CPSC 424 Assignment 2

Term: September 2022, Instructor: Alla Sheffer, sheffa@cs.ubc.ca, http://www.ugrad.cs.ubc.ca/~cs424

Due: Oct 3, 2022 in class

Assignment 2.1: De Casteljau Algorithm (6 Points)

For each of the following three cubic control polygons, draw the control polygon, and perform the de Casteljau algorithm to evaluate the Bézier curve at parameter values $t = 1/2$, $t = 3/4$, and $t = 2/3$. Use the properties of Bézier curves and the specific control polygons to determine the location of the points for $t = 0$, $t = 1/3$, $t = 1/4$, and $t = 1$. Then sketch the curve itself. (Note: use a thin pencil for the de Casteljau construction, otherwise the the diagram will be cluttered quickly).

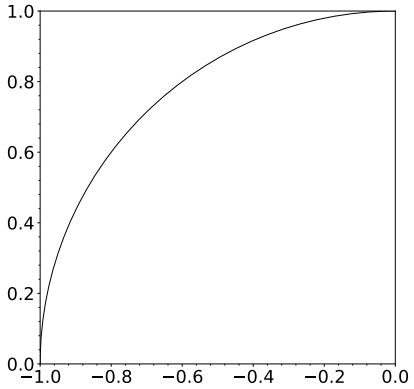
a) $\mathbf{b}_0 = \begin{pmatrix} -4 \\ 0 \end{pmatrix}, \mathbf{b}_1 = \begin{pmatrix} -1 \\ 4 \end{pmatrix}, \mathbf{b}_2 = \begin{pmatrix} 1 \\ 4 \end{pmatrix}, \mathbf{b}_3 = \begin{pmatrix} 4 \\ 0 \end{pmatrix}$

b) $\mathbf{b}_0 = \begin{pmatrix} -2 \\ 0 \end{pmatrix}, \mathbf{b}_1 = \begin{pmatrix} 1 \\ 4 \end{pmatrix}, \mathbf{b}_2 = \begin{pmatrix} -1 \\ 4 \end{pmatrix}, \mathbf{b}_3 = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$

c) $\mathbf{b}_0 = \begin{pmatrix} -2 \\ 0 \end{pmatrix}, \mathbf{b}_1 = \begin{pmatrix} -1 \\ 2 \end{pmatrix}, \mathbf{b}_2 = \begin{pmatrix} 1 \\ 2 \end{pmatrix}, \mathbf{b}_3 = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$

Assignment 2.2: Quadratic Approximation of a Quarter Circle (4 Points)

In this assignment, we would like to approximate a quarter circle over the first quadrant (see figure) using a Bézier curve. In particular, we want to define a quadratic Bézier curve that shares the same endpoints as the quarter circle (i.e. $(-1, 0)^T$ and $(0, 1)^T$). Moreover, we want our Bézier curve to be tangential to the quarter circle in these points.



a) Where do the the control points of the quadratic Bézier curve have to be located to meet the above conditions?

b) Edit the provided MATLAB script (a2_2022.m) to plot both the quarter circle and the Bézier curve into a single plot. Submit your plot with the assignment (print out or handin).

Are the two curves the same? Explain your observations.

MATLAB is installed on the computers in the undergrad labs and can also be downloaded from UBC IT servers under student license To run the script, just open it in MATLAB, click "Run" (F5), in the dialog that shows up - "Add to the path".

If you are not a fan of MATLAB you can use Julia. However in this case you would need to to write the function from scratch.