

CS3388B, Winter 2023

Problem Set 4

Due: February 10, 2023

Exercise 1.

Let A and B be points in 2D space. Define the parametric formula $P(t)$ for the Bezier curve of degree 4 between those points which uses the control points c_1, c_2, c_3 .

$$P(t) = A(1-t)^4 + 4c_1t(1-t)^3 + 6c_2t^2(1-t)^2 + 4c_3t^3(1-t) + Bt^4$$

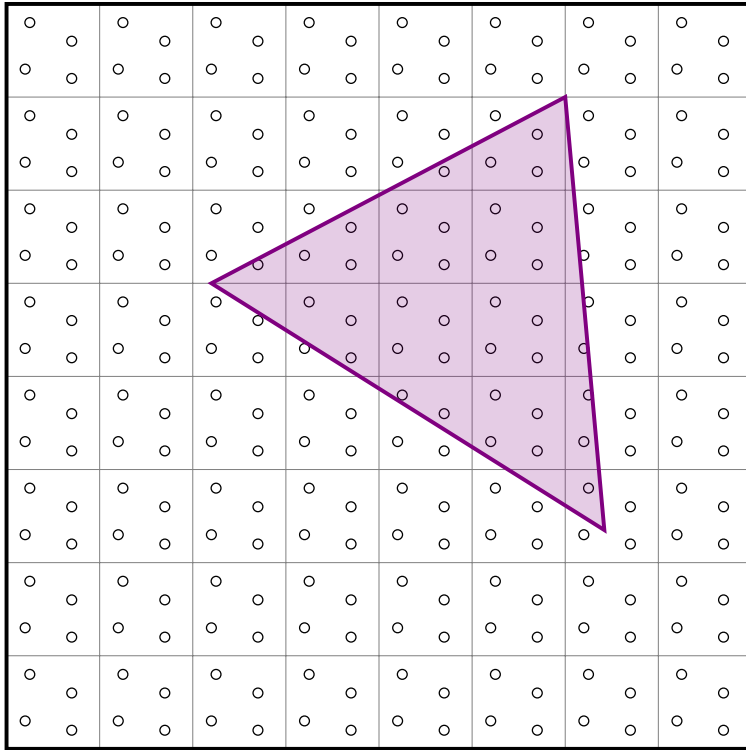
Exercise 2. In the programming language of your choice, define a function which linearly interpolates between two floats X and Y , but over the range t_{min}, t_{max} .

Your function should take 5 arguments: $X, Y, t, t_{min}, t_{max}$. Inside this function *clamp* t to the range $[t_{min}, t_{max}]$. Clamp means this: if $t < t_{min}$ let $t = t_{min}$; if $t > t_{max}$, let $t = t_{max}$.

```
1 lerp(X, Y, t, tmin, tmax) {  
2     if (t < tmin) t = tmin;  
3     if (t > tmax) t = tmax;  
4  
5     t = (t - tmin) / (tmax - min);  
6     return X*(1-t) + Y*t;  
7 }
```

Exercise 3.

Consider the below grid of supersampled pixels. In the rasterization of the purple triangle, how many times is its color sampled?



Exercise 4. In this exercise you have to create an OpenGL program. Please submit your source code along with your written solutions to the previous 3 exercises.

The following lists define two different sets of 11 vertices as 22 floats. They are ordered $v_{1x}, v_{1y}, v_{2x}, v_{2y}, \dots$

Your goal is to create an OpenGL program which continuously tweens between each. Your program should:

- Define an orthographic viewing area bounded by $(-20,20)$ and $(20,20)$.
- Over 400 frames, linearly tween from the star, to the decagon, and then back to the star. On each frame, draw the tweened vertices as a polyline.
- Repeat this animation forever.

```
star = [0 10 2.5 2.5 10 2.5 4 -2.5 7 -10 0 -5 -7 -10 -4 -2.5 -10 2.5 -2.5 2.5 0 10]
```

```
decagon = [5 15.388 13.0902 9.51056 16.1803 0 13.0902 -9.51056 5 -15.388 -5 -15.388  
-13.0902 -9.51056 -16.1803 0 -13.0902 9.51056 -5 15.388 5 15.388]
```

