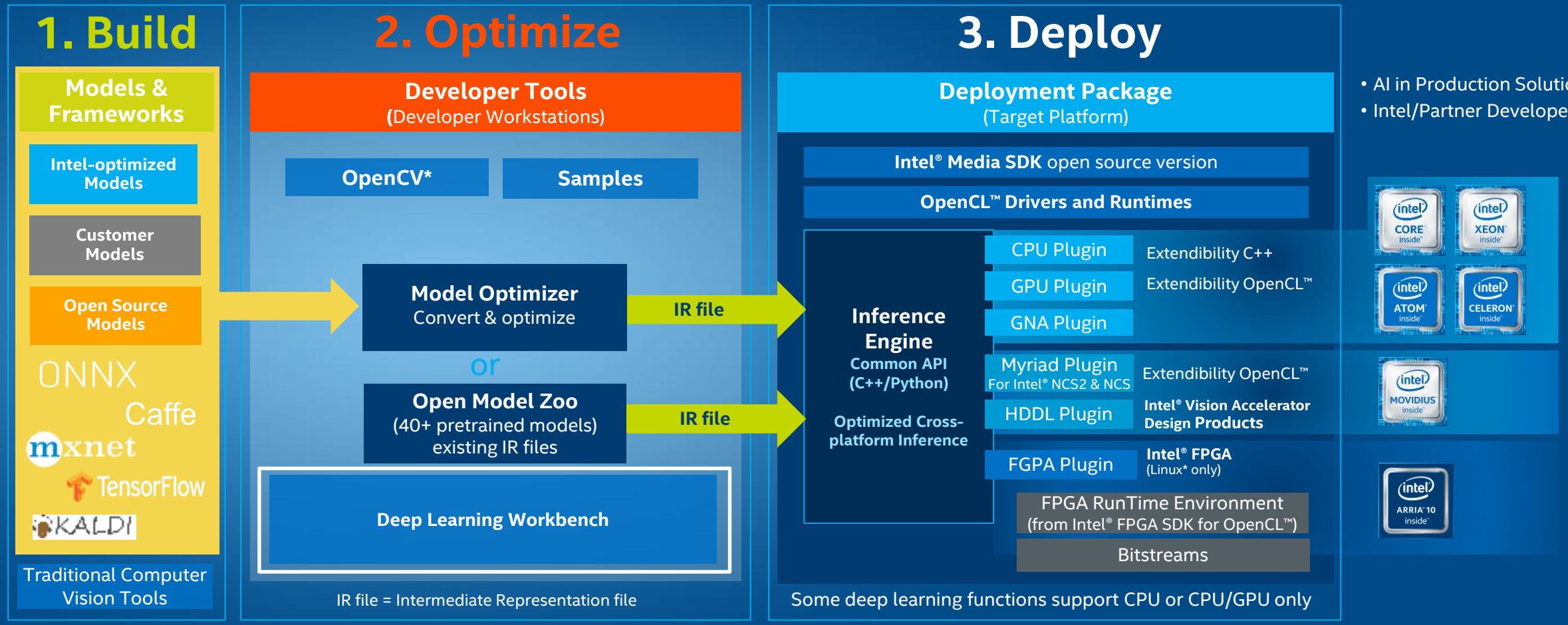
Action Recognition
Classifies actions that are being performed on input video

And more..

DEMO APPLICATIONS
https://github.com/opencv/open_model_zoo

USING THE INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT

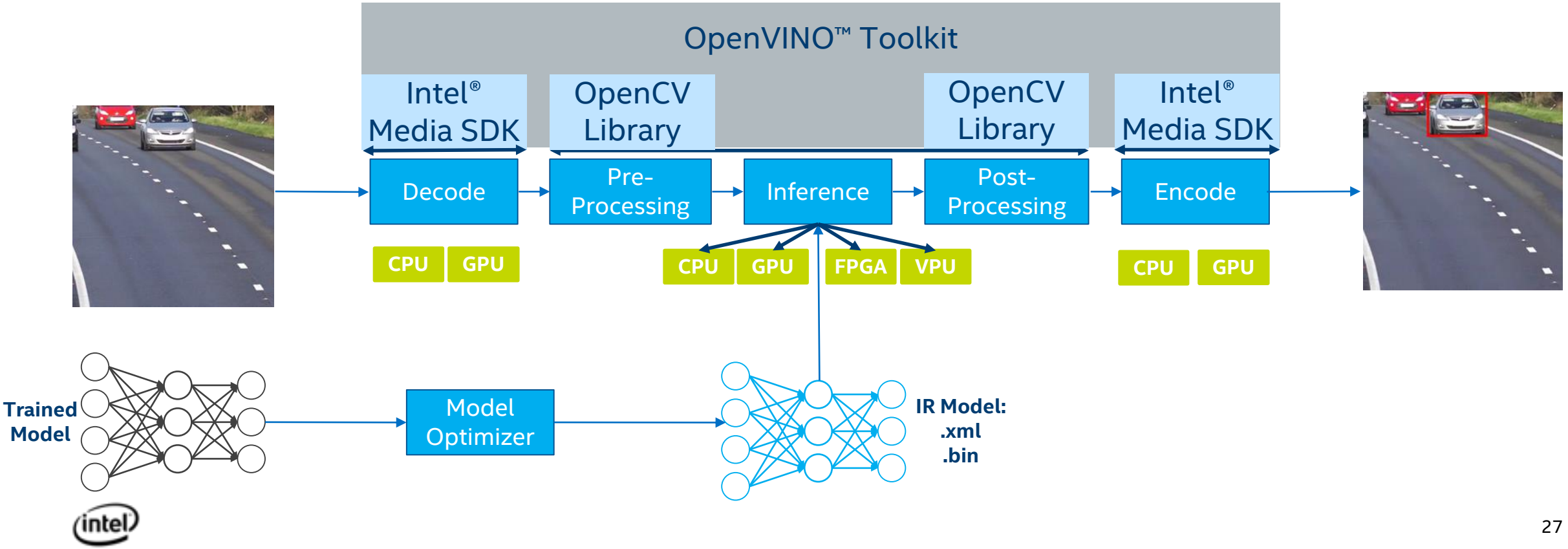
ADVANCED CAPABILITIES TO STREAMLINE DEEP LEARNING DEPLOYMENT



Intel® NCS = Intel® Neural Compute Stick (VPU)

Workflow of Applying OpenVINO™ in CV Applications, Accelerate Streaming Performance

Using Intel® Media SDK and the OpenVINO™ toolkit together enables customers to build high performance, intelligent vision solutions.



TEST HARDWARE WITH THE INTEL® DEVCLOUD FOR THE EDGE

Powered by Intel® Distribution of OpenVINO™ toolkit

Trained Model
Model trained using one of the supported frameworks

-or-

Using a pre-trained model available from the Open Model Zoo

→ OpenVINO

Intel® Distribution of OpenVINO™ toolkit
Model Optimizer
Inference Engine

→

Intel® DevCloud for the Edge
A development sandbox to try AI and vision workloads remotely before purchasing Intel® platforms

- Prototype on the latest hardware and software to future proof your solution
- Benchmark your customized AI application
- Run AI applications from anywhere in the world
- Reduce development time and cost

https://devcloud.intel.com/edge/

Deploy and Scale

GETTING STARTED WITH INTEL® DISTRIBUTION OF OPENVINO™ TOOLKIT

Recommendations to the customer or developer

QUALIFY

- Use a trained model and check if framework is supported

  - *or* –

- Take advantage of a pre-trained model from the Open Model Zoo

INSTALLATION

- Download the Intel® OpenVINO™ toolkit package from Intel® Developer Zone, or by YUM or APT repositories
- Utilize the Getting Started Guide

PREPARE

- Understand sample demos and tools included
- Understand performance
- Choose hardware option with Performance Benchmarks
- Build, test and remotely run workloads on the Intel® DevCloud for the Edge before buying hardware

HANDS ON

- Visualize metrics with the Deep Learning Workbench
- Utilize prebuilt, Reference Implementations to become familiar with capabilities
- Optimize workloads with these performance best practices
- Use the Deployment Manager to minimize deployment package

SUPPORT

- Ask questions and share information with others through the Community Forum
- Engage using #OpenVINO on Stack Overflow
- Visit documentation site for guides, how to's, and resources
- Attend training and get certified

JUMPSTART DEEP LEARNING TODAY!

Download Free ▸
Intel® Distribution of OpenVINO™ toolkit

Also available from
Docker | YUM | APT | [NEW] Anaconda Cloud


intel