Advanced Topics in Computer Graphics II

Universität Bonn
Institut für Informatik II
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Sheet G02 - Bézier Curves and TPS

Solutions for the theoretical and practical part via eCampus by Mo, 27.10.2025, **10:00**.

Practical Part

Please download the zip file `framework_g02.zip` from eCampus and unzip them into the framework's folder. Configure the project like last time.
Submit this exercise by uploading the complete source file (source.cpp) onto eCampus!

Assignment 1) Tensor Product Surfaces *(3Pts)*

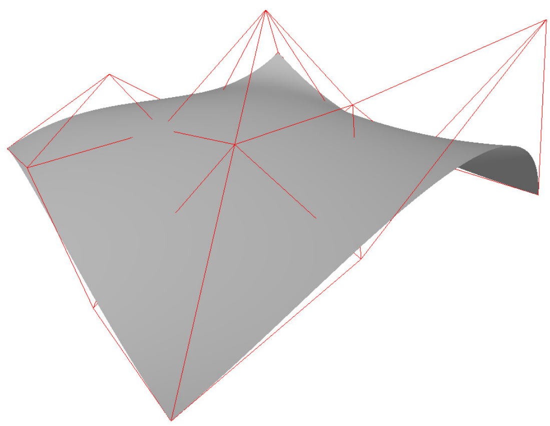

Figure 1: A Tensor Product Surface.

In the file `exercises/exercise02Surface/source.cpp` you will find the exercise for this assignment.

- In the function **getBezierCoefficients**(...), implement the Bézier Coefficients for a degree 3 Bezier Curve.
- In the function **calculate_surface**(...), implement the computation of the points on the tensor product surface according to

$$\boldsymbol{q}(u,v) = \sum_{i=0}^{m}\sum_{i=0}^{n} \boldsymbol{c}_{ij} F_i^m(u) \cdot G_j^n(v)$$

  where $F_i^m = G_i^n = B_i^n$ are the Bernstein polynomials of degree $n = 3$.

After a correct implementation, the result should look like Figure 1.

Theoretical Part

Please hand in a sheet-G02-*lastname*.pdf sheet written in LaTeX via eCampus!

Assignment 2) B-spline Basis Functions *(4Pts)*

a) Compute and plot all basis functions up to degree 2 for knot vector $U = \{0, 1, 2, 3, 4\}$.

b) Compute and plot all basis functions up to degree 2 for knot vector $U = \{0, 1, 2, 3, 3, 3, 4, 5, 6\}$.

c) Verify the following propositions with convincing arguments:
- $N_{i,p}(u)$ is a degree p polynomial.
- For all i, p and u, $N_{i,p}(u)$ is non-negative.

d) Given knot sequences $U_1 = \{0, 0, 1, 1\}$ and $U_2 = \{0, 0, 0, 1, 1, 1\}$, use hand calculation to verify that the B-spline basis functions on U_1 and U_2 are identical to the Bézier basis functions.

Good luck!