Announcements

- Project team and abstract due Oct 8, IN CLASS.
- MP2 is due Oct 1.
- MP3 will be out on Oct 6.
- Reading: Chapter 6 by Mather
4D Minecraft

• Ultimate exploration: to a new dimension!
• Build your own 4D living room - with 4D blocks. Start simple - see if you are comfortable inside of the 6 walls, then add on furniture :) 
• Contacts: lead student: Julius Chuang <jbchuan2@illinois.edu>, prof. Francis Wang
• Meet with Jeff Ludwig, the director of Jump Labs.
• Learn the needs of the cutting edge trading company and bring visualization models to the next (VR) level.
VR Robots Dancing Together

• Consider a set of robots/platforms that have a wildly different number of appendages/actuators and other physical characteristics – how would they dance together? How would they complete similar tasks?
• Make seemingly different creatures dance together using the freedom produced by virtual reality.
• Contacts: prof. Amy Laviers <alaviers@illinois.edu> Robotics, Automation, and Dance (RAD) Lab, Mech. Eng. Department, UIUC

https://www.youtube.com/watch?v=opokUHsDXqi
• Learn human behavior through a fun game.
• Develop a plugin that will enable scientists in psychology to monitor player behavior in an online game.
• Collect variable, such as in-game location and reaction time to events, and learn how to vary parameters of the game to control these variables.
• Contact: Cybelle Smith <cmsmit13@illinois.edu> (PhD student in psycholinguistics).
The Caves of Dunhuang

- Preserve one of the wonders of the world, the ancient World Heritage Site from the 4 AD, through VR, augmented with narrative by one of the leading historian on Buddhism and Chinese Arts History.
- Contacts: closed
Canonical Transformation

\[ T_{st} = \begin{bmatrix} \frac{2}{\ell^2} & 0 & 0 & \frac{1}{\ell} \\ 0 & \frac{2}{b^2} & 0 & 0 \\ 0 & 0 & \frac{2}{n^2} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \]
Viewport Transformation

$T_{vp}$ converts $-1..1$ range to pixel coordinates:

$n_x = \# \text{horizontal pixels}$

$n_y = \# \text{vertical pixels}$

$$T_{vp} = \begin{bmatrix}
\frac{n_x}{2} & 0 & 0 & 0 & \frac{n_x-1}{2} \\
0 & \frac{n_y}{2} & 0 & 0 & \frac{n_y-1}{2} \\
0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 1
\end{bmatrix}$$
Refraction, Diffraction, Reflection and Absorption

Snell's law: $n_1 \sin \theta_1 = n_2 \sin \theta_2$
Refraction in a Prism
Simple (Spherical) Lens
The Lensmaker's Equation: Converging Lens

- $d$
- $f$
- $R_1$
- $R_2$
- Axis
- Focal point
The Lensmaker's Equation: Diverging Lens

https://www.youtube.com/watch?v=4zuB_dSJn1Y
Convenient Unit: Diopter
Structure of the Human Eye

- Cornea
- Anterior chamber (aqueous humor)
- Ciliary muscle
- Suspensory ligament
- Lens
- Vitreous humor
- Hyaloid canal
- Fovea
- Optic nerve
- Retinal blood vessels
- Optic disc
- Choroid
- Sclera
- Iris
- Pupil
- Posterior chamber
- Zonular fibres
Optical Power the Human Eye
Imaging Properties of a Lens

- $S_1$
- $f$
- $S_2$

Object

Real image
Imaging Properties of a Lens