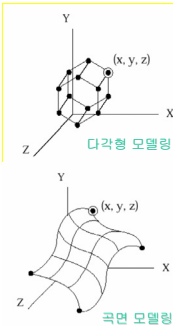
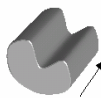


3차원 모델링

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



3차원 모델링

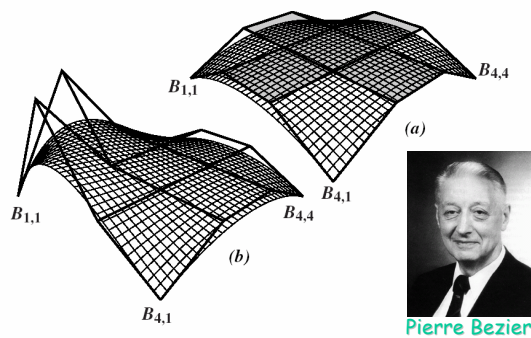
서울대학교 컴퓨터공학부

김명수

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

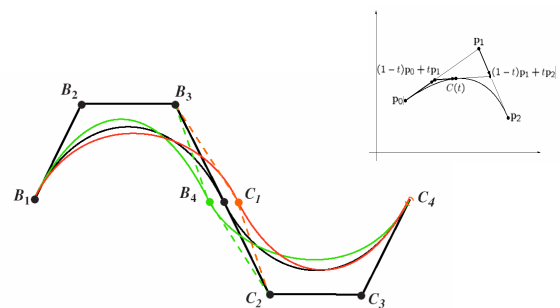
<http://3map.snu.ac.kr>

Bezier 곡면

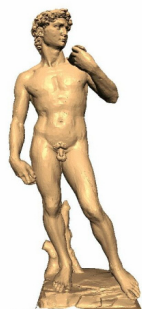


Pierre Bezier

Bezier 곡선



3차원 모델링의 예

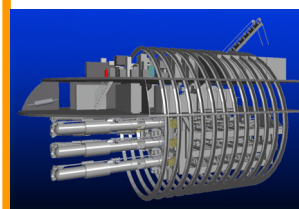


5600만 polygon



1700만 polygon

다각형 모델링의 예

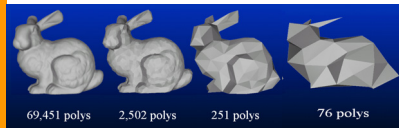


70만 다각형

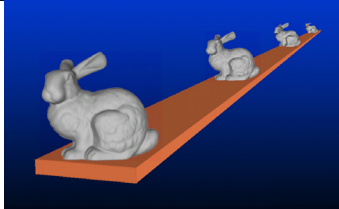


1300만 다각형

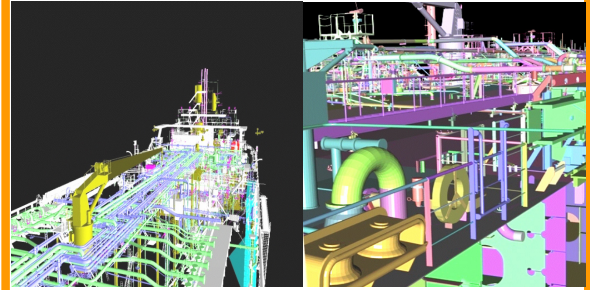
Level of Detail (LOD)



69,451 polys 2,502 polys 251 polys 76 polys



3차원 모델링의 예



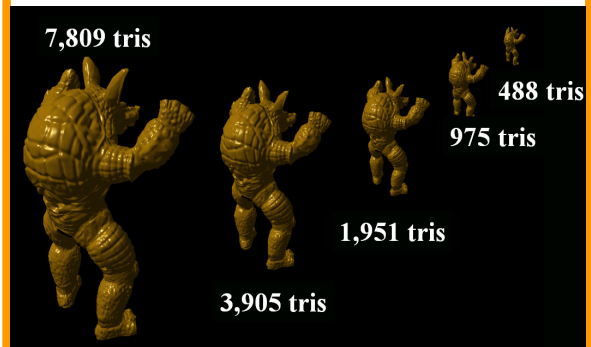
8200만 polygon

Level of Detail (LOD)



Triangles:
41,855
27,970
20,922
12,939
8,385
4,766

Level of Detail (LOD)



7,809 tris

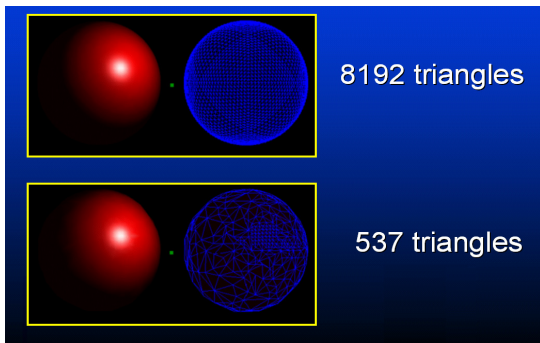
488 tris

975 tris

1,951 tris

3,905 tris

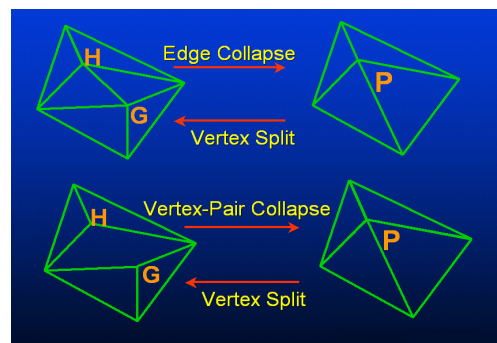
시점 종속 LOD



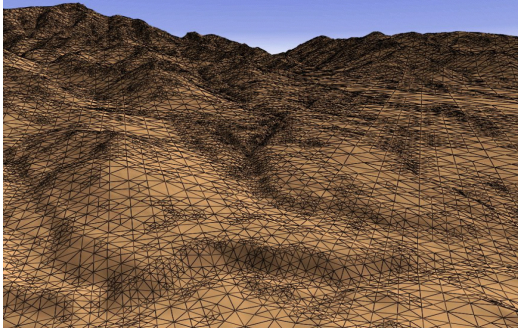
8192 triangles

537 triangles

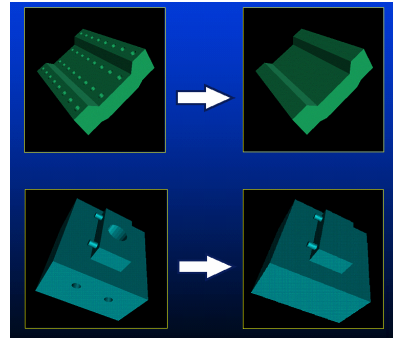
LOD 생성방법



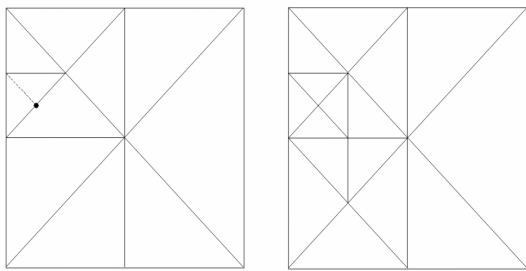
지형의 LOD



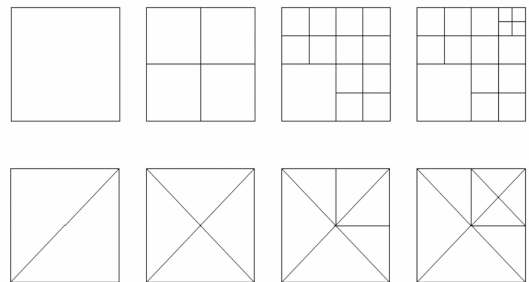
특징기반 LOD



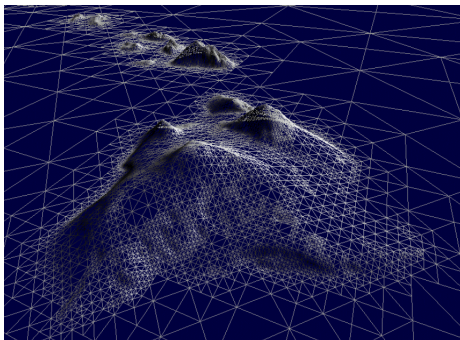
T-Junction 처리



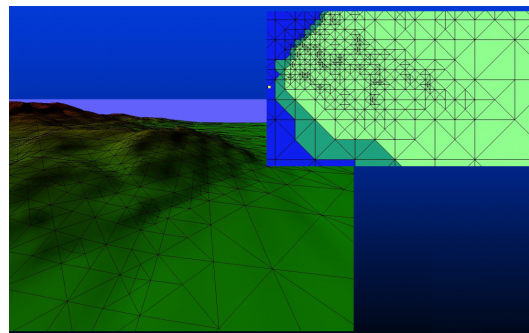
Quadtree and Bintree



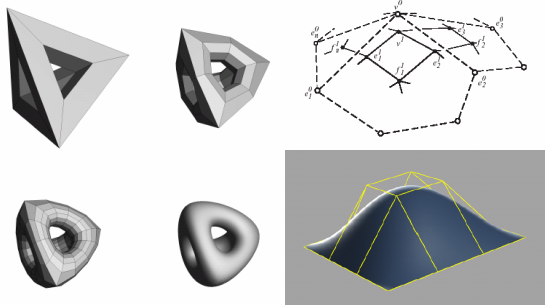
지형의 LOD



지형의 LOD

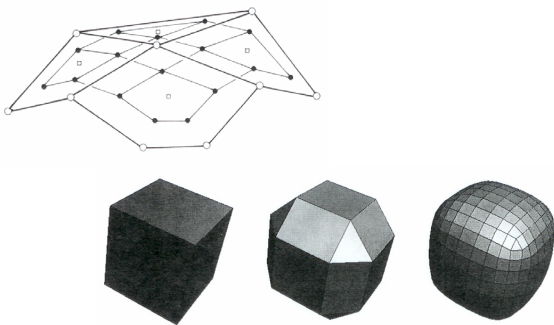


Subdivision 곡면

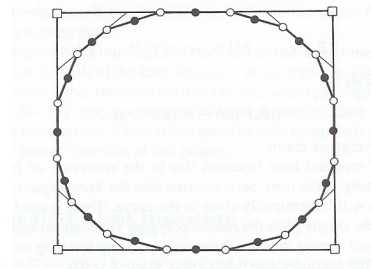


고급 그래픽스 기법들

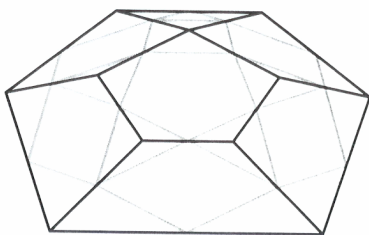
Doo-Sabin 알고리즘



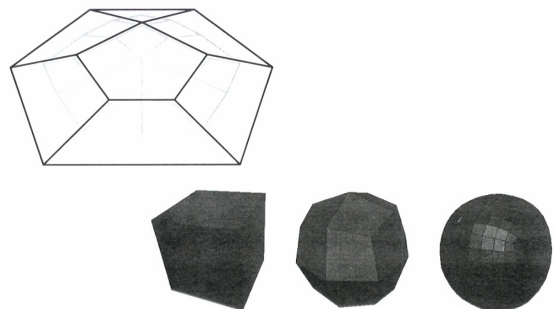
Chaikin의 알고리즘 (1974)



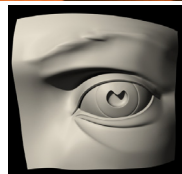
중간점 분할 알고리즘



Catmull-Clark 알고리즘



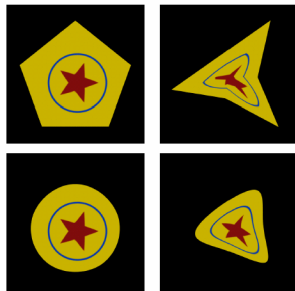
Subdivision 곡면 모델링의 예



Geri's Game: Pixar Animation



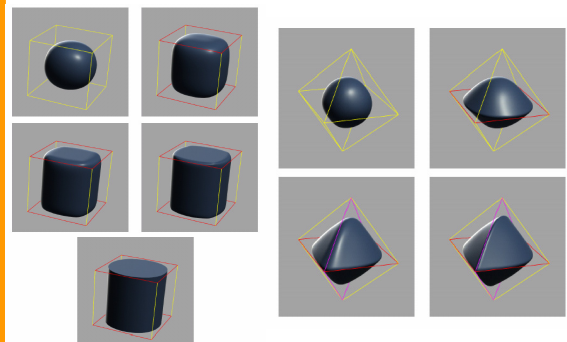
텍스처 매핑



5개의 삼각형으로 이루어진 다각형에 대한 텍스처 매핑

Subdivision 곡면으로 모델링된 경우의 텍스처 매핑

Sharpness 제어

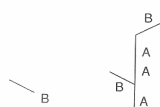


식물체 성장모델링

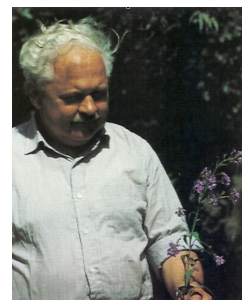
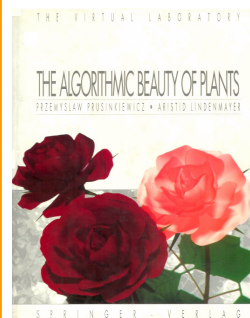
• $A \rightarrow AA$
• $B \rightarrow A[B]AA[B]$



• $A \rightarrow AA$
• $B \rightarrow A[B]AA(B)$

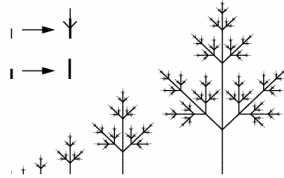
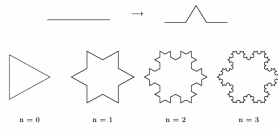


L-System



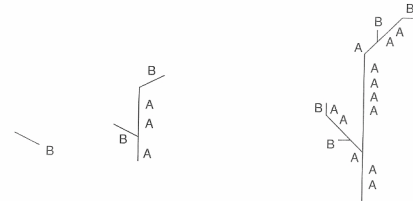
Aristid Lindenmayer (1925-1989)

문법기반 모델링



식물체 성장모델링

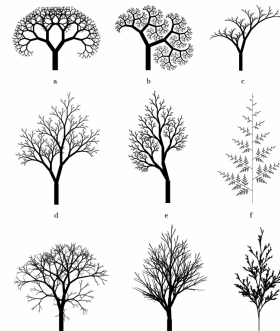
$B \Rightarrow A[B]AA(B)$
 $\Rightarrow AA[A[B]AA(B)]AAAA(A[B]AA(B))$



다양한 형태의 나무 모델링



다양한 형태의 나무 모델링



식물 모델링 프로그램



```
#define S /* seed shape */
#define R /* ray floret shape */
#include M N O P /* petal shapes */

ω : A(0)
p1 : A(n) : * → +(137.5) [f(m/0.5)C(n)]A(n+1)
p2 : C(n) : n ≤ 440 → ~S
p3 : C(n) : 440 < n & n ≤ 565 → ~R
p4 : C(n) : 565 < n & n ≤ 580 → ~M
p5 : C(n) : 580 < n & n ≤ 595 → ~N
p6 : C(n) : 595 < n & n ≤ 610 → ~U
p7 : C(n) : 610 < n → ~P
```

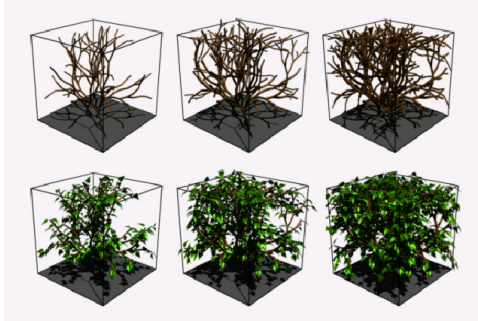
나무 모델링 프로그램



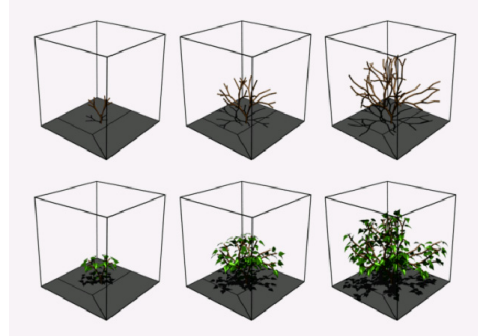
```
n = 10
#define r1 0.9 /* contraction ratio 1 */
#define r2 0.7 /* contraction ratio 2 */
#define a1 10 /* branching angle 1 */
#define a2 60 /* branching angle 2 */
#define w_r 0.707 /* width decrease rate */

ω : A(1,10)
p1 : A(l,w) : * → !(w)F(1) [k(a1)B(l*r1,w*w_r)]
/((180) [k(a2)B(l*r2,w*w_r)]
p2 : B(l,w) : * → !(w)F(1) [(+a1)$B(l*r1,w*w_r)]
[-(a2)$B(l*r2,w*w_r)]
```

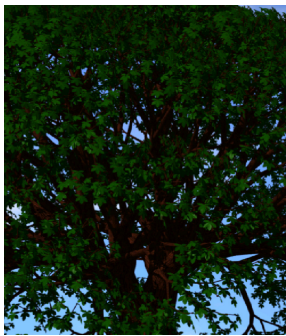
식물성장 모델링



식물성장 모델링



나무 모델링 및 렌더링



식물성장 모델링



식물체 모델링 및 렌더링

