Introduction to Deep Learning: Hands-on Workshop in Computer Vision

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Overview of the Workshop

- **Goals**
  - Gaining hands-on experience in deep learning [DL] for computer vision [CV]
  - Getting familiar with core technologies: Python, PyTorch, Jupyter, …
  - Training, evaluating & applying DL-models in Python
  - Some theoretical background on key concepts as we encounter them
  - Brief discussion of potentials of integrating Symbolic AI and DL → **Neurosymbolic AI**
- **Non-goals**
  - Broad overview of AI, DL, CV, … and their applications, ethical/legal considerations, etc.
  - Theoretical (mathematical, statistical) foundations of DL
  - Learning Python
  - Employing pre-trained foundation models (like ChatGPT) to solve our problems
- **Outline**
  1. Python setup
  2. “Hello World” example: Classifying images of hand-written digits
  3. “Real-word” example: Traffic sign recognition by re-engineering our famous ;) ***Crash Me If You Can***

Setting Up Python

1. Clone the Git repository / pull latest version:

```
$ git clone https://github.com/risc-mi/dl-cv-workshop.git
```

or

```
$ git pull
```

2. Download and install Miniconda (available for Windows, MacOS, Linux)
   - https://docs.anaconda.com/free/miniconda/miniconda-install/
   - Even if you have Python pre-installed (e.g., on Linux), it is **strongly recommended** to use (Mini)conda for managing Python installations and Python environments

3. After installation, open a new terminal window, cd to the workshop directory, and execute the commands below:

```
$ conda env create --file environment.yml

$ conda activate cv_dl_workshop
```

4. **Done – you have successfully installed Python and all add-on packages we are going to need today ☺**

“Hello World” Example: Hand-written Digit Classification

- From now on, we are going to use **Jupyter notebooks**
  - Similar to *Mathematica* notebooks, but less fancy and for Python (among other languages)

- In the terminal window used for installing Miniconda, simply execute the following command to start Jupyter:

```
$ jupyter notebook
```

  - A new browser tab should open now (at localhost:8888), displaying the contents of the current directory
  - Double-click on MNIST.ipynb to open it

- If you run Python on a remote computer via SSH, you need to create an SSH tunnel instead:

```
$ ssh -L 8888:localhost:8888 <REMOTE COMPUTER>
```

← local

```
$ conda activate dl_cv_workshop
$ cd <PATH TO GIT REPO>
$ jupyter notebook --no-browser
```

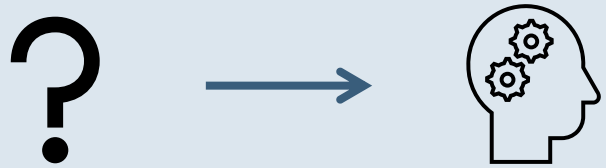
← remote

  - As a result, a URL starting with “http://localhost:8888/” will be printed somewhere in the console output
  - Navigate to that URL in the browser on your laptop, e.g., by Ctrl-clicking on it

https://www.digitalocean.com/community/tutorials/how-to-install-run-connect-to-jupyter-notebook-on-remote-server

Symbolic AI vs. Deep Learning

Symbolic AI



Problem statement involving **structured, abstract** data (e.g., mathematical objects)

Careful thinking, logical reasoning, consideration of **some examples**

New algorithm (**formally verified**)

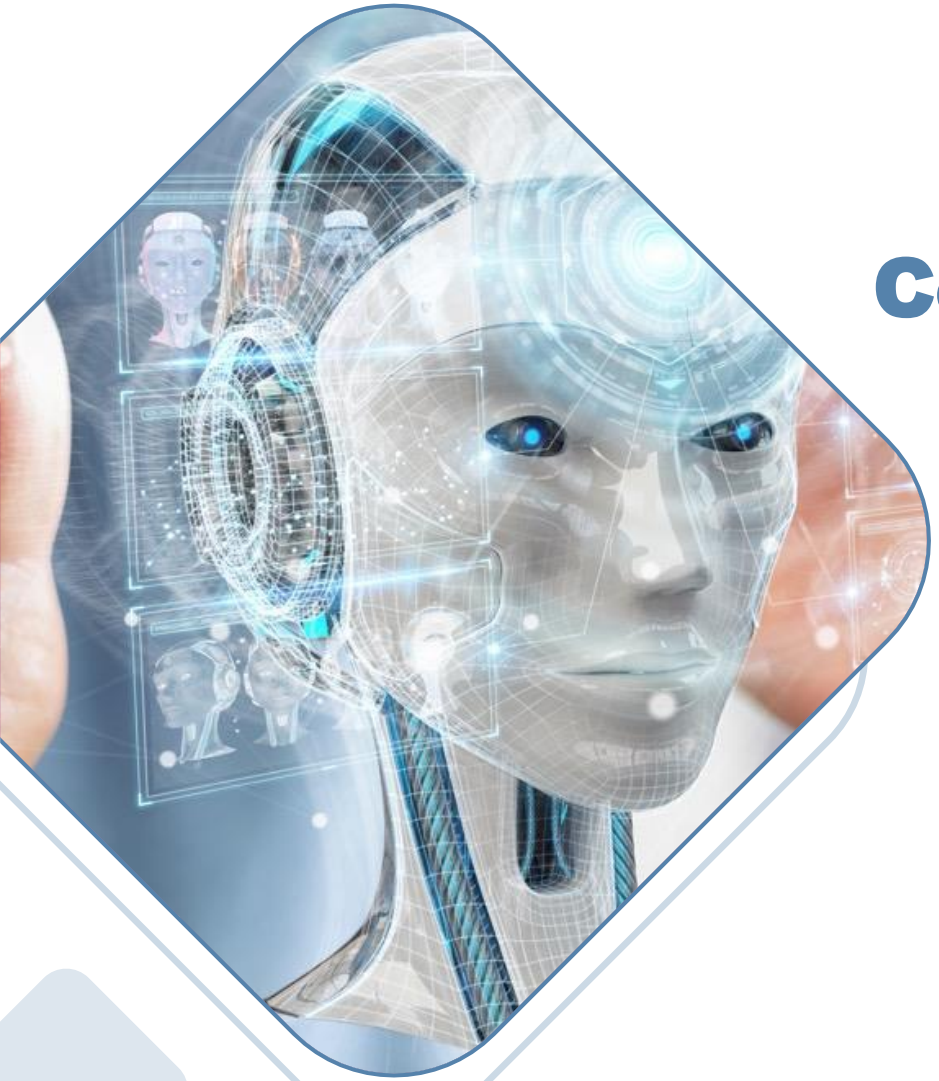
Deep Learning

Problem statement, often involving **unstructured, fuzzy** data (e.g., images)

Data set with **many examples**, i.e., problem instances and their solutions

Train DL model on given data set, using existing algorithms

Trained model (learned rules), **validation** instead of **verification**



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