

**EF432**

## **Introduction to spaghetti and meatballs**



## **CSC418 Computer Graphics**

**Karan Singh**  
[www.dgp.toronto.edu/~karan](http://www.dgp.toronto.edu/~karan)

**Hours: MW 1**  
**Tutorials: F 1**

**Text: Computer Graphics**  
**using OpenGL, F.S. Hill, Jr.**

**Grading:**  
**Assigments: 15%, 15%, 30%**  
**Midterm: 15%**  
**Final: 25%**



[http://www.dgp.toronto.edu/~karan/courses/csc418/fall\\_2002/index.html](http://www.dgp.toronto.edu/~karan/courses/csc418/fall_2002/index.html)

## What is Computer Graphics?

Computers...

accept, process, transform and present information.

Computer Graphics...

involves technology to accept, process, transform and present information in a visual form.

## Ok but... what is the course really about?

Graphics algorithms

Graphics data structures

Color and human vision

Graphical interface design and programming

Modeling, Animation, Rendering

### What its not about?

Photoshop, AutoCAD, Maya, Renderman, Graphics APIs.

...**WOW**, heavy math and computer science!!

## CG is Movies

To Reality and beyond!!

- Define directions of CG
- Set quality standards



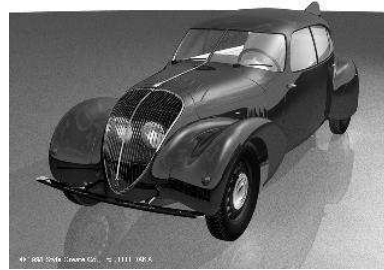
## Games are allowed

- Focus on interactivity
- Push current hardware to its limits
- Games drive the baseline



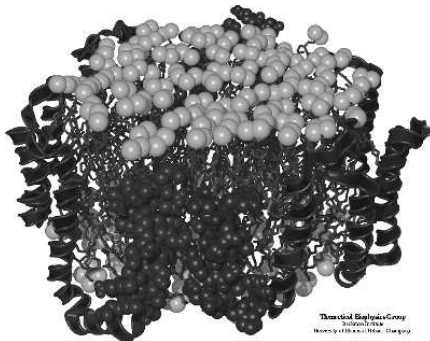
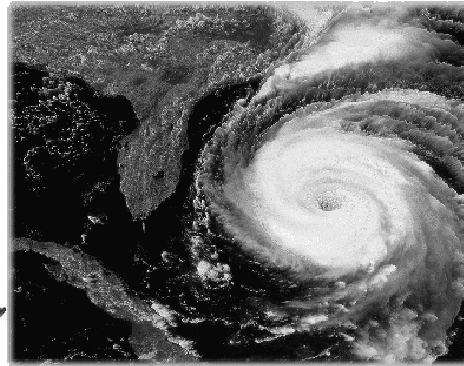
## Industrial Design

- Precision modeling
- Engineering Visualization



## Scientific Visualization

- Device interaction
- Large data sets



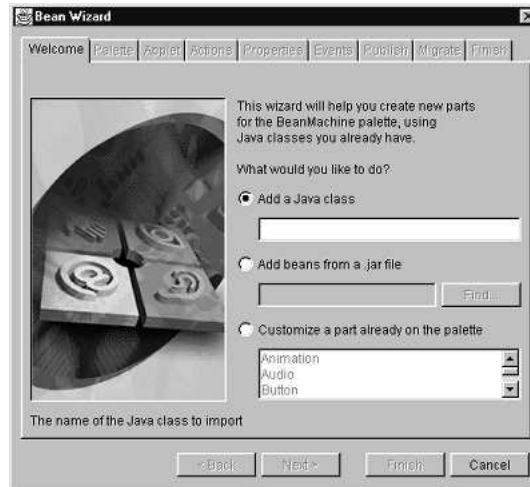
## Medical Imaging

- Geometric modeling
- Interaction
- Real  $\Leftrightarrow$  Digital data



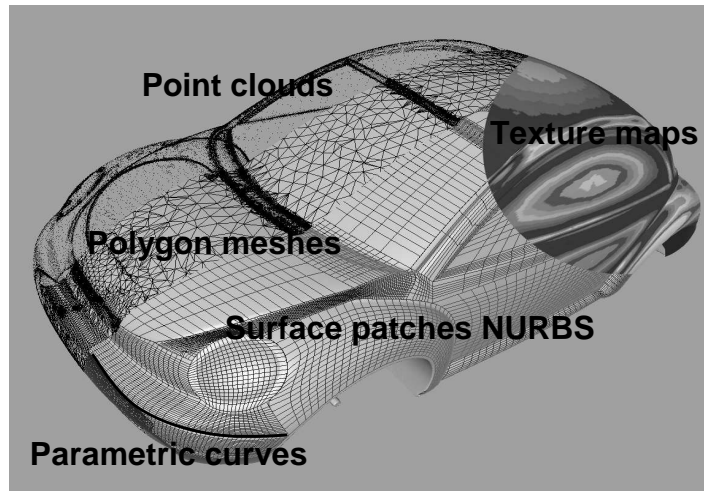
## Graphical User Interfaces

- Interaction with software and hardware



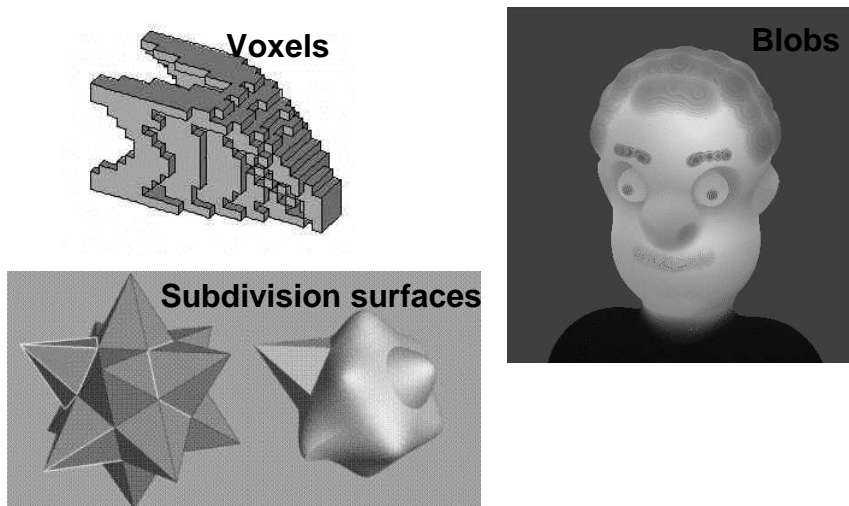
## Elements of CG (modeling)

How do we represent an object geometrically on a computer?



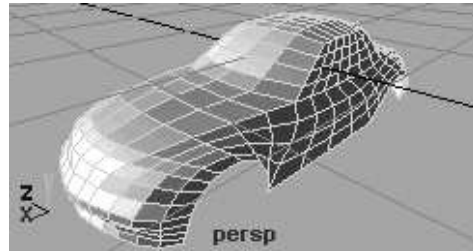
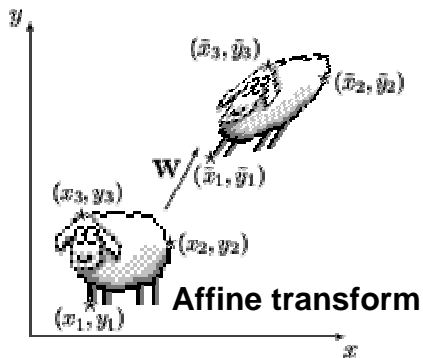
## Elements of CG (modeling) II

How do we represent an object geometrically on a computer?



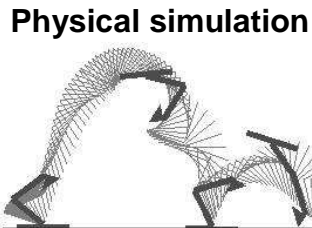
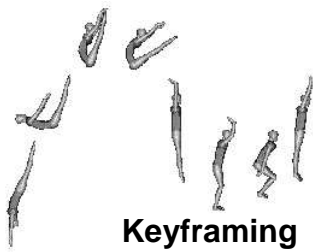
## Elements of CG (modeling) III

How can one change a digital model?



## Elements of CG (animation)

How does one make digital models move?



## Elements of CG (animation) II

How does one make digital models move?



## Elements of CG (rendering)

How does one present a digital scene?





## Elements of CG (rendering) II

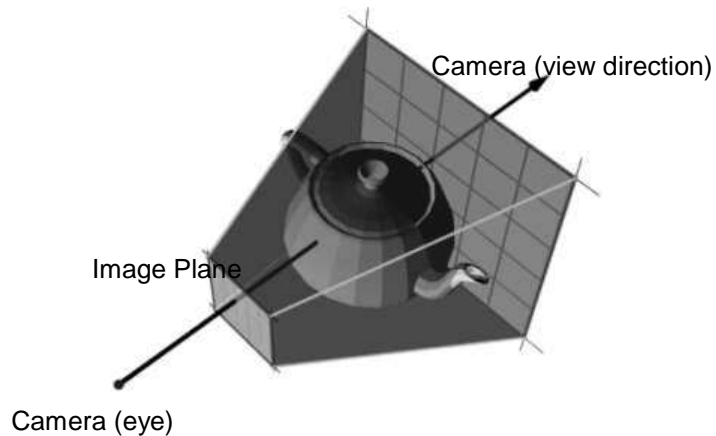
How does one present a digital scene?

- **Scene Graph:** Hierarchical description of objects and parts of objects relative to each other.
- **Lighting:** Where are the lights in the scene?
- **Cameras:** Where is the scene viewed from (pin-hole model)?
- **Projection:** How is the scene projected onto an image (parallel vs. perspective)?
- **Visibility**
- **Clipping**
- **Scan Conversion**
- **Illumination**
- **Textures**
- **Special Effects**



## Elements of CG (rendering) III

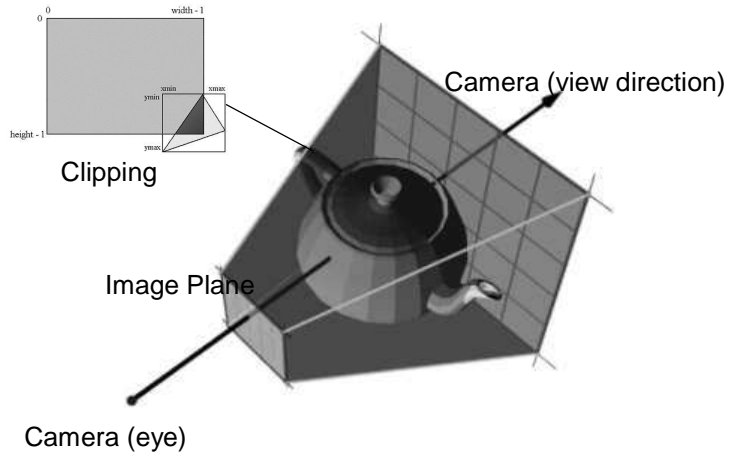
How does one present a digital scene?



How does one tell which faces are visible?

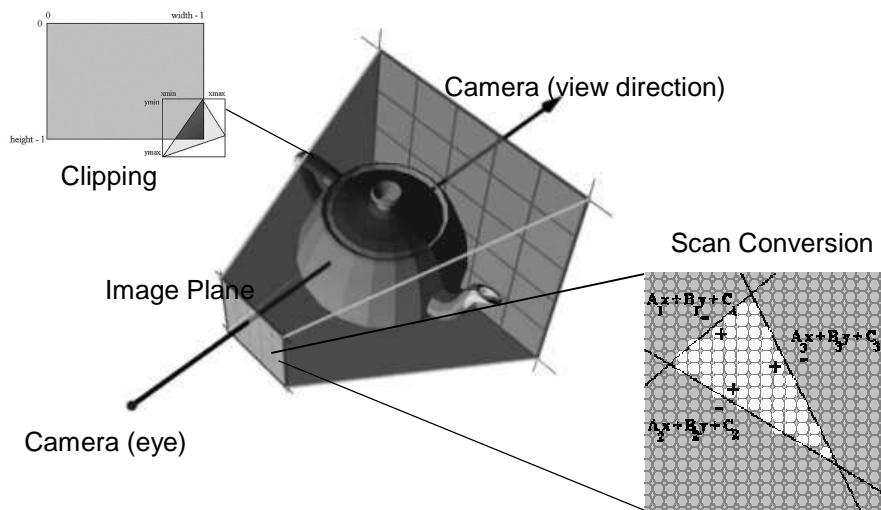
## Elements of CG (rendering) III

How does one present a digital scene?



## Elements of CG (rendering) III

How does one present a digital scene?



## Elements of CG (rendering) IV

How does one present a digital scene?



**So what's wrong with computer graphics?**

The Tiger Experience  
By Alain Fournier

## The Tiger Experience



## The Tiger Experience

*Alain Fournier*

The story so far:

A large tiger walks alone through the dense mid-day jungle.

His steps spring elastic. His skin, loose around his body as he moves, swings under him from side to side. His stripes sometimes mesh with the tall grass to make him almost invisible, sometimes almost beat against the background to make him bigger and more menacing yet.

The fur when seen close-up is dry and slightly mottled, probably dirty and covered by anything from mud to dust.

## The Tiger Experience

The light is carrying green down from the canopy,  
sometimes touching the tiger, sometimes missing,  
sometimes surrounding with a hollow kernel.

Leaves and branches move away on his path, it seems  
reluctantly, the only things not afraid, but only revealing  
their defiance once he has passed.

Ahead an opening, at first only visible as a lightening of the  
green, then a hole in the curtain, then mist, then almost  
unbearable light bouncing back from the water. The river.

## The Tiger Experience

The river flows swiftly, but some eddies seem motionless.  
Half-decayed trunks float as pirogues paddled by a  
demon crew, racing to the village upstream, though they  
are still behind their wakes.

Now the tiger wades into the water, goes back to the bank  
as if testing, and finally climbs on a branch and dives, the  
splash releasing the fears of all the potential preys hiding  
in the grass.

## The Tiger Experience

The tiger swims, slowly, as calm and as powerful as the waters around him, oblivious to the current and all it advects past its glistening body, sometimes only stripes floating at the surface.

Then the tiger swims towards the other bank, now walks still half in water, now is totally out, and water runs off his body, briefly like a liquid fur.

Still for a moment, he is surrounded by a thin layer of steam. Then the tiger shakes his whole body and streams of droplets disperse and amplify his shape, until his fur appears almost dry again.

## The Tiger Experience

He starts to walk away, but suddenly stops. A few drops fall. He listens and sniffs. He must have spotted you. He turns around and stares exactly in your direction. You are certain that he cannot see you or smell you, but certainty is weaker than the tiger.

He seems to have decided you are not a threat, in fact not even worth a closer look. He turns around and walks away, and before he disappears behind the trees he sears in your mind for ever his fearful symmetry.

## What is wrong with these pictures:

- shape modelling
- lighting
- motion control
- textures and patterns
- fluid flow
- interaction
- purple prose

## So, what is the point?

Even though modelling and rendering in computer graphics have been improved tremendously in the past 35 years, we are still not at the point where we can model **automatically** a tiger swimming in the river in all its glorious details. By automatically I mean in a way that does not need careful manual tweaking by an artist/expert.

The bad news is that we have still a long way to go.

The good news is that we have still a long way to go.



## The Tiger Experience

Any question?

## CSC418 Computer Graphics

Next Lecture....

- Display Technology
- Pin-hole Camera model
- Basic display algorithms
  - Zbuffer
  - Ray tracing
- Drawing lines and scanning polygons