Metacognition

- Learning by doing
- Notes
- Discussion
- Assignments
- Tests
- Sleep and distributed learning (in time)
What is Graphics for?

- Visualization
- Design
- Animation
- UIs
Data visualization (visLab)
You will learn everything needed to do something like this.
Design
Animation
Light and the Environment
User Interfaces

Contigra Components
- 3D Widgets
  - Direct 3D Object Interaction
    - Object Selection
      - 3D Cursor
      - Virtual Hand
    - Occlusion Selection
    - Distance Selection
      - Arm Extension
      - Raycasting
      - Spotlight
      - Image Plane
  - Geometric Manipulation
    - Linear Transformation
    - Non-Linear Transformation
    - High-Level Object Manipulation
  - 3D Scene Manipulation
    - Orientation and Navigation
      - Direct Viewpoint Selection
    - Guided Transport
      - Flying Chair
      - Elevator
      - Train

Navigator

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Course organization

- www.ccom.unh.edu/vislab/GraphicsCourse
Pinhole camera and Perspective geometry

3D (world) -> 2D screen

Derive it.
Write equations to show how something appears on a screen

X,Y,Z (coordinate system)

x,y,z (world coords of a point)
x_p, y_p, z_p (screen coords of a point)
d: distance from origin to screen
Other aspects of the pinhole camera

- Camera Field of view
  - Theta = \( \arctan\left(\frac{w}{2d}\right) \) – derive it.
- Depth of focus (not with a pinhole)

- Projective geometry – all the rest is translations, rotations and scales.
The human eye

Three colors (Because of cones)
Graphics Pipeline

- Geometry
- Rotations
- Translations
- Scales
- Rasterization
- Interpolation
- Texture
- Color blending

CPU

Graphics bus

Vertex processor

Pixel processor

GPU

VRAM

Graphics Card

RAM

Clipping
Assignment 1

- Simple video game

Paddle
OpenGL and glut

- OpenGL based on sgi gl. A widely used standard
- Alternative is direct X
- Based on the pipeline architecture
- Giving way to “shaders” GPU programs
  - Low level mostly pixel based
  - Very fast e.g. 128 processors
  - We will not cover these methods because too low level
Glut

- Graphics library utility toolkit.
- Provides windows, simple menus. (and removes the need for a lot of ugly code)
GlutCB Mouse
GlutCB Keyboard
GlutCB Menus

Main
Setup callbacks Glut
Hand control to OS

OS
The opengl pipeline (again)

What? -- mostly polygons
Graphics Primitives

- `glBegin( <feature type> );`
  - `GL_LINES, GL_TRIANGLES, GL_POINTS`
- `glColor();`
- `glVertex( a list of vertices );`
- `glEnd();`

- Note there are also pixel-based operations that Bypass the frame buffer.