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Computer Animation Course (Assignment Sheet 1)

This tiny Exercise will introduce you with the Math-Framework `Eigen`. In some steps you will learn to create vectors and matrices and do basic arithmetic with. In a next step we use this framework to do transformations on points.

Assignment 1.0 (Prerequisites) Download and unpack the `Exercise` Folder from https://cloud9.informatik.uni-erlangen.de/index.php/s/TId2hQjmN4jaejp. It contains a `Contrib` subfolder and the first assignment. In the following assignments on this sheet you will edit the file `main.cpp`. Once you are done, submit this file to `matteo.colaianni@fau.de`.

Assignment 1.1 [5 Points] (Basic Vectors)

a) Initialize a basic 3-dimensional `float` vector v_1 with zeroes.

b) Set v_1 to $\begin{pmatrix}1 & -1 & 2\end{pmatrix}$.

c) Setup another 3-dimensional `float` vector v_2 to be $\begin{pmatrix}6 & 5 & 4.5\end{pmatrix}$.

d) Set the vector v_{sum} to be the sum of v_1 and v_2.

e) Set the vector v_{diff} to be the difference of v_1 and v_2.

f) Set the `float` value s_{dot} to be the scalar-product of v_1 and v_2.

g) Set the vector v_{cross} to be the cross-product of v_1 and v_2.

h) Calculate the length between the vectors v_1 and v_2.

Assignment 1.2 [5 Points] (Basic Matrices)

a) Initialize a basic 3×3 `float` matrix M_1 with zeroes.

b) Initialize a basic 3×3 `float` matrix M_2 to be the identity.

c) Calculate and output: the ...

... sum of M_1 and M_2

... difference of M_1 and M_2

... the product of M_1 and M_2

... the matrix-vector product of M_1 and M_2

... division of M_1 with the scalar 10

Assignment 1.3 [5 Points] (Advanced Matrices)

a) Initialize a basic 3×3 `float` matrix M_3 to be an *upper right triangular* matrix with the value 2.

b) What issue occurs usint the matrix transposition `'M3 = M3.transpose()'`. Write your answer as a comment in the code?

c) Fix the issue mentioned in (b).

d) Invert the matrix M_4 and output the result.

e) Initialize the matrix M_5 to be $\begin{pmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ and check wether it is orthogonal or not using `Eigen`.

Assignment 1.4 [5 Points] (Block Operations)

a) Output the second column of M_5 using block operations.

b) Output the second column of M_6 using block operations.

Assignment 1.5 [5 Points] (Advanced Matrices II / Rigid Transoformation)

a) Given: a rotation matrix M_{rot} and a translation vector v_{trans}. Output the rigid transformation $\tilde{x} = M_{rot} \cdot x + v_{trans}$.

b) Build a 4×4 float matrix T, that allows the transformation $T \cdot x$ with a single matrix-vector multiplication. Consider also to convert the 3-dimensional vector x into a properly dimensioned vector in order to do that.

Good Luck!