

CPSC 314

Computer Graphics

Dinesh K. Pai

Lecture 1: Introduction

Course website:

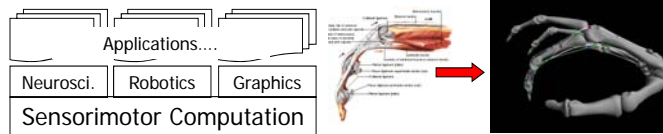
<http://www.ugrad.cs.ubc.ca/~cs314/Vjan2015/>

People

- Instructor: Dinesh K. Pai, pai@cs.ubc.ca
Office X853. Office hours W3-4pm.
- TAs: Shailen Agrawal, Joao Cardoso, Ben Janzen
- For fastest response to general course-related questions, use the discussion board.
 - You can also meet with TAs during scheduled lab times.

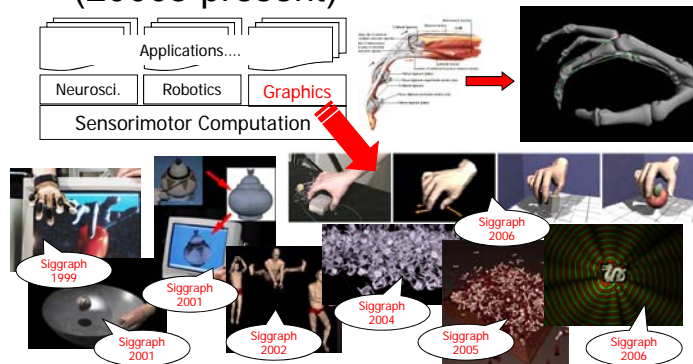
About me...

- Professor and Canada Research Chair



Sensorimotor Computation in Graphics

- (2000s-present)

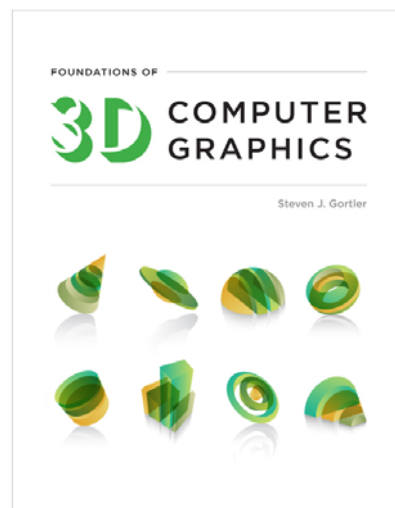


Course Communication

- Lectures: MWF 1-2pm Dempster 301
- Labs: In ICICS 005. **Labs start next week.** Attendance is not mandatory but highly recommended.
- Course website: Assignments and materials will be posted here
<http://www.ugrad.cs.ubc.ca/~cs314/Vjan2015>
- Grades will be posted on Connect.
- Discussions: We will use Piazza. You will need an access code. Instructions on Connect.

Required Textbook

- Textbook: Steven J. Gortler (2012) Foundations of 3D Computer Graphics, MIT Press
- Available online from UBC library, **free** to UBC students.



Prerequisites

- All of MATH 200, MATH 221 and either
 - (a) CPSC 221 or
 - (b) all of CPSC 260, EECE 320.
- The following are essential for success
 - good grasp of linear algebra
 - exposure to calculus; “mathematical maturity”
 - programming maturity
- This is not an easy course!

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Grading

marks %	work
40	programming assignments (4)
27	final exam
33	quizzes (3)

First assignment will be available next week

Important change this year

- The assignments will use the WebGL API, which is closely related to the OpenGL API used in previous years
- A huge advantage is that your code will run on any modern browser, without any special compilation
- But this requires JavaScript, which you will have to learn yourself
- We will also use the Three.js library to simplify some aspects

CPSC 314 Computer Graphics

Dinesh K. Pai

What is Computer Graphics?

Many slides courtesy of Min Hyuk Kim, KAIST

What is Computer Graphics?



What is Computer Graphics?



What is Computer Graphics?



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What is Computer Graphics?



Answers: Graphics

Graphics

Graphics

- All of them are purely computer graphics images, created by the latest *graphics* techniques

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What is Computer Graphics?

- *The Study of Algorithms and Systems for **Generating Images** with Computers*

- Includes the study of:
Representation



Manipulation

- Interaction

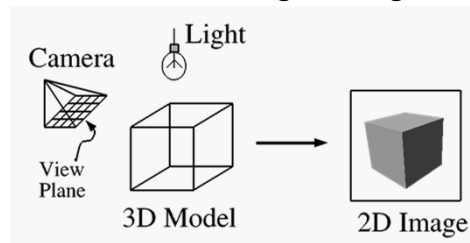


Applications



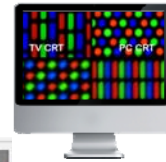
What is Computer Graphics?

- **Imaging** = representing 2D images
- **Modeling** = representing 3D objects
- **Rendering** = constructing 2D images from 3D models
- **Animation** = simulating changes over time



Areas of Computer Graphics

- 2D imaging
 - Digital imaging/filtering
 - Color transformations
 - Display technology
 - Compositing and layering
- 2D drawing
 - Sketching, illustration
 - User interface

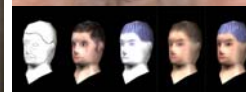


Areas of Computer Graphics

- 3D modeling
 - Scanning 3D shapes
 - 2D texture mapping
 - Polygons, curved surfaces
 - Procedural modeling



2D texture



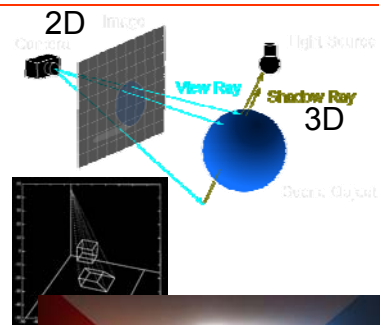
Virtual 3D character



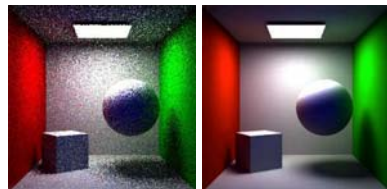
- More in CPSC 424

Areas of Computer Graphics

- 3D rendering
 - 2D views of 3D geometry
 - Projection and perspective
 - Removing hidden surfaces
 - Lighting simulation



Tracing ray transport



4 rays per pixel 1024 rays per pixel



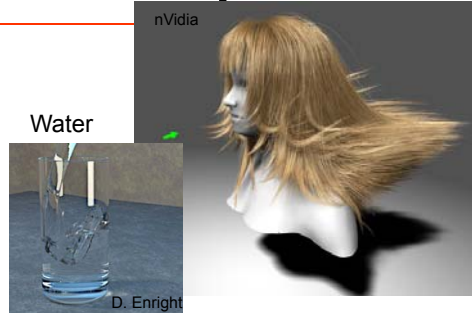
Areas of Computer Graphics

- User Interaction
 - 2D graphical user interfaces
 - 3D modeling interfaces



Areas of Computer Graphics

- Animation
 - Physical simulation
 - Key-frame animation
- Check out CPSC 426 this term!



Allowing artists complete controls over animation



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Thin Skin Elastodynamics


Duo Li, Shinjiro Sueda*, Debang R. Neog, and Dinesh K. Pai

University of British Columbia

*Now at Disney Research Boston / MIT

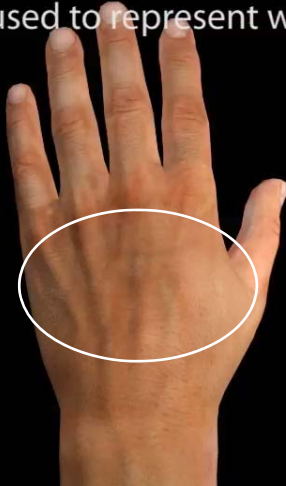


Human Head Movements



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Normal map is used to represent wrinkles and veins



Note: mesh vertices do not move

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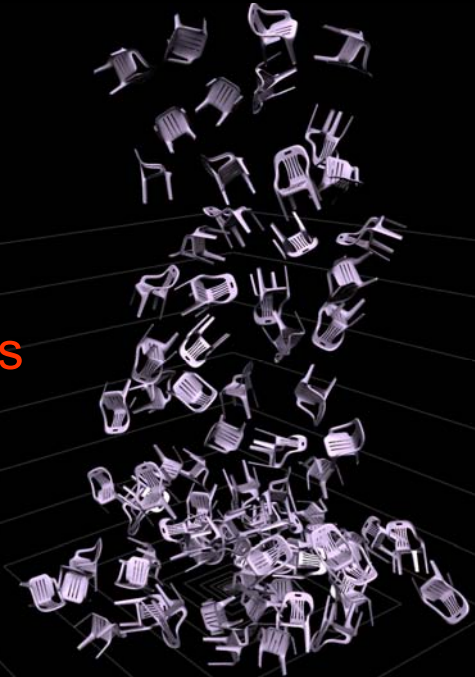
BD-Tree

**Output-Sensitive
Collision Detection
for Reduced
Deformable Models**

Doug L. James


Dinesh K. Pai

SIGGRAPH 2004




**Output-Sensitive Collision
Processing for Reduced-Coordinate
Deformable Models**


Applications of Computer Graphics



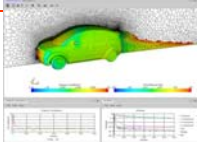
Movies




Games




Computer-Aided Design



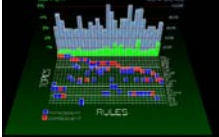
Computer-Aided Analysis



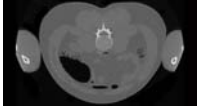
Cultural Heritage




User Interface



Information Visualization




Medical Imaging



Simulation Training

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Applications of Computer Graphics



Pixar - Ratatouille (2007)

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Applications of Computer Graphics



WETA Digital – King Kong (2005)

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Applications of Computer Graphics



SEGA - Iron Man 2, 2010

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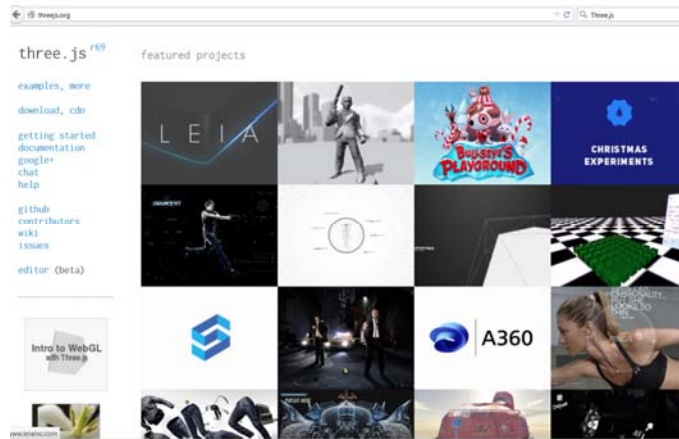
Applications of Computer Graphics



Microsoft Studio - Halo 4, 2012

Applications of Computer Graphics

3D in a web browser using HTML5



In this course you will learn how to

- Represent 3D shapes
- Transform 3D shapes
- Render 2D images from 3D shapes
- Model shading and lighting
- Create details of appearance using textures
- Program all of the above using the Three.js library, WebGL API and the GL Shading Language

For next class

- Review Chapter 1 of textbook
- Review Math 200 and Math 221.. We'll start off by reviewing some essential mathematics for 3D graphics
- This week: review/learn JavaScript. See "Resources" tab on course web page. Will need it for next week's assignment.