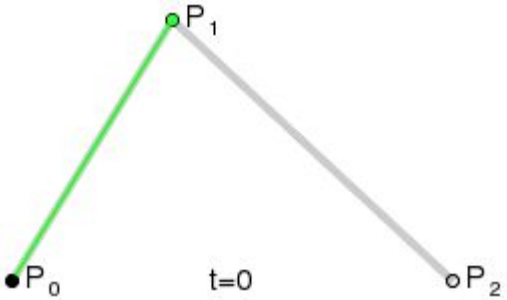
3-D Spline

COSC 4364: Zhao Li, Harshesh Shah

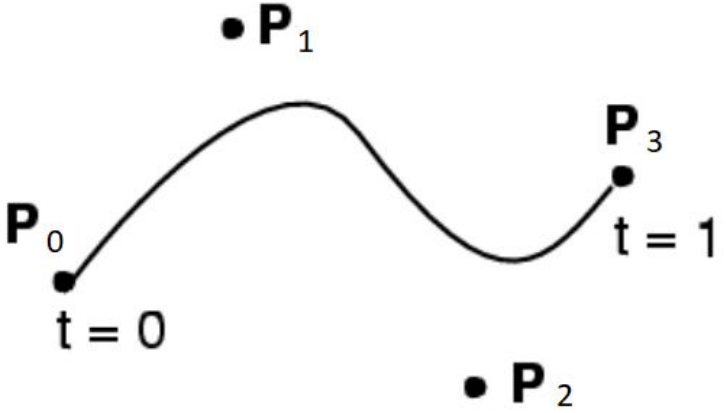
Bézier curve

- We used Bézier curve to determine the smooth path of the curve (the spline).
- Named after Pierre Bézier, who used it in the 1960s, is now particularly used in animation, user interface design and smoothing cursor trajectory.



Bézier curve …Cont’d

- User specifies 4 control points P0 … P3
- Curve goes through (interpolates) the ends P0, P3
- Approximates the two other ones
- Cubic polynomial



Algorithms

- Linear, quadratic, cubic Bézier implemented
- Default is cubic Bézier, with 50 samples between each points
- To create actual curve, points are split depending on which type of Bézier
- Linear: B(t) = (1 - t)P0 + tP1
- Quadratic: B(t) = ((1 - t)^2 * P0) + (2(1 - t)tP1) + (t^2 * P2)
- Cubic: B(t) = ((1 - t)^3 * P0) + (3(1 - t)^2 * tP1) + (3(1 - t) t^2 * P2) + t^3 * P3
- 0<= t <=1 for all

Code Organization

- Graphical user interface in main.py
- Bézier calculations are in BézierCurve.py
- In BézierCurve.py, options available
  - Type of Bézier Curve
  - Sampling points

Input/Output

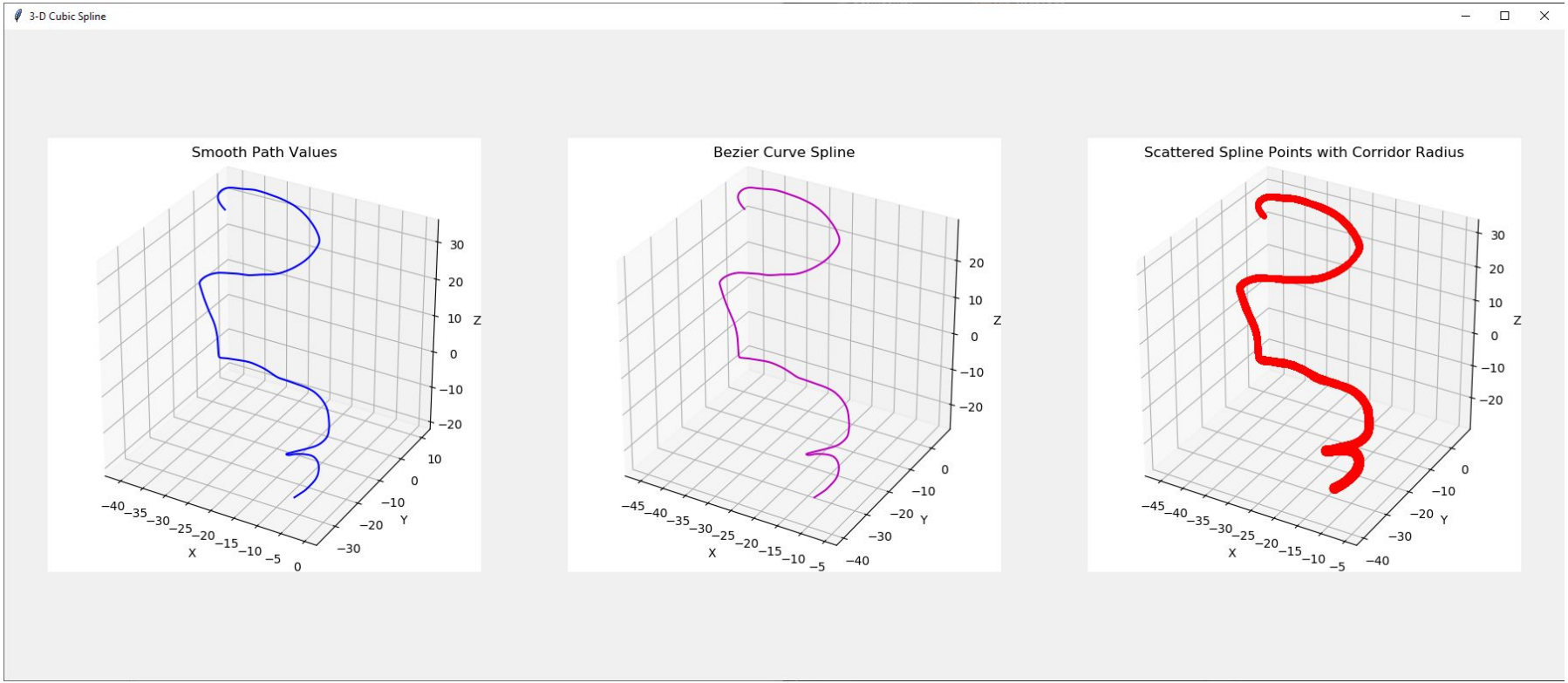
- 2 input files:
  - GCorridor.csv
  - smooth_path.csv

- Output are the interpolated coordinates (x, y, z)
- GUI output is:
  - Actual values, spline, spline with radius
  - Could also uncomment plt.show() on line 203 in BezierCurve.py

GUI

- Used Tkinter to represent the input, and the spline on the window.
- Created Canvas to implement the graphs.
- Used Tkinter widget libraries to put the matplotlib graphs on the same window.

GUI Output


3-D Cubic Spline
Smooth Path Values
Bezier Curve Spline
Scattered Spline Points with Corridor Radius
X
Y
Z

Performance

- Using Python’s time library
- Sample points vs time using Cubic Bézier:
  - 10 points, 31 milliseconds
  - 50 points, 150 ms
  - 100 points, 301 ms
  - 1000 points, 3045 ms

- Linear points vs time

References

- Our Github Repo: https://github.com/frankzhaoli/COSC4364FinalProject/tree/master
- https://en.wikipedia.org/wiki/B%C3%A9zier_curve
- http://web.mit.edu/hyperbook/Patrikalakis-Maekawa-Cho/node12.html