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Exercise Sheet 1
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Augmented Reality

Exercise 1 – Setting things up

In this exercise, we will build upon the game engine Godot (3.5.3 LTS) and the computer vision library OpenCV (4.9.0). In order to use OpenCV within Godot, we need to use the GDNative API. As a first step, we will run an example project doing just that.

What we need for the setup:

- A camera
- Godot 3.5.3 LTS at https://godotengine.org/
- OpenCV 4.9.0 C++ matching your OS at https://opencv.org/get-started/
- Get the "bouncy" example project from https://github.com/lukacu/bouncy
- Compiling the <bouncy-repo>/native/ part of the example project:
    - Edit the <bouncy-repo>/native/CMakeLists.txt to include the line
      `SET(OpenCV_DIR <path-to-opencv>/opencv-4.9.0/build/x64/vc16/lib)`
      right before the line
      `FIND_PACKAGE(OpenCV REQUIRED)`
    - Depending on your OS, follow the specific instructions in Moodle to compile the C++ code (not run but BUILD)
- Once you're done with the platform specific compilation, run the project in Godot
- Understanding what's happening:
    - Check the camera object in the Gameplay.gd script in combination with the <...>/native/wrapper.c file to see how calls are made from Godot to the native library
    - <...>/native/camera.cpp (especially the constructor) to see how OpenCV opens a camera feed and runs a thread reading new frames

Exercise 2 – Getting familiar with Godot

To get a little more familiar with Godot and how to do 3D transformations, input and UI pick the „3D Rotate Direct Constant Smooth“ Demo from the Project Asset Library and play around with it.
Try changing a few things like direction of rotation, introducing a translation, reacting to other inputs or UI elements.

Then try other demos as well and look at their code!

Exercise 3 – Scalar Product

a) What is the definition of a scalar product (dot product) of two vectors?

$$\vec{a} \cdot \vec{b} =$$

b) Calculate the scalar product for

$\vec{a} = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}; \vec{b} = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$

c) Calculate the angle ξ between vectors a and b.