
CS780: Scalable Graphics/Geometric Algorithms

- Summary

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(윤성의)

Course URL:
<http://jupiter.kaist.ac.kr/~sungeui/SGA/>

KAIST

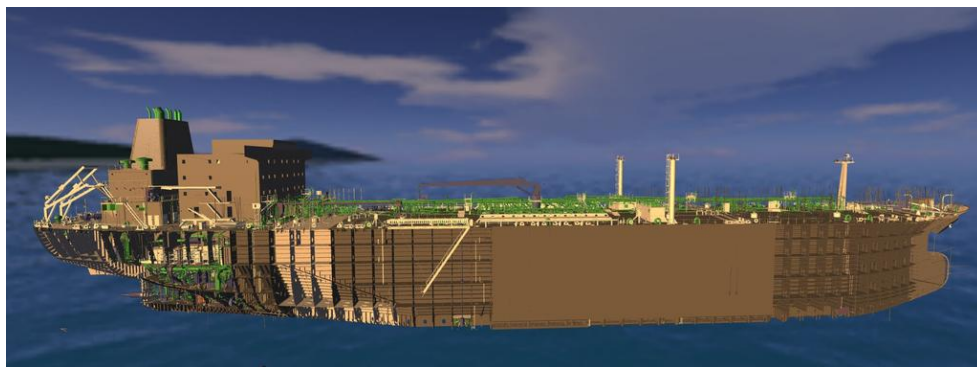
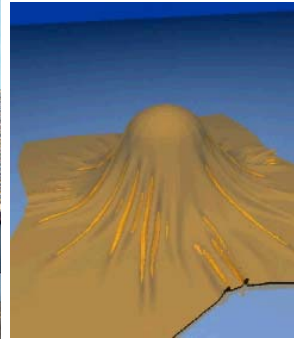


In a Nutshell

- **We have studied:**
 - **Various techniques to design scalable graphics algorithms that can handle massive models**

Geometric Data Explosion

- Massive geometric data
 - Due to advances of modeling, simulation, and data capture techniques



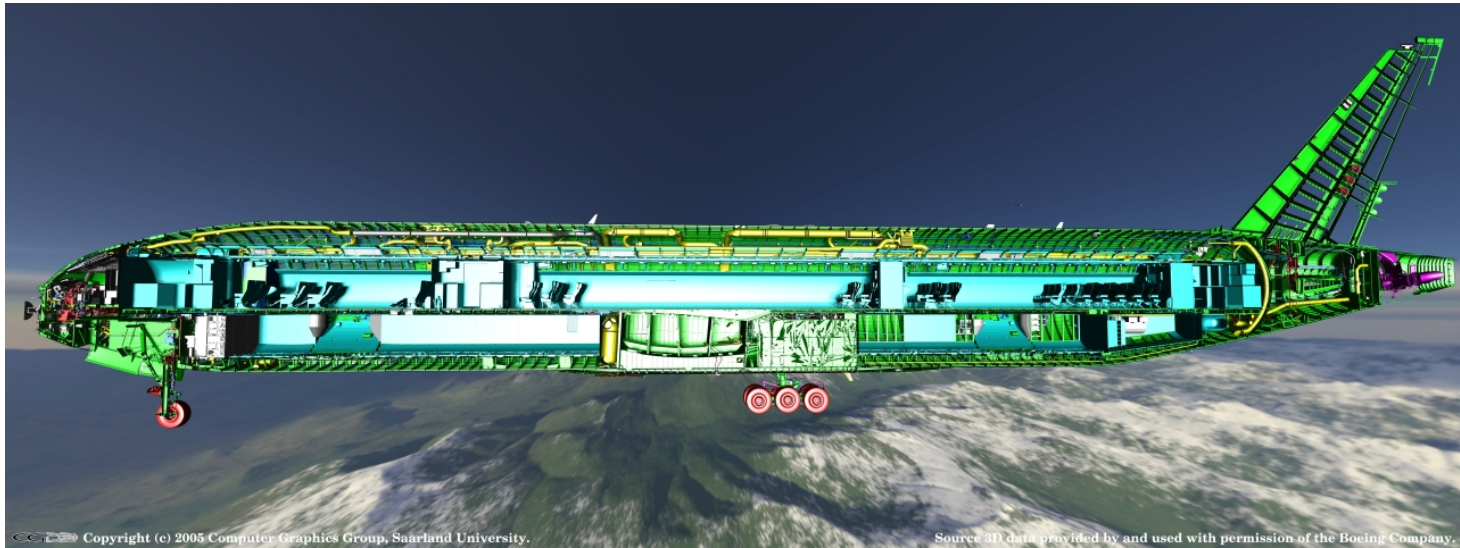
Large-scale Applications

- Entertainment (games/movies)
 - Second Life



Large-scale Applications

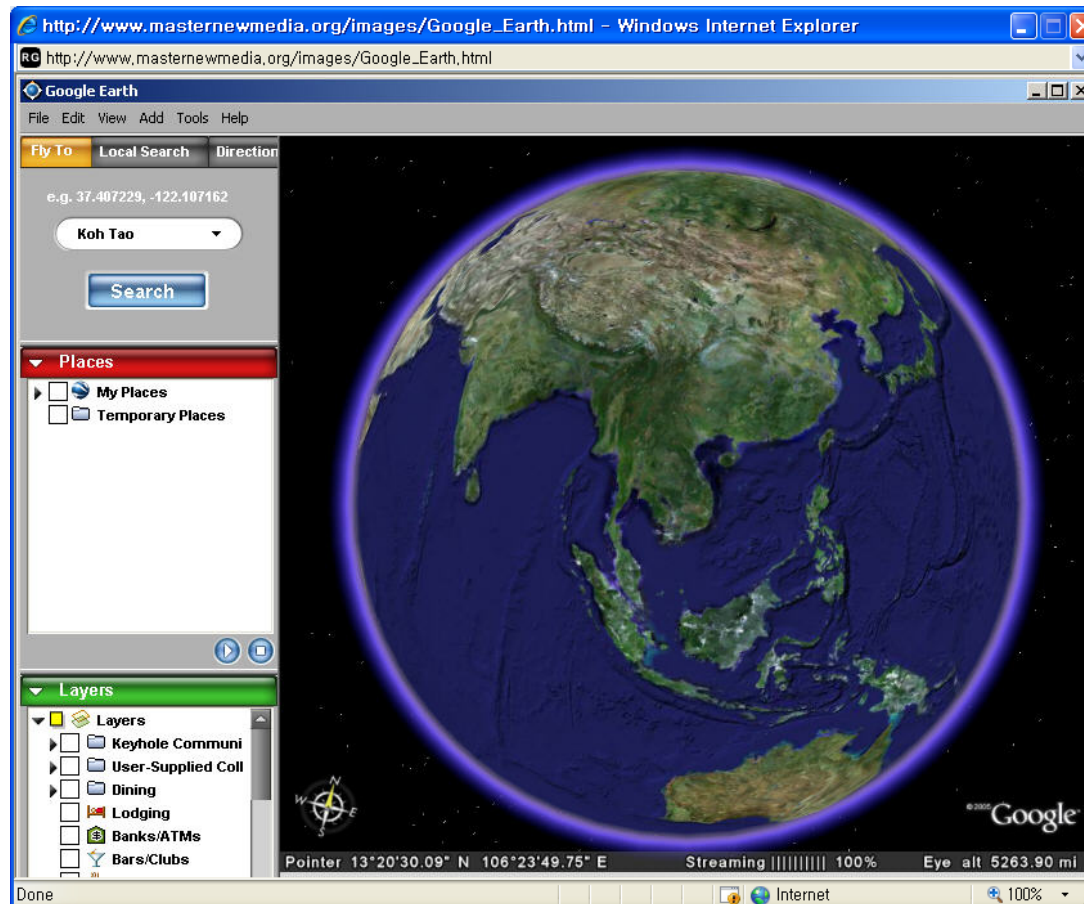
- Computer-aided design (CAD) / virtual prototyping



**Ray Tracing Boeing 777,
470 million triangles**

Large-scale Applications

- Geographic information system (GIS)
 - Google earth



Large-scale Applications

- Robotics
 - Motion planning



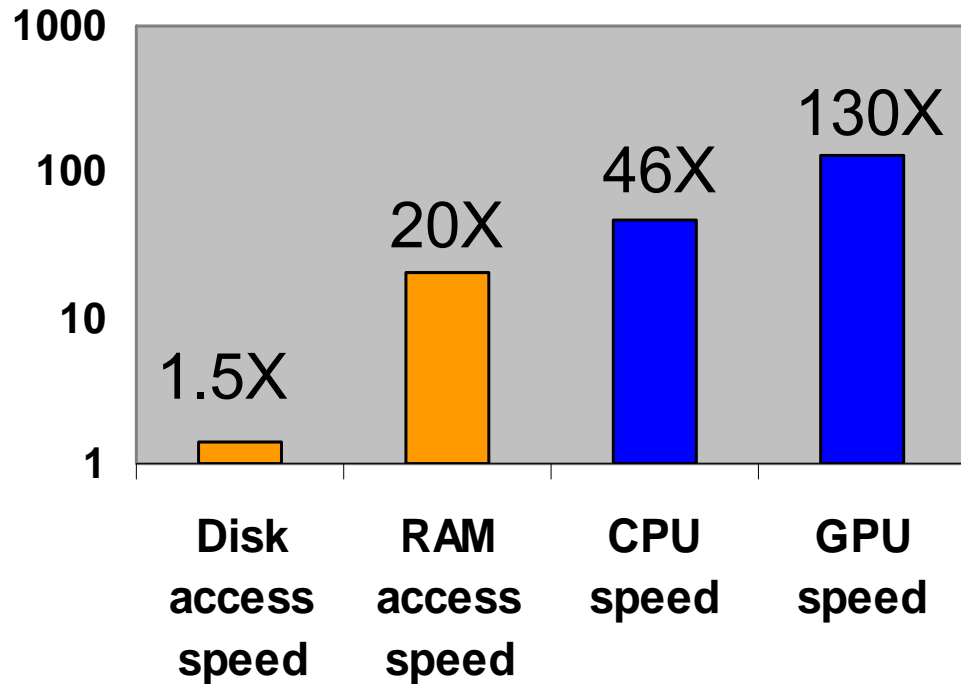
Excerpted from Motion Planning in Virtual Environments and Games, Mark Overmars

Possible Solutions?

- **Hardware improvement will address the data avalanche?**
 - **Moore's law: the number of transistor is roughly double every 18 months**

Current Architecture Trends

Accumulated
growth rates
during 1993 – 2004
(log scale)



Courtesy: Anselmo Lastra,
[http://www.hcibook.com/e3/
online/moores-law/](http://www.hcibook.com/e3/online/moores-law/)

**Data access time becomes
the major computational bottleneck!**

Current Architecture Trends: Many-cores

- Employs multi-cores to keep Moore's law
 - 80 core system in Intel
 - Presents numerous research challenges
- Streaming processors (GPUs) with super Moore's law
 - Multi stages in parallel

Data access time is getting relatively bigger!

Data Growth

- **An observation**
 - **If we got better performance, we attempt to produce bigger data to derive more useful information and handle such bigger data**
- **Amount of data is doubling every 18 ~ 24 months**
 - *“How Much Information,” 2003. Lyman, Peter and Hal R. Varian.,*
www.sims.berkeley.edu/how-much-info-2003

Ubiquitous Computing

- Uses different computational devices
 - Have relative small main memory and L1/L2 caches
 - Pose problems even with small models



**Google Earth:
browsing 3D world**

Our Focus in the Course

- **Technologies for scalable graphics applications**
 - Multi-resolution methods
 - Cache-coherent algorithms
 - Culling techniques
 - Selective construction methods
 - (Data compression, parallel computations, etc)
- **Graphics applications**
 - Rasterization and ray tracing for rendering
 - Collision detection

Multi-Resolution or Levels-of-Detail (LODs)



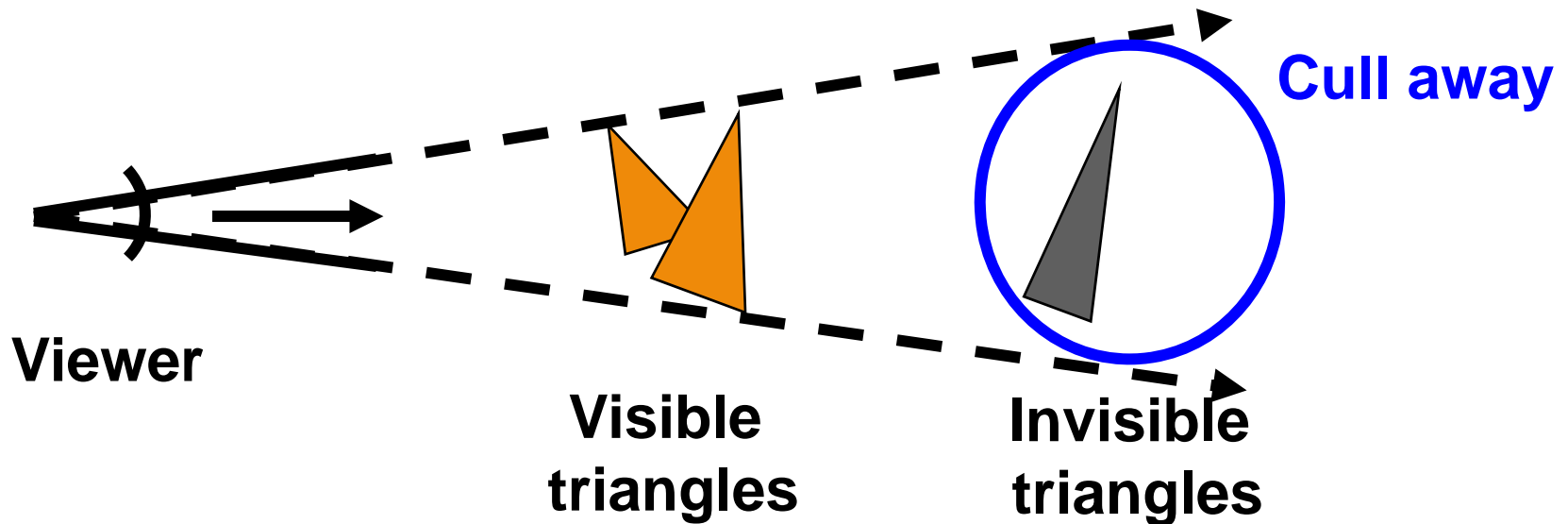
Use simplification
given an error bound



Reduce the model complexity!

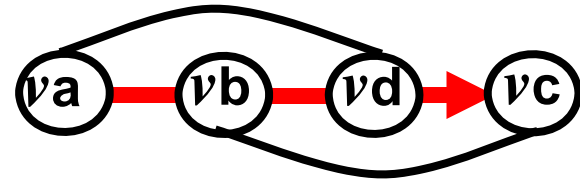
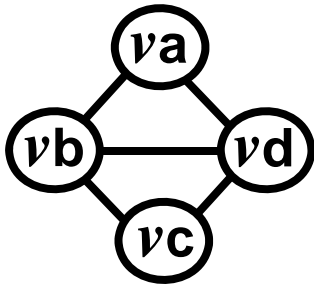
Culling Techniques

- Visibility culling



Reduce the model complexity!

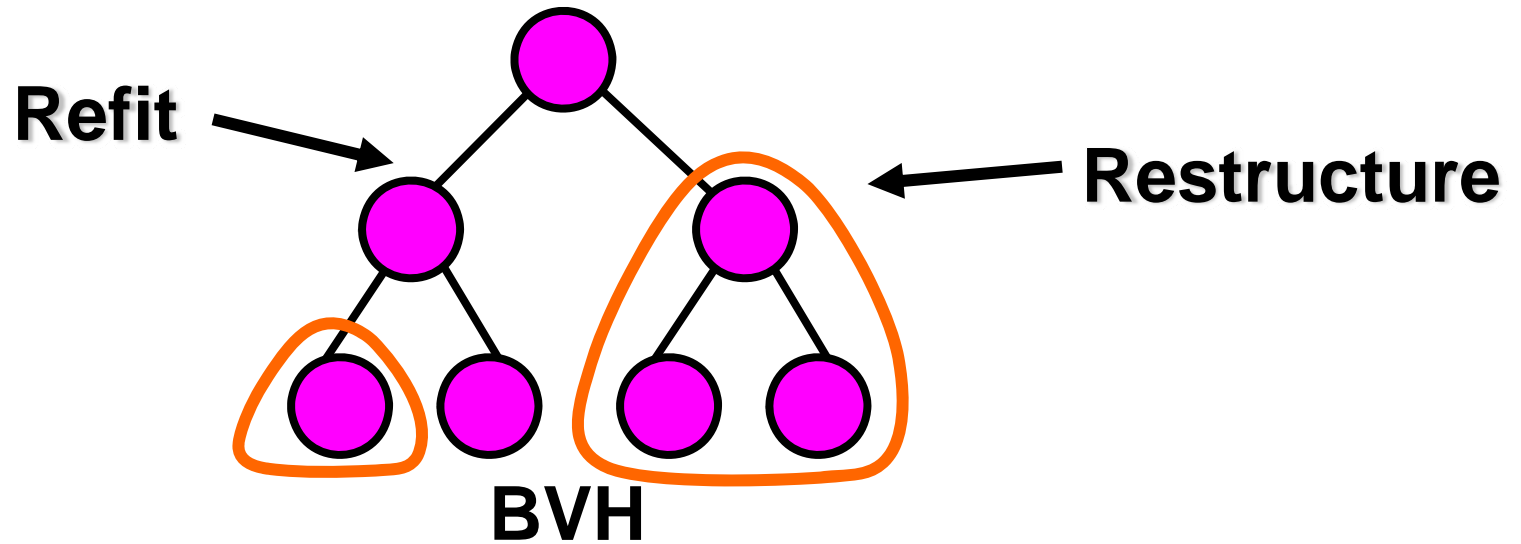
Cache-Coherent Layouts



One dimensional layout

**Data organization
to reduce expensive data access time!**

Selective Restructuring



Uncovered Topics

- **Data compression**
 - Data size is still too large
- **Parallel computations**
 - Many cores are available
- **Cache-coherent algorithms**
 - We only covered coherent data layouts
- **Various other graphics/geometric related applications**

Administrations

- **Give you feedbacks on your reports by early next week**
 - **Grade will be given after that**

- **Course evaluations**
 - **Let's make this course better for coming students!!!**



Thanks!