CS 148: Introduction to Computer Graphics and Imaging

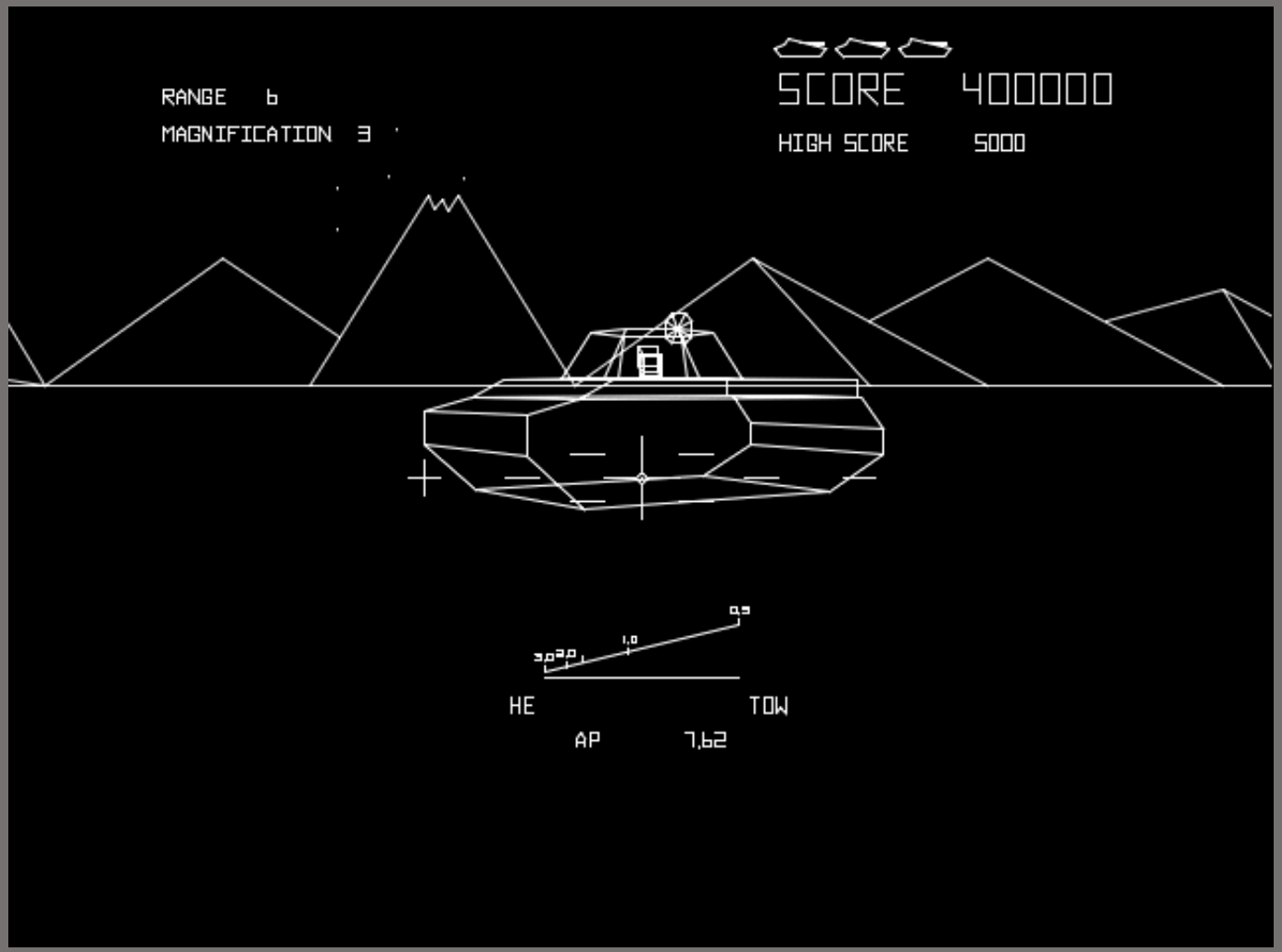
Zahid Hossain

PhD Candidate

Computer Science & Bioengineering

Why Graphics ?

Video Games



Battlezone (1980)

Video Games

Gears of War 3 (2011), Unreal

What we want; maybe ?

Video Games

Crysis 3 (2013), CryEngine

Graphics on mobiles

Zen Garden, on iOS8 (2014), Unreal

Relevant Courses

- **CS148 – Introduction to Computer Graphics**
- **CS 248 – Interactive Computer Graphics**
- **CS205a – Math for Robotics, Vision and Graphics**

Movies

Toy Story (1995)

Movies

Day After Tomorrow (2004)

Movies

The Curious Case of Benjamin Button (2008)

Movies

Brave (2012)

Movies

https://www.youtube.com/watch?v=Tmm4BQX8TCQ

Academy Awards!

Ron Fedkiw won it twice！

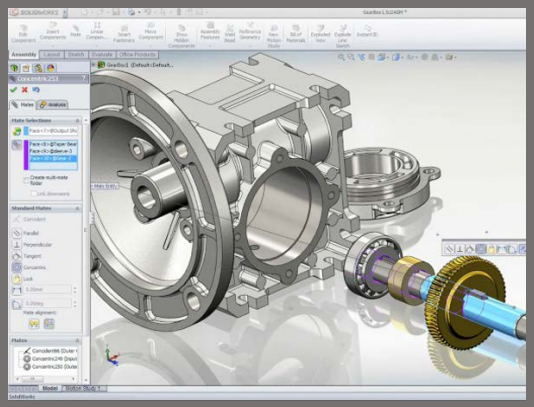
Academy Awards!

Pat Hanrahan won it thrice !

Relevant Courses

- **CS348b – Image Synthesis Techniques**
- **CME306 – Numerical Methods, Level Sets etc.**

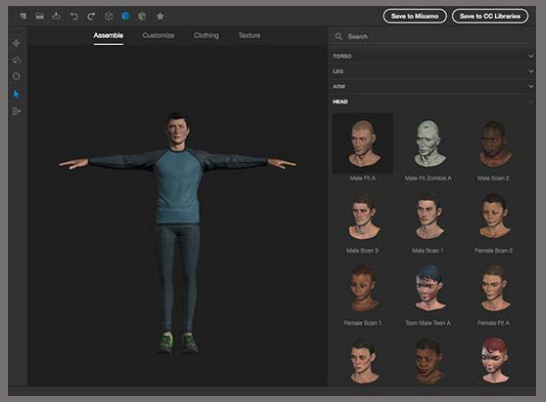
CADs, Animators, Modelers



Solidworks, Dassault Systemes

Maya, Autodesk

ZBrush, Pixologic



Fuse, Adobe

Relevant Courses

- CS 268 – Geometric Algorithm
- CS 348A – Geometric Modeling
- CS 368 – Advanced Geometric Algorithm
- CS 468 – Differential Geometry
- CS 228 – Probabilistic Graphical Model
- CS 229 – Machine Learning
- CS 231N – Neural Network

2D Image Processing

Photoshop, Adobe

Aperture, Apple

GIMP

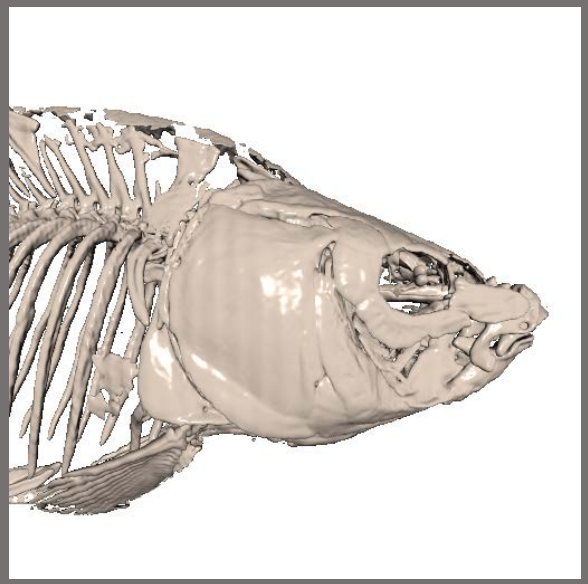
ILLUM, Lytro

Relevant Courses

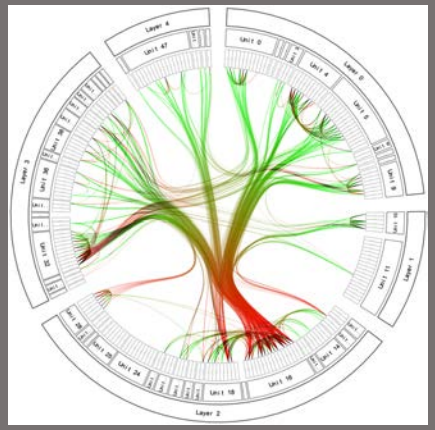
- **CS178 – Digital Photography**
- **CS 131 – Intro. To Computer Vision**
- **CS 231 – Computer Vision II**
- **CS478– Computational Photography**

Visualization

CT scan of Tamut, CNN 2014



Z. Hossain and T. Möller 2011



Hierarchical Edge Bundling

T. Weinkauf and H. Theisel 2010

*http://www.win.tue.nl/vis1/home/dholten/

Relevant Courses

- **CS448b – Visualization**
- **EE169 – Intro to Bioimaging**

Simulators

da Vinci surgical robot, Intuitive Surgical

Boeing 737 Simulator MPL Simulator Solutions

Relevant Courses

- **CS 277 – Experimental Haptics**
- **CS 327 – Advanced Robotic Manipulation**

Virtual and Augmented Reality

I. Sutherland's HMD 1965!

Occulus Rift, Occulus 2016

M. Heilig 1962!

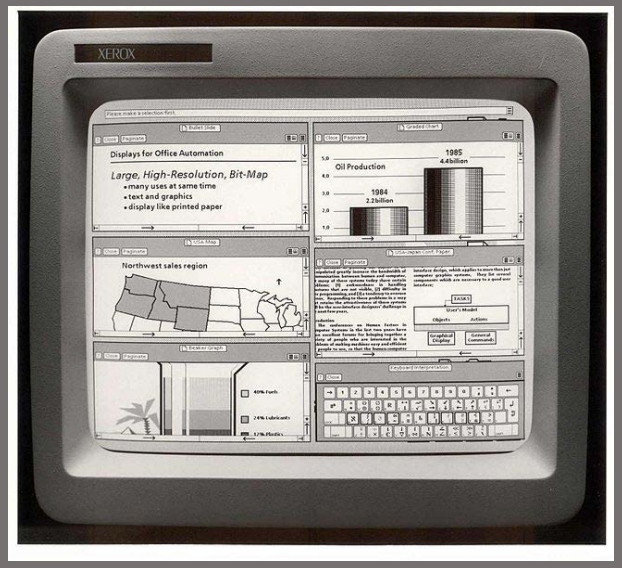
Hololens, Microsoft 2016

Relevant Courses

- **CS 211 - Content Creation in VR**
- **EE 267 – Virtual Reality**
- **CS 377M – HCI in Mixed and AR**

User Interfaces

Sketchpad, I. Sutherland,1963



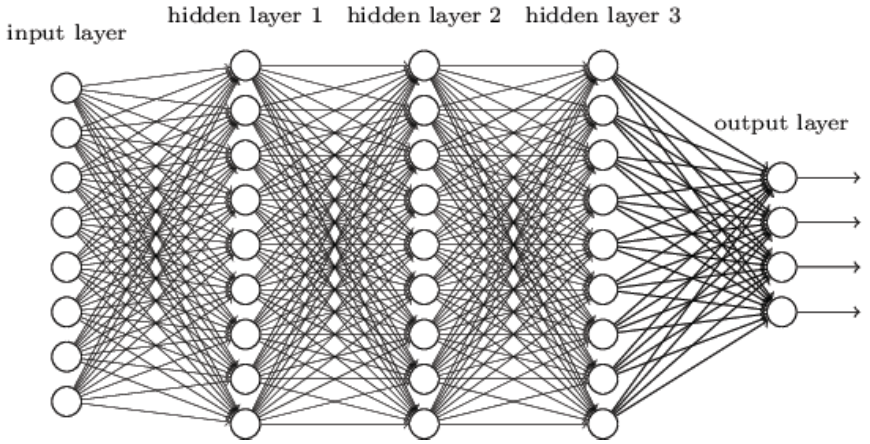
Star, Xerox PARC 1981

Relevant Courses

- **CS 247 – HCI Design Studio**

Technology Driver

GPU



Neural Network

http://neuralnetworksanddeeplearning.com/chap6.html

Computer Graphics Is a Humongous Field

Administrative

On the Web

- Main
  - http://cs148.stanford.edu
- Piazza
  - https://piazza.com/stanford/summer2016/cs148
  - Please post all your questions in Piazza
    - Everybody benefits from this !

Grading

- **60% Homework**
  - 5 homeworks – 1 week each
  - Total 3 late days – 25% penalty / day after that
- **10% Reading Assignments**
  - One reading every week
  - Should not take more than 5-10 minutes
  - **No late days**
- **10% Participation**
  - In person or through Piazza or by helping others
- **20% Final Project**

Final Project

- Open ended !
- Group of **at most 3 people**
- Goal : Demo something cool
- Grade based on:
  - Aesthetics (its Graphics !)
  - Technicalities
  - Report
  - Presentation / Demo
- Important dates and details (**see updates on the website**):
  - 21st July 11:59 PM: Proposal due
  - 11th Aug (Time: TBD) Demo day.
- SCPD students: Make pre-recorded demo, post it in youtube the day before the demo day. Participlate in Q/A through Google Hangout on the demo-day.

Text Books

- None officially
- But we may assign readings from the following: (available through Stanford Library)
  - **[ebook]** Fundamentals of Computer Graphics 3rd Ed. by Shirley et. al.
  - **[ebook]** OpenGL Programming Guide, 7th Edition by Shreiner.
  - Computer graphics : Principles and Practice by Foley et. al.

Course Staff

- Instructor: **Zahid Hossain**
  - Email: zhossain@stanford.edu
  - Office: E350A Clark Center
- CA: **David Hyde**
  - Office: Gates Basement Lobby
  - Office Hours: Saturdays: 1-5PM
- CA: **Minjae Lee**
  - Office: Gates 210
  - Office Hours: Fridays 1-5PM

Administrative Reminder

Points for participation!

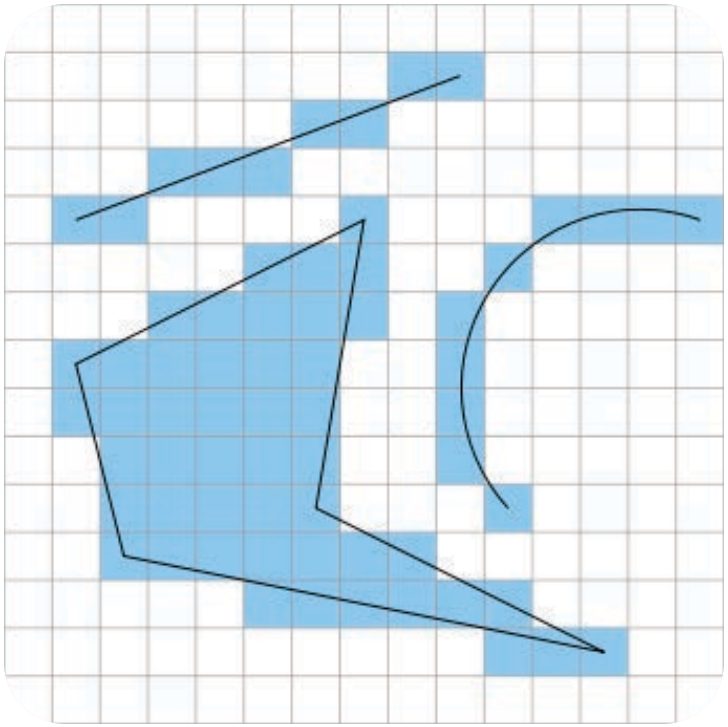
:Credit your collaborators:
helping others will count as participation

Outline

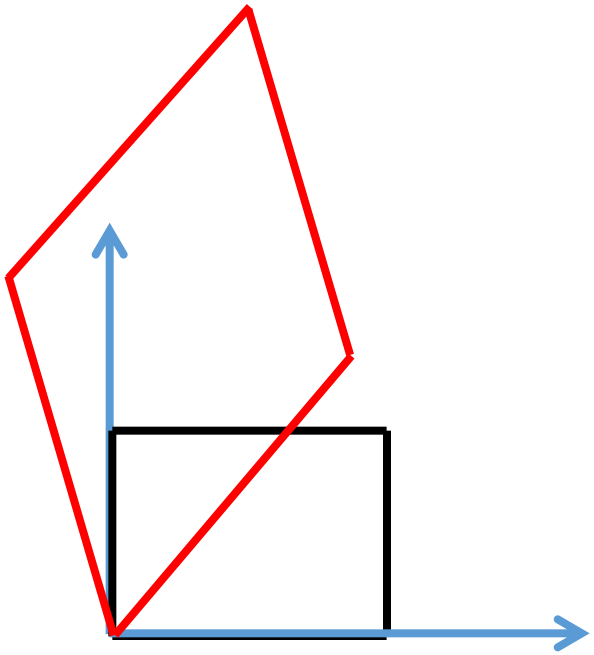
Week 1

Lights and Colors

Week 2



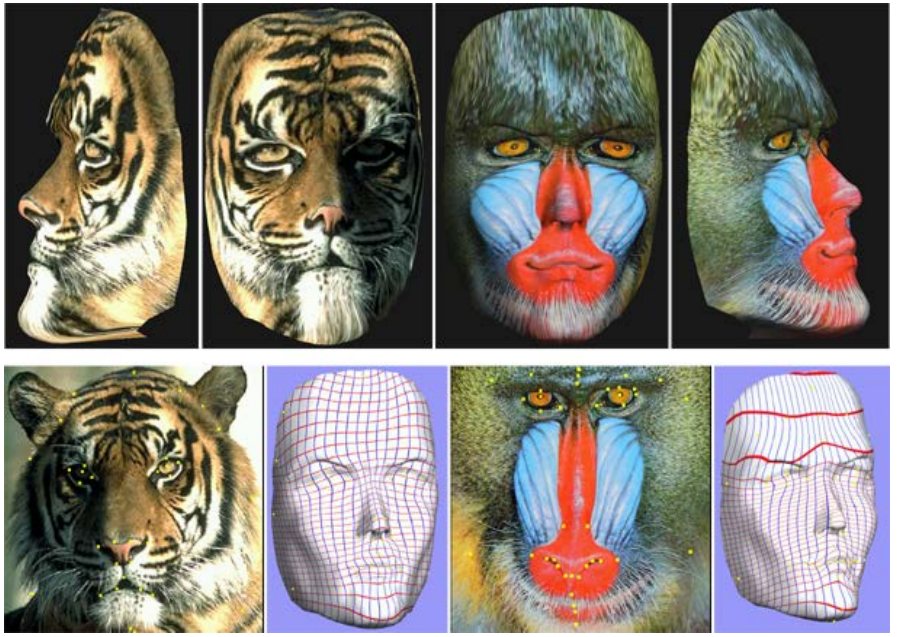
Rasterization



Transformation

Week 3

OpenGL



Texture Mapping

Week 4

Rendering

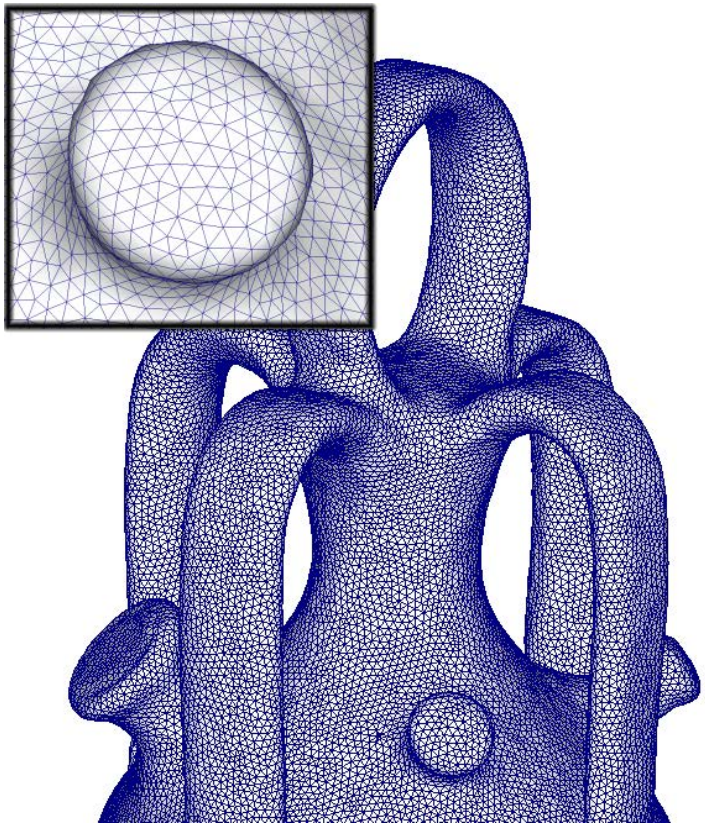
GPUs and Shaders

Week 5

Materials

Ray-Tracing

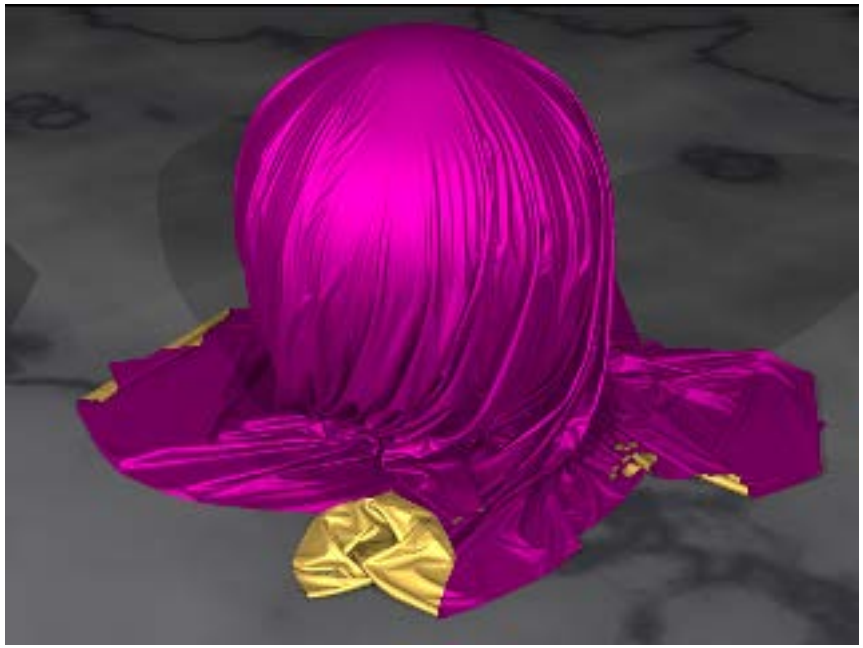
Week 6

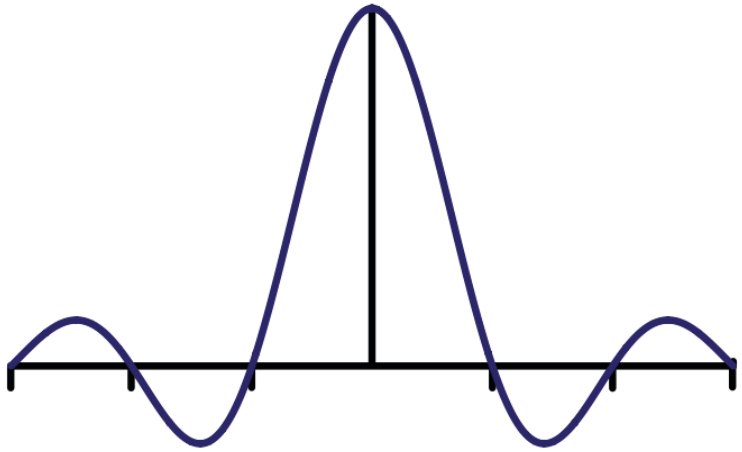


Geometry

Animation

Week 7





Physically Based Animation **Signal Processing**

Week 8

Recap and Project Demo

Credits: Lecture Materials

- Justin Solomon (now at MIT)
- Katherine Breeden
- Mirela Ben-Chen (now at Technion, Israel)
- Ronald Fedkiw
- Pat Hanrahan

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