Human-Centered Computer Graphics

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(with slides from Reynold Bailey, RIT)
Introductions

• Find a partner- you will introduce that person and he/she will introduce you
  – Name
  – Year
  – Major/Department
  – Fun fact
Information

• You are registered for CIS4930 (2D85) or CIS6930 (2D31)
• Class times: MWF Period 4 (10:40am-11:30am)
• Location: CSE E121
• Prerequisites: CAP 4730 (Computer Graphics) or equivalent.
• You should be comfortable programming in MATLAB.
• Instructor: Dr. Eakta Jain
  – ejain@cise.ufl.edu
  – Office: E540
  – Office hours: Wednesdays 11:30am-1:30pm, or by appointment.
• This is a research based class — you will participate in the creation of knowledge!
• The class is structured as far as topics and assignments go, but unstructured in terms of where your projects take you.
• The ideas and work generated in the class belong to UF, and may be used as part of further research by the instructor or collaborators. By enrolling into this class, you are opting into this agreement.
Points to Ponder

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• This may be the first time many of you will be participating in research:
  – problem definitions in research are different from homework problems,
  – open-ended, require you to fill in the details,
  – need to be proactive with looking for resources in the library or on Wikipedia or Google
  – this is not just true of academic research, but any real-life endeavor — so it’s well worth the pain to get this experience ahead of entering the work force.
Communication

• You are expected to attend class. Canvas and email lists are an aid — expect that important announcements will be made in class because I like to take your feedback into account while changing dates etc.

• I have a poor memory for logistics — when in doubt, refer to class syllabus or webpage. If there is confusion, bring it up in class so that we can address it for all students together.

• I repeat — the above point is important. If you ask me the due date for an assignment over email, I will not reply because I know that I will get it wrong : )

• Key dates:
  – Sept 11, Friday 5:00pm: CITI training due
  – Oct 9, Friday 5:00pm: Mini Assignment 1 due (this will be in parts, more on this later)
  – Oct 23, Friday 5:00pm: Mini Assignment 2 due
  – Dec 2+4, Wed/Fri, during class hours: Project final presentations
  – The instructor will communicate with the class in advance if any of these dates need to be changed.
Grading

• Ethics training (10 points)
• Mini assignment * 2 (40 points)
• Project (50 points)
  – Proposal (10 points), Mid-term presentation (10 points), Final presentation (30 points)
  – Best project by class vote (Extra Credit 5 points)
• Extra credit (2 points): Study participation in an eye tracking data collection (pending IRB approval), or a 150 word paragraph on a technical aspect of eye tracking technology
• A typical grading scale is

>90 A
86.7 - 89.9 A-
83.3 - 86.6 B+
80.0 - 83.2 B
76.7 - 79.9 B-
73.3 - 76.6 C+
70.0 - 73.2 C
66.7 - 69.9 C-
63.3 - 66.6 D+
60.0 - 63.2 D
56.7 - 59.9 D-
< 56.7 E
Expectations

- Attendance
- Punctuality, Courtesy, Attention
- No phones
- University Honesty Policy (link in syllabus)
- Expectations for graduate vs undergraduate students:
  - I will have higher standards for graduate students, e.g., while considering the sophistication of their design and implementation, lack of errors, and clarity of communication.
  - Assignments may have extra questions for graduate students
- Individual vs Group assignments:
  - Plagiarism is very bad. Discussion is okay. If two students have discussed an assignment, they should both write the other persons name on their assignment as “Discussed with XYZ”
  - Pick a team you can work well with
- There will be no make up assignments/grading. In case of absence, students will have the option to apply their final project grade to that assignment.
- You will be programming in MATLAB. You are expected to have a working knowledge of it.
- You get out of school what you put into it!
Human Visual Perception in Art

• Traditional Artists:
  – Little knowledge of inner workings of human visual system.
  – Able to create sense of depth and motion on flat static surfaces.
  – They view the human visual system as a black box. Through experimentation, they learned to exploit its features.
  – In a sense, they have reverse engineered the human visual system to learn what type of inputs elicit certain responses in the brain.

Monet (1872), *Impression Sunrise*
Knowledge About Human Visual System

• We now have a much better understanding of inner workings of human visual system:
  – Extensive research from various fields of science:
    • Physics
    • Biology
    • Psychology
    • Physiology
    • Neuroscience
  – In-depth studies of visual system of macaque monkey, which is closely related to that of humans.
Knowledge About Human Visual System

• The visual system is far from being fully understood, but the knowledge gained thus far is quite substantial:
  – Especially of the early stages of the visual pathway.
Knowledge About Human Visual System

Earliest known diagram of the eye shows an area designated as the visual spirit.
Knowledge About Human Visual System

• Scientific study of vision did not begin until the start of the Enlightenment Period in the early 17th century.

• Why did it take so long?
  – Speculative and egocentric theories did not encourage scientific study.
  – Much of Europe was ravaged by poverty, plagues, and religious wars during the Middle Ages.
    • 5th century - 15th century
Historical Perspective

Idea of using primitive computer graphics:

- Greeks
- 1650–1700: First explorative experiments
- 1800’s: First operational computer
- 1950–2000: Head-mounted display systems and eye tracking technology
- 1960: First video game (Spacewars)
Historical Perspective

- Vision research
- Computer age
- Applied visual perception in computer graphics
Broad Topic Areas

- Perceptually driven research in computer graphics
- Fundamentals of human vision
- Collecting eyetracking data
- Analyzing eyetracking data
- Algorithms driven by eye tracking data
Further Reading

• Computer graphics historical timeline:
  – http://design.osu.edu/carlson/history/timeline.html

• Important dates in vision science 1600-1960:
  – http://www.arts.rpi.edu/~ruiz/stereo_history/text/visionsc.html

• Visual science before 1600:

• The history of color vision science:
  – http://www.psych.ucalgary.ca/PACE/VA-Lab/Brian/
Theories about visual perception from early Greek philosophers

Enlightenment: scientific study of vision begins

First microscopic observation of the retina

Luminance and contrast thresholds measured

Young proposes three receptor theory of color vision

Wheatstone invents the stereoscope

Hering proposes opponent theory of color vision

First recording of electrical activity in optic nerve

First random dot stereogram published

400 BC

First explanation of the optics of the eye

Middle Ages: little done to advance understanding of vision

Newton's Opticks published

Newton's prism experiments: the field of color science is born

Stroboscopic movement discovered

Dalton describes color blindness

Helmholtz invents the ophthalmoscope

First complete description of retinal neuroanatomy

Discovery of center-surround organization of cells in the visual system

Spatial maps of cone inputs to receptive fields of cells created

Vision research

Computer age

Applied visual perception in computer graphics and display systems

08/24/14