

3차원 모델링

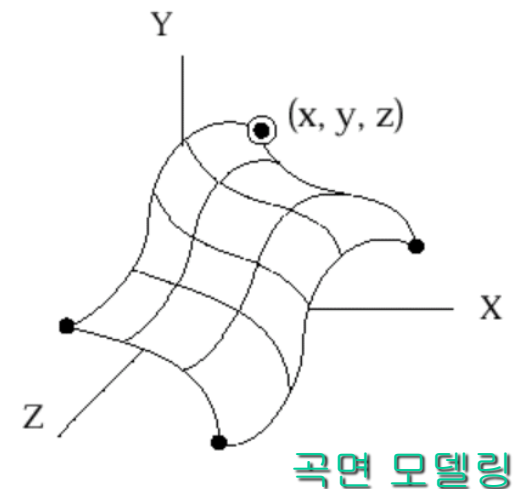
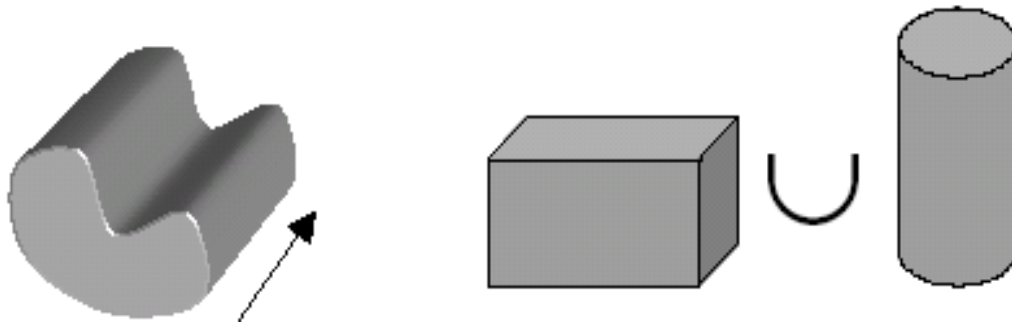
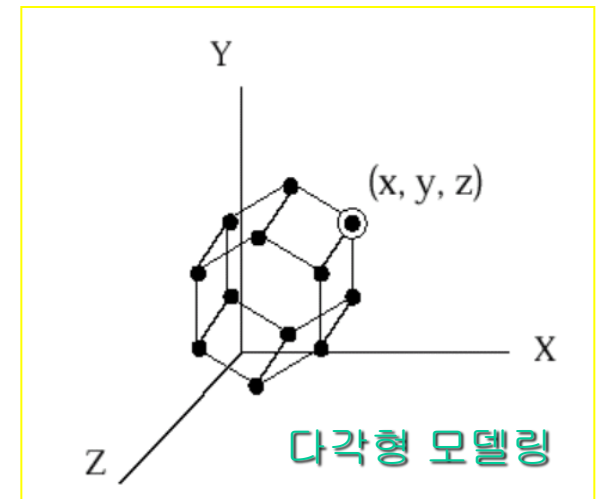
서울대학교 컴퓨터공학부
김명수

<http://cse.snu.ac.kr/mskim>

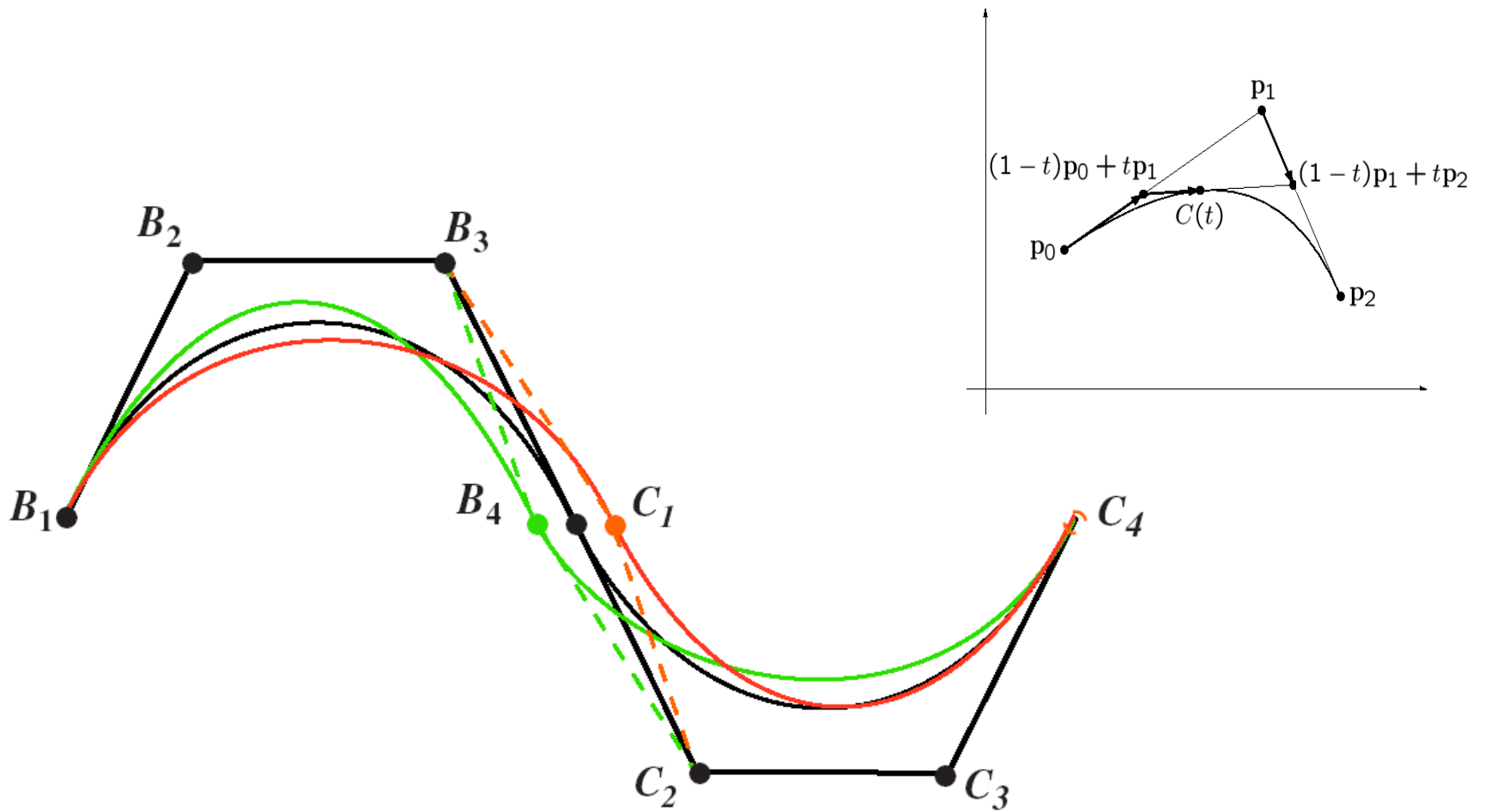
<http://3map.snu.ac.kr>

3차원 모델링

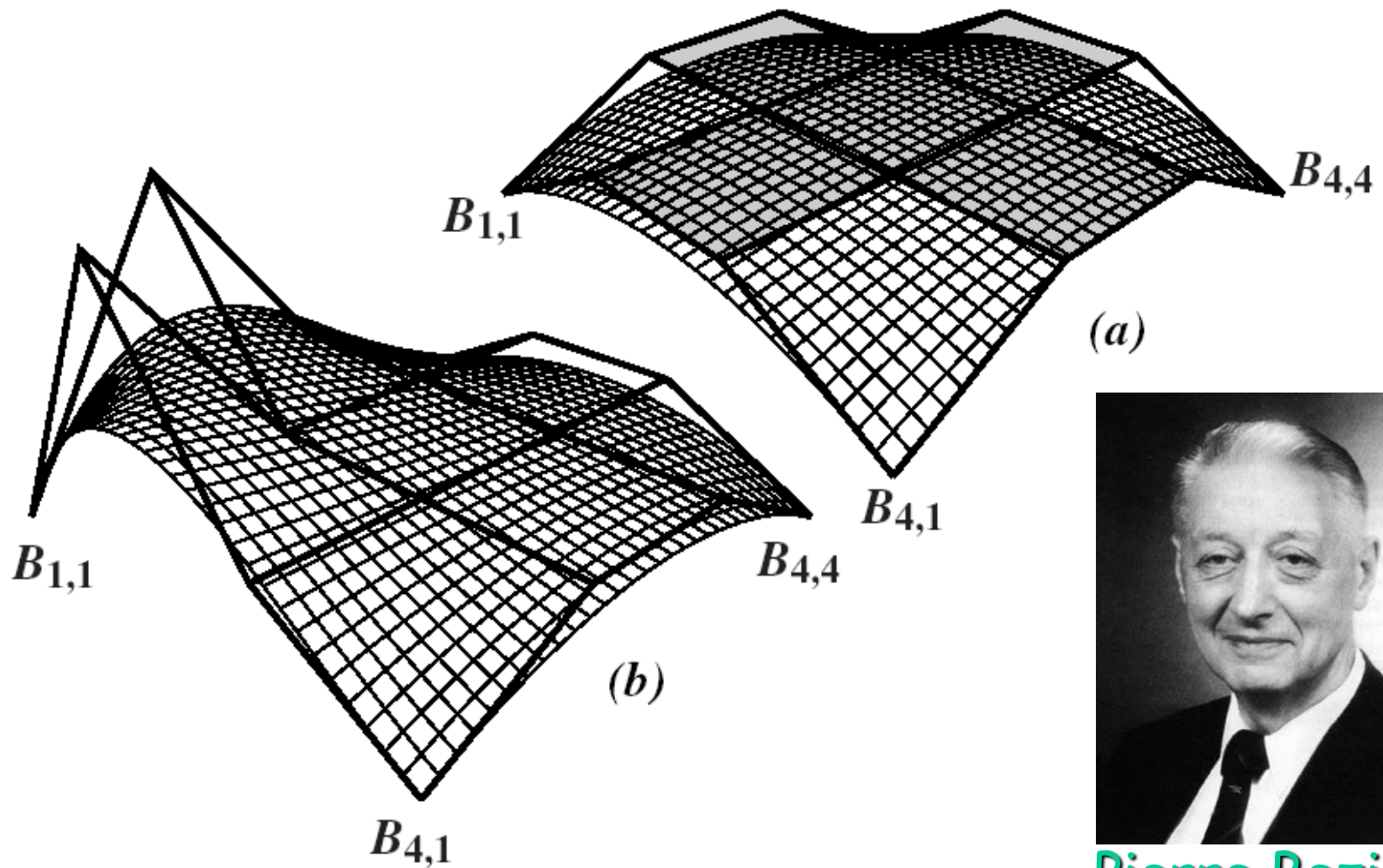
- 다각형 모델링
- 곡선 및 곡면 모델링
- 입체 모델링, 체적 모델링
- 절차적 기법에 의한 모델링



Bezier 곡선

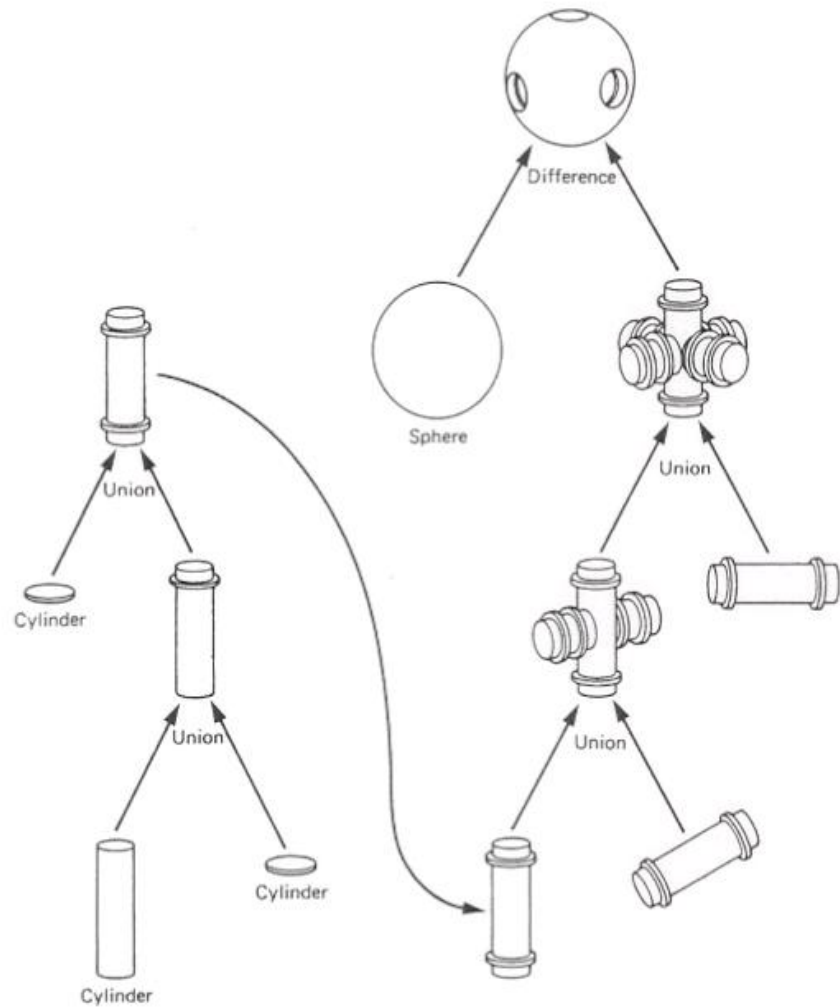
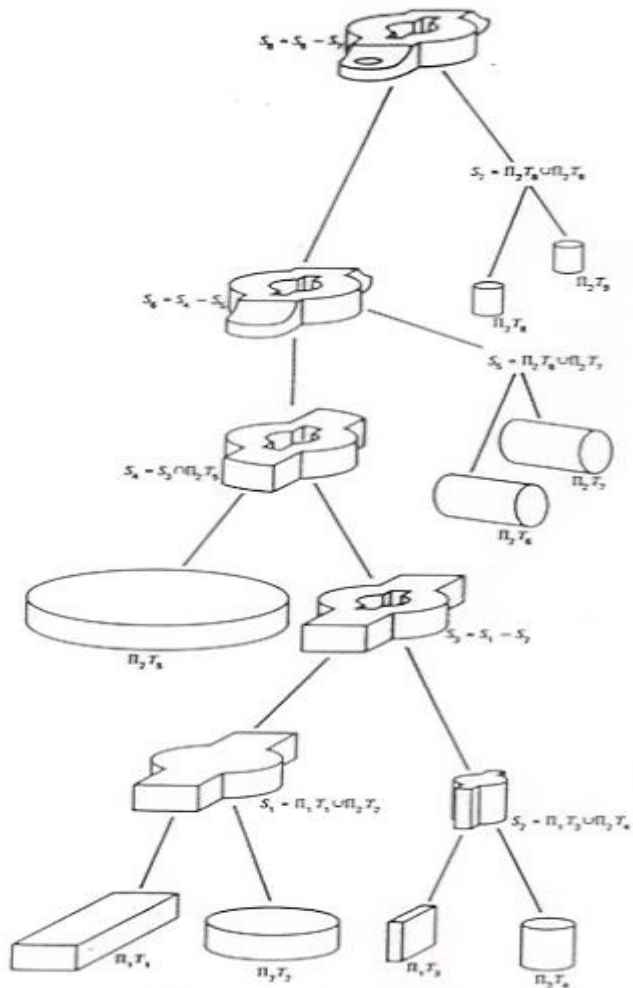


Bezier 곡면



Pierre Bezier

CSG 모델링



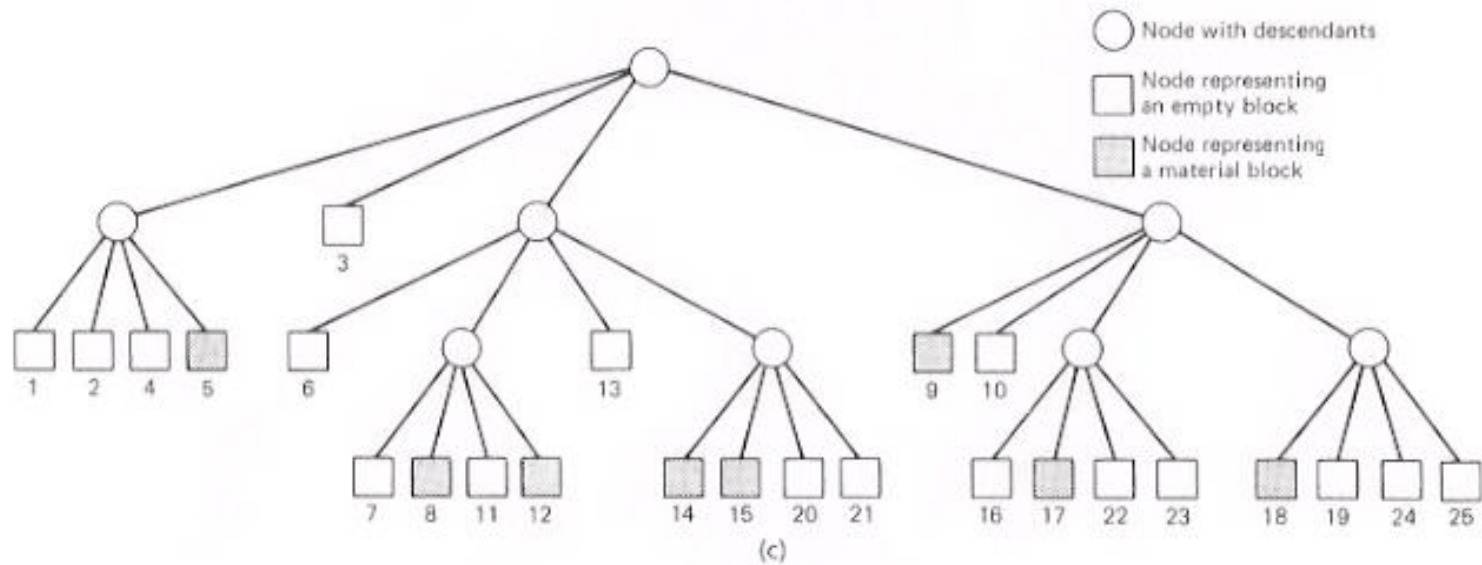
Quadtree



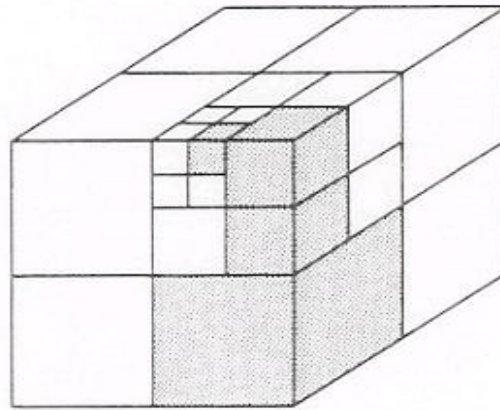
(a)

1	2	3		
4	5			
6	7	8	9	10
	11	12		
13	14	15	16	17
	18	19	20	21
	22	23	24	25

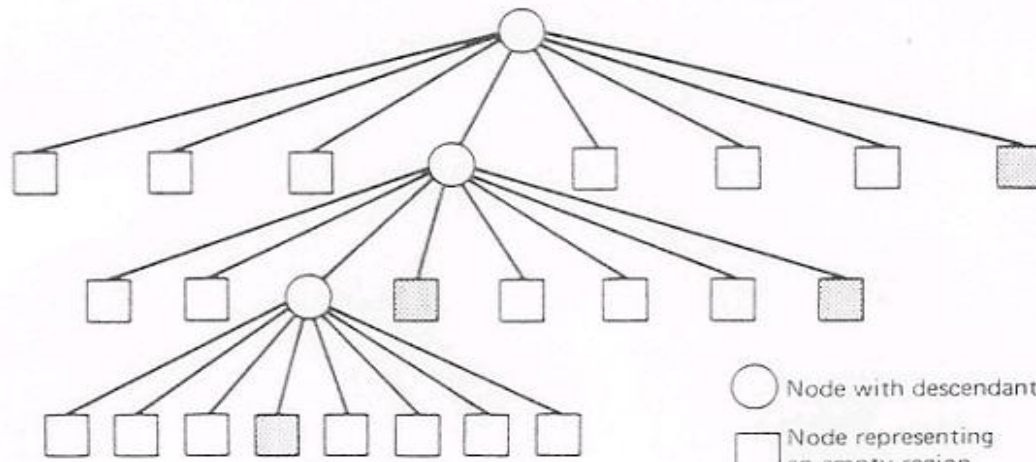
(b)



Octree



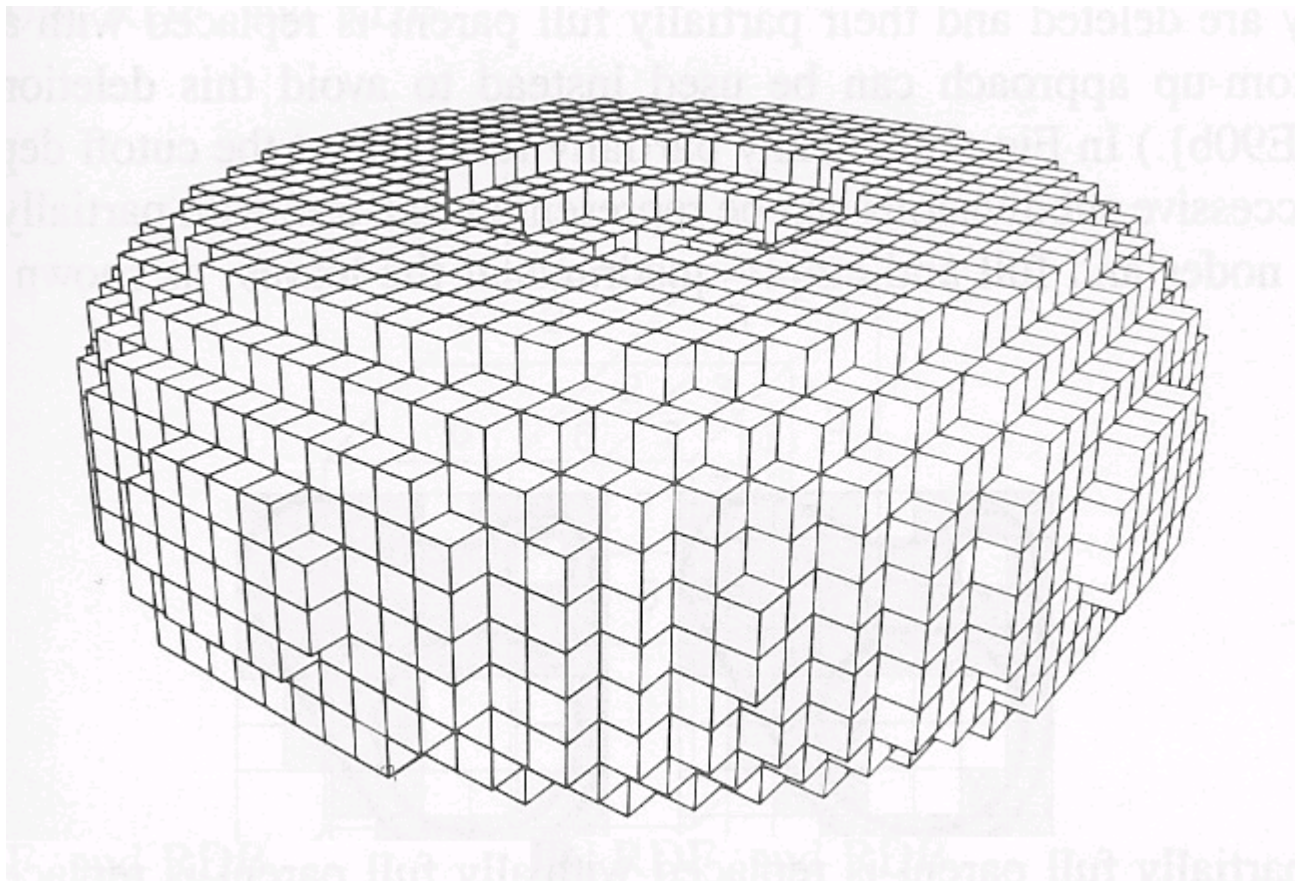
(a)



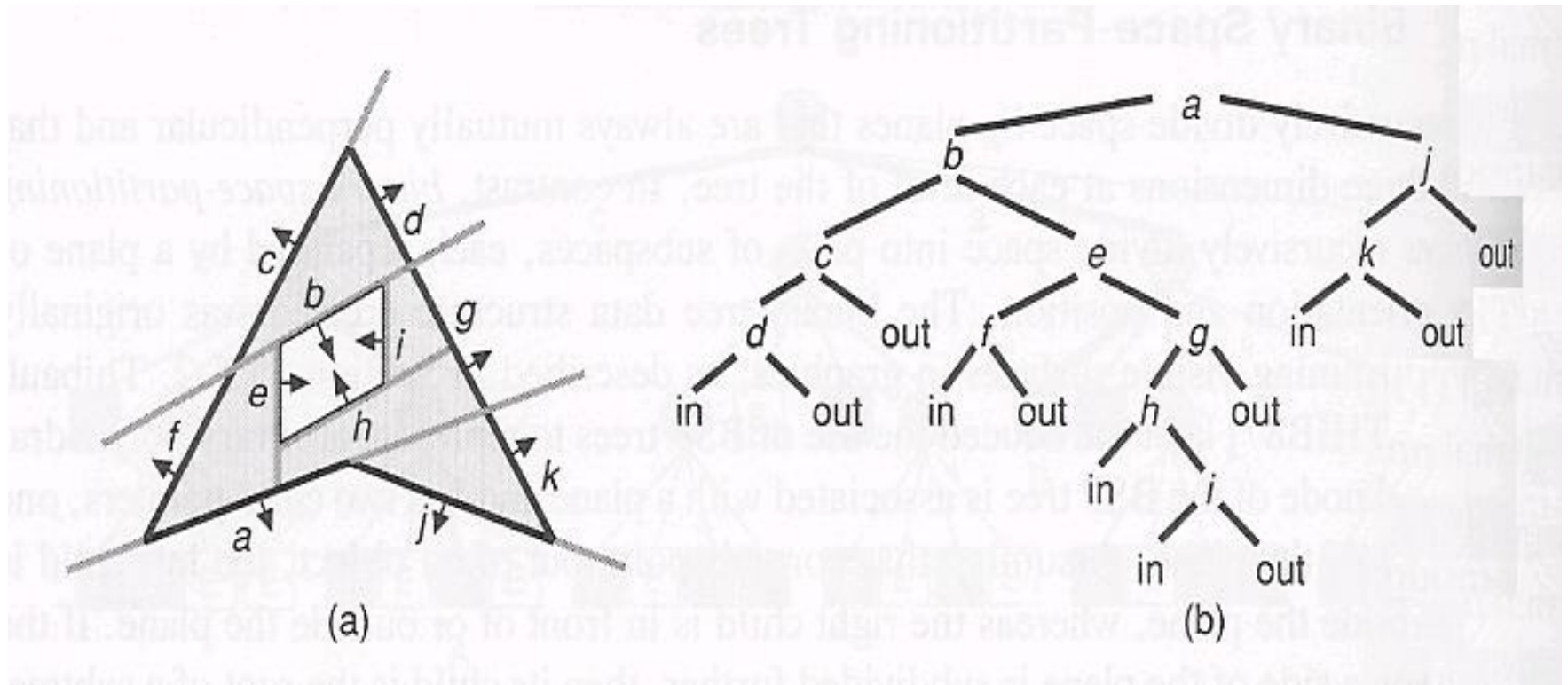
(c)

- Node with descendants
- Node representing an empty region
- Node representing a full region

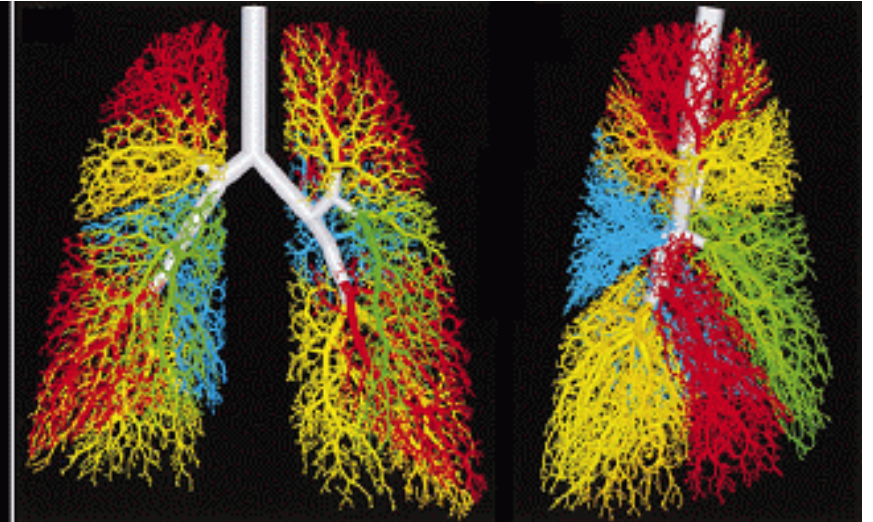
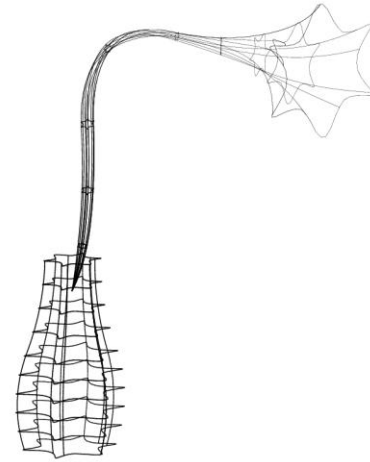
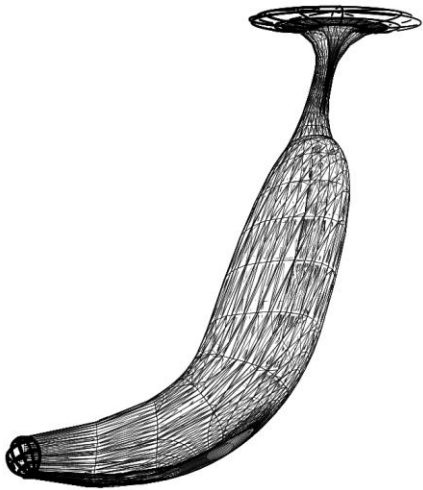
공간나열 모델링



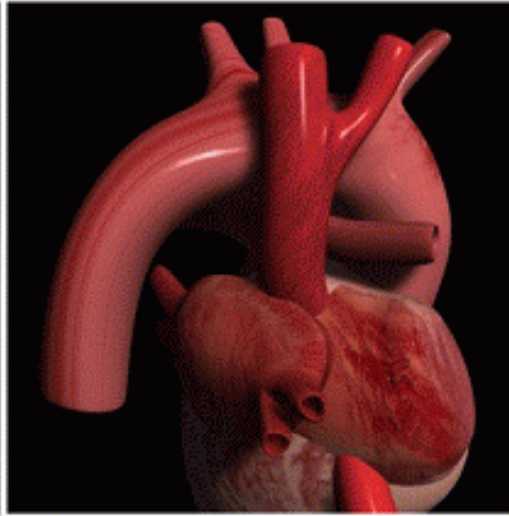
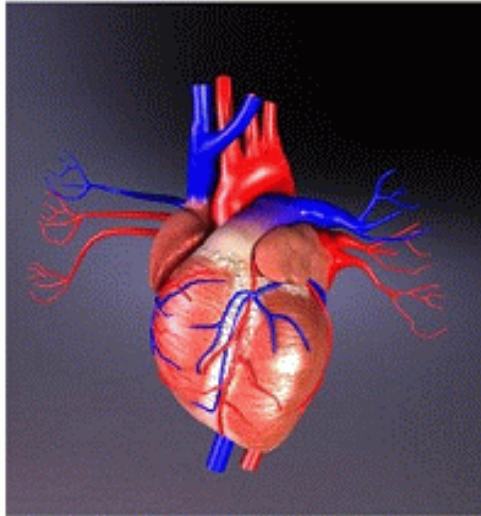
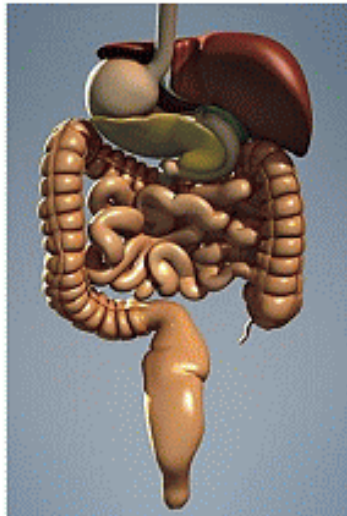
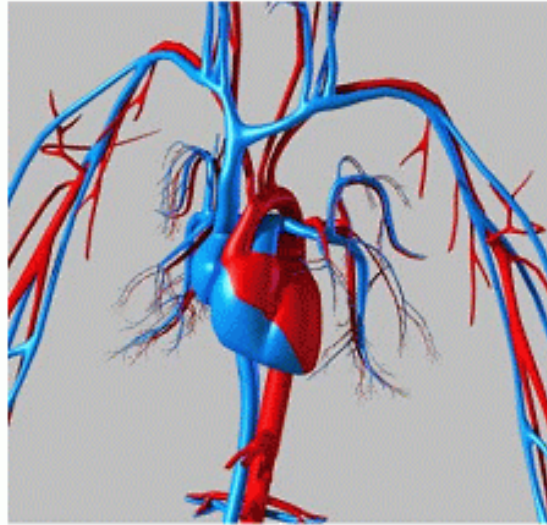
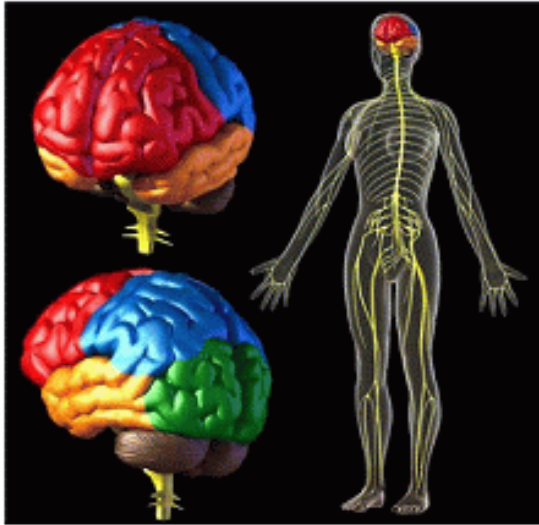
BSP Tree 모델링



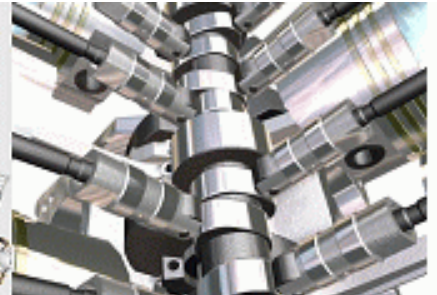
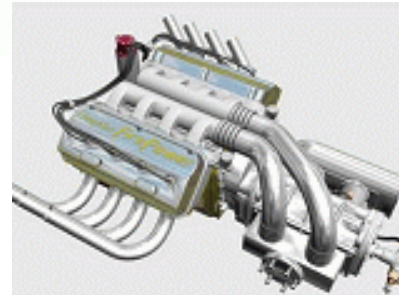
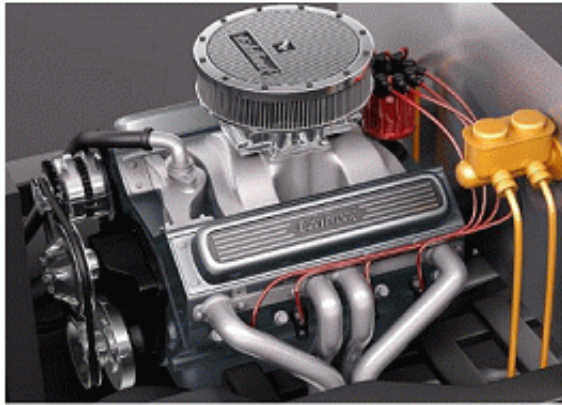
Sweep 모델링



인체장기 3D 모델링

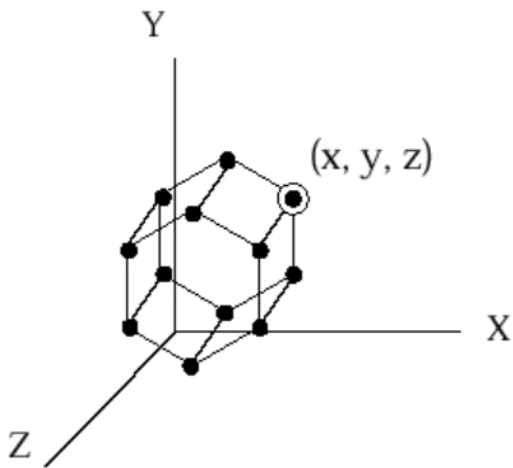


자동차 엔진 3D 모델링



다각형 모델링

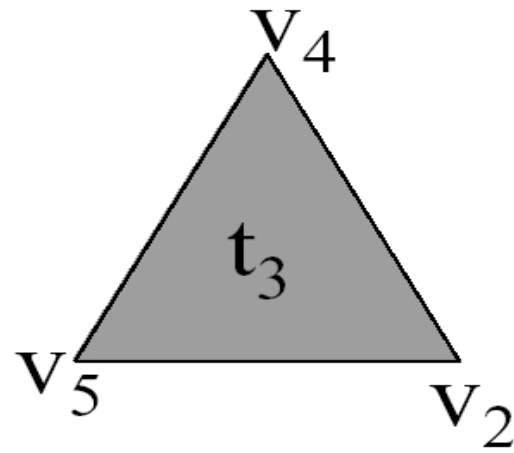
- 꼭지점들을 모두 나열한다.
- 각 다각형은 꼭지점들을 연결하여 만든다.
- 꼭지점들의 연결관계를 나타낸다.



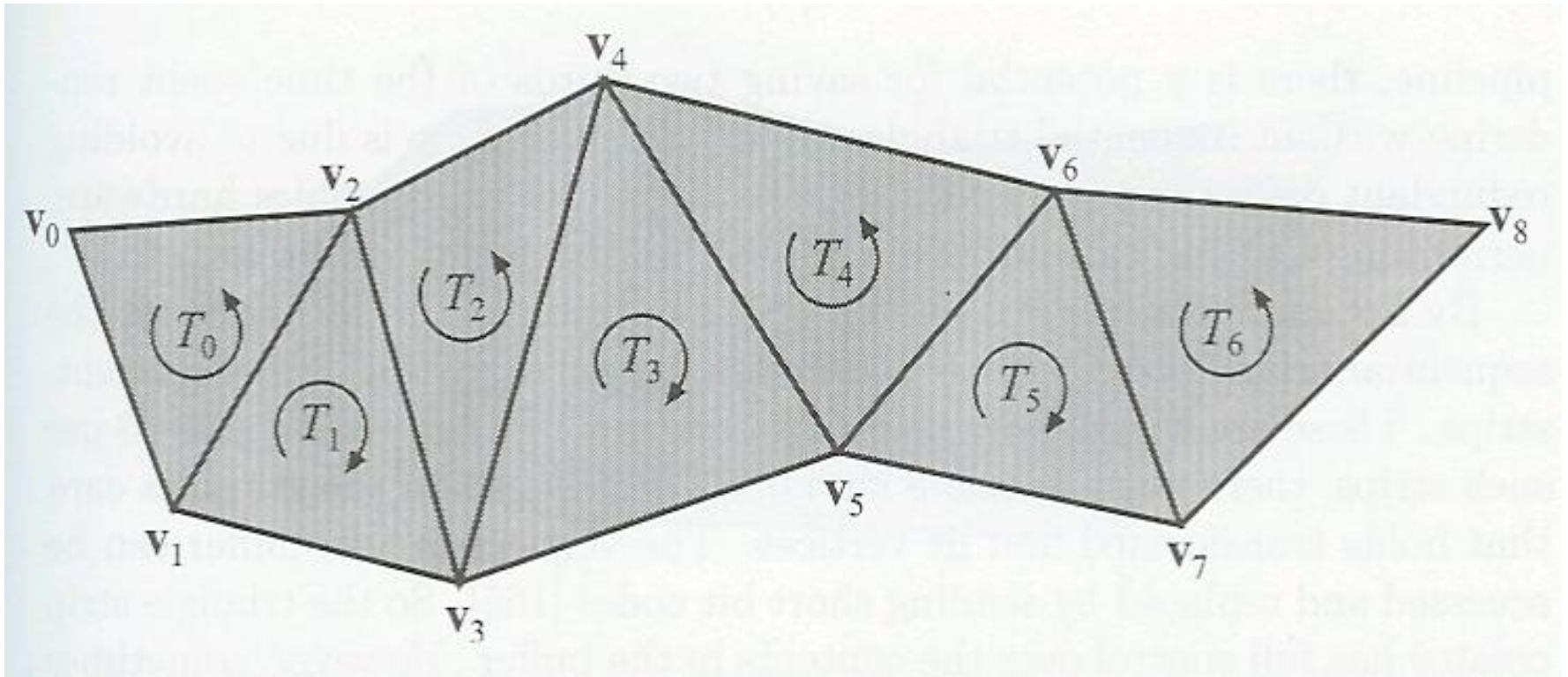
다각형 모델링

vertex 1	x	y	z	c
vertex 2	x	y	z	c
vertex 3	x	y	z	c

Triangle 1	1	2	3
Triangle 2	3	2	4
Triangle 3	4	2	5
Triangle 4	7	5	6
Triangle 5	6	5	8
Triangle 6	8	5	1

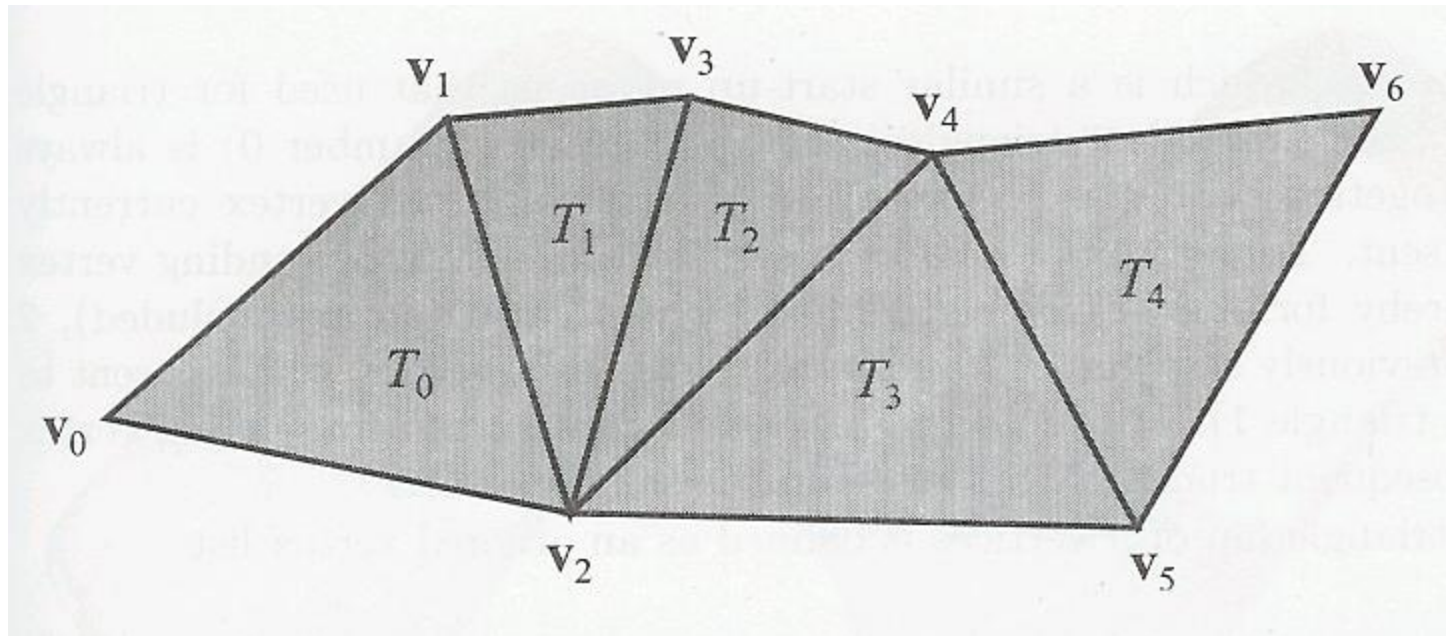


삼각형 띠



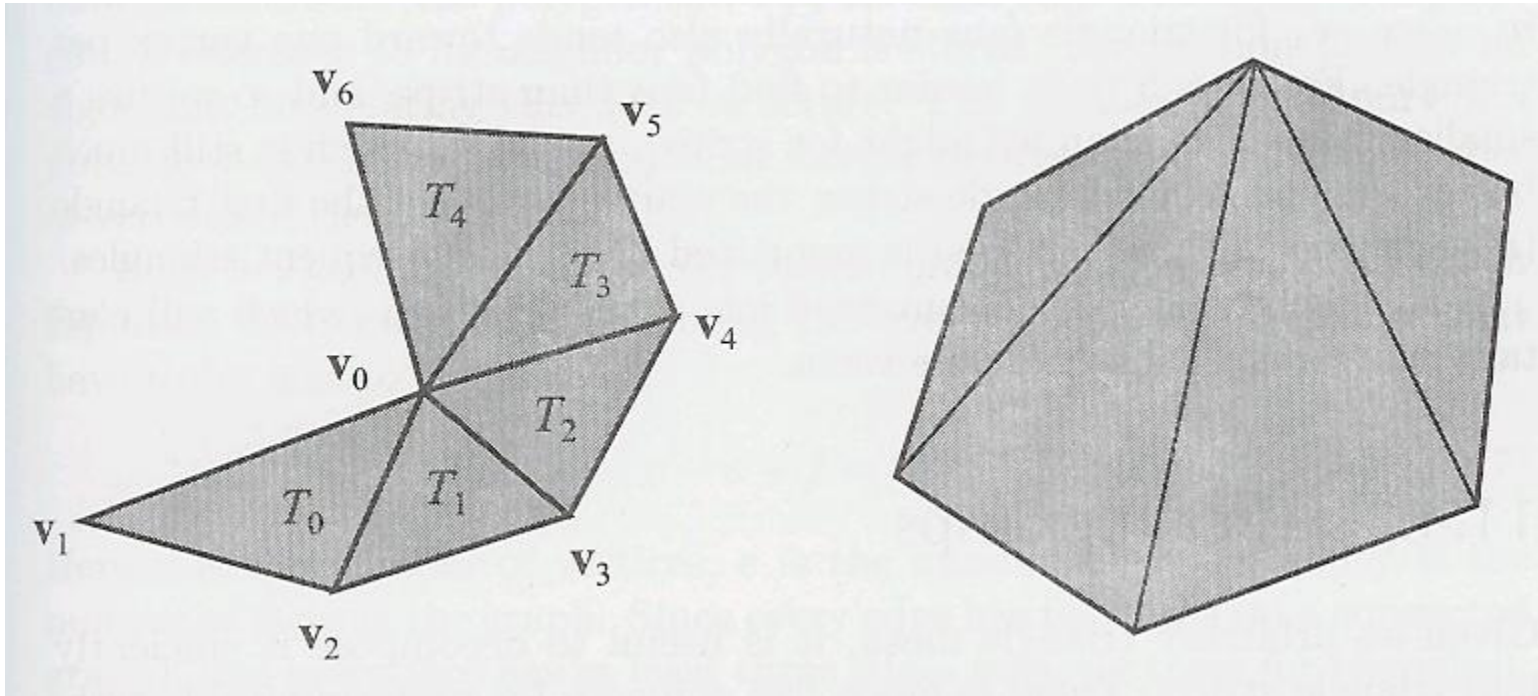
V_0 V_1 V_2 V_3 V_4 V_5 V_6 V_7 V_8

삼각형 띠



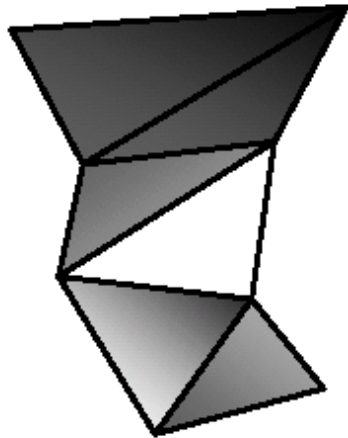
$v_0 \ v_1 \ v_2 \ v_3 \ v_2 \ v_4 \ v_5 \ v_6$
= $v_0 \ v_1 \ v_2 \ v_3 \ \text{SWAP} \ v_4 \ v_5 \ v_6$

삼각형 부채



V0 V1 V2 V3 V4 V5 V6

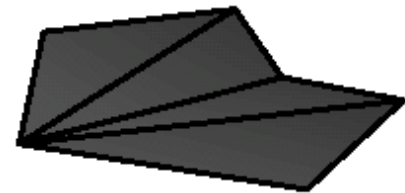
OpenGL의 삼각형



GL_TRIANGLE_STRIP



GL_TRIANGLES



GL_TRIANGLE_FAN

다각형 모델링

```
#include <stdlib.h>
#include <GL/glut.h>
```

```
GLfloat vertices[][3] = {{-1.0,-1.0,-1.0},{1.0,-1.0,-1.0},
{1.0,1.0,-1.0}, {-1.0,1.0,-1.0}, {-1.0,-1.0,1.0},
{1.0,-1.0,1.0}, {1.0,1.0,1.0}, {-1.0,1.0,1.0}};
```

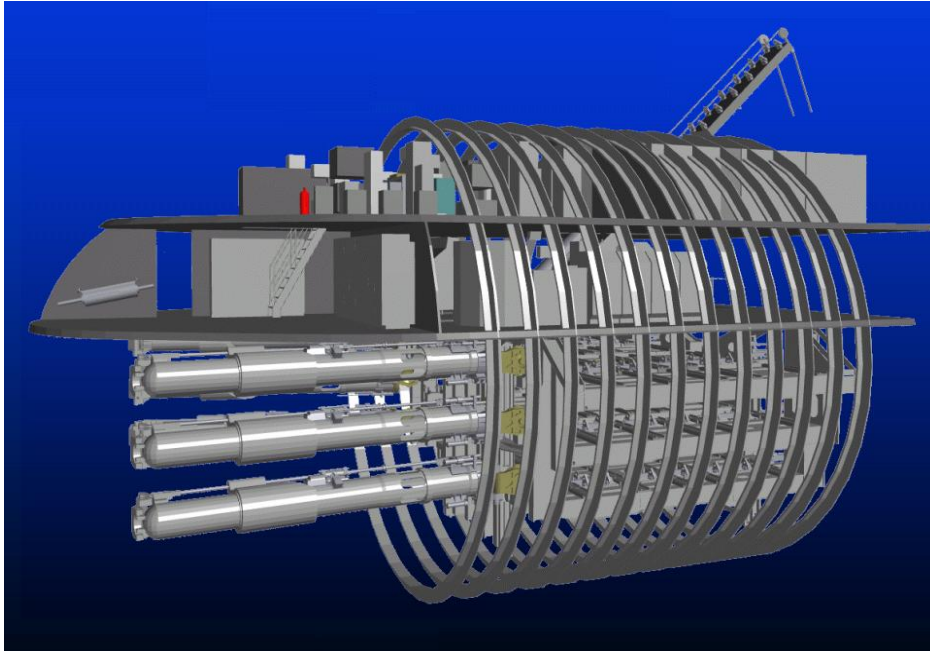
```
void colorcube(void)
{
    /* map vertices to faces */

    polygon(0,3,2,1);
    polygon(2,3,7,6);
    polygon(0,4,7,3);
    polygon(1,2,6,5);
    polygon(4,5,6,7);
    polygon(0,1,5,4);
}
```

```
void polygon(int a, int b, int c , int d)
{
    /* draw a polygon via list of vertices */

    glBegin(GL_POLYGON);
        glColor3fv(colors[a]);
        glNormal3fv(normals[a]);
        glVertex3fv(vertices[a]);
        glColor3fv(colors[b]);
        glNormal3fv(normals[b]);
        glVertex3fv(vertices[b]);
        glColor3fv(colors[c]);
        glNormal3fv(normals[c]);
        glVertex3fv(vertices[c]);
        glColor3fv(colors[d]);
        glNormal3fv(normals[d]);
        glVertex3fv(vertices[d]);
    glEnd();
}
```

다각형 모델링의 예



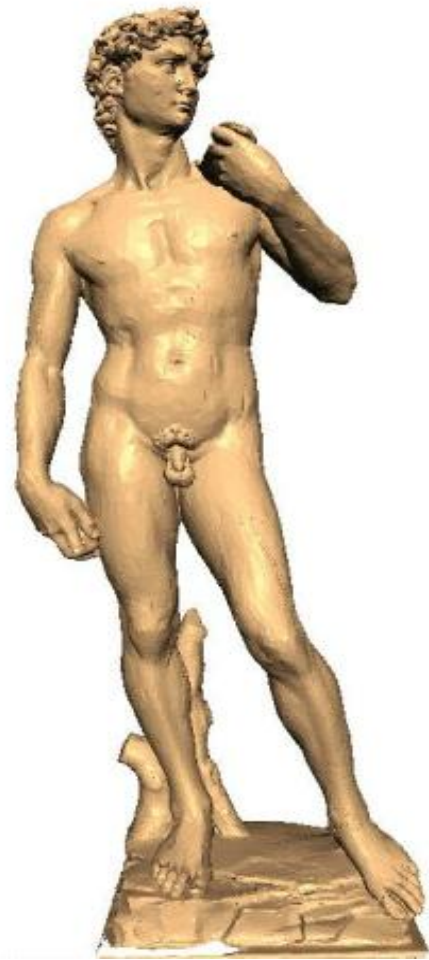
70만 다각형

1300만 다각형



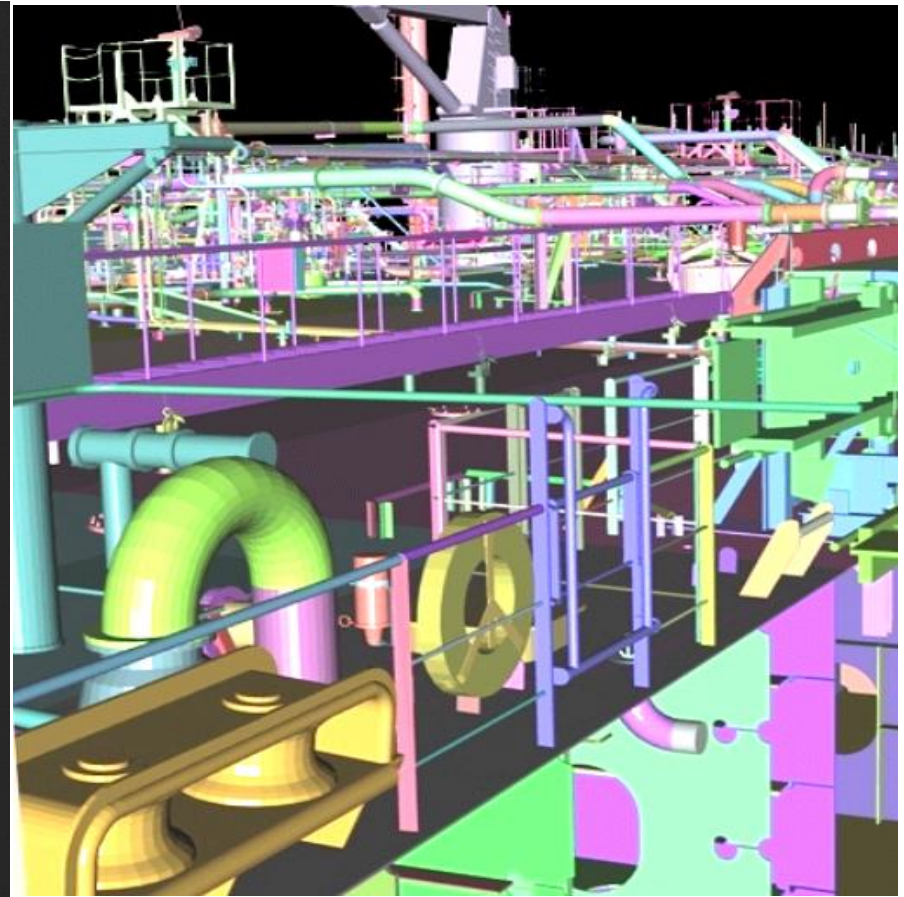
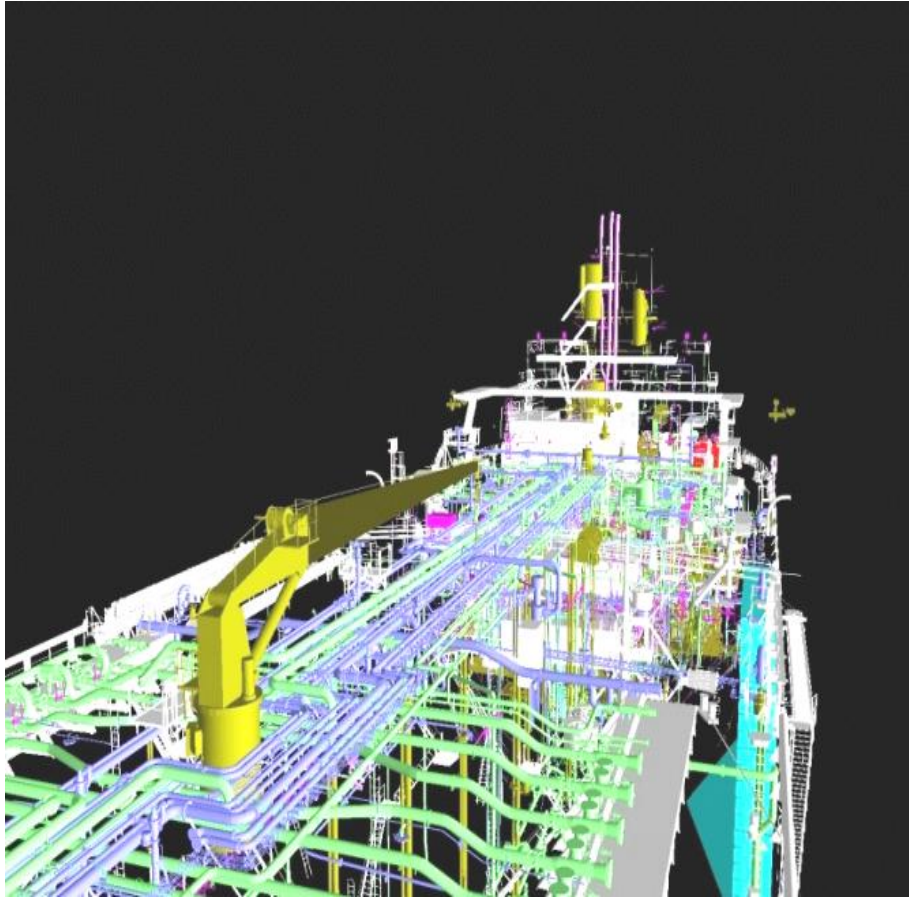
3차원 모델링의 예

1700만 polygon



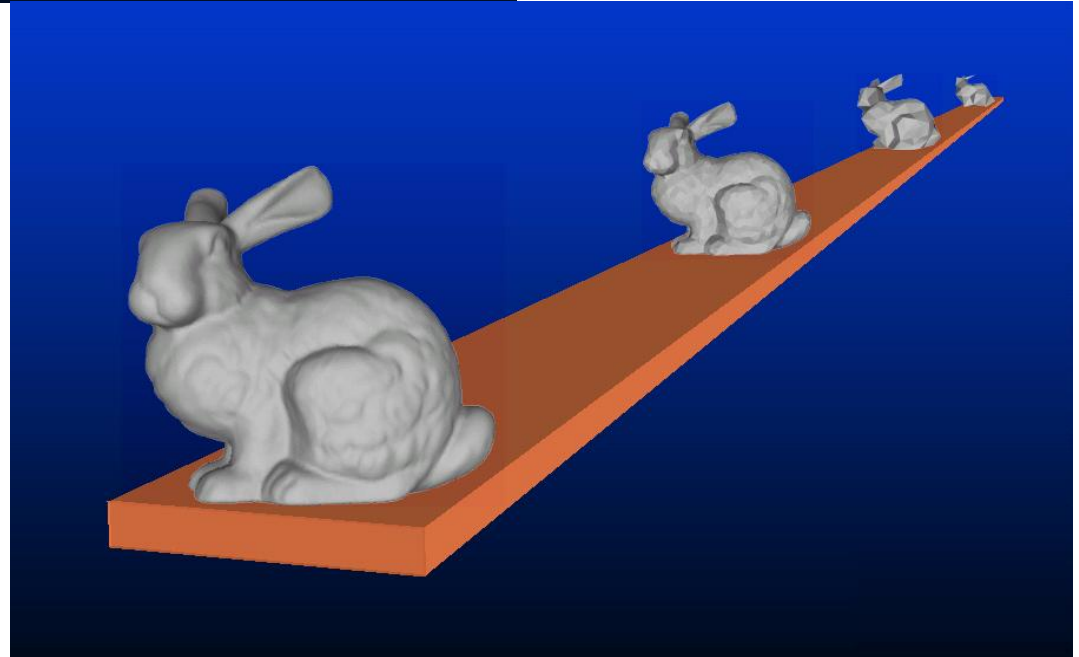
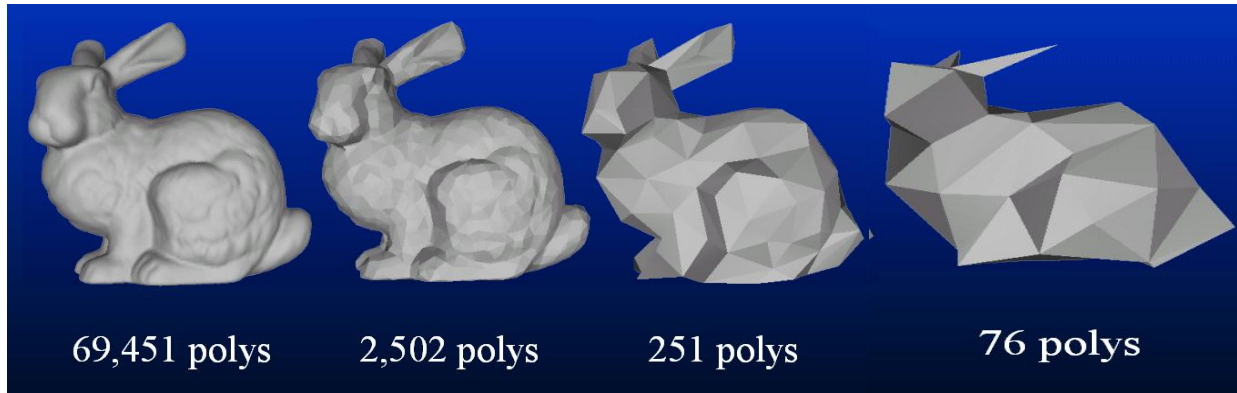
5600만 polygon

3차원 모델링의 예



8200만 polygon

Level of Detail (LOD)



Level of Detail (LOD)

7,809 tris



3,905 tris



1,951 tris



975 tris



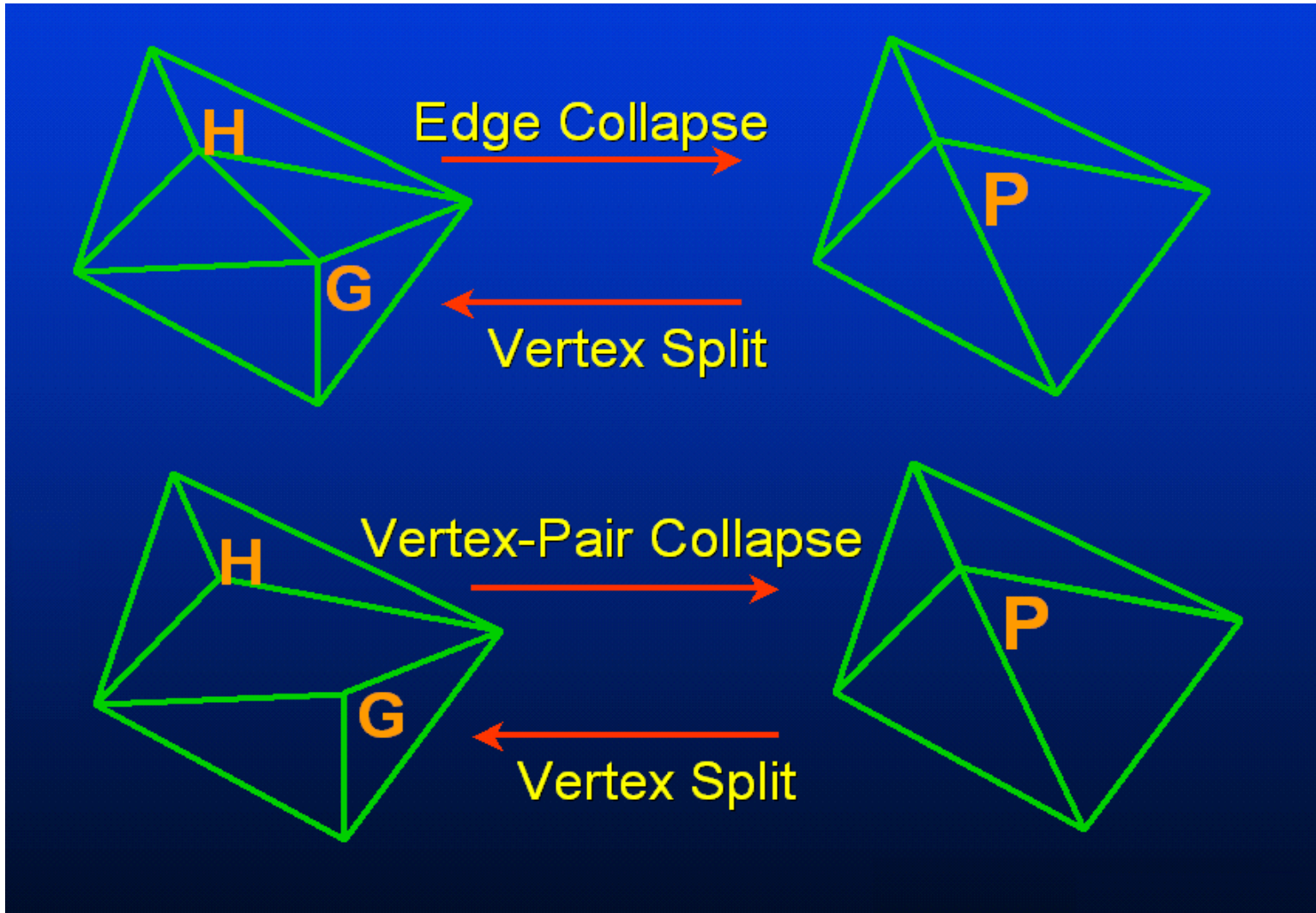
488 tris



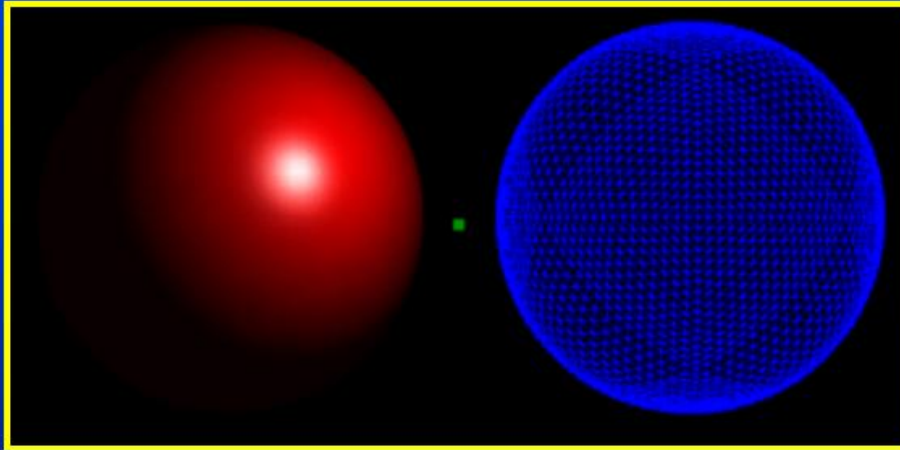
Level of Detail (LOD)



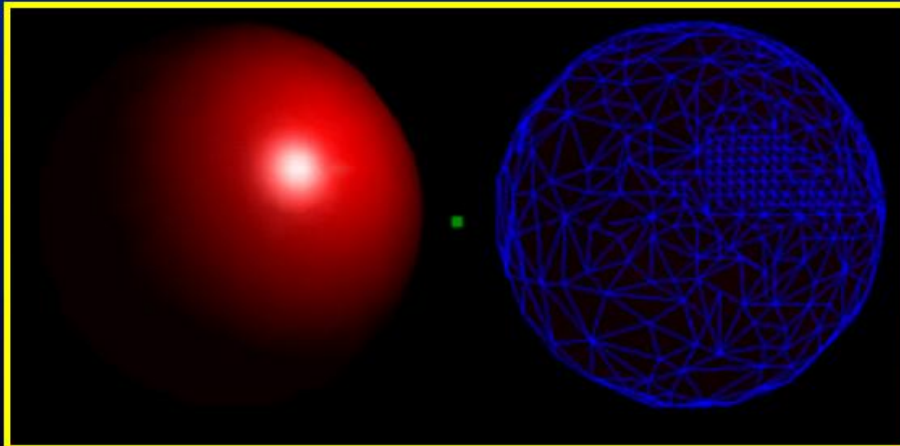
LOD 생성방법



시점 종속 LOD

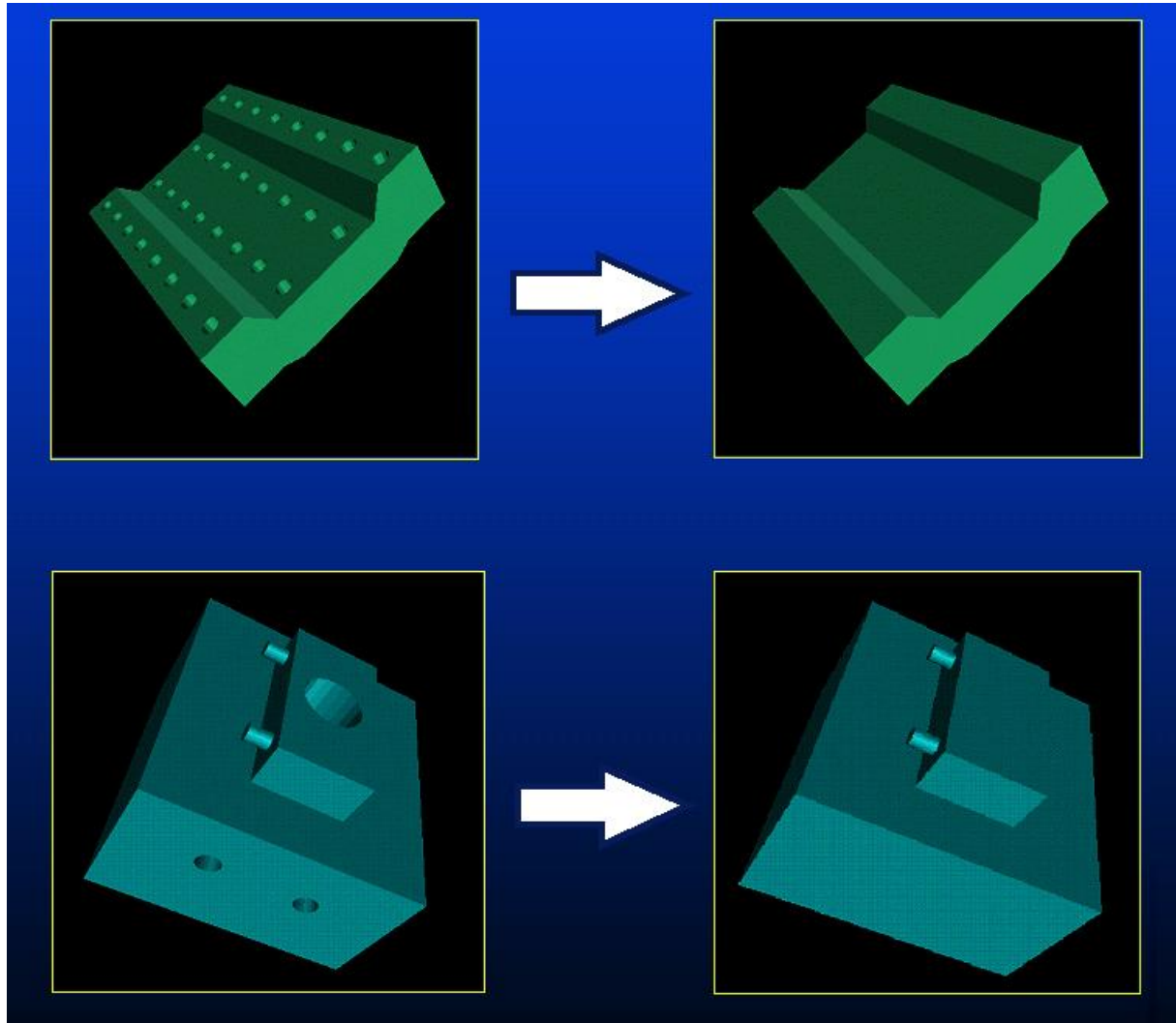


8192 triangles

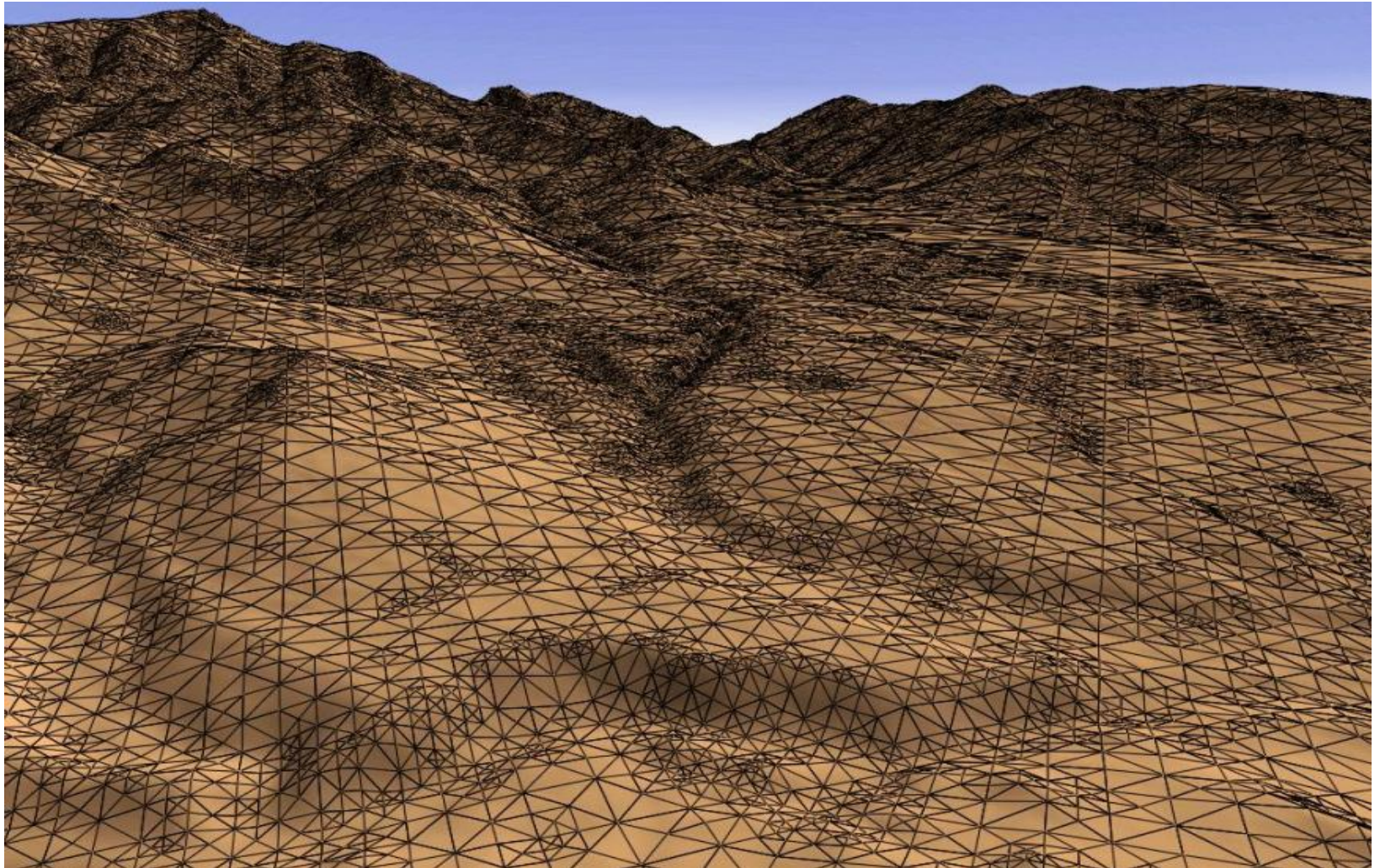


537 triangles

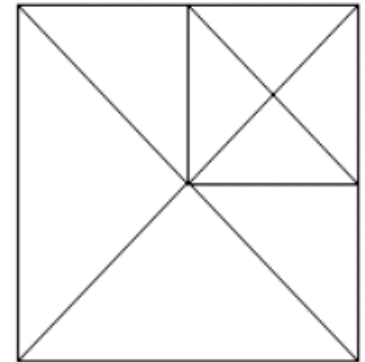
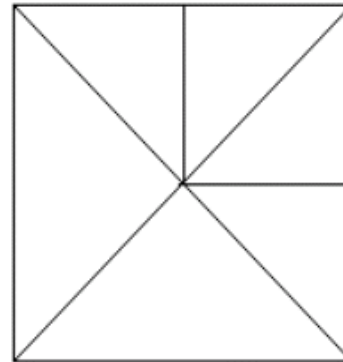
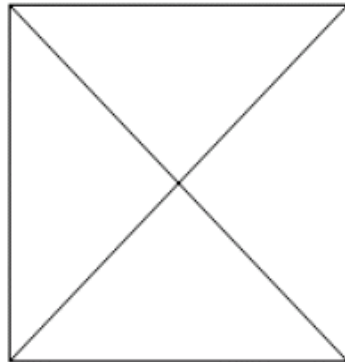
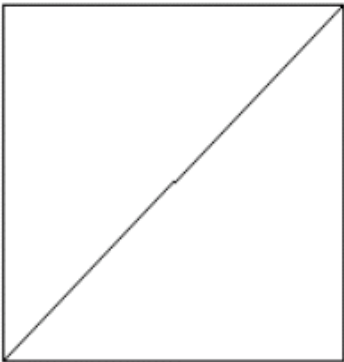
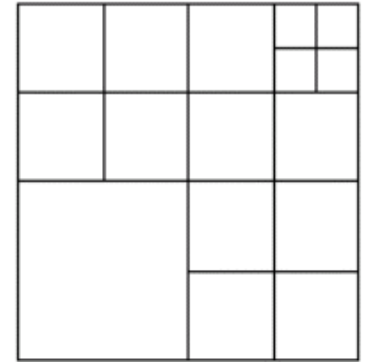
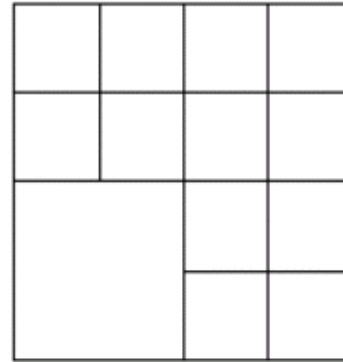
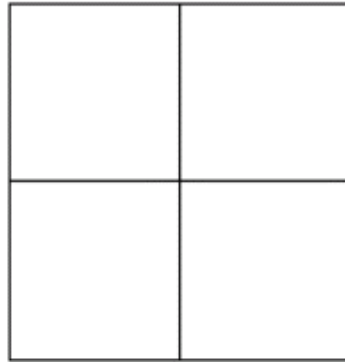
특징기반 LOD



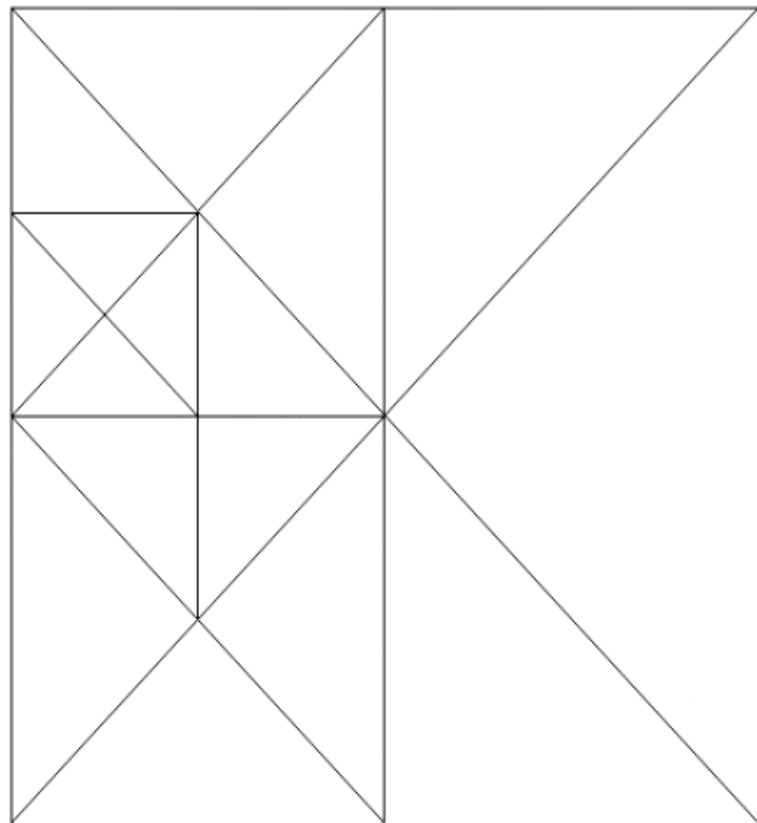
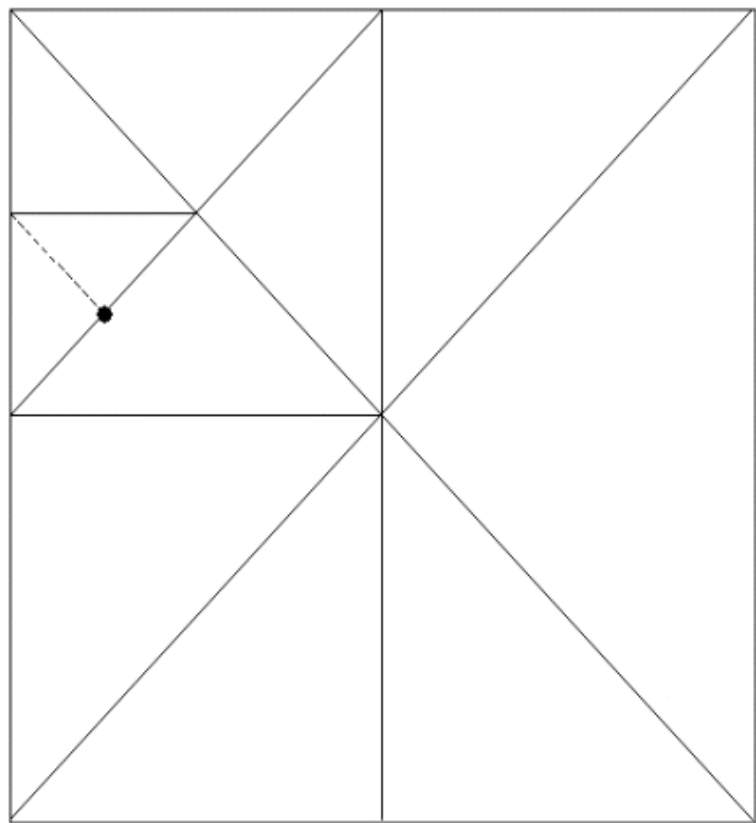
지형의 LOD



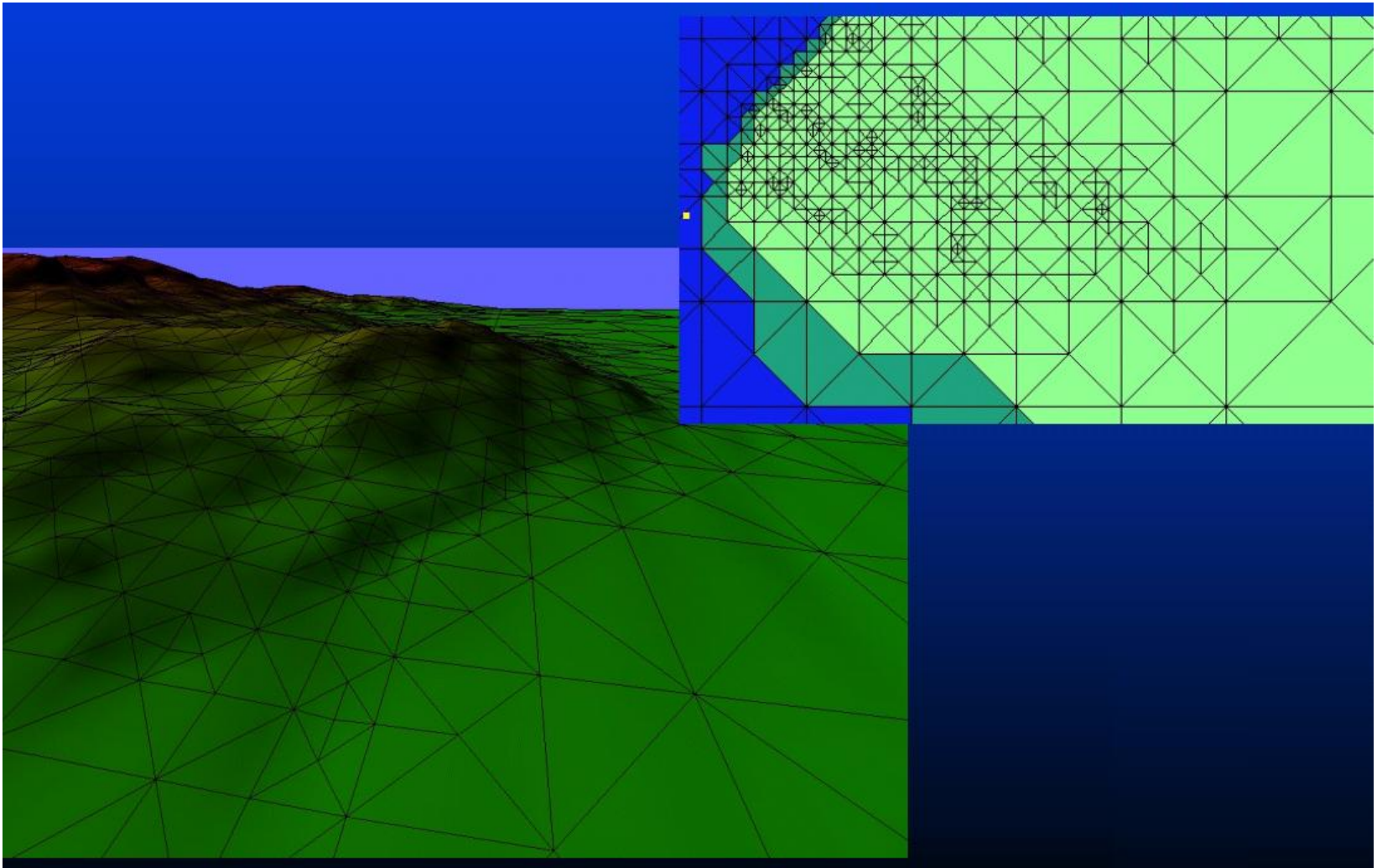
Quadtree and Bintree



T-Junction 처리



지형의 LOD



지형의 LOD

