University of Applied Sciences and Arts
of Southern Switzerland
SUPSI

Series 2

1) Solve:

a) $\begin{bmatrix} 1 & 0 \\ 2 & 3 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 3 & 0.5 \\ 0.5 & 2 \\ -0.5 & 1 \end{bmatrix}$

b) $\left(\left(\begin{bmatrix} 0.5 & -1 & -2 \\ 1 & 0.5 & -1 \\ 2 & 1 & -0.5 \end{bmatrix}^{\mathrm{T}}\right)^{\mathrm{T}}\right)^{\mathrm{T}}$

c) $\begin{bmatrix} 1 & 0 & 30 \\ 0 & 1 & 15 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$

d) $\begin{bmatrix} 1 & -1 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}^{\mathrm{T}} \begin{bmatrix} 1 & 0 & 30 \\ 0 & 1 & 15 \\ 0 & 0 & 1 \end{bmatrix}$

2) Reuse the code of Series 1, Ex. 2 to implement a new class for modeling 3x3 matrices. This new class should feature:

1) Matrix by vector multiplication.
2) Matrix by matrix multiplication.
3) Matrix transpose.

Validate your code by repeating exercise 1) using your classes.

3) Repeat exercise 2) using the vector and matrix classes provided by the GLM library (http://glm.g-truc.net). Compare your software design with the one adopted in GLM.

4) Let a triangle be defined by its vertices **a** = [-15 0 -50], **b** = [15 0 -50] and **c** = [0 15 -50]. Use GLM to compute the position of its vertices in *clip coordinates* after being modified by a perspective projection matrix with a field of view of 45°, an aspect-ratio of 1, near plane at 1 and far plane at 100 units.

Add then the following operations to the pipeline (first one by one, then all together):

$\mathbf{T}_1$ = isotropic scaling of 0.5, $\mathbf{T}_2$ = rotation of 90° on Z, $\mathbf{T}_3$ = translation of 10 units on X.