School of Computer Science
Faculty of Science
National University of Engineering

Test 2

Subject: Computational Mathematics **Period: 2020.1**

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

2. With the same notation of the previous question:

   (a) (3 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.

3. Let $P_0 := (-1, 0)$, $P_1 := (1, 4)$, $P_2 := (3, -2)$, $P_3 := (4, 3)$ and $P_4 := (6, 1)$:

   (a) (2 pts.) Construct a uniform cubic B-spline using the control points P_0, P_1, P_2, P_3 and P_4. Find the parametric expressions for the coordinates x and y.

   (b) (4 pts.) Verify by finding the derivatives that, at the joining point between the first and second segment, the first and second derivatives match.

4. Write a program that shows:

   (a) (2 pts.) the interpolating curve of question 1 with its interpolating points;

   (b) (2 pts.) the Bézier curve of question 2 with its control points;

   (c) (2 pts.) the uniform cubic B-spline of question 3 with its control points;

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