Session 01 - 08/22/17

Introductions, course overview, housekeeping

- About this class
    - Experimental, taught for the 1st time
        - Despite the various different section names, this is not two classes!
        - This is one class that is both/neither "Future of Digital Media" and "AR/VR in Architectural Environments"
        - I don't want to make a wall between the ACS and the ARCH students. Will learn same skills in this class.
    - Check this github repository for most up-to-date syllabus/info.
    - The focus of this class:
        - Things that are "Experienced" rather than "Used"
        - Trying and failing is OK!
        - We will test ideas and develop tools that you can use
    - Expectations: Participation and Flexibility
        - I do not want to talk *at* you. I want to facilitate - help you try things. Participation is a huge part of that - the class should evolve into a dialog.
        - Please be flexible as the class itself is an experiment and subject to change.
    - Assignments
        - Keep up with reading
        - "mini" project - completed in class time over ~3 sessions
        - Midterm project and Final project
            - Midterm and Final projects will require out-of-class time
    - Grading
        - Your final grade will be made up from:
            - Participation, attendance, in-class projects/exercises: 60%
            - Midterm project: 15%
            - Final project: 25%
    - Format
        - Discussion - readings will help get better intuition and deeper understanding.

- - Please read the assignments. More time explaining = less time making actual projects. I trust you to keep up with the reading, so please do or I will have to assign HW.
    - First session of each week will usually be talking/discussion, second sessions will be more technical.
    - I don't want to get too literal with lecturing on the future of media. This is the future of media. Thinking about design, bridging tech and creativity. We'll be doing it. We will have some recap at the end of the semester to put it into more bite size takeaways, but the point is I don't care if you can talk about the future of media - I want us to be the ones actually making it.
  - Goals
    - Specific Skills
      - Will have completed multiple VR/AR Projects
      - Experience with HTC Vive, Hololens
      - Proficiency in Unity
    - Conceptual Proficiency
      - New paradigms of design
      - A new set of tools available to you
    - Proficiency as in "Comfort"
      - You will not be experts in 16 weeks, but you will be able to jump into a project and start working.
      - Not daunted by own tools.
  - Misc
    - Work on own **Windows** laptops if you have them, bring portable drives if you don't.
    - *You are not required to have your own computer.*

Intro to AR/VR design principles: designing the real world

First concept of a "Virtual Reality"?

- Immanuel Kant 1781 - *Critique of Pure Reason* - Dual Nature of Reality
  - Kant was a philosopher dealing with Metaphysics
  - Branch of philosophy exploring the fundamental nature of reality.
  - In *Critique of Pure Reason* he stated that there are two parallel worlds: the **nouminal** and the **phenomenal**.

- The nouminal world is the objective external world, which is the source of the light that stimulates the retina. This is the world studied by science, and is populated by invisible entities such as atoms, electrons, and invisible forms of radiation.
- The phenomenal world is the internal perceptual world of conscious experience, which is a copy of the external world of objective reality constructed in our brain on the basis of the image received from the retina.
- The only way we can perceive the nouminal world is by its effects on the phenomenal world. *Therefore the world we experience as external to our bodies is not actually the world itself, but only an internal virtual reality replica of that world generated by perceptual processes within our head.*

- If we take this to logical conclusion, could we interrupt the process of perception and create our own reality?
  - Would this reality be any less "real"?
- Let's find a more tangible definition:
  - Steven M. LaValle, Professor, University of Illinois, Chief Scientist of VR/AR/MR at Huawei Technologies Co. Ltd
  - **Inducing targeted behavior in an organism by using artificial sensory stimulation, while the organism has little or no awareness of the interference.**
  - This, plus Kant's dual realities, will be our working definition of what we're doing here.
  - Examples
    - Head mounted displays tracking in space
    - Mobile phones (Think: pokemon go)
    - Snapchat filters
  - Does not have to even be visual!
    - "Overheard" - Luxloop, 2016
    - Overheard is a site-specific audio narrative woven into the Minneapolis Institute of Art. Similar to immersive theatre, it allows you to explore stories in your own way, at your own pace as you journey through the museum.
  - Where do we draw the line?
    - *"Perhaps listening to music through headphones should be included. What about watching a movie at a theater? Clearly, technology has been used in the form of movie projectors and*

audio systems to provide artificial sensory stimulation. Continuing further, what about a portrait or painting on the wall? The technology in this case involves paints and a canvass. Finally, we might even want reading a novel to be considered as VR. The technologies are writing and printing. The stimulation is visual, but does not seem as direct as a movie screen and audio system. We will not worry too much about the precise boundary of our VR definition. Good arguments could be made either way about some of these border cases. They nevertheless serve as a good point of reference for historical perspective." - LaValle

Brief history of Augmented/Virtual Reality

- So why are we so excited now? Why does it seem like AR/VR is a new thing?
- Look at quick history of "modern" Virtual Reality.
- Philco 1961 - "Headsight"
  - First Head Mounted Display (HMD)
  - Controls Remote Camera - user's head movements would pan/tilt a camera placed somewhere where they could not go themselves.
- Ivan Sutherland 1963
  - Invents the concept of an interactive Graphical User Interface, interacting with computers visually instead of with text.
  - (He does this as his PhD. No big deal)
  - *"A display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking glass into a mathematical wonderland."*
- 5 years later, he invents the *Sword of Damocles*. A spatially-tracked headset that superimposed a 3D cube over the wearer's field of view.
  - First true example of AR/VR
- For most of the 70s and 80s, AR and VR research is done for the military with few notable viable inventions moving substantially beyond Sutherland's tech.
- Over the course of the 80s and 90s, Steve Mann becomes obsessed with wearable computing, tinkering with several prototypes...
- ...Leading to the MIT Wearable Computing Project
- The 90s saw a curious intersection of academic interest in VR, "CyberPunk" fashion, and the mainstreaming of computers into popular culture, which led to...

- The first VR hype wave in the 1990s.

So, It's nothing new. It's been around for 50 years. So why don't we all live in the Metaverse already?

- Why did that first wave fizzle-out?
- Because the tech was very expensive.
- It was hard to *make* content for it, so few people actually did, which means that the content that did exist wasn't enough to satisfy consumers.
- Lastly (probably most importantly) the time AOL and the first dot-com bubble came and captured the public imagination with a much more viable technology to be obsessed by.
- What Happened?
  - June 29, 2007 - Apple released the first iPhone.
  - This device had nothing to do with VR, but it contained some very important technology: small, high-res screens and IMUs (Inertial Measurement Units) aka Gyroscopes and Accelerometers.
  - The phone's popularity, and the subsequent wave of similar phones, drove the cost of these components waayyyy down (supply & demand)
- Palmer Luckey - 2012.
  - Luckey was an intern at the USC lab where filmmaker Nonny De La Pena develops her VR project "Hunger in LA" using a $35,000 VR headset called the **Wide5**. The project is the first VR film to get into Sundance, but they realize that they can't afford to bring the headset to the festival.
  - Using these now low-cost electronic components , Luckey is able to hack together two headsets that are good enough to replaces the $35k headset for audiences to experience the project.
  - 6 months later, launches the Oculus Rift kickstarter.

We're back in the Hype Machine, baby!

- It's likely that the VR/AR tech of today looks just as silly in 20 years as this stuff looks to us now.
  - **The important thing is that now the tools for making content are much more democratized, and content is poised to drive adoption.**
- We'll cut it off there, for now.
  - Haven't even touched on google glass, snapchat spectacles.
  - Will talk more when we go over AR as social interaction.

- *When asked, "How could you possibly have done the first interactive graphics program, the first non-procedural programming language, the first object oriented software system, all in one year?" Ivan replied: "Well, I didn't know it was hard."* - Ivan Sutherland (Again)

The Unity Game Engine

Why use gaming engines?

- First, let's talk about **Abstraction**
  - In software engineering and computer science, **abstraction is a technique for arranging complexity of computer systems**. It works by establishing a level of complexity on which a person interacts with the system, **suppressing the more complex details below the current level.** The programmer works with an idealized interface (usually well defined) and can add additional levels of functionality that would otherwise be too complex to handle. For an example, a programmer writing code that involves numerical operations may not be interested in the way numbers are represented in the underlying hardware (e.g. whether they're 16 bit or 32 bit integers), and where those details have been suppressed it can be said that they were abstracted away, leaving simply numbers with which the programmer can work. In addition, a task of sending an email message across continents would be extremely complex if the programmer had to start with a piece of fiber optic cable and basic hardware components. By using layers of complexity that have been created to abstract away the physical cables and network layout, and presenting the programmer with a virtual data channel, this task is manageable. [wikipedia](#)
- Next, let's talk about **Sandwiches**
  - [Computer Science PB&J](#)
  - **In a nutshell: how specific do you have to be with what you tell the computer vs what does it already know?**
- Why Unity? Why use a Game Engine? (Are we making games?)
  - Because Unity Has some knowledge about the world. It knows some rules.
  - **Specifically, games assume that you're working with physical forces and bodies in some kind of space.**
- **PHYSICS**

- Unity *Abstracts* the math/physics/graphics away for us and we get to work on a higher level.
  - Knows about: Mass, gravity, inertia, acceleration...

Designing for a real world

- It's not that we're making games, its that we're designing for the real world
  - it would be helpful not to have to reinvent the wheel every time.
- *"The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked.*" - Sutherland (My favorite)
- It is important to keep in mind that we are in the middle of a step forward. This technology will get better, be replaced, disappear - become indistinguishable from reality. The *how* may change, but we are also thinking of the *why*.
  - CS people - put on designer hats!
  - Designers - think algorithmically!

Assignments for next time

- Read: Virtual Reality - Chapter 1
- Set up Unity somewhere you can work.

Extra reading

This is not required! Just some additional resources you might find interesting/relevant/funny.
Reddit thread on 90's VR hype vs now
Palmer Luckey Forum Review of Wide5 VR Headset
Ivan Sutherland Demonstrating Sketchpad
Jon Cohen - History of early AR/VR
Virtual Reality as a Moral Ideal
History of the tech that made VirtualBoy possible
VR: 90's vs today
Short demo of Ivan Sutherland's HMD
Ivan Sutherland Lecture recounting development of HMD

Sutherland's HMD Paper

Everything you need to know about AR in 5 minutes

Sundance Origin Story of Oculus Rift