CSE 167:
Introduction to Computer Graphics

Jürgen P. Schulze, Ph.D.
University of California, San Diego
Fall Quarter 2019

TAs and Tutors

- Teaching Assistants:
  - Sainan Liu
  - Karen Lucknavalai
- Tutors:
  - Guangyan (Nick) Cai
  - Kevin Huang
  - Weichen Liu
  - Haoqi Wu

Course Overview

Rendering

- Synthesis of a 2D image from a 3D scene description
  - Rendering algorithm interprets data structures that represent the scene in terms of geometric primitives, textures, and lights
- 2D image is an array of pixels
  - Red, green, blue values for each pixel
- Objectives
  - Photorealistic
  - Interactive

Photorealistic rendering

Photorealistic rendering

- Physically-based simulation of light, camera
- Shadows, global illumination, multiple bounces of light
- Slow, can take minutes or hours to render an image
- Used in movies, animation
- Covered in CSE 168: Rendering Algorithms

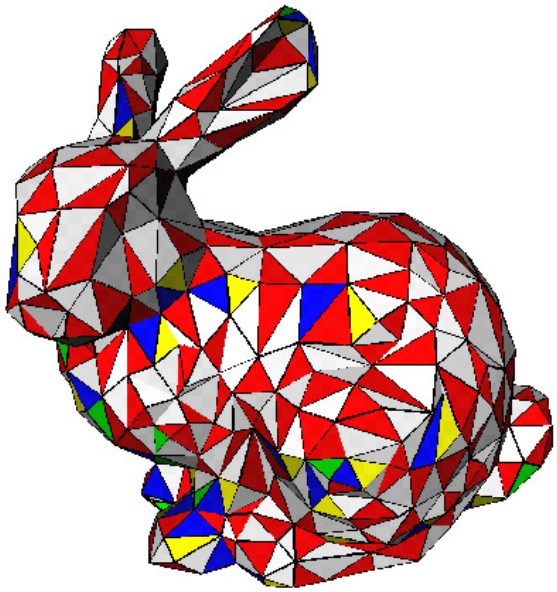
Interactive rendering

Interactive rendering

- Produce images within milliseconds
- Using specialized hardware, graphics processing units (GPUs)
- Standardized APIs (OpenGL, DirectX, Vulkan)
- Tries to be as photorealistic as possible
- Hard shadows, only single bounce of light
- Used in games, technical design, etc.
- Covered in this course

What will we render?

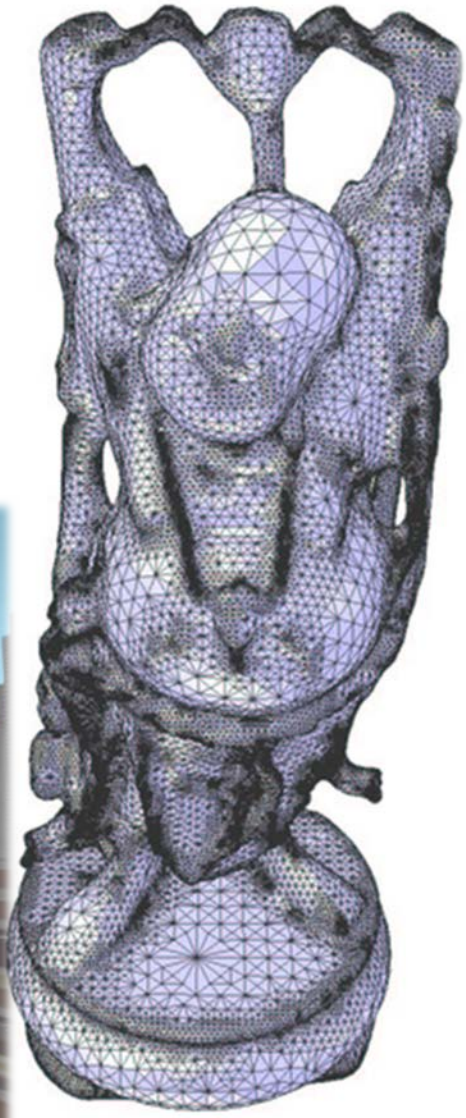
- Simple shapes: points, lines, triangles, quads
- 3D models
  - Basic 3D models consist of arrays of triangles



- Sources of 3D models:
  - Created with 3D modeling tool
  - Procedurally generated by algorithms
  - Created by scanning real objects

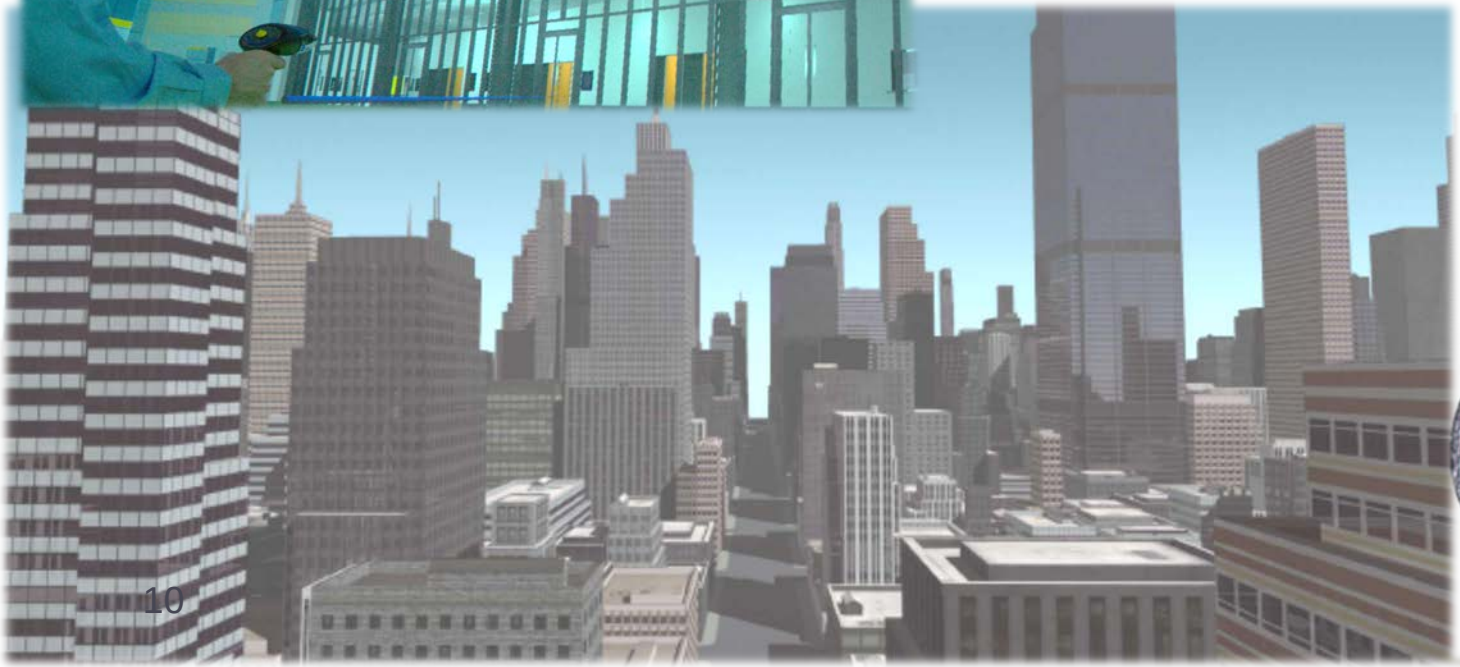
Modeling

Scanned statue



3D modeled building

Procedural city



Prerequisites

Familiarity with:

- C++
- Object oriented programming
- CSE 100: Advanced Data Structures
  - Data structures in C++: linked lists, graph structures, class or struct arrays
  - Data structure analysis
  - Deciding on appropriate data structures to solve problems
- Standard Template Library
- Git version control system for **private** source code repository

Topics Covered

- Basic skills:
  - Vector and matrix mathematics
  - Coordinate system transformations
  - 3D to 2D projection
  - Rasterization

Topics Covered

- OpenGL:
  - Lighting
  - Texturing
  - Shading
  - GL Shading Language (GLSL)

Topics Covered

- High Level Concepts:
  - Scene Graph
  - Culling
  - Parametric Curves and Surfaces
  - Procedural Modeling

Topics Covered

- Visual Effects:
  - Environment Mapping
  - Shadows
  - Deferred Rendering

Course Organization

Information on Course Web Site

URL: http://ivl.calit2.net/wiki/index.php/CSE167F2019

- Course Staff
- Office Hours
- Weekly Schedule
- Textbooks
- Homework Assignments
- Grading Information
- Course Schedule

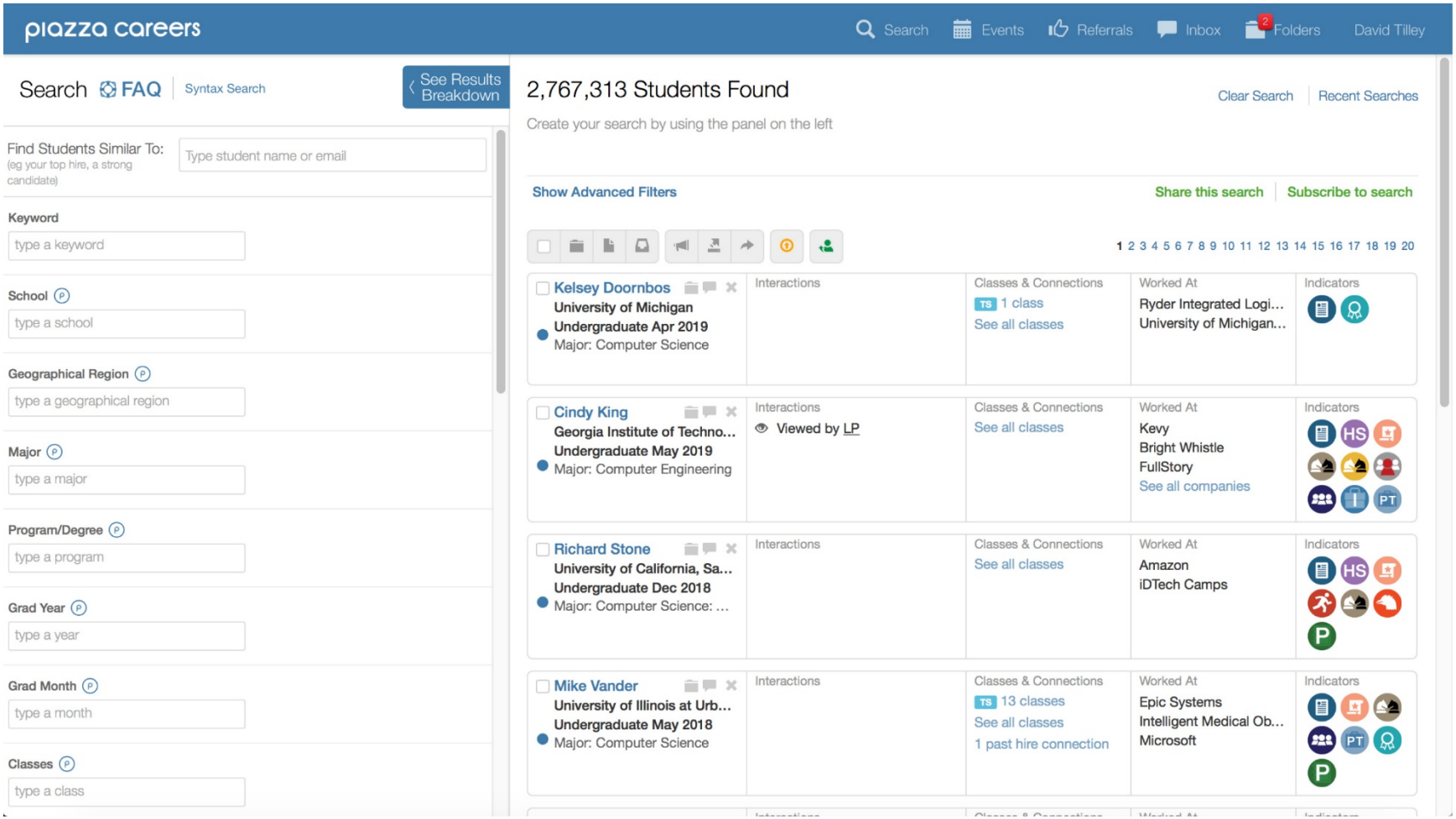
Canvas

- For homework and exam grades
  - Check your grades regularly
  - Let us know if a grade is missing or incorrect
    - Allow a few days for grades to be entered
- Upload source code
  - Only ASCII (text) files
- Discussion forums for homework projects, midterms, other topics

Why not Piazza?

- George Porter found out that Piazza collects data via the Q&A portal that we are familiar with and sell it to companies via their "careers" portal.
- The data is not anonymized. They sell a database search interface that includes the student's name, their email address, any information they filled out in their profile, a list of the classes they took, as well as whether the students posted a lot or received many faculty endorsements (that's when you click "that was a good question" or "that was a good answer").
- Certainly some students might benefit from this career portal. But companies might use it to select who they interview, etc.

Piazza Careers Portal



Programming Projects

- 5 programming assignments
  - First four projects are individual projects, final project is team project
- Find assignments and due dates on home page
  - Due dates every other week
- Starter code is on home page
- Use CSE basement labs or your own PC/laptop
- Individual assistance by TAs/tutors during office hours
- Turn in by demonstration to course staff during homework grading hours on Fridays
  - Demonstration can be done on lab PC or personal laptop
  - Grading from 2pm until at least 3:15pm
  - Required: submit source code to Canvas by 2pm
- All programming projects have extra credit option for extra 10% score

If you can't come to grading

- Submit source code by 2pm on due date as usual
- Email instructor:
  - Reason of absence
  - When you can demo project instead (in TA/tutor office hours)

Waitlisted Students

- Includes Extension School and Concurrent Enrollment
- Recommended to work on first homework project even if not yet enrolled
- Canvas access only once enrolled

Homework Project 1

- Will go on-line by tomorrow evening
- In the meantime: get starter code working

Announcements

- First homework discussion
  - Monday 7-7:50pm
  - Solis Hall 104

Final Projects from Fall 2018

- Domino in "Ourscraft"
  - Yiming Cai, Yue Pan, Ke Che
  - https://www.youtube.com/watch?v=6WzA6nAiVBA&list=PLINx2DKpKpTvFEnpwyzLmtmZK5LXlBP5x&index=23&t=0s
- Star Date 700
  - Chris Crutchfield, Jake Sutton, Alex Lui
  - https://www.youtube.com/watch?v=87pFNy-YAzI&list=PLINx2DKpKpTvFEnpwyzLmtmZK5LXlBP5x&index=44&t=0s
- Western town ft. pig
  - Joel Andersson Pablo Canas Castellanos
  - https://www.youtube.com/watch?v=Q6wrhBo337k&list=PLINx2DKpKpTvFEnpwyzLmtmZK5LXlBP5x&index=13&t=0s