Solution Brief
Data Center
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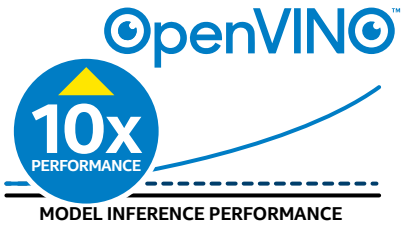
IT@Intel: Streamline Deep-Learning Integration into Auto Defect Classification

At an Intel factory, the Intel® Distribution of OpenVINO™ toolkit is helping streamline the integration of deep neural networks (DNNs) into the factory's computer vision automatic defect-classification system



The OpenVINO toolkit helps data scientists more easily interface with TensorFlow and speeds inference performance by 10x.[1]

Executive Summary

Intel factories have been using computer vision for over a decade to automate defect detection and classification. We have been using TensorFlow as the core open source library to help develop and train deep-learning models. However, the interface between our computer vision systems and TensorFlow is cumbersome and requires days of custom programming from data scientists. The Intel® Distribution of OpenVINO™ toolkit significantly streamlines this interface (see Figure 1). Therefore, we have found it to be the most convenient and fastest way to deploy deep learning in the Microsoft Windows environment.

- The OpenVINO toolkit helps data scientists more easily interface with powerful back-end deep-learning engines like TensorFlow.
- This frees up data scientists to use their time more productively.
- There is no unique hardware to deploy—OpenVINO toolkit runs on our existing Intel® Xeon® processor-based servers. It also runs on Intel Atom® and Intel® Core™ processors.
- Because it is optimized for Intel® hardware, OpenVINO toolkit boosted model inference performance by 10x.[1]

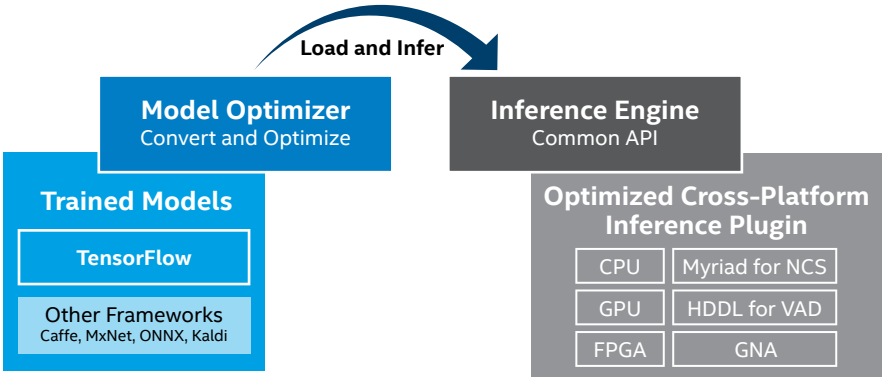


Figure 1. The Intel® Distribution of OpenVINO™ toolkit includes a model optimizer and an inference engine.

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Acronyms

ADC automatic defect classification
CNN convolutional neural network

Business Challenge

Using computer vision to analyze manufacturing processes, look for defects, and classify them is a massive time-saver for Intel's factories. For years, we used mainly traditional computer vision methods and feature descriptors. Increasingly, the demand for deep learning is growing due to the complexity of the tasks that computer vision must do. For example, as products get smaller, obtaining high-quality images is more difficult, and even with good images, the manipulation of images to extract specific features is complicated. Also, it is challenging to use TensorFlow's APIs to create back-end deep-learning building blocks for use with our computer vision systems. These APIs are relatively poorly documented, and it sometimes took many days for our team to interface computer vision systems with TensorFlow.

Pre-built TensorFlow packages for Windows systems were not reliably linkable to our systems—even for the most common deep-learning models. Workable integration of TensorFlow binaries under Microsoft Windows requires installing multiple additional build tools, packages, and dependencies, followed by cumbersome assembling/compiling from source code. This process is time-consuming even for very experienced computer vision software developers. We needed a way to streamline this process.

Solution

Product quality is critical in Intel's factories. We selected the Intel® Distribution of OpenVINO™ toolkit as our interface to TensorFlow because it provides pre-built binaries that can be used out of the box. In our experience, this is the fastest and most convenient way to deploy deep learning in a Microsoft Windows environment. Our exploration of OpenVINO began with a proof of concept in August 2018. We found it easy to use and adopted it as part of our manufacturing plan of record not long after the proof of concept completed.

We are using two components of the OpenVINO toolkit stack (see Figure 1 on previous page):

- The model optimizer
- The inference engine

We found OpenVINO to be a fast and efficient interface compared to TensorFlow's not-well-documented back-end APIs. We also use OpenVINO's Model Zoo for Intel® architecture—an open-sourced collection of optimized machine-learning inference applications. Model Zoo contains a wide set of pretrained models, including the model type from the convolutional neural network (CNN) family that we needed.

Our experience is that using the OpenVINO toolkit offers the following benefits:

- It is easy to integrate with our computer vision systems.
- Complexity is hidden, leading to faster time to deep-learning deployment.
- The solution is scalable across Intel architecture-based platforms.
- Model inference runs 10x faster than without OpenVINO.[1]

Next Steps

When we began using the OpenVINO toolkit, we weren't concerned with inference speed. However, the 10x performance increase that we experienced is an added benefit and opens up additional use cases. For example, we are now exploring the use of OpenVINO for real-time process control, which requires millisecond response times. We are currently working with the OpenVINO development team to add the necessary temporal convolutional network model into the Model Zoo.

Conclusion

Intel IT is committed to making Intel's manufacturing processes as accurate and efficient as possible. Computer vision was an important step in achieving those goals. Now, the OpenVINO toolkit helps save time so that highly qualified engineers can accomplish more productive tasks, rather than coding a cumbersome interface to TensorFlow. OpenVINO helped us simplify development and optimize TensorFlow for top performance. We saw OpenVINO advertised, selected it, tried it, used it like any other customer, and found that it frees up our time for other tasks.

Related Content

If you liked this paper, you may also be interested in the "Faster, More Accurate Defect Classification Using Machine Vision" paper.

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[1] Based on Intel Manufacturing IT experience. Internal measurements from Q4 2018.

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