UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# SYLLABUS DEL CORSO

# Elements of Human-Technology Interaction

**2526-2-F5105P029**

## Learning area

Applied Experimental Psychological Sciences

## Learning objectives

*Knowledge and understanding*

- To develop an understanding of the interaction between people and technology, focusing on new technological developments such as virtual reality, augmented reality, robots and conversational agents.
- Knowledge of how these technologies can be used as a means to create practical applications as well as contexts within which human behaviour and cognition can be studied, supported, and improved.
- Basic knowledge of the human-centred design process applied to novel technologies.
- Basic knowledge of the functioning of Unity3D, one of the main authoring platforms for real-time content, e.g. VR, AR, or 2/3D simulations and games.

*Applying knowledge and understanding*

- Students will be able to apply basic concepts of human-technology interaction to everyday relevant issues.
- Students will grow their ability to identify, discuss, and eventually address human factors issues caused by design flaws and constraints posed by current, and possibly future, technologies.
- Students will have the chance, even if not mandatory, to acquire basic computational thinking skills applied to the development of systems using new technologies with direct experience on C#, Unity3D scripting language

*Making judgements*
Students will develop the ability to critically assess theories, empirical evidence, and design solutions in Human-Technology Interaction. In particular, they will learn to interpret and evaluate research papers and invited talks

(e.g., on VR/AR interaction, conversational systems, HRI), identifying assumptions, methodological strengths/limitations, and potential threats to validity. They will also learn to justify design choices and trade-offs (usability, safety, accessibility/inclusiveness, cognitive load, presence/immersion, ethical and societal implications) when proposing or revising interactive solutions. These skills are developed through guided class discussions, flipped-classroom activities on novel technologies, in-class exercises/tests about talks and student presentations, and the iterative design–prototype–evaluation cycle applied in the Unity3D project work.

*Communication skills*
Students will acquire communication skills to present and discuss technological solutions and research evidence in a clear, structured, and scientifically grounded way, using the discipline-specific lexicon of HCI/HTI and interaction design. This includes the ability to communicate both to specialist and non-specialist audiences, to argue for design decisions with appropriate rationale, and to coordinate within teamwork. These skills are trained via in-class group presentations (with slides) on multiple technologies, paper/technology presentations during the final oral exam, discussion and Q&A on invited talks, and the presentation/demonstration of project prototypes and evaluation outcomes.

*Learning skills*
The course promotes students' capacity to continue learning autonomously in a rapidly evolving field by providing methods and tools to (a) approach a new technology systematically (from requirements elicitation to prototyping and evaluation), (b) identify and use appropriate learning resources (course materials, digital library readings, documentation/tutorials for Unity3D and prototyping tools), and (c) update competencies by tracking relevant scientific and technological developments (e.g., new interaction techniques, devices, and design patterns). This is achieved through the continuous engagement with papers and talks, technology-focused flipped classroom work, hands-on Unity3D / computational thinking exercises (including optional bonus activities), and instructor-guided guidance on how to select references and deepen topics beyond lectures when preparing presentations and projects.

## Contents

This course provides an overview of the field of human-technology interaction, with a focus on the application of psychological knowledge to the design life cycle with new technologies.

- The course will provide students with tools and techniques for creating, prototyping and improving interactions in different fields encompassing new technologies such as ubiquitous computing, virtual and augmented reality.
- Different new technologies relevant to human interaction will be studied as well as the general process of approaching a new technology from the perspective of an interaction designer.
- By the end of the course, students will have learned some useful techniques and gained an understanding of systematic procedures for creating usable and useful designs and systems.
- Students will be involved in a real software development project: they will design, create and evaluate an interactive experience using Unity3D, one of the main authoring platforms for real-time content, e.g. VR, AR, or 2/3D simulations and games.
  - The course is NOT programming intensive.

**Learning outcomes:**
• Being able to design effective interactions between humans and technology (i.e., computers, wearable devices, car systems, mobile phones, websites, apps, etc.) in specific areas (medical, entertainment, educational, etc.).
• Being able to apply design principles and knowledge from research to a new interaction problem or technology.
• Being able to go through the iterative process of needs finding, prototyping, evaluating and revising.
• Being able to discover the goal behind a design (e.g., usability, research, behavioural change, entertainment, etc.) and to measure the effectiveness in achieving it.
• Being able to build a prototype with Unity3D for the evaluation of interactions.

## Detailed program

1. Introduction.

• The place of HTI between UI, UX, HCI, IxD, Accessibility and inclusiveness

• The design cycle.

2. Recap of Design Principles (especially for students who did not attend Cognitive Ergonomics or Applied Neuroscience courses)

• Identifying a task

• Human abilities and cognitive load.

• Theories, principles and heuristics: affordances, cognitive modelling, human needs and motivation, activity theory and situated cognition.

• Explain the main principles and advantages of a user-centered approach.

• Cognitive aspects of interaction design

Human Error

Attention and multitask performance

Memory limits and interaction design

Compare cognitive frameworks applied to HCI.

Mental models

• Requirements Elicitation

Prepare and run data-gathering programs, interviews and questionnaires preparation and execution

• Prototyping

Translation of models and requirements in prototypes

Types of prototypes and models: verbal, paper, Wizard of Oz, wireframe, physical prototype, personas, user profiles, timelines, scenarios, storyboards, video prototyping, user modeling.

• Evaluation

• Types of Evaluation: Qualitative, Empirical and Predictive evaluations.

• Challenges of Evaluation

• Inspections: Heuristic Evaluation and Walk-Throughs

• Agile methods: A/B testing, live prototyping.

Computational Thinking
What is a computer?
Computational Thinking
from a recipe to your first flowchart and C# program
Introduction Variables, Structures, Objects and Classes

Unity3D
What do you think is inside Unity3D
Unity3D Elements
Base Unity Tutorial
UXF - Unity Experiment FrameworkURL
First Unity3D but 2D program

6 Voice Interaction System Design

• What Is a Conversation

• Natural Language Interfaces

• Conversational UX Design Process

• Conversational UX Patterns

• Introduction to code free Conversational System prototyping tools

7 Interaction in Other Realities

• Introduction to code free immersive interaction systems prototyping tools

• Hardware

The Convergence of AR and VR

VR Input Devices

HMD System Calibration

HMD Latency Reduction

• VR Perception

Perceptual Constancies, Adaptation, Attention

Perceptual Stability, Attention, and Action

Distal and Proximal Stimuli

Sensation vs. Perception

Bottom-Up and Top-Down Processing

Limited Field of View, Exploration and Saliency

Motion Perception

• VR Interaction Concepts, Patterns and Techniques

Immersion, Presence, and Reality Trade-Offs

Interaction Fidelity

Proprioceptive and Egocentric Interaction

Reference Frames

Sickness and Fatigue

Visual-Physical Conflict and Sensory Substitution

Interaction Selection, Manipulation, Viewpoint Control, Indirect Control, and Compound Patterns

8 Human Robot Interaction

• Introduction to code free HRI prototyping tools (in simulation for the moment)

• Hardware: success and failures

• Anthropomorphism Applications in Interaction Design and Human Robot Interaction

• Theory of mind and intention recognition

• Spatial Interaction

• Nonverbal Interaction

• Verbal Interaction

• Robots in Society

## Prerequisites

Interest in human technology interaction and in achieving a basic understanding of how technologies, particularly computer-based technologies, works are the main requirements.

Good knowledge of the basis of Psychology enables a more aware use of the course contents, in particular: perception, memory, learning; research methods, and experimental design.

Students lacking such knowledge are encouraged to ask for a list of basic references that will be supplied during the course. Students are strongly recommended to attend Cognitive Ergonomics or Applied Neuroscience before taking this course.

No previous programming experience is required. Computational concepts will be explained in an intuitive and simple manner by relating them to cognitive concepts, simple exercises and examples.

## Teaching methods

Lessons will be held in presence.
Teaching mixes frontal lessons and invited talks with collaborative problem solving, active discussion on case studies and flipped classrooms on specific novel technologies.

Students are encouraged to design and test interactive systems starting from the introductory material provided by the instructor

Course attendance is strongly recommended in order to take advantage of interactive lessons, research and technology hands-on activities.

Teaching modality:
Lecture-based Teaching 34h
Interactive Teaching 18h
Lectures, laboratories, and teacher supervised activities

## Assessment methods

Assessment comprises a final oral exam and in-class activities including:

- In-class group presentation (+ slides) of at least 2 technologies agreed with the instructor
- In-class exercises and tests about invited talks, & students presentations
- Computational thinking, Unity3D and C# exercises, which will provide bonus marks.

Oral exam covers one of these two:

- a UX project (group) presentation [grades not topped]
- OR: a research paper or technology presentation of about 20 minutes AND an oral interview on the course material (slides or technology topics covered in invited talks) [grades topped]

**Important**

- **If no technology presentation took place in class, the student must prepare an additional research paper or technology presentation of about 20 minutes**
- **If in-class exercises and tests about invited talks & students' presentations were not submitted during the course they will be discussed during the oral interview**

You must:

- consult with the instructor ASAP to choose the project topic/technology/paper
- send the presentation to the instructor at least a week before the exam date

Note that:

- Project and technology presentations can be organized as a group of at most three students.
- In group works contributions must be specified.

## Textbooks and Reading Materials

1. The material will be downloadable from eLearning and from the Bicocca digital library.
2. Slides discussed during the lessons in PDF format will be downloadable from eLearning.
3. Papers and book chapters in PDF will be downloadable from the Bicocca Digital Library and/or from eLearning.
4. Reccomended optional books:

- Interaction Design beyond human computer interaction
- The Encyclopedia of Human-Computer Interaction, 2nd Ed.
- The VR Book Human-Centered Design for Virtual Reality
- Unity Virtual Reality Projects
- Conversational UX Design: A Practitioner's Guide to the Natural Conversation Framework
- Research methods in human computer interaction

5.Real life examples: videos, hands-on with prototypes and final products.
6. Practice tasks: Collaborative design with prototyping tools and evaluation

## Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE