• Read chapter 1 of LaValle's book.
• Does anyone have access to the VR Lab?
• First MP to be released on Monday, September 4
Realism vs Simplicity in Cartoons
Realism vs Lower Cost and Portability
How many FPS are enough?

https://www.youtube.com/watch?v=-Qk7ZSXujRo
Evolution of Computer Games
Realism vs Simplicity in Computer Games
History of VR

Introducing... sensorama
The Revolutionary Motion Picture System that takes you into another world with

- 3-D
- WIDE VISION
- MOTION
- COLOR
- STEREO-SOUND
- AROMAS
- WIND
- VIBRATIONS

SENSORAMA, INC., 855 GALLOWAY ST., PACIFIC PALISADES, CALIF. 90272
TEL (213) 459-2162

https://www.youtube.com/watch?v=lSJWZpFIAiQ
Headsets vs Cave

≈ 10K

Higher cost: $10,000

Lower cost: $300
Hardware: Senses vs Sensors

A sensor is a transducer that transforms the physical world energy into a signal.
Sensors vs Physical World

Each sensor moves through space or changes in some way. These changes:

- are controlled by the brain
- form a space of configurations

In how many different ways can the world move wrt to these sense organs?

6 DOF

1 DOF for eye
3 DOF for head rotation
3 DOF for head translation
1 DOF for accommodation
VR System: Hardware, Software and Perceptual Psychology
Definition of VR

Inducing targeted behavior in an organism by using artificial sensory stimulation, while the organism has little or no awareness of the interference.
Oculus DK2 Teardown

https://www.ifixit.com/Teardown/Oculus+Rift+Development+Kit+2+Teardown/27613
Sensors in Physical World: Reality
Sensors in Physical World: Virtual Reality

natural stimuli

render display

artificial stimuli

neural signal
Audio Displays

Two familiar settings:

headphones

no trading
Visual Displays

Two settings:

↑ transl. tracking

heads tracking
HMDs vs Headphones
Distance to Displays

- Close:
  - Less power
  - Cheaper
  - Privacy
  - Portability

- Far:
  - Sharing
Birds-Eye View: Hardware

Rendering hardware (displays):
- Visual: **tube, LCD, OLEDs, TN, projector, retinal, light field**
- Audio: **speakers, bone conductor**
- Touch: **Oculus, Vive, ...**
- Smell? Taste? Vestibular?

Lens:

Tracking hardware:
- **IMUs**
- **cameras + marker**
- **light house**

Controllers:

Computer:
- CPU
- GPU
Hardware: Lens

Field of View: field of view

Distortion: deviation from straight line
Tracking Hardware: IMUs

Used for: 

Consists of: 

______________________________

______________________________

______________________________
Tracking Hardware: IMUs

Gyroscope

Spring

Mass

Acceleration
Tracking Hardware: IMUs
Tracking Hardware: Cameras
VR System: Software
Software: AWG

Types of self motion:
Software: AWG

Gaming engines

Google street viewer

Robot + camera