The Course

- Introductory Graphics, Vision and Image Processing course
- Prerequisite for Advanced Graphics and Vision courses
- Visual Computing concentration
Course Format

• Lecture Format
  – No textbooks
  – References in class website
  – Notes will be online before class

• 4 Programming Assignments
  – IP, Vision, Graphics, Final project

• 2 Midterms and Final

• Use the noteboard effectively

• Schedule is online
Grading and Office hours

• Do not worry about grades
• Learning is the priority

• Tentative Policy
  – Each Programming Assignment – 7.5%
  – Each Midterm – 15%
  – Final – 40%

• Office hours
  – Right before class on Wed
Course Motivation

• What is Visual Computing?
  – Use of computing to perform the functions of the human visual system

• Traverses within several traditional domains
  – Computer Vision
  – Computer Graphics
  – Image Processing

• Addresses converging domains
Course Organization

- Image-based visual computing
- Geometric visual computing
- Radiometric visual computing
- Visual content synthesis
Course Organization

- Image-based visual computing
- Geometric visual computing
- Radiometric visual computing
- Visual content synthesis
How do we detect features?

- Edges, corners etc
- Cells in retina and brain
How do we understand details?

- Detectors that detect different resolutions
  - Can be also called spatial frequency
Convergence

- Cells that averages information from a neighborhood of receptors
- Convolution
Foreground Background

- Background subtraction
Image Segmentation
Course Organization

• Image-based visual computing
• Geometric visual computing
• Radiometric visual computing
• Visual content synthesis
How do we detect shape?

- Many cues
  - Monocular
  - Binocular
  - Shading
  - Motion
  - Texture
Binocular Cues
Shading Cues
Texture Cues
Motion Cues

Movie
Course Organization

- Image-based visual computing
- Geometric visual computing
- Radiometric visual computing
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How do we see contrast?

- **10,000:1**
- Only a small band at a time
How do we see contrast?

- **High Dynamic Range Imaging**

Sky oversaturated  Ground undersaturated  HDR image
How do we see reflectance?
Course Organization

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Can we reverse engineer?

- How realistic can we get?
- Can we fool the eye
  - Digital instead of real
  - E.g. Perfect storm
Effects

- Geometry
- Lighting
  - Shadows, inter-reflectance, refraction, specularities
- Material property
- Animation
- Tradeoff between speed and accuracy
  - Games (30fps) vs movies (hours per frame)
Basic

- No inter-reflections, plastic like appearance
Much more time is spent
Global Illumination
Subsurface Scattering
Transluscence

Different levels of subsurface scattering (increasing from left to right) on Venus
Can we merge real and synthetic?

Show Fiat Lux
Simulation
Non Photorealistic Rendering

Photorealistic

Illustrations

Painterly Rendering

Dithering

Pen and Ink

Engraving

Fur and Grass
This class

• We will NOT learn ALL of these
• Provide you with the fundamentals so that you can learn all of these