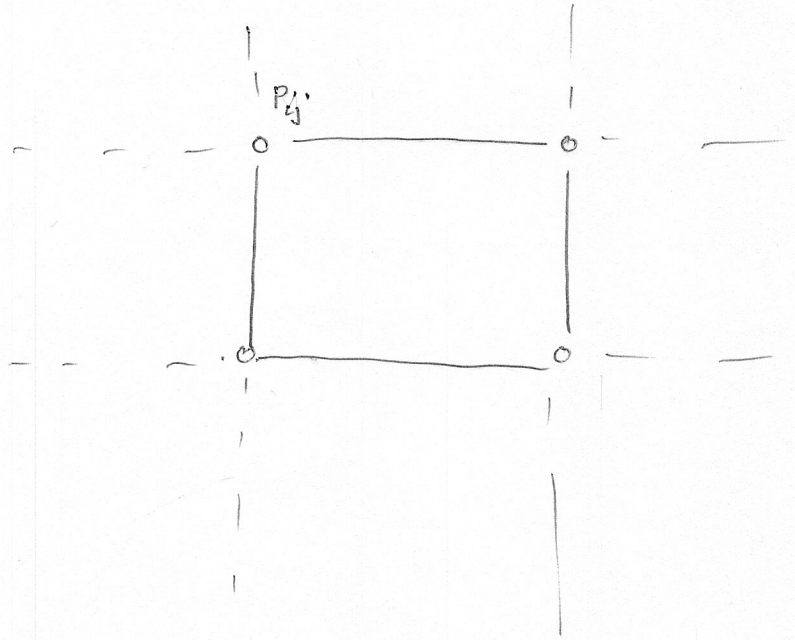
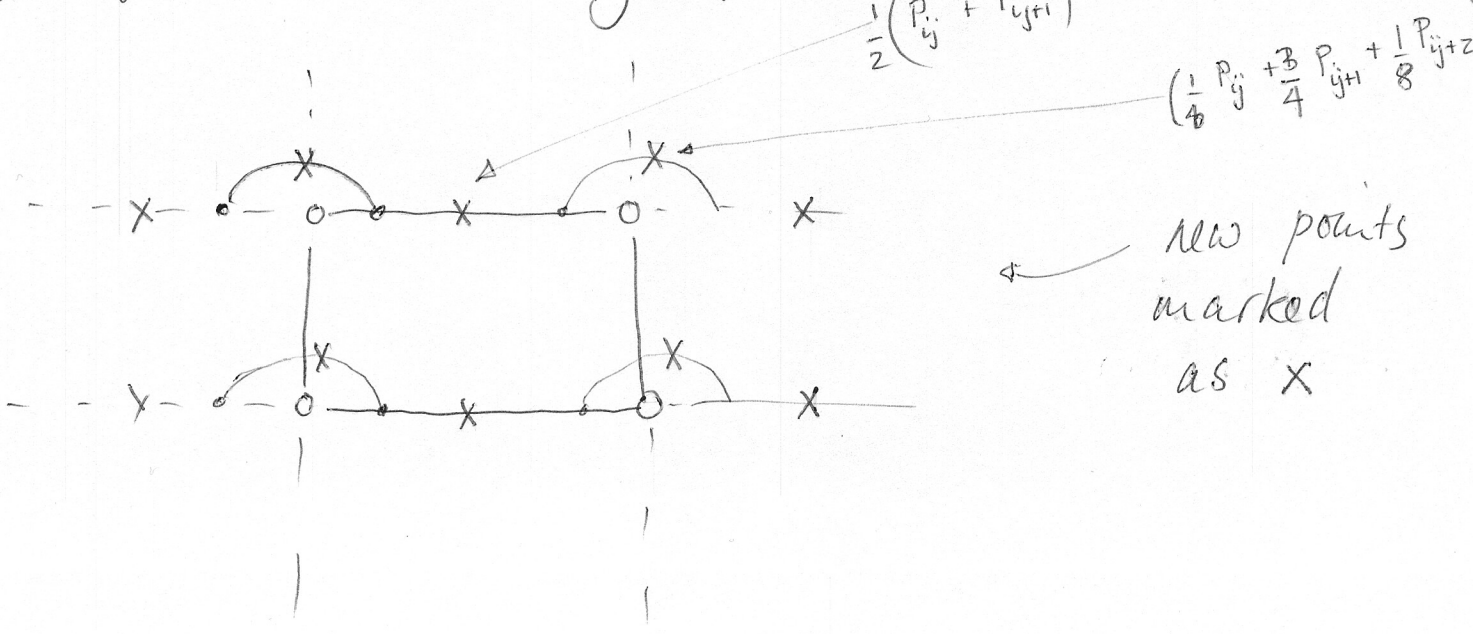
Catmull - Clark subdivision:

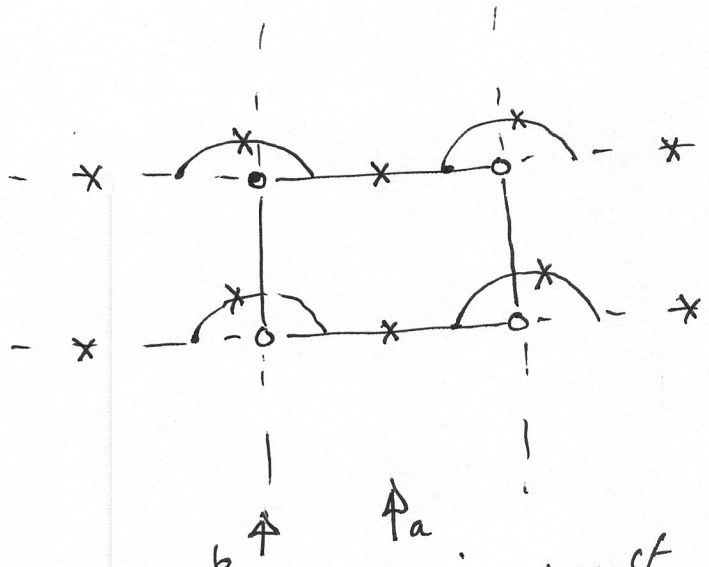
rewrite b-spline subdivision



Now subdivide along j

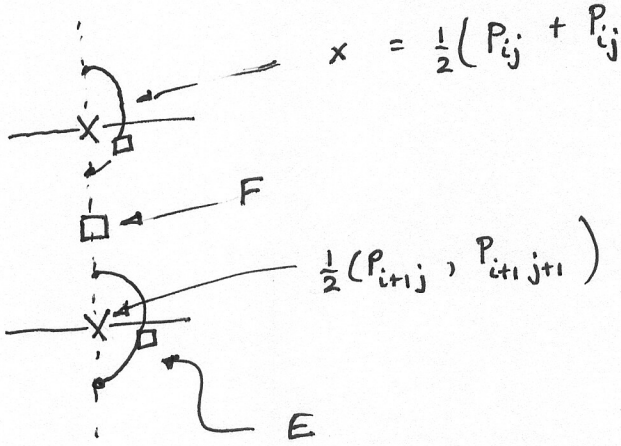


Catmull - Clark



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

. col a



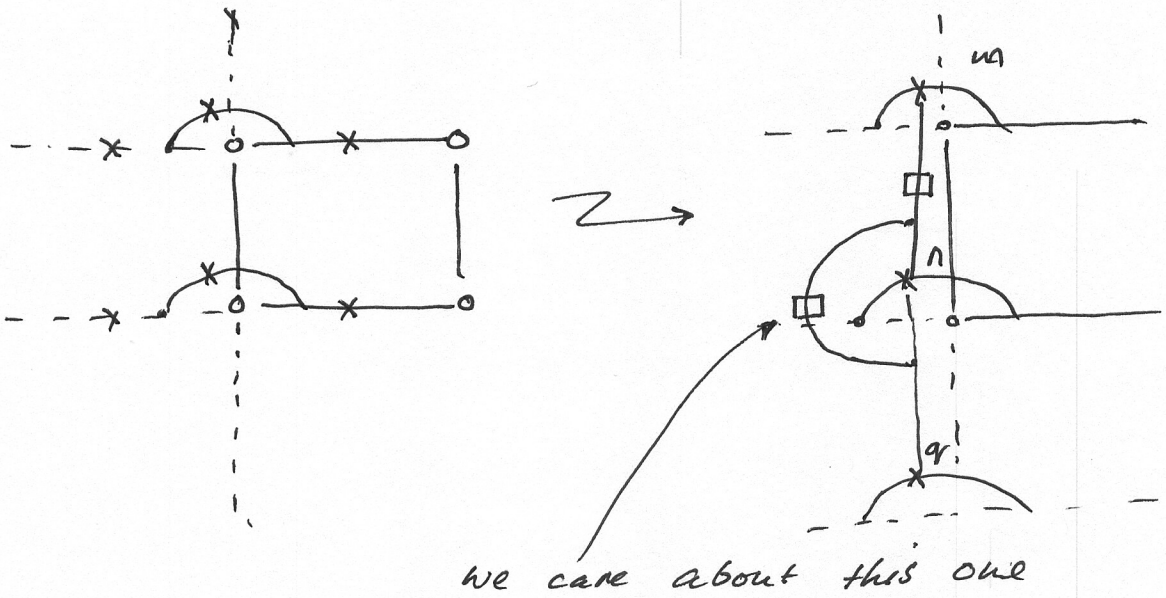
$$F = \frac{1}{4}\left[P_{ij} + P_{ij+1} + P_{i+1\,j} + P_{i+1\,j+1}\right]$$

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

Easier form. follows

Catmull-Clark

now col 6:



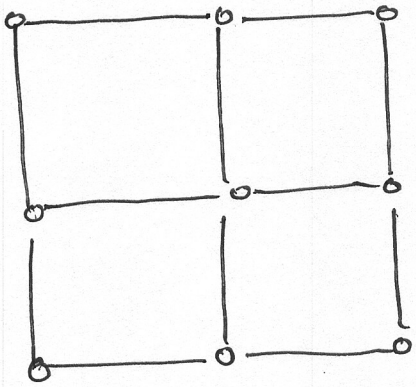
pt is: $\frac{1}{8} m + \frac{3}{4} n + \frac{1}{8} q$

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

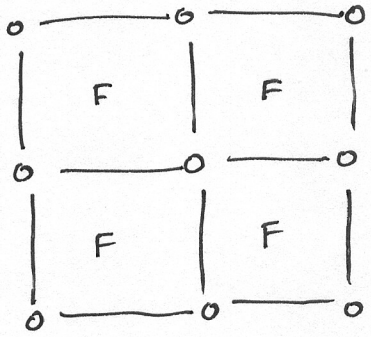
$$+ \frac{3}{4}\left[\frac{1}{8} P_{i+1\,j-1} + \frac{3}{4} P_{i+1\,j} + \frac{1}{8} P_{i+1\,j+1} \right]$$

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

Catmull - Clark:

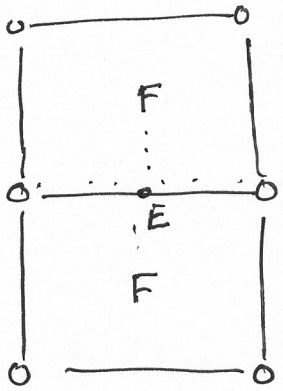


- Take each FACE, construct F_{ij} = [ave verts of face]

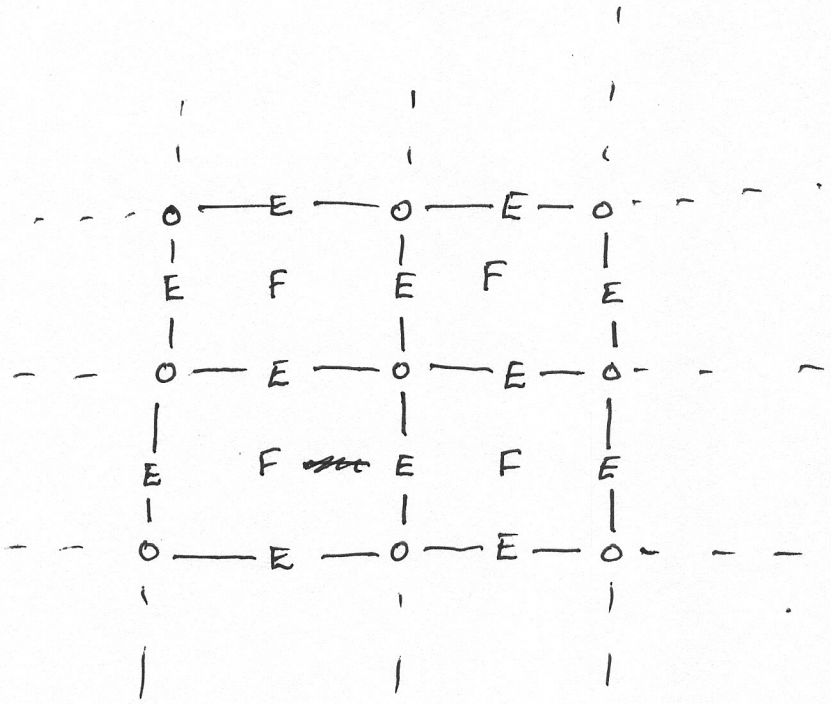


- Now take each edge, construct

$$E = \frac{1}{4}\left[\ \cancel{\text{ave inc \& incident}}\ \text{Sum of incident face points} + \text{Sum of incident points}\ \right]$$



(check against formula p 2)



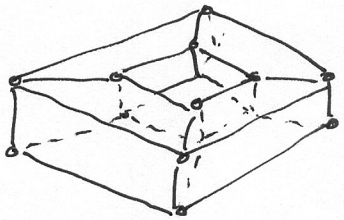
Now we just need the last points (at o)

$$= \frac{1}{4}\left[\begin{array}{l}\text{Ave incident face points} + \\ 2\cdot[\text{Ave incident edge points}] \\ + \quad \text{~~Ave incident~~} \quad P\end{array}\right]$$

↑ 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:

$$P = \frac{1}{n}\Big[\text{Ave incident face points} + 2*[\text{Ave incident edge points}] + (n-3).(\text{old value})\Big]$$

(catmull-clark)

(Other schemes exist)

Crucial point:

- Make, edit coarse mesh
- "looks like" result
- Subdiv gives smooth surf.