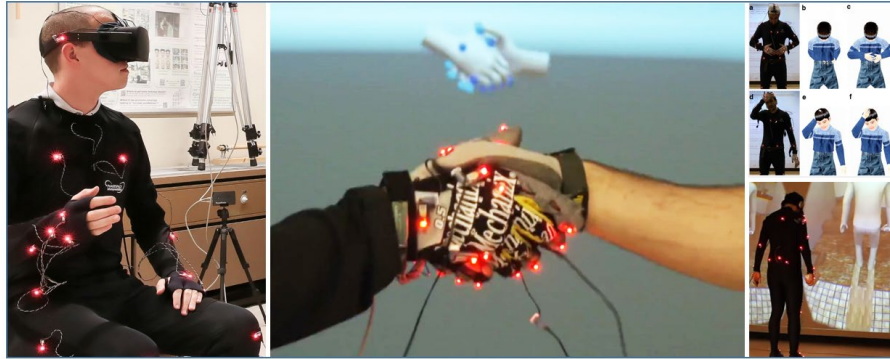# Virtual Reality
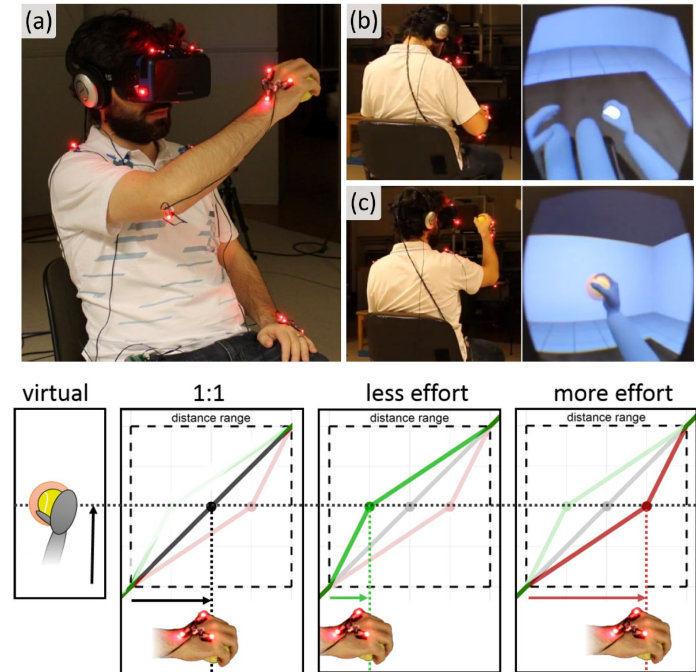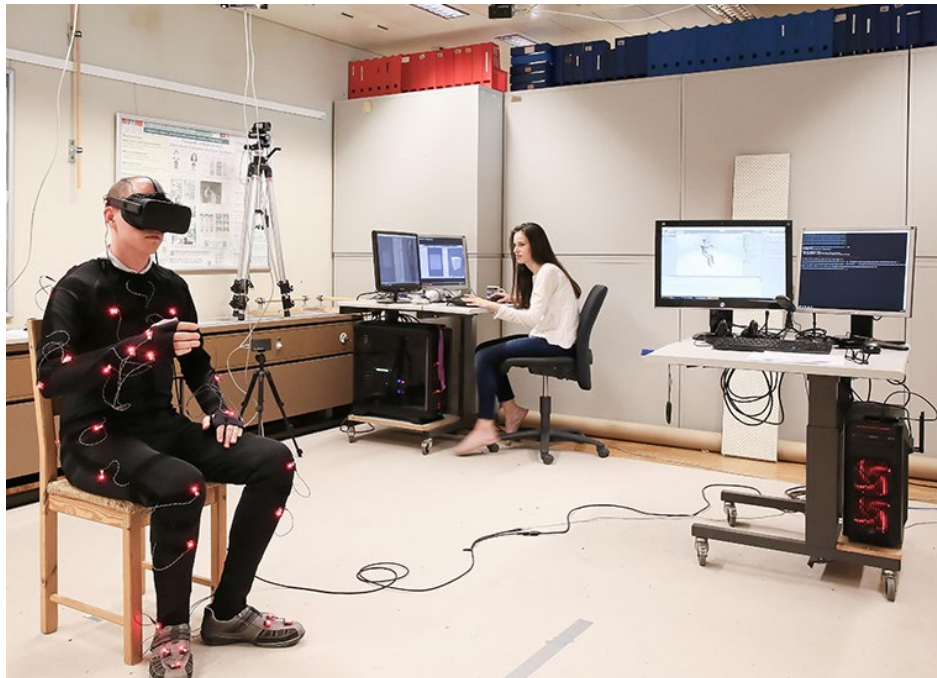


- Lecturers and Teaching Assistants
- Course goals
- Course map
- Grading scheme
- Assignments structure
- Required prior  knowledge
- References

1

# Lecturers

## Dr Ronan Boulic

Senior scientist / MER

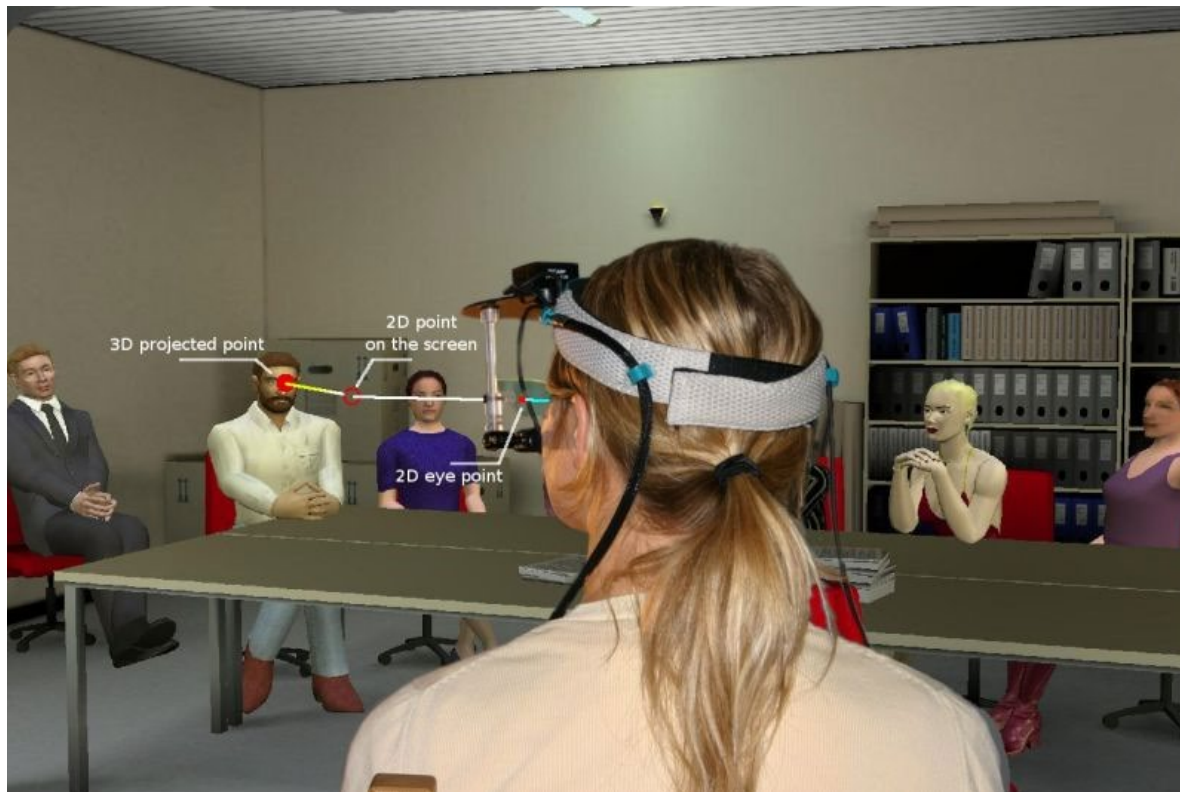Leader of the Immersive Interaction research group (IIG)

# Dr Bruno Herbelin

## Senior Researcher
## Cognitive Neuroscience Laboratory

Teaching & HW Assistants



Mathias Delahaye

PhD student in IIG



Nana Tian

PhD student in IIG

& one student-assistant : Hugo Hueber

# 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*
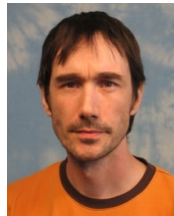
**Present various applications**

**Course Map**

R. Boulic
1 VR concepts
2 Immersion
3 Presence
4 3D Interaction
5 3D Interaction
6 Action
7 Haptic
8 Haptic
9 Believability
10 Full-body Int.
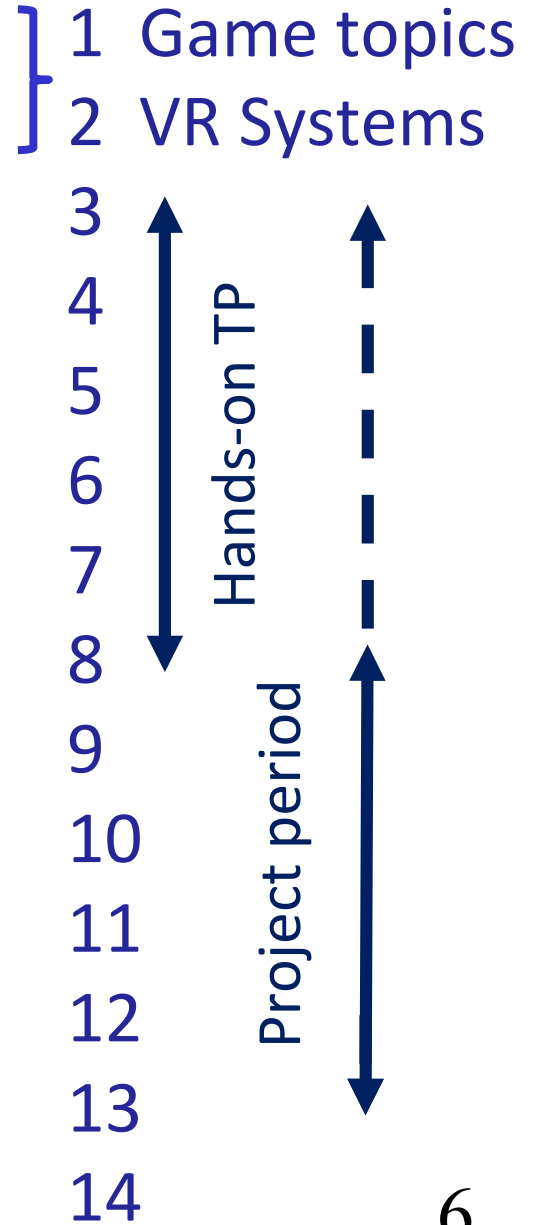11
12 *project time*
13 *project demo*
14 *final oral*



Mathias Delahaye
Nana Tian

} 1 Game topics
  2 VR Systems

B. Herbelin

11 VR & NeuroSc.

1
2
3
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7
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13
14

Hands-on TP

Project period

6

## Course Map

| week | 10h15-11h00 | 11h15-12h | 12h15-13h |
|------|-------------|-----------|-----------|
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| 11 | B. Herbelin | B. Herbelin | project |
| 12 | Project | Project | project |
| 13 | Live project demos | Live project demos | Live project demos |
| 14 | final oral(s) | final oral(s) | final oral(s) |

# Grading Scheme

Exam form: during the semester
4 components:

- 20%: 1 article study and citation analysis [weeks **2 – 5**]

- 50%: 1 project (group of 3 persons) [weeks **3-8-12,+13**]

- 30%: short theoretical online oral control on the chosen article and general VR concepts [week 14]

**Assignment structure**

## 20 % **Individual** article study [weeks 2-5] :

Week2: select one paper from the proposed list
Week5: write a short structured report …

- highligthing 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

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# VR Hands-on
# (5 weeks: 3/4-8)

Assignment structure

| week | 10h15-11h00 | 11h15-12h | 12h15-13h |
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https://cs444-practice.epfl.ch

## Nana Tian and Mathias Delahaye

# https://cs444-practice.epfl.ch



Browser address bar: `https://cs444-practice.epfl.ch`

## LIST OF HANDS-ON

**Forum documentation (Discourse)**
Documentation on how to use the dedicated forum for this course

**Weeks 1 and 2 : Setup of the environment**
Installation of Unity3D, `adb` and configuration of the `$PATH`

**Week 3 : Introduction to Unity 3D**
Discovery of Unity3D mechanics

**Week 4 : 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

**Week 5 : Design of an interaction**
Design a simple interaction using the Oculus Quest's Touch Controllers

**Week 6 : Structuring collection behavior and callbacks**
Design of a structure to collect items, derviate those items with upgrades allowing new features and callbacks

**Week 7 : Finger tracking and locomotion**
Setup a scene with the finger tracking and design a locomotion method

**Questions ?** Use the dedicated channels on the course Discord server :  https://discord.gg/t7jv8HGChj

**Etiquette for asking questions on Discord:** use your IS-Academia firstname & family name instead of a pseudo

# Weeks 2 : Setup of the environment (HO0)

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 : Introduction to Unity 3D (Without VR headset)

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

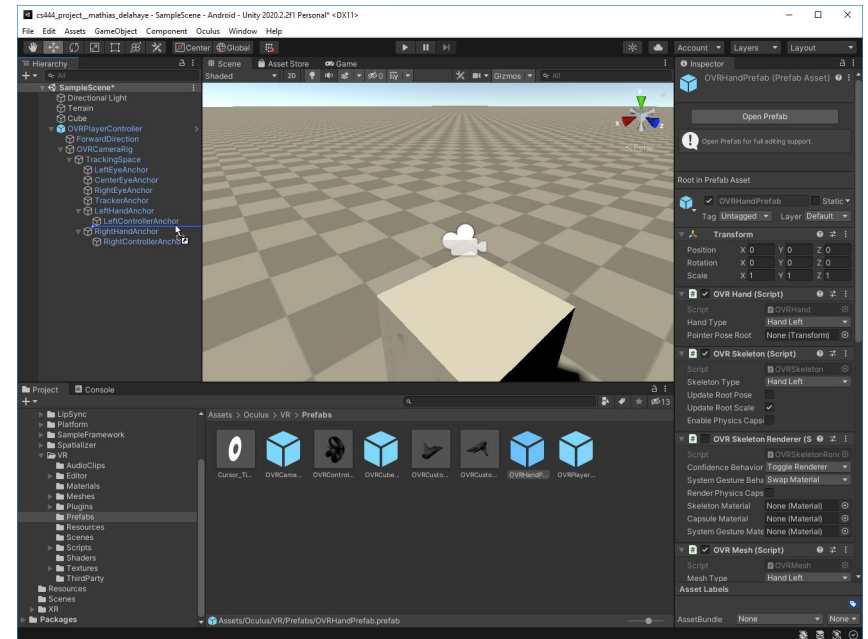This hands-on mainly includes tutorials from **Unity Learn**.



Illustration of the Unity3D layout

**Resources**

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

**Assignment structure**

## 50%: project (group of 3 persons) [3-8-12, +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 7th: free choice of group

-> After March 7th, for those without group:

   -> automatic constitution of groups

   -> groups of 2 persons are completed to 3

-> borrow 1 Oculus Quest per group
   between March 8th and 11th

# HO2 Weeks 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 [3-8-12, +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 7th

- **Week5 Public Project Elevator Pitch** -> March 21$^{st}$
  - Upload a 2 pages summary latest on March 20$^{th}$
  - Public oral pitch (3 min) followed by 5min Q&A

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

# HO3 Weeks 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 graps objects and integrate modules to the scene.

**Resources**

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

# HO4 Weeks 7 : 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/

# HO5 Weeks 7 : Finger tracking and locomotion

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 [3-8-12, +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 7th
- **Project Pitch & feedback** -> March 21st
- **Open Project Demo on Monday May 23rd**

**Week 13: Project Deadline** Wednesday **May 25th** (@23:55)
**Fully Playable Build**, Report and Code.

**Week14:** Individual oral exam 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. Poupirev, *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

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# Questions ?

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