DRIVES

Development and Research on Innovative Vocational Education Skills

COMPUTER VISION IN PRACTICE

U3.E1. FAMILIARIZATION WITH WELL-KNOWN COMPUTER VISION TOOLS

Computer Vision Expert

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Co-funded by the Erasmus+ Programme of the European Union

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LEARNING OBJECTIVES

The student is able to

CVE.U3.E1.PC1	Know some of the most commonly used computer vision tools.
CVE.U3.E1.PC2	Correctly install the mentioned programs.
CVE.U3.E1.PC3	Know the operation of each program and its main functionalities.
CVE.U3.E1.PC4	Handle programs easily and intuitively.

COMPUTER VISION TOOLS: OPENCV

OpenCV was released in 2000.

It's a open source library that contains different functions for computer vision and machine learning.

Has different algorithms that perform different tasks like:

- Facial detection and recognition;
- Object identification, monitoring moving objects;
- Tracking camera movements and eye movements;
- Extracting 3D models of objects;
- Creating an augmented reality overlay with a scenery;
- Recognizing similar images in an image database;
- Etc.

OPENCV FUNCTIONALITY

- Image/video I/O, processing, display (core, imgproc, highgui)
- Object/feature detection (objdetect, features2d, nonfree)
- Geometry-based monocular or stereo computer vision (calib3d, stitching, videostab)
- Computational photography (photo, video, superres)
- Machine learning & clustering (ml, flann)
- CUDA acceleration (gpu)

COMPUTER VISION TOOLS: OPENCV

OpenCV supports various operating systems such as Windows, Android, Mac OS and Linux. Has interfaces for **C++, Java, Python, MATLAB** and others.

Image processing includes three steps:

- Importing the image
- Analysing and manipulating the image
- Output in which result can be altered image or report that is based on image analysis

INSTALL OPENCV

There are two ways of installing OpenCV on your machine: download prebuilt version for your platform or compile from sources.

You can find the installation tutorials for your preferred system like Linux, Windows, and others on the OpenCV official website.

https://docs.opencv.org/4.5.2/d9/df8/tutorial_root.html

COMPUTER VISION TOOLS: TENSORFLOW

TensorFlow is a free open-source platform with a variety of tools, libraries and resources for Artificial Intelligence and Machine-learning which includes Computer Vision.

It can be used to build and train Machine Learning models related to computer vision that include facial recognition, object identification, etc.

TensorFlow supports Python, C, C++, Java, JavaScript, Go, Swift, and others, without an API backward compatibility guarantee. There are also third-party packages for languages like MATLAB, C#, Julia, Scala, R, Rust, etc.

COMPUTER VISION TOOLS: TENSORFLOW

TensorFlow provides multiple APIs (Application Programming Interfaces) that can be classified into 2 major categories:

- Low level API:
  - complete programming control
  - recommended for machine learning researchers
  - provides fine levels of control over the models
  - **TensorFlow Core** is the low level API of TensorFlow.
- High level API:
  - built on top of **TensorFlow Core**
  - easier to learn and use than **TensorFlow Core**
  - make repetitive tasks easier and more consistent between different users
  - **tf.contrib.learn** is an example of a high level API.

INSTALL TENSORFLOW

You can follow the guide to TensorFlow installation in:

https://www.tensorflow.org/install/

Once installed, you can ensure a successful installation by running this command in python interpreter:

```
import tensorflow as tf
```

COMPUTER VISION TOOLS: MATLAB

MATLAB was developed by MathWorks in 1984. It is a numerical computing environment, contains a Computer Vision Toolbox which provides various algorithms and functions for computer vision such as:

- object detection;
- object tracking;
- feature detection;
- feature matching;
- camera calibration in 3-D;
- 3D reconstruction;
- Etc.

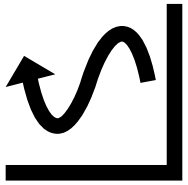
COMPUTER VISION TOOLS: MATLAB

To create and train custom object detectors in Matlab it is used machine learning algorithms such as YOLO v2, ACF, Faster R-CNN, etc.

These algorithms can also be run on multicore processors and GPUs to make them much faster.

The Matlab toolbox algorithms support C and C++.

MATLAB CAPABILITIES

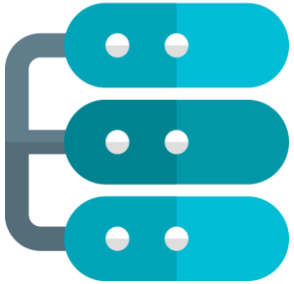


Graphics

Algorithm Development

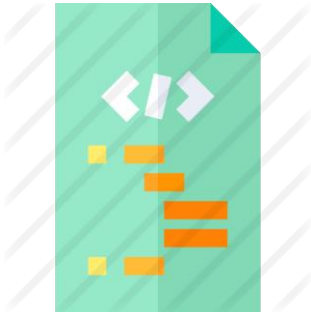
App Building

Data Analysis

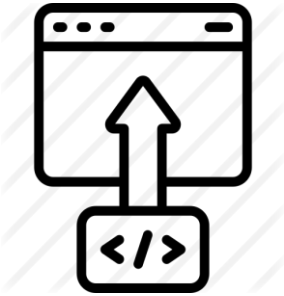


Parallel Computing

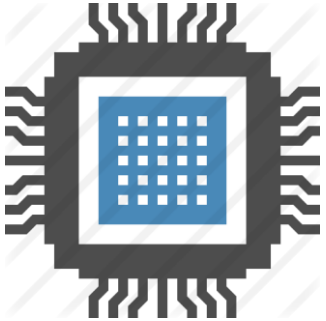
MATLAB in the Cloud



Using MATLAB with others languages



WEB and Desktop depoyment



Hardware

INSTALL MATLAB

To install **MATLAB** in Desktop you need a license, if you don't have one, you can download a trial free for 30 Days.

You can **download** here:

https://www.mathworks.com/products/get-matlab.html?s_tid=gn_getml

COMPUTER VISION TOOLS: SIMPLECV

SimpleCV is an open source framework. It gives access to several high-powered computer vision libraries such as OpenCV, without having to first learn about bit depths, file formats, colour spaces, buffer management, eigenvalues, or matrix versus bitmap storage. It is a computer vision platform that uses Python.

It lets work with the images or video streams that come from webcams, Kinects, FireWire and IP cameras, or mobile phones.

INSTALL SIMPLECV

To install **SimpleCV** in Desktop you need to do a download first.

You can **download** here:

http://simplecv.org/download/

There is a document that help the intallation of SimpleCV.

COMPUTER VISION TOOLS: CUDA

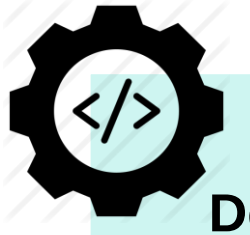
CUDA (Computer Unified Device Architecture) is a parallel computing platform. Cuda is used for processing by software engineers and has the Nvidia Performance Primitives library that contains various functions for image, signal, and video processing.

While using CUDA, the developers can program in C, C++, Fortran, MATLAB, Python, etc.

CUDA accelerates applications from domains like image processing, to deep learning, numerical analytics and computational science.

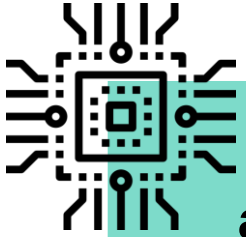
CUDA CAPABILITIES

CUDA work as a common platform across all NVIDIA GPU families so you can deploy and scale your application across GPU configurations.

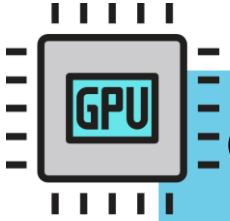


Desktop Development

Data Center Solutions



Embedded applications



GPU-Accelerated cloud

INSTALL CUDA

The CUDA Toolkit is a free download from NVIDIA and is supported on Windows, Mac, and most standard Linux distributions.

There is a QuickStart document that help the intallation of CUDA. You can follow the first-steps instructions to get CUDA running on a standard system in:

https://docs.nvidia.com/cuda/cuda-quick-start-guide/index.html

COMPUTER VISION TOOLS: YOLO

It is a real-time object detection system, and it is extremely fast and accurate as compared to the other object detectors. The algorithm is fast due to the application of neural network to the full image in order to classify the objects. The neural network then partitions the image into regions and predicts probabilities for each region.

INSTALL YOLO

Darknet is easy to install with only two optional dependancies that are optional:

- OpenCV if you want a broad variety of supported image types.
- CUDA if you want GPU computation.

There is a QuickStart document that help the intallation of YOLO. You can follow the first-steps instructions in:

https://pjreddie.com/darknet/install/

COMPUTER VISION TOOLS: BOOFCV

It is an open-source library that is written specifically for real-time computer vision. BoofCV functionality covers a variety of subjects, low-level image processing, camera calibration, feature detection/tracking, structure-from-motion, fiducial detection, and recognition.

The packages in BoofCV contain **image processing** functions that operate on pixels, **geometric vision** for extracting image features using 2D and 3D geometry, **calibration** which has functions to set the camera's intrinsic and extrinsic parameters, **recognition** for recognizing complicated visual objects, etc.

INSTALL BOOFCV

BoofCV is available from its central repository at Github.

There is a QuickStart document that help the intallation of BoofCV. You can follow the first-steps instructions in:

http://boofcv.org/index.php?title=Download

SUMMARY

- Most common computer vision tools are: OpenCV, MATLAB, YOLO, BoofCV, CUDA and TensorFlow.
- **OpenCV** is a open source library that contains different functions for computer vision and machine learning.
- **TensorFlow** can be used to build and train Machine Learning models related to computer vision that include facial recognition, object identification, etc.
- **MATLAB** provides various algorithms and functions for computer vision, such as object detection, object tracking, feature detection, feature matching, camera calibration in 3-D, 3D reconstruction, etc.
- **CUDA** is used for processing by software engineers and has the Nvidia Performance Primitives library that contains various functions for image, signal, and video processing.
- **YOLO** is a real-time object detection system.
- **BoofCV** is organized into several packages: image processing, features, geometric vision, calibration, recognition,visualize, and IO.

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DRIVES

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Thank you for your attention

DRIVES project is project under **The Blueprint for Sectoral Cooperation on Skills in Automotive Sector**, as part of New Skills Agenda.

The aim of the Blueprint is **to support an overall sectoral strategy and to develop concrete actions to address short and medium term skills needs.**

Follow DRIVES project at:

More information at:

www.project-drives.eu

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