# Homework Assignment 3 (40 points)

Due: 2/27/2018

1. "Cubic interpolation" is a popular path smoothing technique (slides 38-39 of the notes: Interpolating Values III). The approach is as follows: for each point $P_i$, construct a cubic curve $P(t)$ to interpolate $P_{i-2}$, $P_{i-1}$, $P_{i+1}$ and $P_{i+2}$ at $P(0)$, $P(1/4)$, $P(3/4)$ and $P(1)$, and then use the value of $P(1/2)$ to adjust $P_i$. The new location of $P_i$ is defined as

$$P_i' = P(1/2) + P_i$$

   Why wouldn't we use $P(1/2)$ as the new location of $P_i$ directly? (10 points)

2. Using the "Shortest path" approach to find a path from a start point (S) to a destination point (D) on a polygonal surface mesh, one needs to check that, after unfolding of all the faces, if the line segment that connects S and D lies completely inside the unfolded faces. Design an algorithm to do this work. The input to this algorithm is a polygonal surface mesh (polyhedron) and two points on the polygonal surface mesh. Use the data structure introduced in CS535 to represent the input polygonal surface mesh. (10 points)

3. $A = (x, y, z)$ and $B = (a, b, c)$ are two points of a bicubic Bezier surface patch $S(u, v)$, $0 \le u, v \le 1$. A path along the surface $S(u, v)$ from $A$ to $B$ can be constructed as follows: find the points $(s, t)$ and $(p, q)$ in the parameter space of $S(u, v)$ such that $A = S(s, t)$ and $B = S(p, q)$, then map the line segment that connects $(s, t)$ and $(p, q)$ to the surface. The resulting curve is a good path from $A$ to $B$. How would you find $(s, t)$ and $(p, q)$? (10 points)

4. In 3D free-form deformation, after the manipulation of the 3D coordinate grid, the deformed position of a vertex of the object is determined through a *trivariate Bezier interpolation process*. What is the reason in doing so (in your opinion)? (10 points)