Assignment 01(Generating Bezier curves)

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A cubic Bezier curve has the following formula

$$\mathbf{B}(t) = (1-t)^3\mathbf{P}_0 + 3(1-t)^2 t\mathbf{P}_1 + 3(1-t)t^2\mathbf{P}_2 + t^3\mathbf{P}_3,\ 0 \le t \le 1.$$

This shows it requires 4 control points P0,P1,P2,P3, where P0 and P3 (endpoints) are provided by the user, and the rest of the control points are to be found. So for that, we use the midpoint formula.

Initially, each adjacent control point lies at a ¼th distance from their corresponding endpoints.
When a new control point is added by the user, to ensure C1 continuity at the point, I have used the midpoint formula to get the control point corresponding to that point. For the first control point I used the mid point formula and calculated both the x and y coordinate and for the adjacent control point I shifted the x coordinate by 0.5 units on the right.

Explanation of calculatePiecewiseCubicBezier() function

The function begins by clearing the cubicBezier vector(since it is regenerated each time a new point is added by the user. Then we start the for loop which ensures that the loop only runs after there are atleast 2 points provided (i<(sz-3)). Then we generate P0(x[0],y[0]), P1(x[1],y[1]), P2(x[2],y[2]), P3(x[3],y[3]). Then push back the first point of the Bezier curve to the vector cubic_Bezier. Then we generate 50 points on the curve using previously calculated P0,P1,P2,P3 and plug these in the above equation, pushing each new point into the cubicBezier vector. Then after all the 50 points have been pushed, the last point P3(x[3],y[3]) is pushed into the vector.

Now if a new point is added we clear the cubicBezier vector and rerun the whole loop with that extra added coordinates of the new point, generating its control points P1(x[2],y[2]), P2(x[3],y[3]) using the midpoint formula.

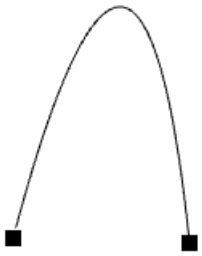
Data Structures Used

The data structures used in the code are arrays and vectors

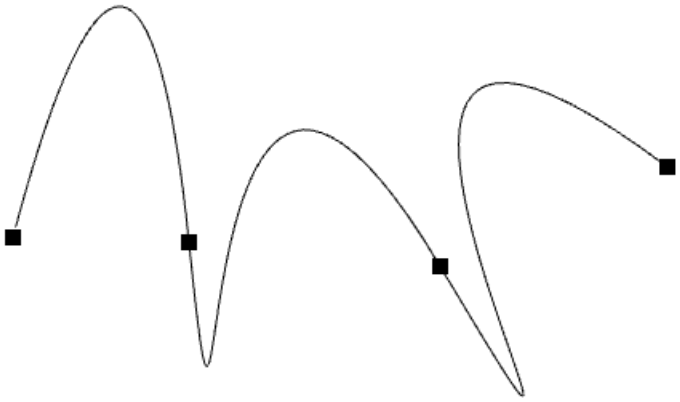
- Vectors have helped in storing and modifying the control points dynamically.
- Arrays have helped to store the values of P0,P1,P2,P3 derived from the control points

1 SCREENSHOTS OF THE OUTPUT

After the first 2 points have been added.



After more points are added:



Source:
The formula of the Bezier curve has been taken from www.wikipedia.org.