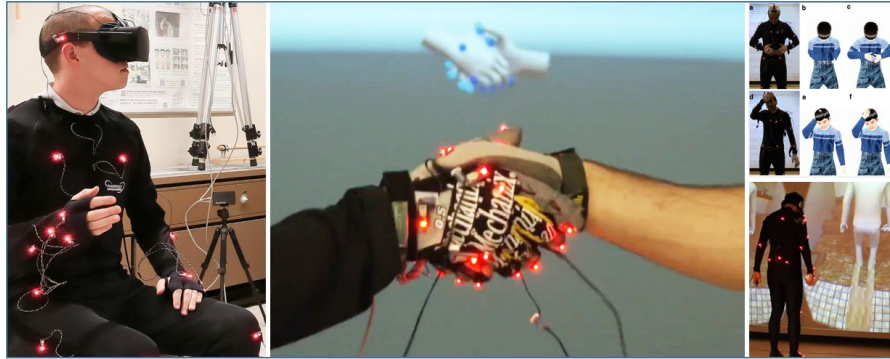


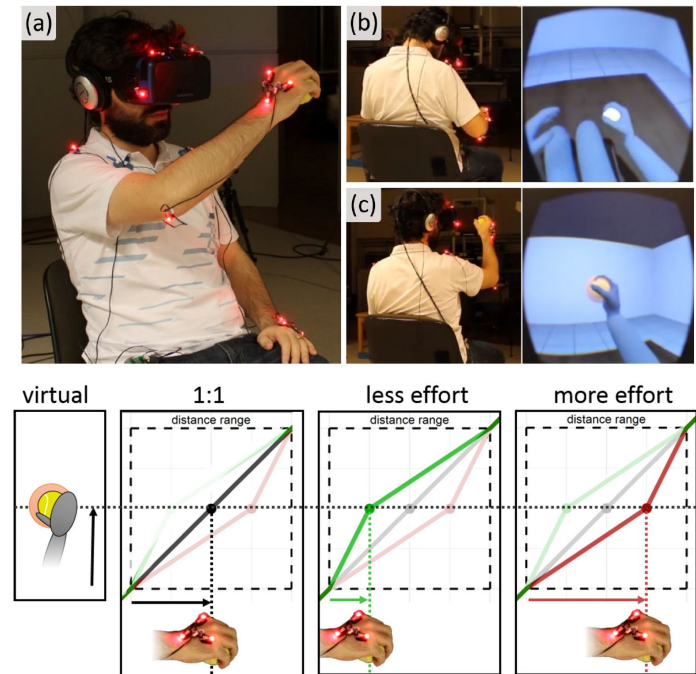
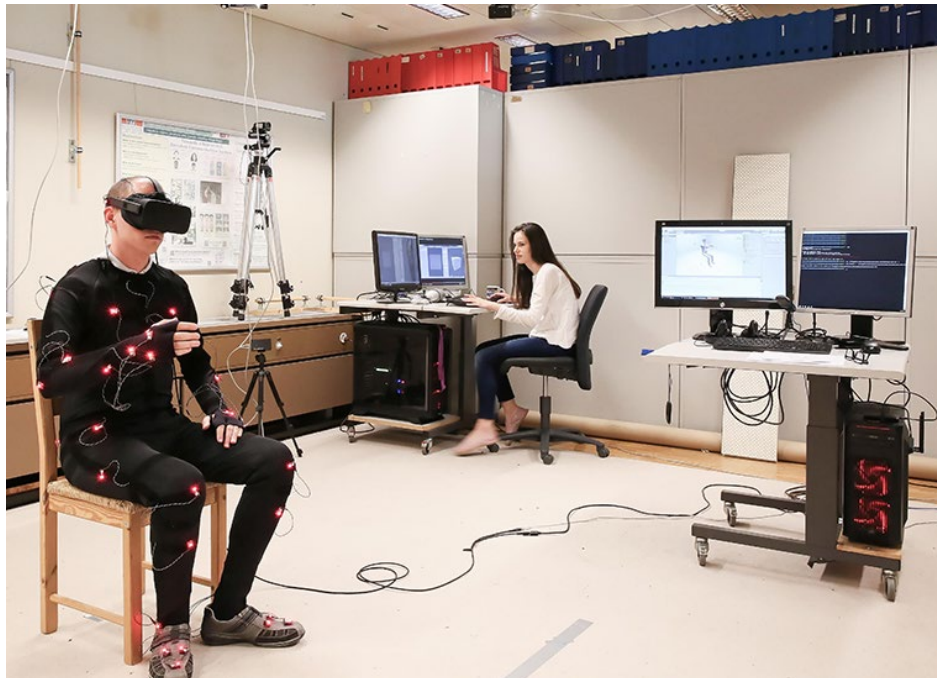
# Virtual Reality



- Lecturers and Teaching Assistants
- Course goals
- Course map
- Grading scheme
- Assignments structure
- Required prior knowledge
- References

## Lecturers

Dr Ronan Boulic  
 Senior scientist / MER  
 Leader of the Immersive Interaction  
 research group (IIG)

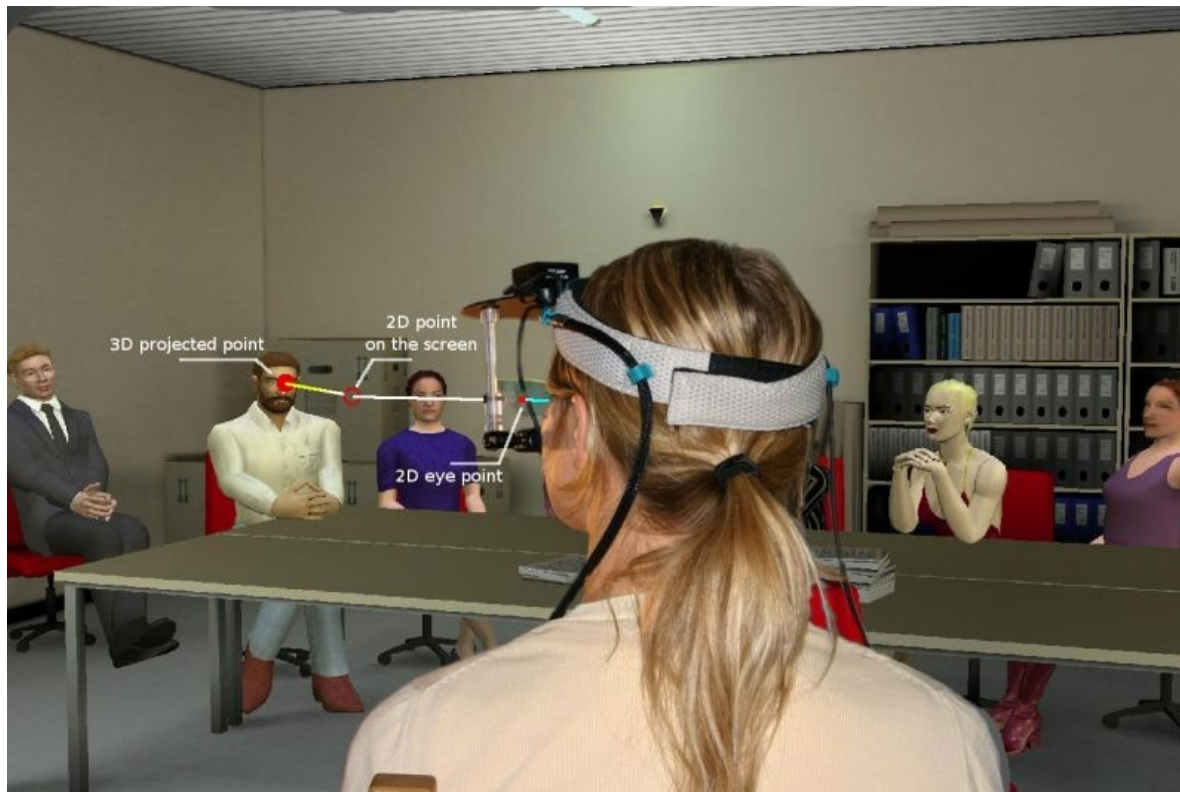


# Lecturers

Dr Bruno Herbelin

Senior Researcher

Cognitive Neuroscience Laboratory



# Teaching & HW Assistants



**Loën Boban**

PhD student in IIG



**Nana Tian**

PhD student in IIG

& 3 student-assistant : Adriano Viegas Milani

Leo Dupont

Paul Oliver

# Course Goals

## Introduction to the field of VR

*concepts & technologies of immersive real-time interaction*

## Background in human perception-action

*ensure the users are able to react as if the virtual environment were real, even if it is not “realistic”*

## Cover some key interface modalities:

*visual, haptic, movement*

## Present various applications

# Course Map

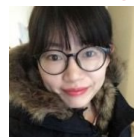


R. Boulic

1 VR concepts & Immersive Perception

2 Game Topics

Nana Tian



2 VR Systems

3 Presence

4 3D Interaction

5 3D Interaction

6 Action

7 Haptic

B. Herbelin

8 Haptic



9 Believability

10 Full-body Int.

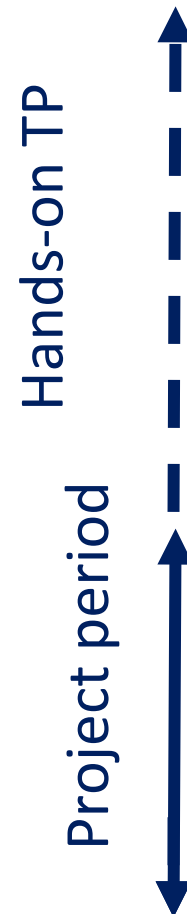
11

11 VR & NeuroSc.

12

13

14 *final oral exams*



## Course Map

week	10h15-11h00	11h15-12h	12h15-13h
1	Course presentation R. Boulic Embodied VR	R. Boulic Perception & Immersion	R. Boulic Depth perception
2	Nana Tian Intro to Game design	Nana Tian Play Testing	R. Boulic VR System + setup (HO1-a)
3	R. Boulic Immersion, presence, flow	R. Boulic Cybersickness	HO1-b:INTRO UNITY laptop + Project groups
4	R. Boulic	HO2: Intro Oculus Quest	Intro Oculus Quest
5	R. Boulic	Project pitch	Project pitch
6	R. Boulic <b>Paper Study Deadline</b>	HO3: Basic interaction with controllers	Basic interaction with controllers
7	R. Boulic	HO4: Advanced Interaction: Finger tracking, locomotion	Advanced Interaction: Finger tracking, locomotion
8	R. Boulic	project baseline peer assessment	project baseline peer assessment
9	R. Boulic	HO5: Structuring interaction behavior & Callbacks	Structuring interaction behavior & Callbacks
10	R. Boulic	R. Boulic	project
11	B. Herbelin	B. Herbelin	project
12	project play testing (with peer assessment)	project play testing (with peer assessment)	project play testing (with peer assessment)
13	project	project	project
14	project & theoretical oral exams	project & theoretical oral exams	project & theoretical oral exams

# Grading Scheme

Exam form: during the semester

4 components:

- **15%**: 1 article study and citation analysis [weeks **2 – 5**]
- **50%**: 1 project (group of 3 persons) [weeks **3-13**]
- **35%**: closed book theoretical oral control on the chosen article (as starting point) followed by more general VR concepts [week 14]



# Assignment structure

Week2: select one paper from the proposed list

Week5: write a short structured report ...

- highlighting the key contributions of the paper.
  - > **one page including paper title & your name**
- presenting how that topic is still evolving through a short survey of the articles who cited it (use **google scholars** citation list): **one page**
- list of key references & citing articles: **one page**
- **One page = [2'400-3'000] char including spaces**

# VR Hands-on

(5 hands-on tutorials over week3 to 9)

Assignment structure

week	10h15-11h00	11h15-12h	12h15-13h
1	Course presentation R. Boulic Embodied VR	R. Boulic Perception & Immersion	R. Boulic Depth perception
2	Nana Tian Intro to Game design	Nana Tian Play Testing	R. Boulic VR System + setup (HO1-a)
3	R. Boulic Immersion, presence, flow	R. Boulic Cybersickness	HO1-b:INTRO UNITY laptop + Project groups
4	R. Boulic	HO2: Intro Oculus Quest	Intro Oculus Quest
5	R. Boulic	Project pitch	Project pitch
6	R. Boulic <b>Paper Study Deadline</b>	HO3: Basic interaction with controllers	Basic interaction with controllers
7	R. Boulic	HO4: Advanced Interaction: Finger tracking, locomotion	Advanced Interaction: Finger tracking, locomotion
8	R. Boulic	project baseline peer assessment	project baseline peer assessment
9	R. Boulic	HO5: Structuring interaction behavior & Callbacks	Structuring interaction behavior & Callbacks
10	R. Boulic	R. Boulic	project
11	B. Herbelin	B. Herbelin	project
12	project play testing (with peer assessment)	project play testing (with peer assessment)	project play testing (with peer assessment)
13	project	project	project
14	project & theoretical oral exams	project & theoretical oral exams	project & theoretical oral exams

<https://cs444-practice.epfl.ch>

Loën Boban

<https://cs444-practice.epfl.ch> (still some minor timeline updates to do)



## LIST OF HANDS-ON

### **HO1 - a : Setup of the environment**

Installation of Unity3D, `adb` and configuration of the `$PATH`

### **HO1 - b : Introduction to Unity 3D**

Discovery of Unity3D mechanics

### **HO2 : Setup of a basic scene for the Oculus Quest**

Creating a simple scene for the Oculus Quest, compile, debug, push the build to the HMD and record videos

### **HO3 : Design of an interaction**

Design a simple interaction using the Oculus Quest's Touch Controllers

### **HO4 : Finger tracking and locomotion**

Setup a scene with the finger tracking and design a locomotion method

### **HO5 : Structuring collection behavior and callbacks**

Design of a structure to collect items, deviate those items with upgrades allowing new features and callbacks



**Questions ?** Use the dedicated channel on the EdStem tool

**Etiquette for asking questions :** check first whether the answer to your question is already present on edstem through a keyword search

# Week 2 : Setup of the environment (HO1-a)

## Assignment structure

you will need to **install Unity 3D** on your own computer.

In order to push and debug your game on Oculus Quest, you will also need to install the Android Debug Bridge: **adb**.

Last but not least duty: configuring the PATH

### Resources

<https://cs444-practice.epfl.ch/setup/environment/>



# Week 3 HO1-b : Introduction to Unity 3D (Without VR headset)

## Assignment structure

Master basics of **Unity 3D**  
(Like: Getting familiar with  
**Unity 3D, c sharp**  
**programming etc**) with your  
own computer.

This hands-on mainly  
includes tutorials from **Unity**  
**Learn.**

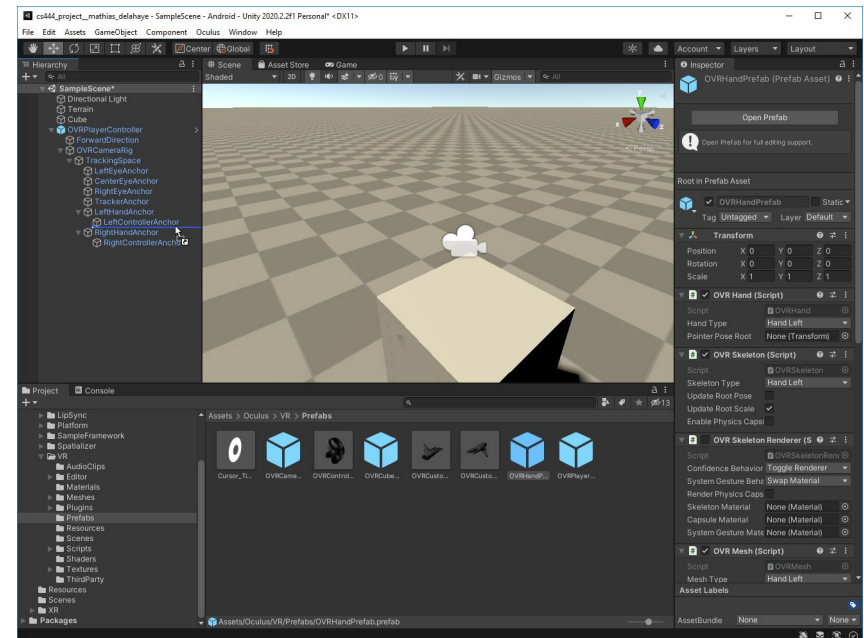


Illustration of the Unity3D layout

## Resources

<https://cs444-practice.epfl.ch/tp/tp1/>

50%: project (group of 3 persons) [3-13]:

- Topic: **Build a 3D VR Game** using **Unity 3D** and the **Oculus Quest**.
- **Project Guidelines:** Details on Moodle.
  - **Please Read Them!**
- **Week2-3:** Project Group Registration on Moodle
  - > **Until March 6th:** free choice of group
  - > **After March 6th,** for those without group:
    - > automatic constitution of groups
    - > groups of 2 persons are completed to 3
  - > borrow 1 Oculus Quest per group of 3 persons **between March 7<sup>th</sup> and 10<sup>th</sup>**

# H02 Week 4 : Setup of a basic scene for the Oculus Quest (group level).



With this tutorial, you will learn how to create a simple VR project, and finally, build and run the game to the **Oculus Quest** so that you can enjoy your first VR application.

Additionally, you will learn some extra skills like *versioning with GitLab, debugging, and recording videos in VR headset.*

## Resources

<https://cs444-practice.epfl.ch/tp/tp2/>

50%: 3 person group projects [3-13]:

- Topic: **Build a 3D VR Game** using **Unity 3D** and the **Oculus Quest**.
- **Project Guidelines**: Details on Moodle.
  - **Please Read Them!**
- Project Group Registration on Moodle: March 6th
- **Week5 Public Project Elevator Pitch** -> March 20<sup>th</sup>
  - Upload a 2 pages summary latest on March 19<sup>th</sup>
  - Public oral pitch (3 min) followed by 5min Q&A

**Pitch Feedback** provided through the Q&A



# H03 Week 6 : Design of an interaction

This hands-on focuses on **implementing a basic interaction (Grasping objects)** in the VR scene.

Goals include handling inputs from the Oculus Touch controllers, implementing anchors to grasp objects and integrate modules to the scene.

## Resources

<https://cs444-practice.epfl.ch/tp/tp3/>

# H04 Week 7 : Finger tracking and locomotion

## Assignment structure



You will learn to take advantage of the **finger tracking features** of Oculus Quest and **implement a teleportation locomotion behavior with finger gestures recognition.**

### Resources

<https://cs444-practice.epfl.ch/tp/tp5/>



# Assignment structure

50%: 3 person group projects [3-13]:

- Topic: **Build a 3D VR Game** using **Unity 3D** and the **Oculus Quest**.
- **Project Guidelines:** Details on Moodle.
  - **Please Read Them!**
- Project Group Registration on Moodle: March 6th
- **Project Pitch & feedback** -> March 20th
- **Week8: basic game interactions peer assessment on Monday April 17<sup>th</sup> (after vacation)**

# H05 Week 9 : Structuring collection behavior and callbacks

Upgrade the previous tutorials on basic interaction and dive a bit more into programming skills (Note: It will be useful to follow the C# basics in **Unity Learn** first.)

Focus on Event driven scenarios and callbacks

## Resources

<https://cs444-practice.epfl.ch/tp/tp4/>

50%: 3 person group projects [3-13]:

Topic: **Build a 3D VR Game** using **Unity 3D** and the **Oculus Quest**.

Project Guidelines: Details on Moodle.

Please Read Them!

Project Group Registration on Moodle: March 6th

Project Pitch & feedback -> March 20th

Basic game interactions peer assessment -> April 17<sup>th</sup>

**Week 12: Playtesting peer assessment on May 15th**

**Week 13: Project Deadline Wednesday May 22th**

(@23:55)

**Fully Playable Build, Report and Code.**

**Week14:** Individual oral exams on the project code

# Required prior knowledge

## Requested background in programming:

- Object Oriented Programming:  
=> C# is the language used for VR with UNITY 3D

## Recommended EPFL course in Graphics:

- Introduction to Visual Computing  
elements of Computer graphics, Computer Vision, Human-Computer Interaction, game design, interaction project
- Introduction to Computer Graphics  
perspective transf., modelling hierarchy, orientation coordinate system transformations, rigid body movt.  
Rendering: mesh, material, texture, light

# References

J. Jerald, [The VR Book](#), ACM Press 2016

D. Bowman, E. Kruijff, J. Laviola, I. Poupirov, *3D user Interface*, 2<sup>nd</sup> edition Addison Wesley 2017

T. Parisi, *Learning Virtual Reality*, O'Reilly 2015

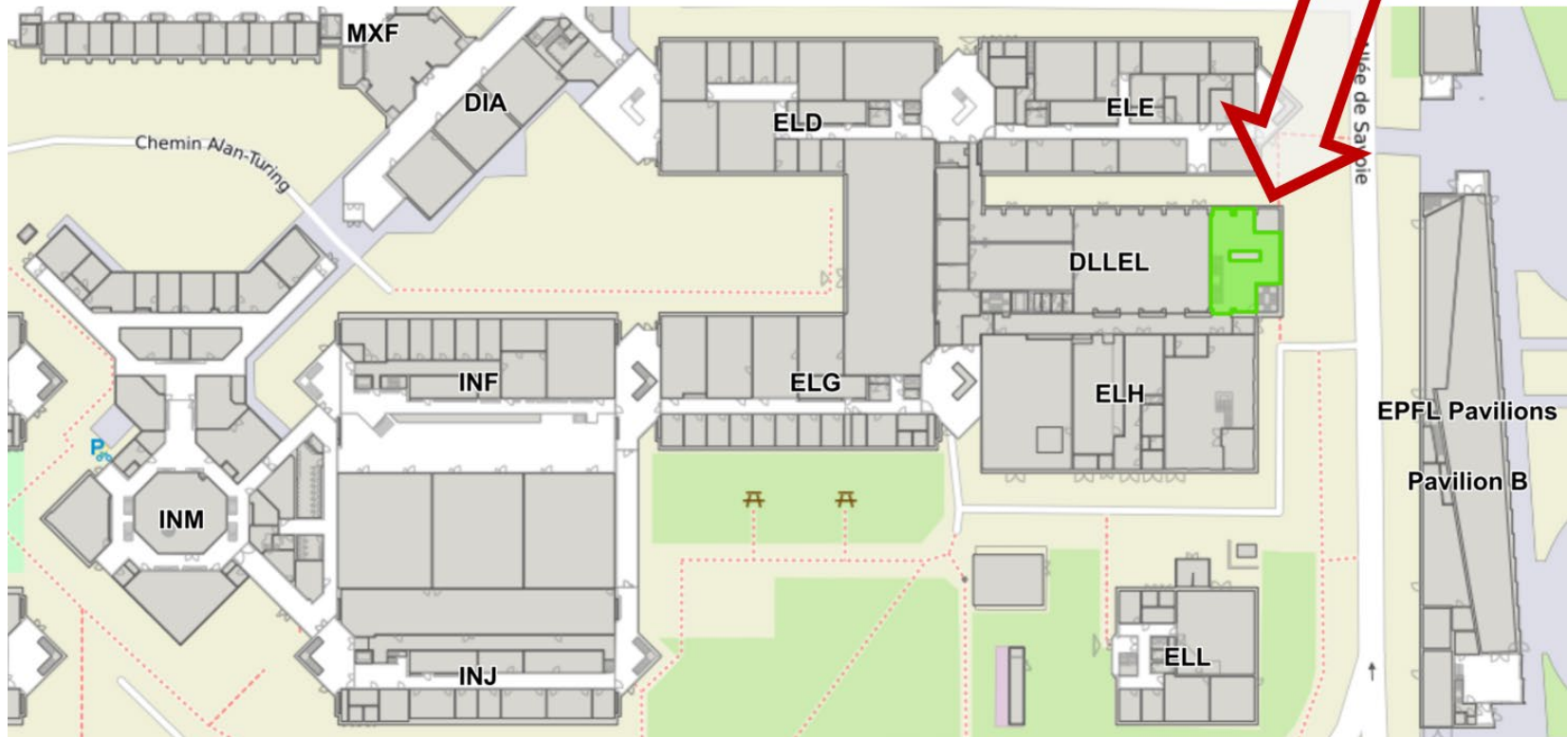
Philippe Fuchs, Guillaume Moreau, Pascal Guitton, *Virtual Reality: Concepts and Technologies*, July 27, 2011 by CRC Press, 432 Pages  
ISBN 9780415684712 - CAT# K13701

Bruno Arnaldi, Pascal Guitton and Guillaume Moreau, *Réalité virtuelle et réalité augmentée, Mythes et réalités*, ISTE 2018

## How to borrow one of the 12 Oculus Quest HMD from the new DLL :

- Go to the welcome desk and ask the staff in yellow jacket from 13h to 19h Monday to Friday

-> **Spring 2023**: presently, you can use the borrowed HMD only locally, within the DLL



A ~one hour online training to safety is requested for working in the DLL



# Disclaimer

Given its limited number of credits the VR course does not cover these topics:

- Augmented Reality : is traditionnally a Computer-Vision Topic
- Shared Virtual Environment (aka Metaverse): network, multi-users
- buzz words often associated to VR: AI, ML, Blockchain, Security...

week	10h15-11h00	11h15-12h	12h15-13h
1	Course presentation R. Boulic Embodied VR	R. Boulic Perception & Immersion	R. Boulic Depth perception
2	Nana Tian Intro to Game design	Nana Tian Play Testing	R. Boulic VR System + setup (HO1-a)
3	R. Boulic Immersion, presence, flow	R. Boulic Cybersickness	HO1-b:INTRO UNITY laptop + Project groups
4	R. Boulic	HO2: Intro Oculus Quest	Intro Oculus Quest
5	R. Boulic	Project pitch	Project pitch
6	R. Boulic <b>Paper Study Deadline</b>	HO3: Basic interaction with controllers	Basic interaction with controllers
7	R. Boulic	HO4: Advanced Interaction: Finger tracking, locomotion	Advanced Interaction: Finger tracking, locomotion
8	R. Boulic	project baseline peer assessment	project baseline peer assessment
9	R. Boulic	HO5: Structuring interaction behavior & Callbacks	Structuring interaction behavior & Callbacks
10	R. Boulic	R. Boulic	project
11	B. Herbelin	B. Herbelin	project
12	project play testing (with peer assessment)	project play testing (with peer assessment)	project play testing (with peer assessment)
13	project	project	project
14	project & theoretical oral exams	project & theoretical oral exams	project & theoretical oral exams

<https://moodle.epfl.ch/course/view.php?id=6841>