School of Computer Science
Faculty of Science
National University of Engineering

Test 2

Subject: Computational Mathematics **Period: 2021-1**

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1. (4 pts.) With the eye point (E) at $(0, 0, 20)$, project the line segment from $(2, -1, 7)$ to $(3, 6, -4)$ onto the xy plane.

2. (3 pts.) By using the properties of linear transformations, show that once we know where a linear transformation sends the basis vectors in a coordinate system, we can determine where any vector is sent.

3. (3 pts.) In Example 5.3 (see [1]), the matrix $M_{\mathcal{W}\to\mathcal{C}}$ has -0.02 in the upper right corner. Show that, theoretically, this should be zero and, therefore, round-off error must explain the difference.

4. (3 pts.) Let $P_0 := (-3, 0)$, $P_1 := (-1, 4)$, $P_2 := (2, 3)$ and $P_3 := (4, 1)$. Write a Python program to find the parametric description $P(t)$ of the curve that interpolates these points using Lagrange interpolation.

5. With the same notation of the previous exercise, write e a Python program such that:

   (a) (2 pts.) Find the parametric description $P(t)$ of the cubic Bézier curve with control points: P_0, P_1, P_2 and P_3.

   (b) (1 pt.) Find the slope of the tangents at the first and last control points by finding the derivative of the blending functions.

(c) (1 pt.) Verify that the slopes match the slopes of the line segments P_0P_1 and P_2P_3.

May 26, 2021

Bibliography

[1] Janke, S. J. *Mathematical Structures for Computer Graphics.* Wiley, 2015.