VIRTUAL REALITY
LECTURE 1A: COURSE OVERVIEW

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Outline

- Intro to virtual reality
- VR status quo (and how we got here!)
- What this course is about
- Course structure and logistics

Virtual Reality

- What is virtual reality?
- How many of you have experimented with VR?
- How many of you have access to VR hardware?

Virtual Reality

- The computer-generated simulation of a 3D image or environment that can be interacted with in a seemingly real way. Person in the VR world **perhaps** needs to use special electronic equipment

Existing Virtual Reality Systems

- Standard VR systems use VR headsets or multi-projected environments to generate realistic images, sounds, or other sensations that simulate a user's presence in a VR environment!
  - VR headsets use a head mount display (HMD) with screens in front of eyes
  - can also use rooms with large screens
- VR typically uses audio and video feedback, but may also allow other sensory (force, vibration) feedback through haptic technology or 3D touch (create an experience of touch)

A 1980 HMD and wired gloves at the NASA Ames

What about other senses?

Fully Immersive VR Experience

- A fully immersive VR experience require complete immersion in the virtual environment
  - High quality video, audio, motion, touch, taste, smell, …

Omni treadmill being used at a VR convention

VR Applications

simulation & training

visualization & entertainment

remote control of vehicles, e.g. drones

gaming

robotic surgery

architecture walkthroughs

education

virtual travel

a trip down the rabbit hole

VR Industry Growth Perspective

- VR technology is on an explosive growth path
- Consumer VR hardware and software had a market cap of $6.2 Billion and is expected to be more than $16 billion in the next three years
  - **COVID impact on accelerated VR growth and adoption**

- Silicon valley is also heavily investing in VR startups
  - Lots of application beyond the previous slide in healthcare (e.g., anxiety treatment), military, and industry

- All major tech companies (e.g., Facebook, Apple, Amazon, Microsoft, Google) are investing heavily in VR

National Academy of Engineering

"Enhance Virtual Reality" is 1 of 14 NAE grand challenges in the 21st century

image from NAE

Realm of Reality

- **Virtual reality:** a simulated experience that can be similar or completely different form the real world

- **Augmented reality:** blends what the user sees in their real surroundings with digital content generated by computer software

- **Mixed reality:** merging of real world and virtual worlds to produce new environments where physical and digital objects co-exist and interact in real time.

- **Simulated reality:** is a hypothesis that reality could be simulated in a way indistinguishable from “true” reality.

Engineering Aspects of VR/AR

- cloud computing
- shared experiences

- CPU, GPU
- IPU, DPU?

- sensors & imaging
- computer vision
- scene understanding

- compression, streaming

- VR cameras

- photonics / waveguides
- human perception
- displays: visual, auditory, vestibular, haptic, …

- HCI
- applications

images by microsoft, facebook

Where We Are Trying to Go!

Evolution of Computing

Personal Computer
e.g. Commodore PET 1983

Laptop
e.g. Apple MacBook

Smartphone
e.g. Google Pixel

AR/VR
e.g. Microsoft Hololens

???

A Brief History of Virtual Reality