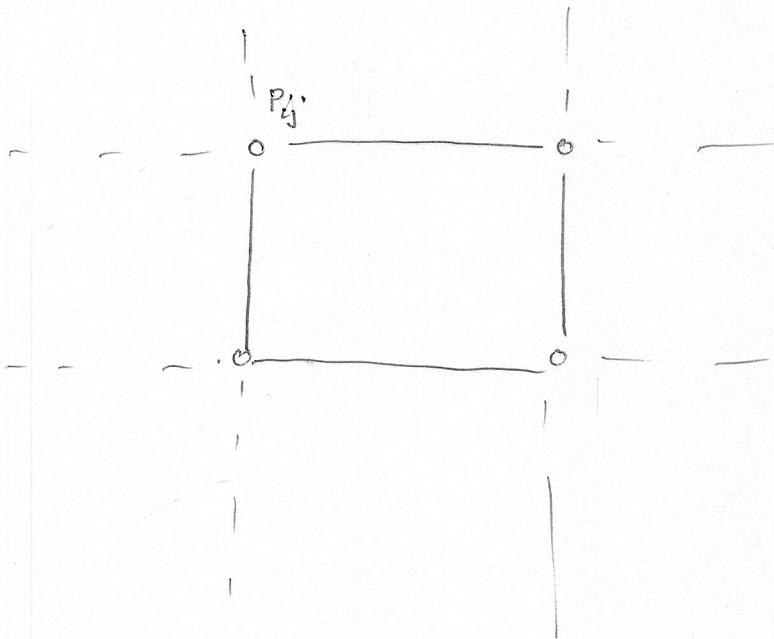
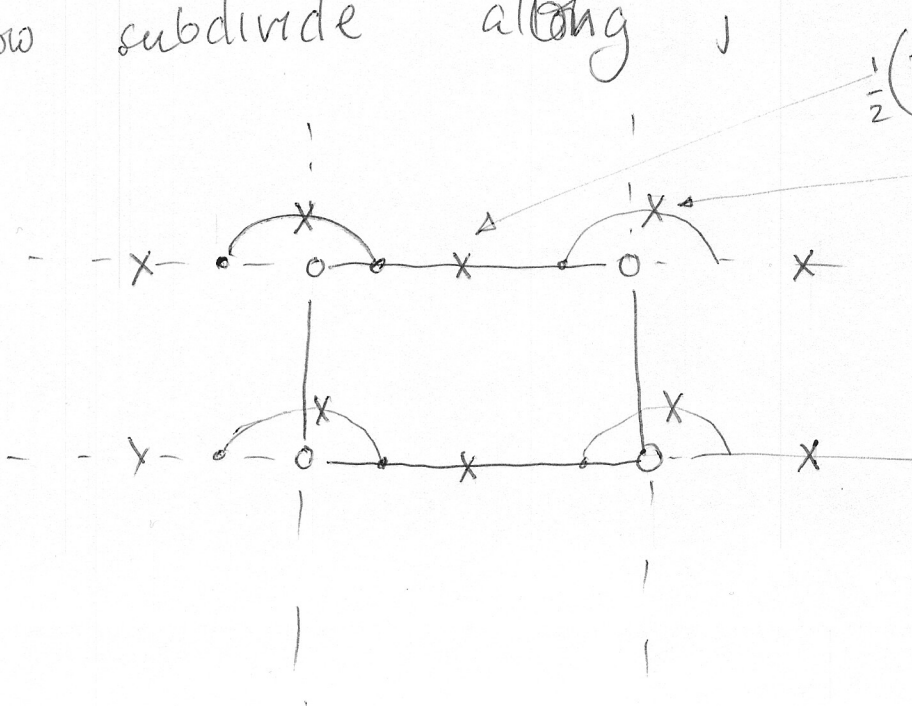


Catmull - Clark subdivision:

rewrite b-spline subdivision



Now subdivide along j

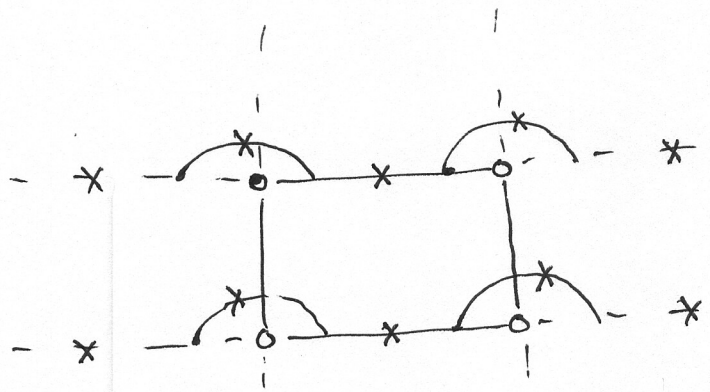


$$\frac{1}{2}(P_{ij} + P_{i,j+1})$$

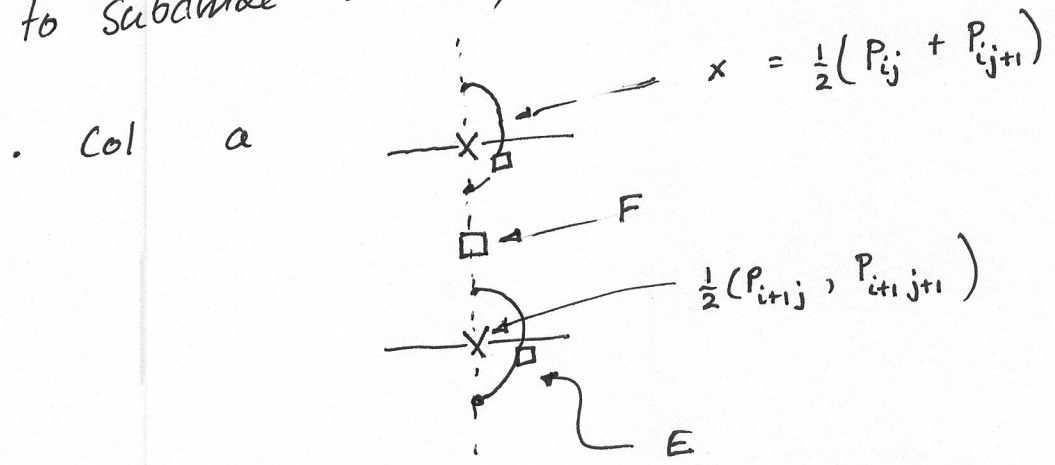
$$\left(\frac{1}{4} P_{ij} + \frac{3}{4} P_{i,j+1} + \frac{1}{8} P_{i,j+2}\right)$$

new points
marked
as X

Catmull - Clark



to subdivide in i , must do col a , col b



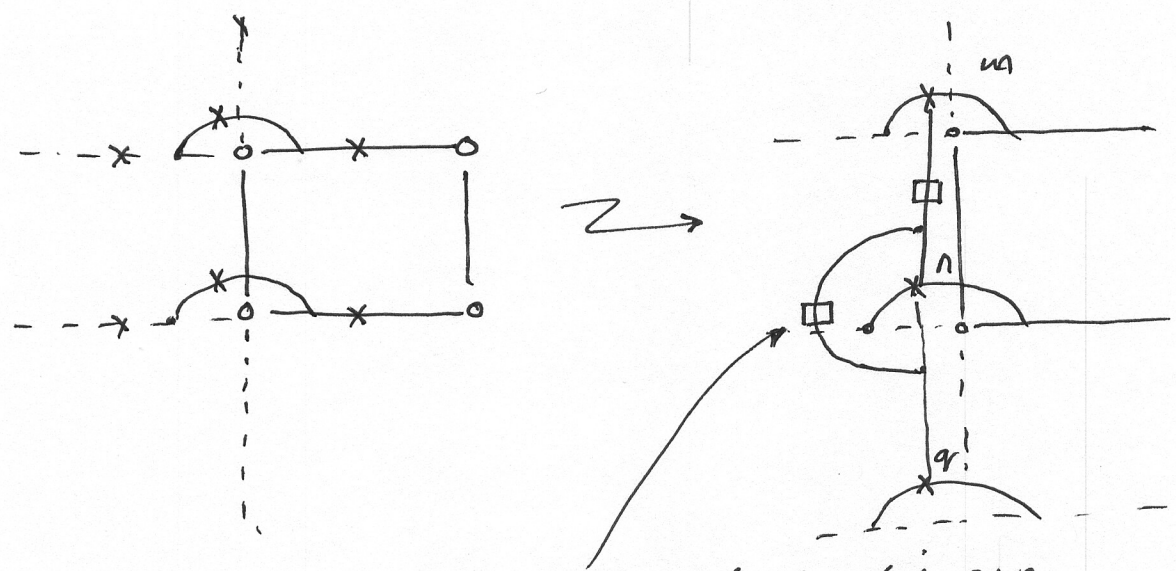
$$F = \frac{1}{4} [P_{ij} + P_{ij+1} + P_{i+1j} + P_{i+1j+1}]$$

$$E = \frac{1}{8} \left[\frac{1}{2} (P_{ij} + P_{ij+1}) \right] + \frac{3}{4} \left[\frac{1}{2} (P_{i+1j} + P_{i+1j+1}) \right] + \frac{1}{8} \left[\frac{1}{2} (P_{i+2j} + P_{i+2j+1}) \right]$$

Easier form follows

Catmull-Clark

Now col 6:



we care about this one

pt is:

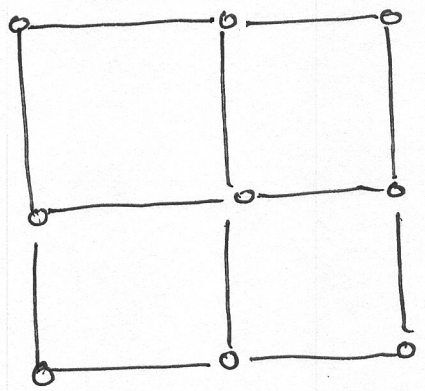
$$\frac{1}{8} m + \frac{3}{4} n + \frac{1}{8} q$$

$$= \frac{1}{8} \left[\frac{1}{8} P_{ij+1} + \frac{3}{4} P_{ij} + \frac{1}{8} P_{ij+1} \right]$$

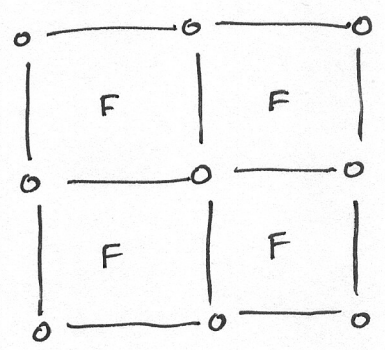
$$+ \frac{3}{4} \left[\frac{1}{8} P_{i+1j-1} + \frac{3}{4} P_{i+1j} + \frac{1}{8} P_{i+1j+1} \right]$$

$$+ \frac{1}{8} \left[\frac{1}{8} P_{i+2j-1} + \frac{3}{4} P_{i+2j} + \frac{1}{8} P_{i+2j+1} \right] = P$$

Catmull - clark :

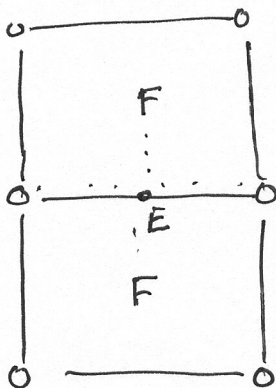


• Take each FACE, construct $F_{ij} = [\text{ave verts of face}]$

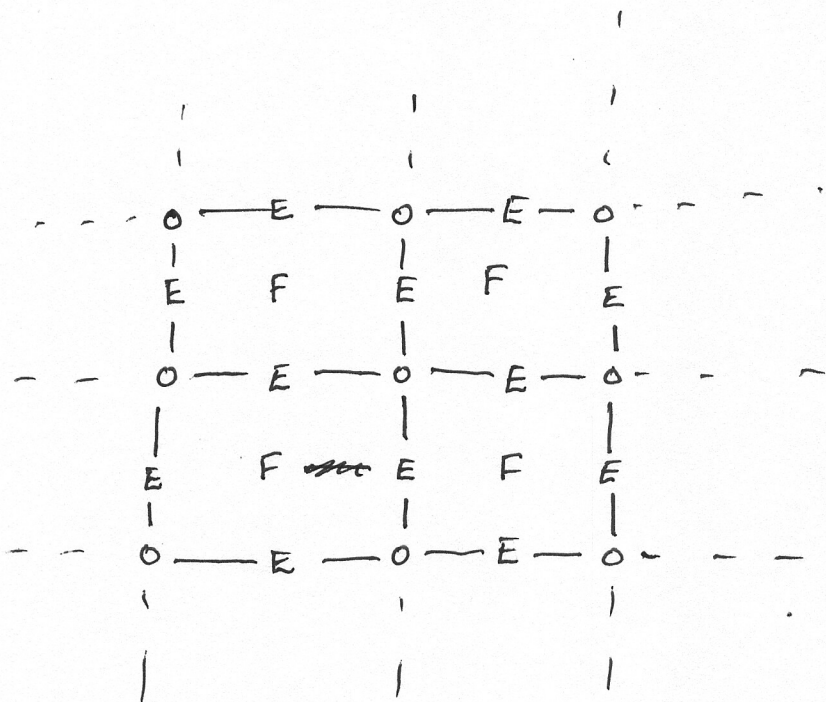


• Now take each edge, construct

$$E = \frac{1}{4} [\text{Sum of incident face points} + \text{Sum of incident points}]$$



(check against formula)
p 2



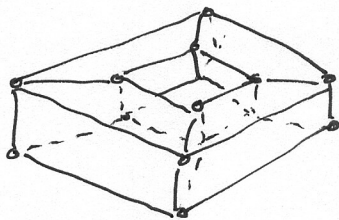
Now we just need the last points (at 0)

$$= \frac{1}{4} \left[\begin{aligned} & \text{Ave incident face points} + \\ & 2 * [\text{Ave incident edge points}] \end{aligned} \right] + \text{Ave incident } P$$

↑ original value

Catmull-Clark:

- join up to make natural mesh
- doesn't have to be grid



- What about extraordinary verts?
(where there are more/less than 3 incident faces)

Idea:

$$P = \frac{1}{n} \left[\begin{array}{l} \text{Ave incident face points} + \\ 2 * [\text{Ave incident edge points}] \\ + (n-3) \cdot (\text{old value}) \end{array} \right]$$

(Catmull-Clark)

(other schemes exist)

⑦

Crucial point:

- Make, edit coarse meshes
- "looks ~~z~~ like" result
- subdiv gives smooth surf.