

**MODEL:**

**Mustang-V100-MX8**

**Intel<sup>®</sup> Vision Accelerator Design with Intel<sup>®</sup> Movidius<sup>™</sup> VPU**  
Powered by Open Visual Inference & Neural Network Optimization (OpenVINO<sup>™</sup>) toolkit

# User Manual

# Revision

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Date	Version	Changes
April 16, 2019	1.01	Added a warning message in Section 3.3: Hardware Installation
January 17, 2019	1.00	Initial release

# Copyright

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# Manual Conventions

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## **WARNING**

Warnings appear where overlooked details may cause damage to the equipment or result in personal injury. Warnings should be taken seriously.



## **CAUTION**

Cautionary messages should be heeded to help reduce the chance of losing data or damaging the product.



## **NOTE**

These messages inform the reader of essential but non-critical information. These messages should be read carefully as any directions or instructions contained therein can help avoid making mistakes.

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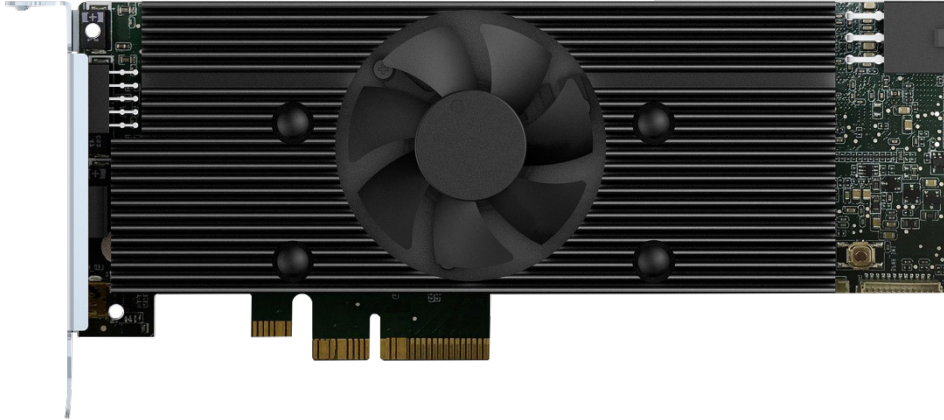
Chapter

1

# Introduction

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## 1.1 Introduction



**Figure 1-1: Mustang-V100-MX8**

The Mustang-V100-MX8 is a deep learning convolutional neural network acceleration card for speeding up AI inference, in a flexible and scalable way. Equipped with Intel® Movidius™ Myriad™ X Vision Processing Unit (VPU), the Mustang-V100-MX8 PCIe card can be used with the existing system, enabling high-performance computing without costing a fortune. VPUs can run AI faster, and is well suited for low power consumption applications such as surveillance, retail and transportation. With the advantage of power efficiency and high performance to dedicate DNN topologies, it is perfect to be implemented in AI edge computing device to reduce total power usage, providing longer duty time for the rechargeable edge computing equipment.

"Open Visual Inference & Neural Network Optimization (OpenVINO™) toolkit" is based on convolutional neural networks (CNN), the toolkit extends workloads across Intel® hardware and maximizes performance. It can optimize pre-trained deep learning model such as Caffe, MXNET, Tensorflow into IR binary file then execute the inference engine across Intel®-hardware heterogeneously such as CPU, GPU, Intel® Movidius™ Neural Compute Stick, and FPGA.

## Mustang-V100-MX8

### 1.2 Features

Mustang-V100-MX8 features are listed below:

- Intel® Movidius™ Myriad™ X Vision Processing Unit
- Interface: PCIe 2.0 x4
- Form factor: Standard half-height, half-length, single-width
- Active fan
- OpenVINO™ Toolkit, AI edge computing ready device
- Eight Intel® Movidius™ Myriad™ X chips can execute eight topologies simultaneously
- Low power consumption, approximate 2.5W for each Intel® Movidius™ Myriad™ X
- 12V external power
- Equipped with rotary switch and LED indicator for card number identification

### 1.3 Block Diagram

Figure 1-2 shows the block diagram of the Mustang-V100-MX8.

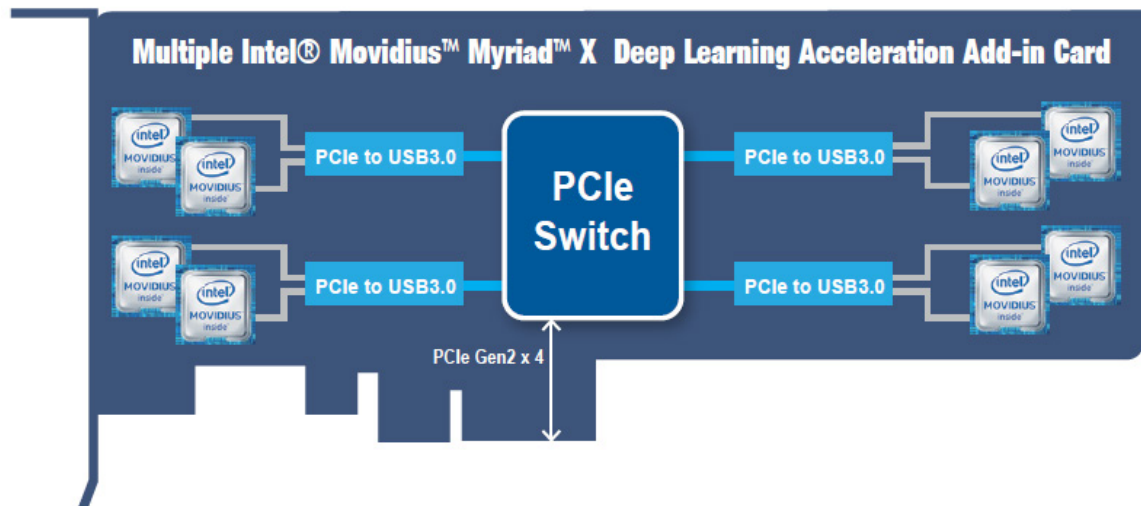


Figure 1-2: Block Diagram

### 1.4 I/O and Dimensions

The I/O interfaces and dimensions of the board are listed below:

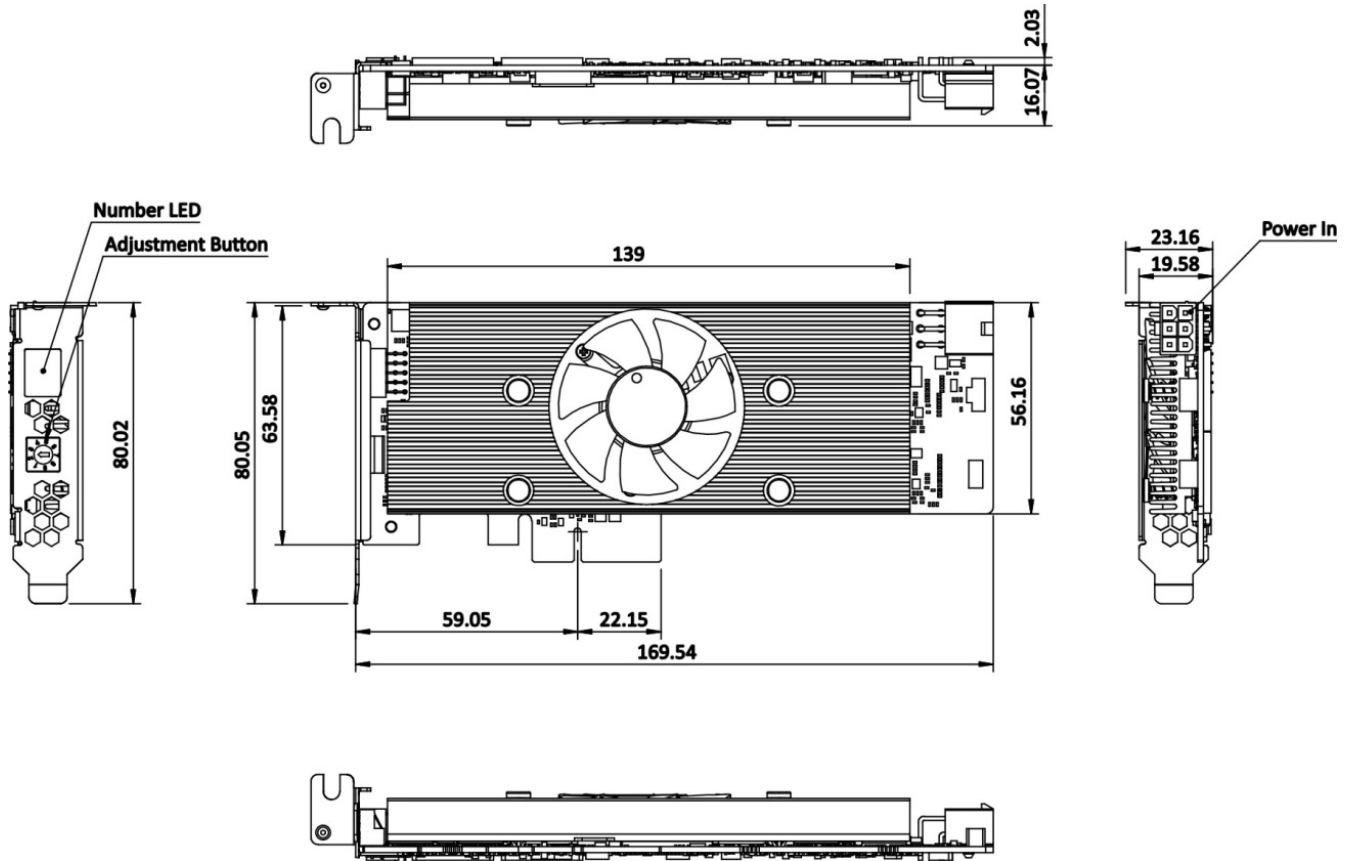


Figure 1-3: Dimensions (mm)

## Mustang-V100-MX8

### 1.5 Technical Specifications

Mustang-V100-MX8 technical specifications are listed below.

Specification	Mustang-V100-MX8
<b>Main Chip</b>	Intel® Movidius™ Myriad™ X
<b>Operating Systems</b>	Ubuntu* 16.04.3 (LTS), 64-bit CentOS 65-bit
<b>Physical PCIe Interface</b>	PCI Express x4 Compliant with PCI Express Specification v2.0
<b>Indicator</b>	7-segment LED display for card ID
<b>Fan</b>	Active fan
<b>External Power Connector</b>	12 V external power
<b>Power Consumption</b>	<25 W
<b>Operating Temperature</b>	5°C ~ 60°C / 41°F ~ 140°F (ambient temperature)
<b>Operating Humidity</b>	5% ~ 90%
<b>Dimensions (WxHxD)</b>	169.54 mm x 80.05 mm x 23.16 mm Standard half-height, half-length, single-width

**Table 1-1: Technical Specifications**

Chapter

**2**

# Unpacking

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## Mustang-V100-MX8

### 2.1 Anti-static Precautions

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#### WARNING!

Static electricity can destroy certain electronics. Make sure to follow the ESD precautions to prevent damage to the product, and injury to the user.

---

Make sure to adhere to the following guidelines:

- **Wear an anti-static wristband:** Wearing an anti-static wristband can prevent electrostatic discharge.
- **Self-grounding:** Touch a grounded conductor every few minutes to discharge any excess static buildup.
- **Use an anti-static pad:** When configuring any circuit board, place it on an anti-static mat.
- **Only handle the edges of the PCB:** Don't touch the surface of the motherboard. Hold the motherboard by the edges when handling.

### 2.2 Unpacking Precautions

When the Mustang-V100-MX8 is unpacked, please do the following:

- Follow the antistatic guidelines above.
- Make sure the packing box is facing upwards when opening.
- Make sure all the packing list items are present.

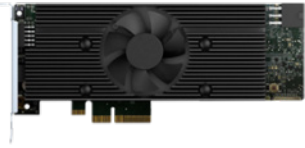

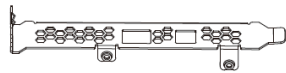
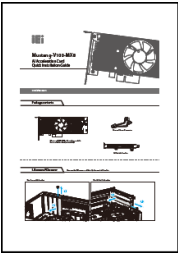
## 2.3 Packing List



**NOTE:**

If any of the components listed in the checklist below are missing, do not proceed with the installation. Contact the IEI reseller or vendor the Mustang-V100-MX8 was purchased from or contact an IEI sales representative directly by sending an email to [sales@ieiworld.com](mailto:sales@ieiworld.com).

The Mustang-V100-MX8 is shipped with the following components:

Quantity	Item and Part Number	Image
1	Mustang-V100-MX8 AI acceleration card	
1	PCIe power adapter	
1	Full-height bracket	
1	Quick Installation Guide	



Chapter

**3**

# Hardware Installation

---

### 3.1 Anti-static Precautions

---

**WARNING:**

Failure to take ESD precautions during the installation of the Mustang-V100-MX8 may result in permanent damage to the Mustang-V100-MX8 and severe injury to the user.

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Electrostatic discharge (ESD) can cause serious damage to electronic components, including the Mustang-V100-MX8. Dry climates are especially susceptible to ESD. It is therefore critical that whenever the Mustang-V100-MX8 or any other electrical component is handled, the following anti-static precautions are strictly adhered to.

- ***Wear an anti-static wristband:*** Wearing a simple anti-static wristband can help to prevent ESD from damaging the board.
- ***Self-grounding*** Before handling the board, touch any grounded conducting material. During the time the board is handled, frequently touch any conducting materials that are connected to the ground.
- ***Use an anti-static pad:*** When configuring the Mustang-V100-MX8, place it on an anti-static pad. This reduces the possibility of ESD damaging the Mustang-V100-MX8.
- ***Only handle the edges of the PCB:*** When handling the PCB, hold the PCB by the edges.

### 3.2 Installation Considerations

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**NOTE:**

The following installation notices and installation considerations should be read and understood before installation. All installation notices must be strictly adhered to. Failing to adhere to these precautions may lead to severe damage and injury to the person performing the installation.

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## Mustang-V100-MX8

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### **WARNING:**

The installation instructions described in this manual should be carefully followed in order to prevent damage to the Mustang-V100-MX8, its components and injury to the user.

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Before and during the installation please **DO** the following:

- Read the user manual:  
The user manual provides a complete description of the Mustang-V100-MX8 installation instructions and configuration options.
- Wear an electrostatic discharge cuff (ESD):  
Electronic components are easily damaged by ESD. Wearing an ESD cuff removes ESD from the body and helps prevent ESD damage.
- Turn off system:  
When installing the Mustang-V100-MX8, make sure that the system to be connected is disconnected from all power supplies and that no electricity is being fed into the system.

Before and during the installation of the Mustang-V100-MX8 **DO NOT:**

- Remove any of the stickers on the PCB board. These stickers are required for warranty validation.
- Use the product before verifying all the cables and power connectors are properly connected.
- Allow screws to come in contact with the PCB circuit, connector pins, or its components.

### 3.3 Hardware Installation

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**WARNING:**

DO NOT install the Mustang-V100-MX8 into the TANK AIoT Dev. Kit before shipment. It is recommended to ship them with their original boxes to prevent the Mustang-V100-MX8 from being damaged.

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To install the Mustang-V100-MX8, please follow the steps below.

**Step 1: Prepare the computer.** Turn off the computer, and remove the power cord from the rear of the power supply.

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**WARNING:**

Disconnect the computer from the power supply and from any networks to which you will install the Mustang-V100-MX8, or you risk damaging the system or experiencing electrical shock.

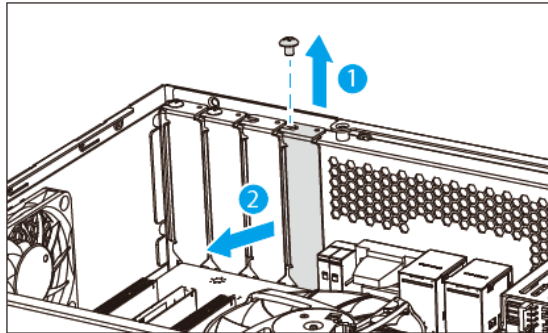
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**Step 2: Remove the cover from the chassis.**

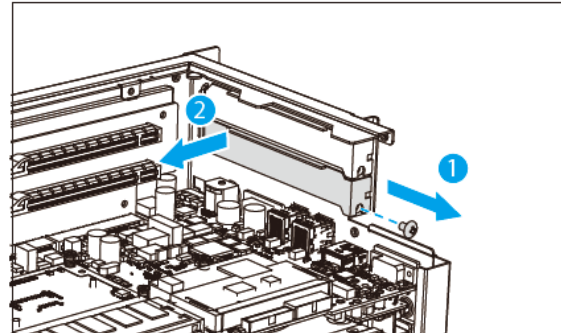
**Step 3: Locate available PCIe slots and remove the blank brackets.** The Mustang-V100-MX8 is compatible with PCIe x4 slots, and only needs one PCIe slot for installation. Remove a blank bracket panel on the back of the computer that aligns with the PCIe slot for installing the Mustang-V100-MX8. Save the bracket screw.

## Mustang-V100-MX8

**Low-profile bracket**

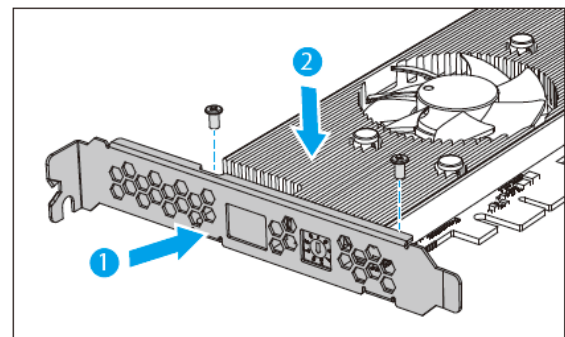
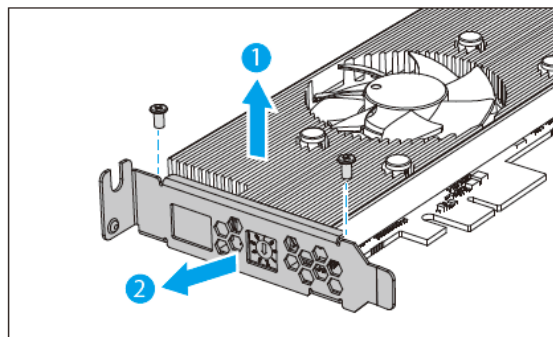


**Full-height bracket**



**Figure 3-1: Remove One Blank Bracket**

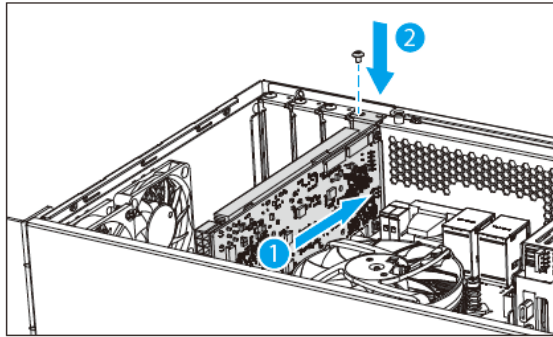
**Step 4:** [Only needed for full-height installation] Change the bracket on the Mustang-V100-MX8 from low-profile bracket to full-height bracket.



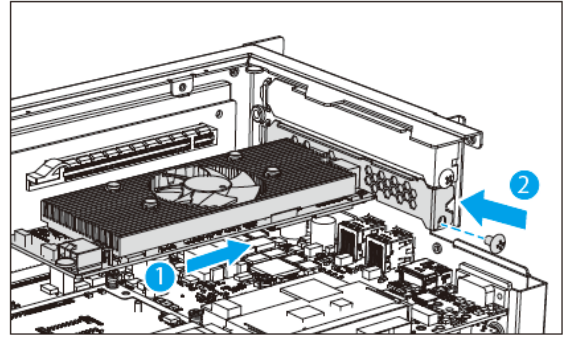
**Figure 3-2: Change to Full-height Bracket**

**Step 5:** Install and secure the Mustang-V100-MX8 to the system. Align the Mustang-V100-MX8 to the PCIe slot. Press down gently, but firmly, to seat the Mustang-V100-MX8 correctly in the slot. Install the bracket screw to secure the Mustang-V100-MX8 to the system's chassis.

**Low-profile bracket**

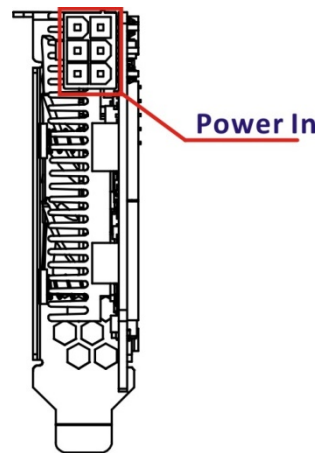


**Full-height bracket**



**Figure 3-3: Change to Full-height Bracket**

**Step 6:** Connect a power cable to the **Mustang-V100-MX8**. The Mustang-V100-MX8 requires 12V DC power. Use a power cable with 6-pin connector from the system, if applicable, or add the 4-pin to 6-pin PCIe power adapter to connect to the power connector of the Mustang-V100-MX8.



**Figure 3-4: Power Connector Location**

**Step 7:** Assign a card ID to the **Mustang-V100-MX8** by adjusting the rotary switch. The card ID number assigned here will be shown on the LED display of the card after power-up. **NOTE:** The LED digit only displays 0 through 7; if switched to 8, the LED will display 0; if switched to F, LED will display 7.

## Mustang-V100-MX8

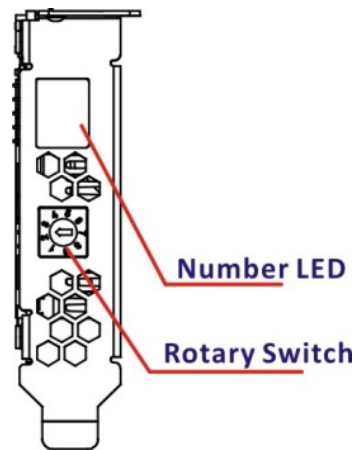


Figure 3-5: Assign a Card ID

- Step 8:** Repeat **Step 3 ~ Step 7** to install multiple Mustang-V100-MX8 into the system if available.
- Step 9:** Re-install the cover of the chassis.
- Step 10:** Reconnect any power cords and any network cables to the system. Power up the system.

Chapter

4

# OpenVINO™ Toolkit Installation (Linux)

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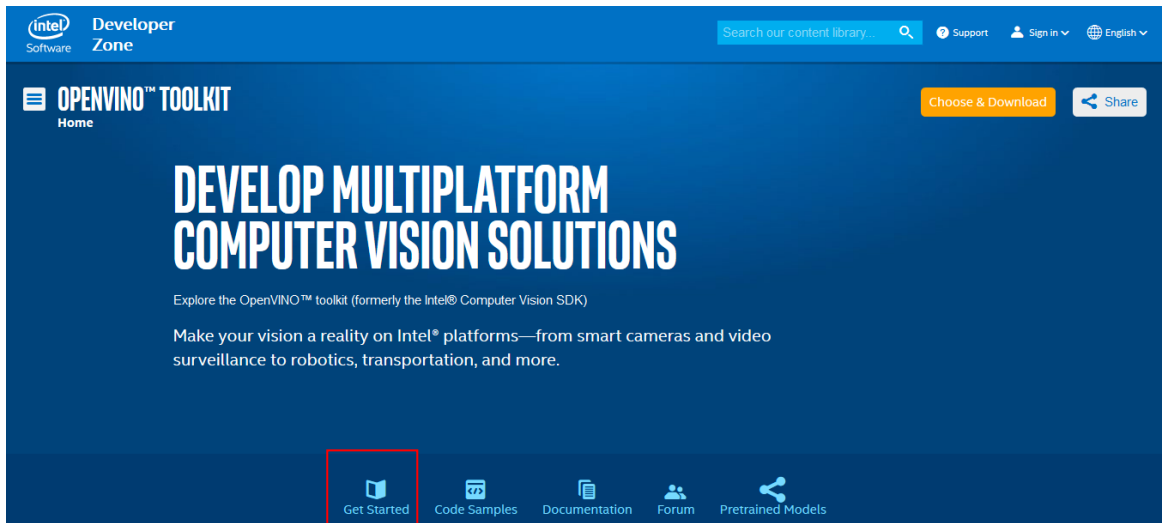
## Mustang-V100-MX8

### 4.1 System Requirements

- Linux Ubuntu 16.04.3 LTS 64bit
- CentOS 64-bit
- OpenVINO™ Toolkit was pre-installed in TANK-870AI.

### 4.2 Online Installation Guide

Go to <https://software.intel.com/en-us/openvino-toolkit>. Click “Get Started” then choose your configuration from “Development Environment Installation Guides & Videos”. Follow the instruction to complete the installation procedure.



#### INSTALLATION & SETUP GUIDES

##### Development Environment Installation Guides & Videos

- Linux\*: Guide | Video
- Windows\*: Guide | Video
- Linux\* with FPGA: Guide

##### Target Device Installation Guides

- Quick Start Guide for Intel® Programmable Acceleration Card with Intel® Arria® 10 FPGA GX
- Acceleration Hub for Intel® FPGA Development Kit for Intel® Arria® 10 FPGA GX
- Intel® Movidius™ Neural Compute Stick Quick Start Guide

##### Intel® Deep Learning Deployment Toolkit References

- Model Optimizer Developer Guide
- Inference Engine Developer Guide
- Pretrained Models & Algorithms

## 4.3 Installation - Step by Step

This guide assumes you downloaded the Intel Distribution of OpenVINO toolkit for Linux\* OS. If you do not have a copy of the toolkit package file, [download the latest version](#) and then return to this guide to proceed with the installation.

**NOTE:** Before beginning the installation, make sure you have the correct Linux kernel version:

```
cat /proc/version
```

Make sure you are using a Linux kernel version 4.14 and later.

For example:

- 4.15.0-38-Generic

Install kernel of 4.15.0-38

- `apt-get install linux-image-4.15.0-38-generic`
- `apt-get install linux-headers-4.15.0-38-generic`
- `apt-get install linux-modules-extra-4.15.0-38-generic`
- `apt-get remove linux-modules-extra-4.15.0-38-generic`

### 4.3.1 Install External Software Dependencies

1. Open the **Terminal\*** or your preferred console application and go to the **directory** in which you downloaded the Intel® Distribution of OpenVINO™ toolkit. This document assumes this is your ~/Downloads directory. If not, **replace** ~/Downloads with the directory where the file is located:

```
cd ~/Downloads/
```

2. By default, the package file is saved as **l\_openvino\_toolkit\_p\_<version>.tgz**

3. Unpack the **.tgz** file you downloaded:

```
tar -zxvf l_openvino_toolkit_p_<version>.tgz
```

4. The files are unpacked to a directory named **l\_openvino\_toolkit\_p\_<version>**.

## Mustang-V100-MX8

5. Go to the `l_openvino_toolkit_p_<version>` directory:  

```
cd l_openvino_toolkit_p_<version>
```
6. Run a script to automatically download and install **external software dependencies**. These dependencies are required for the Intel-optimized version of OpenCV, the Deep Learning Inference Engine, and the Deep Learning Model Optimizer tools. Install these before the Intel Distribution of OpenVINO toolkit:  

```
sudo -E ./install_cv_sdk_dependencies.sh
```
7. As an option, you can install all the dependencies manually instead of running `install_cv_sdk_dependencies.sh`. In this case, use the list of dependencies at System Requirements.

The dependencies are installed. Continue to the next section to install the OpenVINO toolkit core components.

**Note:** The Model Optimizer has additional prerequisites that are addressed later in this document.

### 4.3.2 Install the Intel® Distribution of OpenVINO™ Toolkit Core Components

If you have a previous version of the toolkit installed, rename or delete **two directories**:

- `/home/<user>/inference_engine_samples`
- `/home/<user>/openvino_models`

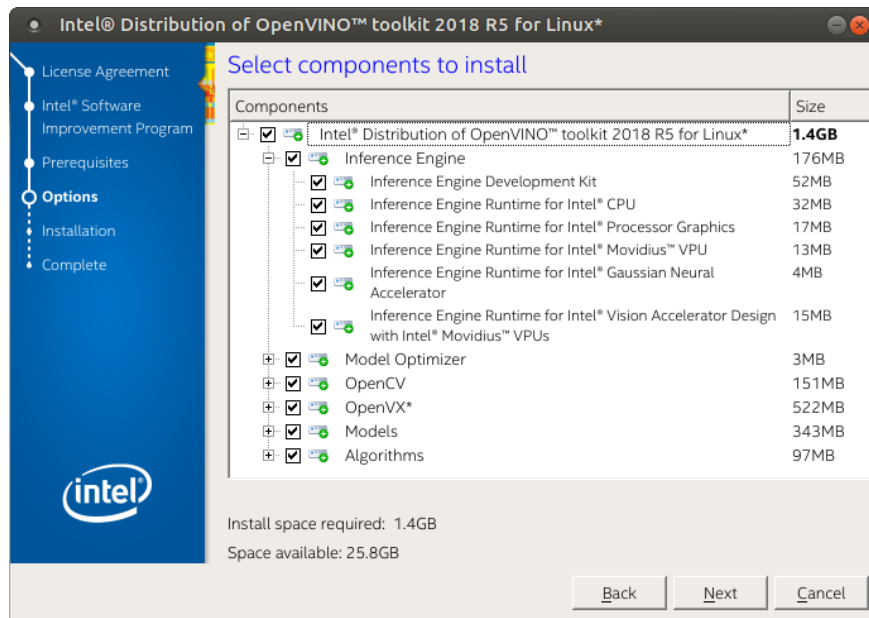
To install the OpenVINO™ core components:

1. Choose one of the installation options below and run the related script with root or regular user privileges. The default installation directory path depends on the privileges you choose for the installation.  
You can use either a GUI installation wizard or command-line instructions. The only difference between the two options is that the command-line instructions are text-based. This means that instead of clicking options in a GUI, command-line prompts ask for input on a text screen.

- GUI installation Wizard:

```
sudo ./install_GUI.sh
```

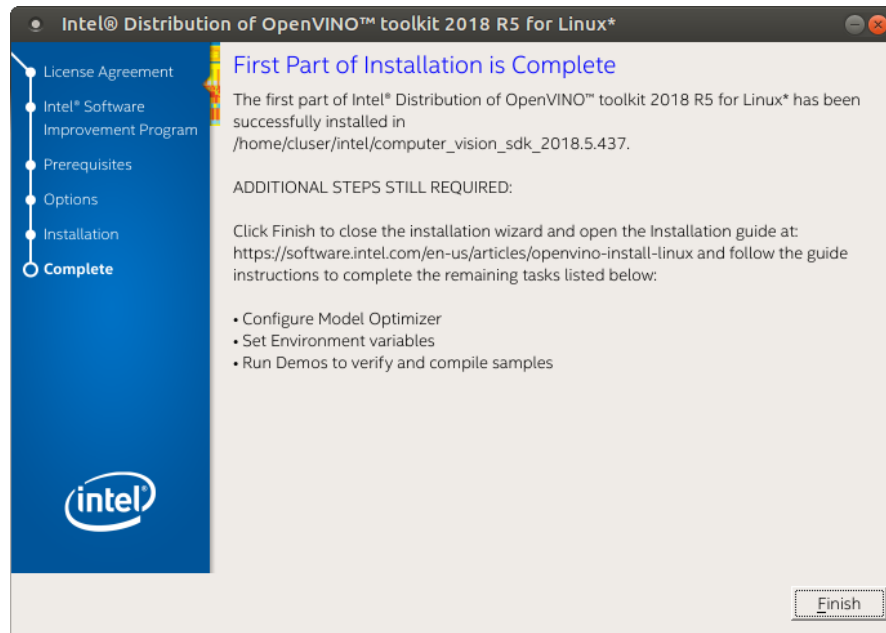
2. Follow the instructions on your screen. Watch for informational messages such as the following in case you must complete additional steps:
  
3. Click **Next**.
  
4. The **Installation summary** screen shows you the default component set to install:
  - o If you used **root privileges** to run the installer, it installs the Intel Distribution of OpenVINO toolkit in this directory: `/opt/intel/computer_vision_sdk_<version>/`  
For simplicity, a symbolic link to the latest installation is also created:  
`/opt/intel/computer_vision_sdk/`
  
  - o If you used **regular user** privileges to run the installer, it installs the Intel Distribution of OpenVINO toolkit in this directory:  
`/home/<user>/intel/computer_vision_sdk_<version>/`  
For simplicity, a symbolic link to the latest installation is also created:  
`/home/<user>/intel/computer_vision_sdk/`
  
5. If needed, click **Customize** to change the installation directory or the components you want to install:



Click **Next** to save the installation options and show the Installation summary screen.

## Mustang-V100-MX8

6. On the **Installation summary** screen, press **Install** to begin the installation.
7. When the first part of installation is complete, the final screen informs you that the core components have been installed and additional steps still required:



8. Click **Finish** to close the installation wizard. A new browser window opens to the next section of the installation guide to set the environment variables. You are in the same document. The new window opens in case you ran the installation without first opening this installation guide.

The core components are installed. Continue to the next section to set environment variables.

### 4.3.3 Set the Environment Variables

You must update several environment variables before you can compile and run OpenVINO™ applications. **Run the following script** to temporarily set your environment variables:

```
source /opt/intel/computer_vision_sdk/bin/setupvars.sh
```

**(Optional)** The Intel Distribution of OpenVINO toolkit environment variables are removed when you close the shell. As an option, you can permanently set the environment variables as follows:

1. Open the `.bashrc` file in `<user_directory>`:  
`vi <user_directory>/.bashrc`
2. **Add this line** to the end of the file:  
`source /opt/intel/computer_vision_sdk/bin/setupvars.sh`
3. **Save and close the file:** press the Esc key and type `:wq`.
4. To test your change, **open a new terminal**. You will see `[setupvars.sh] OpenVINO environment initialized`.

The environment variables are set. Continue to the next section to configure the Model Optimizer.

#### 4.3.4 Configure the Model Optimizer

**Important:** This section is required. You must configure the Model Optimizer for at least one framework. The Model Optimizer will fail if you do not complete the steps in this section.

The Model Optimizer is a key component of the Intel Distribution of OpenVINO toolkit. You cannot do inference on your trained model without running the model through the Model Optimizer. When you run a pre-trained model through the Model Optimizer, your output is an Intermediate Representation (IR) of the network. The IR is a pair of files that describe the whole model:

- `.xml`: Describes the network topology
- `.bin`: Contains the weights and biases binary data

The Inference Engine reads, loads, and infers the IR files, using a common API across the CPU, GPU, or VPU hardware.

The Model Optimizer is a Python\*-based command line tool (`mo.py`), which is located in `/opt/intel/computer_vision_sdk/deployment_tools/model_optimizer`.

## Mustang-V100-MX8

Use this tool on models trained with popular deep learning frameworks such as Caffe\*, TensorFlow\*, MXNet\*, and ONNX\* to convert them to an optimized IR format that the Inference Engine can use.

This section explains how to use scripts to configure the Model Optimizer either for all of the supported frameworks at the same time or for individual frameworks. If you want to manually configure the Model Optimizer instead of using scripts, see the [using manual configuration](#) process section in the Model Optimizer Developer Guide.

For more information about the Model Optimizer, see the [Model Optimizer Developer Guide](#).

### Model Optimizer configuration steps

You can either configure the Model Optimizer for all supported frameworks at once, or for one framework at a time. Choose the option that best suits your needs. If you see error messages, make sure you installed all dependencies.

Note: If you did not install the Intel Distribution of OpenVINO toolkit to the default installation directory, replace /intel/ with the directory where you installed the software to.

Option 1: Configure the Model Optimizer for all supported frameworks at the same time:

1. **Go to the Model Optimizer prerequisites directory:**

```
cd
/opt/intel/computer_vision_sdk/deployment_tools/model_optimizer/install_prerequisites
```

2. **Run the script** to configure the Model Optimizer for Caffe, TensorFlow, MXNet, Kaldi\*, and ONNX:

```
sudo ./install_prerequisites.sh
```

Option 2: Configure the Model Optimizer for each framework separately:

1. **Go to the Model Optimizer prerequisites directory:**

```
cd
/opt/intel/computer_vision_sdk/deployment_tools/model_optimizer/install_prerequisites
```

2. **Run the script** for your model framework. You can run more than one script:

- o For Caffe:

```
sudo ./install_prerequisites_caffe.sh
```

- o For TensorFlow:

```
sudo ./install_prerequisites_tf.sh
```

- o For MXNet:

```
sudo ./install_prerequisites_mxnet.sh
```

- o For ONNX:

```
sudo ./install_prerequisites_onnx.sh
```

- o For Kaldi:

```
sudo ./install_prerequisites_kaldi.sh
```

The Model Optimizer is configured for one or more frameworks. You are ready to use two short demos to see the results of running the Intel Distribution of OpenVINO toolkit and to verify your installation was successful. The demo scripts are required since they perform additional configuration steps. Continue to the next section.

#### 4.4 Steps for Intel® Vision Accelerator Design with Intel® Movidius™ VPUs Mustang-V100-MX8 Driver Installation

1. Install dependencies:

```
sudo apt install libusb-1.0-0 libboost-program-options1.58.0  
libboost-thread1.58.0 libboost-filesystem1.58.0 libssl1.0.0  
libudev1 libjson-c2
```

2. Add the current Linux user to the users group:

```
sudo usermod -a -G users "$(whoami) "
```

3. Log out and log in for it to take effect.

4. If your Intel® Vision Accelerator Design with Intel® Movidius™ VPUs card requires SMBUS connection to PCIe slot (Raw video data card with HW version Fab-B and before), generate rules for SMBUS controller and enable the i2c\_i801 driver (Intel® SMBUS controller driver):

```
cd ${HDDL_INSTALL_DIR}  
sudo chmod +x ./generate_udev_rules.sh
```



## Mustang-V100-MX8

```
sudo ./generate_udev_rules.sh /etc/udev/rules.d/98-hddlbsl.rules
```

5. Check if the file `/etc/modprobe.d/blacklist.conf` contains the line "blacklist i2c\_i801" and comment it out if so:

```
sudo sed -i "s/\(.*i2c_i801$\)/#\1/g"
/etc/modprobe.d/blacklist.conf
```

```
sudo modprobe i2c_i801
```

6. Before you start installing the drivers, make sure there is no inference application is running. Use the following command to make sure there is no HDDL service is running:

```
kill -9 $(pidof hddldaemon autoboot)
```

7. Install the drivers:

```
cd ${HDDL_INSTALL_DIR}/drivers
sudo chmod +x ./setup.sh
sudo ./setup.sh install
sudo cp -av ${HDDL_INSTALL_DIR}/../97-myriad-usbboot.rules
/etc/udev/rules.d/
sudo cp -av ${HDDL_INSTALL_DIR}/etc /
sudo udevadm control --reload-rules
sudo udevadm trigger
sudo ldconfig
```

Now, the Mustang-V100-MX8 drivers are installed.

## 4.5 Use the Demo Scripts to Verify Your Installation

Important: This section is required. In addition to confirming that your installation was successful, the demo scripts perform additional steps, such as setting up your computer to use the Model Optimizer samples.

To learn more about the demo applications, see `README.txt` in `/opt/intel/computer_vision_sdk/deployment_tools/demo/`.

For detailed description of the pre-trained object detection and object recognition models, go to `/opt/intel/computer_vision_sdk/deployment_tools/intel_models/` and open `index.html`.

Note:

The paths in this section assume you used the default installation directory to install the Intel Distribution of OpenVINO toolkit. If you installed the software to a directory other than `/opt/intel/`, update the directory path with the location where you installed the toolkit to.

If you installed the product as a root user, you must switch to the root mode before you continue: `sudo -i`

#### 4.5.1 Run the Image Classification Demo

1. Go to the Inference Engine demo directory:

```
cd /opt/intel/computer_vision_sdk/deployment_tools/demo
```

2. Set environment variables and run the **Image Classification** demo:

- 1) Set your environment variables:

```
source /opt/intel/computer_vision_sdk/bin/setupvars.sh
```

- 2) Modify `.sh` content:

```
sudo gedit demo_squeezenet_download_convert_run.sh
```

Search MYRIAD and modify to HDDL then save

- 3) Assign Mustang-V100-MX8 (`-d HDDL`) and run demo

```
/demo_squeezenet_download_convert_run.sh -d HDDL
```

3. The Image Classification demo uses the Model Optimizer to convert a SqueezeNet model to `.bin` and `.xml` Intermediate Representation (IR) files. The Inference Engine component uses these files.

For a brief description of the Intermediate Representation `.bin` and `.xml` files, see [Configuring the Model Optimizer](#).

This demo creates the directory `/home/<user>/inference_engine_samples/`.

This demo uses `car.png` in the demo directory. When the demo completes, you will see the label and confidence for the top-10 categories:

## Mustang-V100-MX8

```

Top 10 results:
Image /opt/intel/computer_vision_sdk_fpga_2018.2.298/deployment_tools/demo/./demo/car.png
817 0.8363345 label sports car, sport car
511 0.0946488 label convertible
479 0.0419131 label car wheel
751 0.0091071 label racer, race car, racing car
436 0.0068161 label beach wagon, station wagon, wagon, estate car, beach waggon, station waggon, waggon
656 0.0037564 label minivan
586 0.0025741 label half track
717 0.0016069 label pickup, pickup truck
864 0.0012027 label tow truck, tow car, wrecker
581 0.0005882 label grille, radiator grille

[ INFO ] Execution successful

#####
Demo completed successfully.

```

This demo is complete. Continue to the next section to run the Inference Pipeline demo.

### 4.5.2 Run the Inference Pipeline Demo

1. While still in `/opt/intel/computer_vision_sdk/deployment_tools/demo/`, **run the Inference Pipeline demo**.
2. Modify `.sh` content:
 

```
sudo gedit demo_squeezenet_download_convert_run.sh
```

Search MYRIAD and modify to HDDL then save
3. Assign Mustang-V100-MX8 (`-d HDDL`) and run demo
 

```
/demo_security_barrier_camera.sh -d HDDL
```
4. This demo uses `car.png` in `/opt/intel/computer_vision_sdk/deployment_tools/demo/` to show an inference pipeline. This demo uses three pre-trained models. The demo uses vehicle recognition in which vehicle attributes build on each other to narrow in on a specific attribute. The demo works as follows:
  - 1) An object is identified as a vehicle.
  - 2) This identification is used as input to the next model, which identifies specific vehicle attributes, including the license plate.
  - 3) The attributes identified as the license plate are used as input to the third model, which recognizes specific characters in the license plate.

For more information about the demo, see the Security Camera Sample.

- 5. When the demo completes, two windows are open:
  - o A console window that displays information about the tasks performed by the demo
  - o An image viewer window that displays a picture similar to the following:



- 6. Close the image viewer screen to end the demo.

In this section, you saw a preview of the Intel Distribution of OpenVINO toolkit capabilities.

You have completed all the required installation, configuration, and build steps to work with your trained models using the Mustang-V100-MX8.

Chapter

5

# OpenVINO™ Toolkit Installation (Windows 10)

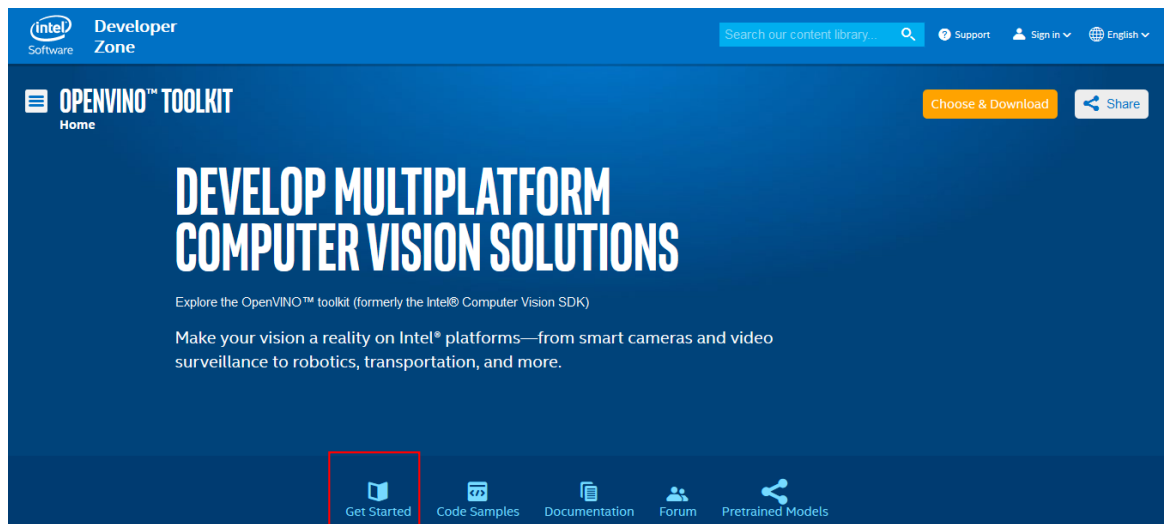
---

## 5.1 System Requirements

- Windows 10 64-bit
- OpenVINO™ Toolkit was pre-installed in TANK-870AI.

## 5.2 Online Installation Guide

Go to <https://software.intel.com/en-us/openvino-toolkit>. Click “Get Started” then choose your configuration from “Development Environment Installation Guides & Videos”. Follow the instruction to complete the installation procedure.



### INSTALLATION & SETUP GUIDES

#### Development Environment Installation Guides & Videos

- [Linux\\*: Guide | Video](#)
- [Windows\\*: Guide | Video](#)
- [Linux\\* with FPGA: Guide](#)

#### Target Device Installation Guides

- [Quick Start Guide for Intel® Programmable Acceleration Card with Intel® Arria® 10 FPGA GX](#)
- [Acceleration Hub for Intel® FPGA Development Kit for Intel® Arria® 10 FPGA GX](#)

- [Intel® Movidius™ Neural Compute Stick Quick Start Guide](#)

#### Intel® Deep Learning Deployment Toolkit References

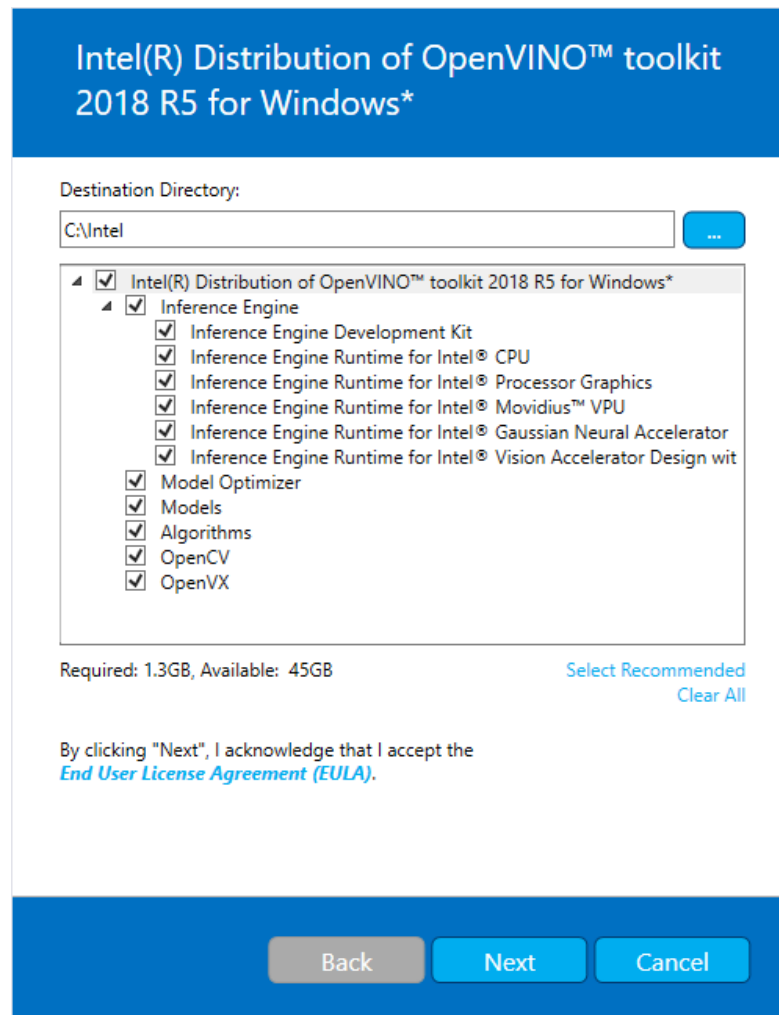
- [Model Optimizer Developer Guide](#)
- [Inference Engine Developer Guide](#)
- [Pretrained Models & Algorithms](#)

## Mustang-V100-MX8

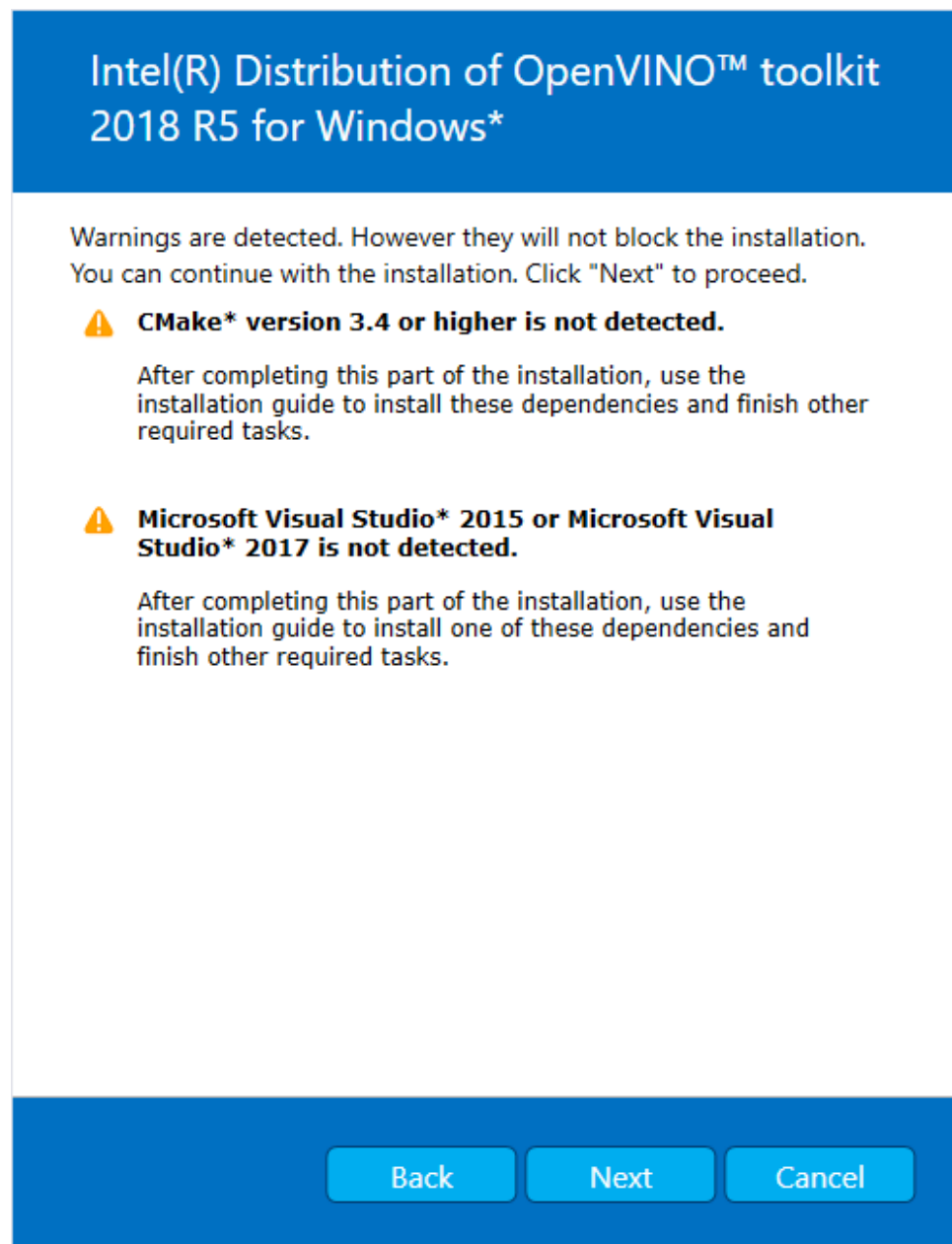
## 5.3 Installation - Step by Step

## 5.3.1 Install the Intel® Distribution of OpenVINO™ Toolkit Core Components

1. If you have not downloaded the Intel® Distribution of OpenVINO™ toolkit, download the [latest version](#). By default, the file is saved to the Downloads directory as `w_openvino_toolkit_p_<version>.exe`.
2. Go to the **Downloads** folder.
3. Double-click `w_openvino_toolkit_p_<version>.exe`. A window opens to let you choose your installation directory and components. The default installation directory is `C:\Intel`. If you choose a different installation directory, the installer will create the directory for you.



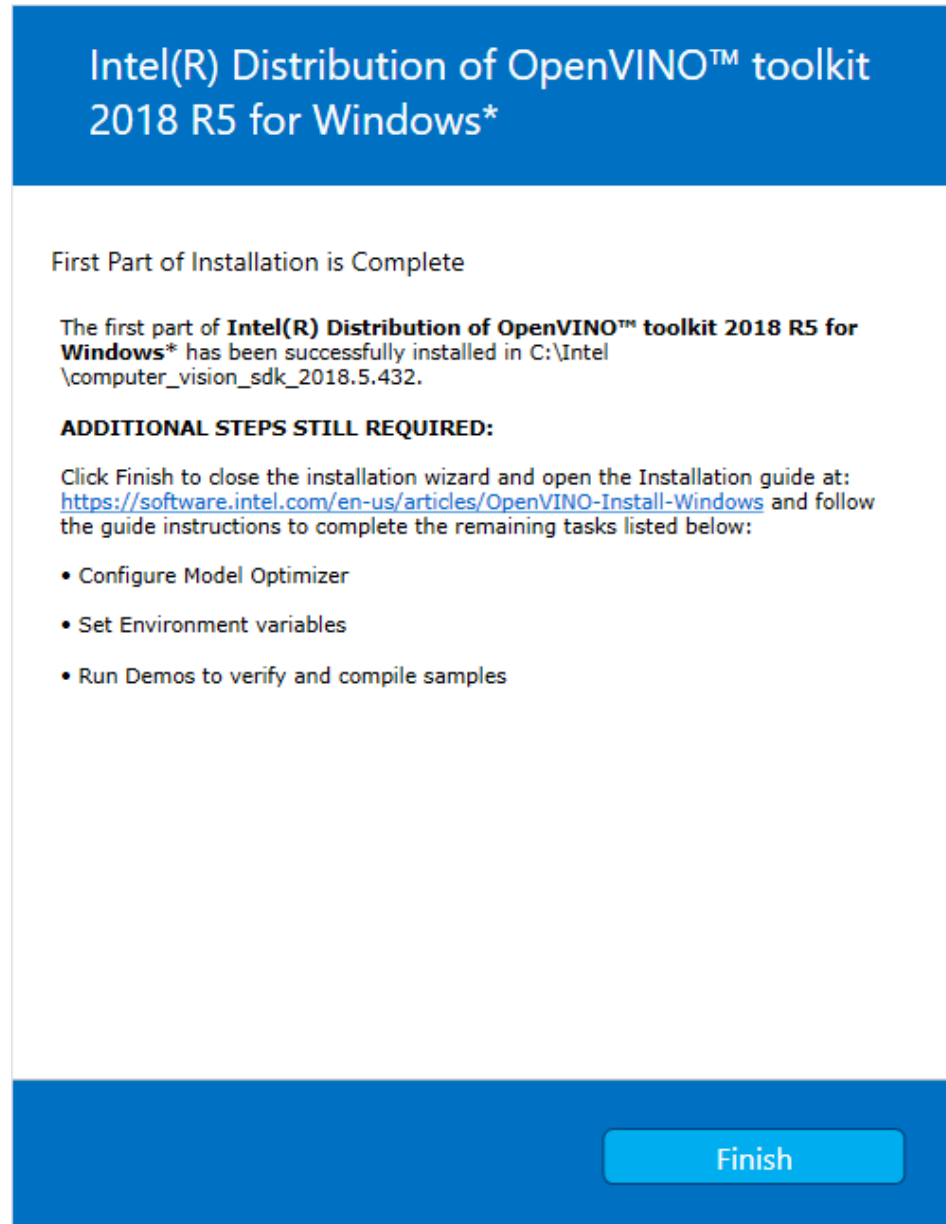
4. Click **Next**.
5. You are asked if you want to provide consent to gather information. Choose the option of your choice. Click **Next**.
6. If you are missing external dependencies, you will see a warning screen. Write down the dependencies you are missing. **You need to take no other action at this time.** After installing the Intel® Distribution of OpenVINO™ toolkit core components, you will be provided instructions to install the missing dependencies.  
The screen example below indicates you are missing two dependencies:





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- Click **Next**.
- When the first part of installation is complete, the final screen informs you that the core components have been installed and additional steps still required:



- Click **Finish** to close the installation wizard. A new browser window opens to the next section of the installation guide to install the dependencies. You are in the same document. The new window opens in case you ran the installation without first opening this installation guide. If the installation did not indicate you must install dependencies, you can skip ahead to [Configure the Model Optimizer](#).

### 5.3.2 Install the External Software Dependencies

If the installation process indicated if you are missing dependencies, you must install each missing dependency. Click the link for the first dependency you must install:

- [Microsoft Visual Studio\\* with C++ 2017 or 2015 with MSBuild](#) and the [Visual Studio Build Tools](#). This is a two-part installation. You must install both components.
- [CMake 3.4 or higher](#)
- [Python 3.6.5](#)

If you have no missing dependencies, skip ahead to [Configure the Model Optimizer](#).

#### 5.3.2.1 Microsoft Visual Studio\* with C++ and MSBuild

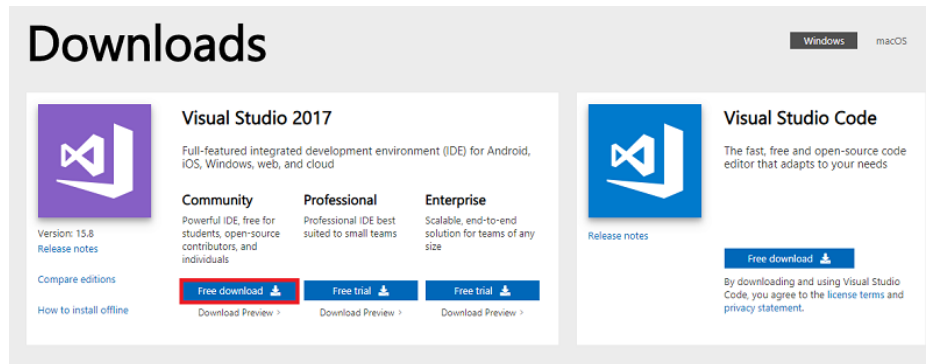
Microsoft Visual Studio with Visual Studio C++ is required for building the Intel® Deep Learning Deployment Toolkit samples and demonstration applications. **You can install the free Community version of Microsoft Visual Studio.**

**IMPORTANT:** The Microsoft Visual Studio dependency is a two-part installation that consists of **Microsoft Visual Studio 2017 or 2015** and the **Microsoft Visual Studio Build Tools**. This guide includes steps for installing both parts of this dependency. These are separate installations. **MAKE SURE YOU INSTALL BOTH COMPONENTS.**

The steps below apply to Microsoft Visual Studio 2017. If you prefer to use Microsoft Visual Studio 2015, see [Installing Microsoft Visual Studio\\* 2015 for Intel® Distribution of OpenVINO™ toolkit](#).

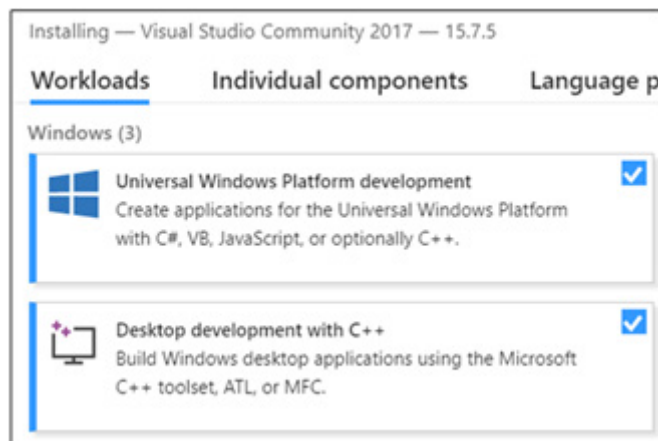
1. Go to the [Visual Studio downloads page](#).
2. Click **Free Download** in the **Visual Studio 2017** box, **Community** section:

## Mustang-V100-MX8

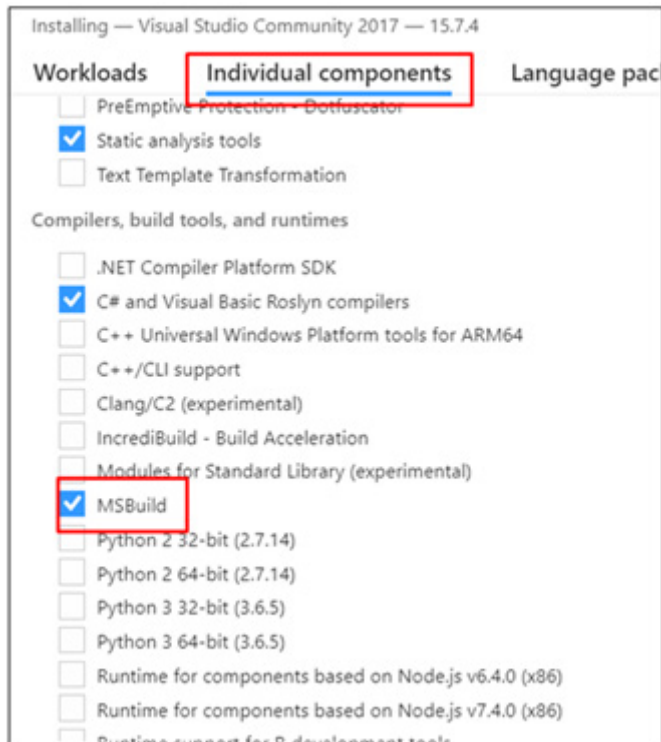


An executable file named **vs\_community\_\_313888930.1524151023.exe**, or similar, is saved in your **Downloads** folder.

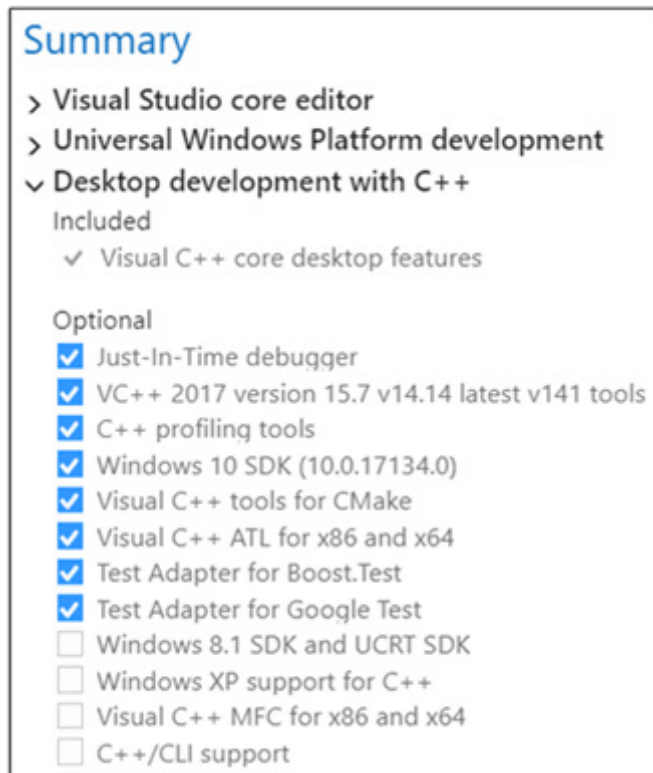
3. Double-click the executable file to launch the **Visual Studio Community 2017** installer.
4. From the Workloads tab, use the check boxes to select **Universal Windows Platform development** and **Desktop development with C++**.



5. Under the **Individual components** tab, select **MSBuild**:



The **Summary** at the right side of the screen displays your installation selections:



6. Make no other changes. Click **Next**. The installation begins, and takes around 30

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minutes to complete.

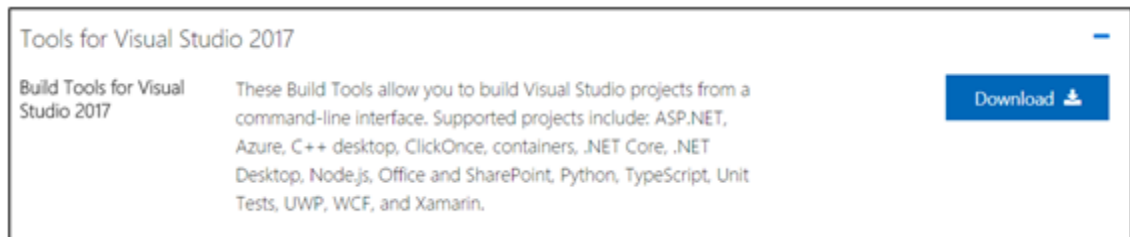
- If you see a prompt to restart your computer after the installation completes, dismiss it.

Continue to the next section to install the Build Tools for Visual Studio 2017.

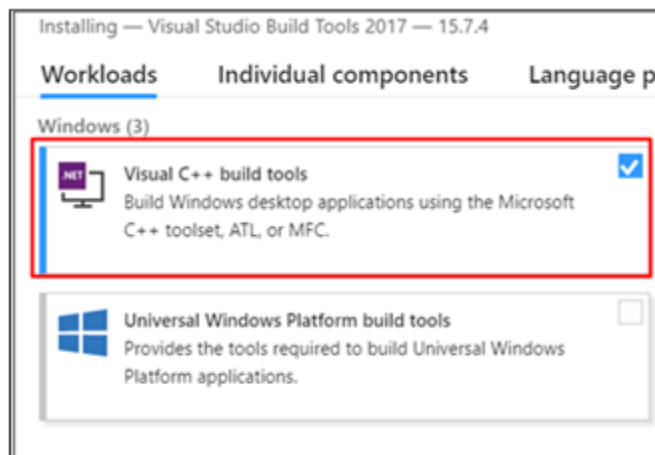
### 5.3.2.2 Install the Build Tools for Visual Studio 2017

The Build Tools for Visual Studio 2017 is the second part of the Microsoft Visual Studio dependency. You must complete this installation.

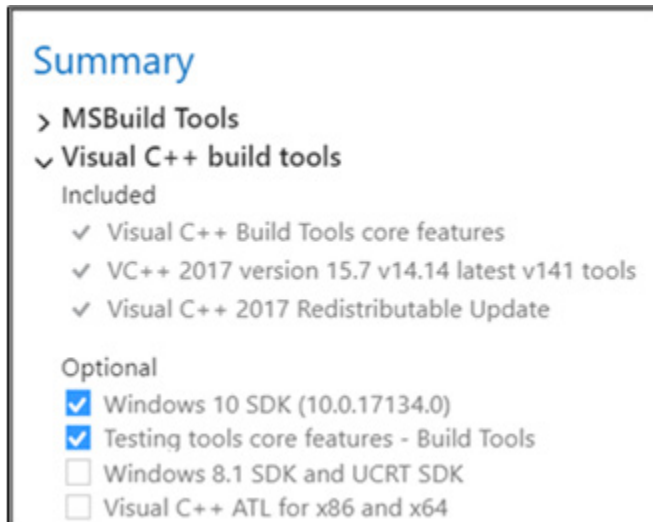
- Go to the [Tools for Visual Studio 2017](#) section of the Microsoft Visual Studio Downloads page.
- Click the **Download** button next to **Build tools for Visual Studio 2017**:



- An executable file named **vs\_buildtools.exe**, or similar, is saved in your **Downloads** folder.
- Double-click the file to install **Build Tools for Visual Studio 2017**.
- The installation opens to the **Workloads** tab. Select **Visual C++ build tools**:



The Summary on the right side shows the features you chose to install:



6. Click **Install**.
7. When the installation completes, restart your computer if prompted to do so.

You have completed the Visual Studio 2017 installation.

Install your next dependency:

- [CMake 3.4 or higher](#)
- [Python 3.6.5](#)

Or if you have installed all the dependencies, you are ready to configure the Model Optimizer.

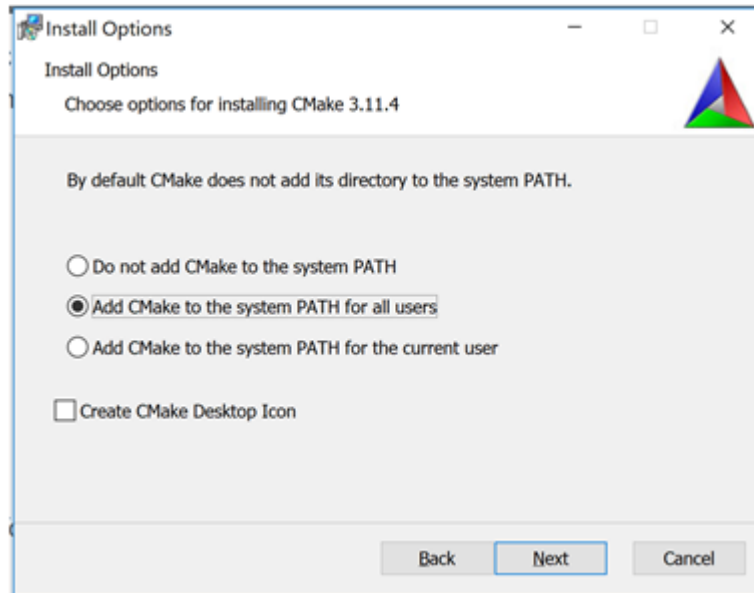
### 5.3.2.3 Install CMake\* 3.4 or higher

These steps guide you through installing CMake 3.4 or higher, which is required to build the Intel® Distribution of OpenVINO™ toolkit samples.

1. Go to the [CMake download site](#).
2. Under the heading **Get the Software**, click the link for **latest stable** in the first paragraph. Your screen displays **Latest Release** information.
3. Scroll down to the line **Windows win64-x64 Installer**.
4. Click the associated file name to download the installer. The file name will have the extension .msi. The file is saved to your Downloads folder.

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5. Go to the Downloads folder.
6. Double-click the file to launch the installer.  
**Note:** If you have a previous version of CMake installed, you are prompted to uninstall it. You must uninstall the previous version before installing the new version. Follow the instructions on the screen and then launch the installer again to install the new version.
7. In the installer, select the option to **Add CMake to the system PATH for all users**:



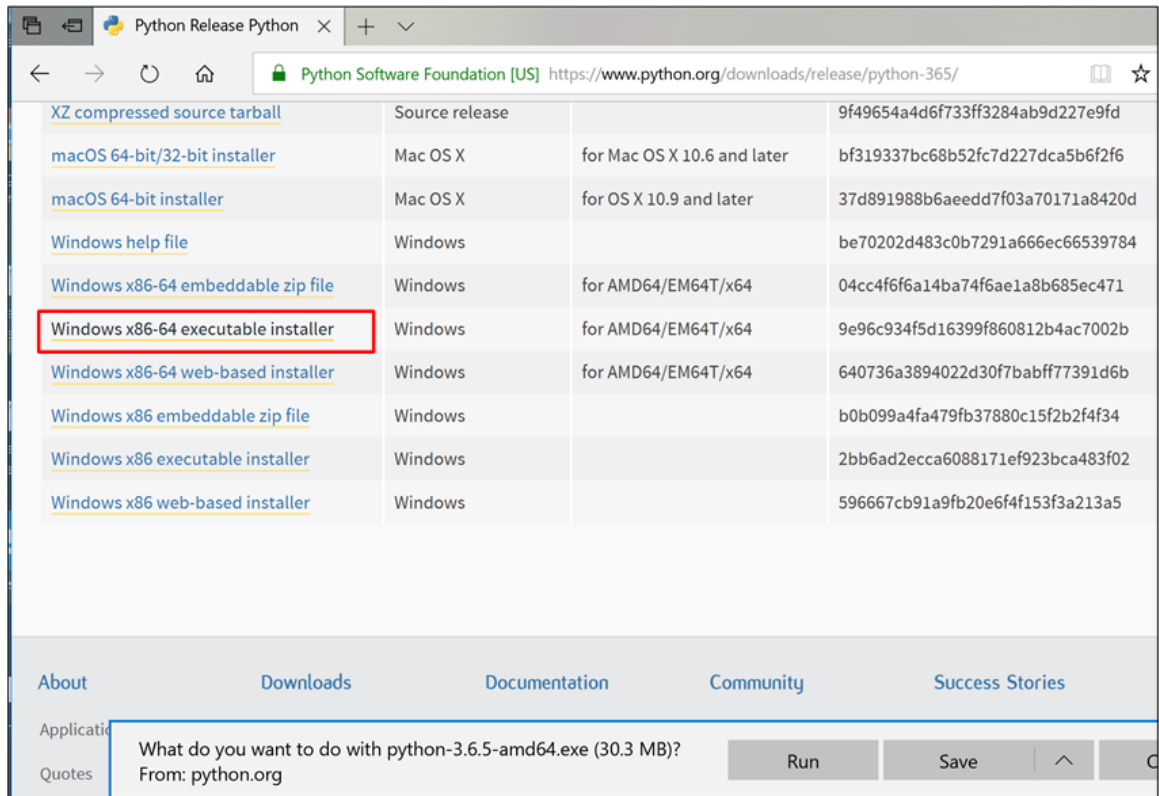
8. Click **Next**.
9. Click **Finish** when the installation completes.

You have completed the CMake installation. Next, install Python 3.6.5 if the Intel® Distribution of OpenVINO™ toolkit installation indicated you are missing the software.

### 5.3.2.4 Install Python\* 3.6.5

Python 3.6.5 with pip is required to run the Model Optimizer. Use these steps to install the correct version of the Python software.

1. Go to the [Python 3.6.5 download page](#) and click **Windows x86-64 executable installer** to download the executable file. The file is saved as python-3.6.5-amd64.exe in your Downloads folder.



2. Double-click the file to launch the installation.
3. Make sure the top of the screen shows **Python 3.6.5 (64-bit)**.
4. **IMPORTANT:** At the bottom of the install screen, select **Add Python 3.6 to PATH**.





## Mustang-V100-MX8

5. Click **Install Now** near the top of the install screen and let the installation complete.
6. When the installation finishes, click **Close**.

You have completed the Python installation and are ready to set environment variables. Continue to the next section.

### 5.3.3 Set the Environment Variables

You must update several environment variables before you can compile and run OpenVINO™ applications. Open the Command Prompt and run the following batch file to temporarily set your environment variables:

```
C:\Intel\computer_vision_sdk\bin\setupvars.bat
```

**(Optional):** OpenVINO toolkit environment variables are removed when you close the Command Prompt window. As an option, you can permanently set the environment variables manually.

The environment variables are set. Continue to the next section to configure the Model Optimizer.

### 5.3.4 Configure the Model Optimizer

**Important:** These steps are required. You must configure the Model Optimizer for at least one framework. The Model Optimizer will fail if you do not complete the steps in this section.

If you see an error indicating Python is not installed when you know you installed it, your computer might not be able to find the program. For instructions to add Python to your system environment variables, see [Update Your Windows Environment Variables](#).

The Model Optimizer is a key component of the Intel® Distribution of OpenVINO™ toolkit. You cannot do inference on your trained model without running the model through the Model Optimizer. When you run a pre-trained model through the Model Optimizer, your output is an Intermediate Representation (IR) of the network. The IR is a pair of files that describe the whole model:

- .xml: Describes the network topology
- .bin: Contains the weights and biases binary data

The Inference Engine reads, loads, and infers the IR files, using a common API across the CPU, GPU, or VPU hardware.

The Model Optimizer is a Python\*-based command line tool (mo.py), which is located in **C:\Intel\computer\_vision\_sdk\_<version>\deployment\_tools\model\_optimizer**, where <version> is the version of the Intel® Distribution of OpenVINO™ toolkit that you installed. Use this tool on models trained with popular deep learning frameworks such as Caffe, TensorFlow, MXNet, and ONNX to convert them to an optimized IR format that the Inference Engine can use.

This section explains how to use scripts to configure the Model Optimizer either for all of the supported frameworks at the same time or for individual frameworks. If you want to manually configure the Model Optimizer instead of using scripts, see the Using Manual Configuration Process section in the Model Optimizer Developer Guide.

For more information about the Model Optimizer, see the [Model Optimizer Developer Guide](#).

### 5.3.4.1 Model Optimizer Configuration Steps

You can configure the Model Optimizer either for all supported frameworks at once or for one framework at a time. Choose the option that best suits your needs. If you see error messages, make sure you installed all dependencies.

**Note:** These steps use a command prompt to make sure you see error messages.

In the steps below:

- Replace **<version>** with the version number of your Intel® Distribution of OpenVINO™ toolkit
- If you did not install Intel® Distribution of OpenVINO™ toolkit to the default installation directory, replace \Intel\ with the directory where you installed the software.

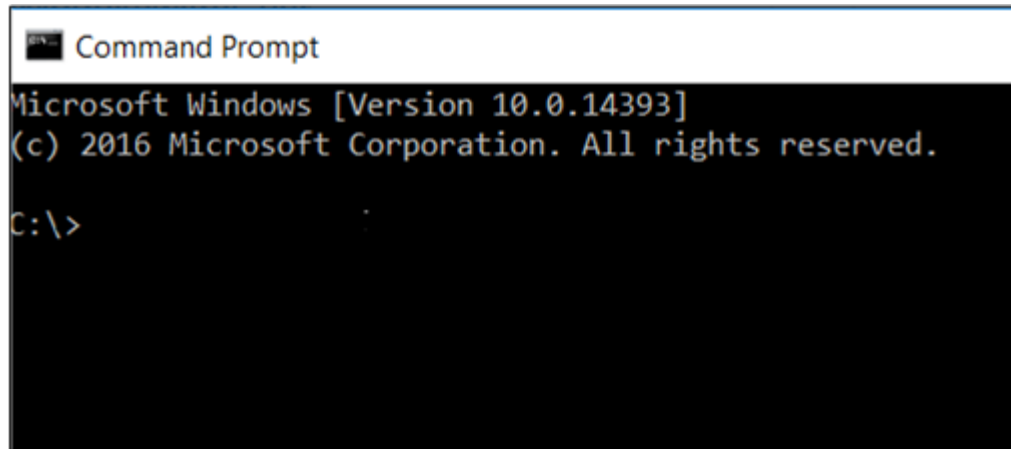
## Mustang-V100-MX8

### Option 1: Configure the Model Optimizer for all supported frameworks at the same time:

1. Open a command prompt. To do so, type the following in your **Search Windows** box and then press **Enter**:

```
Cmd
```

2. Type commands in the opened window:



```
Command Prompt
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.
C:\>
```

3. Go to the Model Optimizer prerequisites directory. Remember to replace <version> with the version of the Intel® Distribution of OpenVINO™ toolkit that you installed:

```
cd
C:\Intel\computer_vision_sdk_<version>\deployment_tools\model_
optimizer\install_prerequisites
```

4. Run the following batch file to configure Model Optimizer for Caffe\*, TensorFlow\*, MXNet\*, Kaldi\*, and ONNX\*:

```
install_prerequisites.bat
```

### Option 2: Configure the Model Optimizer for each framework separately:

1. Go to the Model Optimizer prerequisites directory:

```
cd
C:\Intel\computer_vision_sdk_<version>\deployment_tools\model_
optimizer\install_prerequisites
```

2. Run the batch file for the framework you will use with the Model Optimizer. You can use more than one:

- o For Caffe:
  - install\_prerequisites\_caffe.bat
- o For TensorFlow:
  - install\_prerequisites\_tf.bat
- o For MXNet:
  - install\_prerequisites\_mxnet.bat
- o For ONNX:
  - install\_prerequisites\_onnx.bat
- o For Kaldi:
  - install\_prerequisites\_kaldi.bat

The Model Optimizer is configured for one or more frameworks. Success is indicated by a screen similar to this:

```

Command Prompt
Collecting typing-extensions>=3.6.2.1 (from onnx>=1.1.2->-r ..\requirements.txt (line 6))
  Downloading https://files.pythonhosted.org/packages/15/f1/ef4e69d77cd850af1cb7d6de62fc8a0e92eb6fe7b37e3dc563b41378b567
/typing_extensions-3.6.5-py3-none-any.whl
Collecting typing>=3.6.4 (from onnx>=1.1.2->-r ..\requirements.txt (line 6))
  Downloading https://files.pythonhosted.org/packages/4a/bd/eee1157fc2d8514970b345d69cb9975dcd1e42cd7e61146ed841f6e68309
/typing-3.6.6-py3-none-any.whl
Collecting markdown>=2.6.8 (from tensorboard<1.10.0,>=1.9.0->tensorflow==1.9.0->-r ..\requirements.txt (line 1))
  Downloading https://files.pythonhosted.org/packages/6d/7d/488b90f470b96531a3f5788cf12a93332f543dbab13c423a5e7ce96a0493
/Markdown-2.6.11-py2.py3-none-any.whl (78kB)
100% |████████████████████████████████████████| 81kB 1.3MB/s
Collecting werkzeug>=0.11.10 (from tensorboard<1.10.0,>=1.9.0->tensorflow==1.9.0->-r ..\requirements.txt (line 1))
  Downloading https://files.pythonhosted.org/packages/20/c4/12e3e56473e52375aa29c4764e70d1b8f3efa6682bef8d0aae04fe335243
/Werkzeug-0.14.1-py2.py3-none-any.whl (322kB)
100% |████████████████████████████████████████| 327kB 1.6MB/s
Requirement already satisfied: urllib3<1.24,>=1.21.1 in c:\users\ddeuerme\appdata\roaming\python\python36\site-packages
(from requests->mxnet==1.0.0->-r ..\requirements.txt (line 2))
Requirement already satisfied: idna<2.8,>=2.5 in c:\users\ddeuerme\appdata\roaming\python\python36\site-packages (from r
equests->mxnet==1.0.0->-r ..\requirements.txt (line 2))
Requirement already satisfied: chardet<3.1.0,>=3.0.2 in c:\users\ddeuerme\appdata\roaming\python\python36\site-packages
(from requests->mxnet==1.0.0->-r ..\requirements.txt (line 2))
Requirement already satisfied: certifi>=2017.4.17 in c:\users\ddeuerme\appdata\roaming\python\python36\site-packages (fr
om requests->mxnet==1.0.0->-r ..\requirements.txt (line 2))
Installing collected packages: six, gast, termcolor, numpy, protobuf, absl-py, astor, wheel, grpcio, markdown, werkzeug,
tensorboard, tensorflow, graphviz, mxnet, decorator, networkx, typing-extensions, typing, onnx
Running setup.py install for gast ... done
Running setup.py install for termcolor ... done
Running setup.py install for absl-py ... done
Running setup.py install for networkx ... done
Successfully installed absl-py-0.4.1 astor-0.7.1 decorator-4.3.0 gast-0.2.0 graphviz-0.9 grpcio-1.14.2 markdown-2.6.11 m
xnet-1.0.0 networkx-2.1 numpy-1.15.1 onnx-1.3.0 protobuf-3.5.1 six-1.11.0 tensorboard-1.9.0 tensorflow-1.9.0 termcolor-1
.1.0 typing-3.6.6 typing-extensions-3.6.5 werkzeug-0.14.1 wheel-0.31.1
You are using pip version 9.0.3, however version 18.0 is available.
You should consider upgrading via the 'python -m pip install --upgrade pip' command.
*****
Warning: please expect that Model Optimizer conversion might be slow.
You can boost conversion speed by installing protobuf-*egg located in the
"model-optimizer\install_prerequisites" folder or building protobuf library from sources.
For more information please refer to Model Optimizer FAQ, question #80.

C:\Intel\computer_vision_sdk_2018.3.349\deployment_tools\model_optimizer\install_prerequisites>

```

## Mustang-V100-MX8

You are ready to use two short demos to see the results of running the Intel Distribution of OpenVINO toolkit and to verify your installation was successful. The demo scripts are required since they perform additional configuration steps. Continue to the next section.

### 5.4 Installation Steps for Intel® Vision Accelerator Design with Intel® Movidius™ VPUs Mustang-V100-MX8

To perform inference on Mustang-V100-MX8, the following additional installation steps are required:

1. Install the Movidius™ VSC driver:
  - 1) Go to the  
`<INSTALL_DIR>\deployment_tools\inference-engine\external\  
directory, where <INSTALL_DIR> is the directory in which the OpenVINO™ toolkit is installed.`
  - 2) Right click on the `Movidius_VSC_Device.inf` file and choose **Install** from the pop up menu.
2. Install the SMBUS driver:
  - 1) Go to the  
`<INSTALL_DIR>\deployment_tools\inference-engine\external\hddl\  
SMBusDriver directory, where <INSTALL_DIR> is the directory in which the OpenVINO™ toolkit is installed.`
  - 2) Right click on the `hddlsmbus.inf` file and choose **Install** from the pop up menu.
3. Download and install Visual C++ Redistributable for Visual Studio 2015

You are done installing your device driver and are ready to use Mustang-V100-MX8.

### 5.5 Use the Demo Scripts to Verify Your Installation

**Important:** This section is required. In addition to confirming your installation was successful, demo scripts perform other steps, such as setting up your computer to use the Model Optimizer samples.

**Note:** To run the demo applications on Intel® Processor Graphics, Intel® Movidius™ Neural Compute Stick or Intel® Neural Compute Stick 2, make sure you completed the Additional Installation Steps first.

To learn more about the demo applications, see `README.txt` in `C:\Intel\computer_vision_sdk_<version>\deployment_tools\demo\`.

For detailed description of the pre-trained object detection and object recognition models, go to

`C:\Intel\computer_vision_sdk_<version>\deployment_tools\intel_models\` and open `index.html`.

**Notes:**

- The paths in this section assume you used the default installation directory. If you used a directory other than `C:\Intel`, update the directory with the location where you installed the software.

- If you are migrating from the Intel® Computer Vision SDK 2017 R3 Beta version to the Intel® Distribution of OpenVINO™ toolkit, read this information about porting your applications.

1. Open a command prompt window.
2. Go to the Inference Engine demo directory:  
`cd`  
`C:\Intel\computer_vision_sdk_<version>\deployment_tools\demo\`
3. Run the demos by following the instructions in the next two sections.

### 5.5.1 Run the Image Classification Demo

This demo serves two purposes:

- It creates a directory named `build_<version>` in `C:\Intel\computer_vision_sdk_<version>\deployment_tools\inference_engine\samples`.
- It uses the Model Optimizer to convert a SqueezeNet model to `.bin` and `.xml` Intermediate Representation (IR) files that are used by the Inference Engine.

## Mustang-V100-MX8

For a brief description of the Intermediate Representation .bin and .xml files, see [Configuring the Model Optimizer](#).

For more information about the Inference Engine, see the [Inference Engine Developer Guide](#).

1. Run the Image Classification demo:

```
demo_squeezenet_download_convert_run.bat
```

2. This demo uses the car.png image located in the

C:\Intel\computer\_vision\_sdk\_<version>\deployment\_tools\demo directory. When the demo completes, the label and confidence for the top-10 categories are displayed on your screen:

```
Top 10 results:
Image C:\Intel\computer_vision_sdk_2018.3.343\deployment_tools\demo\..\demo\car.png
817 0.8363345 label sports car, sport car
511 0.0946488 label convertible
479 0.0419131 label car wheel
751 0.0091071 label racer, race car, racing car
436 0.0068161 label beach wagon, station wagon, wagon, estate car, beach waggon, station waggon, waggon
656 0.0037564 label minivan
586 0.0025741 label half track
717 0.0016069 label pickup, pickup truck
864 0.0012027 label tow truck, tow car, wrecker
581 0.0005882 label grille, radiator grille

total inference time: 13.9224678
Average running time of one iteration: 13.9224678 ms

Throughput: 71.8263466 FPS

[ INFO ] Execution successful

#####|| Classification demo completed successfully ||#####

Waiting for 0 seconds, press a key to continue ...

C:\Intel\computer_vision_sdk_2018.3.343\deployment_tools\demo>
```

This demo is complete. Leave the console open and continue to the next section to run the Inference Pipeline demo.

## 5.5.2 Run the Inference Pipeline Demo

1. While still in the  
C:\Intel\computer\_vision\_sdk\_<version>\deployment\_tools\demo\  
directory, run the Inference Pipeline demo:  

```
demo_security_barrier_camera.bat
```
  
2. This demo uses the car.png image located in  
C:\Intel\computer\_vision\_sdk\_<version>\deployment\_tools\demo\ to  
show an inference pipeline. This demo uses three pre-trained models. The demo  
uses vehicle recognition in which vehicle attributes build on each other to narrow in on  
a specific attribute. The demo works as follows:
  - 1) An object is identified as a vehicle.
  - 2) This identification is used as input to the next model, which identifies specific  
vehicle attributes, including the license plate.
  - 3) The attributes identified as the license plate are used as input to the third model,  
which recognizes specific characters in the license plate.

For more information, see the Security Camera Sample.

3. When the demo completes, you have two windows open:
  - o A console window that displays information about the tasks performed by the  
demo.
  - o An image viewer window that displays a picture similar to the following:



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4. Close the image viewer window to end the demo.

In this section, you saw a preview of the Intel® Distribution of OpenVINO™ toolkit capabilities.

You have completed all the required installation, configuration, and build steps to work with your trained models using the Mustang-V100-MX8.

Appendix

**A**

# Regulatory Compliance

---

## Mustang-V100-MX8

### DECLARATION OF CONFORMITY



This equipment has been tested and found to comply with specifications for CE marking. If the user modifies and/or installs other devices in the equipment, the CE conformity declaration may no longer apply.

### FCC WARNING



This equipment complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Appendix

**B**

# Product Disposal

---

## Mustang-V100-MX8

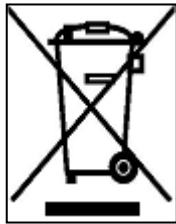


### CAUTION:

Risk of explosion if battery is replaced by an incorrect type. Only certified engineers should replace the on-board battery.

Dispose of used batteries according to instructions and local regulations.

- Outside the European Union – If you wish to dispose of used electrical and electronic products outside the European Union, please contact your local authority so as to comply with the correct disposal method.
- Within the European Union – The device that produces less waste and is easier to recycle is classified as electronic device in terms of the European Directive 2012/19/EU (WEEE), and must not be disposed of as domestic garbage.



EU-wide legislation, as implemented in each Member State, requires that waste electrical and electronic products carrying the mark (left) must be disposed of separately from normal household waste. This includes monitors and electrical accessories, such as signal cables or power cords. When you need to dispose of your device, please follow the guidance of your local authority, or ask the shop where you purchased the product. The mark on electrical and electronic products only applies to the current European Union Member States.

Please follow the national guidelines for electrical and electronic product disposal.

Appendix

**C**

# Hazardous Materials Disclosure

---

## Mustang-V100-MX8

The details provided in this appendix are to ensure that the product is compliant with the Peoples Republic of China (China) RoHS standards. The table below acknowledges the presences of small quantities of certain materials in the product, and is applicable to China RoHS only.

A label will be placed on each product to indicate the estimated “Environmentally Friendly Use Period” (EFUP). This is an estimate of the number of years that these substances would “not leak out or undergo abrupt change.” This product may contain replaceable sub-assemblies/components which have a shorter EFUP such as batteries and lamps. These components will be separately marked.

Please refer to the following table.

Part Name	Toxic or Hazardous Substances and Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (CR(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Housing	O	O	O	O	O	O
Display	O	O	O	O	O	O
Printed Circuit Board	O	O	O	O	O	O
Metal Fasteners	O	O	O	O	O	O
Cable Assembly	O	O	O	O	O	O
Fan Assembly	O	O	O	O	O	O
Power Supply Assemblies	O	O	O	O	O	O
Battery	O	O	O	O	O	O

O: This toxic or hazardous substance is contained in all of the homogeneous materials for the part is below the limit requirement in SJ/T11363-2006 (now replaced by GB/T 26572-2011).

X: This toxic or hazardous substance is contained in at least one of the homogeneous materials for this part is above the limit requirement in SJ/T11363-2006 (now replaced by GB/T 26572-2011).

此附件旨在确保本产品符合中国 RoHS 标准。以下表格标示此产品中某有毒物质的含量符合中国 RoHS 标准规定的限量要求。

本产品上会附有“环境友好使用期限”的标签，此期限是估算这些物质“不会有泄漏或突变”的年限。本产品可能包含有较短的环境友好使用期限的可替换元件，像是电池或灯管，这些元件将会单独标示出来。

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (CR(VI))	多溴联苯 (PBB)	多溴二苯 醚 (PBDE)
壳体	○	○	○	○	○	○
显示	○	○	○	○	○	○
印刷电路板	○	○	○	○	○	○
金属螺帽	○	○	○	○	○	○
电缆组装	○	○	○	○	○	○
风扇组装	○	○	○	○	○	○
电力供应组装	○	○	○	○	○	○
电池	○	○	○	○	○	○

○: 表示该有毒有害物质在该部件所有物质材料中的含量均在 SJ/T 11363-2006 (现由 GB/T 26572-2011 取代) 标准规定的限量要求以下。

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 (现由 GB/T 26572-2011 取代) 标准规定的限量要求。