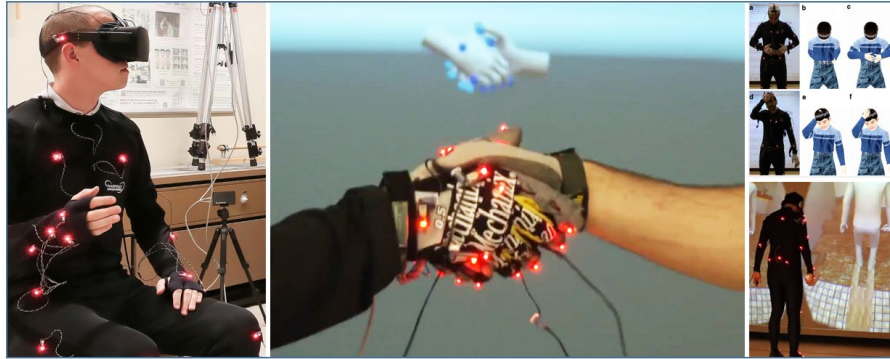


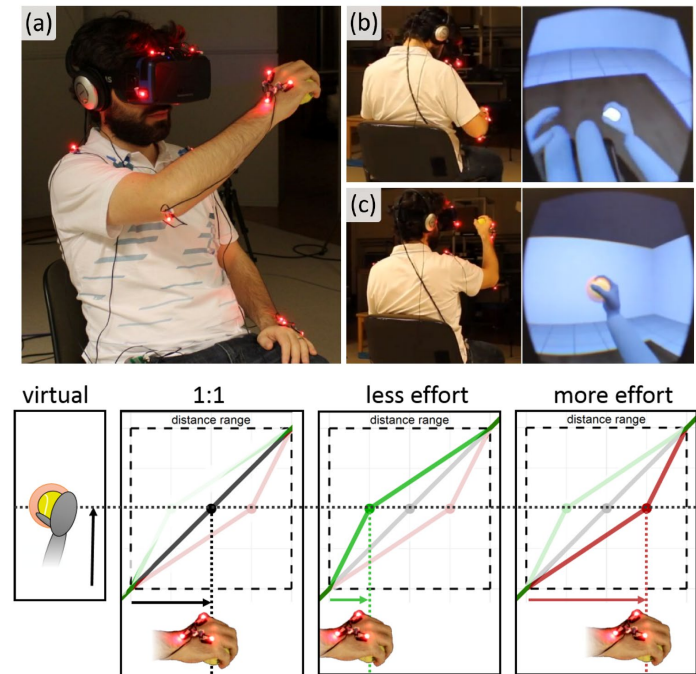
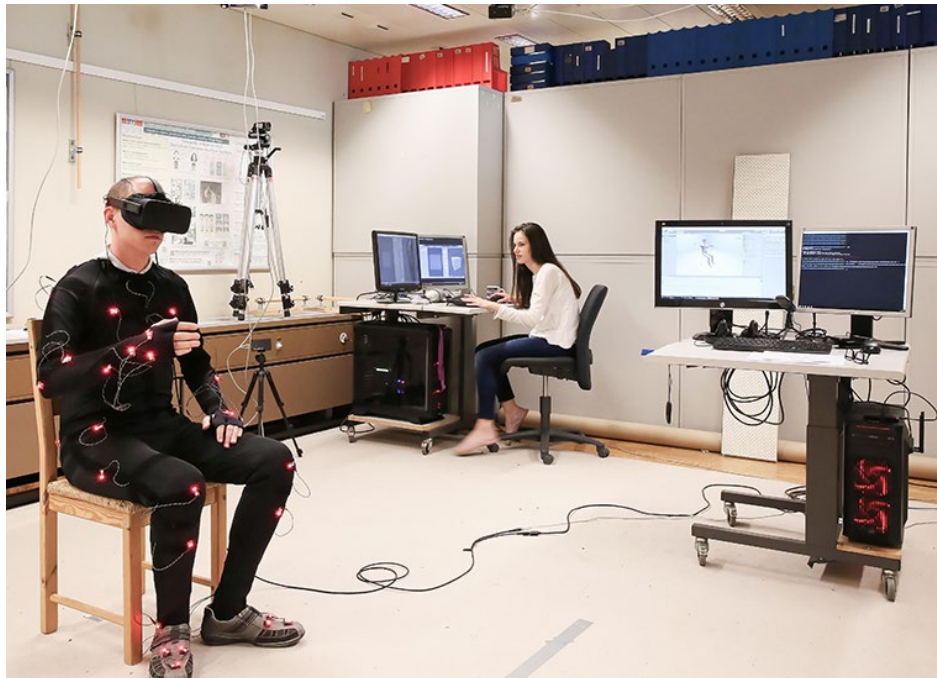
Virtual Reality



- 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)

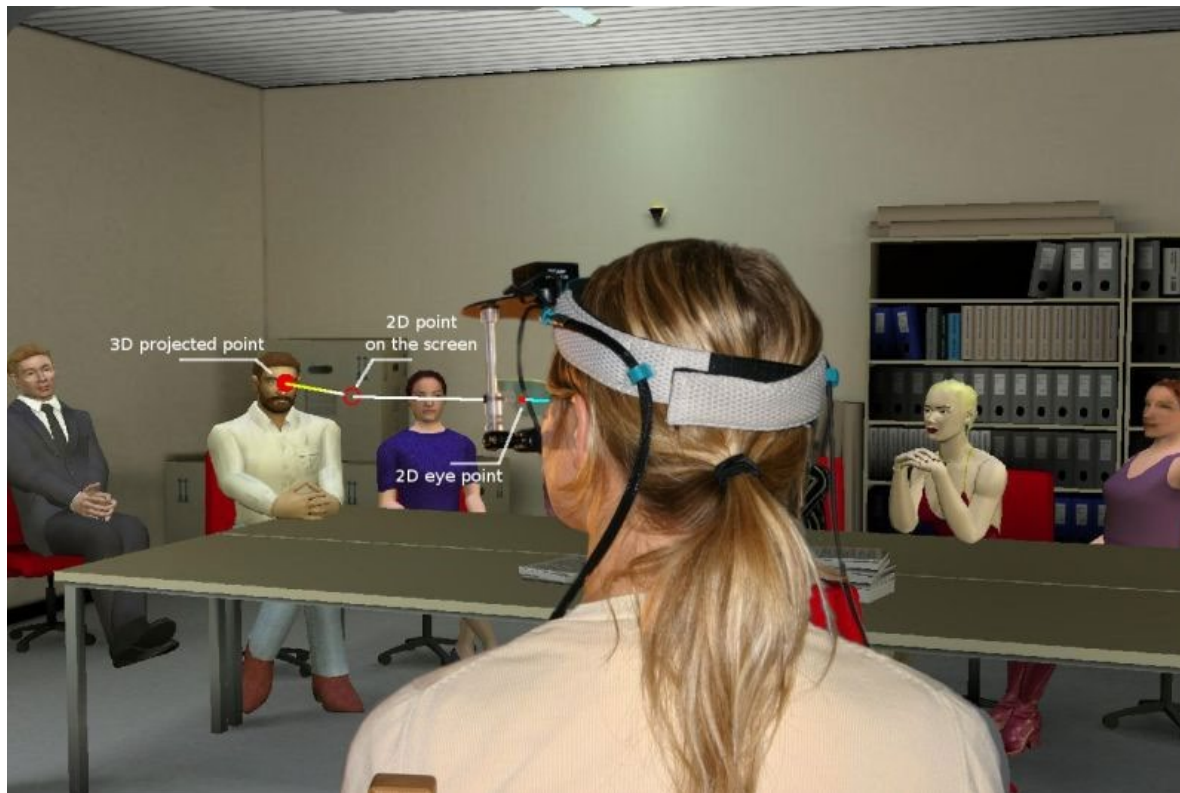


Lecturers

Dr Bruno Herbelin

Senior Researcher

Cognitive Neuroscience Laboratory



Teaching & HW Assistants



Loën Boban
PhD student in IIG



Fatma-Betül Güres
PhD student in ML4ED

& 2 student-assistants : Elif Kurtay and Dylan Vairoli

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

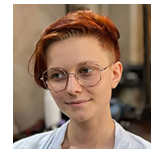
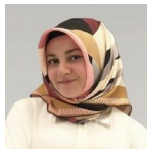
2 Game Topics

Betül Güres

Loën Boban

2 VR Systems

3 Presence



3

4 3D Interaction

4

5 3D Interaction

5

6 3D Interaction

6

7 Haptic

7

8 Haptic/Action

B. Herbelin



8

9 Action

9

10 Believability

10

11

11 VR & NeuroSc.

11

12

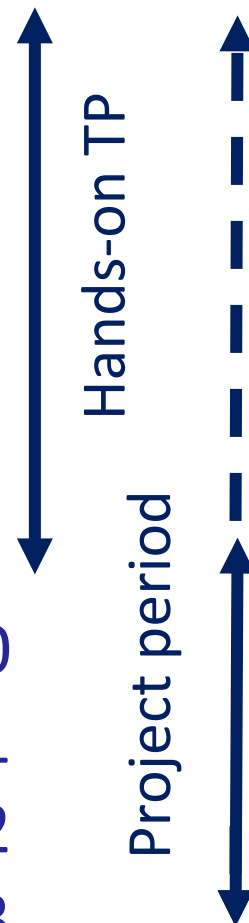
12

13

13

14 *final oral exams*

14



Course Map

week	10h15-11h00	11h15-12h	12h15-13h
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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 – 6**]
- **50%**: 1 project (group of 3-4 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
Week6: upload 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
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<https://cs444-practice.epfl.ch>

<https://cs444-practice.epfl.ch> (still some 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.

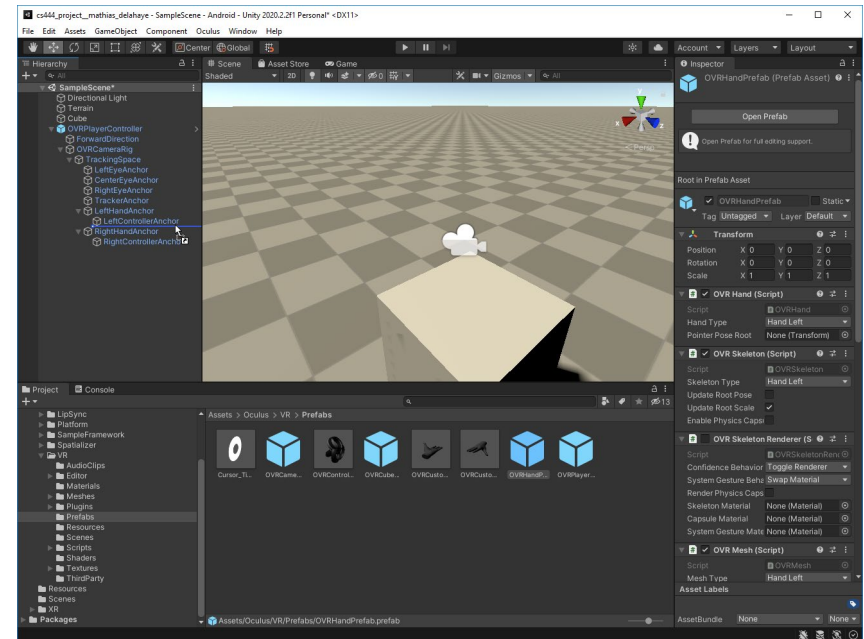


Illustration of the Unity3D layout

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 4th:** free choice of group
 - > **After March 4th,** for those without group:
 - > automatic constitution of groups
 - > groups of 2 persons are completed to 3
- > borrow 1 Oculus Quest per group of 3-4 persons
between March 5th and 8th

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/>

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 4th
- **Week5 Public Project Elevator Pitch** -> March 18th
 - Upload a 2 pages summary latest on March 17th
 - 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 4th
- Project Pitch & feedback -> March 18th
- **Week8: basic game interactions peer assessment on Monday April 8th**

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/>

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 4th

Project Pitch & feedback -> March 18th

Basic game interactions peer assessment -> April 8th

Week 12: Playtesting peer assessment on May 13th

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

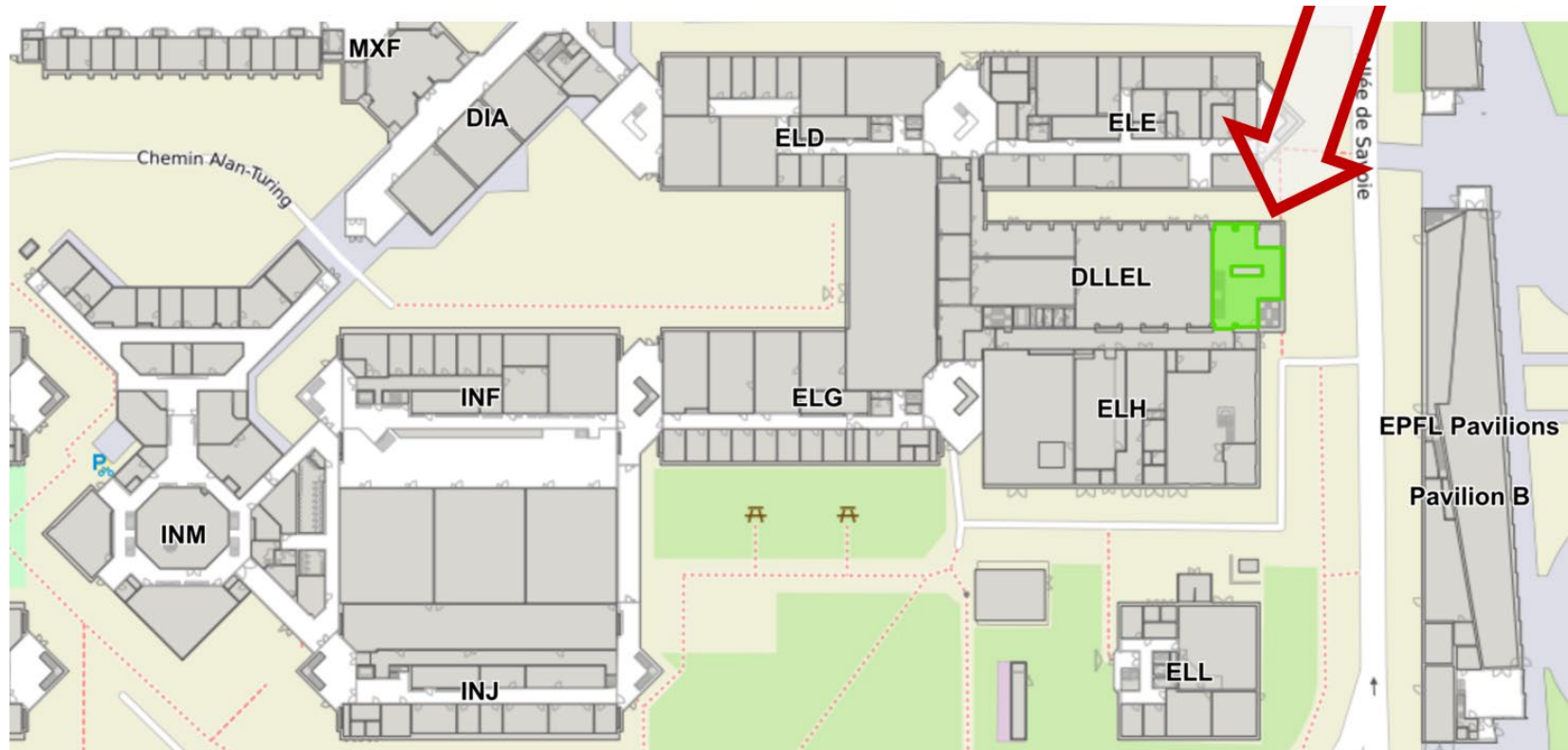
D. Bowman, E. Kruijff, J. Laviola, I. Poupirov, *3D user Interface*, 2nd edition Addison Wesley 2017

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

12 Oculus Quest 2 can be borrowed in the **SPOT** (DLLEL 0 21) *for local use only*.
ask to the student-assistant at the welcome desk (monday-friday 14-20h),
or to a SPOT coach (monday-friday 9h-12h). First-come first-served.



Disclaimer

Given its limited number of hours 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...

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Questions ?

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