CS 498VR: Virtual Reality

In-class Worksheet

## Simulating Motion and Spatial Data Structures

## 1. Numerical Integration

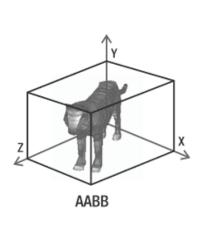
Given a function for acceleration and an initial position and velocity, at a time t=0 we can approximate the function for position with respect to time by using Euler integration:

$$p(t + \Delta) = p(t) + \dot{p}(t)\Delta t$$
 and  $\dot{p}(t + \Delta) = \dot{p}(t) + \ddot{p}(t)\Delta t$ 

What are two factors that influence the amount of error in our approximation?

## 2. Axis-Aligned Bounding Box

Suppose we have a geometric model expressed as a triangle mesh in an indexed-face format. Describe an efficient way to compute an AABB that encloses the mesh.

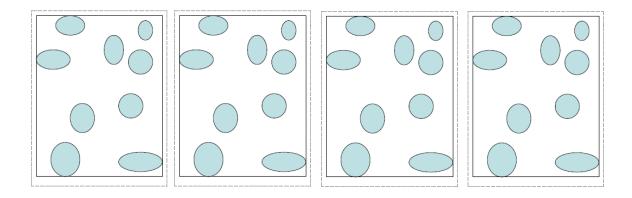


	Face List
fO	v0 v4 v5
f1	v0 v5 v1
f2	v1 v5 v6
f3	v1 v6 v2
f4	v2 v6 v7
f5	v2 v7 v3
f6	v3 v7 v4
f7	v3 v4 v0
f8	v8 v5 v4
f9	v8 v6 v5
f10	v8 v7 v6
f11	v8 v4 v7
f12	v9 v5 v4
f13	v9 v6 v5
f14	v9 v7 v6
f15	v9 v4 v7

Vertex List		
v0	0,0,0	f0 f1 f12 f15 f7
v1	1,0,0	f2 f3 f13 f12 f1
V2	1,1,0	f4 f5 f14 f13 f3
v3	0,1,0	f6 f7 f15 f14 f5
V4	0,0,1	f6 f7 f0 f8 f11
v5	1,0,1	f0 f1 f2 f9 f8
v6	1,1,1	f2 f3 f4 f10 f9
٧7	0,1,1	f4 f5 f6 f11 f10
v8	.5,.5,0	f8 f9 f10 f11
v9	.5,.5,1	f12 13 14 15

## 3. Bounding Volume Hierarchy

a. Draw 4 levels of a bounding volume hierarchy for the following objects below, splitting (approximately) either on the median centroid or the average centroid. Split on the longest axis.



b. Is it possible for two nodes in a BVH to intersect? If not, why not? If so, draw such a situation and describe in what way this will affect a collision detection system.