Exercise 5

Exercise 5.1 [3 Points] Delaunay Triangulation - Edge-Flip

orange edges: violated
light green edges: after flip
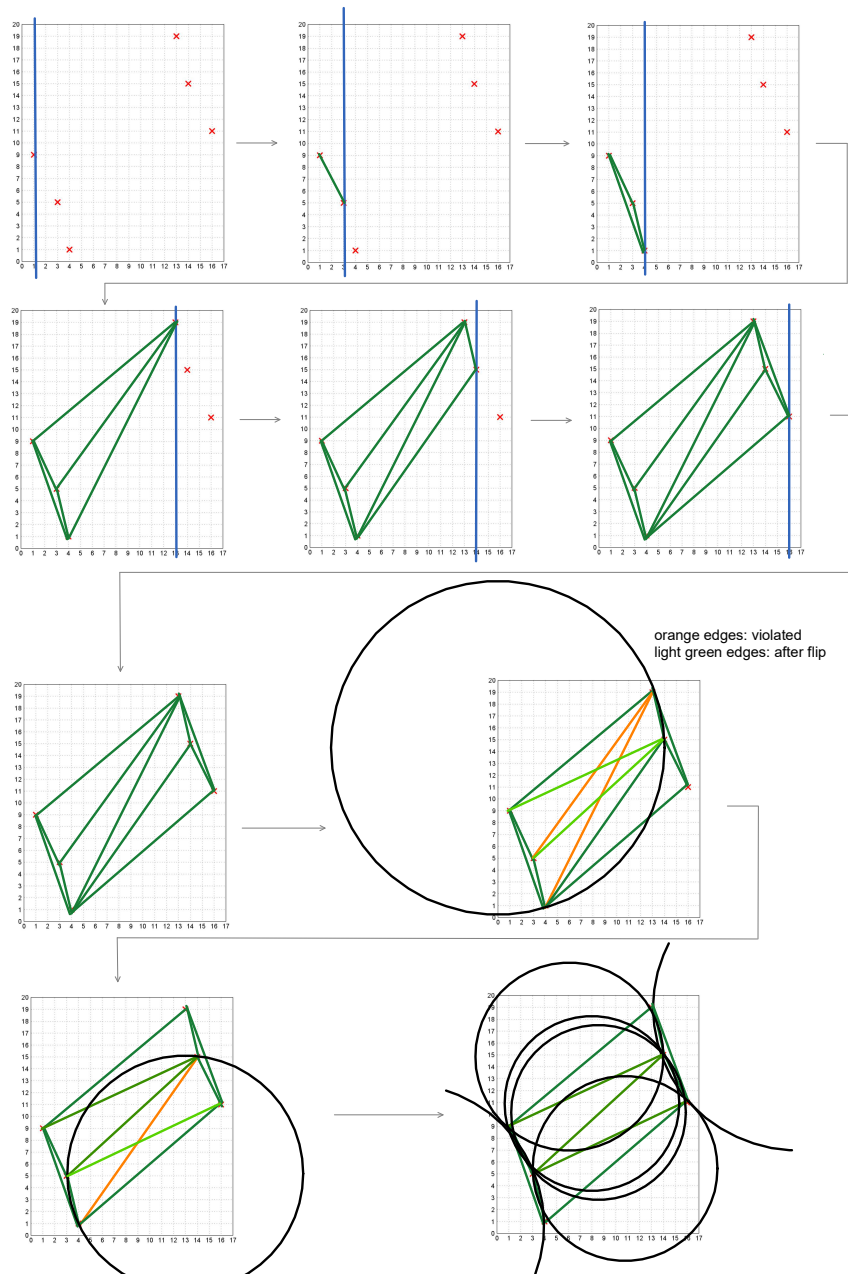
Exercise 5.2 [3 Points] Inverse Distance Weighting

P_7:
distances:

- $P_1 = \left\| \begin{pmatrix} 3 \\ 3 \end{pmatrix} - \begin{pmatrix} 2 \\ 2 \end{pmatrix} \right\| = \sqrt{2}$

- $P_2 = \left\| \begin{pmatrix} 3 \\ 3 \end{pmatrix} - \begin{pmatrix} 4 \\ 3 \end{pmatrix} \right\| = \sqrt{5}$

- $P_3 = \left\| \begin{pmatrix} 3 \\ 3 \end{pmatrix} - \begin{pmatrix} 4 \\ 5 \end{pmatrix} \right\| = 1$

- $P_4 = \left\| \begin{pmatrix} 3 \\ 3 \end{pmatrix} - \begin{pmatrix} 5 \\ 5 \end{pmatrix} \right\| = \sqrt{8}$

basis functions:

$$\phi_1 \begin{pmatrix} 3 \\ 3 \end{pmatrix} = \frac{\sqrt{2}^{-2}}{\sqrt{2}^{-2} + \sqrt{5}^{-2} + 1^{-2} + \sqrt{8}^{-2}}$$
$$= \frac{0.5}{0.5 + 1. + 0.2 + 0.125}$$
$$= \frac{0.5}{1.825}$$
$$= 0.274$$

$$\phi_2 \begin{pmatrix} 3 \\ 3 \end{pmatrix} = \frac{0.2}{1.825}$$
$$= 0.110$$

$$\phi_3 \begin{pmatrix} 3 \\ 3 \end{pmatrix} = \frac{1}{1.825}$$
$$= 0.548$$

$$\phi_4 \begin{pmatrix} 3 \\ 3 \end{pmatrix} = \frac{0.125}{1.825}$$
$$= 0.068$$

$$f_7 \begin{pmatrix} 3 \\ 3 \end{pmatrix} = 0.274 * 11 + 0.110 * 9 + 0.548 * 2 + 0.068 * 12$$
$$= 5.916$$

P_8:
distances:

- $P_2 = 2.5$

- $P_3 = 1.5$

- $P_4 = \sqrt{4.25}$

- $P_5 = 1.5$

- $P_6 = \sqrt{4.25}$

basis functions:

$$\phi_2 \begin{pmatrix} 5.5 \\ 3 \end{pmatrix} = \frac{2.5^{-2}}{2.5^{-2} + 1.5^{-2} + \sqrt{4.25}^{-2} + 1.5^{-2} + \sqrt{4.25}^{-2}}$$
$$= \frac{0.160}{0.160 + 0.444 + 0.235 + 0.444 + 0.235}$$
$$= \frac{0.160}{1.52}$$
$$= 0.105$$

$$\phi_3 \begin{pmatrix} 5.5 \\ 3 \end{pmatrix} = \phi_5 \begin{pmatrix} 5.5 \\ 3 \end{pmatrix} = \frac{0.444}{1.52} = 0.293$$

$$\phi_4 \begin{pmatrix} 5.5 \\ 3 \end{pmatrix} = \phi_6 \begin{pmatrix} 5.5 \\ 3 \end{pmatrix} = \frac{0.235}{1.52} = 0.155$$

$$f_8 \begin{pmatrix} 5.5 \\ 3 \end{pmatrix} = 0.105 * 9 + 0.293 * 2 + 0.155 * 12 + 0.293 * 8 + 0.155 * 13$$
$$= 7.75$$

Exercise 5.3 [1 Points] Interpolation inside a prism

- Get barycentric coordinates for upper an lower triangle we will get α, β, γ for each triangle
- plug these into the formula and get the interpolated values for P_{upper} and P_{lower}
- linear interpolation between P_{upper} and P_{lower} with inverse distance

Exercise 5.4 [5 Points] Paraview: Simple Gradient Plugin

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