0. ORGANIZATION
1. DIGITAL TECHNOLOGIES
2. SENSORS
3. ACTUATORS
4. COMPUTER VISION
5. GENERATIVE AI
6. NATURAL LANGUAGE PROCESSING
7. USER INTERFACES
8. CLOUD SERVICES
9. DATABASES

The slides are meant as visual support for the lecture.
They are neither a documentation nor a script.

Please do not print the slides.

Comments and feedback at n.meseth@hs-osnabrueck.de

ORGANIZATION

ILIAS
Microsoft Teams

sessions

group work

examination

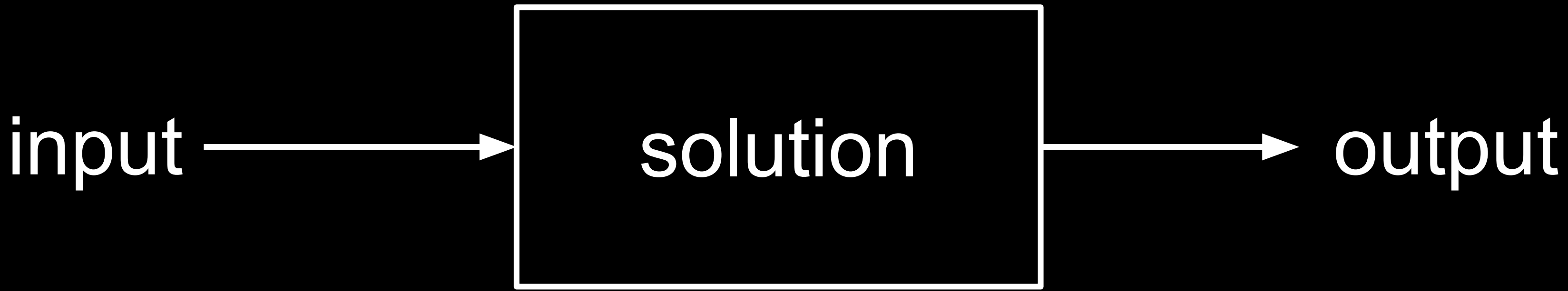
working environment

visual studio code
python
tinkerforge
git

DIGITAL TECHNOLOGIES

BACK

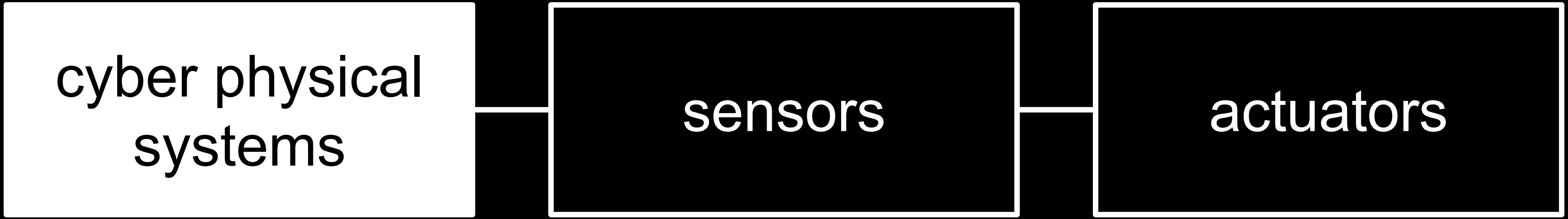
a model for solving problems



cyber physical systems

artificial intelligence

software prototyping



cyber physical systems

sensors

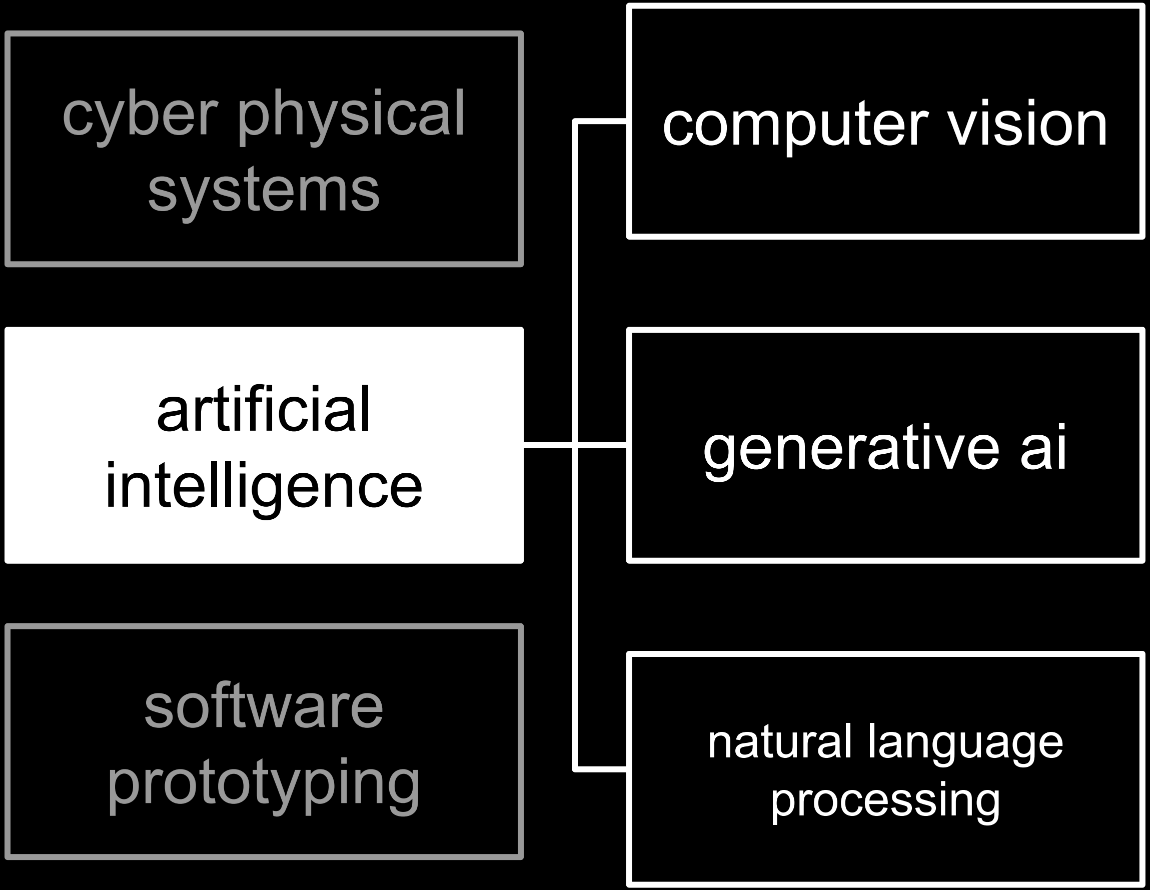
actuators

artificial intelligence

software prototyping

temperature
humidity
co2
uv light
ambient light
sound pressure
thermal image
camera
...

led
speaker
display
motor
…



cyber physical systems

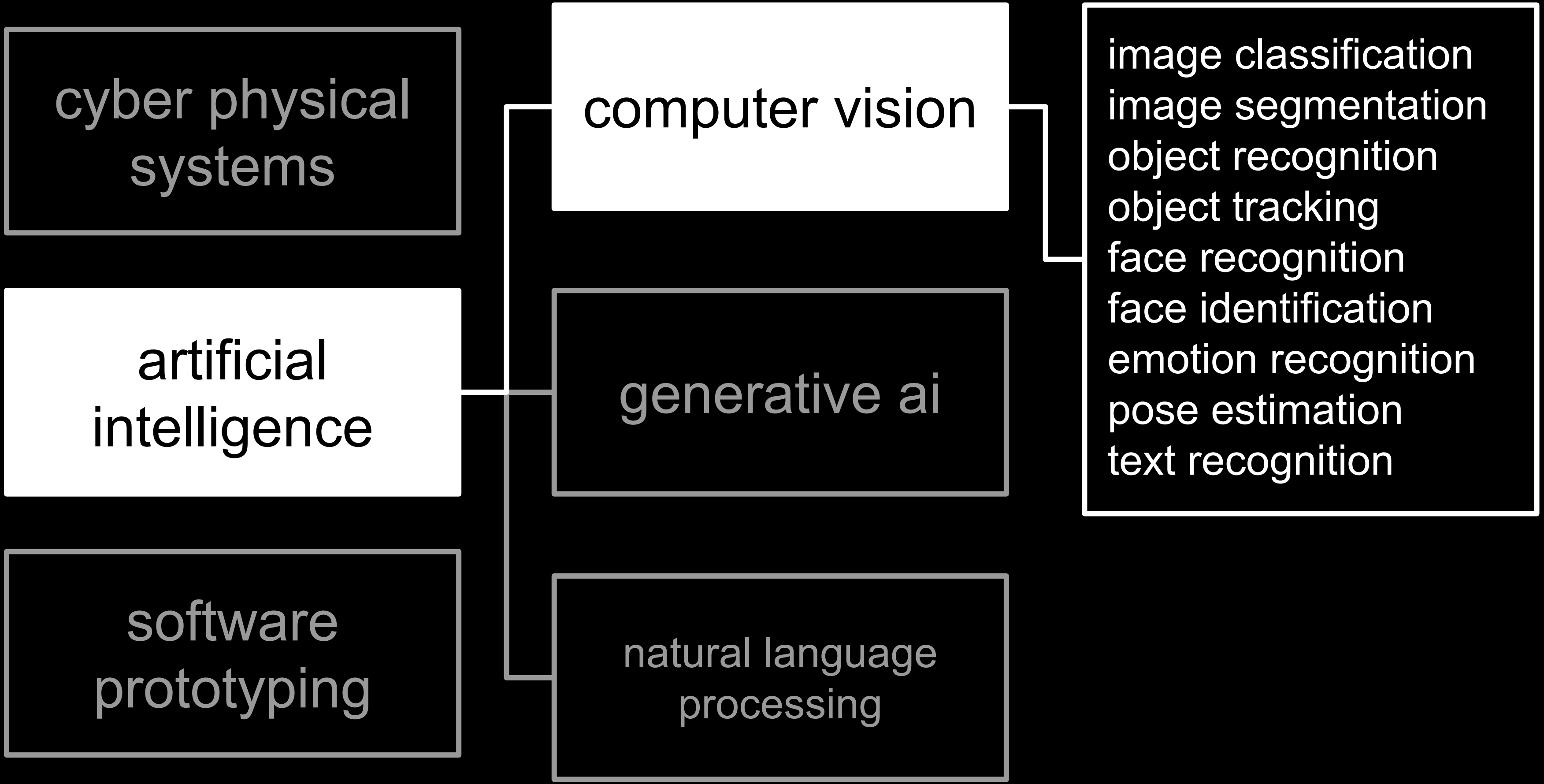
artificial intelligence

software prototyping

computer vision

generative ai

natural language processing



cyber physical systems

artificial intelligence

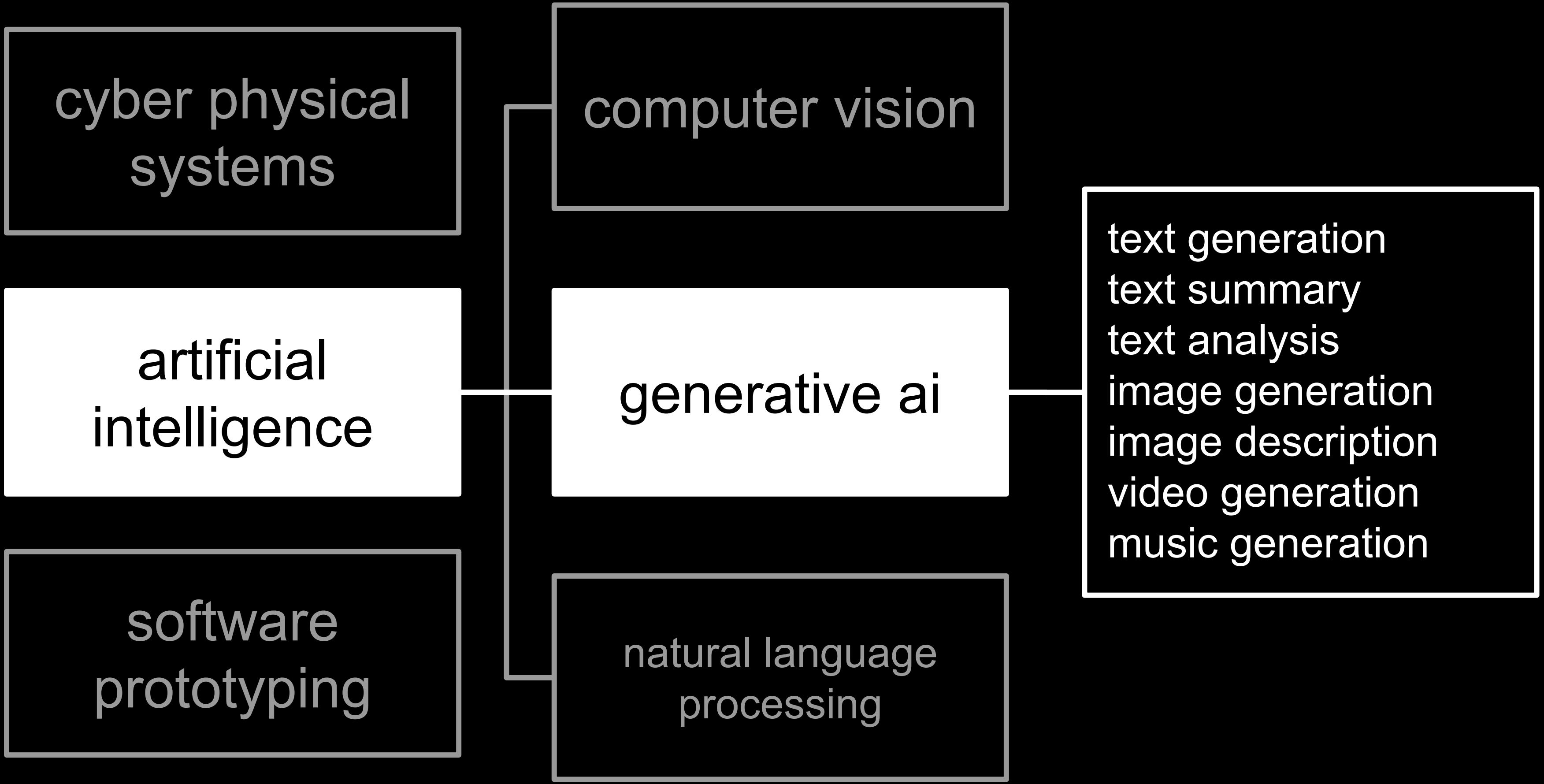
software prototyping

computer vision

generative ai

natural language processing

image classification
image segmentation
object recognition
object tracking
face recognition
face identification
emotion recognition
pose estimation
text recognition



cyber physical systems

artificial intelligence

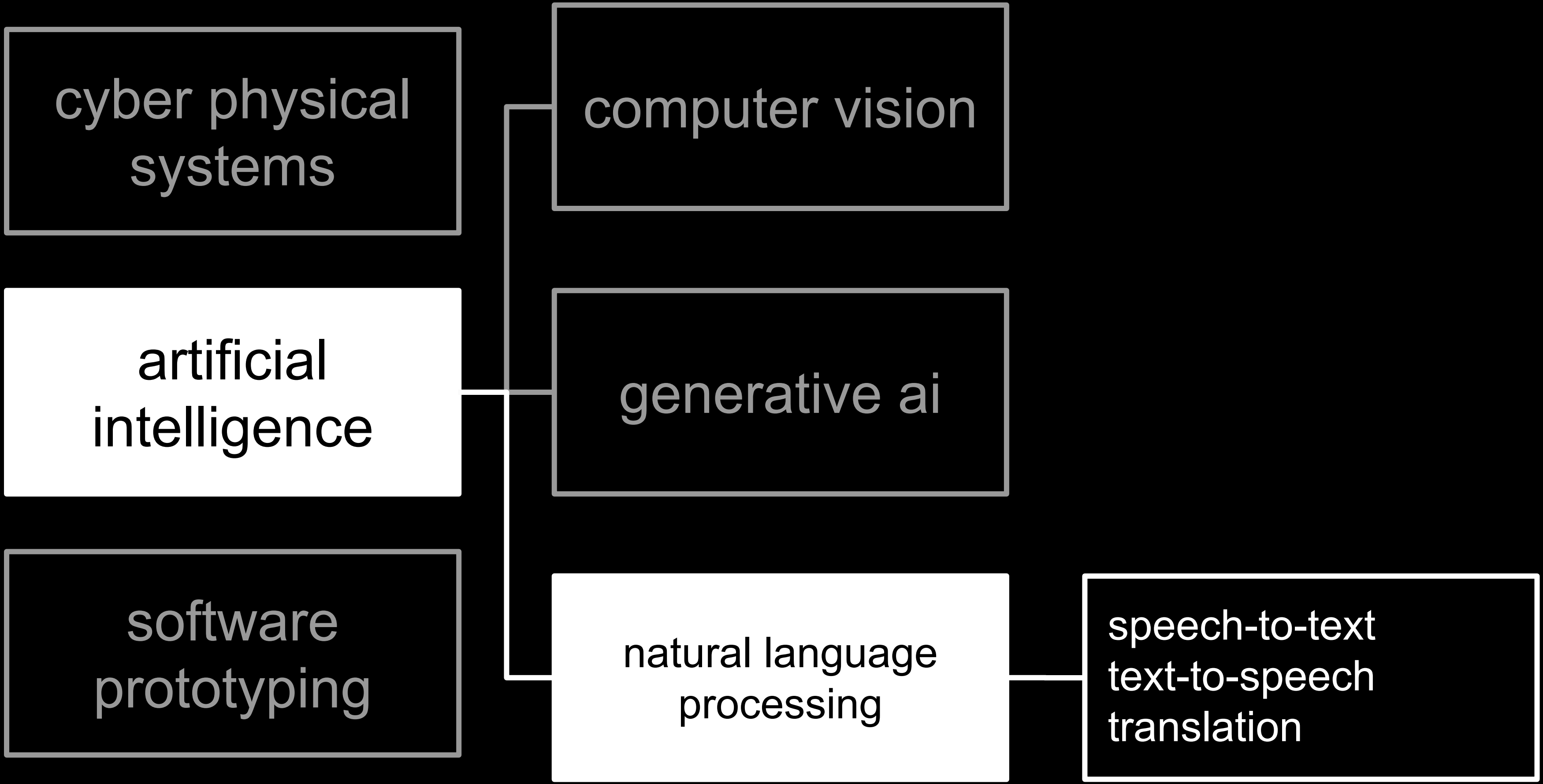
software prototyping

computer vision

generative ai

natural language processing

text generation
text summary
text analysis
image generation
image description
video generation
music generation



cyber physical systems

artificial intelligence

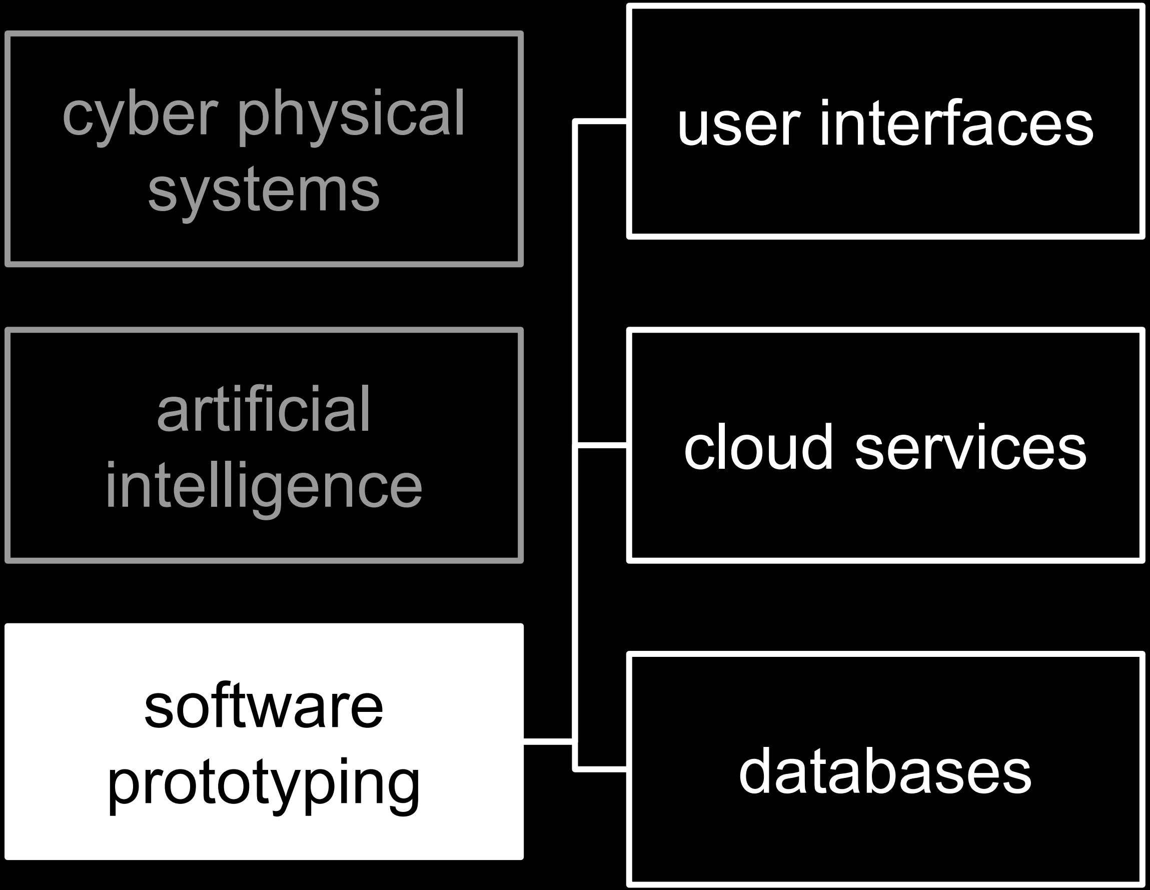
software prototyping

computer vision

generative ai

natural language processing

speech-to-text
text-to-speech
translation



cyber physical systems

artificial intelligence

software prototyping

user interfaces

cloud services

databases

introductory example

visual studio code
programs
python

LEDs

large language models

speech-to-text

user interface

SENSORS

temperature / humidity

rgb led button

camera

thermal imaging camera

microphone

keyboard

temperature / humidity

```
th = BrickletHumidityV2(UID, ipcon)…
```

```
th.get_humidity()

th.get_temperature()
th.register_callback(th.CALLBACK_HUMIDITY, cb_humidity)
th.register_callback(th.CALLBACK_TEMPERATURE, ...)
th.set_humidity_callback_configuration(250, False, "x", 0, 0)
th.set_temperature_callback_configuration(...)
```

rgb led button

```
btn = BrickletRGBLEDButton(UID, ipcon)…
```

```
btn.set_color(255, 0, 0)
btn.get_button_state()
btn.register_callback(...)
```

camera

OpenCV

```
import cv2
```

```
# Get video capture device (webcam)
webcam = cv2.VideoCapture(0)
```

```
# Read a frame
success, frame = webcam.read()
```

```
# Show the image from the frame
cv2.imshow("Webcam", frame)
```

```
# Save the frame as .png
cv2.imwrite("screenshot.png", frame)
```

thermal imaging camera

OpenCV

Tinkerforge

```
ti = BrickletThermalImaging(UID, ipcon)
ti.set_image_transfer_config(...)
img = ti.get_high_contrast_image()
```

```
ti.register_callback(...)
```

microphone

```
import pyaudio
```

```
# Define recording parameters
FORMAT = pyaudio.paInt16
CHANNELS = 1
RATE = 44100
CHUNK = 1024
```

```python
# Get access to the microphone
audio = pyaudio.PyAudio()
```

```
# Start listening
stream = audio.open(...)
```

```
# Read a chunk of frames
stream.read(CHUNK)
```

```
# Stop and close stream
stream.stop_stream()
stream.close()
```

```
# Terminate access to microphone
audio.terminate()
```

keyboard

```
import keyboard
```

```
# Define a callback function for a key
def record_audio():
    print("Recording audio…")
```

```
# Add key listener
keyboard.add_hotkey("r", record_audio)
```

```python
# Wait until a specific key was pressed
keyboard.wait("esc")
```

ACTUATORS

rgb led

OLED display

speaker

rgb led

```
led = BrickletRGBLEDV2(UID, ipcon)
led.set_rgb_value(255, 0, 0)
```

OLED display

```
oled = BrickletOLED128x64V2(UID, ipcon)
oled.clear_display()
oled.write_line(0, 0, "Welcome!")
```

speaker

```
import simpleaudio as sa
```

```
# Create a wave object from .wav-file and play it
wav = sa.WaveObject.from_wave_file("sound.wav")
wav.play().wait_done()
```