An Introduction to Computer Graphics and Computer Vision

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Computer graphics is the art of imaging virtual and imagined scenes. Computer vision is the science of extracting information about the world from captured images. Both rely heavily on the physics of light and cameras. This class will be an immersive introductory exploration through the these two fascinating subjects. You will utilize math, physics, and computer programming as your tools in this exploration. Your efforts will come together through creations and analysis of visual applications.

Session Breakdown

Everyday consists of a 2.5 hour morning session and a 3.5 afternoon session. Nicholas Dwork will lead the morning session; the Teaching Assistants will lead the afternoon session. The morning session will focus on presenting new material. The afternoon session will focus on learning and exploring that material by tackling relevant challenges. Each morning session will be broken into three sub-sessions; each sub-session will consist of material from one subject: Math, Physics, Programming, Image Processing, Computer Graphics, or Computer Vision. There will be short breaks between sessions that will consist of meditations, stretching, or short demonstrations. We will also be discussing topics like communication, presentations, truth, logic, and the future (often with short video prompts).

Opportunities to Learn

Assignments: Assigned every Monday and Thursday. Assignment solutions are due
   every Monday and Thursday at the start of class. Assignment solutions must be
   immaculate.
Main Applications: As consultants, you are asked to satisfy several customer desires.
   You are tasked with delivering at least one solution to your customer (*Me!*).
Final Presentation: Our class will make a presentation during the final week of the
   quarter. Each member will present how he/she addressed a Main Application.

Resources

Course website: www.stanford.edu/~ndwork/si2015
Introduction to Matrix Methods and Applications by Boyd and Vandenberghe
   Available online for free at: http://stanford.edu/class/ee103/mma.html
Multiple View Geometry by Hartley and Zisserman
   You shouldn't need this text. I present it here in case you would like to learn
   more after the class.

Week 1: **The Basics, Initial Applications**
      Math: Geometry, Vectors, Matrices, Rotations, Homogeneous Coordinates
      Programming: Variables, Flow, Scope, Loops, If .. then .. else, Images, Plotting
      Guest Lecture: Corey McCall - Starting an Engineering Company

Week 2: **Computer Graphics, Physics of Light**
      Math: Projections, Camera Matrices, Color Images
      Programming: Displaying Images, Objects
      The Pinhole Camera
      Guest Lecture: John Pauly - The Kick of the Discovery

Week 3: **Computer Vision, Videos**
      Image Stitching, Object Detection, Stereoscopic Perception, the Photoelectric Effect
      Guest Lecture: Uzair Sikora - Making Inexpensive Medical Equipment from Cell Phones

Week 4: **Medical Imaging, Advanced Math Concepts**
      Geometric Distortion of Images, X-Ray, Ultrasound, Types of Sets, The Four Subspaces
      Guest Lecture: Gennifer Smith - Fighting Cancer with Medical Imaging and Phantoms

Example Main Applications:
      Making a Virtual World
      Image Stitching
      Object Detection and Making Cars Disappear
      X-Ray Simulation of Beating Heart

Note:
- This schedule is a guideline and subject to change based on the interests of the students
- This course will require an enthusiasm in mathematics. We will be exploring some advanced math concepts and focus on the rigor of thought associated with mathematics.
- Above all, from this course, I hope you get an accurate understanding of what it means to be an engineer. You'll be acting as an engineer!