CPSC 314
Computer Graphics

Dinesh K. Pai

Lecture 1: Introduction

Course website:

http://sensorimotor.cs.ubc.ca/cpsc-314/

(link also available through Connect)

People

- Instructor: Dinesh K. Pai, pai@cs.ubc.ca
  Office X853. Office hours TBD.
- TAs: Amon Ge, Edoardo Dominici, Prashant Sachdeva, Silver Burla, Syed Iqbal
- For fastest response to general course-related questions, use the discussion board.
  - You can also meet with TAs during scheduled lab times.
  - The instructor is also available by appointment for questions not suitable for the discussion board
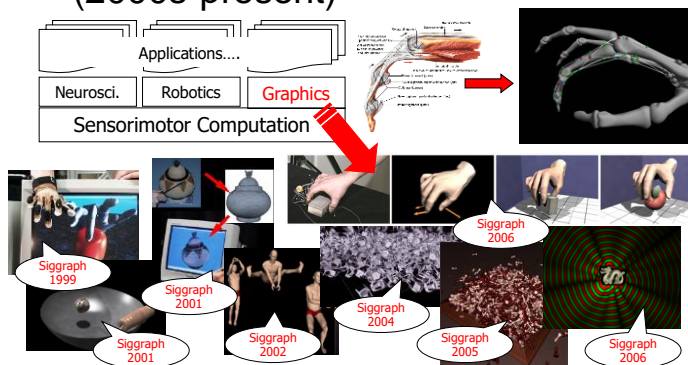
About me…

- Professor and Canada Research Chair
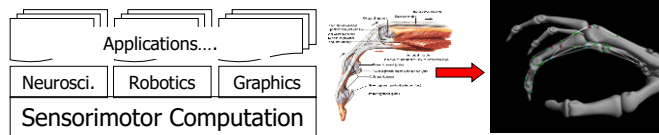

Sensorimotor Computation in Graphics

- (2000s-present)

More details at http://sensorimotor.cs.ubc.ca/pai/

Course Communication

- Lectures: MWF 10-11am Dempster 110
- Labs: In ICICS 005. Labs start next week. Attendance is not mandatory but highly recommended.
- Course website: Official announcements, assignments and materials will be posted here http://sensorimotor.cs.ubc.ca/cpsc-314/
- Discussions: We will use Piazza. Please join the course discussion group: https://piazza.com/ubc.ca/winterterm12017/cpsc 314/home

Required Textbook

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

FOUNDATIONS OF

3D COMPUTER GRAPHICS

Steven J. Gortler

6
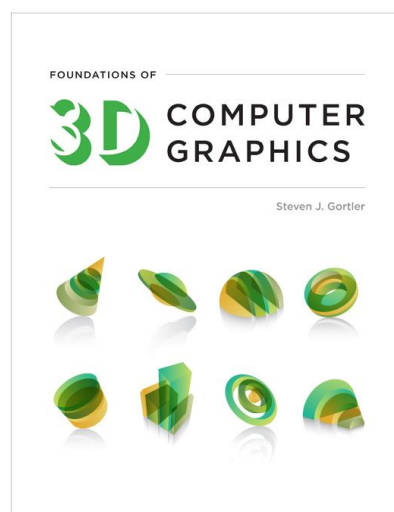
Prerequisites

- One of <u>MATH 200</u>, <u>MATH 217</u>, <u>MATH 226</u>, <u>MATH 253</u> AND
- One of <u>MATH 152</u>, <u>MATH 221</u>, <u>MATH 223</u> AND
- Either (a) <u>CPSC 221</u> or (b) all of <u>CPSC 260</u>, <u>EECE 320</u>
- The following are essential for success
  - good grasp of linear algebra
  - exposure to calculus; "mathematical maturity"
  - "CS maturity"; programming experience
- This is not an easy course!

7

Grading

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

First assignment will be available next week

First quiz is on September 22, in class.

CPSC 314
Computer Graphics

Dinesh K. Pai

What is Computer Graphics?

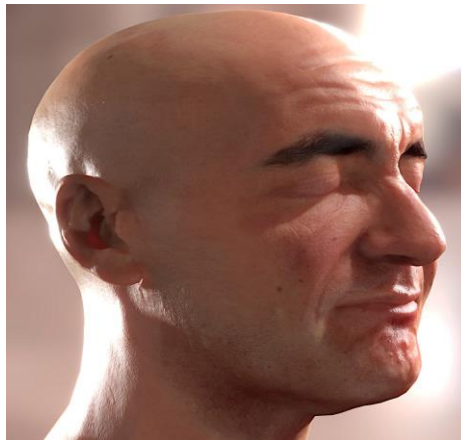Many slides courtesy of Min Hyuk Kim, KAIST

What is Computer Graphics?

What is Computer Graphics?

11

What is Computer Graphics?

12

What is Computer Graphics?

(a)

Fiero Ardi

(b)

Al Dean

(c)

Jorge Jimenez

Answers: Graphics

Graphics

Graphics

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

13

What is Computer Graphics

https://vimeo.com/199867074

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APPROPRIATE AUDIENCES
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PG-13
Some Material May Be Inappropriate for Children Under 13

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ACTION VIOLENCE

www.filmratings.com

www.mpaa.org

What is Computer Graphics?

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

- Includes the study of:

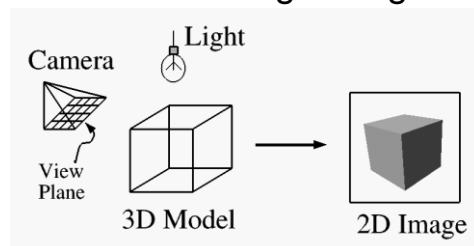Representation

Interaction
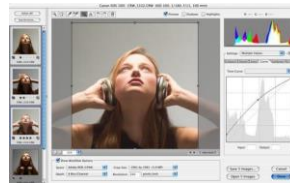
Manipulation

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

Light

Camera

View Plane

3D Model

2D Image

16

Areas of Computer Graphics

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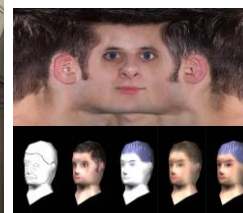 - Sketching, illustration
  - User interface

Areas of Computer Graphics
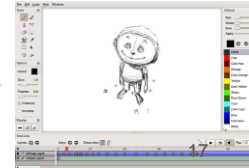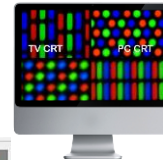
2D texture

Virtual 3D character

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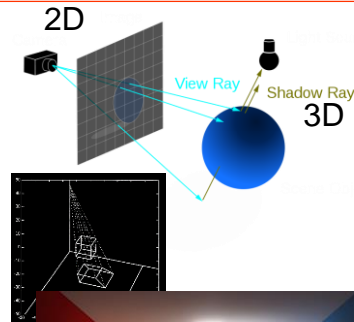 - Polygons, curved surfaces
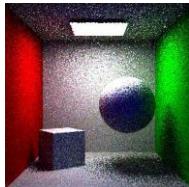 - Procedural modeling

- More in CPSC 424

18

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

- Virtual Reality / Augmented Reality
- User Interaction
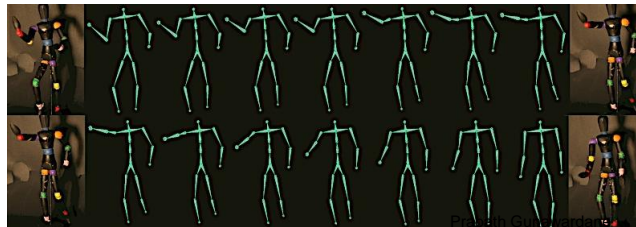 - 2D graphical user interfaces
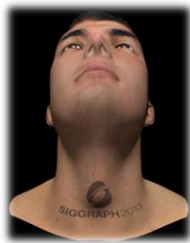 - 3D modeling interfaces

NASA

Areas of Computer Graphics

- Animation
  - Physical simulation
  - Key-frame animation
- More in CPSC 426 + grad courses

Hair

nVidia

Water

D. Enright

Allowing artists complete controls over animation

21

Thin Skin Elastodynamics

Duo Li, Shinjiro Sueda[*], Debanga R. Neog, and Dinesh K. Pai

University of British Columbia

[*]Now at Disney Research Boston / MIT

SENSORIMOTOR COMPUTATION

UBC a place of mind
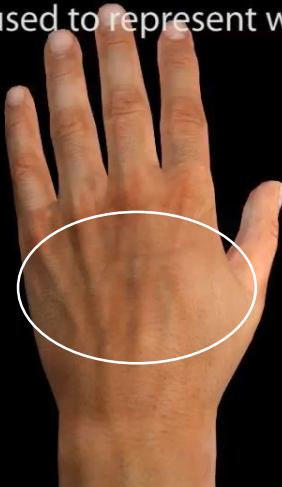THE UNIVERSITY OF BRITISH COLUMBIA

SIGGRAPH2013

Human Head Movements

23

Normal map is used to represent wrinkles and veins
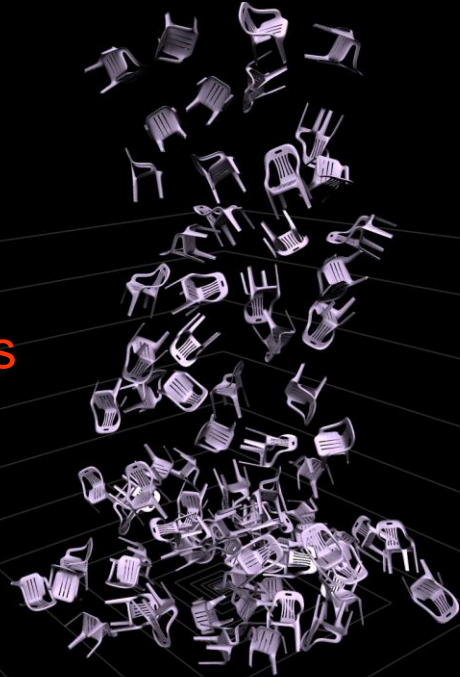
Note: mesh vertices do not move

24

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
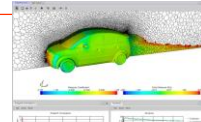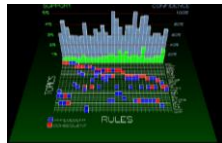
Applications of Computer Graphics

Movies

Games
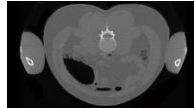
Computer-Aided Design

Computer-Aided Analysis

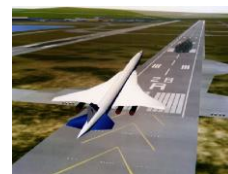Cultural Heritage

User Interface

Simulation Training

Information Visualization

Medical Imaging

27

Applications of Computer Graphics

Pixar - Ratatouille (2007)

28

Applications of Computer Graphics

WETA Digital – King Kong (2005)

29

Applications of Computer Graphics

SEGA - Iron Man 2, 2010

30

Applications of Computer Graphics

Microsoft Studio - Halo 4, 2012

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 WebGL API and 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