**2018 Numerical Analysis Computer Project #2, Interpolation**

1. Generate a 2D polygon with N+1 vertices (sample points) and keep the coordinates of the vertices in a table as follows:
   * Where *Xi* and *Yi* are the coordinates of the vertices, and *ti* and *Wi* are the parametric values and weights of the vertices. You can give vertices different parametric values and weights. However, and *Wi* > 0.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| T[i] | t0 | t1 | t2 | … | tn-1 | tn |
| X[i] | X0 | X1 | X2 | … | Xn-1 | Xn |
| Y[i] | Y0 | Y1 | Y2 | … | Yn-1 | Yn |
| W[i] | W0 | W1 | W2 | … | Wn-1 | Wn |

1. Transform the vertices into the homogeneous space:
2. Implement an interpolation method by using Lagrange polynomial or Newton polynomial to interpolate M points and keep the results in Qx[i], Qy[i] and Qw[i].
3. Project the results to the 2D space by
   * Px[i] = Qx[i]/Qw[i], Py[i]=Qy[i]/Qw[i].
4. Try N=4 and form a closed polygon. That is, the last vertex = the 1st vertex. Complete the following tasks. (40%)
   * Draw your polygon.
   * Let *ti* = 0, 1, 2, …, N and *Wi* = 1. Compute more than 30 interpolation points. Print out the results:
     1. Xw[.], Yw[.], and w[.].
     2. Qx[.], Qy[.], and Qw[.]
     3. Px[.] and Py[i].
   * Draw the curve formed by {Px[i], Py[i]}, i=0,1,…,M.
5. Try different parametric values, for example chord-length parameterization and repeat previous tasks. (40%)
6. Create a convex polygon and a concave polygon for this assignment .Give different weight to different vertices and repeat the interpolation process.
   * What are the benefits of chord-length parametrization?
   * What are the effects of the weights?

