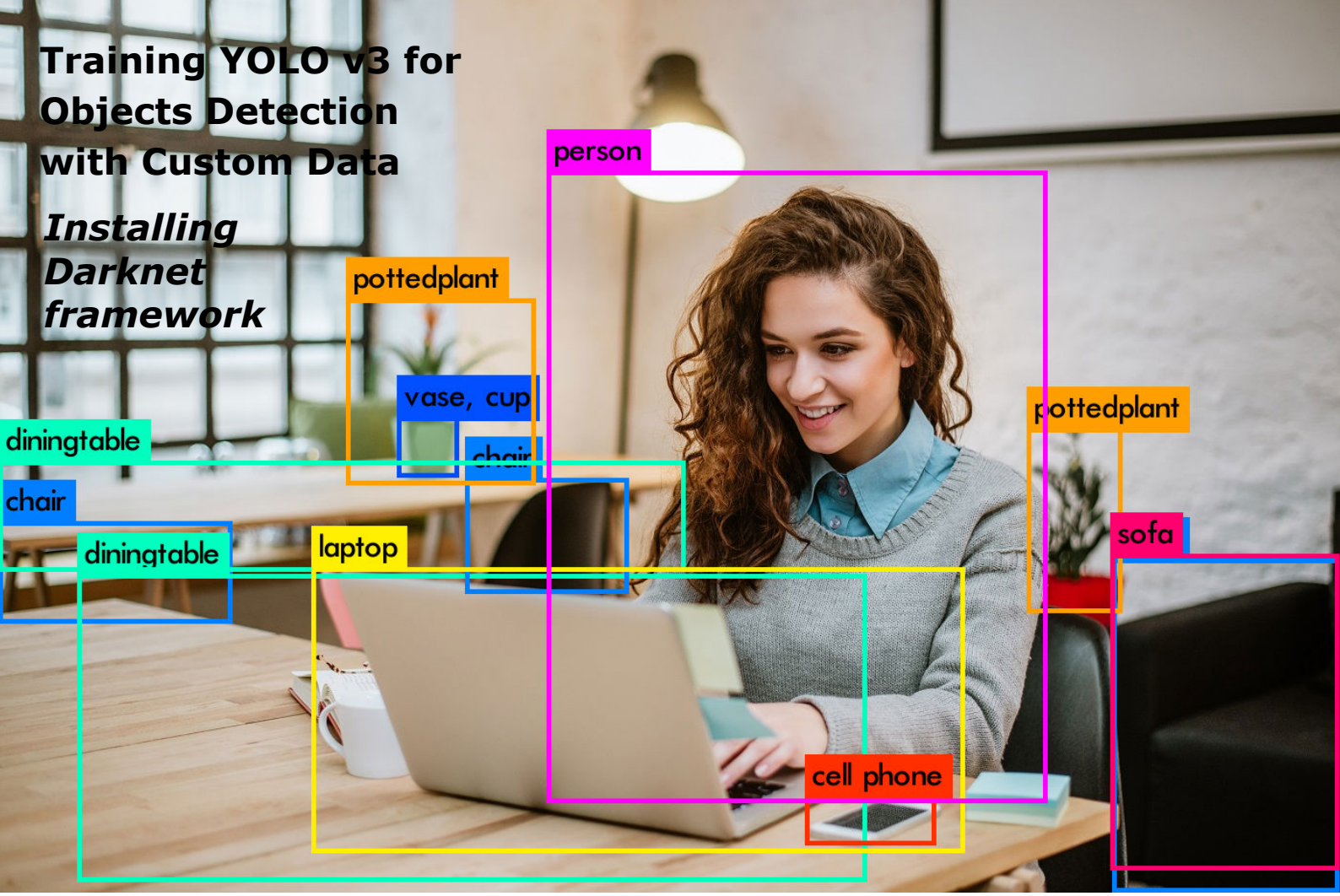
Training YOLO v3 for Objects Detection with Custom Data

Installing Darknet framework



Installing Darknet framework

Let's consider some examples on how to install *Darknet framework*, namely, the most popular fork *AlexeyAB*, that also supports *Windows* and has huge community to find answers from.

(!) While going the step-by-step instructions below, don't forget to scroll down to the end of this PDF and find "Useful Links". It has information where to find solutions for possible issues. Somebody else might already encountered the same issue and solution might be described there.

(!) An important note. To eliminate possible pain points while building Darknet on Windows, consider using Linux Ubuntu as it is much easier to compile Darknet framework on this Operating System.

General Algorithm

In most of the cases the general approach is as following or quite similar:

- Install prerequisites (*OpenCV, CUDA, cuDNN, etc.*)
- Clone repository
- Adjust options in *Makefile* (for Linux & Mac)
- Compile it (for Linux & Mac) or Build it (for Windows)

Linux

Instructions on how to install *Darknet* on *Linux*.

Base CPU system on Linux

Installing Basic option of *Darknet framework* to use it with *CPU* on Linux consists of the steps described below.

- **Clone repository.** The first step to implement is *cloning repository*. Navigate to the desired directory and run following command in *Terminal*:
  ```
  git clone https://github.com/AlexeyAB/darknet.git
  ```
  If you don't have *git* been installed, run following command in *Terminal*:
  ```
  conda install git
  ```

- **Compile Darknet framework.** Navigate to the root directory of *Darknet framework* by using following command in *Terminal*:
  ```
  cd darknet
  ```
  Compile *Darknet framework* by using following command in *Terminal*:
  ```
  make
  ```

- **Verify successful installation** by using following command in *Terminal*:
  ```
  ./darknet
  ```
  As a respond, following line should appear:
  ```
  usage: ./darknet <function>
  ```

Base CPU system on Linux + OpenCV

Installing Basic option of *Darknet framework* to use it with *CPU* on Linux along with *OpenCV* consists of the steps described below. *OpenCV* has to be installed beforehand (Section-1 of the course).

- **Clone repository.** The first step to implement is *cloning repository*. Activate your environment with *OpenCV* been installed, navigate to the desired directory and run following command in *Terminal*:
  ```
  git clone https://github.com/AlexeyAB/darknet.git
  ```
  If you don't have *git* been installed, run following command in *Terminal*:
  ```
  conda install git
  ```

- **Change flag in Makefile.** Navigate to the root directory of *Darknet framework* and open file *Makefile* in any editor like *notepad* or any other. Change flag in the following line from *0* to *1*:
  ```
  OPENCV=1
  ```

- **Compile Darknet framework.** Navigate to the root directory of *Darknet* framework by using following command in *Terminal*:
  ```
  cd darknet
  ```
  Compile *Darknet framework* by using following command in *Terminal*:
  ```
  make
  ```

- **Verify successful installation** by using following command in *Terminal*:
  ```
  ./darknet
  ```
  As a respond, following line should appear:
  ```
  usage: ./darknet <function>
  ```

GPU system on Linux

Installing option of *Darknet framework* to use it with *GPU* on Linux.

- **CMake installation.** Install *CMake* for modern *CUDA* support by following instructions described on official resource here.

- **CUDA 10.0 installation**
  - **Pre-installation actions.** Implement following instructions described on official *nvidia guide* here. By doing these steps, you will:
    - Verify the system has a *CUDA-capable GPU*
    - Verify the system is running a supported version of *Linux*
    - Verify the system has *gcc* installed
    - Verify the system has the correct kernel headers and development packages installed
  - **Download** the *NVIDIA CUDA Toolkit version 10.0* from archive here
  - **Install *CUDA Toolkit version 10.0*** by following one of the instructions:
    - *Package Manager Installation* here
    - *Runfile Installation* here. For instance, for *runfile* option, sequence of commands to be run in *Terminal* looks like following or quite similar:
      ```
      sudo apt-get update
      sudo apt-get upgrade
      sudo sh cuda_10.0.130_410.48_linux.run
      ```
  - **Post-installation actions.** Implement actions that have to be taken after the installation before the *CUDA Toolkit 10.0* can be used. They are described on official *nvidia guide* here.
  - Check out *Frequently Asked Questions* described on official *nvidia guide* here.

- **cuDNN 7.4.1 installation (this step can be skipped)** – *GPU-accelerated library* of for deep neural networks.
  - **Download archive** of *cuDNN version 7.4.1* for *CUDA 10.0 version* (might need to try different versions like 7.3, 7.4, etc.) from official resource here.
  - **Run installation** by following instructions described on official resource here.
  - **Find** and **copy-paste files** as described in the official resource here: https://docs.nvidia.com/deeplearning/sdk/cudnn-install/index.html#installlinux-tar

- **OpenCV installation.** Till this point we have to have *OpenCV* been installed. Anyway, check options on how to install it from Section-1 of the course.

- **Clone repository.** Navigate to the desired directory and run following command in *Terminal*:
  ```
  git clone https://github.com/AlexeyAB/darknet.git
  ```
  If you don't have *git* been installed, run following command in *Terminal*:
  ```
  conda install git
  ```

- **Change flags in Makefile.** Navigate to the root directory of *Darknet framework* and open file *Makefile* in any editor like *notepad* or any other. Change following flags from *0* to *1* (don't change flag for CUDNN to 1 if you skipped that step):
  ```
  GPU=1
  CUDNN=1
  OPENCV=1
  ```

- **Compile Darknet framework.** Navigate to the root directory of *Darknet* framework by using following command in *Terminal*:
  ```
  cd darknet
  ```
  Compile *Darknet framework* by using following command in *Terminal*:
  ```
  make
  ```

- **Verify successful installation** by using following command in *Terminal*:
  ```
  ./darknet
  ```
  As a respond, following line should appear:
  ```
  usage: ./darknet <function>
  ```

Windows

Instructions on how to install *Darknet* on *Windows*.

Base CPU system on Windows + OpenCV

Installing Basic option of *Darknet framework* to use it with *CPU* on Windows along with OpenCV consists of the steps described below.

- **OpenCV 3.3.0 installation.** In order to use *Darknet framework* on Windows it is needed to install ***OpenCV of version 3.3.0*.**
  - **Download installation file** from official resource here and extract it to the folder *C:\opencv_3.0*
  - **Create system variable** with name *OpenCV_DIR* and path to folder *build* (it includes extracted folders *include* and *x64*). To do so:
    - in the *File Explorer* right click on *This PC* and open *Advanced system settings*; choose *Environment Variables*
    - click *New* in *System variables*
    - create new variable with name *OpenCV_DIR*

      and path *C:\opencv_3.0\opencv\build*
    - click *Ok*
  - **Find following dll files** in the folder *C:\opencv_3.0\opencv\build\x64\vc14\bin:*

    `opencv_world320.dll`

    `opencv_ffmpeg320_64.dll`

    or

    `opencv_world330.dll`

    `opencv_ffmpeg330_64.dll`

    or

    `opencv_world340.dll`

    `opencv_ffmpeg340_64.dll`
  - **Copy paste** these two files in the directory *darknet\build\darknet\x64* next to executable file *darknet.exe (or darknet_no_gpu.exe, or darknet_gpu.exe)*. **This file will appear later, after building Darknet. Don't forget to do it after building Darknet.**

- **ffmpeg**

  Verify successful installation of *ffmpeg* by following command in *Anaconda Prompt*:

  ```
  ffmpeg -version
  ```

  Re-install *ffmpeg*, if needed, by *conda* (but install it globally, not inside any specific environment):

  ```
  conda install -c conda-forge ffmpeg
  ```

- **Visual Studio installation 2015 / 2017 / 2019.** In order to build *Darknet framework* on Windows it is needed to install *Visual Studio of version 2015 or 2017 or 2019*.
  - **Pay attention!** Visual Studio has to be installed before *CUDA* (if you're planning to use GPU).
  - **Download installation file** of free, community version *Visual Studio* from official resource here, double-click on it and follow prompts

- **Clone repository.** Navigate to the desired directory and run following command in *Anaconda Prompt*:
  `git clone https://github.com/AlexeyAB/darknet.git`

  If you don't have *git* been installed, run following command in *Anaconda Prompt*:
  `conda install git`

- **Build Darknet framework.** By using installed *Visual Studio*, find and open following file in the directory *darknet\build\darknet*:
  `darknet_no_gpu.sln`

  Then, in *Visual Studio* drop-down menus set following:
  `x64`
  and
  `Release`

  Finally, choose *Build* and *Build darknet_no_gpu*

  Find executable file *darknet.exe (or darknet_no_gpu.exe)* created in the directory *\build\darknet\x64*

- **Don't forget to copy dll files as described above for OpenCV.**

- **Verify successful installation.** Navigate to the directory with executable file *\build\darknet\x64* and type one of the following command in *command line or Anaconda Prompt*:
  `darknet.exe`
  `darknet_no_gpu.exe`

GPU system on Windows

Installing option of *Darknet framework* to use it with *GPU* on Windows.

- **OpenCV 3.3.0 installation.** In order to use *Darknet framework* on Windows it is needed to install ***OpenCV of version 3.3.0*.**
  - **Download installation file** from official resource here and extract it to the folder *C:\opencv_3.0*
  - **Create system variable** with name *OpenCV_DIR* and path to folder *build* (it includes extracted folders *include* and *x64*). To do so:
    - in the *File Explorer* right click on *This PC* and open *Advanced system settings*; choose *Environment Variables*
    - click *New* in *System variables*
    - create new variable with name *OpenCV_DIR*

      and path *C:\opencv_3.0\opencv\build*
    - click *Ok*
  - **Find following dll files** in the folder *C:\opencv_3.0\opencv\build\x64\vc14\bin:*

    `opencv_world320.dll`

    `opencv_ffmpeg320_64.dll`

    or

    `opencv_world330.dll`

    `opencv_ffmpeg330_64.dll`

    or

    `opencv_world340.dll`

    `opencv_ffmpeg340_64.dll`
  - **Copy paste** these two files in the directory *darknet\build\darknet\x64* next to executable file *darknet.exe (or darknet_no_gpu.exe, or darknet_gpu.exe)*. **This file will appear later, after building Darknet. Don't forget to do it after building Darknet.**

- **Visual Studio installation 2015 / 2017 / 2019.** In order to build *Darknet framework* on Windows it is needed to install *Visual Studio of version 2015 or 2017 or 2019*.
  - **Pay attention!** Visual Studio has to be installed before *CUDA*.
  - **Download installation file** of free, community version *Visual Studio* from official resource here, double-click on it and follow prompts

- **CUDA 10.0 installation**
  - **Download** *NVIDIA CUDA Toolkit version 10.0* from archive here
  - **Install *CUDA Toolkit version 10.0*** by executing the *CUDA* installer and following the on-screen prompts. Find also installation instructions on official *nvidia guide* here.

- **cuDNN 7.4.1 installation** – *GPU-accelerated library* of for deep neural networks.
  - **Download archive** of *cuDNN version 7.4.1* for *CUDA 10.0 version* from official resource here.
  - **Install cuDNN** by following instructions on official *nvidia guide* here.
  - **Create system variable** with name *CUDNN* and path to where *cuDNN* was installed. To do so:
    - Open *File Explorer*, right click on *This PC* and open *Advanced system settings*; choose *Environment Variables*.
    - click *New* in *System variables*
    - create new variable with name *CUDNN*

      and path where *cuDNN* was installed, like following or quite similar: *C:\Program Files\NVIDIA GPU Computing Toolkit*
    - click *Ok*
  - **Find following dll file:**
    `cudnn64_7.dll`
  - **Copy-paste** this file in the directory *darknet\build\darknet\x64* next to executable file *darknet.exe (or darknet_gpu.exe)*. **Executable file will appear later, after building Darknet. Don't forget to do it after building Darknet.**
  - **Find** and **copy-paste files** as described in the official resource here: https://docs.nvidia.com/deeplearning/sdk/cudnn-install/index.html#installwindows

- **Clone repository.** Navigate to the desired directory and run following command in *Anaconda Prompt*:
  `git clone https://github.com/AlexeyAB/darknet.git`

  If you don't have *git* been installed, run following command in *Anaconda Prompt*:
  `conda install git`

- **Build Darknet framework.** By using installed *Visual Studio,* find and open following file in the directory *darknet\build\darknet*:
  `darknet.sln`

Then, in *Visual Studio* drop-down menus set following:
`x64`
and
`Release`

Finally, choose *Build* and *Build darknet*

Find executable file *darknet.exe (or darknet_gpu.exe)* created in the directory *\build\darknet\x64*

- **Don't forget to copy dll file as described above for cuDNN.**

- **Verify successful installation.** Navigate to the directory with executable file *\build\darknet\x64* and type one of the following command (any you have) in *command line or Anaconda Prompt*:
`darknet.exe`
`darknet_gpu.exe`

MacOS

Instructions on how to install *Darknet* on *MacOS*.

Base CPU system on MacOS + OpenCV

Installing Basic option of *Darknet framework* to use it with *CPU* on MacOS along with *OpenCV* consists of the steps described below.

- **CMake installation.** Install *CMake* for by following instructions described on official resource here.

- **OpenCV installation.** One of the simplest way to install *OpenCV* on Mac is with Homebrew. If you don't have Homebrew installed, use following command in *Terminal* (zoom in and copy-paste):
`/usr/bin/ruby -e "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/install)"`

  Then, install *OpenCV* by following command in *Terminal*:
`brew install opencv`

- **Clone repository.** Navigate to the desired directory and run following command in *Terminal*:
`git clone https://github.com/AlexeyAB/darknet.git`

  If you don't have *git* been installed, run following command in *Terminal*:
`conda install git`

- **Change flag in Makefile.** Navigate to the root directory of *Darknet framework* and open file *Makefile* in any editor like *notepad* or any other. Change flag in the following line from *0* to *1*:
  `OPENCV=1`

  Also, change in *Makefile* line 139:
  `$(CPP) -std=c++11 $(COMMON) $(CFLAGS) -o $@ src/yolo_console_dll.cpp $(LDFLAGS) -L ./ -l:$(LIBNAMESO)`

  this `-l:$(LIBNAMESO)`
  to this `-l$(EXEC)`

- **Compile Darknet framework.** Navigate to the root directory of *Darknet* framework by using following command in *Terminal*:
  `cd darknet`

  Compile *Darknet framework* by using following command in *Terminal*:
  `./build.sh`

- **Verify successful installation** by using following command in *Terminal*:
  `./darknet`

  As a respond, following line should appear:
  `usage: ./darknet <function>`

GPU system on MacOS

Installing option of *Darknet framework* to use it with G*PU* on MacOS.

- **CMake installation.** Install *CMake* for by following instructions described on official resource here.

- **OpenCV installation.** One of the simplest way to install *OpenCV* on Mac is with Homebrew. If you don't have Homebrew installed, use following command in *Terminal* (zoom in and copy-paste):
  `/usr/bin/ruby -e "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/install)"`

  Then, install *OpenCV* by following command in *Terminal*:
  `brew install opencv`

- **CUDA 10.0 installation**
  - **Download** *NVIDIA CUDA Toolkit version 10.0* from archive here
  - **Install *CUDA Toolkit version 10.0*** by following installation instructions on official *nvidia guide* here.

- **cuDNN 7.4.1 installation (this step can be skipped)** – *GPU-accelerated library* of for deep neural networks.
  - **Download archive** of *cuDNN version 7.4.1* for *CUDA 10.0 version* from official resource here.
  - **Install cuDNN** by following instructions on official *nvidia guide* here.

- **Clone repository.** Navigate to the desired directory and run following command in *Terminal*:

  ```
  git clone https://github.com/AlexeyAB/darknet.git
  ```

  If you don't have *git* been installed, run following command in *Terminal*:

  ```
  conda install git
  ```

- **Change flag in Makefile.** Navigate to the root directory of *Darknet framework* and open file *Makefile* in any editor like *notepad* or any other. Change flag in the following line from *0* to *1* (don't change flag for CUDNN to 1 if you skipped that step):

  ```
  GPU=1
  CUDNN=1
  OPENCV=1
  ```

  Also, change in *Makefile* line 139:

  ```
  $(CPP) -std=c++11 $(COMMON) $(CFLAGS) -o $@ src/yolo_console_dll.cpp $(LDFLAGS) -L ./ -l:$(LIBNAMESO)
  ```

  this `-l:$(LIBNAMESO)`
  to this `-l$(EXEC)`

- **Compile Darknet framework.** Navigate to the root directory of *Darknet* framework by using following command in *Terminal*:

  ```
  cd darknet
  ```

  Compile *Darknet framework* by using following command in *Terminal*:

  ```
  ./build.sh
  ```

- **Verify successful installation** by using following command in *Terminal*:

  ```
  ./darknet
  ```

  As a respond, following line should appear:

  ```
  usage: ./darknet <function>
  ```

Useful Links

How to handle issues while installing Darknet?

To handle issues while *installing Darknet* on *Windows, Linux* or *Mac*, look for possible solutions here (type in the search field your specific issue):
https://github.com/AlexeyAB/darknet/issues/

How to handle issues while installing Visual Studio?

To handle issues while installing Visual Studio on Windows, Linux and Mac, find useful information on official resources here:
https://visualstudio.microsoft.com/ru/vs/
https://docs.microsoft.com/visualstudio/?view=vs-2019
https://developercommunity.visualstudio.com/spaces/8/index.html
https://devblogs.microsoft.com/visualstudio/

How to handle issues while installing CUDA?

To handle issues while installing CUDA 10.0 on Windows, Linux and Mac, find useful information on official resource here (open "Known issues" tab):
https://docs.nvidia.com/cuda/archive/10.0/cuda-toolkit-release-notes/index.html

Where else is it possible to look for any type of solution?

Find possible solutions to any type of issue in here (type in the search field your specific issue):
https://stackoverflow.com

Check out these links with official resources for installing and using *Darknet framework* as well as the links to *possible issues*:

[1] Fork of AlexeyAB – the most popular fork of *Darknet framework* **chosen for this course**, that has improvements on performance, answers on the popular issues
[2] Issues - try to find answer to encountered issue from more than 2000 community posts on how to install and use *Darknet framework*
[3] Issue #500 – describes which version of *OpenCV* is needed for installing *Darknet framework* on Windows
[4] Issue #2983 – describes needed changes in *Makefile* needed for installing *Darknet framework* on MacOS
[5] CUDA Toolkit – installation guide with step-by-step instructions on how to install and verify *CUDA* on Linux, Windows and MacOS
[6] NVIDIA CUDA Deep Neural Network library (cuDNN) – installation guide with step-by-step instructions on how to install and check cuDNN on Linux, Windows and MacOS