Playing with Collisions

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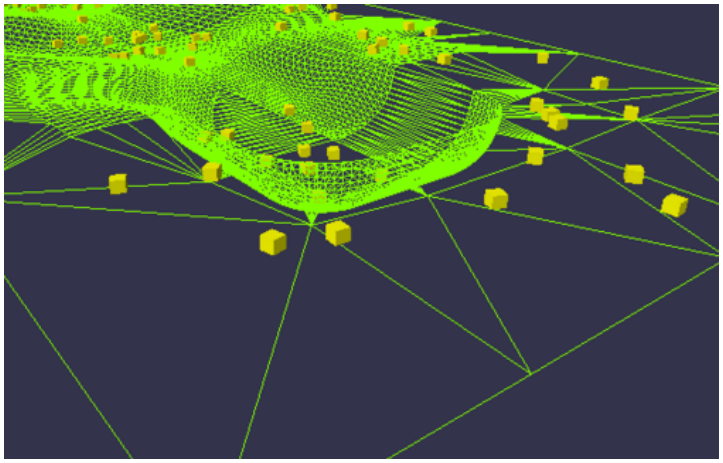
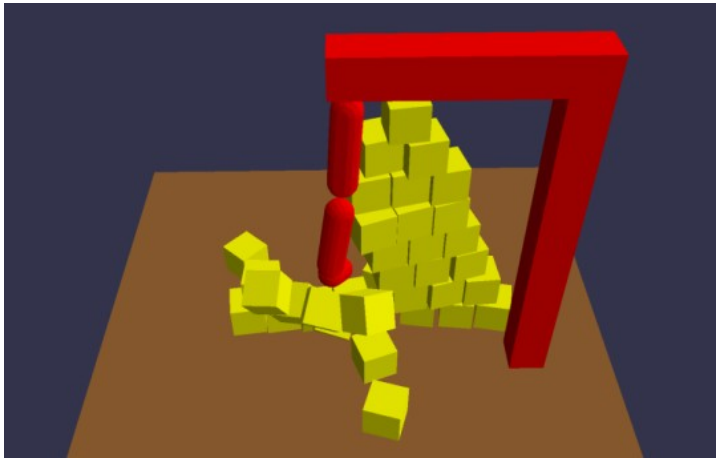
Current Game Physics

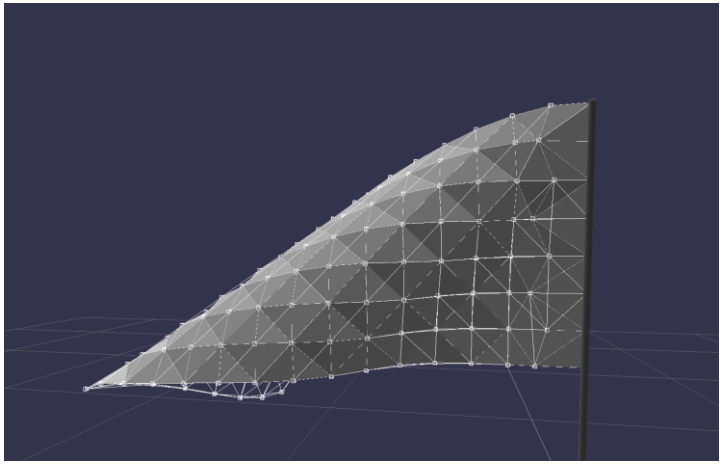


Avoiding Interpenetration

Object Motion

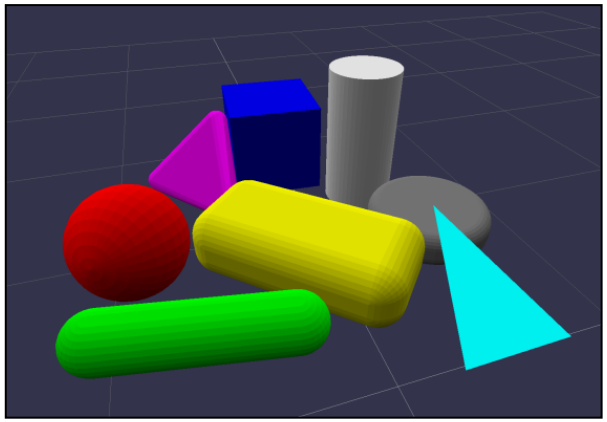


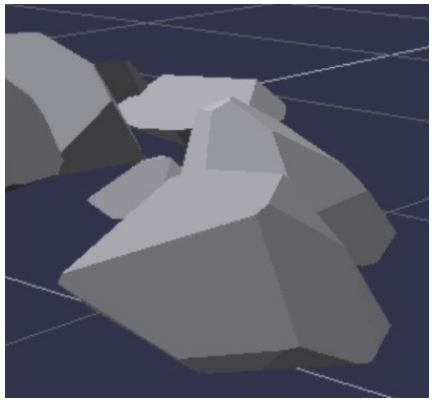
Simulate Stacking and Joints

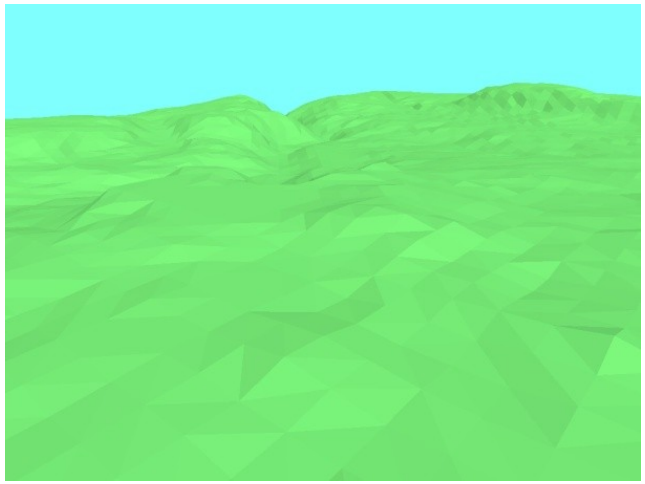


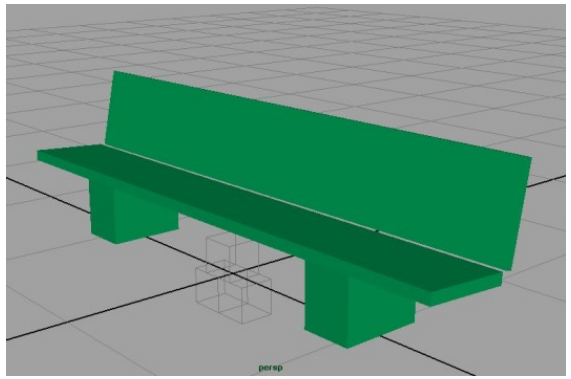
Cloth and Clothing

Collision Shapes

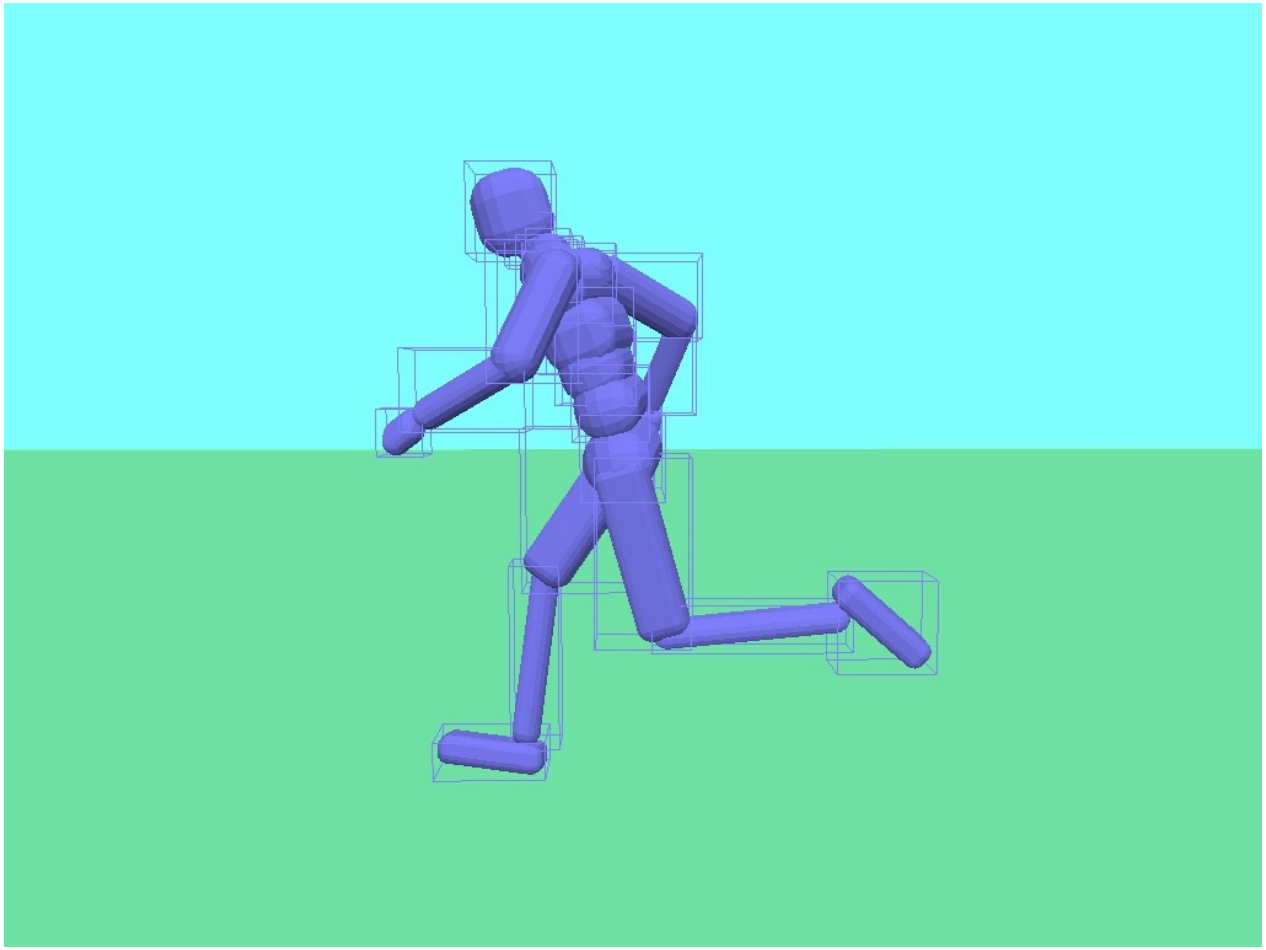








Bounding Volumes



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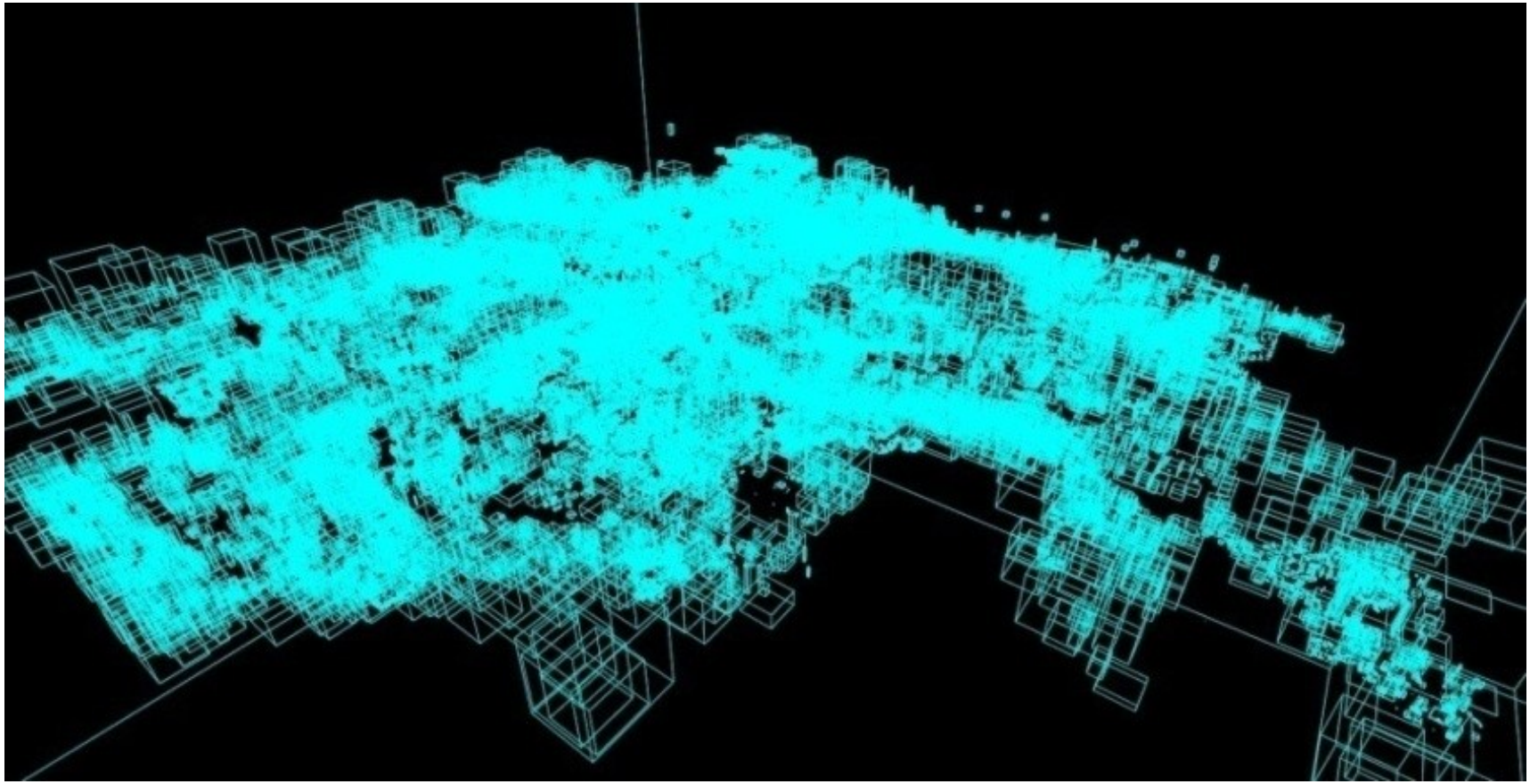
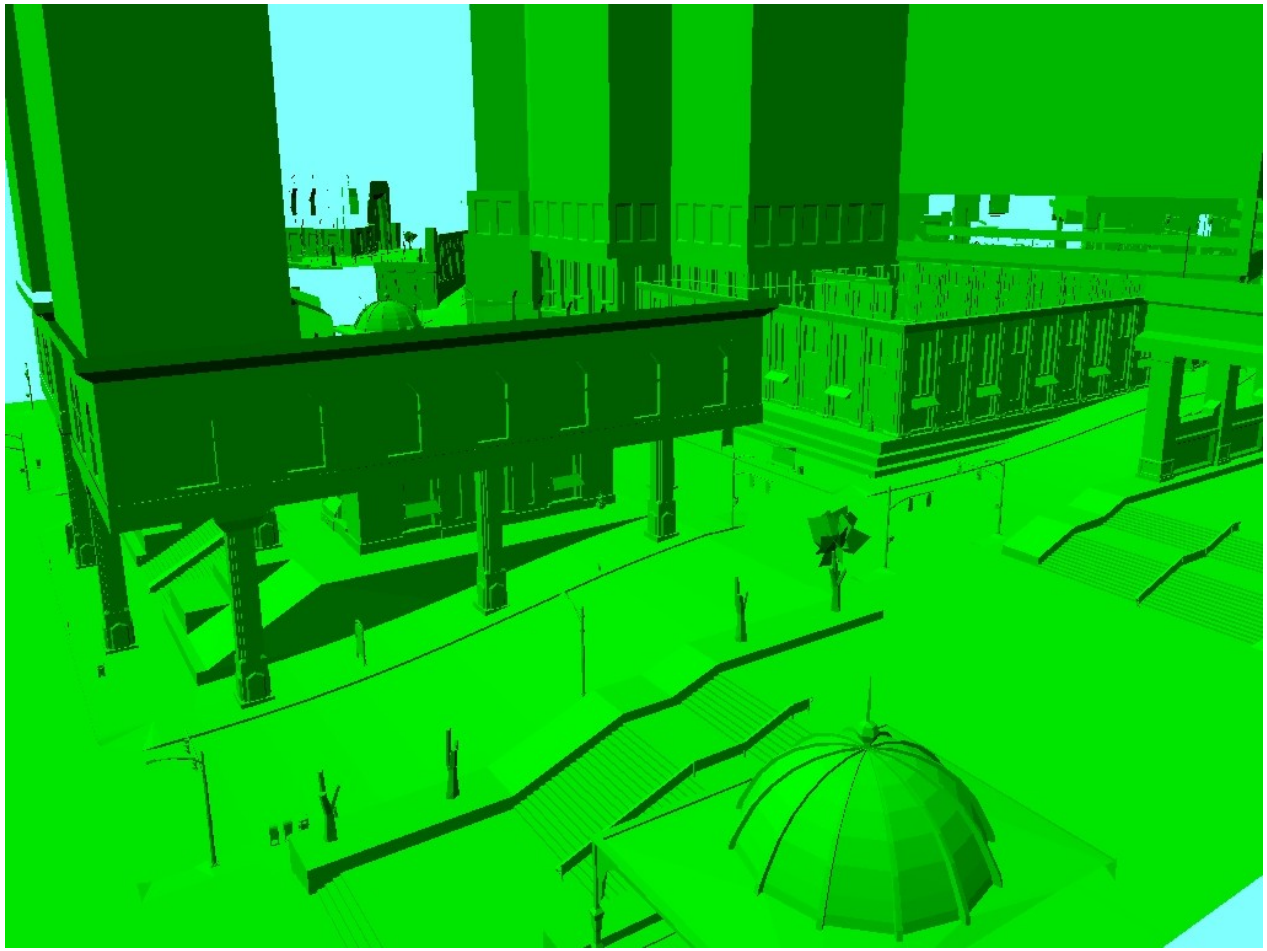
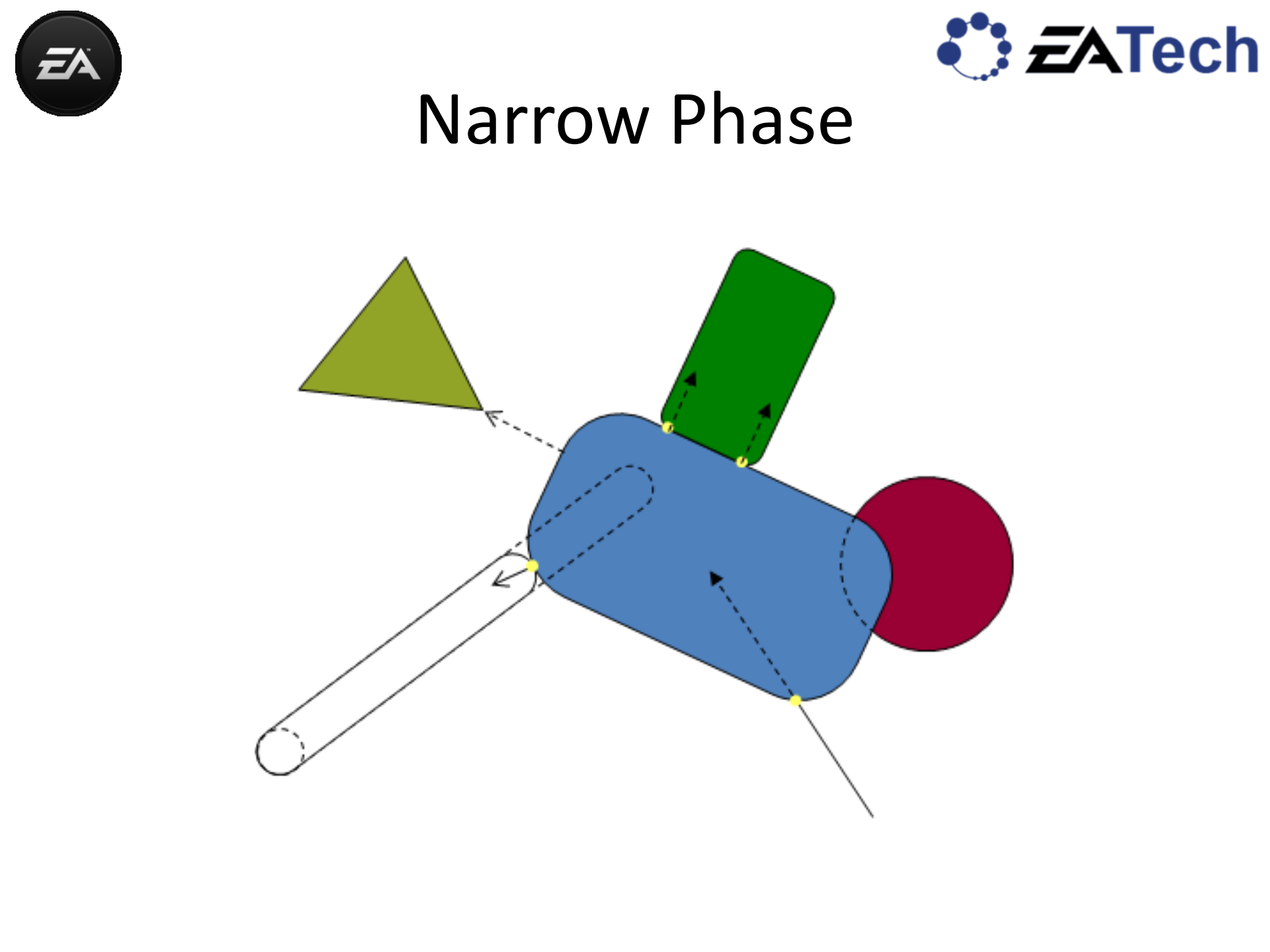
Broad Phase

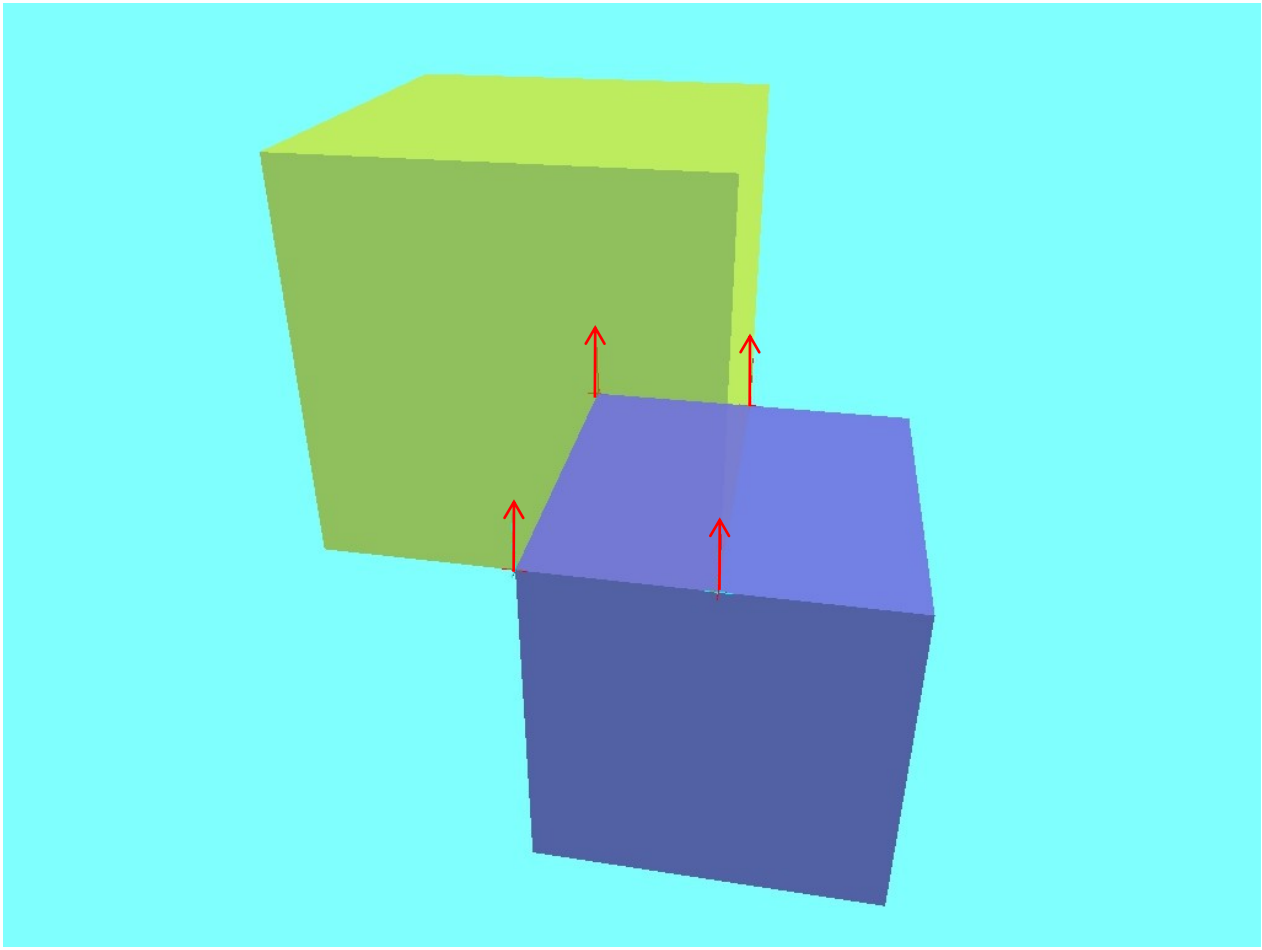


Mid Phase

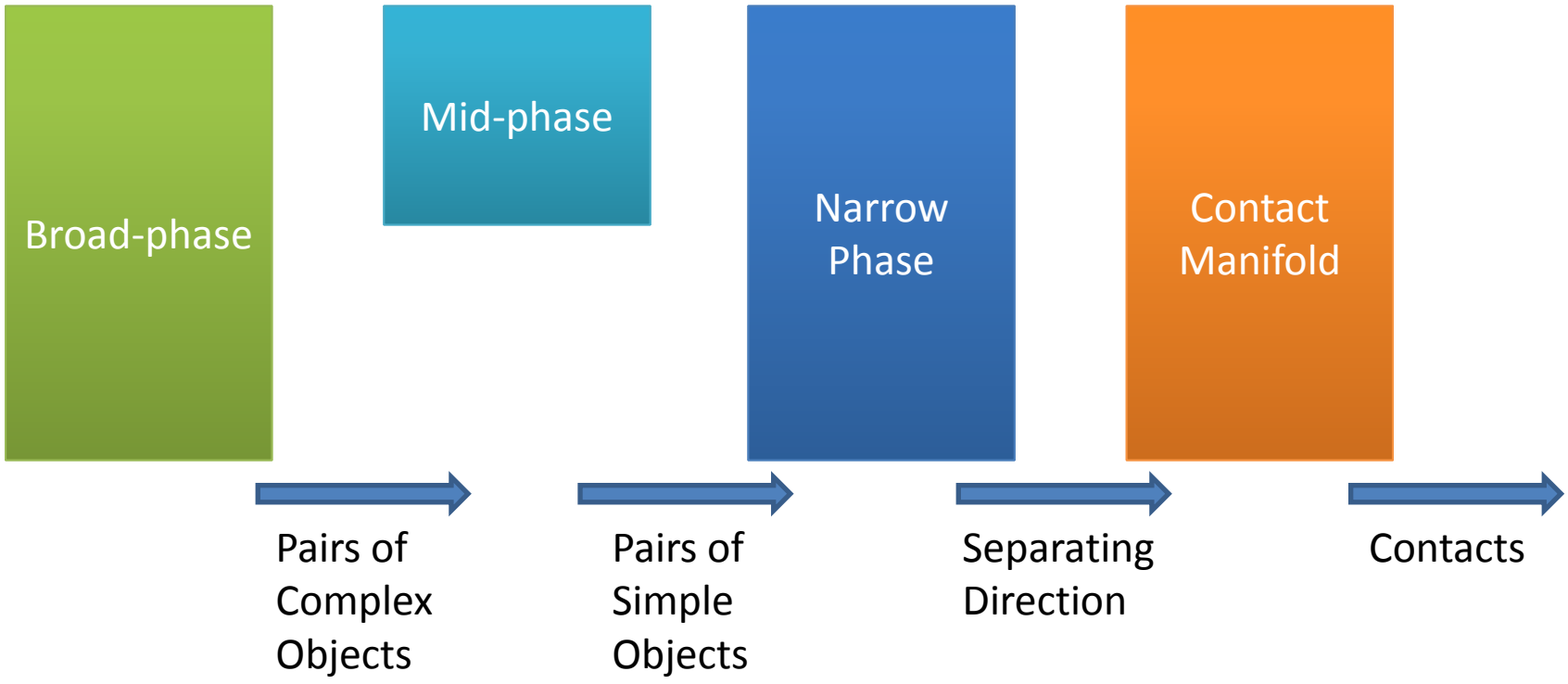



Narrow Phase

Contact Manifolds



Typical Pipeline



Typical Pipeline

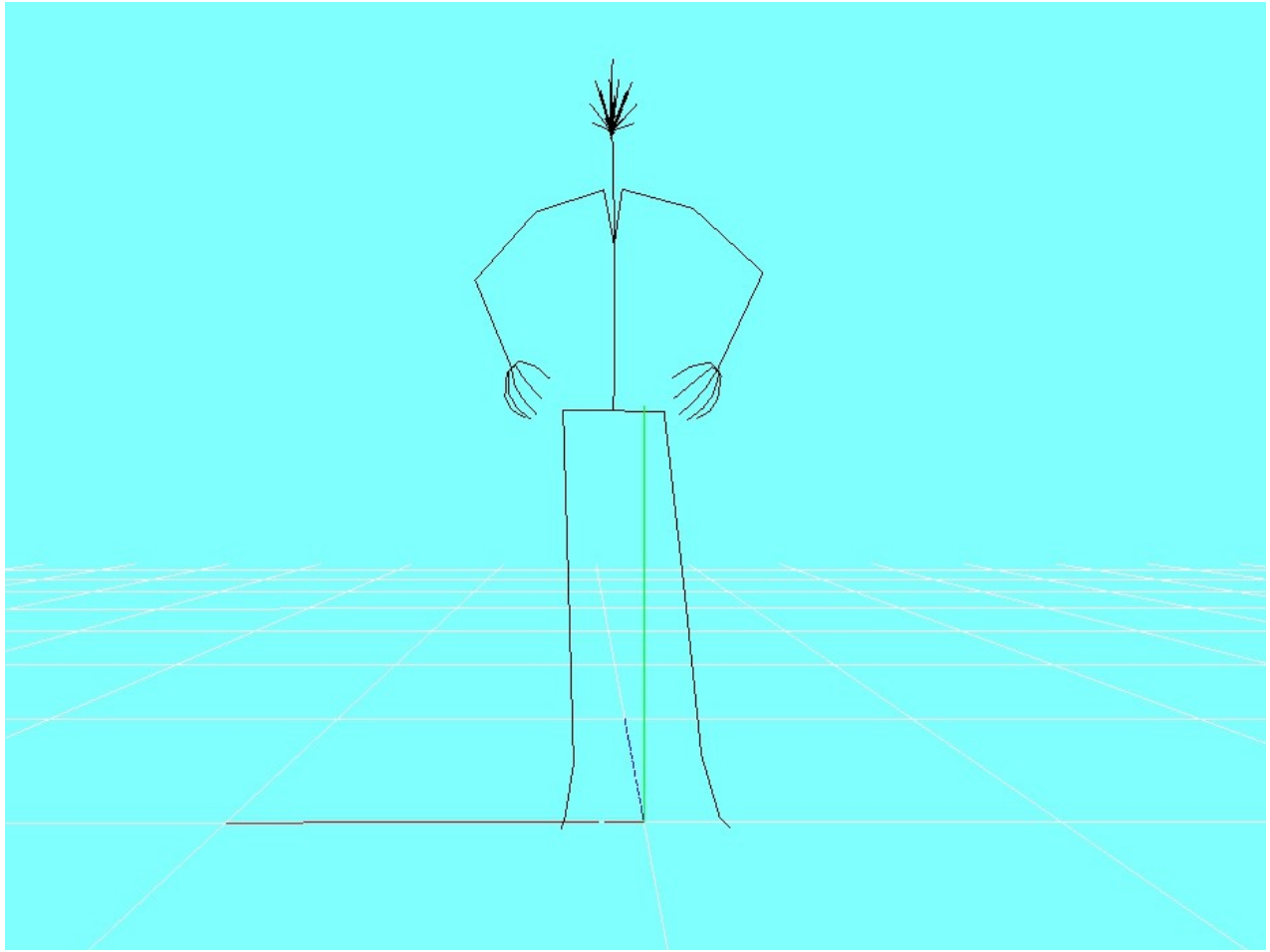
Typical Pipeline

FIFA Example

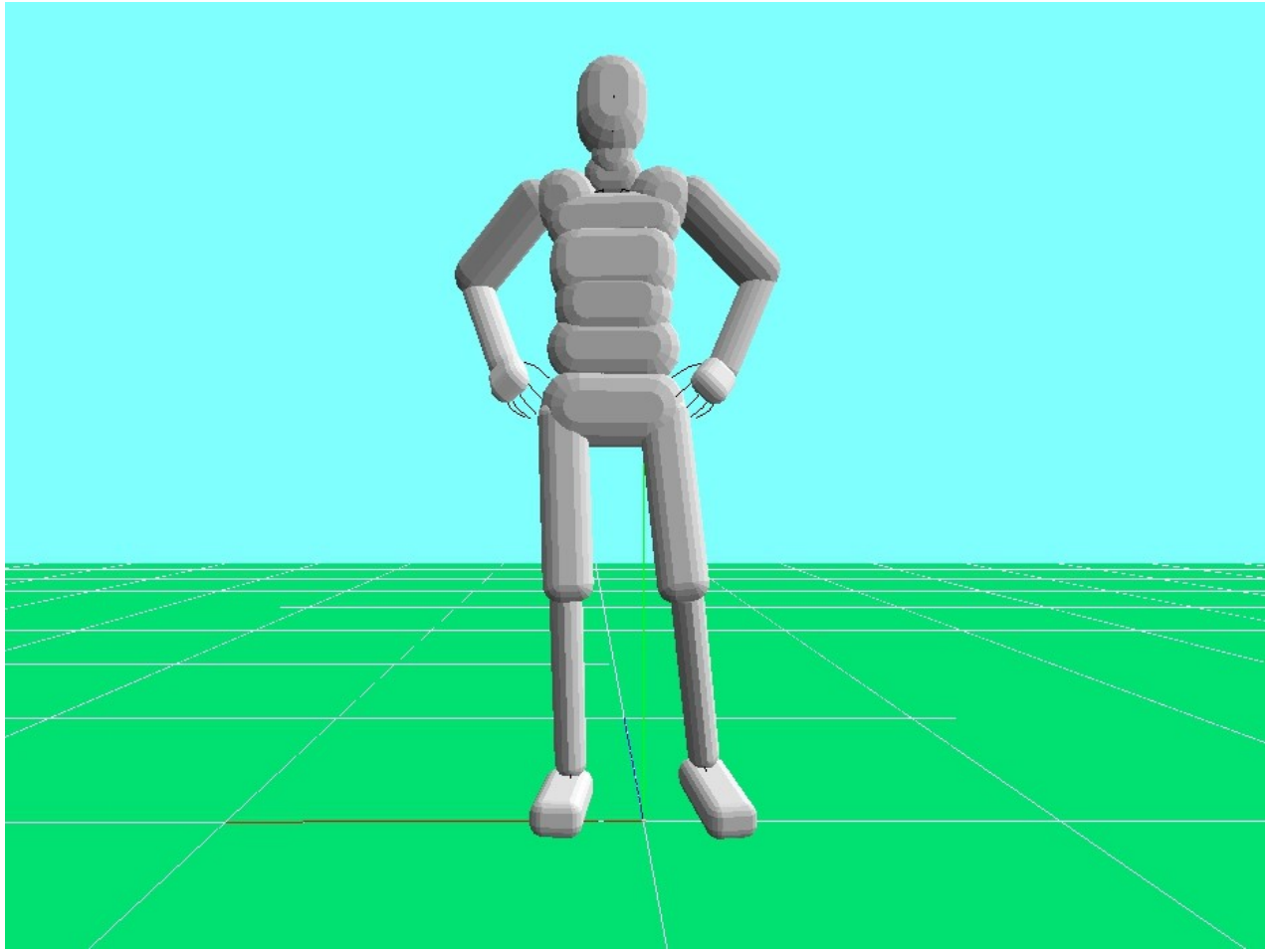
FIFA Example

- Small number of players
- Simple environment
- High level of detail in simulation

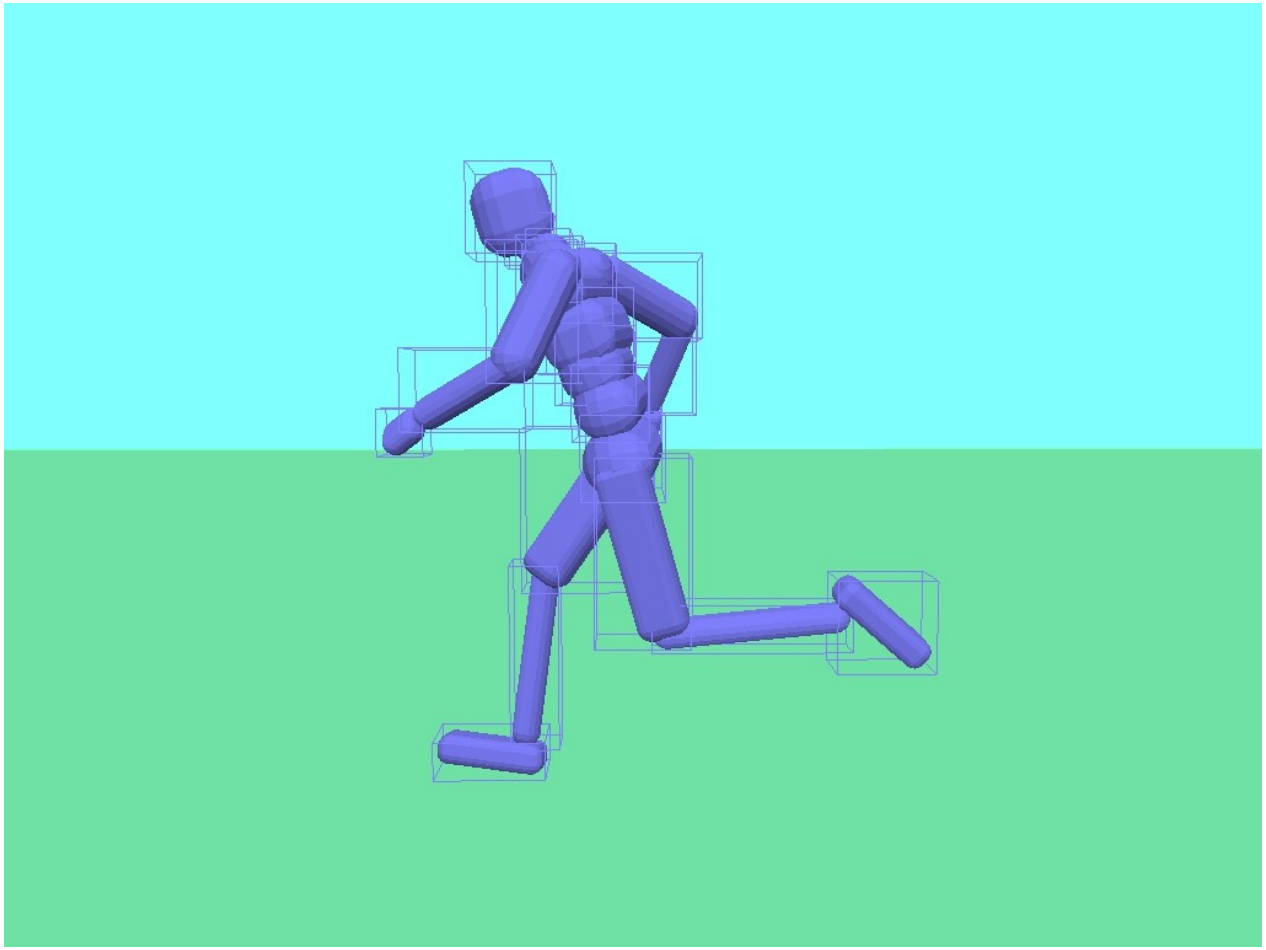
Animation Skeleton



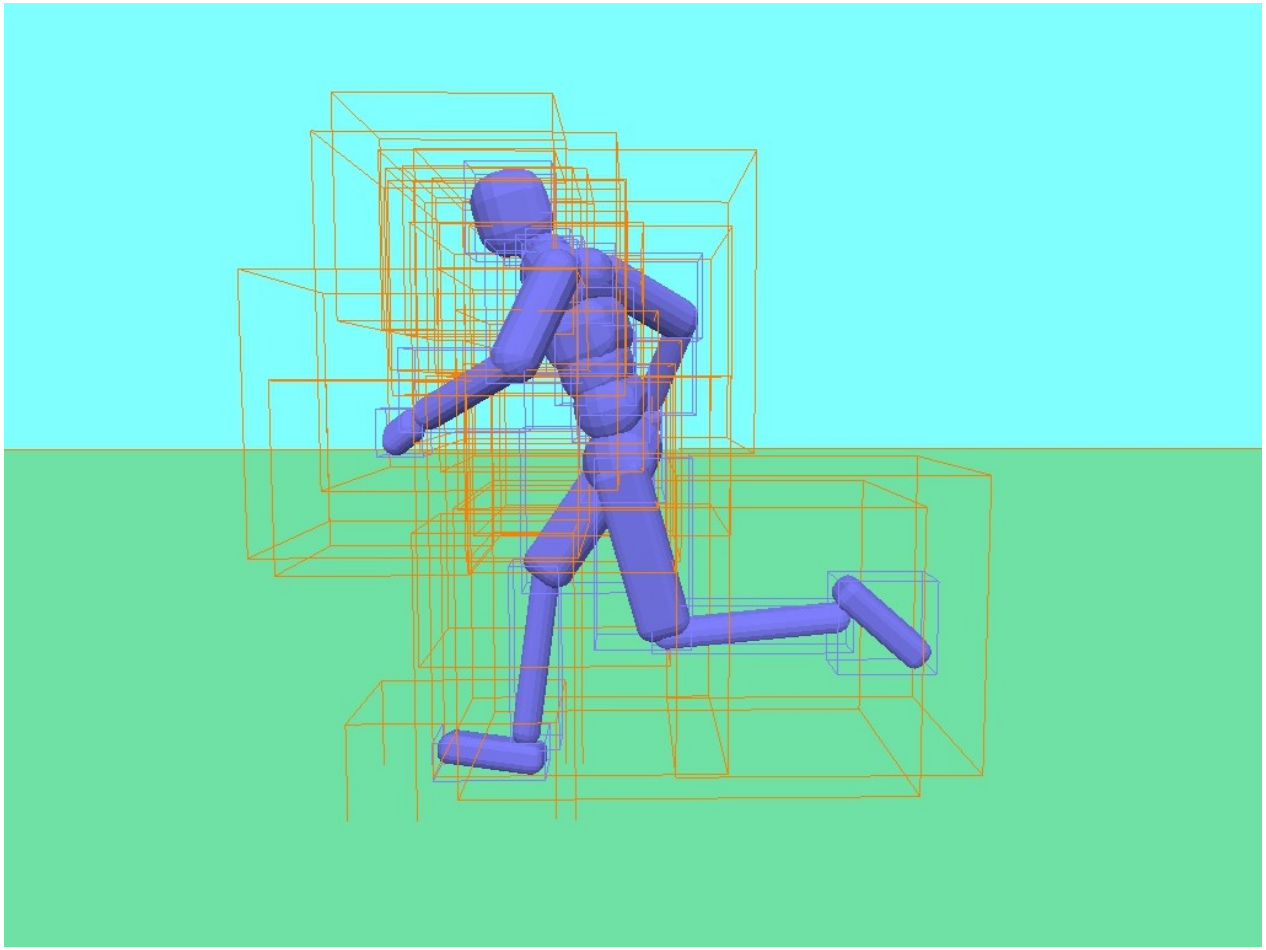
Ragdoll

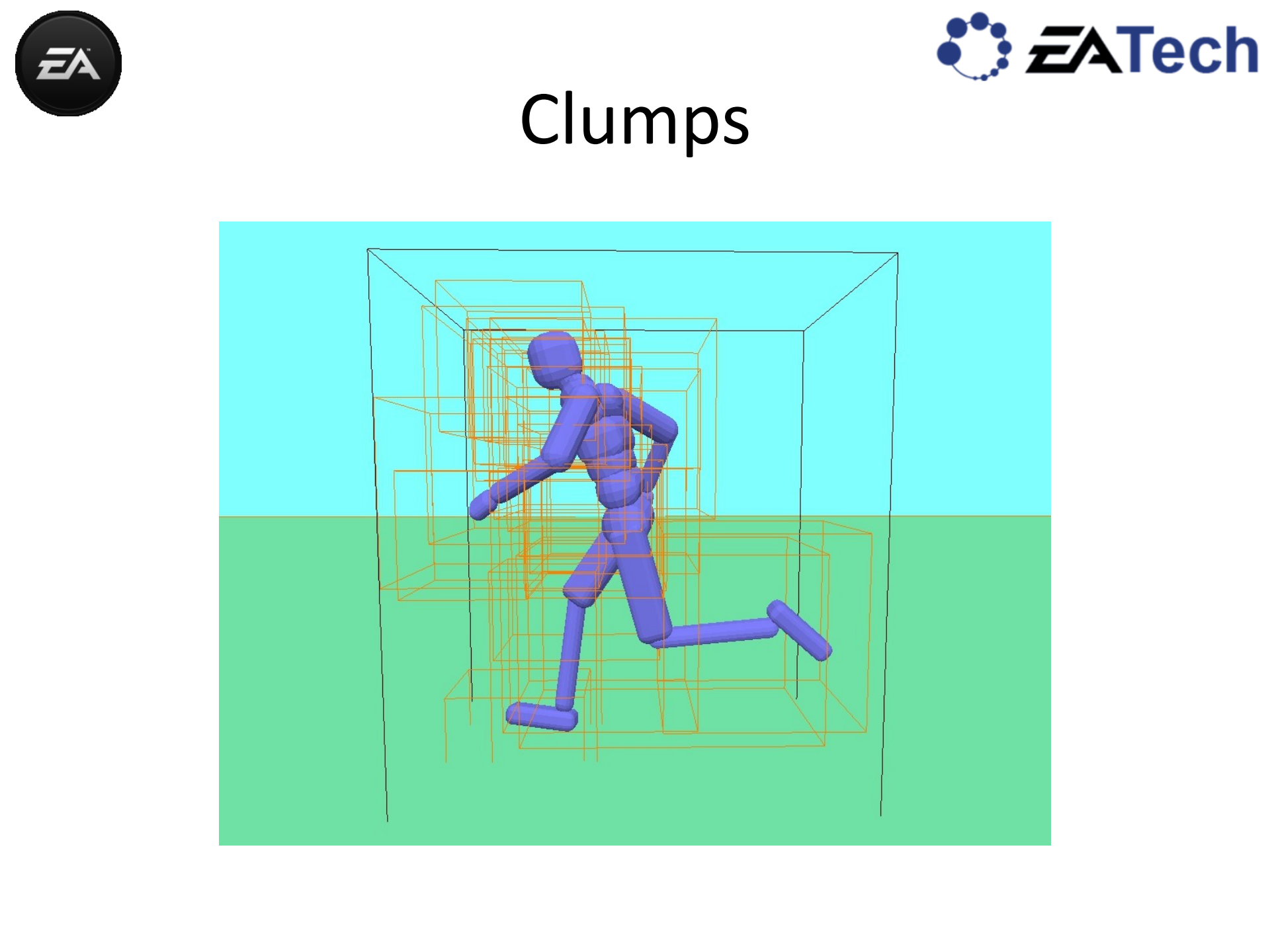


BBoxes



Padding





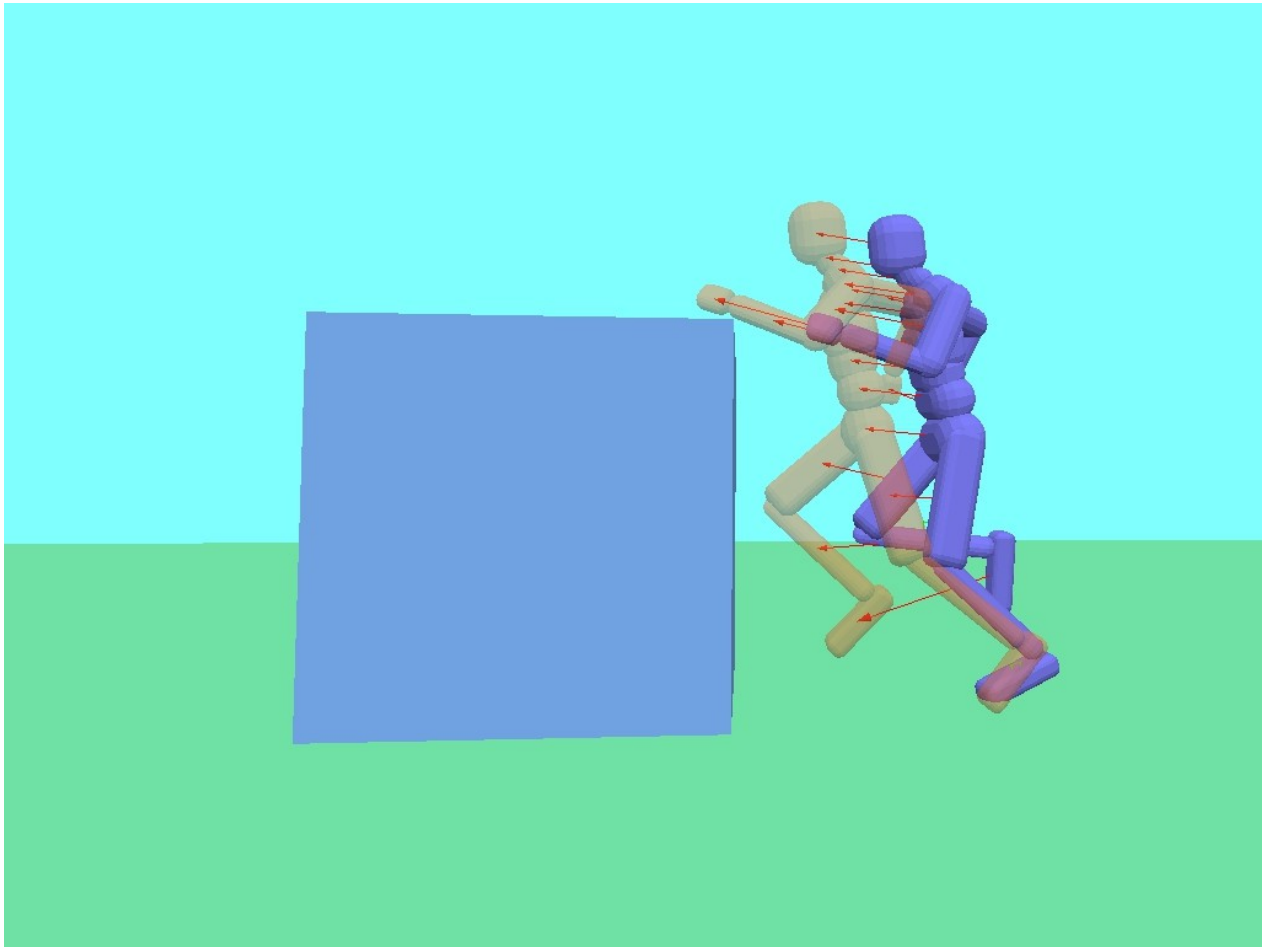
Clumps

Brute Force

	1	2	3	4	5	6	7	8	9
1				X					
2									
3						X	X		
4									
5									
6							X		
7									
8									
9									

$(N^2-N)/2$ ok as long as $N << 100$

Swept Queries



Contact Generation

- Simple primitives
- Frames of change are key points of interest
- No stacking
- Contacts tend to be transitory

FIFA Pipeline

FIFA Video

- http://www.youtube.com/watch?v=xVYnjMc1Z9k

Challenges

- Many contacts in ragdoll-ragdoll collision
- Padded contacts/TOI make it even harder

SSX Example


PS3
PlayStation.Network
SSX
7
www.pegi.info
PROVISIONAL
EA SPORTS

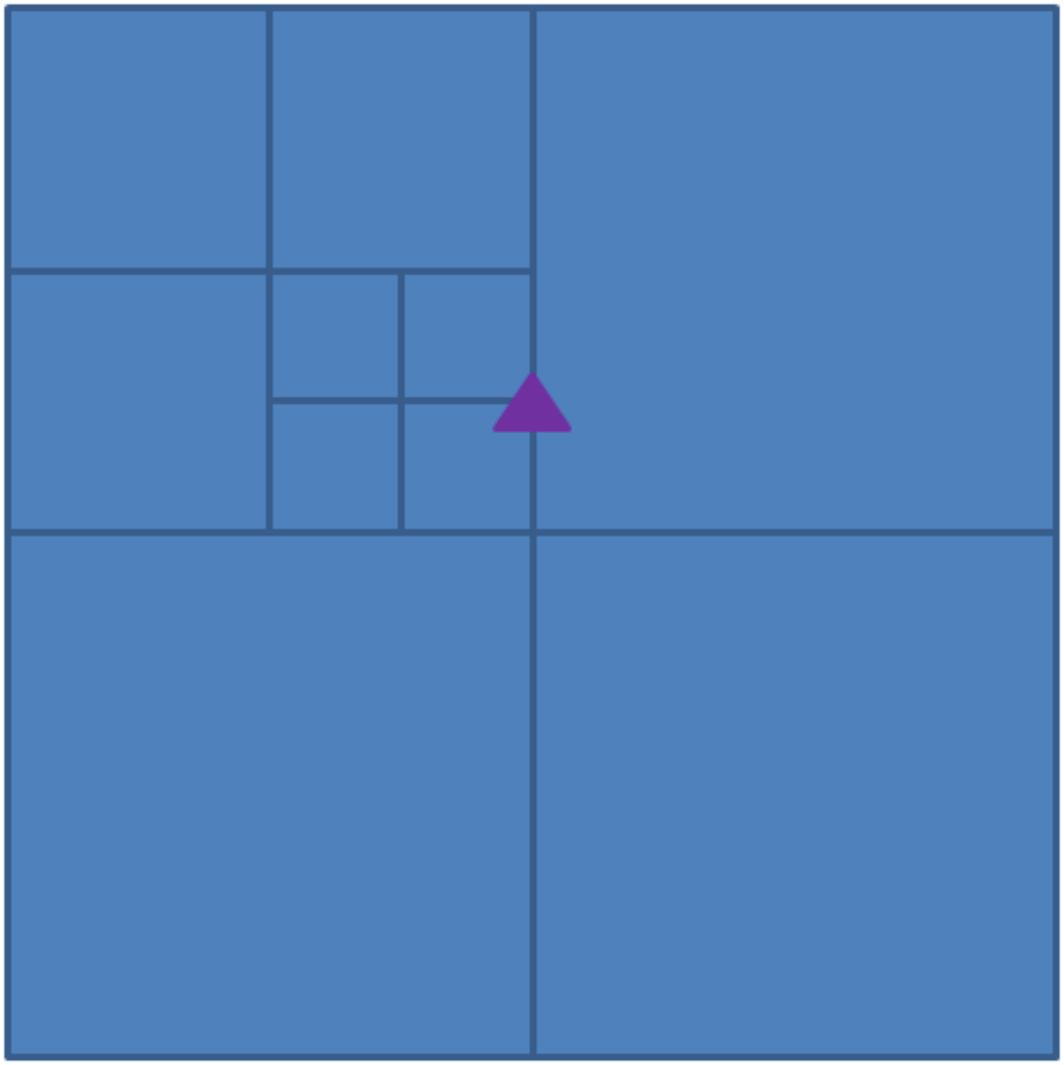
SSX Example

- Lots of ray casting
- Flying carpet of terrain
- Multiple meshes: trees, rocks etc.

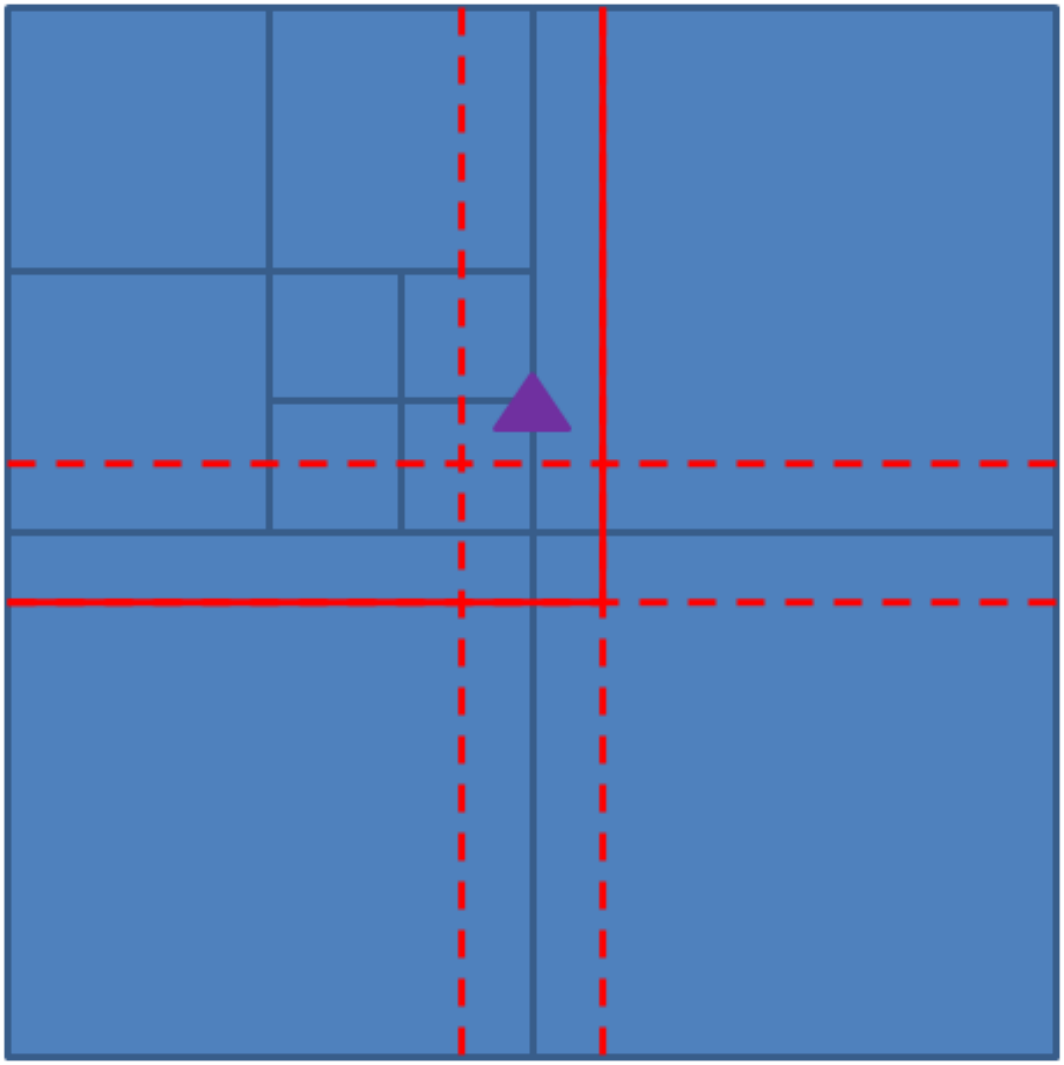
Octree Broad Phase

- Game Programming Gems 1
  - Thatcher Ulrich (2000)
- Add & remove is quick
- AABBox & Line queries supported

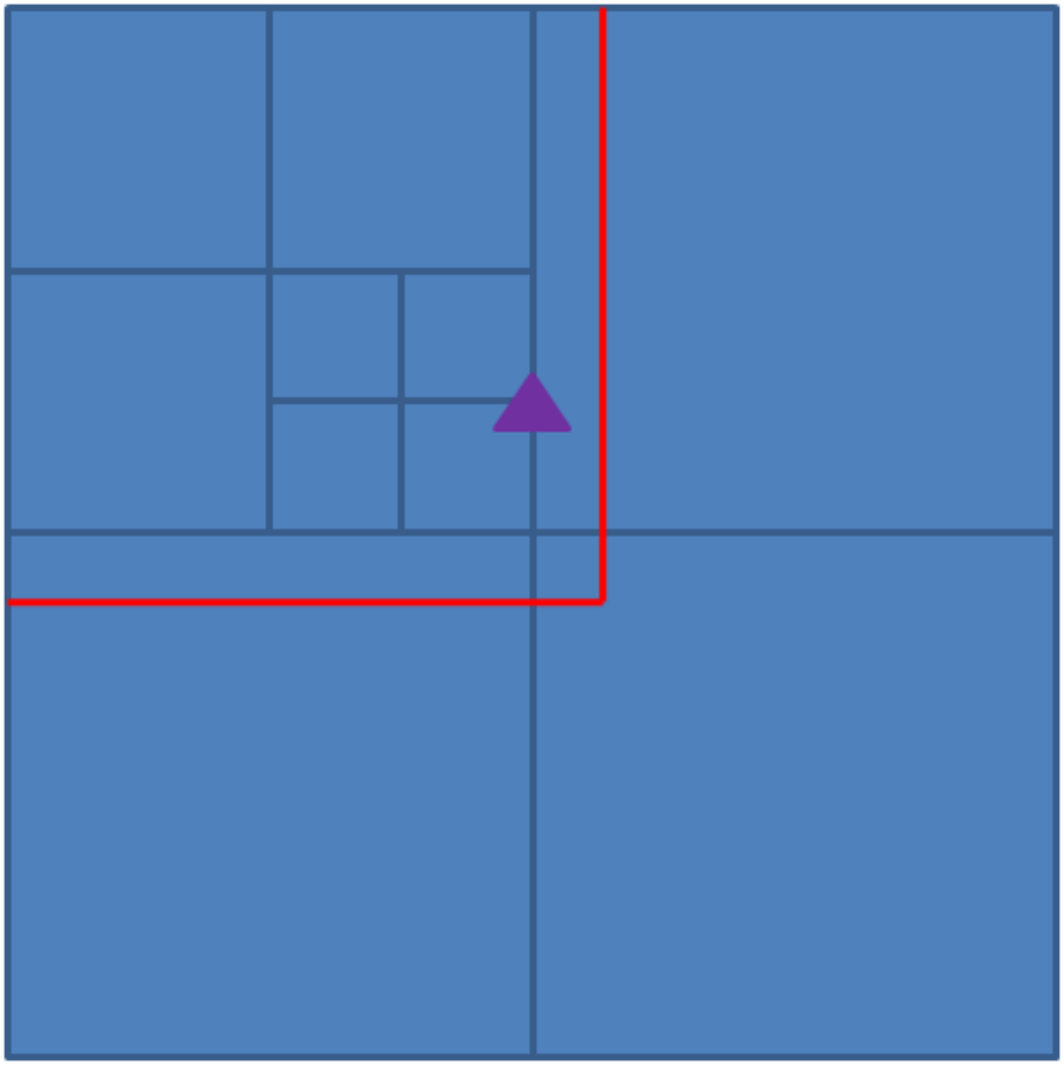
Octree Problem



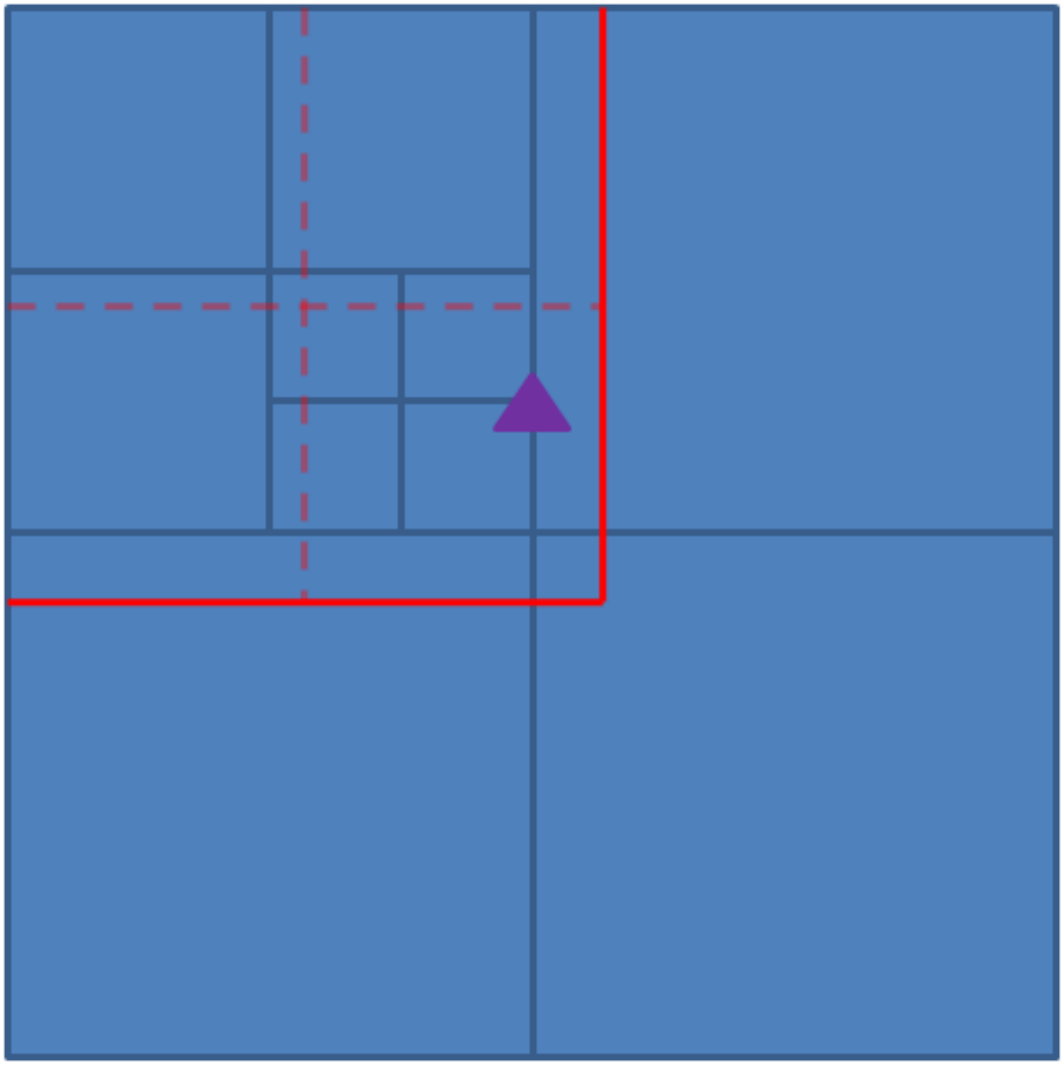
Loose Octree



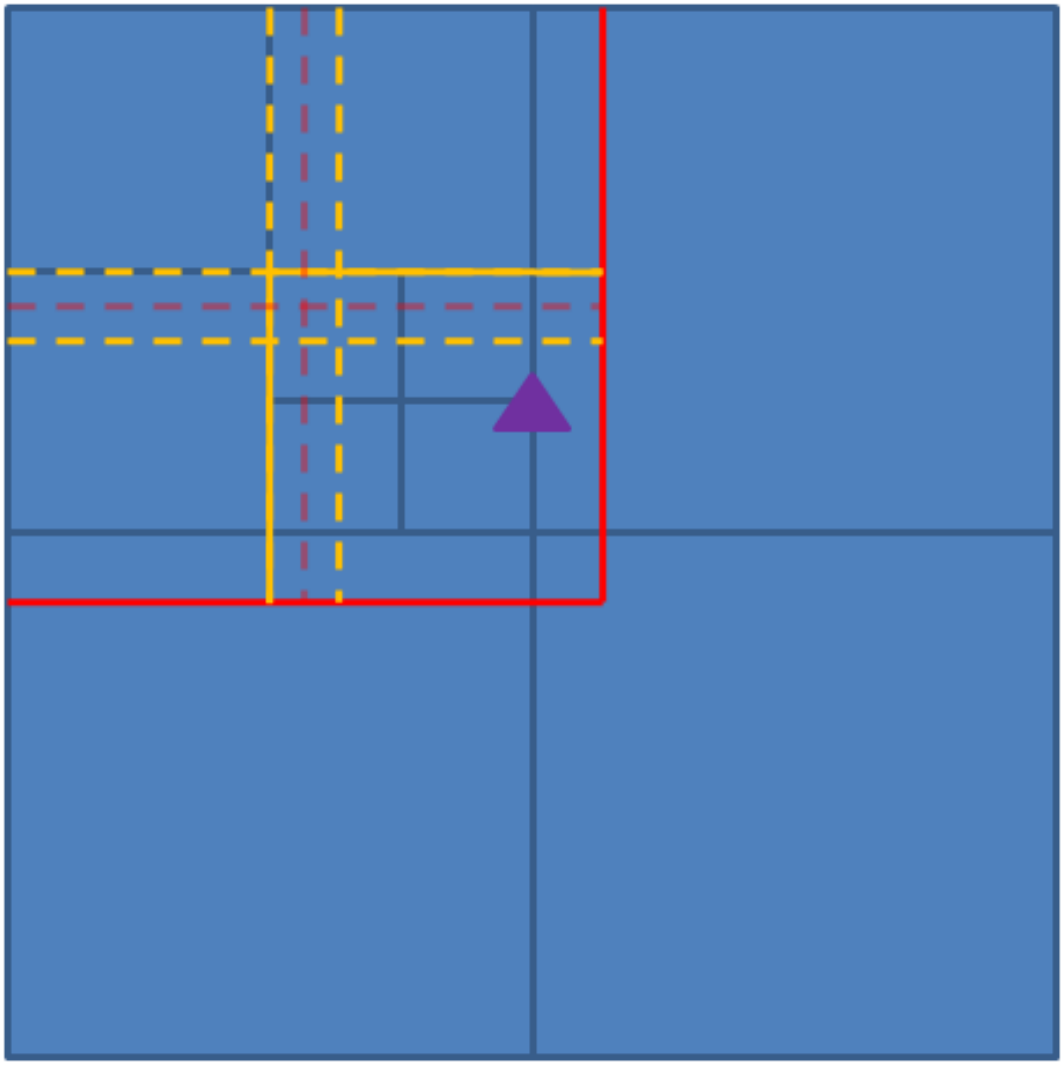
Loose Octree



Loose Octree



Loose Octree



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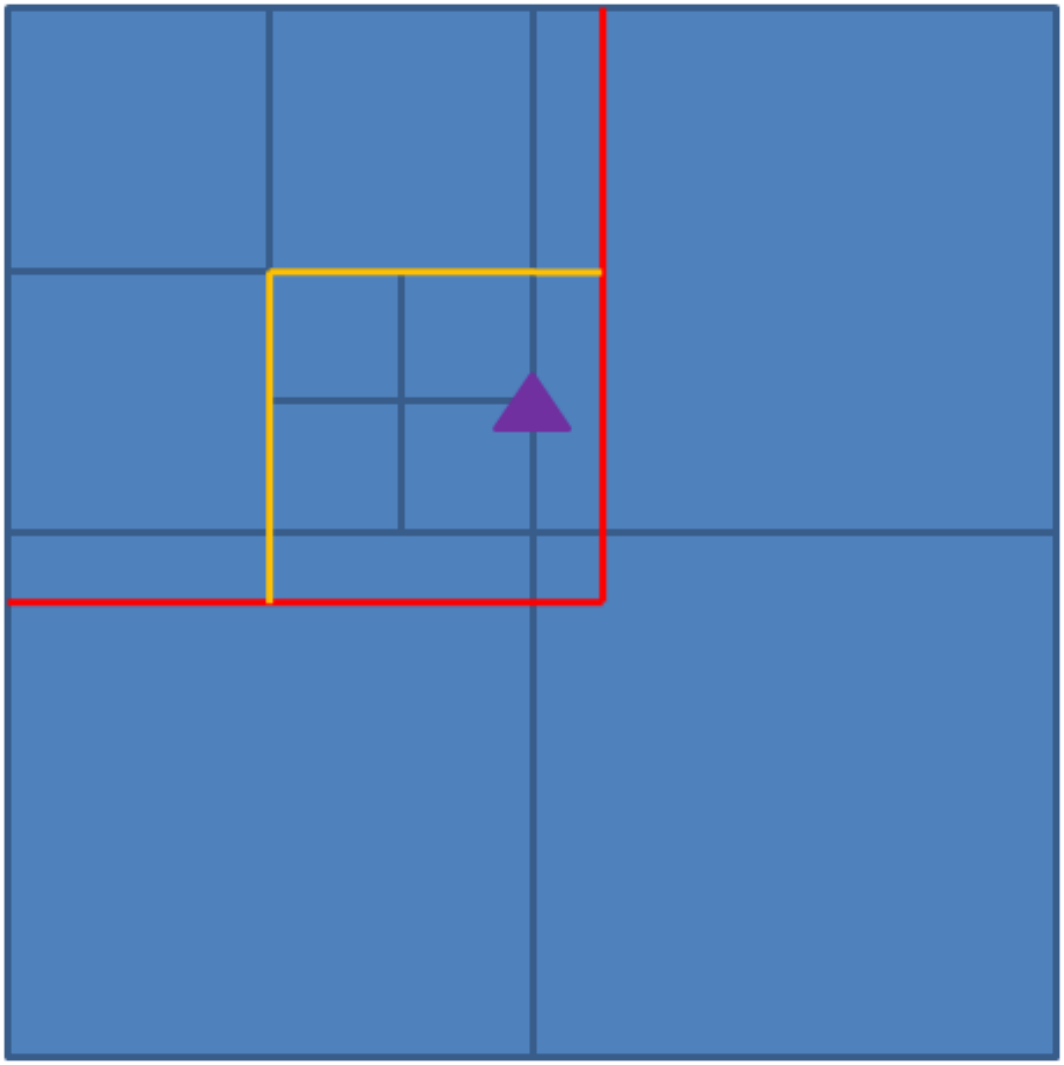

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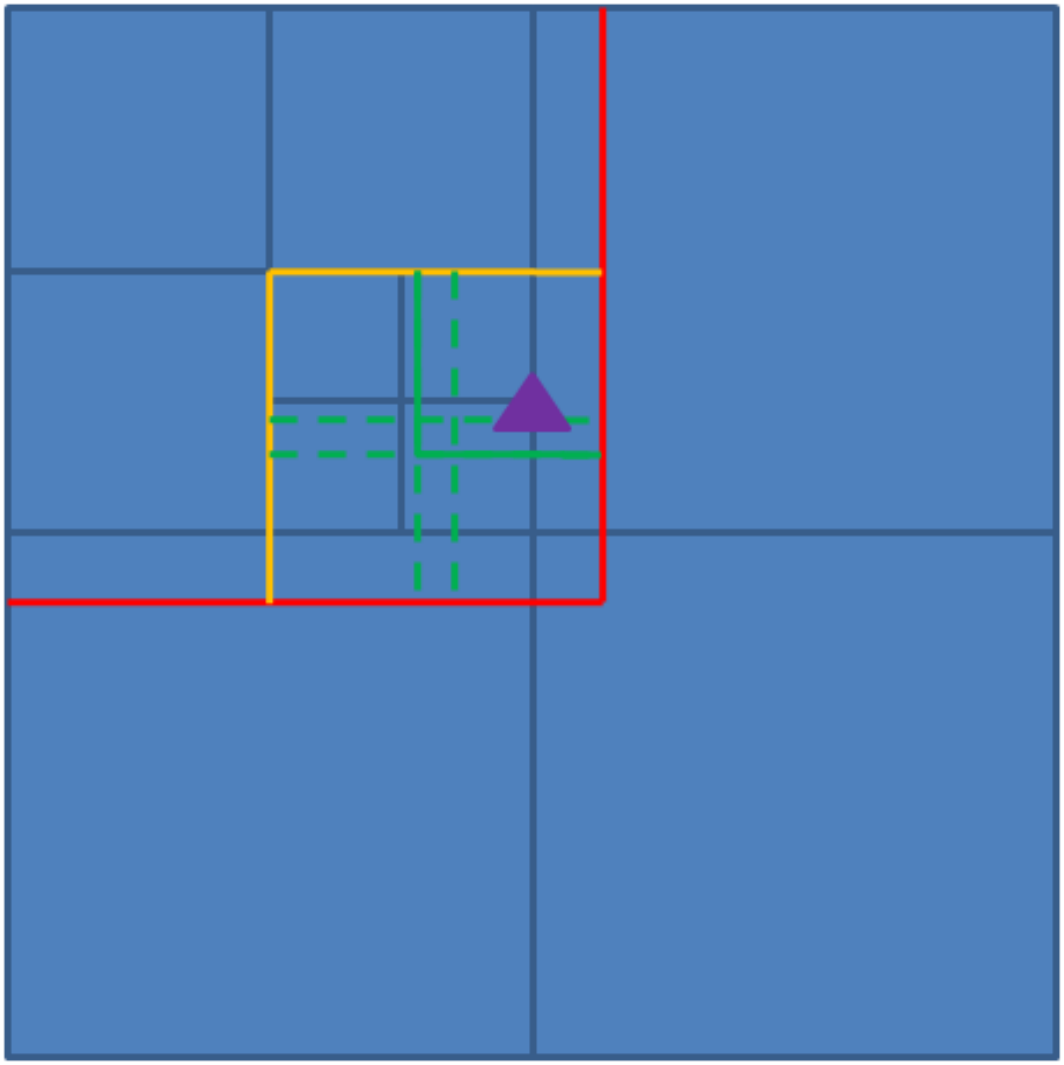

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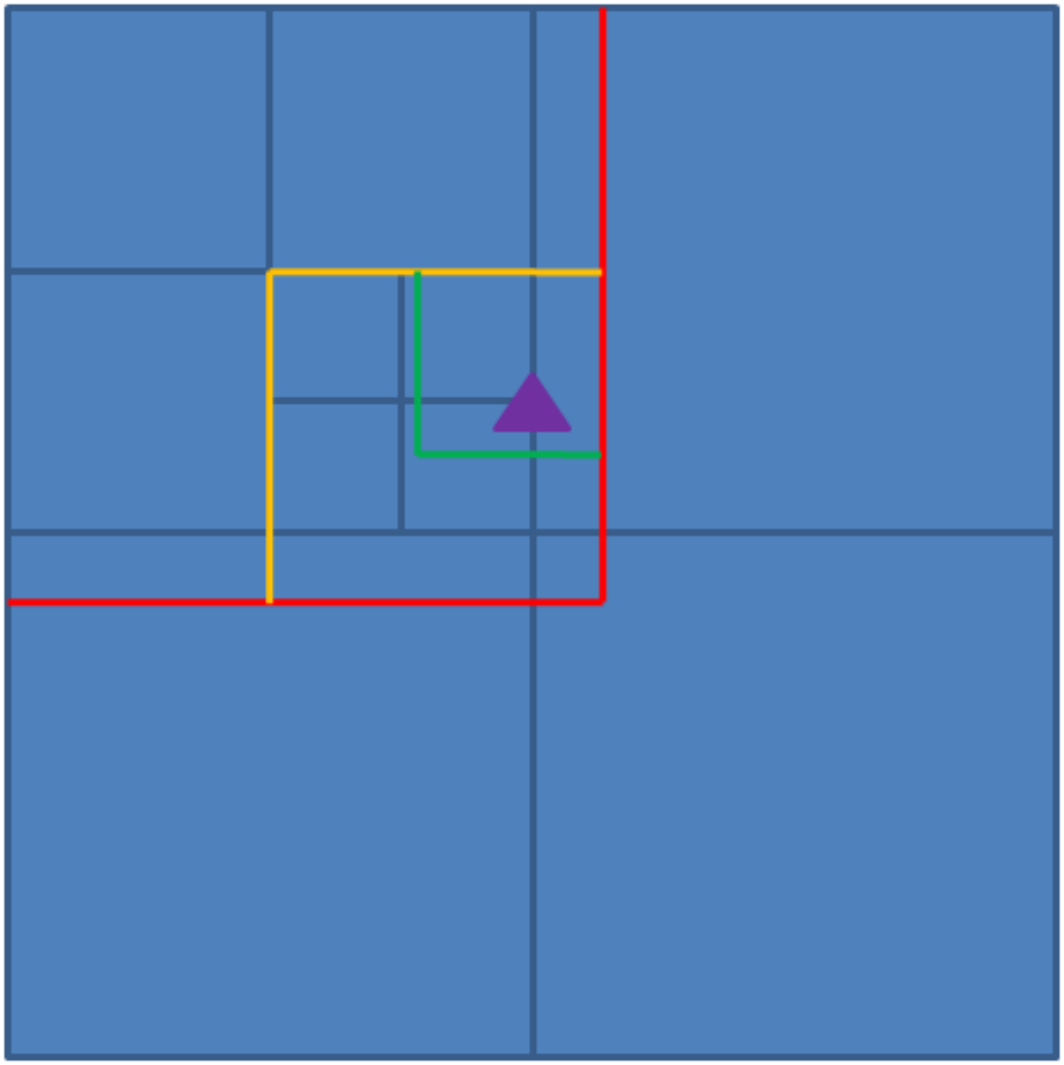

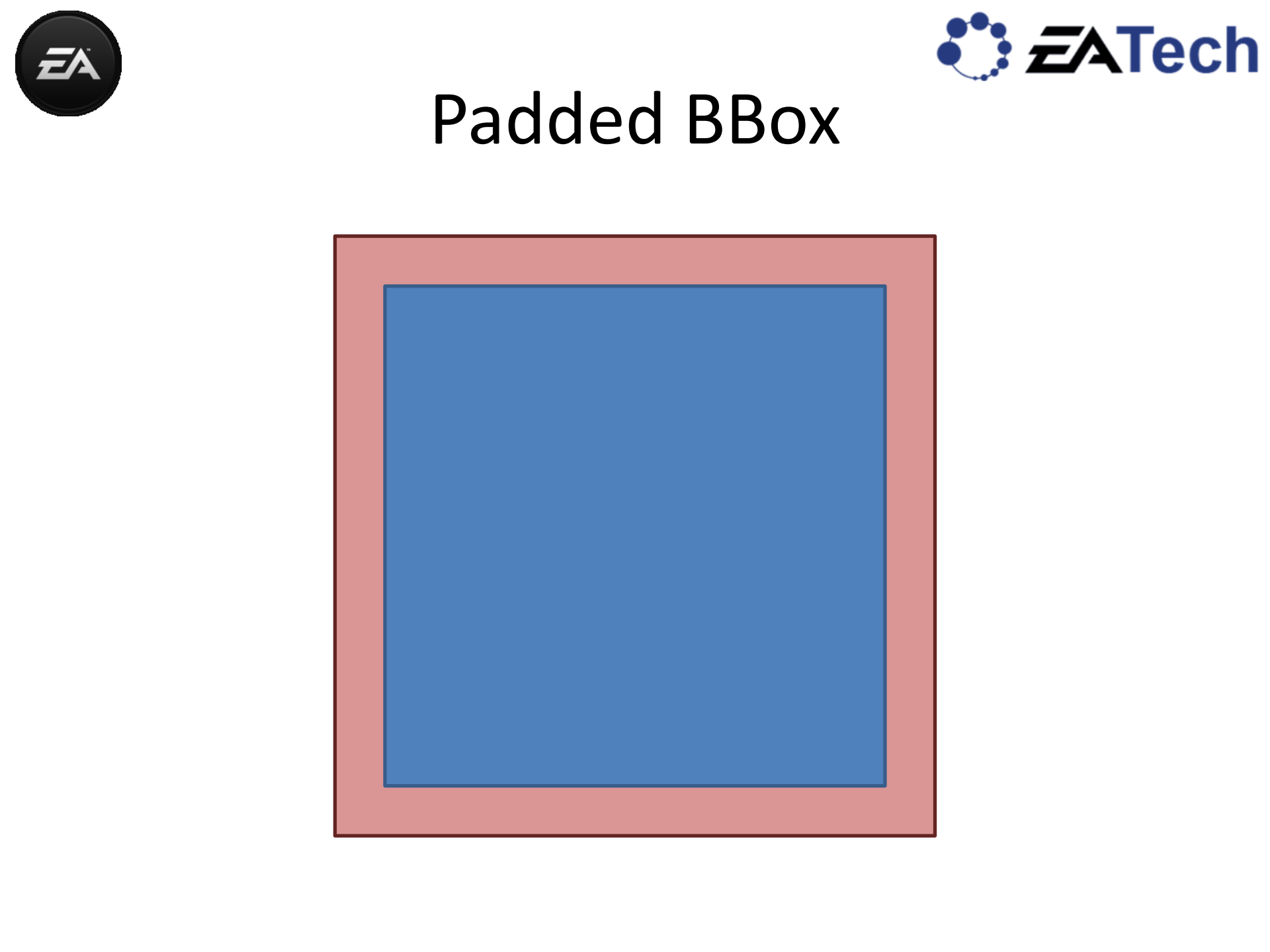
EA
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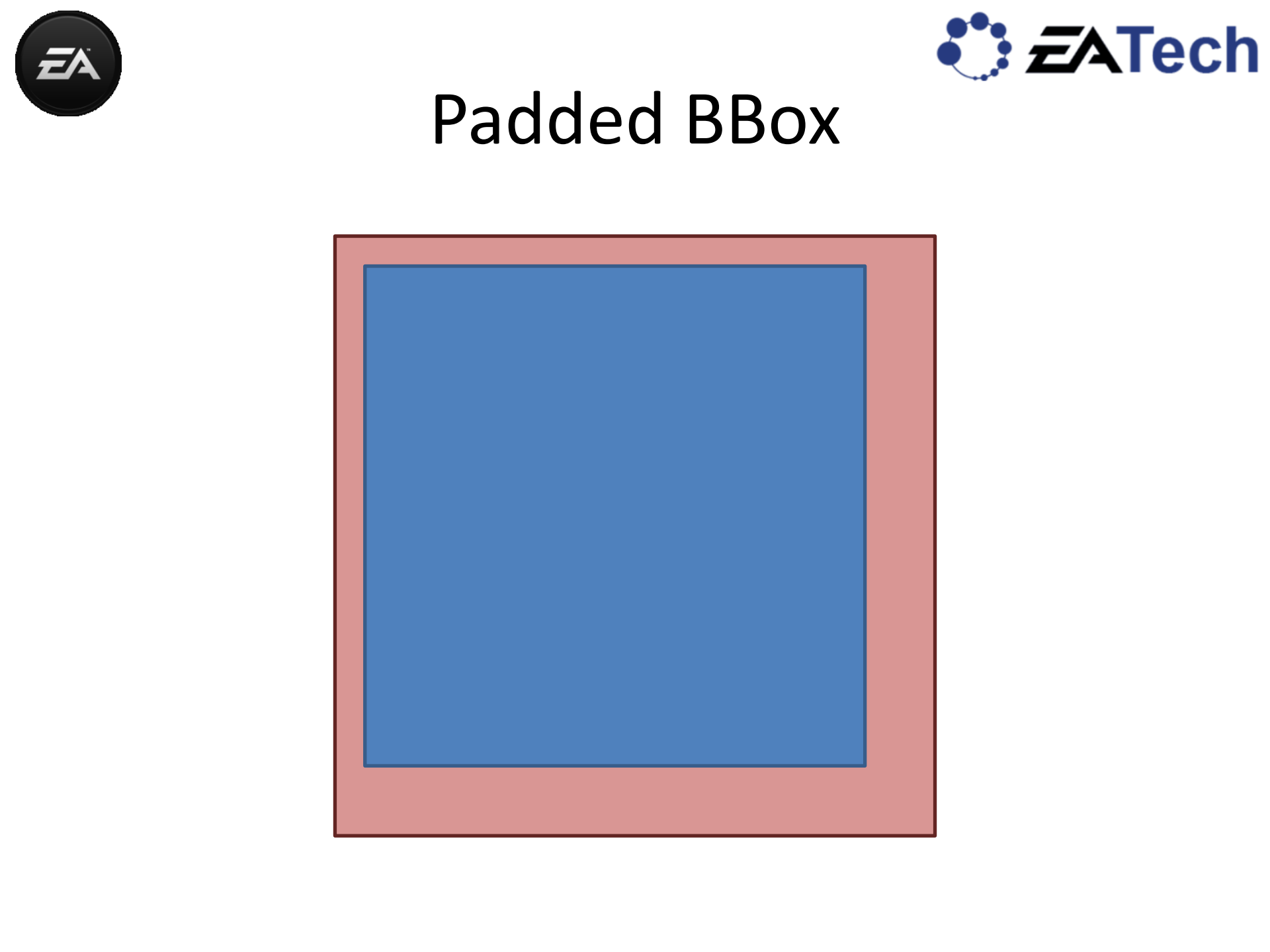
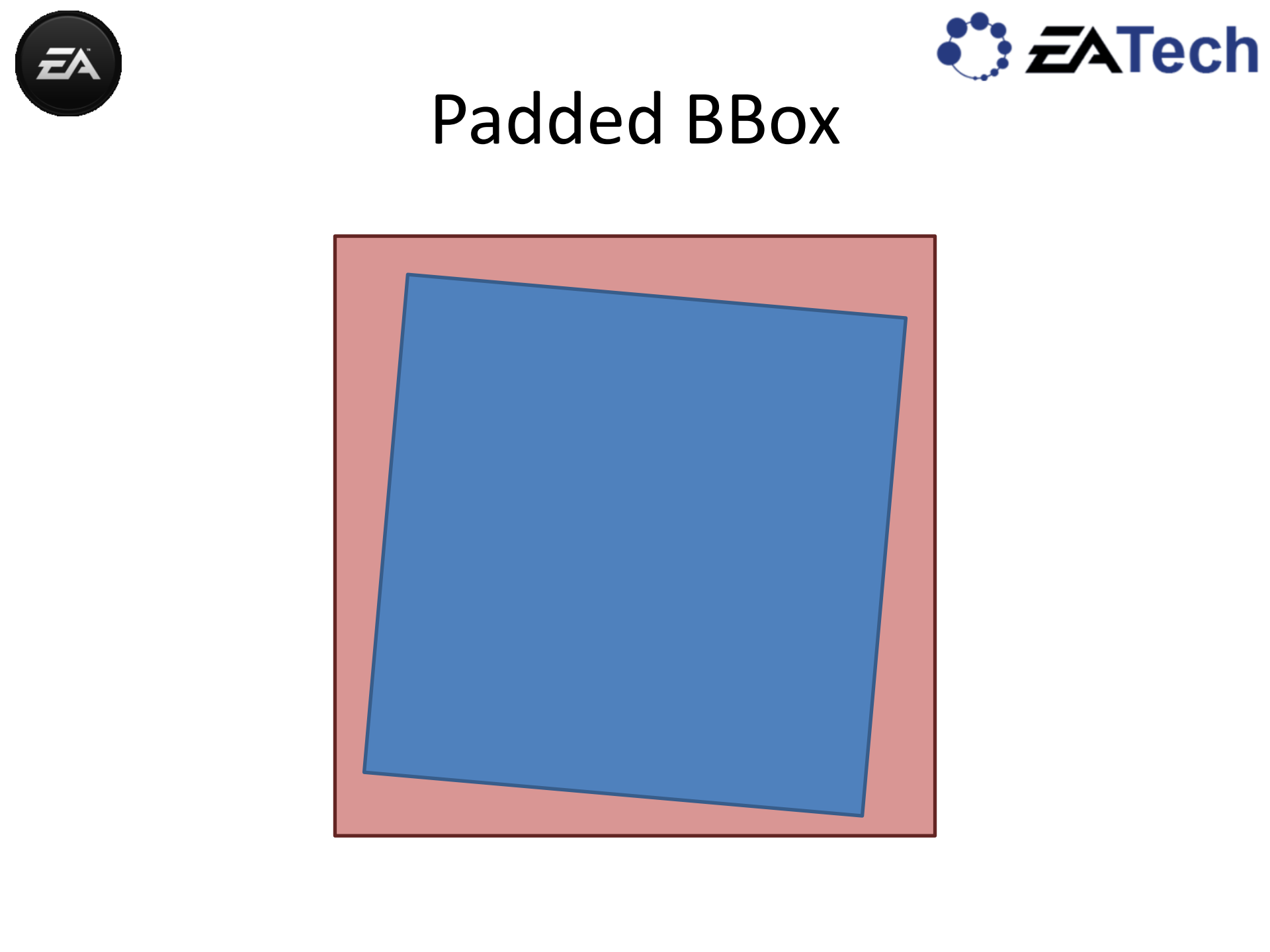
Padded BBox


EA
EATech
Padded BBox



Padded BBox

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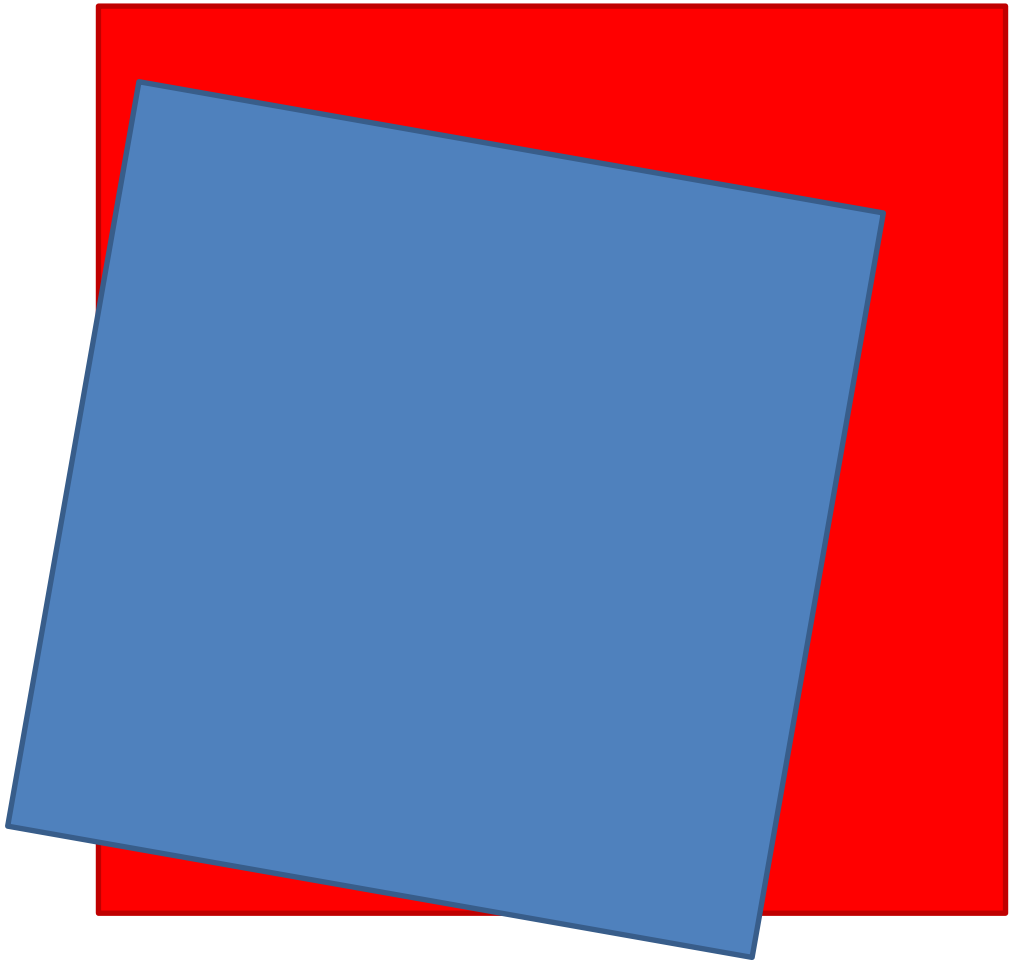
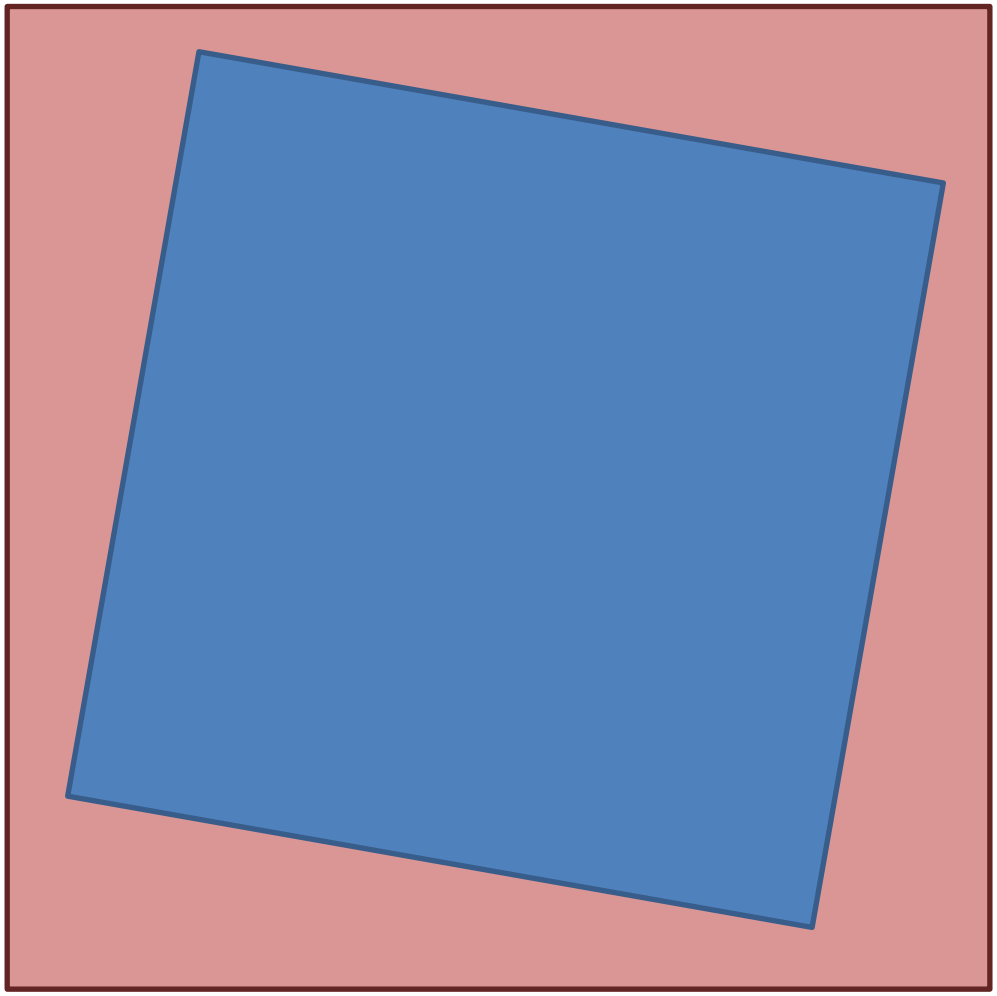


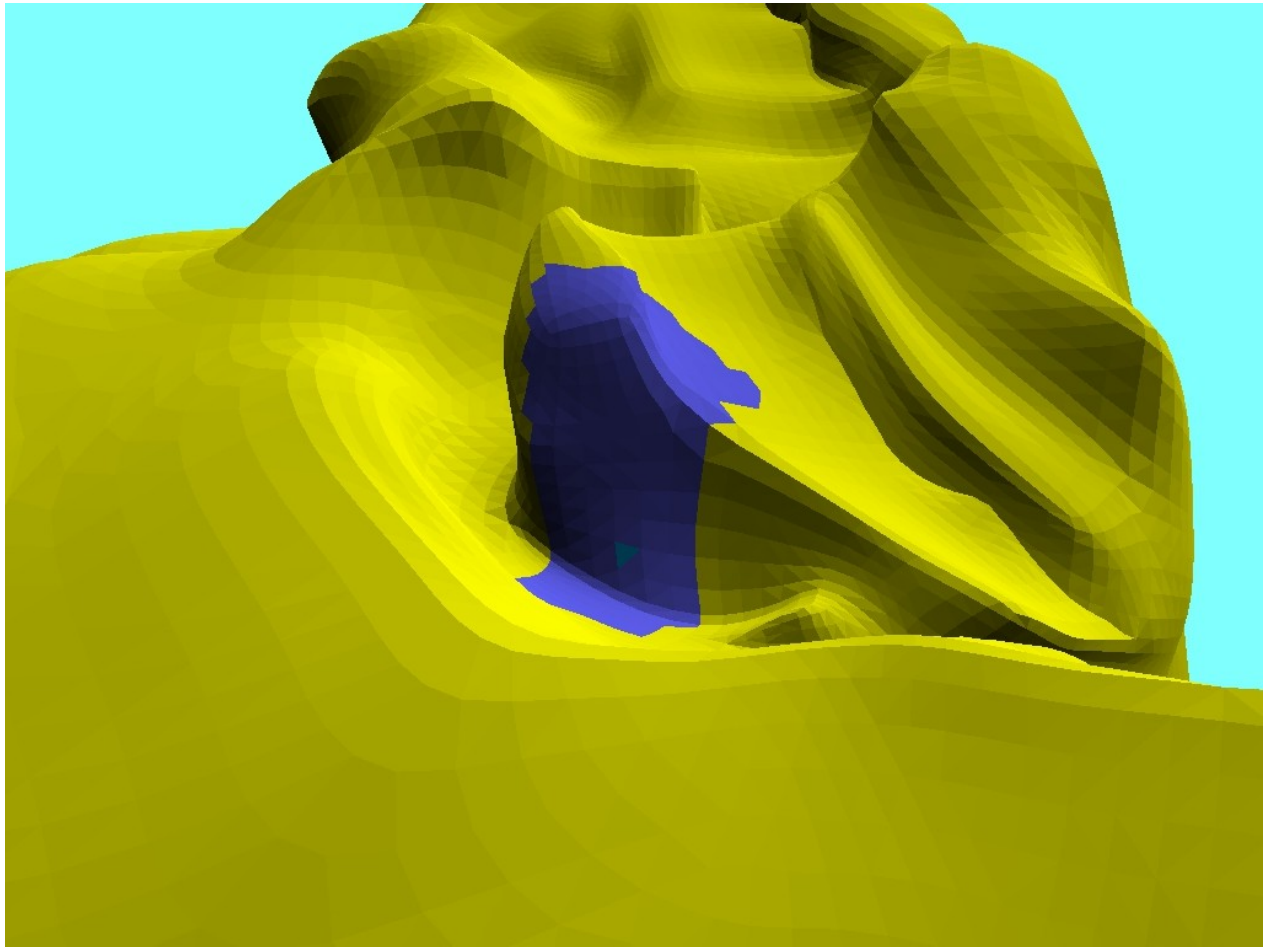
Padded BBox



Meshes & Narrow Phase

- Clustering
- Spatial Indexing
- Edge Filtering

Clusters

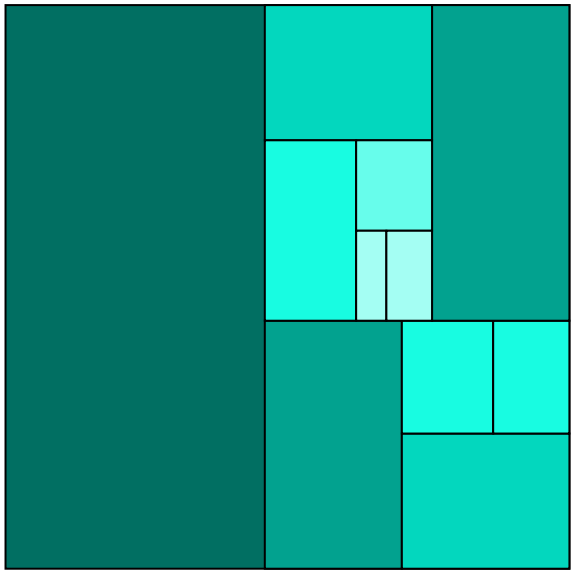


Quantization

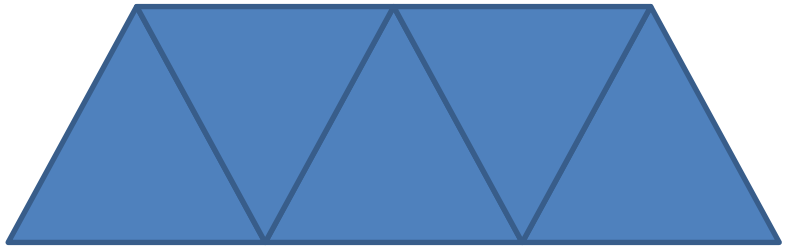
- Local coordinate system
- Compress vertex positions
- Careful about degenerate triangles
- Need to account for this in kd-tree

Kd-Tree

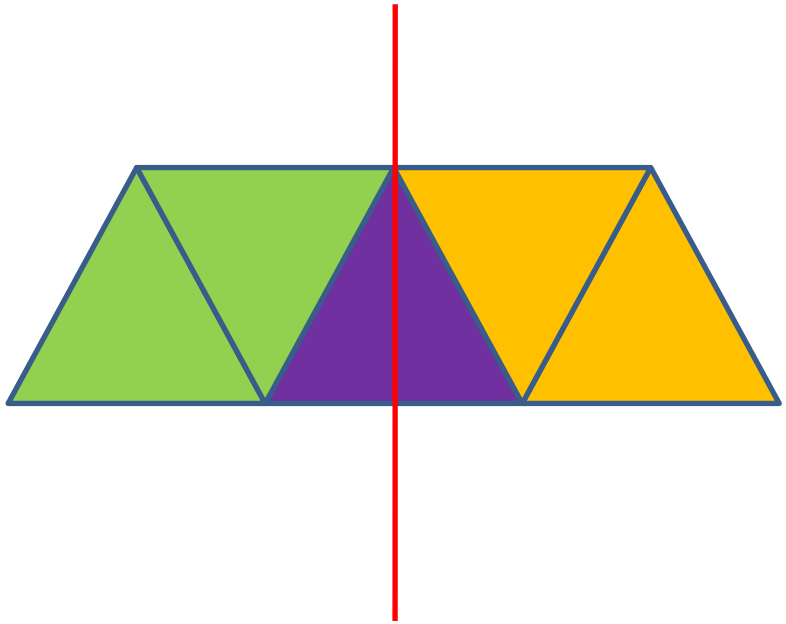
- “Loose kd-tree”
- Good for indexing static sets
- Use it to generate clusters



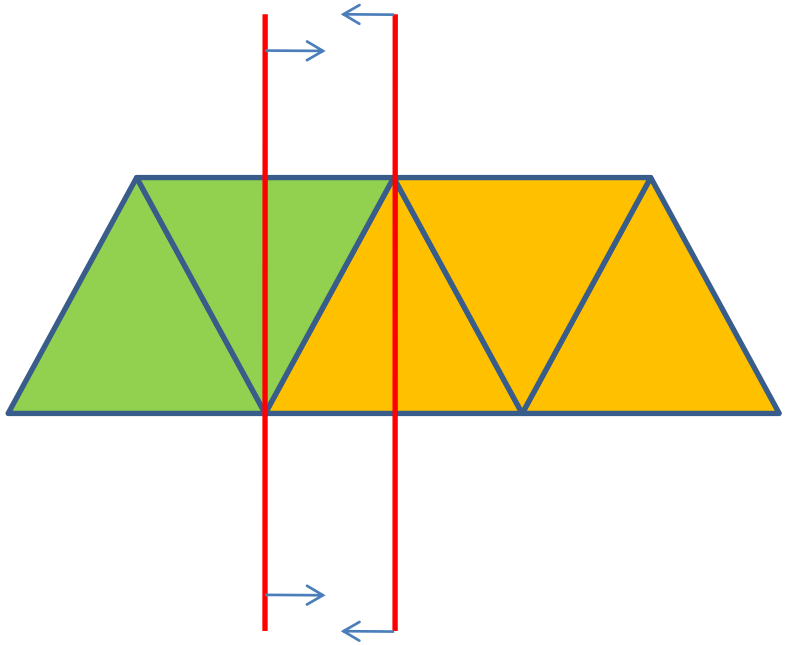
Kd-tree Split Problem



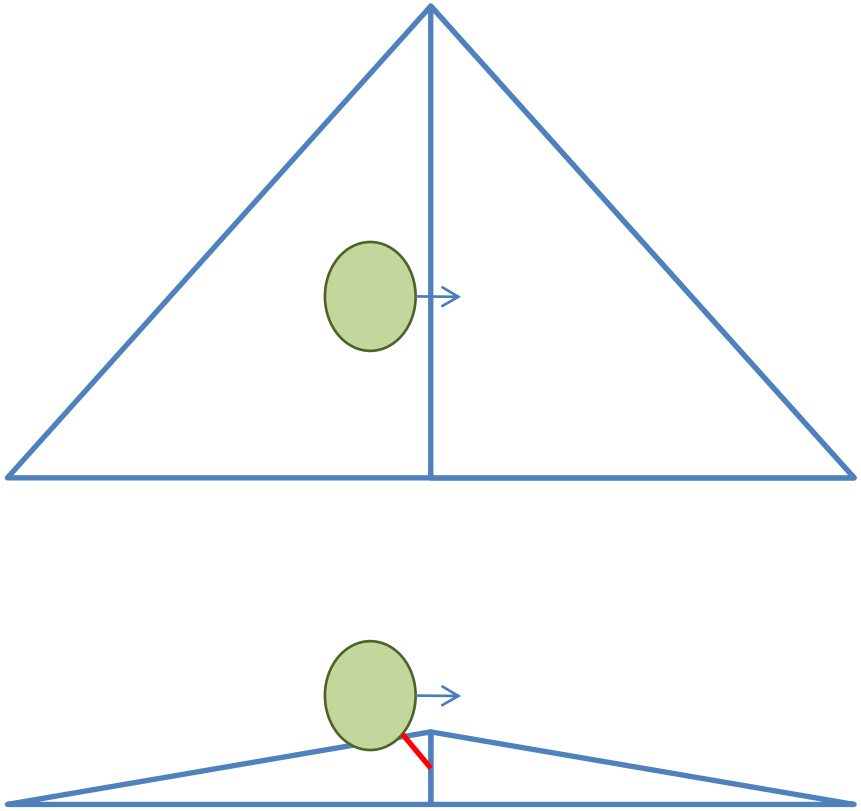
Kd-tree Split Problem



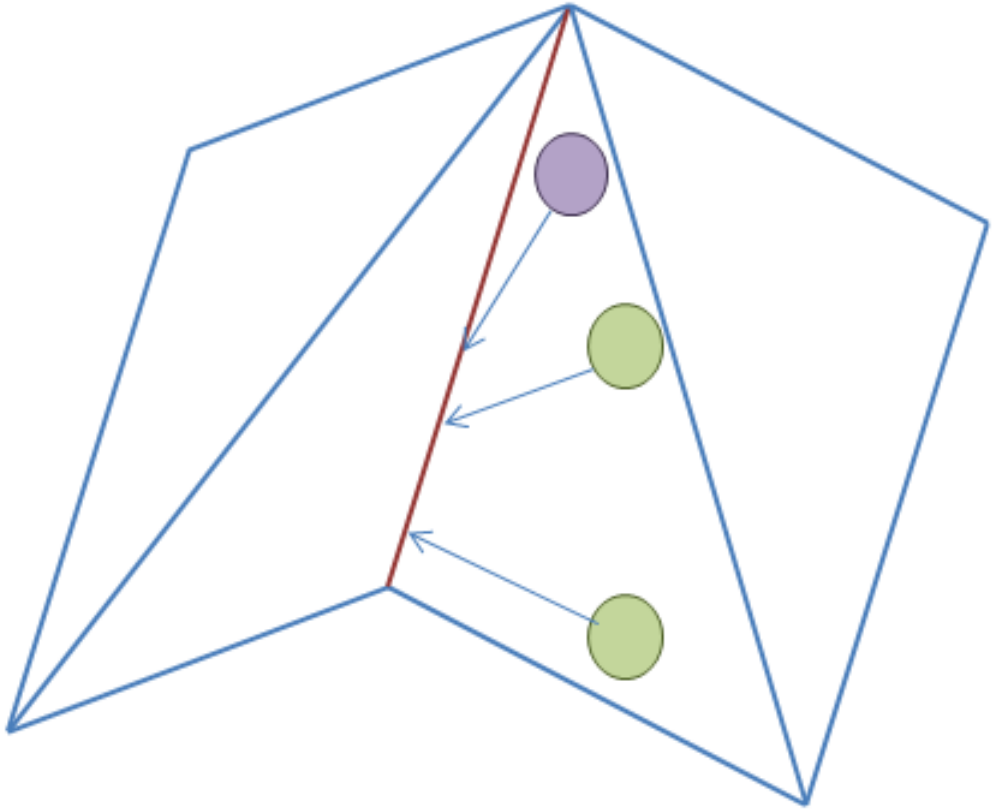
Loose Kd-tree



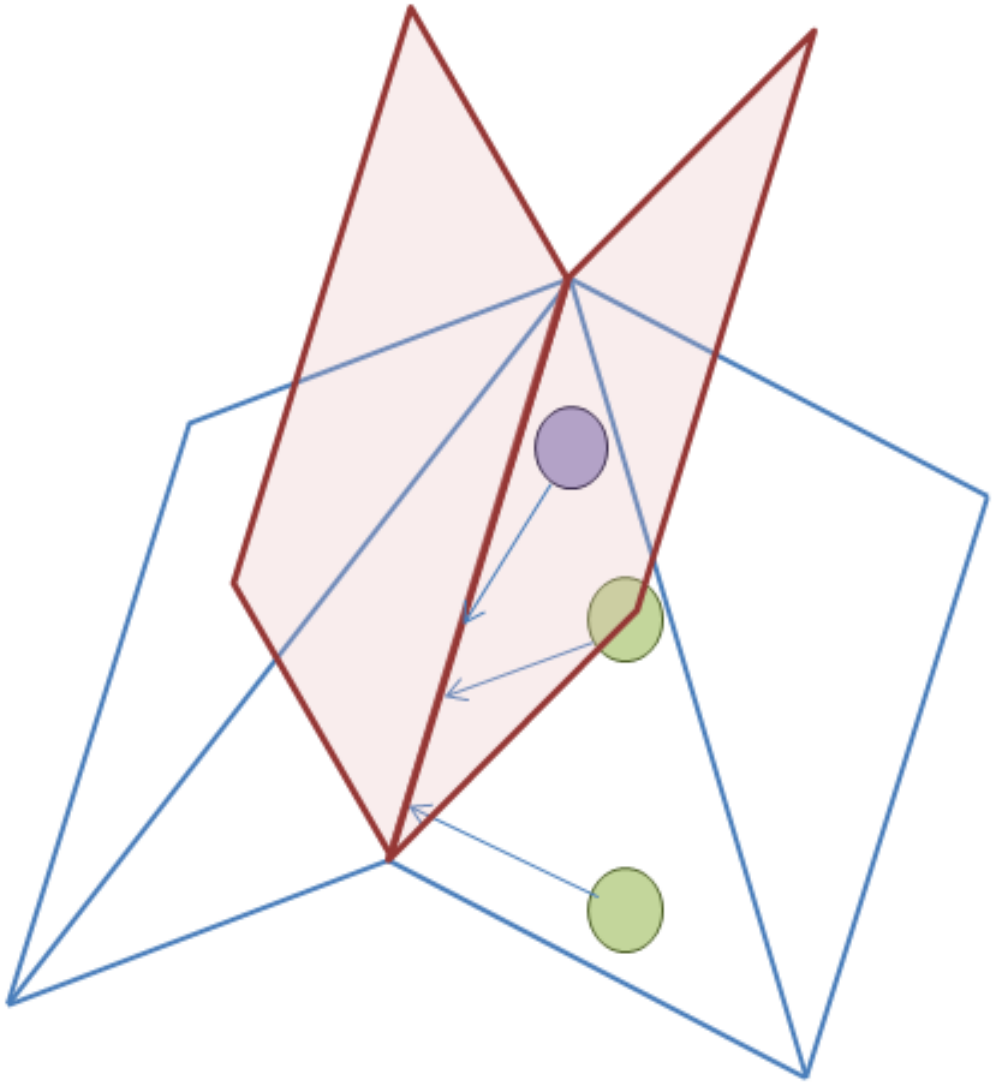
Edge Filtering



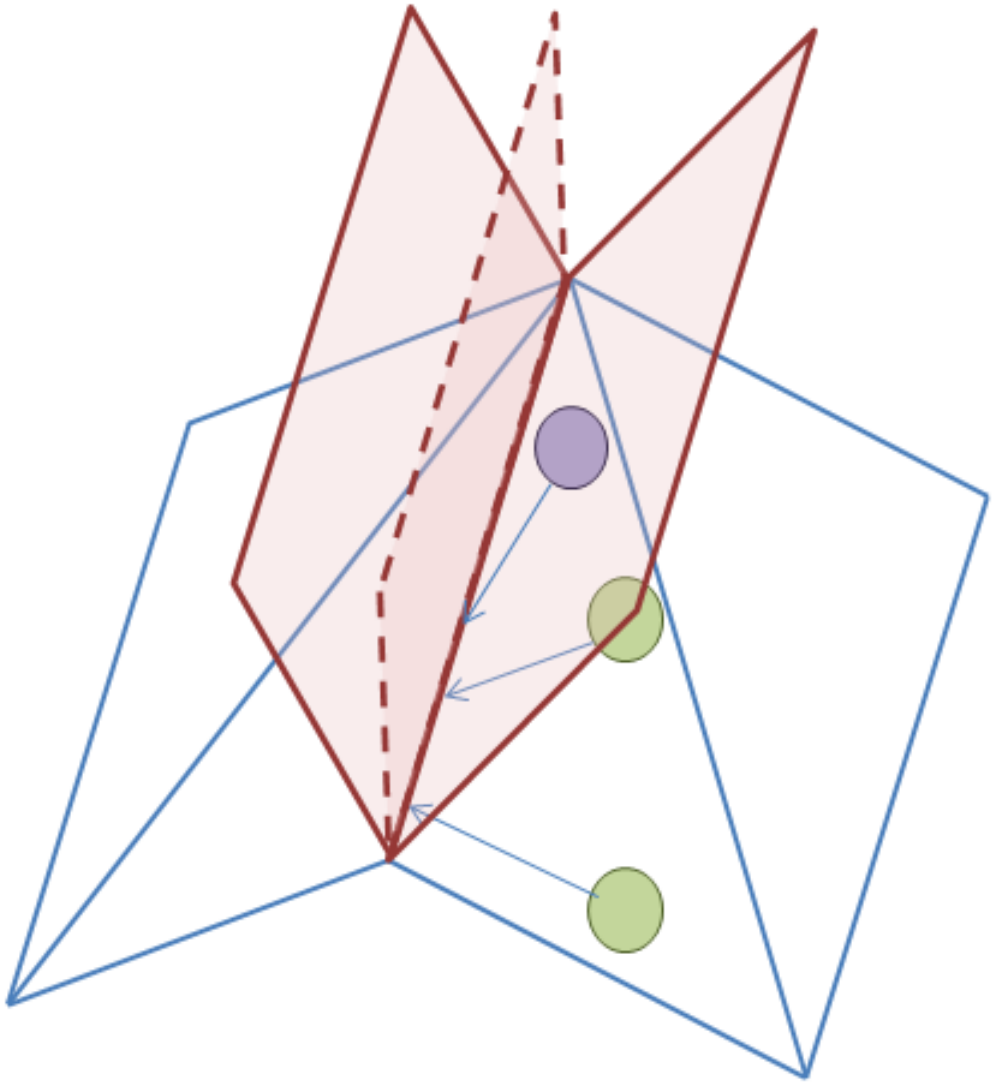
Voronoi Region



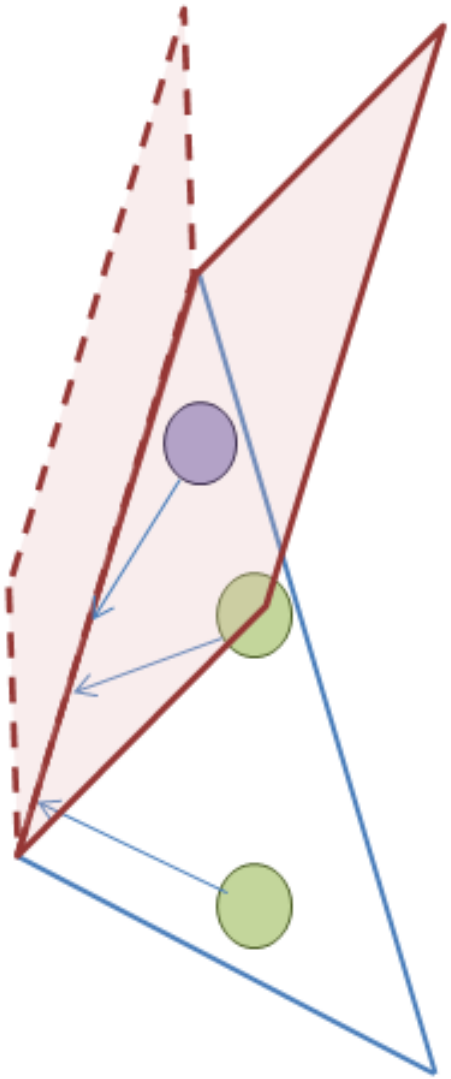
Voronoi Region



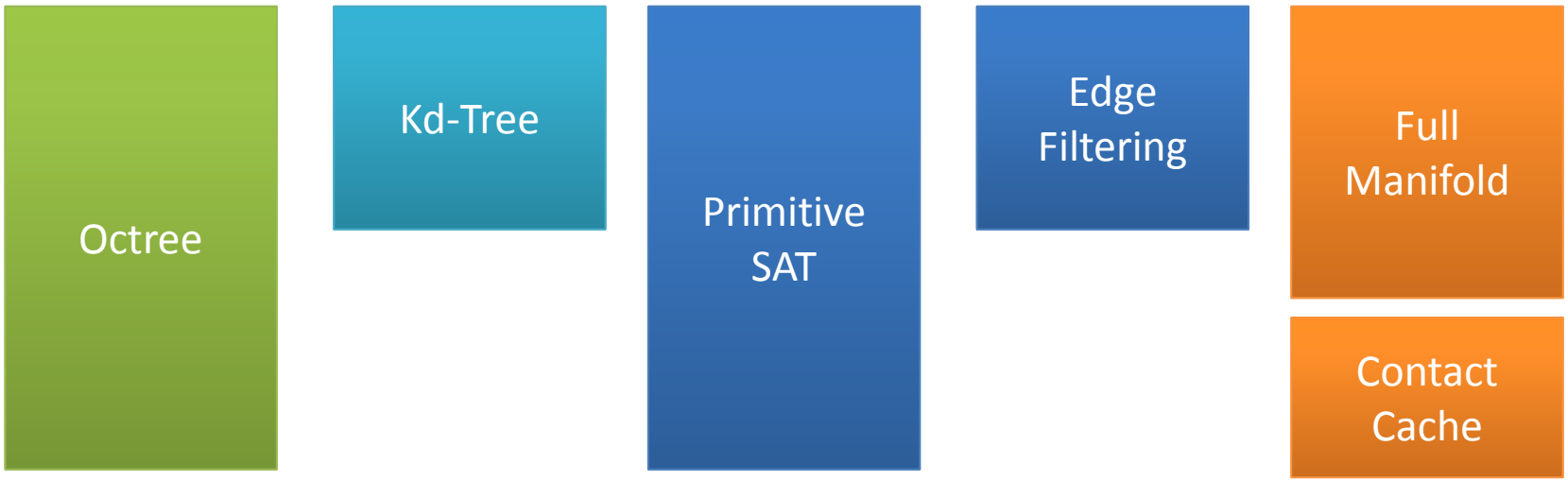
Voronoi Region



Voronoi Region



SSX Pipeline



SSX Video

- http://www.youtube.com/watch?v=Duz7f2yye5k

Challenges

- Many “mesh” representations
  - Graphics LODs
  - Collision
  - Audio
  - Nav mesh
- What algorithms will run on GPU?
- Is it possible to do collision LOD?

Questions?

Contact: sfrye@ea.com