

Novel Approach for Teaching AI in Entry Level Education

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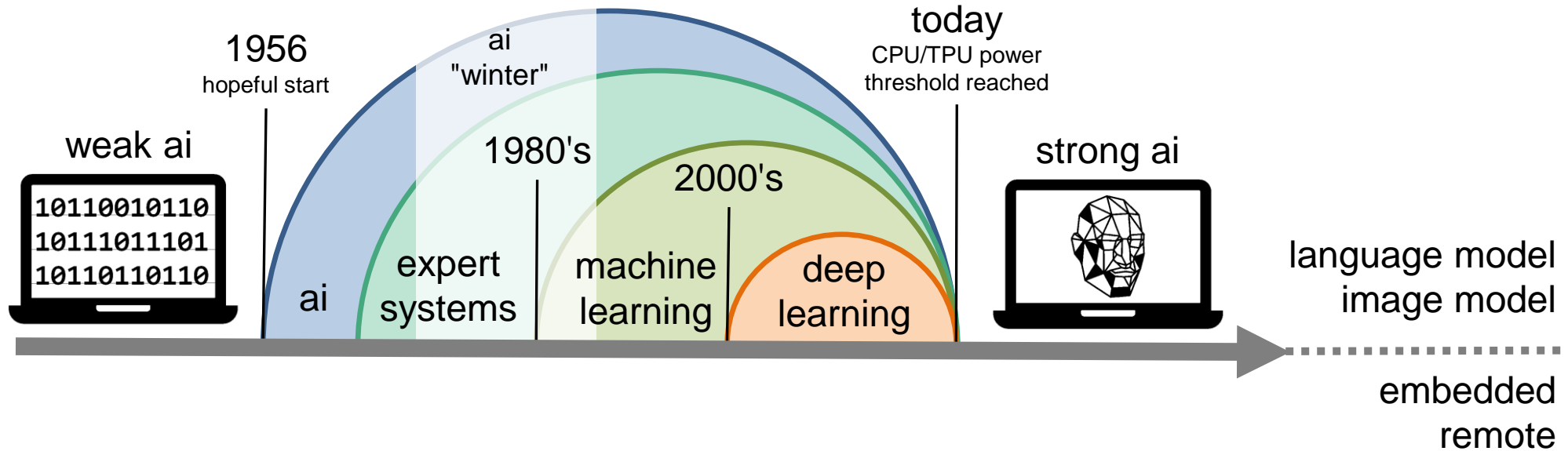
15.3.2024



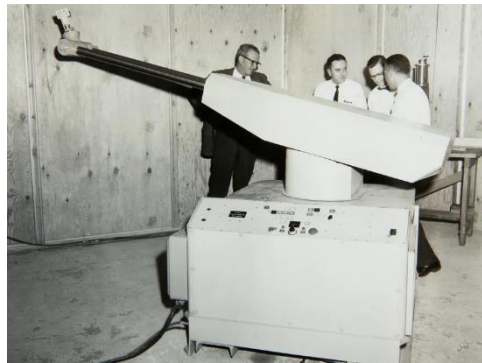
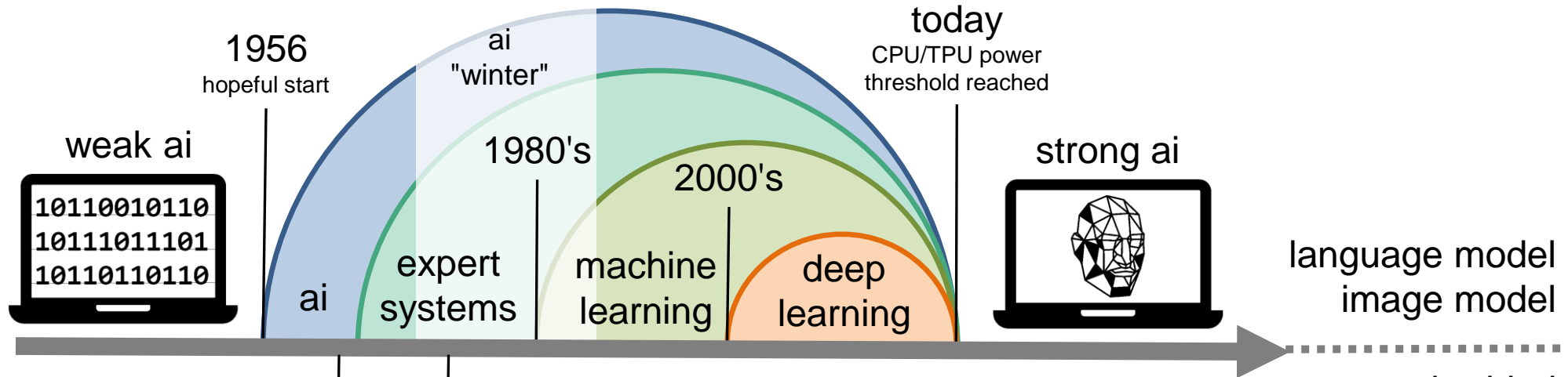
International Conference
**NEW PERSPECTIVES
in SCIENCE EDUCATION**



motivation: past, present, future



motivation: past, present, future



1961 1971



today 3,9 million robots

TOP 5 GLOBAL ROBOTICS TRENDS IN 2024

IFR International Federation of Robotics

- 1 AI AND MACHINE LEARNING
- 2 ROBOTS IN NEW APPLICATIONS
- 3 MOBILE MANIPULATORS
- 4 DIGITAL TWIN
- 5 HUMANOIDS

Find out more at:
<https://ifr.org/ifr-press-releases/news/top-5-robot-trends-2024>

Source: International Federation of Robotics

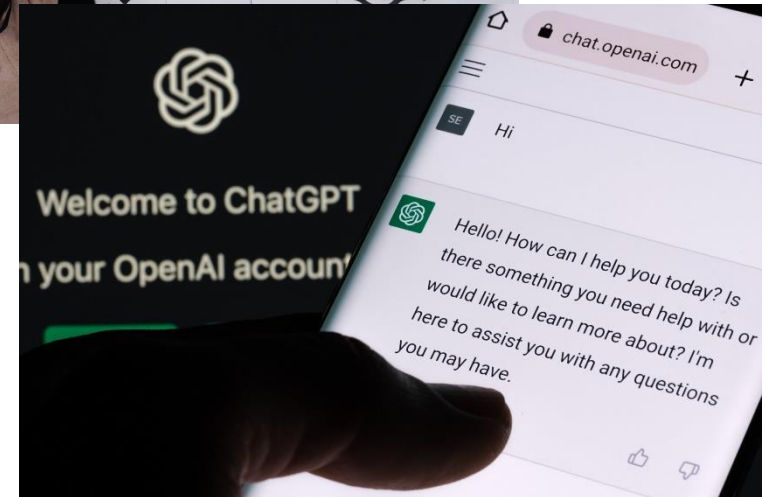
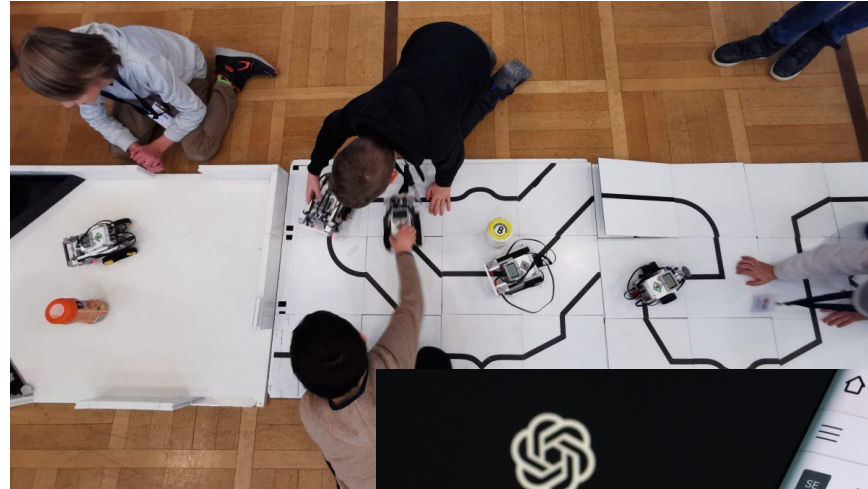
motivation: education

typical robot exercises are in mobile robots (RoboCup):
inexpensive components, yet all technologies:

sensors, drive mechanics,
mechatronics, electronics,
programming, ...

however this is not ai !
embedded software running an **algorithm**

ChatGPT is ai, but no real-world interaction



first level exercise: program the robot

creating a real-live application:

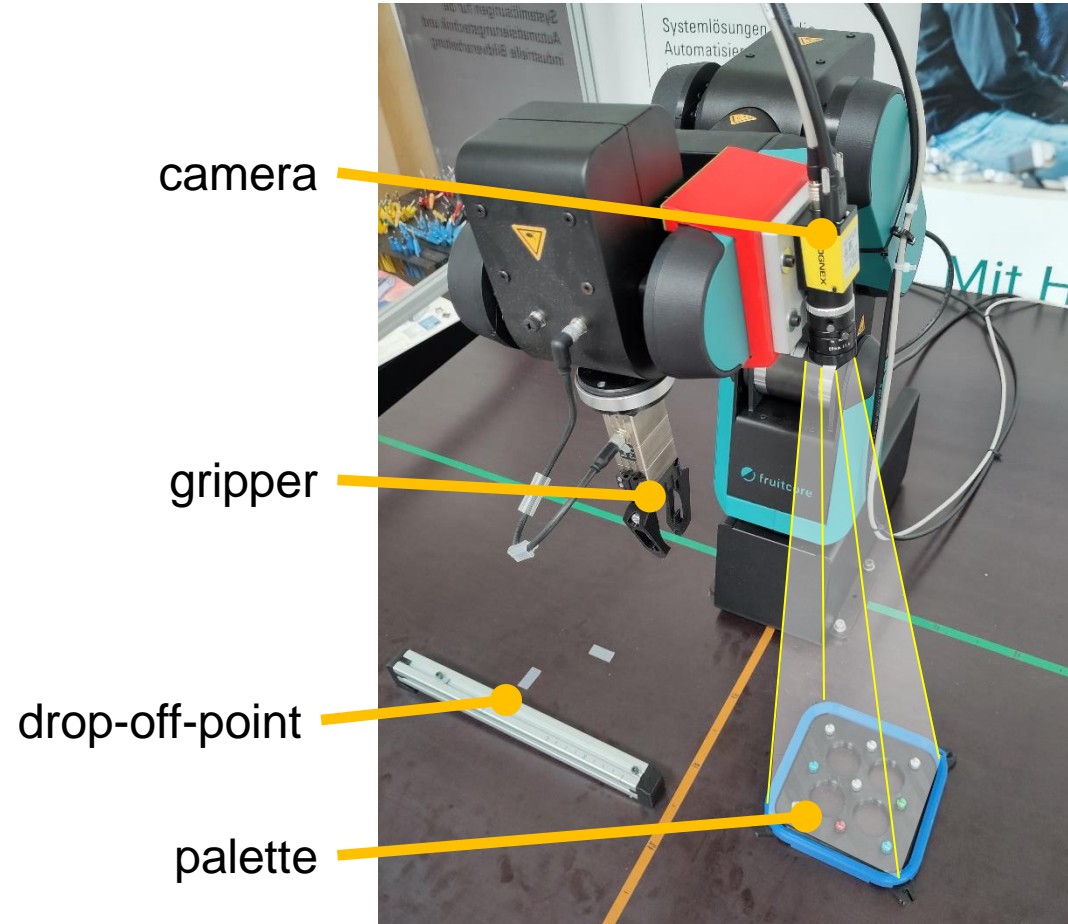
pick-up, dip and drop-off



first level exercise: program the robot

creating a real-live application:

pick-up, dip and drop-off



first level exercise: program the robot

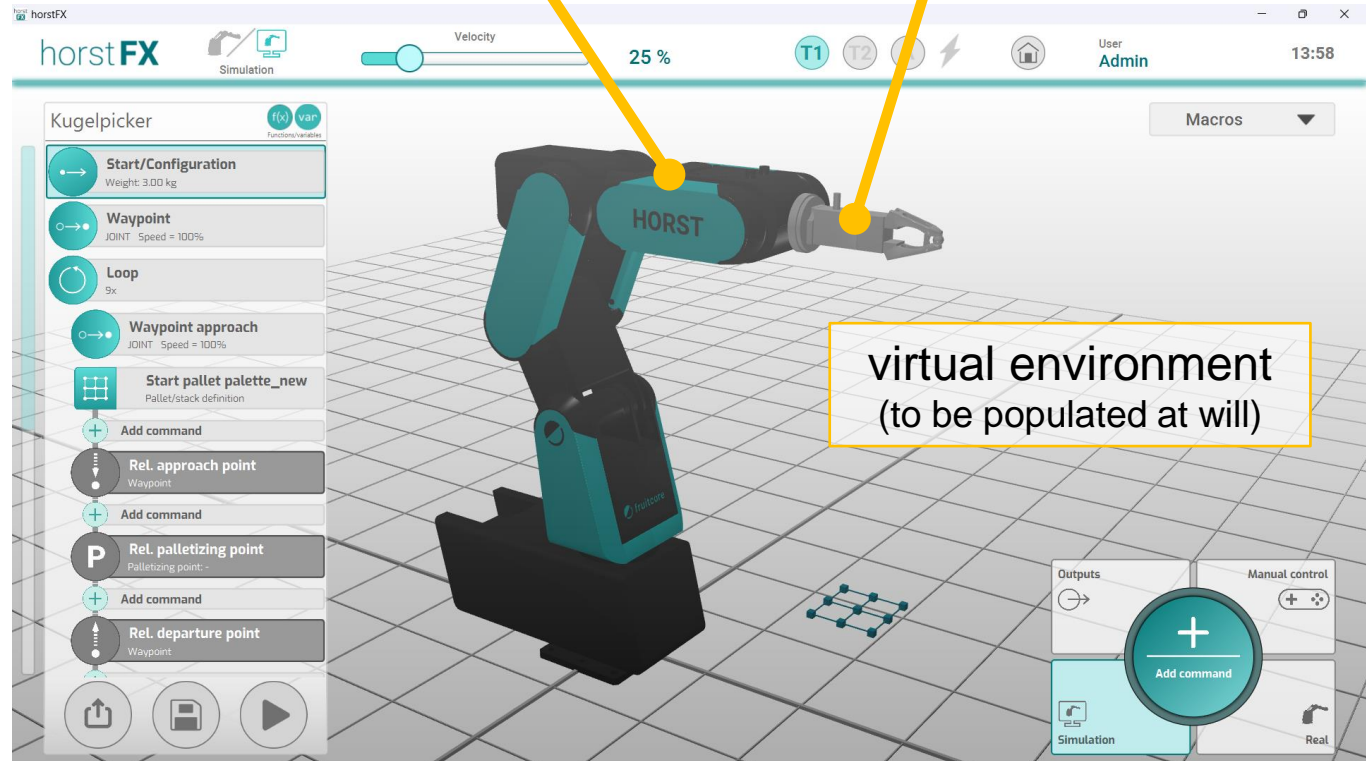
SW can run on

- normal desktop
- panel-PC
- true robot control unit

identical interface allows
for **offline exercises**,
then transfer of RP's

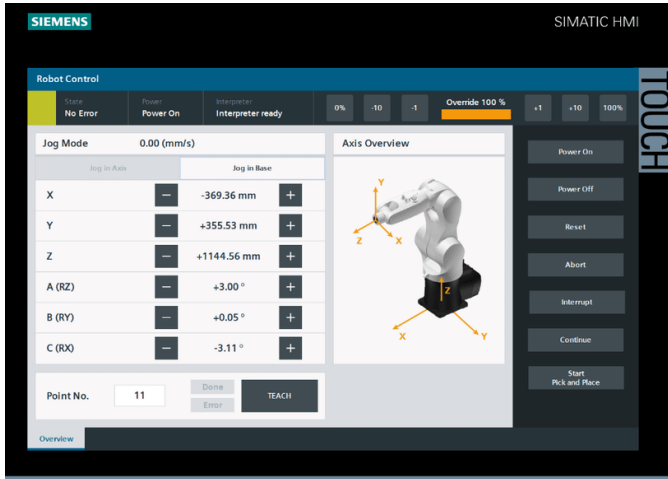
digital twin

3D-model of gripper
(created and imported)



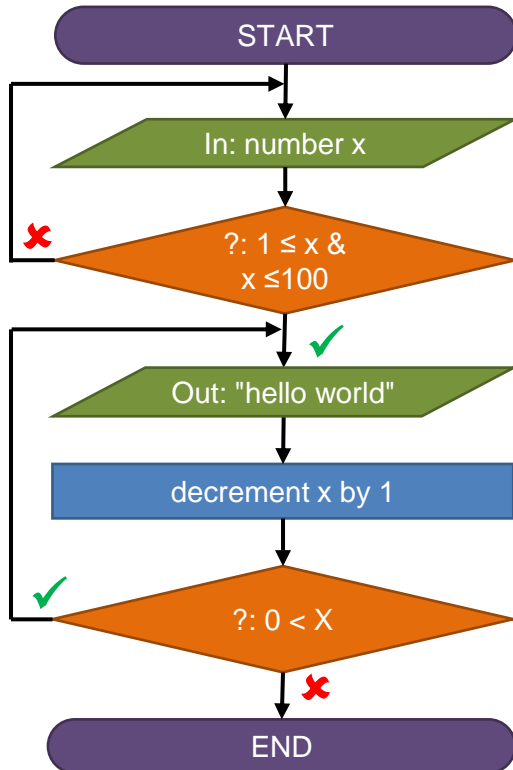
first level exercise: program the robot

all robot manufacturers optimize their interface for ease-of-use.....

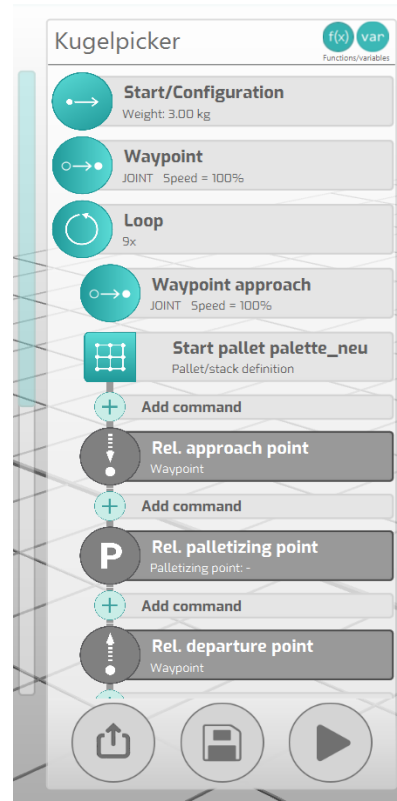


first level exercise: program the robot

Robot Program (RP): a list of sequential commands (~ assembler or BASIC)
loop and *if-then-else* logic by jumps in RP-list



inspiration



inspiration

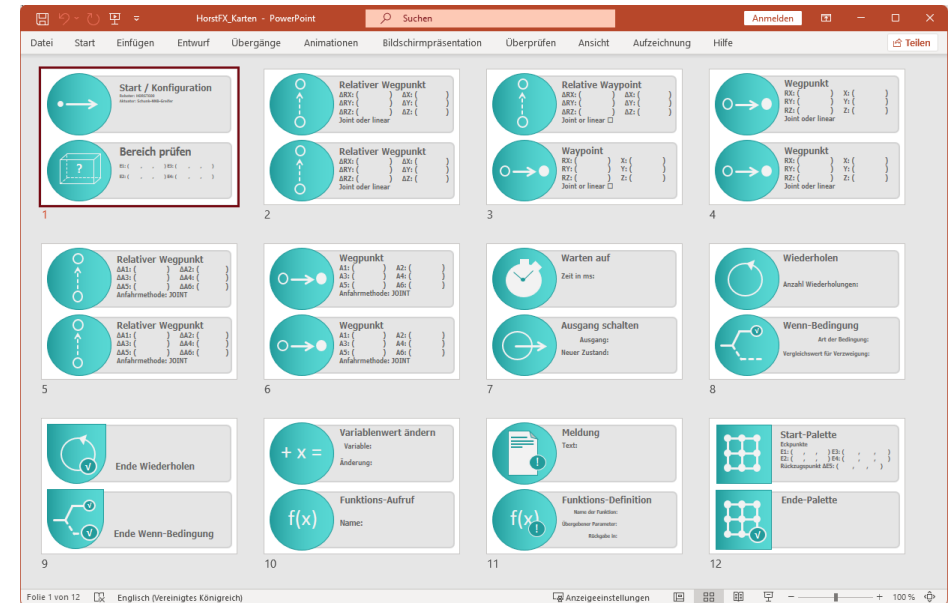
step1:
create RP with
cards

first level exercise: program the robot

Inspiration by a commercial board game: RoboRally ©: movements need to be "programmed" by shuffled and dealt cards 6 movements ahead

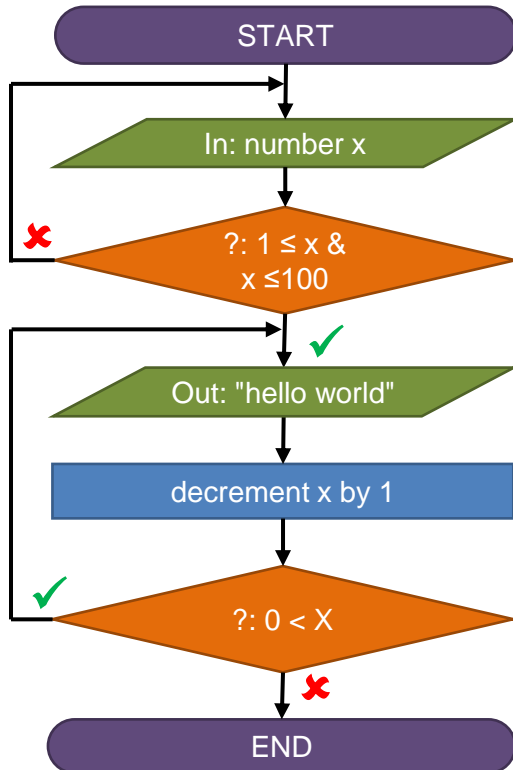


"copy" cards with PP, print and laminate a sufficient number:

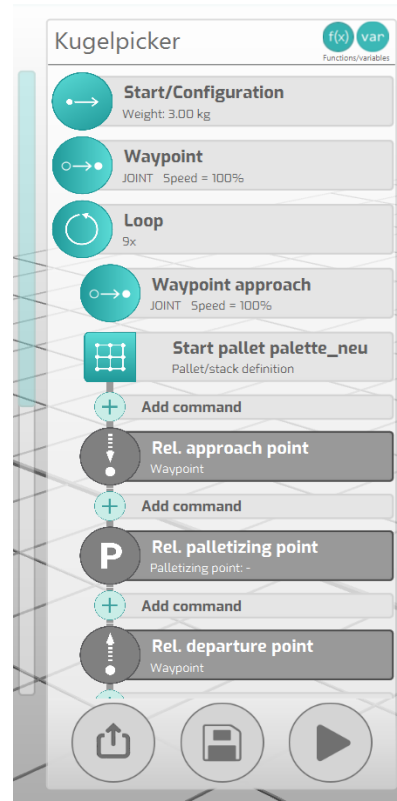


first level exercise: program the robot

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inspiration



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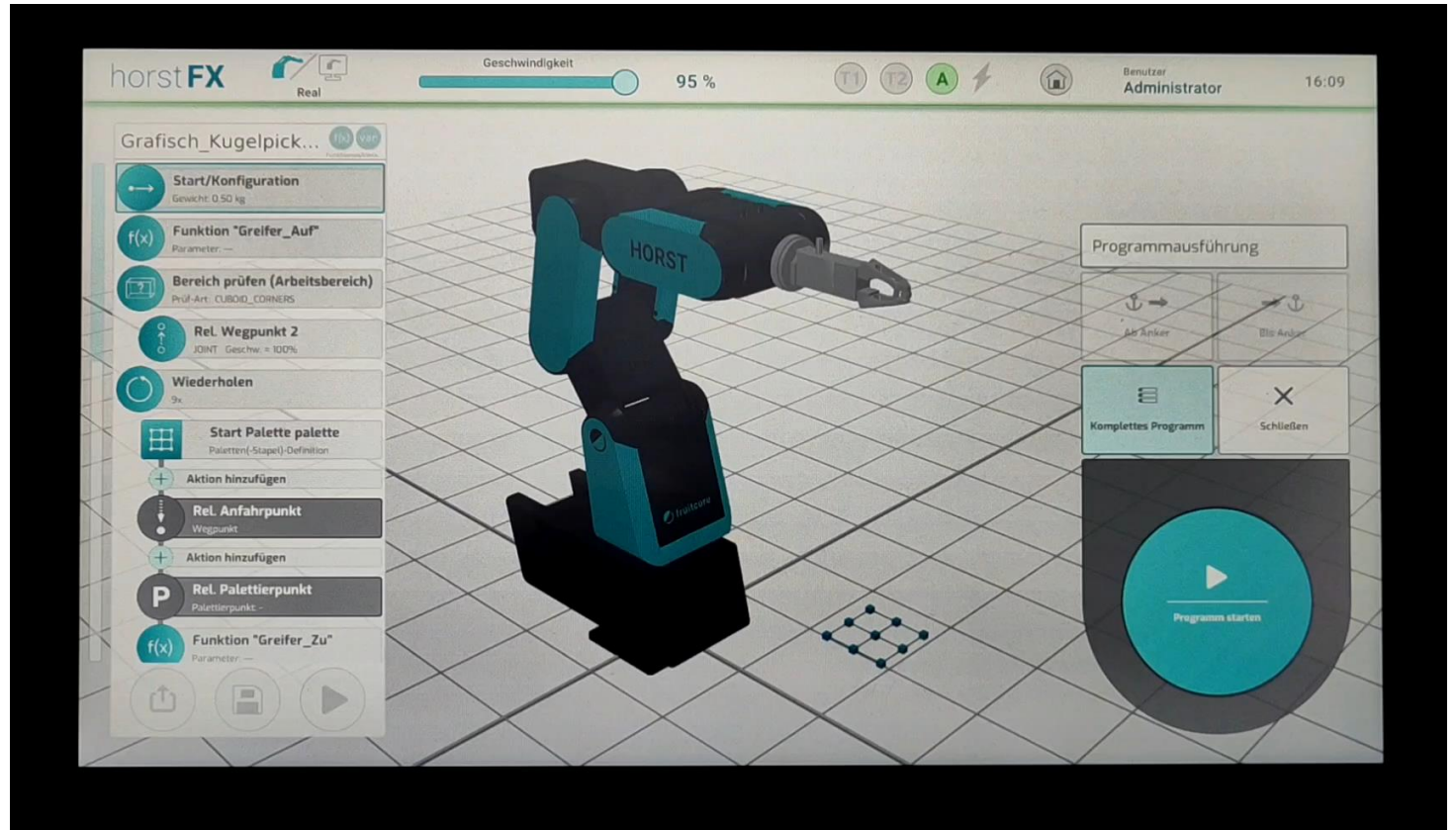
step1:
create RP with cards

step2:
follow cards to create RP



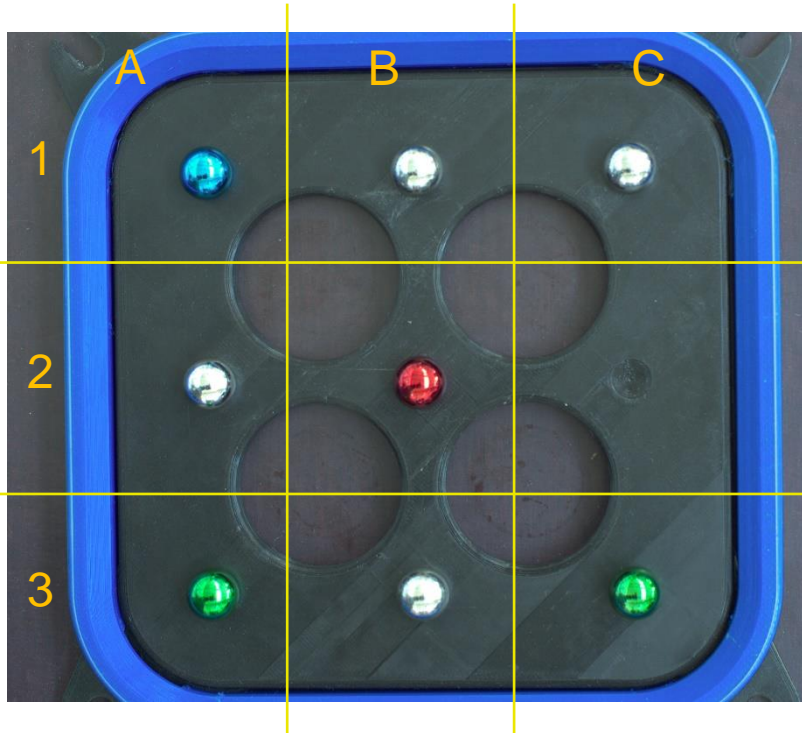
AI enhanced robot

Exercise typically completed in 45 minutes, including short introduction



task for DeepLearning

pick only "good" colored balls: SilverBall
skip the "bad" ones (BlueBall, RedBall, GreenBall)
and ignore empty slots !



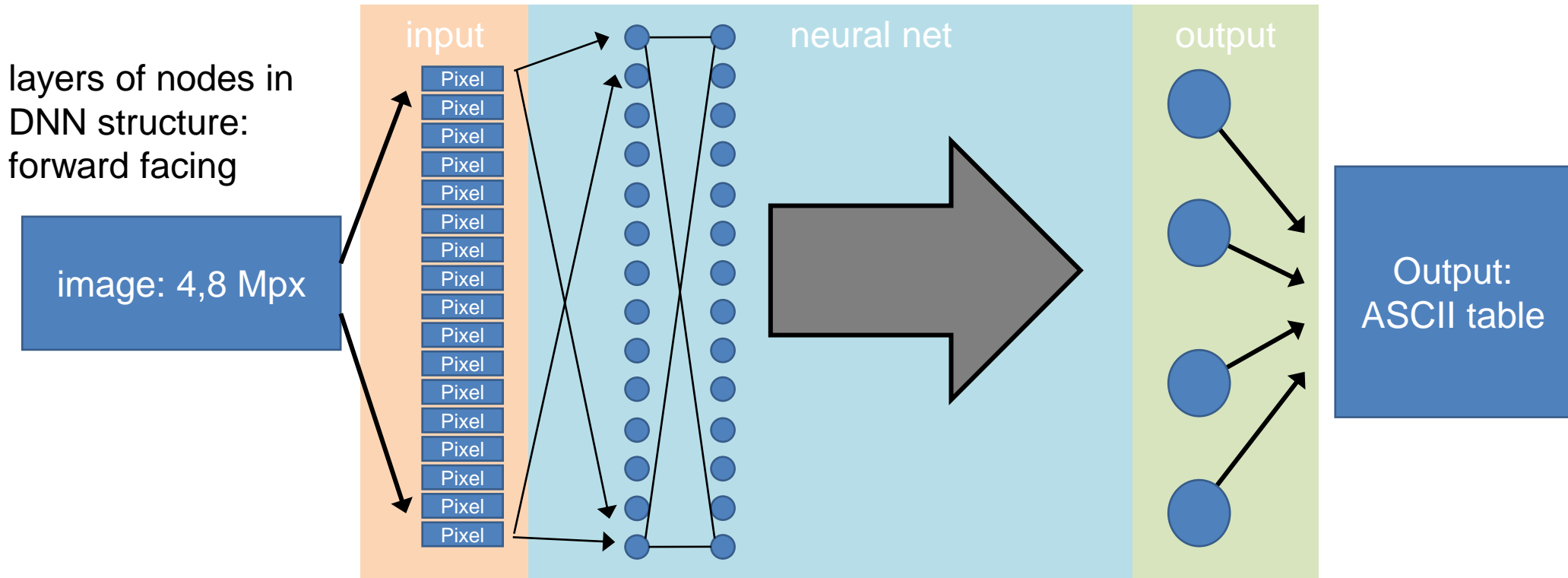
use a commercial Deep-Learning-ai software which is designed for fault recognition in quality control

user must define patterns, for which the ai-module searches

ai will return found patterns in an ASCII table
user-defined-name | X-position | Y-position**

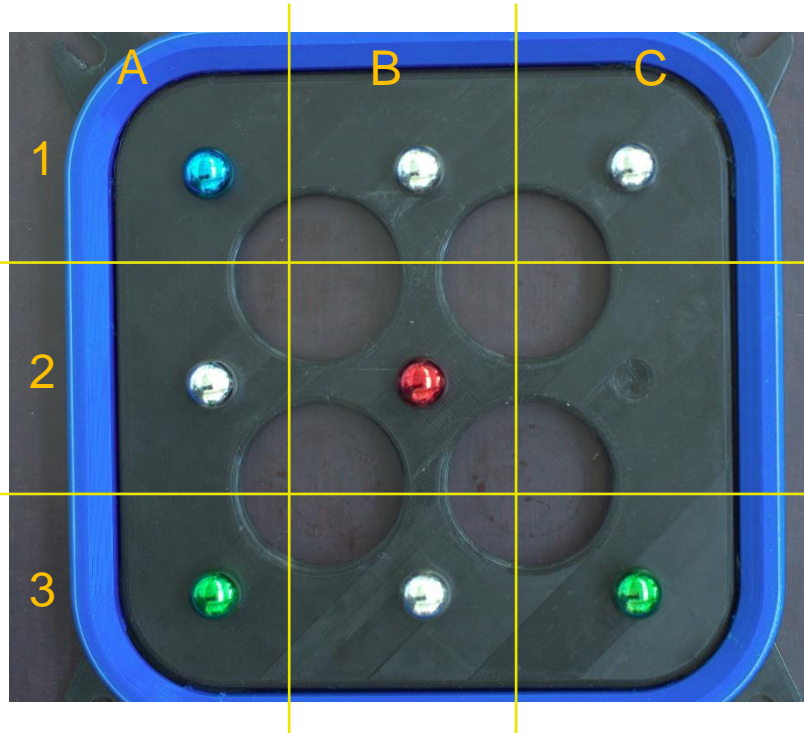
*with positions in pixel-count

AI: DeepLearning in neural net

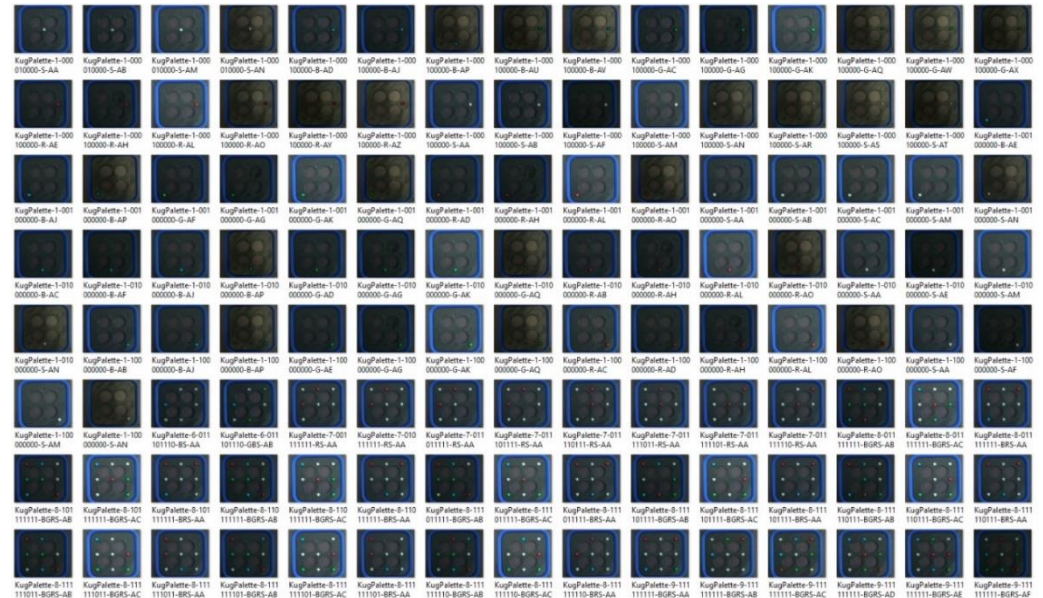


task for DeepLearning

pick only "good" colored balls: SilverBall
skip the "bad" ones (BlueBall, RedBall, GreenBall)
and ignore empty slots !



Step1: gather appropriate collection of images



AI enhanced robot

task for DeepLearning

Step2 import all images into DL-GUI

Step3 define objects with names

Step4 mark patterns in image as objects (about 1/2 of images), define those as training set

Step5 let network train itself

? if insufficient, back to Step1

Step6 export ai module to file

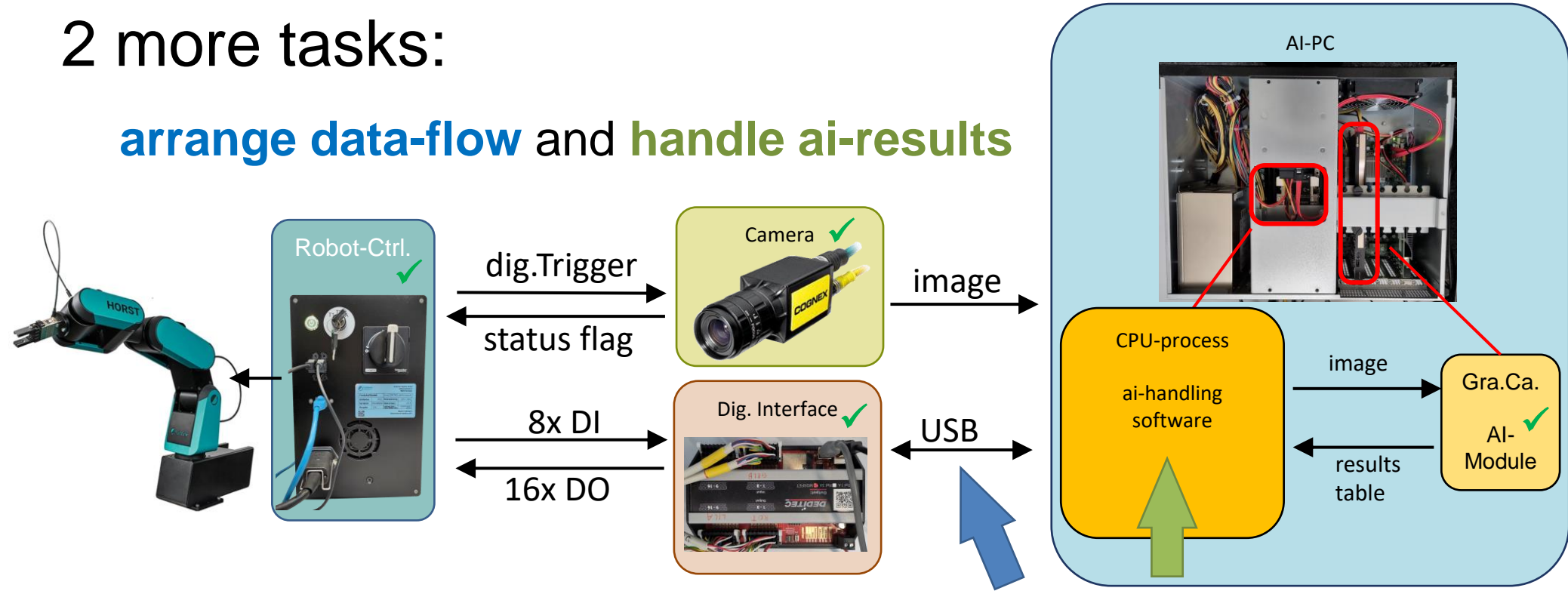
The screenshot shows the KameraTest v2 - Cognex Deep Learning Studio interface. The main window displays a grid of images with objects marked by colored circles and labels like 'BlueB', 'SilverB', 'RedB', and 'GreenB'. A 'Locate' button is visible. On the right, a 'Confusion Matrix' is shown with a table of performance metrics for different classes.

Feature	Found	Train	Labeled	Recall	Precision	F-Score
BlueB	91	35	91	100.0	100.0	100.0
GreenB	98	36	98	100.0	100.0	100.0
Leer	1397	1340	1389	100.0	100.0	100.0
RedB	126	39	125	100.0	100.0	100.0
SilverB	241	42	241	100.0	100.0	100.0
	1953	1494	1944	100.0	100.0	100.0
(3 classes)						

dataflow between AI and robot

2 more tasks:

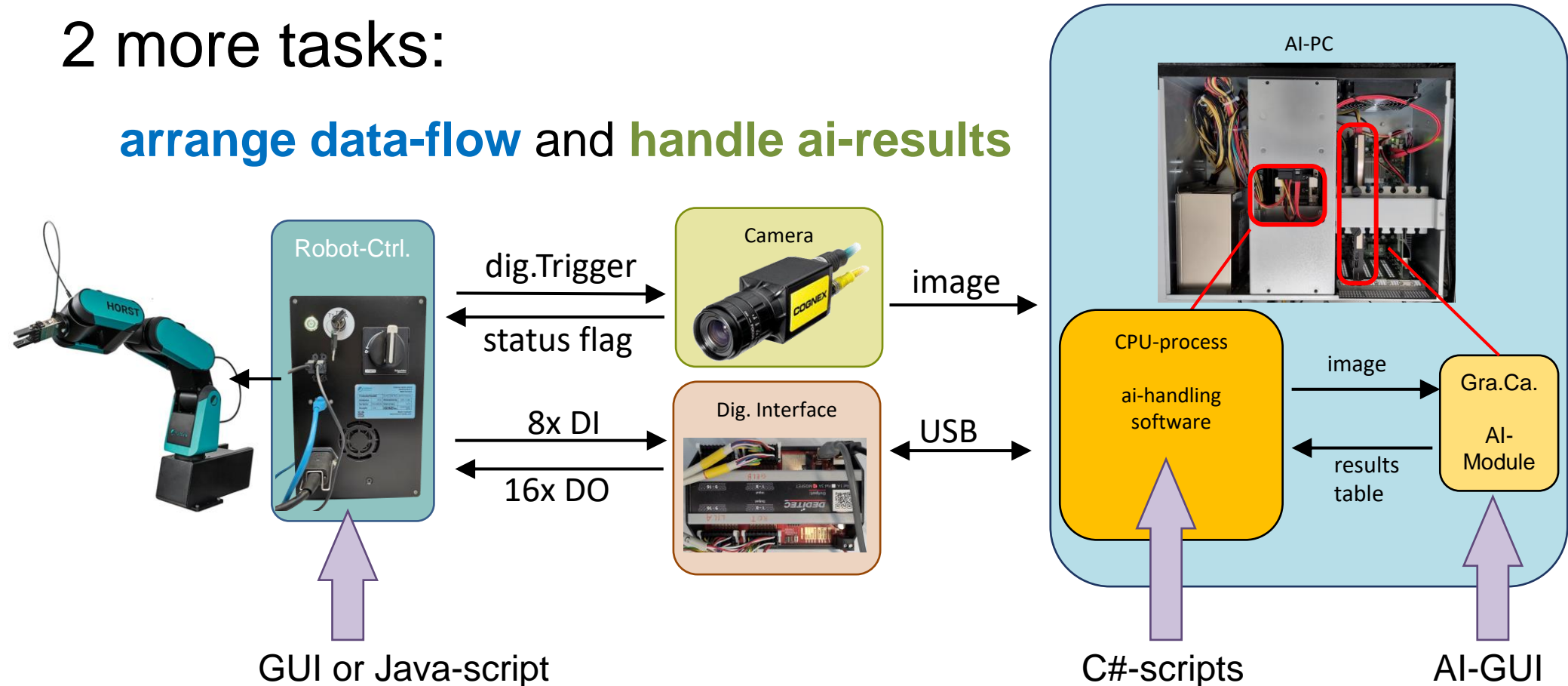
arrange data-flow and handle ai-results



dataflow between AI and robot

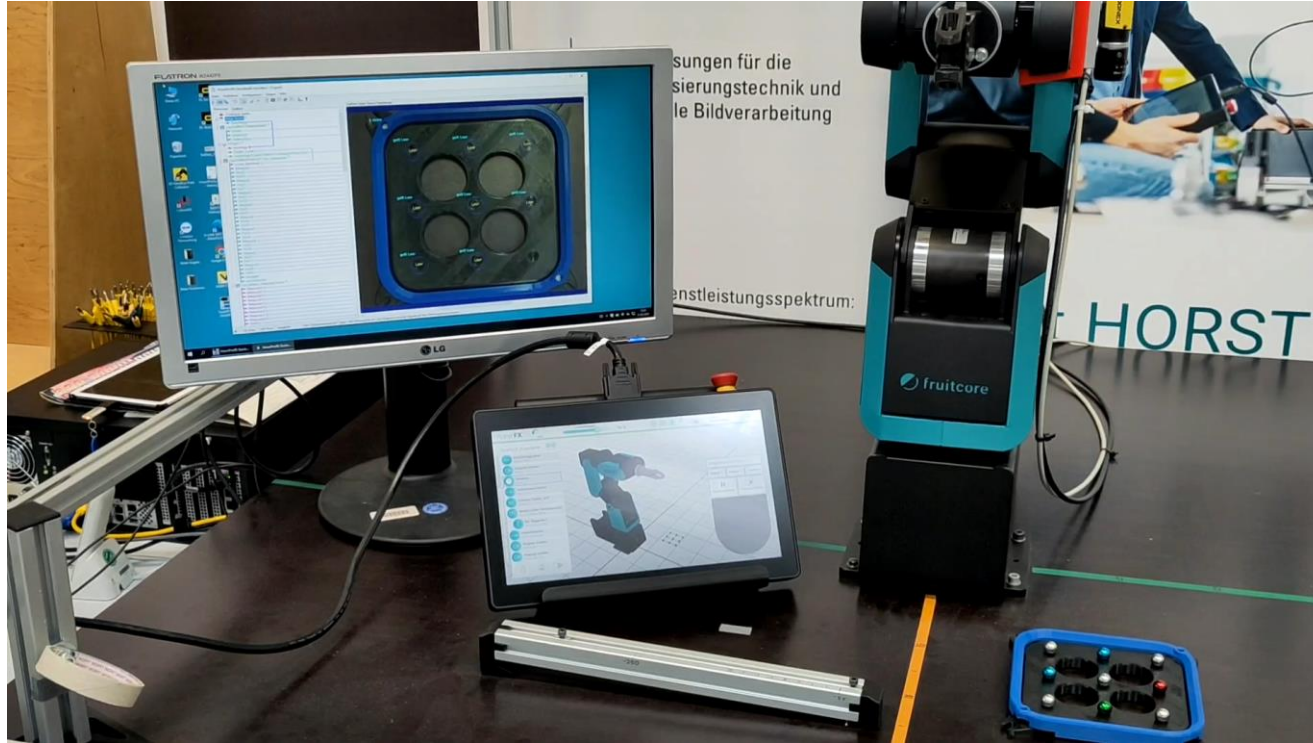
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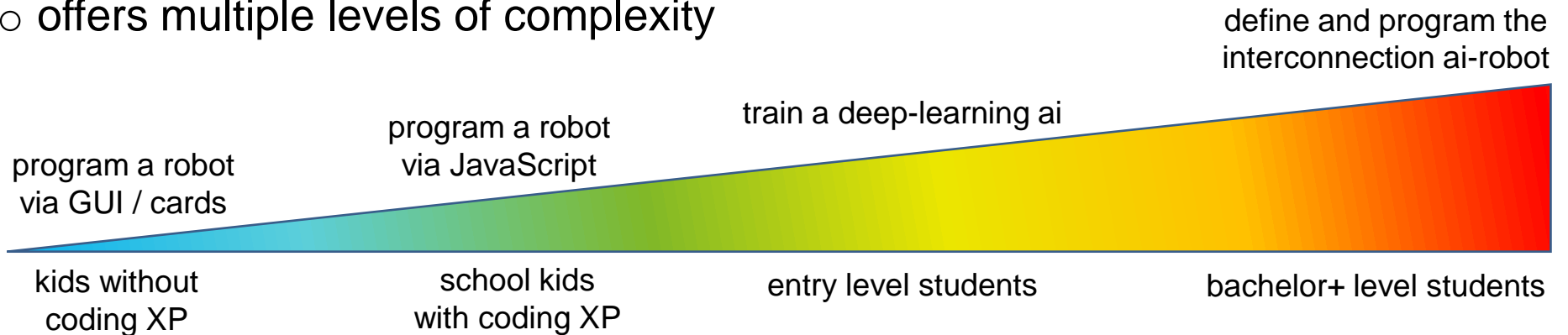
AI enhanced robot

run it all together



Summary

- installed an Integrated Learning Environment with industrial equipment
- emphasis in on application with close to real-life-application (no building)
- offers multiple levels of complexity



- having fun with the outcome