Representation of 3D objects :-
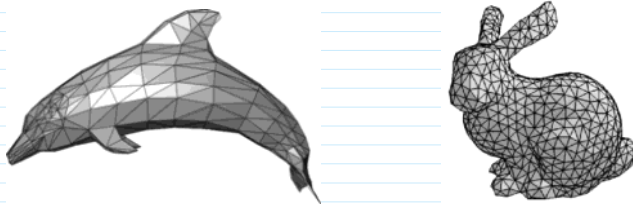
Various geometric primitives :-
① Circle
② Polygons.
⑥ Bezier Surfaces

All these objects are converted into a triangular mesh.

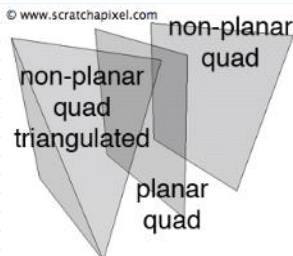## Why triangles ?

Converting a Bezier patch is into a triangle mesh is much simpler than computing ray - Bezier patch intersection. True for all geometric primitives.
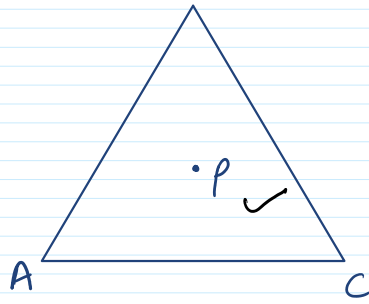
Triangles are coplanar :-

Three vertices of a triangle describe a plane, with all three vertices residing in the same plane.
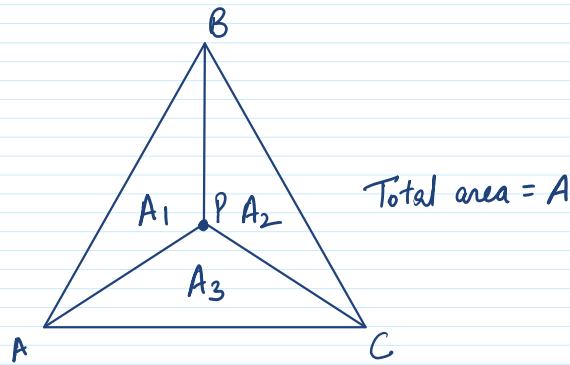

Let polygon is a triangle,

B

Is point P inside the triangle or outside?

Barycentric Coordinates

$$\boxed{P = uA + vB + wC} \leftarrow$$

A, B, C are the vertices of the triangle.
u, v, w are the barycentric coordinates.

Total area = A

Area Coordinates

$$u = \frac{A_1}{A}, \quad v = \frac{A_2}{A}, \quad w = \frac{A_3}{A}$$

$$u + v + w = 1$$
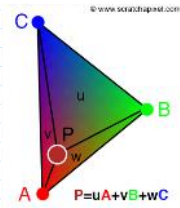
$$u \geq 0, \quad v \geq 0, \quad w \geq 0$$

⇒ The point is within the triangle if
$$0 \leq u, v, w \leq 1$$

⇒ If any one of the coordinates is less than zero or greater than one, point is outside.

⇒ If any of them is zero, P is on the lines joining the vertices of the triangle.

Shading using Barycentric Coordinates :—

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Let vertex A, B, C as Red, Green, Blue
What is colour at point P?

Barycentric coordinates are used to interpolate
vertex data across the triangle's surface.

color interpolation using
barycentric coordinates

color=(u, v, 1-u-v)

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