Announcements

- **MP3** is due Oct 26@11am.

Final project upcoming deadlines:

- **Oct 31**, submit two .jpg files:
  
  1. Picture-title of your project - an image that best describes your project. These will be posted on the class webpage: https://courses.engr.illinois.edu/cs498sl3/gallery.php

    **This is visible to everyone! :)**

  2. Snapshot of your first scene for the final project in Unity

- **Nov 14**, a short video of your progress.
Studying **perception** is studying how the brain makes conclusions about visual information.

**Cues** are visual features that trigger the brain to make conclusion about visual concepts.

**Two kinds of depth cues:**
- Metric (continuous)
- Ordinal (combinatorial)

**Importance to VR:** If we present enough of depth cues to the brain, the computation can be done in the brain instead of expensive GPUs and CPUs!!!

**Ex.** panoramas
Monocular Cues for Depth Perception:

[Diagram showing the difference in perceived depth between two images of a hand and trees, illustrating how monocular cues can affect depth perception.]
Depth Perception:

http://psych.hanover.edu/Krantz/art/rel_hgt.html
Depth Perception:
Depth Perception:

http://psych.hanover.edu/Krantz/art/texture.html
Depth Perception:
Depth Perception:

Have you seen VR experiences taking advantage of this? Be the first one!
Depth Perception:

http://www.psypress.co.uk/mather/resources/swf/Demo10_1.swf
Depth Perception:
Depth Perception:
Depth Perception:
Depth Perception:
Depth Perception:

http://www.psypress.co.uk/mather/resources/swf/Demo10_3.swf
Depth Perception:

https://en.wikipedia.org/wiki/Spinning_Dancer
Depth Perception:
Depth Perception:

Relative Motion

http://www.psypress.co.uk/mather/resources/swf/Demo10_2.swf

http://psych.hanover.edu/Krantz/MotionParallax/MotionParallax.html
Binocular Cues For Depth Perception:

- **Daffodil**
  - Left-eye view: Close
  - Right-eye view: Far
- **Tulip**
  - Left-eye view: Far
  - Right-eye view: Close

![Comparison of left and right eye views](image)
Depth Perception:

Uncomfortable in VR?
Depth Perception:

![Diagram showing depth perception with labels A and B.]
# Depth Perception: Depth Cues

<table>
<thead>
<tr>
<th>Monocular</th>
<th>Binocular</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Retinal image size</td>
<td>• Vergence angle</td>
</tr>
<tr>
<td>• Height in visual field</td>
<td>• Binocular disparity</td>
</tr>
<tr>
<td>• Texture gradient</td>
<td>• Diplopia</td>
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<tr>
<td>• Image blur</td>
<td></td>
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<tr>
<td>• Atmospheric perspective</td>
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<tr>
<td>• Accommodation</td>
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<tr>
<td>• Motion parallax</td>
<td></td>
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<tr>
<td>• Shadows/shading</td>
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<tr>
<td>• Interposition</td>
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## Combination of depth cues:
- Decision theory; machine learning
- Bayesian/probabilistic
  - Priors/Bias
  - Consistent or contradictory
  - How discriminatory is each cue in the context
Depth/Scale Perception in VR:

Do you need to verge more for higher values of IPD? Is it comfortable?
Scale Perception (vs. Depth Perception)

How large the object that I see is?

You perception of scale and depth are affected by your IPD (inter pupillary distance) in the virtual world.

https://www.youtube.com/watch?v=HEBEQhwG-rU
Developer Advice

- Design your world in meters.

- Do not place objects closer than 1 meter away.

- Match IPD in ____________ and ____________ to your physical IPD.
Horopter: Optimal Focal Curve
Optimal Focal Curve
Motion Perception: Purposes

Purposes:

1) Segmentation/Segregation via quick eye fixation on moving objects.

2) Extract 3D structure of an object (spin chair around).

3) Visual guidance for action:
   - manipulation - grab a cup
   - hand-eye coordination
   - self motion information.

https://www.youtube.com/watch?v=PhWUf9D52RQ
Motion Perception

Why car wheels rotate backwards in movies

https://en.wikipedia.org/wiki/Wagon-wheel_effect
Neural Circuitry for Motion

http://www.psypress.co.uk/mather/resources/swf/Demo11_1.swf
Fundamental Principles: Occlusions, Rigidity and Shutter

http://www.michaelbach.de/ot/mot-motionBinding/index.html
http://www.michaelbach.de/ot/mot-breathingSquare/index.html
http://www.michaelbach.de/ot/mot-Ternus/index.html