

1. FEBRUARY 2021

## GRAPHISCHE DATENVERARBEITUNG ASSIGNMENT 12

**Submission deadline for the exercises:** 8. February 2021 6.00 am

### Written Solutions

Written solutions have to be submitted digitally as one PDF file via Ilias.

### 12.1 De Casteljau (24 Points)

Use the de Casteljau algorithm to evaluate the position of the cubic Bézier curve with its control points at  $(0, 0)$ ,  $(1, 3)$ ,  $(3, 2)$  and  $(4, 0)$  for the parameter values  $u_0 = 0.5$ , and  $u_1 = 0.75$ . Draw a sketch for each parameter value.

### 12.2 Derivative of a Bézier Curve ( $8 + 8 + 4 = 20$ Points)

- Compute the derivative of a cubic Bézier curve.
- Determine the first derivative (the hodograph) of the Bézier curve given in 12.1 (draw a sketch).
- Is the Bézier curve in the interval  $(0, 1)$   $C^0$ ,  $C^1$ ,  $C^2$ ,  $C^3$  or  $C^\infty$  continuous?

### 12.3 Hermite Curves ( $16 + 10 = 26$ Points)

- Derive the transformation Hermite to Bézier.
- Take the cubic Bézier curve from 12.1 and transform it to a Hermite curve (calculate the parameters).

### 12.4 Splines (20 Points)

Is it possible to draw a circle with a uniform B-Spline? Justify your answer.

### 12.5 Random Questions ( $5 + 5 = 10$ Points)

- If a high-pass filter is applied to an image, what image characteristic is increased?
- What is the Nyquist frequency?